3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter describes the existing conditions of the physical, biological, cultural, and socioeconomic resources in the general Wright analysis area which includes all six of the Lease by Application (LBA[1]) tracts (the affected environment). This chapter also analyzes the direct and indirect impacts (the environmental consequences) to those resources if the tracts are leased and mined under the Proposed Action or Alternative 2 or 3. The potential environmental consequences of the No Action Alternative (Alternative 1, rejecting the application for the tract) are also considered in this chapter.

In addition to this EIS, a separate document entitled *Supplementary Information on the Affected Environment in the General Analysis Areas for the Wright Area Coal Lease Applications EIS* has been prepared. The supplemental document provides detailed site-specific information on the existing environment associated with the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA tracts. Copies of the supplemental information document are available upon request and can be viewed at the BLM offices in Casper and Cheyenne.

Furthermore, this chapter considers regulatory compliance; mitigation; monitoring; residual impacts; the relationship between local short-term uses of man's environment and the maintenance of long-term productivity; and the irreversible and irretrievable commitments of resources that would occur with the implementation of the Proposed Action or Alternative 2 or 3 for each tract. As discussed in Chapter 2, regulatory compliance and mitigation and monitoring measures that are required by federal and/or state law are considered to be part of the Proposed Action and Alternative 2 or 3 for each tract.

Under the Proposed Action for each tract, the tract as applied for would be offered for lease at one sale. As discussed in Chapter 2, Bureau of Land Management (BLM) has identified a study area for each LBA tract that consists of the tract as applied for and adjacent lands that BLM is considering adding to the tract. BLM is evaluating these study areas for the purpose of identifying potential alternate tract configurations to the Proposed Action that would be technically, economically, or environmentally preferable to the Proposed Action. Alternative 2 for each tract evaluates holding one sale for a tract modified by adding some or all of BLM's study area to the tract. Alternative 3 for the West Hilight Field tract evaluates holding one sale for the tract modified by adding some or all of BLM's study area and or some or all of Ark Land Company's (ALC's) permitted Northwest Rail Loop Amendment Area to the tract. The Proposed Action and Alternative 2 or Alternative 3 for each LBA tract will be referred to collectively as the Action Alternatives.

[1] Refer to page xxvi for a list of abbreviations and acronyms used in this document.

If any of the tracts are leased under the Proposed Action or Alternative 2 or 3, it is assumed that an area larger than the tract would have to be disturbed in order to recover all of the coal in the tract. The disturbances outside the coal removal area would be due to activities like overstripping, highwall backsloping (including catch benches), highwall reduction after mining to match undisturbed topography, and construction of flood control and sediment control structures. For analysis purposes, this disturbance buffer is assumed to extend ¼ mile outside the BLM study area boundary, where future mining disturbance can occur. In this environmental impact statement (EIS), the general analysis area for each tract is defined as the BLM study area (the LBA tract as applied for and the additional area evaluated under Alternative 2) plus the ¼-mile disturbance buffer.

Figure 3-1 shows the general Wright analysis area for most environmental resources. The general Wright analysis area does not have a defined boundary but includes the combined general analysis areas for the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts.

The resources that are addressed here were identified during the scoping process or interdisciplinary team review as having the potential to be affected.

Critical elements of the human environment (BLM 2008a) that could potentially be affected by the Proposed Action or Alternative 2 or 3 for each tract include air quality, cultural resources, Native American religious concerns, T&E species, U.S. Department of Agriculture-Forest Service Region 2 Sensitive Species and Thunder Basin National Grassland plant species of local concern, migratory birds, hazardous or solid wastes, water quality, wetlands/riparian zones, invasive non-native species, and environmental justice. Five other critical elements (areas of critical environmental concern, prime or unique farmlands, floodplains, wild and scenic rivers, and wilderness) are not present in the general Wright analysis area and are not addressed further. In addition to the critical elements that are potentially present in the general Wright analysis area, this EIS discusses the status and potential effects of mining each LBA tract on topography and physiography, geology and mineral resources, soils, water quantity, alluvial valley floors, vegetation, wildlife, land use and recreation, paleontological resources, visual resources, noise, transportation resources, and socioeconomics.

Tables 3-1 through 3-6 show the total leased and disturbance areas for the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines (which represent the No Action Alternatives), and how the total leased areas and estimated total mine disturbance areas would change under the Proposed Action, Alternative 2 or Alternative 3.

As indicated in Tables 3-1 through 3-3, Black Thunder Mine's current coal leases include approximately 20,656 acres. Under the mine's currently approved mining and reclamation plan, a total of approximately 26,812 acres

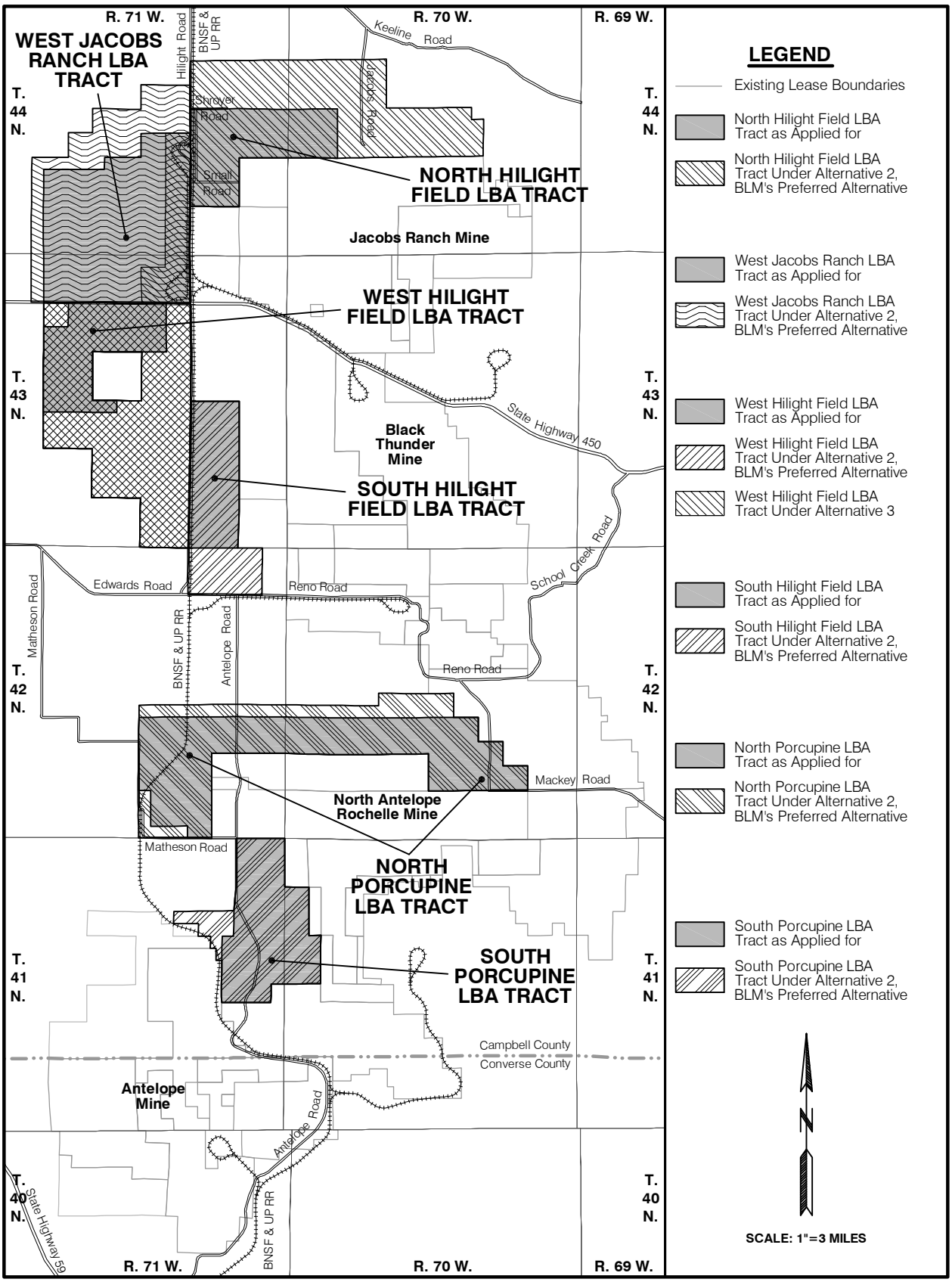


Figure 3-1. General Wright Analysis Area.

Table 3-1. Comparison of Existing and Proposed Black Thunder Mine Disturbance Area and Mining Operations for the North Hilight Field LBA Tract.

	No Action Alternative (Existing Permit Area)	**Proposed Action**	**Alternative 2**
Additional Lease Area (Acres)	---	2,613.5	7,139.4
Total Lease Area (Acres)[1]	20,656	23,269.5	27,795.4
Increase in Lease Area (Percent)	---	12.7	34.6
Estimated Additional Mine Disturbance Area (Acres)[2]	---	5,053.0	12,908.8
Estimated Total Mine Disturbance Area (Acres)	26,812.0	31,865	39,720.8
Increase in Estimated Disturbance Area (Percent)	---	18.8	48.1
Estimated Additional Recoverable Coal (Million Tons)[3]	---	263.4	652.8
Estimated Recoverable Coal for Mine as of 1/08 (Million Tons)	1,236.4	1,499.8	1,889.2
Increase in Estimated Recoverable Coal as of 1/08 (Percent)	---	21.3	52.8

1 Includes federal, state, and private coal.
2 Total Disturbance Area = area to be mined + area disturbed for mine facilities, access roads, haul roads, highwall reduction, railroad facilities, stockpiles, etc.
3 Estimated Recoverable Coal Resources = tons of mineable coal × recovery factor (92 percent).

Table 3-2. Comparison of Existing and Proposed Black Thunder Mine Disturbance Area and Mining Operations for the South Hilight Field LBA Tract.

	No Action Alternative (Existing Permit Area)	**Proposed Action**	**Alternative 2**
Additional Lease Area (Acres)	---	1,976.7	2,922.4
Total Lease Area (Acres)[1]	20,656	22,632.7	23,578.4
Increase in Lease Area (Percent)	---	9.6	14.1
Estimated Additional Mine Disturbance Area (Acres)[2]	---	1,126.0	2,731.4
Estimated Total Mine Disturbance Area (Acres)	26,812.0	27,938.0	29,543.4
Increase in Estimated Disturbance Area (Percent)	---	4.2	10.2
Estimated Additional Recoverable Coal (Million Tons)[3]	---	213.6	304.3
Estimated Recoverable Coal for Mine as of 1/08 (Million Tons)	1,236.4	1,450.0	1,540.7
Increase in Estimated Recoverable Coal as of 1/08 (Percent)	---	17.3	24.6

1 Includes federal, state, and private coal.
2 Total Disturbance Area = area to be mined + area disturbed for mine facilities, access roads, haul roads, highwall reduction, railroad facilities, stockpiles, etc.
3 Estimated Recoverable Coal Resources = tons of mineable coal × recovery factor (92 percent).

Table 3-3. Comparison of Existing and Proposed Black Thunder Mine Disturbance Area and Mining Operations for the West Hilight Field LBA Tract.

	No Action Alternative (Existing Permit Area)	**Proposed Action**	**Alternative 2**	**Alternative 3**
Additional Lease Area (Acres)	---	2,370.5	7,191.3	8,570.1
Total Lease Area (Acres)[1]	20,656	23,026.5	27,847.3	29,226.1
Increase in Lease Area (Percent)	---	11.5	34.8	41.5
Estimated Additional Mine Disturbance Area (Acres)[2]	---	6,351.4	10,250.8	10,250.8
Estimated Total Mine Disturbance Area (Acres)	26,812.0	33,163.4	37,062.8	37,062.8
Increase in Estimated Disturbance Area (Percent)	---	23.7	38.2	38.2
Estimated Additional Recoverable Coal (Million Tons)[3]	---	377.9	965.2	965.2
Estimated Recoverable Coal for Mine as of 1/08 (Million Tons)	1,236.4	1,614.3	2,201.6	2,201.6
Increase in Estimated Recoverable Coal as of 1/08 (Percent)	---	30.6	78.1	78.8

1 Includes federal, state, and private coal.
2 Total Disturbance Area = area to be mined + area disturbed for mine facilities, access roads, haul roads, highwall reduction, railroad facilities, stockpiles, etc.
3 Estimated Recoverable Coal Resources = tons of mineable coal × recovery factor (92 percent).

Table 3-4. Comparison of Existing and Proposed Jacobs Ranch Mine Disturbance Area and Mining Operations for the West Jacobs Ranch LBA Tract.

	No Action Alternative (Existing Permit Area)	**Proposed Action**	**Alternative 2**
Additional Lease Area (Acres)	---	5,944.4	8,076.2
Total Lease Area (Acres)[1]	9,720.0	15,664.4	17,796.2
Increase in Lease Area (Percent)	---	61.2	83.1
Estimated Additional Mine Disturbance Area (Acres)[2]	---	7,023.0	9,370.0
Estimated Total Mine Disturbance Area (Acres)	14,853.0	21,876.0	24,223.0
Increase in Estimated Disturbance Area (Percent)	---	47.3	63.1
Estimated Additional Recoverable Coal (Million Tons)[3]	---	669.6	912.6
Estimated Recoverable Coal for Mine as of 1/08 (Million Tons)	423.0	1,092.6	1,335.6
Increase in Estimated Recoverable Coal as of 1/08 (Percent)	---	158.3	215.7

1 Includes federal, state, and private coal.
2 Total Disturbance Area = area to be mined + area disturbed for mine facilities, access roads, haul roads, highwall reduction, railroad facilities, stockpiles, etc.
3 Estimated Recoverable Coal Resources = tons of mineable coal × recovery factor (90 percent).

Table 3-5. Comparison of Existing and Proposed North Antelope Rochelle Mine Disturbance Area and Mining Operations for the North Porcupine LBA Tract.

	No Action Alternative (Existing Permit Area)	**Proposed Action**	**Alternative 2**
Additional Lease Area (Acres)	---	5,795.8	7,366.8
Total Lease Area (Acres)[1]	18,066.0	23,861.8	25,432.8
Increase in Lease Area (Percent)	---	32.1	40.8
Estimated Additional Mine Disturbance Area (Acres)[2]	---	9,864.0	11,444.0
Estimated Total Mine Disturbance Area (Acres)	27,443.0	37,307.0	38,887.0
Increase in Estimated Disturbance Area (Percent)	---	35.9	41.7
Estimated Additional Recoverable Coal (Million Tons)[3]	---	601.2	745.4
Estimated Recoverable Coal for Mine as of 1/08 (Million Tons)	1,031.4	1,632.6	1,776.8
Increase in Estimated Recoverable Coal as of 1/08 (Percent)	---	58.3	72.3

1 Includes federal and state coal.
2 Total Disturbance Area = area to be mined + area disturbed for mine facilities, access roads, haul roads, highwall reduction, railroad facilities, stockpiles, etc.
3 Estimated Recoverable Coal Resources = tons of mineable coal × recovery factor (92 percent).

Table 3-6. Comparison of Existing and Proposed North Antelope Rochelle Mine Disturbance Area and Mining Operations for the South Porcupine LBA Tract.

	No Action Alternative (Existing Permit Area)	**Proposed Action**	**Alternative 2**
Additional Lease Area (Acres)	---	3,186.0	3,568.0
Total Lease Area (Acres)[1]	18,066.0	21,252.0	21,634.0
Increase in Lease Area (Percent)	---	17.6	19.7
Estimated Additional Mine Disturbance Area (Acres)[2]	---	3,366.0	4,068.0
Estimated Total Mine Disturbance Area (Acres)	27,443.0	30,809.0	31,511.0
Increase in Estimated Disturbance Area (Percent)	---	12.3	14.8
Estimated Additional Recoverable Coal (Million Tons)[3]	---	309.7	339.3
Estimated Recoverable Coal for Mine as of 1/08 (Million Tons)	1,031.4	1,341.1	1,370.7
Increase in Estimated Recoverable Coal as of 1/08 (Percent)	---	30.0	32.9

1 Includes federal and state coal.
2 Total Disturbance Area = area to be mined + area disturbed for mine facilities, access roads, haul roads, highwall reduction, railroad facilities, stockpiles, etc.
3 Estimated Recoverable Coal Resources = tons of mineable coal × recovery factor (92 percent).

will be disturbed in order to recover that coal. According to Black Thunder Mine's 2007 Annual Report submitted to the Wyoming Department of Environmental Quality/Land Quality Division (WDEQ/LQD), the mine had disturbed a total of approximately 12,990.6 acres as of December 31, 2007. Of that total area of disturbance, approximately 4,323.1 acres (33.3 percent) were occupied by permanent or temporary facilities (stockpiles, hydrologic control structures, mine buildings and coal loading facilities, railroad loop, environmental monitoring areas, etc.), 2,555.1 acres (19.7 percent) were occupied by areas being actively mined, and 6,112.4 acres (47.0 percent) were occupied by areas that had been mined and reclaimed or were in the process of being reclaimed (TBCC 2007).

If the North Hilight Field, South Hilight Field, and West Hilight Field LBA Tracts are leased to the applicant as maintenance tracts under the Proposed Action or Alternative 2 or 3, the permit area for the adjacent Black Thunder Mine would have to be amended to include the new lease areas before they could be disturbed by mining activities. Tables 3-1 through 3-3 also show how the leased area and disturbance area would change, for each of the tracts as applied for and under Alternatives 2 and 3, if all the federal coal in the BLM study area discussed in Chapter 2 is included in the tract that is offered for sale. The estimates of recoverable coal, associated disturbance, and mine life shown in Tables 3-1 through 3-3 and elsewhere in this chapter assume that coal currently unsuitable for mining due to the presence of public roads is not mined. If the Campbell County Board of Commissioners determine that the county roads that border or cross the tracts can be closed and/or moved, the estimated tons of recoverable coal, associated disturbance, and Black Thunder Mine life would increase as discussed in Sections 2.1, 2.2, and 2.3 and as indicated in Tables 2-2, 2-4, and 2-6 for the North Hilight Field, South Hilight Field, and West Hilight Field LBA Tracts, respectively. A portion of the South Hilight Field LBA Tract as applied for lies inside the current mine permit area (Figure 2-2), a portion of the West Hilight Field LBA Tract under Alternative 3 lies inside the current mine permit area (Figure 2-3), and the North Hilight Field LBA Tract under both the Proposed Action and Alternative 2 borders, but lies entirely outside of, the current mine permit area (Figure 2-1). If a tract is leased, the area that would have to be added to the existing mine permit area would be that portion of the LBA tract that lies outside the existing permit boundary plus an adjacent strip of land that would be used for highwall reduction after mining and such mine-related activities as construction of diversions, flood and sediment control structures, roads, and stockpiles. Portions of the LBA tracts as applied for or as configured under Alternative 2 or Alternative 3 that are contiguous to existing coal leases (Figure 3-1) and within approved mine permit areas will be disturbed by the current mining operations. The environmental consequences of leasing the North Hilight Field, South Hilight Field and West Hilight Field LBA Tracts under any one of the Action Alternatives would be similar in nature, but selection of the Proposed Action would disturb less area of land surface.

As indicated in Table 3-4, Jacobs Ranch Mine's current coal leases include approximately 9,720 acres. Under the mine's currently approved mining and reclamation plan, a total of approximately 14,853 acres will be disturbed in order to recover that coal. According to Jacobs Ranch Mine's 2007 Annual Report submitted to WDEQ/LQD, the mine had disturbed a total of approximately 9,130 acres as of December 31, 2007. Of that total area of disturbance, approximately 1,184 acres (13 percent) were occupied by permanent or temporary facilities (stockpiles, hydrologic control structures, mine buildings and coal loading facilities, railroad loop, environmental monitoring areas, etc.), 1,964 acres (22 percent) were occupied by areas being actively mined, and 5,982 acres (65 percent) were occupied by areas that had been mined and reclaimed or were in the process of being reclaimed (JRCC 2007).

If the West Jacobs Ranch LBA Tract is leased to the applicant as a maintenance tract under the Proposed Action or Alternative 2, the permit area for the Jacobs Ranch Mine would have to be amended to include the new lease area before it could be disturbed by mining activities. Table 3-4 also shows how the leased area and disturbance area would change, for the tract as applied for and under Alternative 2, if all the federal coal in the BLM study area discussed in Chapter 2 is included in the tract that is offered for sale. The estimates of recoverable coal, associated disturbance, and mine life shown in Table 3-4 and elsewhere in this chapter assume that coal currently unsuitable for mining due to the presence of public roads is not mined. If the Campbell County Board of Commissioners determines that the portion of Hilight Road bordering the east side of the tract can be closed and/or moved, the estimated tons of recoverable coal, associated disturbance, and Jacobs Ranch Mine life would increase as discussed in Section 2.4 and as indicated in Table 2-8 for the West Jacobs Ranch LBA Tract. As shown in Figure 2-4, no portion of the West Jacobs Ranch LBA Tract under the Proposed Action or Alternative 2 lies inside Jacobs Ranch Mine's current permit area; however, the eastern portion of the LBA Tract as applied for does lie within Black Thunder Mine's current permit area, which is referred to as ALC's or Black Thunder Mine's Northwest Rail Loop Amendment Area. Consequently, no portion of the tract has been disturbed by the Jacobs Ranch Mine, but as discussed in Sections 2.1, 2.3, and 2.4, surface disturbances related to the construction of a new rail spur, rail loops, storage silos, and coal loadout facilities for the Black Thunder Mine are presently occurring within ALC's Northwest Rail Loop Amendment Area (Figures 2-3 and 2-4). No portion of the West Jacobs Ranch LBA Tract will be disturbed under the current mining plans in order to recover coal in the existing adjacent coal leases due to the presence of the Burlington Northern Santa Fe & Union Pacific (BNSF & UP) railroad, which borders the eastern side of the tract and effectively separates mining operations on either side of the rail line. If the tract is leased to the applicant, the area that would have to be added to the existing mine permit area would be the entire LBA tract plus an adjacent strip of land that would be used for highwall reduction after mining and such mine-related activities as construction of diversions, flood and sediment control structures, roads, and stockpiles. The environmental

consequences of leasing the West Jacobs Ranch LBA Tract under the Proposed Action or Alternative 2 would be similar in nature, but selection of the Proposed Action would disturb a smaller area of land surface.

As indicated in Tables 3-5 through 3-6, North Antelope Rochelle Mine's current coal leases include approximately 18,066 acres. Under the mine's currently approved mining and reclamation plan, a total of approximately 27,443 acres will be disturbed in order to recover that coal. According to North Antelope Rochelle Mine's 2007 Annual Report submitted to the WDEQ/LQD, the mine had disturbed a total of approximately 14,342 acres as of September 30, 2007. Of that total area of disturbance, approximately 3,303 acres (23 percent) were occupied by permanent or temporary facilities (stockpiles, hydrologic control structures, mine buildings and coal loading facilities, railroad loop, environmental monitoring areas, etc.), 6,200 acres (43 percent) were occupied by areas being actively mined, and 4,840 acres (34 percent) were occupied by areas that had been mined and reclaimed or were in the process of being reclaimed (PRC 2007).

If the North Porcupine and South Porcupine LBA Tracts are leased to the applicant as maintenance tracts under the Proposed Action or Alternative 2, the permit area for the adjacent North Antelope Rochelle Mine would have to be amended before the entire new lease areas could be disturbed by mining activities. Tables 3-5 and 3-6 also show how the leased area and disturbance area would change, for each of the tracts as applied for and under Alternative 2, if all the federal coal in the BLM study area discussed in Chapter 2 is included in the tract that is offered for sale. The estimates of recoverable coal, associated disturbance, and mine lives shown in Tables 3-5 and 3-6 and elsewhere in this chapter assume that coal currently unsuitable for mining due to the presence of public roads is not mined. If the Campbell County Board of Commissioners determine that the county roads that border or cross the tracts can be closed and/or moved, the estimated tons of recoverable coal, associated disturbance, and North Antelope Rochelle Mine life would increase as discussed in Sections 2.5 and 2.6 and as indicated in Tables 2-10 and 2-12 for the North Porcupine and South Porcupine LBA Tracts, respectively. The North Porcupine LBA Tract as applied for and under Alternative 2 lies entirely within the current mine permit boundary (Figure 2-5). The South Porcupine LBA Tract as applied for lies entirely within the current mine permit area, as does all but approximately 60 acres of the tract configured under Alternative 2 (Figure 2-6). If a tract is leased however, additional area would have to be added to the existing mine permit area that would be used for highwall reduction after mining and such mine-related activities as construction of diversions, flood and sediment control structures, roads, and stockpiles. Portions of the LBA tracts as applied for or as configured under Alternative 2 that are contiguous to existing coal leases (Figure 3-1) will be disturbed by the current mining operations. The environmental consequences of leasing the North Porcupine and South Porcupine LBA Tracts under the Proposed Action or Alternative 2 would be similar in nature, but selection of the Proposed Action would disturb less area of land surface.

Surface mining and reclamation have been ongoing in the eastern Powder River Basin (PRB) for nearly 3 decades. During this time, effective mining and reclamation technologies have been developed and continue to be refined. Mining and reclamation operations are regulated under the Surface Mining Control and Reclamation Act of 1977 (SMCRA) and Wyoming statutes. WDEQ technically reviews all mine permit application packages to ensure that the mining and reclamation plans comply with all state permitting requirements and that the proposed coal mining operations comply with the performance standards of the Department of the Interior (DOI)-approved Wyoming program. BLM attaches special stipulations to all coal leases (Appendix D), and there are a number of federal and state permit approvals that are required in order to conduct surface mining operations (Appendix A). The regulations are designed to ensure that surface coal mining impacts are mitigated.

Impacts can range from beneficial to adverse and they can be a primary result of an action (direct) or a secondary result (indirect). They can be permanent, long-term (persisting beyond the end of mine life and reclamation), or short-term (persisting during mining and reclamation and until the time the reclamation bond is released). Impacts also vary in terms of significance. The basis for conclusions regarding significance are the criteria set forth by the Council on Environmental Quality (40 CFR 1508.27) and the professional judgment of the specialists doing the analyses. Impact significance may range from negligible to substantial; impacts can be significant during mining but be reduced to insignificance following completion of reclamation.

3.1 General Setting

The general Wright analysis area is located in the PRB, a part of the Northern Great Plains that includes most of northeastern Wyoming. Vegetation is primarily sagebrush and mixed grass prairie.

3.1.1 Climate and Meteorology

The climate in the general Wright analysis area is typical of a semi-arid, high plains environment with relatively large seasonal and diurnal variations in temperature and seasonal variation in precipitation. The average annual precipitation at a Western Regional Climate Center/National Oceanic and Atmospheric Administration (WRCC/NOAA) meteorological station (Wright 12 W), located between 3 and 18 miles west to northwest of the general Wright analysis area, is 13.45 inches (WRCC 2008). May (2.06 inches) and June (2.03 inches) are the wettest months, whereas December (0.33 inch) and January (0.36 inch) are the driest. Snowfall averages 54.8 inches per year, with most occurring in March and April (9.3 inches each). Potential evapotranspiration has been estimated at 31 inches (NOAA 1969), which exceeds annual precipitation. Summers are relatively short and warm, while winters are longer and cold. The annual mean temperature for the WRCC/NOAA meteorological station at Wright for the period of record (1991 through 2007) is 44.7 degrees Fahrenheit (F). The highest recorded temperature was 103 degrees F and the

lowest was minus 39 degrees F. July is the warmest month, with a mean daily temperature of 69.7 degrees F, and January is the coldest month, with a mean daily temperature of 23.9 degrees F. The frost-free period is 100-120 days (Curtis and Grimes 2004).

In the general Wright analysis area, surface wind speeds range from more than 30 miles per hour (mph) during the winter and spring to 10 to 12 mph during the summer. The area also experiences extreme wind gusts, especially during thunderstorm activity that occurs in June, July, and August. Distinct diurnal changes occur, with average wind velocities increasing during the day and decreasing during the night. Local variations in wind speed and direction are primarily due to differences in topography. Wind speeds are highest in the winter and spring (October through April) and are predominantly from the western and northern sectors. During the warmer months (May through September), wind directions are more random, although winds from the northern or southeastern sectors are slightly more predominant.

During periods of strong wind, dust may impact air quality across the region. An average of 15 air-stagnation events occurs annually in the PRB with an average duration of 2 days each (BLM 1974).

3.2 Topography and Physiography

3.2.1 Affected Environment

The general Wright analysis area is a high plains area within the unglaciated Missouri Plateau subregion of the Great Plains Province, near the eastern portion of the Powder River Basin (PRB) in the state of Wyoming. The PRB is both a topographic drainage and geologic structural basin. The structural basin is an elongated, asymmetrical syncline approximately 120 miles east to west and 200 miles north to south. It is bounded in Wyoming by the Black Hills on the east; the Big Horn Mountains on the west; and the Hartville Uplift, Casper Arch, and Laramie Mountains on the south. The northern extent of the structural basin is the Miles City Arch and the Yellowstone River in Montana. The axis of the structural basin trends from the southeast to the northwest near the western margin of the syncline. The general Wright analysis area is located on the gently dipping eastern limb of the structural basin. In general, geologic strata along the eastern limb of the structural PRB dip to the west at 1 to 2 degrees toward the axis of the basin.

The Powder River Basin is so named because it is drained by the Powder River, although it is also drained in part by other major rivers, including the Big Horn, Tongue, Little Missouri, Belle Fourche, and Cheyenne rivers. The general Wright analysis area is within the Cheyenne River drainage basin. Little Thunder Creek, North Prong Little Thunder Creek, Porcupine Creek and Antelope Creek, tributaries of the Cheyenne River, are the most prominent natural topographic features in the general Wright analysis area.

Broad plains, rolling hills, and tablelands dominate the PRB landscape. Internally-drained playas are common in the basin, as are buttes and plateaus capped by sandstone or clinker. Elevations throughout the PRB range from less than 2,500 feet to more than 6,000 feet above sea level. The major river valleys have wide, flat floors and broad floodplains. The drainages dissecting the basin are incised, typically are ephemeral or intermittent, and do not provide year-round water sources.

The topography of the general Wright analysis area, like the areas within the adjacent mines' existing permit areas, is relatively subdued. The landscape of the general Wright analysis area consists primarily of gently rolling terrain broken by minor drainages and internally-drained playa areas. Drainage densities are quite low, and the playas are common topographic and hydrologic features. Much of the land surface covered by the LBA tracts as applied for and the lands added by the BLM study areas do not contribute runoff to any stream, and playas have formed in the lowest portion of these non-contributing drainage areas.

Land surface elevations range from about 4,690 to 5,170 feet above sea level and slopes range from essentially flat to over 50 percent within the general Wright analysis area. Gently rolling uplands comprise most of the general Wright analysis area; most of the land surface (between 75 and 90 percent, depending on the particular LBA tract) seldom exceeds a 5 percent slope. The steepest slopes typically occur near the highest elevations along the ridge lines and drainage divides and at the breaks or transitions between uplands and bottomlands that are dissected by small ravines and gullies. Of the six LBA tracts included in the general Wright analysis area, the topography of the South Porcupine tract is somewhat unique due to the presence of a number of steep draws and gullies that are formed by the headwaters of Antelope, Horse, and Porcupine creeks. However, gently rolling uplands comprise approximately 51 percent of the general analysis area for the South Porcupine tract, and the steepest slopes within the erosionally dissected areas are slightly over 30 percent.

3.2.2 Environmental Consequences

3.2.2.1 Proposed Action and Alternatives 2 and 3

Surface mined lands, both active and reclaimed, dominate the landscape east of Wyoming State Highway 59 in the vicinity of the general Wright analysis area. Surface coal mining would permanently alter the topography of each LBA tract if it is leased and mined. Topsoil would be removed and stockpiled or placed directly on recontoured areas. Overburden would be blasted and stockpiled or directly placed into already mined pits, and coal would be removed. Highwalls with vertical heights equal to overburden (and interburden, if present) plus coal thickness would exist in the active pits. If necessary, streams would be diverted into temporary channels around active

mining areas or would be contained within temporary reservoirs to prevent pits from being flooded.

Typically, a direct permanent impact of coal mining and reclamation is topographic moderation. After reclamation, the postmining topography would be similar to the premining topography, but would be somewhat gentler and more uniform. The original topography in North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine and South Porcupine LBA Tracts ranges from essentially flat playa areas to gently rolling hills to relatively rugged draws and gullies.

As discussed above, slopes on the LBA tracts as applied for range from around zero to over 50 percent, and the average slopes range from about 2.2 percent (for the West Hilight Field LBA Tract) to 6.2 percent (for the South Porcupine LBA Tract). Following reclamation, the average surface elevation on each LBA tract would be lower due to coal removal (see Table 3-7). The removal of the coal would be partially offset by the swelling that occurs when the overburden (and interburden, if present) is blasted, excavated, and backfilled.

Table 3-7 presents the approximate postmining surface elevation change for each LBA tract as applied for under the Proposed Action and Alternative 2. West Hilight's Alternative 3 is also included in the table. These figures represent the estimated average change in surface elevation over the entire area of coal removal. After the coal is removed, highwalls would be eliminated and the land surface would be restored to its approximate original contour or to a configuration approved by WDEQ/LQD when the surface coal mining permit for the existing mine is amended to include the LBA tract, if the tract is leased.

Direct adverse impacts resulting from topographic moderation include a reduction in microhabitats (e.g., cutbank slopes and steep bedrock bluffs and escarpments) for some wildlife species and a reduction in habitat diversity, particularly in slope-dependent shrub communities and associated habitat. These impacts, which would be greater in those areas characterized as rough breaks, may result in a long-term reduction in the carrying capacity for some species.

The applicant mines' existing reclamation plans include measures, to the extent possible, to establish wildlife enhancement features. A direct beneficial impact of the lower and flatter terrain would be reduced water runoff, which would allow increased infiltration and result in a minor reduction in peak flows and potentially accelerate recharge of groundwater. This may help counteract the potential for increased erosion that could occur as a result of higher near-surface bulk density of the reclaimed soils (Section 3.8). It may also increase vegetative productivity, which would result in a benefit to livestock grazing.

The approximate original drainage pattern of all streams within each LBA tract would be restored (Section 3.5). In-channel stockponds and playas (shallow

Table 3-7. Average Overburden, Interburden, and Coal Thicknesses and Approximate Postmining Surface Elevation Changes of the Six LBA Tracts.

LBA Tract and Configuration	Overburden Thickness (ft)	Interburden Thickness (ft)	Total Coal Thickness (ft)	Swell Factor (percent)	Coal Recovery Factor (percent)	Postmining Elevation Change[1]
North Hilight Field						
Proposed Action	246	1	61	16	92	16.6 ft lower
Alternative 2	246	1	61	16	92	16.6 ft lower
South Hilight Field						
Proposed Action	292	94	81	16	92	12.8 ft lower
Alternative 2	292	94	81	16	92	12.8 ft lower
West Hilight Field						
Proposed Action	428	32	93	16	92	12.0 ft lower
Alternative 2	428	32	93	16	92	12.0 ft lower
Alternative 3	428	32	93	16	92	12.0 ft lower
Existing Black Thunder Mine Leases						
No Action Alternative for North, South and West Hilight Field LBA Tracts	282	Included with overburden	78	16	92	26.6 ft lower
West Jacobs Ranch						
Proposed Action	475	0	102	18	90	6.3 ft lower
Alternative 2	486	0	104	18	90	6.1 ft lower
Existing Jacobs Ranch Mine Leases						
No Action Alternative for West Jacobs Ranch LBA Tract	168	9	57	18	90	19.4 ft lower
North Porcupine						
Proposed Action	343	0	75	15.5	92	15.8 ft lower
Alternative 2	354	0	75	15.5	92	13.9 ft lower
South Porcupine						
Proposed Action	346	11	76	15.5	92	14.7 ft lower
Alternative 2	347	10	76	15.5	92	14.7 ft lower
Existing North Antelope Rochelle Mine Leases						
No Action Alternative for North and South Porcupine LBA Tracts	211	17	71	15.5	92	30.0 ft lower

[1] Reclaimed (postmining) surface elevation change calculated as: ((overburden thickness + interburden thickness) × swell factor) – (coal thickness × coal recovery factor).

topographic depressions) would be replaced to provide livestock and wildlife watering sources. These topographic changes would not conflict with regional land use, and the postmining topography would be designed to adequately support anticipated land use.

These impacts are occurring on the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines' coal leases as coal is mined and mined-out areas are reclaimed. Under the Proposed Action or Alternative 2 or 3, the areas that would be permanently topographically changed would increase as shown in Tables 3-1 through 3-6.

3.2.2.2 No Action Alternative

Under the No Action Alternative, the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine coal lease applications would be rejected and coal removal and the associated disturbance and impacts to topography and physiography would not occur on the portions of the LBA tracts as applied for or the LBA tracts configured under Alternative 2 that will not be disturbed under currently approved surface coal mining permits. Coal removal and the associated impacts to topography and physiography would continue as currently permitted on the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle Mine coal leases. Table 3-7 presents the approximate postmining surface elevation change for the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines. Impacts to topography and physiography related to mining operations at these three applicant mines would not be extended onto portions of the LBA tracts that will not be affected under the current mining and reclamation plans.

As discussed in Section 2.2, a decision to reject one or more of these six coal lease applications at this time would not preclude an application to lease that respective tract in the future.

3.2.3 Regulatory Compliance, Mitigation and Monitoring

The mined-out areas must be restored to approximate original contour or other topographic configuration approved by WDEQ/LQD. Topographic configurations would be developed and approved as part of the required mining and reclamation plans within the surface mining permits for the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines. WDEQ/LQD monitors topographic restoration by regularly checking the as-built topography in the annual reports filed by the mines to see if it conforms to the approved topography.

3.2.4 Residual Impacts

Topographic moderation is a permanent consequence of mining. Reclaimed landforms are expected to mimic premining topography, but be more subdued in topographic variation and slightly lower in elevation (Table 3-7). The indirect

impacts of topographic moderation on wildlife habitat diversity would also be considered permanent.

3.3 Geology, Mineral Resources and Paleontology

3.3.1 General Geology and Coal Resources

3.3.1.1 Affected Environment

Geologic units in the general Wright analysis area that would be impacted if the LBA tracts under consideration for leasing are mined include, in descending order, recent (Holocene age) alluvial and eolian deposits; the Eocene age Wasatch Formation (the overburden); and the Paleocene age Fort Union Formation (which contains the target coal seams). Variations between the LBA tracts occur primarily in the thickness of the mineable coal seams, the thickness of overburden, the parting thickness(es) between the various seams comprising the Wyodak coal, and the surface topography. Figure 3-2 shows the stratigraphic relationships of the geologic units in the general Wright analysis area that are typical for the eastern part of the PRB in Wyoming. Additional information about these units is included in Section 3.5 of this EIS.

The majority of the recent Quaternary Holocene age surface deposits in the general Wright analysis area are reworked Wasatch Formation residuum or deposits that are of mixed alluvial and eolian nature. The lithologies of these unconsolidated deposits represent materials eroded locally from the Wasatch Formation and reflect relatively near-source deposition. The alluvial deposits are comprised of fine sands and silts interbedded with clays and fine gravels. Thin (ranging from nearly absent to less than 20 feet thick) alluvial and eolian deposits occur along the larger ephemeral stream channels such as Little Thunder Creek. The valley floor of Porcupine Creek contains appreciable amounts of alluvium, both in width and depth, and the alluvial deposits of Porcupine Creek are comprised of coarser-grained material than the other ephemeral streams that drain the general Wright analysis area. Eolian deposits occur throughout the general Wright analysis area, although are more common in the southern portion where these fine-grained sand, silt and clay deposits can blanket the terrain up to 15 feet thick (Reheis and Coates 1987). Eolian processes have reworked some of the surficial deposits, resulting in isolated deflation basins having no natural drainage. These internally-drained surface features (playas) commonly contain fine-grained sediments recently deposited from seasonal rainfall or snowmelt runoff events.

The Eocene Wasatch Formation forms most of the overburden in the general Wright analysis area. The Wasatch overburden consists of interbedded lenticular sands/sandstones, silts/siltstones, clays and shales with thin discontinuous coal seams. Wasatch rocks are exposed in some localities, particularly along steep bluffs and hills formed by the more erosionally resistant sandstone strata and in the eroded gullies and ravines that separate upland and bottomland areas. Wasatch coals, where present, are typically of

Geologic Unit		Hydrologic Characteristics
RECENT ALLUVIUM HOLOCENE		Typically fine grained and poorly sorted sands interbedded with silts and clays in ephemeral drainages. Occasional very thin, clean interbedded sand lenses. More laterally extensive, thicker, and coarse-grained along the larger stream courses. Excessive dissolved solids generally make this aquifer unsuitable for domestic and agricultural use and marginal for livestock (Class III) use standards. Low infiltration capacity in ephemeral draws unless covered by sandy eolian blanket. Low to moderate infiltration along Little Rawhide Creek.
CLINKER HOLOCENE TO PLEISTOCENE		Baked and fused bedrock resulting from burning coal seams which ignite on the outcrop from lightning, manmade fires or spontaneous combustion. The reddish clinker (locally called scoria, red dog, etc.) formed by melting and partial fusing of overburden above the burning coal. The baked rock varies greatly in the degree of alteration; some is dense and glassy while some is vesicular and porous. It is commonly used as a road construction material and is an aquifer wherever saturated. Considered to be part of the Wasatch Formation.
WASATCH FORMATION EOCENE		Lenticular fine sands interbedded in predominantly very fine grained siltstone and claystone may yield low to moderate quantities of poor to good quality water. The discontinuous nature and irregular geometry of these sand bodies result in low overall permeabilities and very slow groundwater movement in the overburden on a regional scale. Water quality in the Wasatch Formation generally does not meet Wyoming Class I (drinking water) standards due to the dissolved mineral content. Some wells do, however, produce water of considerably better quality that does meet the Class I standard.
FORT UNION FORMATION PALEOCENE	TONGUE RIVER MEMBER	The coal beds serve as regional groundwater aquifers and exhibit highly variable aquifer properties. Permeability and porosity associated with the coal arise almost entirely from fractures. Coal water typically does not meet Class I or Class II (irrigation) use standards. In most cases, water from coal wells is suitable for livestock use. The coal water is used throughout the region as a source of stock water and occasionally for domestic use. USGS (Flores et al. 1999) refers to the thick mineable coals in the Gillette coal field as the Wyodak-Anderson coal zone of the Tongue River Member of the Fort Union Formation.
	LEBO MEMBER	The Lebo member, also referred to as the "Lebo Confining Layer" or "Lebo Shale". Has a mean thickness of 711 ft in the PRB and a thickness of about 400 ft in the vicinity of Gillette. The Lebo typically yields small quantities of poor quality groundwater. Where sand content is locally large, caused by channel or deltaic deposits, the Lebo may yield as much as 10 gpm.
	TULLOCK MEMBER	The Tullock member has a mean thickness of 785 ft in the PRB and a mean sand content of 53 percent which indicates that the unit generally functions well as a regional aquifer. Yields of 15 gpm are common but vary locally and may be as much as 40 gpm. Records from the SEO indicate that maximum yields of approximately 300 gpm have been achieved from this aquifer. Water quality in the Tullock Member often meets Class I standards. The extensive sandstone units in the Tullock Member are commonly developed regionally for domestic and industrial uses. The City of Gillette is currently using eight wells completed in this zone to meet part of its municipal water requirements.
UPPER CRETACEOUS	**LANCE FORMATION/HELL CREEK FORMATION**	Silty, calcareous sandstones and interbedded sandy shales, claystones, and coals. Provides yields generally less than 20 gpm. Higher yields can occur where sand thicknesses are greatest. Water quality is typically fair to good. Also referred to as the "Upper Lance Confining Layer."
	FOX HILLS SANDSTONE	Marine sandstones and sandy shales. Has a mean thickness of 666 ft and a mean sand content over 50 percent in the PRB. Yields up to 200 gpm are common; however, yields can be significantly less. Water quality is good, with TDS concentrations commonly less than 1,000 mg/L. The City of Gillette is currently using five wells completed in this aquifer to meet municipal water requirements.
	PIERRE SHALE	This unit is comprised predominantly of dark marine shales with only occasional local thin sandstone lenses. Maximum yields are minor and overall the unit is not water bearing. Water obtained from this unit is poor with high concentrations of sodium and sulfate as the predominant ions in solution.

Stratigraphy from Stratigraphic Nomenclature Committee, Wyoming Geological Association, 1969.

Figure 3-2. Stratigraphic Relationship and Hydrologic Characteristics of Upper Cretaceous, Lower Tertiary, and Recent Geologic Units, PRB, Wyoming.

no economic significance. Clinker (also referred to as burn or scoria) is sedimentary rocks that were baked, fused or melted in place when an underlying coal seam burned in-situ. Scoria is often exposed on the surface as predominantly red-colored, resistant rock outcrops. The occurrence of scoria is site-specific, typically occurring in areas where coal seams crop out at the surface.

Underlying the Wasatch Formation is the Paleocene Fort Union Formation. The boundary between the Wasatch Formation and the Fort Union Formation is not distinct. From a practical standpoint, however, the top of the mineable coal zone is considered as the contact between the two formations. Table 3-7 indicates the overburden thicknesses in the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts as applied for and under Alternative 2. As discussed in Section 3.2.1, the regional dip in this area is to the west; as a result, the overburden thickness generally increases from east to west. The overburden is also generally thinner in the vicinity of the major drainage channels and increases in thickness away from the channel bottoms. There are no known local, major geologic structures in the general Wright analysis area.

The Fort Union Formation consists primarily of siltstones, mudstones, claystones, shales, lenticular sands/sandstones, and coal seams. As shown in Figure 3-2, the Fort Union Formation is divided into three members: the Tongue River (which contains the mineable coal seams), the Lebo, and the Tullock, in descending order. The Tongue River Member consists of interbedded siltstone, claystone, silty shale, carbonaceous shale, and coal, with lesser amounts of fine-grained sands and sandstones.

The U.S. Geological Survey (Flores et al. 1999) refers to the thick mineable coals in the Gillette coal field as the Wyodak-Anderson coal zone of the Tongue River Member of the Fort Union Formation. The nomenclature of the mineable coal seams in the Tongue River Member varies from mine operator to mine operator in the eastern PRB and are locally referred to as the Anderson and Canyon, Roland and Smith, Wyodak-Anderson, and Wyodak. Operators of the mines in the general Wright analysis area refer to the mineable coal zone as either the Wyodak (Upper Wyodak, Middle Wyodak and Lower Wyodak) or the Wyodak-Anderson. The number of coal seams varies from tract to tract.

There are two coal seams (referred to as Upper and Middle Wyodak) in the North Hilight Field LBA Tract as applied for and three coal seams (referred to as Upper, Middle, and Lower Wyodak) in the North Hilight Field LBA Tract configured under Alternative 2; however, due to quality issues, the Upper Wyodak may not be recovered. There are two coal seams (referred to as Upper and Middle Wyodak) in the South Hilight Field LBA Tract as applied for and three coal seams (referred to as Upper, Middle, and Lower Wyodak) in the South Hilight Field LBA Tract configured under Alternative 2; however, due to quality issues, the Upper Wyodak may not be recovered. There are two coal seams (referred to as Upper and Middle Wyodak) in the West Hilight Field LBA

Tract as applied for and as configured under Alternative 2; however, due to quality issues, the Upper Wyodak may not be recovered. There is one mineable seam (referred to as the Wyodak) in the West Jacobs Ranch LBA Tract as applied for and as configured under Alternative 2. There are two mineable coal seams (referred to as the Wyodak-Anderson 1 and Wyodak-Anderson 2) in both the Porcupine North and Porcupine South LBA Tracts as applied for and under Alternative 2. The combined average thicknesses of the mineable coal seams within each LBA tract as applied for and the additional area evaluated under Alternative 2 (and Alternative 3 for the West Hilight Field tract) are shown in Table 3-7. The combined average thicknesses of interburden between coal seams are also given in Table 3-7.

The Fort Union coal seams are subbituminous and are generally low-sulfur, low-ash coals. Typically, the coal being mined south of Gillette has a higher heating value and lower sulfur content than the coal being mined north of Gillette. In these six tracts that are under consideration for leasing, the heating value of the coal seams is expected to range from around 8,500 to 9,200 Btu/lb; the ash content is expected to vary from about 3.5 to 6.5 percent; the sulfur content is expected to vary from about 0.1 to 0.7 percent; the fixed carbon is expected to vary from 30 to 55 percent, and the moisture content is expected to vary from around 22 to 30 percent.

3.3.1.2 Environmental Consequences

3.3.1.2.1 Proposed Action and Alternatives 2 and 3

The stratigraphic units from the base of the lowest coal seam mined to the land surface would be subject to permanent change after the coal is removed on the LBA tracts under the respective Proposed Action or Alternative 2. The subsurface characteristics of these lands would be radically changed by mining. The replaced overburden and interburden (backfill) would be a mixture of the geologically distinct layers of sandstone, siltstone, claystone, and shale that currently exist. As a result, the physical characteristics of the backfill would be different from the physical characteristics of the existing layered overburden stratigraphy.

3.3.1.2.1.1 North Hilight Field LBA Tract

Mining would remove an average of 246 feet of overburden, 1 foot of interburden, and 61 feet of coal from about 2,349 acres up to about 6,738 acres for the BLM's preferred tract configuration under Alternative 2. These figures represent the estimated area of actual coal removal, assuming that Shroyer Road is not moved. Table 3-7 presents the average overburden, interburden, and coal thicknesses for the North Hilight Field LBA Tract as applied for and for the BLM's preferred tract configuration under Alternative 2.

The replaced overburden and interburden would be a relatively homogeneous (compared to the premining layered overburden and interburden) and partly

recompacted mixture averaging about 291 feet in thickness under both the Proposed Action and Alternative 2. Approximately 263.4 million tons of coal would be recovered from the tract as applied for, and an estimated 652.8 million tons would be recovered from BLM's preferred tract configuration under Alternative 2.

3.3.1.2.1.2 South Hilight Field LBA Tract

Mining would remove an average of 292 feet of overburden, 94 foot of interburden, and 81 feet of coal from about 1,675 acres for the tract as applied for up to about 2,373 acres for the BLM's preferred tract configuration under Alternative 2. These figures represent the estimated area of actual coal removal, assuming that Reno Road is not moved. Table 3-7 presents the average overburden, interburden, and coal thicknesses for the South Hilight Field LBA Tract as applied for and for the BLM's preferred tract configuration under Alternative 2.

The replaced overburden and interburden would be a relatively homogeneous (compared to the premining layered overburden and interburden) and partly recompacted mixture averaging about 454 feet in thickness under both the Proposed Action and Alternative 2. Approximately 213.6 million tons of coal would be recovered from the tract as applied for, and an estimated 304.3 million tons would be recovered from BLM's preferred tract configuration under Alternative 2.

3.3.1.2.1.3 West Hilight Field LBA Tract

Mining would remove an average of 428 feet of overburden, 32 foot of interburden, and 93 feet of coal from about 2,211 acres for the tract as applied for up to about 6,577 acres for the tract as it would be configured under Alternatives 2 and 3; Alternative 2 being BLM's preferred tract configuration. These figures represent the estimated area of actual coal removal, assuming that Wyoming State Highway 450 and Hilight Road are not moved. Table 3-7 presents the average overburden, interburden, and coal thicknesses for the West Hilight Field LBA Tract as applied for and for the tract configured under Alternatives 2 and 3.

The replaced overburden and interburden would be a relatively homogeneous (compared to the premining layered overburden and interburden) and partly recompacted mixture averaging about 541 feet in thickness under both the Proposed Action and Alternatives 2 and 3. Approximately 377.9 million tons of coal would be recovered from the tract as applied for, compared to an estimated 965.2 million additional tons that would be recovered from the tract configured under Alternatives 2 and 3.

3.3.1.2.1.4 West Jacobs Ranch LBA Tract

Mining would remove an average of 475 feet of overburden, no interburden, and 102 feet of coal from about 4,798 acres for the tract as applied for. Under Alternative 2, which is BLM's preferred alternative, mining would remove an average of 486 feet of overburden, 0.5 foot of interburden (where it exists), and 104 feet of coal from about 6,691 acres. These figures represent the estimated area of actual coal removal, assuming that Wyoming State Highway 450 and Hilight Road are not moved. Table 3-7 presents the average overburden, interburden, and mineable coal thicknesses for the West Jacobs Ranch LBA Tract as applied for and for the BLM's preferred tract configuration under Alternative 2.

The replaced overburden and interburden would be a relatively homogeneous (compared to the premining layered overburden and interburden) and partly recompacted mixture averaging about 571 feet in thickness under the Proposed Action and about 584 feet in thickness under Alternative 2, BLM's preferred alternative. Approximately 669.6 million tons of coal would be recovered from the tract as applied for, and an estimated 912.6 million tons would be recovered from BLM's preferred tract configuration under Alternative 2.

3.3.1.2.1.5 North Porcupine LBA Tract

Mining would remove an average of 343 feet of overburden, no interburden, and 75 feet of coal from about 5,024 acres for the tract as applied for. Under Alternative 2, which is BLM's preferred alternative, mining would remove an average of 353.7 feet of overburden, no interburden, and 74.7 feet of coal from about 6,258 acres. These figures represent the estimated area of actual coal removal, assuming that Mackey Road is not moved. Table 3-7 presents the average overburden, interburden, and mineable coal thicknesses for the North Porcupine LBA Tract as applied for and for the BLM's preferred tract configuration under Alternative 2.

The replaced overburden and interburden would be a relatively homogeneous (compared to the premining layered overburden and interburden) and partly recompacted mixture averaging about 402 feet in thickness under the Proposed Action and about 415 feet in thickness under Alternative 2, BLM's preferred alternative. Approximately 601.2 million tons of coal would be recovered from the tract as applied for, and an estimated 745.4 million tons would be recovered from BLM's preferred tract configuration under Alternative 2.

3.3.1.2.1.6 South Porcupine LBA Tract

Mining would remove an average of 345.7 feet of overburden, 10.9 feet of interburden, and 76.1 feet of coal from about 2,531 acres for the tract as applied for. Under Alternative 2, which is BLM's preferred alternative, mining would remove an average of 348.6 feet of overburden, 10.2 feet of interburden, and 76.4 feet of coal from about 2,783 acres. These figures represent the

estimated area of actual coal removal, assuming that a portion of Antelope Road approximately 2.25 miles in length is not moved. Table 3-7 presents the average overburden, interburden, and mineable coal thicknesses for the South Porcupine LBA Tract as applied for and for the BLM's preferred tract configuration under Alternative 2.

The replaced overburden and interburden would be a relatively homogeneous (compared to the premining layered overburden and interburden) and partly recompacted mixture averaging about 418 feet in thickness under the Proposed Action and about 421 feet in thickness under Alternative 2, BLM's preferred alternative. Approximately 309.7 million tons of coal would be recovered from the tract as applied for, and an estimated 339.3 million tons would be recovered from BLM's preferred tract configuration under Alternative 2.

3.3.1.2.2 No Action Alternative

Under the No Action Alternative, the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine coal lease applications would be rejected. Coal removal and the associated disturbance to the stratigraphic units from the base of the lowest coal seam that would be mined to the land surface would not occur on the LBA tracts as applied for or configured under Alternative 2.. Coal removal and associated impacts described above would continue as currently permitted on the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle Mine coal leases. Table 3-7 presents the average overburden, interburden, and coal thicknesses for the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle Mine permit areas. Impacts to the stratigraphic units from the base of the lowest coal seam mined to the land surface related to mining operations at these three applicant mines would not be extended onto portions of the LBA tracts that will not be affected under the current mining and reclamation plans.

As discussed in Section 2.2, a decision to reject one or more of these six coal lease applications at this time would not preclude an application to lease that respective tract in the future.

3.3.1.3 Regulatory Compliance, Mitigation and Monitoring

State and federal regulations require that drilling and sampling programs be conducted on existing leases by all mine operators to identify overburden material that may be unsuitable for reclamation (i.e., material that is not suitable for use in reestablishing vegetation or that may affect groundwater quality due to high concentrations of certain constituents, such as selenium, or adverse pH levels). As part of the mine permitting process, each mine operator develops a management plan to ensure that this unsuitable material is not placed in areas where it may affect groundwater quality or revegetation success. Each mine operator also develops backfill monitoring plans as part of the mine permitting process to evaluate the quality of the replaced overburden.

These plans are in place for the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines and would be developed for the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts if they are leased.

The portions of Wyodak coal seams that may not be recovered (e.g., the Upper Wyodak seam may not be mined in the three Hilight Field tracts) due to quality issues are similar with respect to low sulfur content; therefore, the potential for acid formation is minimal, and any acid formed would be diluted or neutralized by the alkaline overburden. The waste coal from both the mined and unmined seams remains in the pit to be mixed with and covered by backfilled overburden and interburden materials. Any unsuitable materials in the backfill would be buried under adequate fill so as to be below the replaced soil to meet regulatory guidelines for vegetation root zones. Regraded overburden would be sampled to verify suitability as subsoil.

3.3.1.4 Residual Impacts

Geology from the base of the coal to the land surface would permanently change from layered stratigraphy to a mixture of unconsolidated backfill material.

3.3.2 Other Mineral Resources

3.3.2.1 Affected Environment

The PRB contains large reserves of fossil fuels including oil, natural gas (from conventional reservoirs and from coal beds), and coal, all of which are currently being produced. In addition, uranium, bentonite, and scoria are mined in the PRB (WSGS 2003).

3.3.2.1.1 Conventional Oil and Gas

The following discussion is based on information in BLM's Task 2 Report of the PRB Coal Review, the Wyoming State Geological Survey's Oil and Gas Fields Map of the PRB, a May 2008 review of Wyoming Oil and Gas Conservation Commission (WOGCC) database, and a January 2008 reserve estimate prepared by Allen & Crouch Petroleum Engineers, Inc. (A&C) of conventional oil and gas resources in the general Wright analysis area.

The U.S. Geological Survey (USGS) estimated means of undiscovered oil and non-coal bed natural gas resources in the PRB, as of December 2006, are 639 million barrels of oil, 1.16 trillion cubic feet of natural gas, and 131 million barrels of natural gas liquids (USGS 2006). Depths to conventional gas and oil-bearing strata generally range from 4,000 to 13,500 feet.

The Powder River structural basin is one of the richest petroleum provinces in the Rocky Mountain area. Conventional oil and gas resources occur in

reservoirs ranging from Mississippian to Late Cretaceous age rocks, in both structural and stratigraphic traps. Oil was first produced from the PRB in 1887 from the Lower Cretaceous Newcastle Sandstone on the east flank of the basin near Moorcroft, Wyoming. In the 1960s and 1970s, drilling moved into deeper parts of the basin that resulted in the discovery of prolific oil fields in stratigraphic traps in Upper and Lower Cretaceous age rocks. The discovery of oil from the Lower Cretaceous Muddy Sandstone on the Montana side of the basin set off a flurry of exploration that resulted in a number of discoveries in Wyoming in the Muddy Sandstone. Muddy Sandstone production fields in the vicinity of the general Wright analysis area include portions of the Hilight, Porcupine, Payne, and Rocky Hill fields (De Bruin 2002). Drilling continued for deeper targets and resulted in the recovery of oil and gas in deeper reserves in the Permian-Pennsylvanian Minnelusa Formation in the Hilight Field and other fields. Through 2005, there had been a 15-year period of very little conventional oil and gas development activity in the PRB (BLM 2005a).

There are several conventional oil and gas fields that produce in the vicinity of the general Wright analysis area, including the Hilight, Rocky Hill, Porcupine, and Payne Oil and Gas Fields. The Hilight Field is overlain by portions of the North Hilight Field, West Hilight Field, and West Jacobs Ranch LBA Tracts. The Rocky Hill Field is overlain by portions of the North Hilight Field and West Jacobs Ranch LBA Tracts; the Porcupine Field is overlain by portions of the North Porcupine, South Porcupine and South Hilight Field LBA Tracts; and the Payne Field is overlain by a portion of the North Porcupine LBA Tract (De Bruin 2002).

The Hilight Field is producing from or has produced primarily oil from the Lower Cretaceous Muddy-Newcastle Sandstone, which is the main zone of production within that oil and gas field. The Muddy Sandstone play covers much of the PRB and consists of stratigraphic traps, including marine bar, strandline, alluvial, and delta plain sandstone bodies. Depths to productive traps range from 3,000 to 14,000 feet, with most ranging from roughly 9,000 to 10,000 feet below the surface in the general Wright analysis area. Most of the Muddy Sandstone wells in this field were completed in the 1960s and 1970s, and development within the Hilight Field has tended to occur on a 160-acre well spacing. The Rocky Hill Field, which is a minor oil and gas field adjacent to the Hilight Field, is producing or has produced oil and natural gas from the Muddy Sandstone, as well as the Upper Cretaceous Teckla Sandstone Member of the Mesaverde Group, the Upper Cretaceous Niobrara Formation, the Lower Cretaceous Fuson and Lakota Formations and Skull Creek Shale, and the Pennsylvanian Minnelusa Formation. Depths to these Upper and Lower Cretaceous production zones in this field are generally around 9,000 to 10,000 feet below land surface, while depths to the older Minnelusa Formation are around 12,000 feet (WOGCC 2008a).

In the general Wright analysis area, the Porcupine Field and the adjacent Payne Field are producing or have produced oil and gas from the Upper Cretaceous Sussex Sandstone Member of the Cody Shale and the Turner

Sandy Member of the Carlile Shale. Production of oil and gas from these two fields has also been from or is currently from the Lower Cretaceous Muddy Sandstone, Skull Creek Shale, Dakota Sandstone, and Morrison Formation. Depths to these Upper and Lower Cretaceous production zones in these two fields generally range from 8,000 to 11,000 feet below land surface (WOGCC 2008a).

According to the WOGCC database as of May 2008, a total of 74 conventional oil and gas wells have been drilled within the six LBA tracts as applied for and the lands added by the respective BLM study areas included in this analysis. A total of 37 oil wells have been drilled within the North Hilight Field LBA Tract under Alternative 2: 20 of which were still producing; seven were shut in; and 10 were plugged and abandoned. A total of two oil wells have been drilled within the South Hilight Field LBA Tract under Alternative 2: one of which was still producing and one was plugged and abandoned. A total of six oil and gas wells have been drilled within the West Hilight Field LBA Tract under Alternative 2: one gas well of which was still producing; one gas well was shut in; and four oil wells were plugged and abandoned. A total of 12 oil and gas wells have been drilled within the West Jacobs Ranch LBA Tract under Alternative 2: one oil well of which was still producing; one oil well was shut in; and nine oil wells and one gas well were plugged and abandoned. A total of 14 oil and gas wells have been drilled within the North Porcupine LBA Tract under Alternative 2: six gas wells and three oil wells of which were still producing; four oil wells were plugged and abandoned; and one gas well was plugged and abandoned. A total of three oil and gas wells have been drilled within the South Porcupine LBA Tract under Alternative 2: one gas well of which was still producing and two oil wells were plugged and abandoned. As of May 2008, no oil or conventional gas wells have been drilled within these six LBA tract study areas since 1990.

According to the January 2008 reserve estimate of conventional oil and gas resources that was prepared by Allen & Crouch Petroleum Engineers, Inc. of Casper, Wyoming, of the 33 wells capable of producing oil or conventional gas that are located within these six LBA tracts, each configured under Alternative 2, 16 wells are considered to have recoverable reserves using in-place recovery methods. Estimated remaining recoverable reserves from these 16 wells are approximately 43,308 barrels of oil and 1.654 million cubic feet (mmcf) of natural gas (A&C 2008).

Higher oil prices experienced recently have helped prevent the abandonment of low-producing wells and could potentially increase conventional oil and gas exploration in the PRB. Enhanced oil recovery using carbon dioxide (CO_2) flooding has the potential to increase oil recovery in the general Wright analysis area, but the infrastructure (e.g., CO_2 pipelines, etc.) is not currently in place (BLM 2005a).

Section 3.11 includes a discussion of the ownership of the oil and gas resources in each of the BLM study areas for the six LBA tracts included in this

analysis. The 33 conventional oil and gas wells located in the BLM study areas for the six LBA tracts that are capable of production are listed in Appendix E.

3.3.2.1.2 Coal Bed Natural Gas (CBNG)

CBNG has been commercially produced in the PRB since 1989 when production began at the Rawhide Butte Field located northwest of the Gillette, Wyoming (De Bruin and Lyman 1999). Extensive CBNG development has occurred on lands immediately west of the surface coal mines, including the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts. The predominant CBNG production to date in this area has occurred from the Wyodak-Anderson coal zone, which are the same coal beds (or equivalent to the coal beds) being mined by the surface coal mines. The Wyodak-Anderson zone appears to be gas-bearing throughout the PRB and the methane in the coal beds has been determined to be biogenic in origin. CBNG is also being produced from other, deeper coal seams locally throughout the PRB.

In order for CBNG to be produced, the hydrostatic pressure in the coal must be reduced to a level that can vary from coal to coal, which allows the gas to desorb from the coal. This is accomplished by removing water from the coal bed. CBNG reservoirs can be affected by any nearby activities, including coal mining, that reduce the hydrostatic pressure in the coal bed.

The Wyoming BLM State Office-Reservoir Management Group (WSO-RMG) has recently prepared a variety of detailed analyses of CBNG resources in the lands near (meaning those townships within and adjacent to) the existing surface coal mines in the Wyoming PRB for coal leasing and other actions. The WSO-RMG completed a report in 2006 that describes the existing/affected environment of the coal mining areas and adjacent lands, with respect to CBNG resources, and documents the observed and inferred resource depletion that has and will continue to occur (WSO-RMG 2006).

WSO-RMG and the USGS have collected coal gas content data from coal cores near the mines and in other areas of the PRB. Measured gas content was minimal in all of the Wyodak-Anderson coal cores collected in 2000 at locations near the surface coal mines, indicating that the coal seams were already substantially depleted of CBNG in the vicinity of the mines at that time. Average total gas content from the core desorption analyses was approximately 6.8 standard cubic feet per ton (scf/ton) near the coal mines in 2000, compared with an average measured gas content of 37.6 scf/ton from coal cores taken outside the mining areas. Analyses by WSO-RMG, USGS, CBNG operators, and others have shown that dewatering of the coal beds, by both CBNG production and mine dewatering, reduces the hydrostatic pressure in the coals and allows the CBNG to desorb and escape from the coal. These effects have been ongoing and it is likely that desorption has continued since 2000; as a result, coal gas content and the gas-in-place adjacent to the existing mines would currently be expected to be less than in 2000.

WOGCC well data from the areas adjacent to the PRB surface coal mines generally show that operator interest peaked prior to 2000 and declined following 2001. By 2005, drilling activity in the areas adjacent to the coal mines had declined significantly, with only 128 applications to drill CBNG wells filed in all of the townships including and bordering the coal mines in 2005 (WSO-RMG 2006).

CBNG wells were initially drilled on 40-acre spacing in the Wyoming PRB. Production/reservoir analyses that have been submitted to the WOGCC in various public hearings have indicated that CBNG wells in the PRB will produce reserves from larger areas than 40 acres. As a result, the WOGCC established an 80-acre spacing pattern as the default spacing for CBNG wells completed in the PRB within the Fort Union and Wasatch Formations. Most CBNG wells on and near the general Wright analysis area were drilled on an 80-acre pattern, although some were drilled on a 40-acre pattern because they were drilled before the spacing was changed to 80 acres. Certain townships in the PRB are exempt from the 80-acre spacing pattern rule; however, those townships are north of the general Wright analysis area (WOGCC 2008b). Although CBNG has been produced in this area for about 10 years, there are still some undrilled 80-acre spacing units in and around the general Wright analysis area. However, there has been little recent interest in drilling additional wells for completion in the Wyodak-Anderson coal zone in this area.

CBNG is also being produced locally from other deeper seams in the PRB (e.g., Cook, Wall, and Pawnee coal seams of the Tongue River Member of the Fort Union Formation)., although no wells have been completed in the deeper seams on and immediately west of the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts (WOGCC 2008a).

According to the WOGCC database as of May 2008, a total of 287 wells have been drilled for CBNG production within the six LBA tracts as applied for and the lands added by the respective BLM study areas included in this analysis. A total of 40 wells have been drilled within the North Hilight Field LBA Tract under Alternative 2: 34 of which were still producing and six were shut in. A total of 32 wells have been drilled within the South Hilight Field LBA Tract under Alternative 2: 10 of which were still producing; nine were plugged and abandoned, seven were shut it; and six were dry holes. A total of 61 wells have been drilled within the West Hilight Field LBA Tract under Alternative 2: 38 of which were still producing; 13 were plugged and abandoned, nine were shut it; and one was a dry hole. A total of 99 wells have been drilled within the West Jacobs Ranch LBA Tract under Alternative 2: 78 of which were still producing; 11 were shut in; and 10 were plugged and abandoned. A total of 43 wells have been drilled within the North Porcupine LBA Tract under Alternative 2: 42 of which were still producing and one was shut in. A total of 12 wells have been drilled within the South Porcupine LBA Tract under Alternative 2: 10 of which were still producing and two were shut in.

The ownership of oil and gas resources in the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts, which includes the CBNG resources, is discussed in Section 3.11. The 248 CBNG wells located in the BLM study areas for the six LBA tracts that are capable of production (including those that are currently shut in) are listed in Appendix E.

3.3.2.1.3 Other Minerals

Bentonite, uranium, and clinker are commercially produced in the PRB in addition to conventional oil and gas and CBNG.

Layers of bentonite (decomposed volcanic ash) of varying thickness are present throughout the PRB. Some of the thicker layers are mined where they are near the surface, mostly around the edges of the basin. Bentonite has a large capacity to absorb water, and because of this characteristic it is used in a number of processes and products, including drilling mud. No mineable bentonite reserves have been identified on any of the LBA tracts under the Proposed Action or Alternative 2 or 3.

There are substantial uranium resources in southwestern Campbell and western Converse Counties. There is currently one active uranium mining operation in Wyoming, the Smith Ranch-Highland in-situ recovery operation, which is located in west-central Converse County (WSGS 2008). No known uranium reserves exist within the general Wright analysis area.

Clinker, which is also sometimes referred to as scoria, burn, or porcelanite, has been and continues to be a major source of aggregate for road construction in the area due to the shortage of more competent materials. Scoria consists of sediments that were baked, fused, or melted in place when an underlying coal seam burned. Scoria is present within the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle mine permit areas, predominantly east of the mineable coal limit. Scoria does occur on the eastern-most portion of the North Hilight Field LBA Tract configured under Alternative 2, but does not occur on the other five LBA tracts as applied for under the Proposed Actions or within the additional areas evaluated under Alternative 2 or 3.

A search of the BLM Land and Mineral Use Records revealed that no active mining claims are presently located on the LBA tracts as applied for under the Proposed Actions or within the additional areas evaluated under Alternatives 2 or 3 (BLM 2008b).

3.3.2.2 Environmental Consequences

3.3.2.2.1 Proposed Action and Alternatives 2 and 3

During mining, other minerals present on the LBA tracts could not be developed. Some of these other minerals could, however, be developed after coal mining and reclamation are completed.

The conventional oil and gas reservoirs below the mineable Wyodak-Anderson coal beds would not be directly disturbed by removal of the mineable coal. The existing conventional oil and gas wells on the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts under the Proposed Actions or Alternatives 2 or 3, as discussed above, would have to be plugged and abandoned, and all production equipment would have to be removed before mining operations could begin. Following mining and reclamation, the oil and gas lessees could drill new wells to recover oil and gas resources from any productive subcoal oil and gas reservoirs. This would only occur if they believe that the value of the reserves would justify the expense of drilling the wells and rebuilding the production infrastructure. As discussed above, conventional oil and gas resources in the general Wright analysis area have been extensively developed. According to the A&C's 2008 evaluation, the actively producing wells within the BLM study areas for the six LBA tracts included in this EIS appear to have exhausted most of their recoverable reserves, with approximately 5 percent of the recoverable oil and 11 percent of the recoverable gas remaining in these wells (A&C 2008). No wells have been drilled in this area over the last 18 years, so the area generally appears to be unfavorable for additional production from known reservoirs or new discoveries.

Before mining operations could begin, all active CBNG wells would have to be plugged and abandoned, and all gas production equipment would have to be removed. CBNG resources that have not been recovered from the Wyodak-Anderson zone prior to mining would be lost when the coal is removed.

CBNG production requires withdrawal of water from the coal seams to reduce hydrostatic pressure and enable methane desorption from the coals. WSO-RMG's analyses indicate that depletion of the hydrostatic pressures and methane resources starts to occur adjacent to mining areas a short time after mining begins, and that CBNG depletion had already occurred near the mining areas in the Wyodak-Anderson zone by the time that CBNG development began to accelerate in the late 1990s (WSO-RMG 2006). Groundwater level data compiled by the Gillette Area Groundwater Monitoring Organization (GAGMO) in 2000 and earlier indicated that widespread hydrostatic pressure depletion in the affected coal seam aquifers had occurred since mining began in the late 1970s and early1980s. Hydrostatic pressures had declined by as much as 60 percent in the southern group of mines, and coal gas in place can be inferred to have been depleted by similar proportions. The ongoing reduction of

hydrostatic pressure in the coal beds due to mining has been accelerated by extensive CBNG production from surrounding lands.

WSO-RMG's analyses of the production and reservoirs indicate that the CBNG resource within the Wyodak-Anderson seam has been substantially depleted, either by mining or by recovery from producing wells. It seems likely that the wells presently capable of production that are located within the BLM study areas for the six LBA tracts included in this EIS (Appendix E) will have exhausted their economic reserves prior to initiation of mining in the LBA tracts. It is also likely that any undrilled spacing units in the BLM study areas will have been drained by production from the existing wells and nearby mining activity prior to initiation of mining in the LBA tracts. Mining operations within the LBA tracts could not begin until permitting is completed, which generally requires several years after a lease is acquired. By that time, it is likely that most of the economically recoverable CBNG resource would have been produced. CBNG production from the coal zones underlying the Wyodak-Anderson coal zone would not be directly disturbed by surface mining operations and could be delayed as the parcel is mined. If production from these lower seams is established on the LBA tracts in the future, additional measures would be required to accommodate both mining and CBNG production (see Section 3.3.2.3).

Section 3.11.1 includes a discussion on the ownership of the oil and gas resources on the LBA tracts and the oil and gas facilities in the area of the tracts.

3.3.2.2.2 No Action Alternative

Under the No Action Alternative, the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine coal lease applications would be rejected and coal removal and the associated disturbance would not occur on the portions of the LBA tracts as applied for or the LBA tracts configured under Alternative 2 that will not be disturbed under the currently approved surface coal mining permits. Mining operations would continue to limit the development of other mineral resources described above on the existing adjacent Black Thunder, Jacobs Ranch and North Antelope Rochelle Mine coal leases. Mineral development limitations related to mining operations at these three applicant mines would not be extended onto portions of the LBA tracts that will not be affected under the current mining and reclamation plans.

As discussed in Section 2.2, a decision to reject one or more of these six coal lease applications at this time would not preclude an application to lease that respective tract in the future.

3.3.2.3 Regulatory Compliance, Mitigation and Monitoring

The reservoir analyses conducted by the A&C (2008) indicate that most of the recoverable conventional oil and gas resources on the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts have been extracted by the existing wells. Reservoir analyses conducted by the BLM WSO-RMG indicate that most of the recoverable CBNG resources in the Wyodak-Anderson coal zone on these six LBA tracts have probably been produced by the existing wells. Potential does exist for conflicts between coal operations and CBNG and conventional oil and gas wells completed in formations and coal zones below the Wyodak-Anderson seam.

If the federal coal in the tracts is leased and conflicts do develop between the operators of the oil and gas wells and the surface coal mine operators, there are several mechanisms that can be used to facilitate recovery of the conventional oil and gas and CBNG resources prior to mining. These include:

- BLM will attach a Multiple Mineral Development stipulation to the federal coal lease, which states that BLM has the authority to withhold approval of coal mining operations that would interfere with the development of mineral leases issued prior to the coal lease (see Appendix D).

- Conventional oil and gas wells must be abandoned while mining and reclamation operations are in progress but could be recompleted or redrilled following mining if the value of the remaining reserves would justify the expense of reestablishing production.

- BLM has a policy in place on CBNG-coal conflicts (BLM Instruction Memorandum No. 2006-153), which directs BLM decision-makers to optimize the recovery of both resources and ensure that the public receives a reasonable return (BLM 2006a). This memorandum offers royalty incentives to CBNG operators to accelerate production in order to recover the natural gas while simultaneously allowing uninterrupted coal mining operations. In addition, this memorandum also states that it is the policy of the BLM to encourage oil and gas and coal companies to resolve conflicts between themselves; when requested, the BLM will assist in facilitating agreements between the companies.

- Mining of these LBA tracts cannot occur until the coal lessee has a permit to mine the tract approved by the WDEQ/LQD and a MLA mining plan approved by the Secretary of the Interior. Before the MLA mining plan can be approved, BLM must approve the R2P2 for mining the tract. Prior to approving the R2P2, BLM can review the status of CBNG and conventional oil and gas development on the tracts and the mining sequence proposed by the coal lessee. The permit approval process generally takes the coal lessee several years, during which time CBNG resources can continue to be recovered.

- Prior to mining the federal coal, the coal lessee can negotiate an agreement with owners and operators of existing oil and gas facilities on the tract, including owners and operators of oil and gas well and pipeline facilities, regarding removal and relocation of those facilities prior to mining.

3.3.2.4 Residual Impacts

WSO-RMG's 2006 analyses of the CBNG production and reservoirs within the Wyodak-Anderson seam in the areas within and adjacent to the existing PRB coal mines indicated that the resource has been substantially depleted, either by mining or by recovery from producing wells. It therefore seems likely that the CBNG wells capable of production that are located within the BLM study areas for the six LBA tracts (Appendix E) will have exhausted the reserves prior to initiation of mining in the LBA tracts. In the unprobable event that any CBNG remains in the Wyodak-Anderson coal when it is exposed by mining, the gas would be vented to the atmosphere and permanently lost.

3.3.3 Paleontology

3.3.3.1 Affected Environment

The formation exposed on the surface of the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts is the sedimentary Eocene Wasatch Formation, which is known to produce fossil vertebrates of scientific significance throughout Wyoming, including the PRB (Delson 1971, Winterfeld 1978, EVG 2001).

BLM ranks areas according to their potential to contain vertebrate fossils or noteworthy occurrences of invertebrate or plant fossils. The Wasatch Formation is ranked as fulfilling BLM Paleontology Condition No. 1, which is described in the Paleontological Resource Management Handbook 8270-I as "areas that are known to contain vertebrate fossils or noteworthy occurrences of invertebrate or plant fossils." According to the handbook, "consideration of paleontological resources will be necessary if the Field Office review of available information indicates that such fossils are present in the area."

The BLM in Wyoming uses an additional planning tool, called the Fossil Yield Potential Classification (FYPC), which was developed by the U.S. Department of Agriculture-Forest Service (USFS). The FYPC is a planning tool used to classify geological units, usually at the formation or member level, according to the probability that they will yield paleontological resources that are of concern to land managers. This classification system is based largely on how likely a geologic unit is to produce scientifically significant fossils. BLM considers the Wasatch Formation to fulfill either the FYPC Class 4 or Class 5, depending on the nature of bedrock exposures present. FYPC classes 4 and 5 are described as follows:

Class 4 - These geologic units are Class 5 units (see below) that have lowered risks of human-caused adverse impacts and/or lowered risk of natural degradation.

Class 5 - Fossilferous geologic units that regularly and predictably produce vertebrate fossils and/or scientifically significant non-vertebrate (plant and invertebrate) fossils, and that are at risk of natural degradation and/or human-caused adverse impacts.

The FYPC was used by the USFS in their 2001 revised Land and Resource Management Plan (LRMP) for the Thunder Basin National Grassland (TBNG). The USFS has designated the Wasatch Formation in the PRB as a FYPC 5. As coal mining progresses westward, it becomes increasingly likely that significant vertebrate fossils may be encountered.

Vertebrate fossils that have been described from the Wasatch Formation include mammals such as early horses, tapiroids, condylarths, primates, insectivores, marsupials, creodonts, carnivores, and multituberculates; reptiles such as crocodilians, alligators, lizards, and turtles; birds; eggs; amphibians; and fish. Non-marine invertebrates such as mollusks and ostrocods have also been described from the Wasatch.

Fossil plant material is common in the Wasatch Formation. The fossil plants inventoried are primarily leaves and fossilized wood. The leaves usually occur as lignitic impressions in sandstone and siltstone and as compact masses in shale. Leaves are the most abundant fossils found during paleontological surveys and are frequently encountered during mining operations. Fossilized wood often occurs near the top of a coal seam, in carbonaceous shale or within channel sandstone. Exposures of fossil logs are common, but usually very fragmentary. Like fossil leaves, fossil logs can be readily collected in the PRB.

Although the Wasatch Formation is known to produce fossil vertebrates of scientific significance in Wyoming, outcrops of the Wasatch Formation in the PRB are not generally well-exposed and the conditions of deposition of the formation have contributed to a low preservation potential for fossils. Surficial geologic mapping of the general Wright analysis area by the USGS (Reheis and Coates 1987) indicate that unconsolidated surficial deposits (i.e., colluvial and eolian deposits) occur widespread over the area and actual outcrops of the Wasatch Formation that could be prospected for fossils occur infrequently. The landscape of the LBA tracts' general analysis areas is not particularly well suited to bedrock and paleontological exposure.

Professional archeologists, in effort to locate unique pockets of fossilized bone such as those reported elsewhere in the Wasatch Formation in the PRB, closely examined outcrop localities in conjunction with their intensive pedestrian surveys for cultural resources. Such concentrations of fossilized bone were not found. Fossilized (a.k.a. petrified or silicified) wood is much more common and observed at many unrecorded locations, particularly associated with coal.

Because of the ubiquitous nature of fossilized plants and invertebrates, reporting is typically confined to vertebrate specimens or unique finds. The only observed fossils were of petrified wood fragments. No significant or unique paleontological resource localities have been recorded in the general Wright analysis area, no specific mitigation was recommended for paleontology, and no additional paleontological work is recommended.

3.3.3.2 Environmental Consequences

3.3.3.2.1 Proposed Action and Alternatives 2 and 3

The rock outcrops present on the general analysis areas for the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts were examined for the presence of fossils, as discussed above, and no scientifically significant fossils were located. Fossils with scientific significance could be present on the tracts but not exposed at the surface. If the tracts are leased under the Proposed Actions or Alternatives 2 or 3, paleontological resources located on the tract that are not exposed on the surface would be destroyed when the overburden is removed.

3.3.3.2.2 No Action Alternative

Under the No Action Alternative, the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine coal lease applications would be rejected and coal removal and the potential associated impacts to paleontological resources would not occur on the portions of the LBA tracts as applied for or the LBA tracts configured under Alternative 2 that will not be disturbed under the currently approved surface coal mining permits. Mining operations would continue as permitted on the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle Mine coal leases. Impacts to paleontological resources related to mining operations at these three applicant mines would not be extended onto portions of the LBA tracts that will not be affected under the current mining and reclamation plans.

As discussed in Section 2.2, a decision to reject one or more of these six coal lease applications at this time would not preclude an application to lease that respective tract in the future.

3.3.3.3 Regulatory Compliance, Mitigation and Monitoring

If the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts are leased, BLM will attach a stipulation to each lease requiring the operator to report significant paleontological finds to the authorized federal agency and suspend production in the vicinity of the find until an approved paleontologist can evaluate the paleontological resource (Appendix D). No such incidents have occurred on the applicant mines' existing leases.

3.3.3.4 Residual Impacts

Paleontological resources that are not identified and removed prior to or during mining operations would be lost.

3.4 Air Quality

The information in this section and in Appendix F (Supplemental Air Quality Information) is based on the air quality information provided by the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines and from various state and federal sources. This section summarizes the affected environment in the general Wright analysis area and the potential air quality impacts if the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts are leased and mined. Appendix F provides background information on the air quality regulatory framework, regional conditions, dispersion model methodology, the best available control technology (BACT) process, etc. Existing and projected cumulative air quality impacts are discussed in Section 4.2.3.

3.4.1 Background

The air quality of any region is controlled primarily by the magnitude and distribution of pollutant emissions and the regional climate. The transport of pollutants from specific source areas is strongly affected by local topography. In the mountainous western United States, topography is particularly important in channeling pollutants along valleys, creating upslope and downslope circulations that may entrain airborne pollutants, and blocking the flow of pollutants toward certain areas. In general, local effects are superimposed on the general weather regime and are most important when the large-scale wind flow is weak.

The general Wright analysis area, shown in Figure 3-1, is located in the east-central portion of the PRB, a part of the Northern Great Plains that includes most of northeastern Wyoming. As discussed in Section 3.2.1, the topography is primarily rolling plains and tablelands of moderate relief (with occasional valleys and buttes). Elevations range from about 4,690 feet to 5,170 feet above sea level. The climate in the general Wright analysis area is semiarid with relatively short warm summers and longer cold winters. Evaporation exceeds annual precipitation. Section 3.1.1 includes additional information about the climate in the general Wright analysis area.

Air Quality regulations applicable to surface coal mining may include the National Ambient Air Quality Standards/Wyoming Ambient Air Quality Standards (NAAQS/WAAQS), Prevention of Significant Deterioration (PSD), New Source Performance Standards (NSPS), and the Federal Operating Permit Program (Title V). These regulatory programs are described in Appendix F. Air pollution impacts are limited by local, state, tribal, and federal air quality regulations and standards, and state implementation plans, or SIPs,

established under the federal Clean Air Act (CAA) and the Clean Air Act Amendment of 1990 (CAAA). In Wyoming, air pollution impacts are managed by the Wyoming Department of Environmental Quality/Air Quality Division (WDEQ/AQD) under the Wyoming Air Quality Standards and Regulations (WAQSR) and the U.S. Environmental Protection Agency (EPA)-approved State Implementation Plan (SIP).

3.4.1.1 Emission Sources

Air quality conditions in rural areas are typically better than in large urban/industrial centers. Rural areas generally have a smaller number of emission sources (few industrial facilities and residential emissions in the relatively small communities and isolated farms and ranches) and favorable atmospheric dispersion conditions which can result in relatively low air pollutant concentrations. For these reasons, air quality conditions in the rural areas of the PRB are likely to be very good. However, the potential exists for localized pockets of higher concentrations of fugitive dust particles and gaseous emissions related to oil and gas development in the basin (BLM 2005b). Occasional high concentrations of carbon monoxide (CO) and particulate matter may also occur in more urbanized areas (e.g., cities of Gillette, Sheridan, and Buffalo) and around industrial facilities (e.g., surface coal mines and coal-fired power plants), especially under stable atmospheric conditions that occur occasionally during winter.

Surface coal mining activities generate fugitive dust particulates, and gaseous tailpipe emissions from large mining equipment. Specifically, activities such as blasting, excavating, loading and hauling of overburden and coal, and wind erosion of disturbed and unreclaimed mining areas produce fugitive dust. Coal crushing, storage, and handling facilities are the most common stationary or point sources associated with surface coal mining and preparation. Particulate matter is the pollutant emitted from coal mine point sources, although small amounts of gaseous pollutants are emitted from small boilers and off-road diesel engines. Wyoming's ambient air standards for particulates are shown in Table 3-8.

Blasting is also responsible for another type of emission from surface coal mining. Overburden and coal blasting sometimes produces gaseous, orange-colored clouds that contain nitrogen dioxide (NO_2). Exposure to NO_2 may have adverse health effects, as discussed in Section 3.4.3. NO_2 is one of several products resulting from the incomplete combustion of explosives used in the blasting process. Wyoming's ambient air standards for NO_2 are shown in Table 3-8.

Other existing air pollutant emission sources within the region include:

- CO and nitrogen oxides (NO_X) from internal combustion engines used at natural gas and CBNG pipeline compressor stations;

Table 3-8. Assumed Background Air Pollutant Concentrations, Applicable AAQS, and PSD Increment Values (in µg/m³).

Criteria Pollutant	Averaging Time[1]	Background Concentration	Primary NAAQS[2]	Secondary NAAQS[2]	WAAQS	PSD Class I Increments[3]	PSD Class II Increments[3]
Carbon monoxide	1-hour	3,336[4]	40,000	40,000	40,000	---	---
	8-hour	1,381	10,000	10,000	10,000	---	---
Nitrogen dioxide	Annual	5[5]	100	100	100	2.5	25
Ozone	8-hour	70[6]	157	157	157	---	---
Sulfur dioxide	3-hour	181[7]	---	1,300	1,300	25	512
	24-hour	62[7]	365	---	260	5	91
	Annual	13[7]	80	---	60	2	20
PM_{10}[8]	24-hour	54[9]	150	150	150	8	30
	Annual	13[9]	--	--	50	4	17
$PM_{2.5}$[8]	24-hour	13[10]	35	35	65	---	---
	Annual	4[10]	15	15	15	---	---

1 Annual standards are not to be exceeded; short-term standards are not to be exceeded more than once per year.
2 Primary standards are designed to protect public health; secondary standards are designed to protect public welfare.
3 All NEPA analysis comparisons to the PSD increments are intended to evaluate a threshold of concern and do not represent a regulatory PSD Increment Consumption Analysis.
4 Data collected by Amoco at Ryckman Creek for an eight-month period during 1978-1979, summarized in Riley Ridge EIS (BLM 1983).
5 Data collected at Thunder Basin National Grassland, Campbell County, Wyoming in 2002.
6 Data collected at Thunder Basin National Grassland, Campbell County, Wyoming in 2002-2004 (8-hour 4th high).
7 Data collected by Black Hills Power & Light at Wygen 2, Campbell County, Wyoming in 2002.
8 On October 17, 2006, EPA published final revisions to the NAAQS for particulate matter that took effect on December 18, 2006. The revision strengthens the 24-hour $PM_{2.5}$ standard from 65 to 35 µg/m³ and revokes the annual PM_{10} standard of 50 µg/m³. The State of Wyoming will enter into rulemaking to revise the WAAQS.
9 Data collected at the Eagle Butte Mine, Campbell County, Wyoming in 2002.
10 Data collected at the Buckskin Mine in 2002.
Source: (BLM 2005b and WDEQ/AQD)

- CO, NO_X, particulates (PM_{10} and $PM_{2.5}$), sulfur dioxide (SO_2), and volatile organic compounds (VOCs) from gasoline and diesel vehicle tailpipe emissions;
- Particulate matter (dust) generated by vehicle travel on unpaved graded roads, agricultural activities such as plowing, and paved road sanding during the winter months, as well as windblown dust from neighboring areas;
- NO_2 and PM_{10} emissions from railroad locomotives used to haul coal;
- SO_2 and NO_X from power plants. The closest coal-fired power plants are the Dave Johnston plant, located about 40-60 miles south-southwest of these six LBA tracts, and the Wyodak, Wygen, and Neil Simpson plants, located about 35-55 miles north of these six LBA tracts;
- Air pollutants transported from emission sources located outside the PRB; and
- Ground level ozone (O_3) is not emitted directly into the air, but is created by chemical reactions between NO_X and VOCs in the presence of sunlight.

3.4.2 Particulate Emissions

3.4.2.1 Affected Environment for Particulate Emissions

The federal standard for particulate matter pollutant was specified as total suspended particulates (TSP) until 1987. This measurement included all particulates generally less than 100 microns in diameter. In 1987, the form of the standard was changed from TSP to PM_{10} to better reflect human health effects. PM_{10} represents particulate matter with a mean aerodynamic diameter of 10 microns or less that can potentially penetrate into the lungs and cause health problems. In 1997, EPA set separate standards for fine particles (particulate matter with a mean aerodynamic diameter of 2.5 microns or less, or $PM_{2.5}$), based on their link to serious health problems. In 2006, EPA revised the air quality standards for particulate matter by tightening the 24-hour fine particle standard from the previous level of 65 micrograms per cubic meter ($\mu g/m^3$) to 35 $\mu g/m^3$ and revoking the annual PM_{10} standard of 50 $\mu g/m^3$. EPA retained the existing annual $PM_{2.5}$ standard of 15 $\mu g/m^3$ and the 24-hour PM_{10} standard of 150 $\mu g/m^3$. These revisions took effect on December 18, 2006. The current federal ambient air standards are shown in Table 3-8.

While retaining the TSP standard until March 2000, Wyoming added the PM_{10} standard in 1989. Wyoming also adopted a $PM_{2.5}$ standard in March 2000. In view of the December 2006 revisions to the NAAQS for particulate matter, the State of Wyoming will enter into rulemaking to revise the WAAQS for particulate matter so that they remain as stringent as or more stringent than the NAAQS. Even with the evolution of state or federal small size particulate standards, TSP is still monitored in some PRB locations as a surrogate for PM_{10} and as an indication of overall atmospheric levels of particulate matter.

WDEQ/AQD requires monitoring data to document the air quality at all of the PRB mines. As a result, the eastern PRB is one of the most intensely monitored areas in the world. According to EPA AirData, in 2007 there were six TSP monitors, five $PM_{2.5}$ monitors and 36 PM_{10} monitors in the Wyoming portion of the PRB. TSP and PM_{10} data have been collected since 1980 and 1989, respectively. Through 2004, approximately 57,000 TSP samples had been collected and approximately 47,555 PM_{10} samples had been collected through 2007. Information about the regulatory framework, the monitoring network, and PM_{10} concentration trends since monitoring began are included in Appendix F. Existing site specific air quality information is included in the Supplementary Information Document, which is available on request.

Historical particulate matter ambient air quality data for the general Wright analysis area air quality monitoring sites generally show the same results as described above for the PRB as a whole. The locations of PM_{10}, $PM_{2.5}$, and TSP (if monitored) particulate emission monitoring samplers at the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines are shown on Figures 3-3 through 3-5, respectively. The progression of mining operations requires that the location and number of particulate monitors be adjusted in order to provide the best documentation of the ambient air quality. Figure 3-6 presents the average annual particulate emissions, as PM_{10}, measured by the general Wright analysis area mines' particulate monitoring samplers from 1998 through 2007. Annual coal and overburden production for the general Wright analysis area mines for these same years are also shown on Figure 3-6.

There were no monitored exceedances of the PM_{10} standard in the PRB through 2000. No exceedances of the annual PM_{10} particulate standards were documented by the Black Thunder, Jacobs Ranch, or North Antelope Rochelle mines through 2007. From 2001 through 2006, there were a total of nine exceedances of the 24-hour PM_{10} particulate standards associated with the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines. In 2007, a total of three 24-hour PM_{10} exceedances were reported at these three mines (two at North Antelope Rochelle, one at Black Thunder, and none at Jacobs Ranch). Prior to 2007, there was no mechanism in place to account for exceedances demonstrated to be the result of natural events. The WDEQ/AQD collaborated with the Wyoming Mining Association (WMA) to develop a Natural Events Action Plan (NEAP) for the coal mines of the PRB, based on EPA Natural Event Policy guidance. Under certain conditions, excessive PM_{10} concentrations resulting from dust raised by exceptionally high winds or other natural events will be treated as uncontrollable natural events. The NEAP is discussed in Appendix F. All of the nine exceedances that occurred at the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines between 2001 and 2006 were associated with elevated wind speeds exceeding 20 miles per hour (mph), which could have qualified as a high wind event under the NEAP. The two exceedances reported in 2007 at the North Antelope Rochelle Mine have been flagged by EPA as exceptional events under the NEAP and will not be considered when determining the region's air quality designation. The

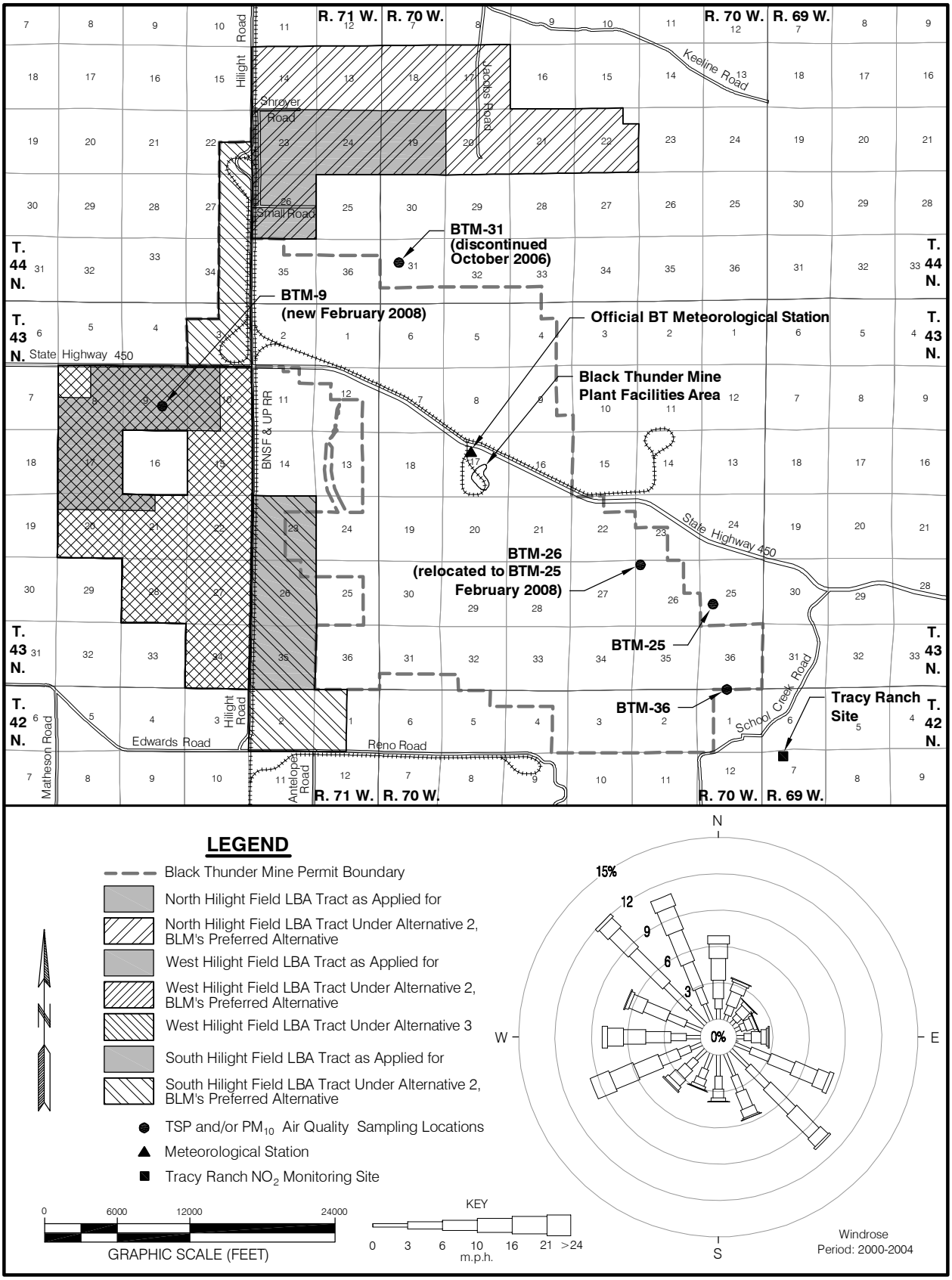


Figure 3-3. Wind Rose, Air Quality and Meteorological Stations at the Black Thunder Mine.

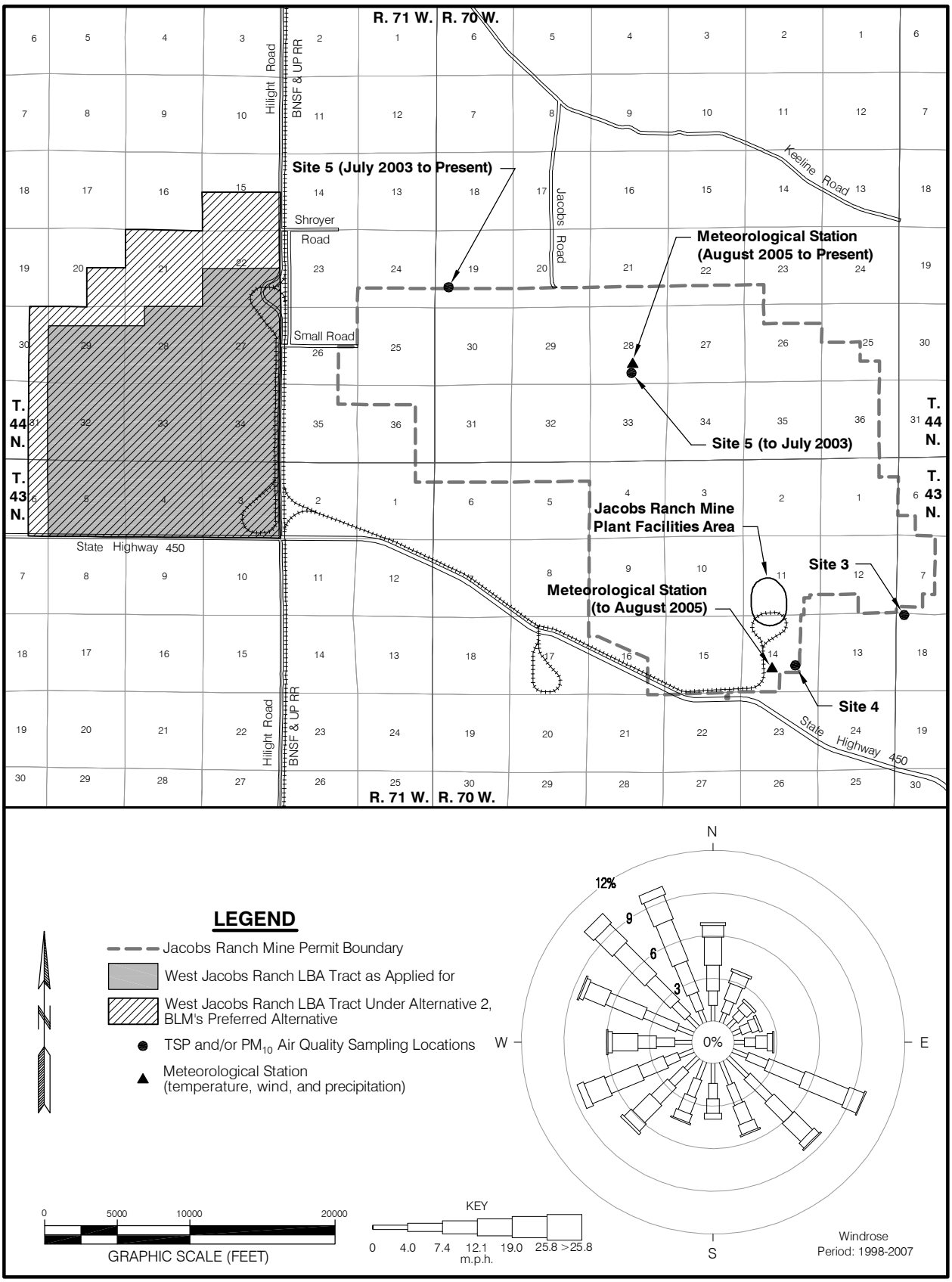


Figure 3-4. Wind Rose, Air Quality and Meteorological Stations at the Jacobs Ranch Mine.

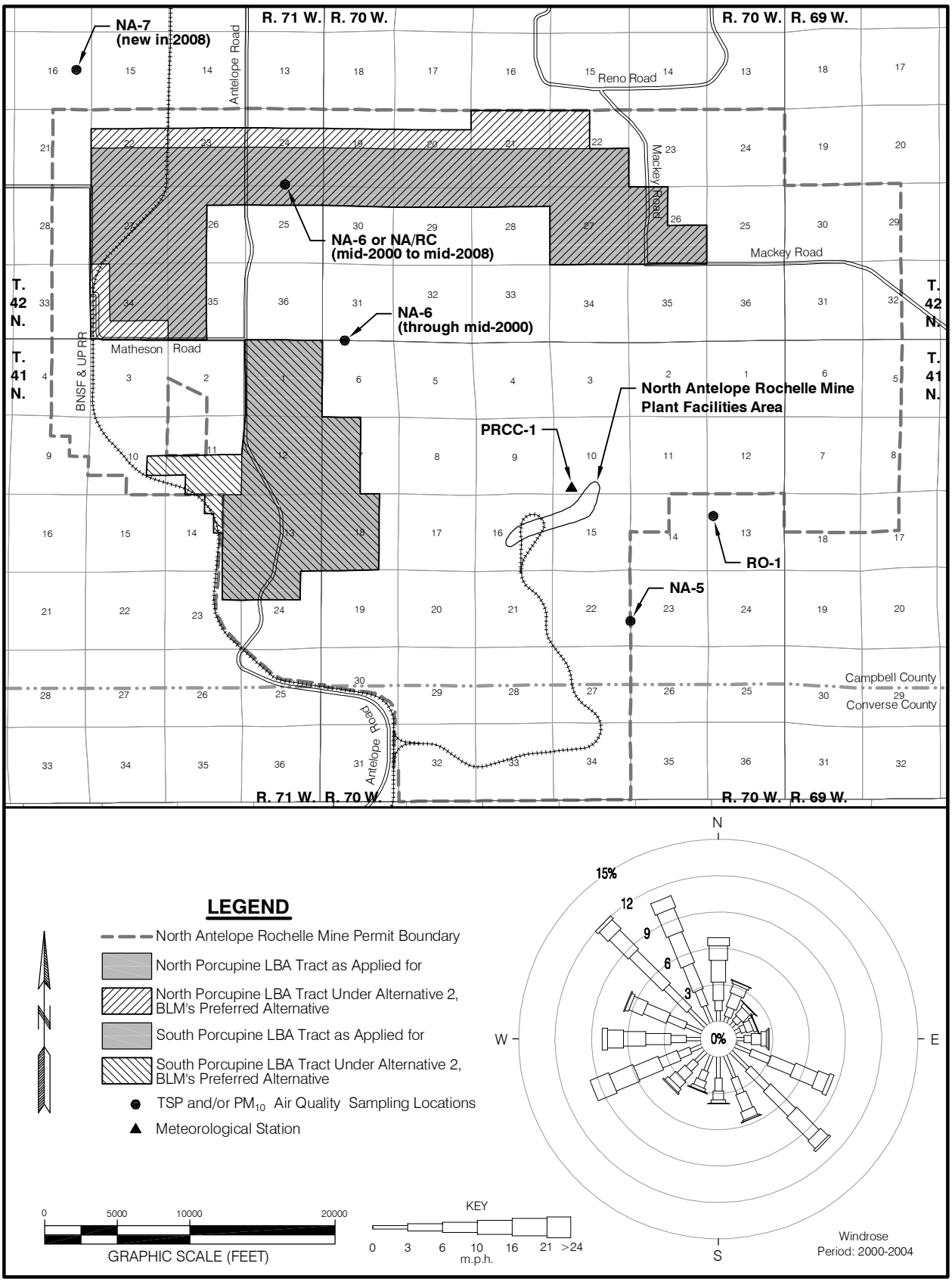


Figure 3-5. Wind Rose, Air Quality and Meteorological Stations at the North Antelope Rochelle Mine.

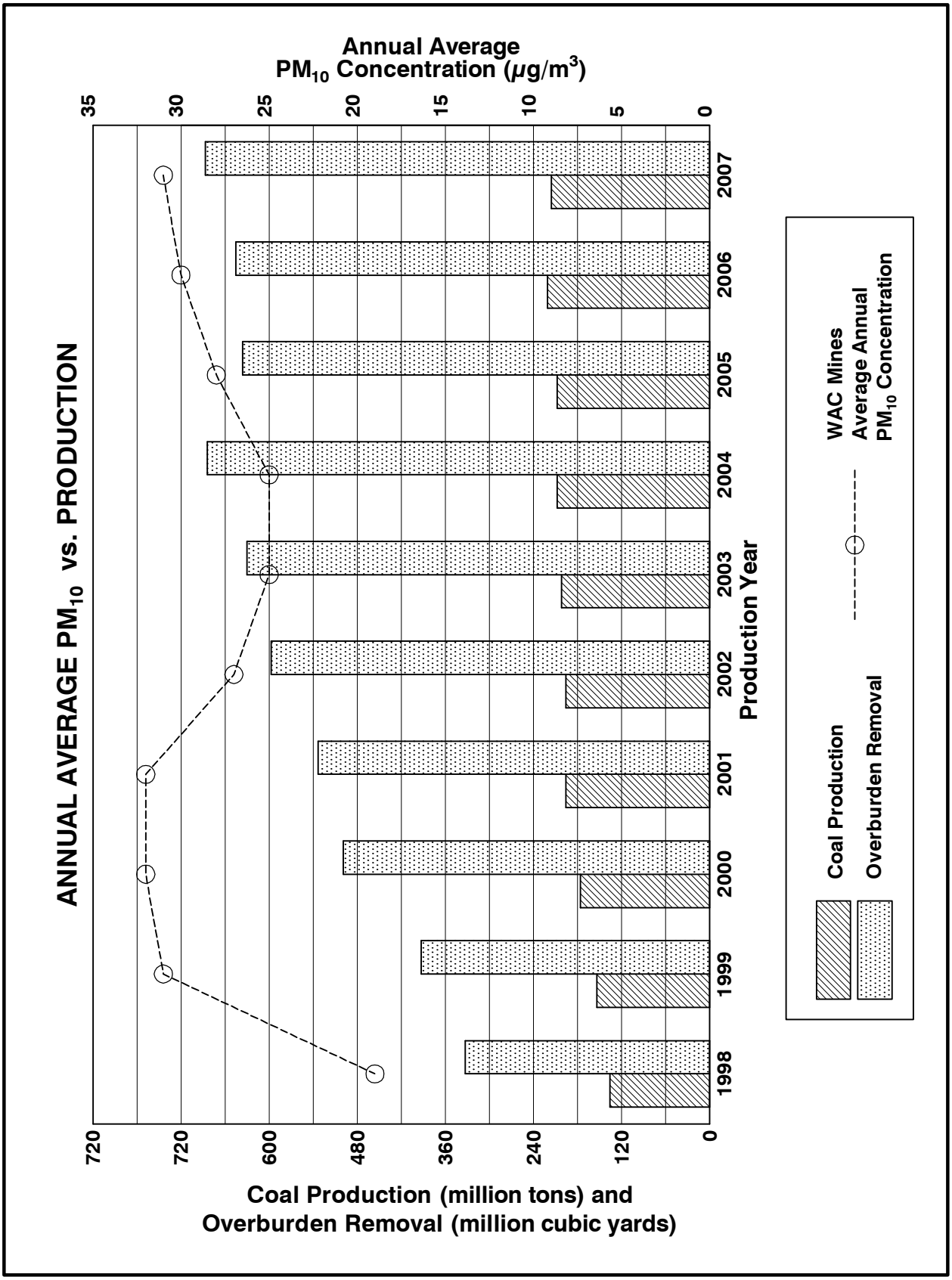


Figure 3-6. Annual Coal Production and Overburden Removal vs. Ambient Particulates for the General Wright Analysis Area (1998 through 2007).

one exceedance reported at the Black Thunder Mine in 2007 is currently under review by EPA and may be flagged as an exceptional event under the NEAP.

3.4.2.2 Environmental Consequences Related to Particulate Emissions

Particulates include solid particles and liquid droplets that can be suspended in air. Particulates, especially fine particles (<2.5 µg/m^3), have been linked to numerous respiratory-related illnesses and can adversely affect individuals with pre-existing heart or lung diseases (EPA 2007a). They are also a major cause of visibility impairment in many parts of the United States. While individual particles cannot be seen with the naked eye, collectively they can appear as black soot, dust clouds, or gray hazes.

3.4.2.2.1 Proposed Action and Alternatives 2 and 3

Potential particulate emissions related to mining operations at the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines are described below. As part of the applicant mines' mining permit applications, air quality impact analyses were prepared using air quality dispersion modeling to predict the effects of the existing mine operations on nearby air quality. Modeling for the three existing mine sites is discussed below and in Appendix F. Due to the similarities in mining rates and mining operations, the potential impacts of mining the LBA tracts have been inferred from the projected impacts of mining the existing coal leases as currently permitted.

To model potential ambient impacts in the area surrounding the mine operations, receptor locations were placed at approximately 500-meter intervals along the Lands Necessary to Conduct Mining (LNCM) boundary, which is also referred to as the ambient air quality boundary, for each mine. As discussed in Appendix F, a PM_{10} concentration of 14.91 µg/m^3 was added to the Black Thunder Mine and the Jacobs Ranch Mine modeled emissions to account for background fugitive dust. The North Antelope Rochelle Mine used a 15.00 µg/m^3 concentration value for PM_{10} modeling. Predicted PM_{10} emissions from the other regional mining operations were inventoried using those mines' most recent WDEQ/AQD air quality permit applications. Impacts on ambient air from the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines and other regional mines vary by year due to annual changes in emission strength, emission density, pit proximity to defined ambient air boundaries, and pit configuration. Emissions for each year are ranked and candidate worst-case years are further evaluated regarding proximity to neighboring mining operations and emissions. The total PM_{10} concentration at each receptor was determined by summing the concentration due to each active mine in the general area and adding the appropriate background concentration. The resulting particulate levels were then compared to the average annual PM_{10} standard of 50 µg/m^3 to determine compliance with the annual WAAQS. This constitutes a demonstration of compliance with the "long-term" or annual WAAQS.

As discussed in Appendix F, surface coal mines in the Wyoming PRB have not been subject to PSD requirements. Only some fraction of the mine emissions included in the WDEQ/AQD air quality permit analyses consumes increment based on permits in place in the baseline year of 1997. As a result, the concentrations predicted by the WDEQ/AQD air quality permit analyses should not be compared to PSD increments.

The Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines' point source emissions inventories include all coal preparation and processing facilities (i.e., crushers, material transfer points, silos, and loadouts). All point source parameters for the regional mining operations, which were obtained from WDEQ/AQD files, were also considered in the modeling analysis. As discussed in Appendix F, a proposed new point source that has the potential to emit more than 250 tons per year (tpy) of any criteria pollutant (the primary pollutant being particulate matter) must undergo a regulatory PSD increment consumption analysis as well as a BACT review.

In Wyoming, monitoring results have been used in lieu of short-term (24-hour) modeling for assessing short-term coal mining-related impacts in the PRB. WDEQ has chosen this procedure in accordance with an agreement between the EPA and the State of Wyoming. That agreement recognizes that appropriate models do not exist to accurately predict 24-hour impacts. Twenty-four-hour impacts have been estimated from recent monitoring and emission control activities. From 2001 through 2006, there were nine exceedances of the 24-hour PM_{10} particulate standards associated with the three applicant mines. All of the nine exceedances were associated with elevated wind speeds exceeding 20 mph, which could have qualified as a high wind event under the NEAP. Three exceedances were reported in 2007. Two of the three exceedances reported in 2007 have been designated by EPA as exceptional events under the NEAP and will not be considered when determining the region's air quality designation. The third exceedance is currently under review by EPA and may be designated as an exceptional event under the NEAP.

The estimated average overburden thickness is generally greater in each of the LBA tracts than within the current leases, but the thickness of the coal in the LBA tracts is about the same as in the existing mine areas (see Table 3-7). The acquisition and mining of the LBA tracts by the applicant mines could result in an increase in fugitive emissions per ton of coal mined above current levels due to the increased volume of overburden that would have to be removed to recover the coal. The increase in fugitive dust emissions could potentially be moderated somewhat if removal of the larger volume of overburden material results in a slower rate of mining advancement through the LBA tracts. This would potentially decrease the number of acres disturbed annually and cause haul distances to increase more slowly.

Current mining and emission mitigation methods to recover the coal in the LBA tracts would be expected to continue for a longer period of time than is shown

in the mines' currently approved air quality permits. The mines would continue to utilize direct cast blasting, draglines, and/or truck and shovel fleets to remove and replace overburden and truck and shovel fleets and overland conveyors to remove and transport coal. Truck haul distances to transport the coal to the processing and rail loadout facilities are not expected to increase, because overland conveyors are likely to be extended onto the tracts. The facilities shown in the current air quality permits would not change as a result of proposed mining of the LBA tracts. There are no plans to change blasting procedures or blast sizes associated with the mining of the LBA tracts. In addition, current BACT measures for particulates would continue to be employed. If the Black Thunder, Jacobs Ranch, and North Antelope Rochelle Mines acquire the LBA tracts, they will have to amend their current air quality permits to include the new leases before mining activities can proceed into the new lease areas. New air quality modeling would need to be conducted in support of that permit application demonstrating on-going compliance with all applicable ambient standards.

3.4.2.2.1.1 North, South, and West Hilight Field LBA Tracts

The North, South, and West Hilight Field LBA Tracts would be mined as integral parts of the Black Thunder Mine under the Proposed Actions and Alternatives 2 and 3.

TBCC projects that the annual coal production is expected to have a maximum production rate of 135 million tons, with or without the North, South, or West Hilight Field LBA Tracts. Black Thunder Mine's currently approved air quality permits from the WDEQ/AQD limit annual coal production to 135 million tons of coal. According to TBCC, if they acquire the additional coal in the LBA tracts, production would continue at an average rate of 135 million tons per year (mmtpy) for approximately 6.4 years under the Proposed Action, or for about 14.2 years under Alternative 2, BLM's preferred configuration for all three tracts. As discussed in Section 3.0, the estimates of recoverable coal, associated disturbance, and mine life shown in Tables 3-1 through 3-3 assume that Shroyer, Reno and Hilight Roads and State Highway 450 are not moved. As indicated in Tables 2-3, 2-5, and 2-7, approximately 132.1 million additional tons of coal could be recovered if these public roads are moved, which would extend operations at the mine for a total of about one additional year under Alternative 2 for all three tracts.

WDEQ/AQD issued air quality permit MD-417A for the Black Thunder Mine on July 1, 1999. This air quality permit was issued based on an analysis using emission factors, estimation methods, and model selection consistent with WDEQ/AQD policy. WDEQ/AQD issued air quality permit MD-6824 on January 22, 2008, which reclassified the Black Thunder Mine as below the minor source threshold (BTM 2008a). Air quality permit MD-3851 was issued on August 18, 2008, combining the Black Thunder Mine and North Rochelle Mine air quality permits and increasing the permitted production from 100 to 135 mmtpy (BTM 2008b). Material movement currently utilizes direct cast

blasting, draglines, and/or truck and shovel fleets for overburden and truck and shovel fleets and overland conveyors for coal removal and transport.

Particulate emission inventories for the mining activities at Black Thunder Mine were prepared for all years in the currently anticipated life of the mine. Two years were then selected for worst-case dispersion modeling of PM_{10} based on mine plan parameters and emission inventories. Fugitive emission sources and point sources were modeled using the ISCLT3 Model to estimate average annual PM_{10} concentrations.

Long-term modeling for air quality permit MD-3851 indicates the currently projected mine activities will be in compliance with the annual PM_{10} ambient air standard for the life of the Black Thunder Mine. Based on mine plan parameters and highest emissions inventories, the years 2015 and 2017 were selected as the worst-case years. The dispersion model showed a maximum concentration on the Black Thunder Mine LNCM boundary of 41.9 $\mu g/m^3$ in 2015 and 49.96 $\mu g/m^3$ in 2017. Coal production in both years was modeled at the maximum permitted production level of 135 million tons (BTM 2008b). The locations of the maximum-modeled PM_{10} concentrations for 2015 and 2017 are shown on Figures 3-7 and 3-8, respectively.

An initial inventory of all point sources, controls, and emissions for the Black Thunder Mine air quality permit showed a maximum potential to emit 110.4 tpy. A reevaluation of point sources emissions (air quality permit MD-6824) estimated the maximum potential to emit 32.2 tpy. Therefore, a PSD increment consumption analysis was not necessary, and because this value is now below the 100 tpy major source threshold limit specified in Chapter 6, Section 3 of the WAQSR, Black Thunder Mine will not be subject to the Title V Operating Permit program (BTM 2008a).

Modeling conducted for air quality permit MD-3851 to revise air quality permit MD-6824 predicted no exceedances of the annual PM_{10} NAAQS at a 135-mmtpy production rate. There were six exceedances of the 24-hour PM_{10} particulate standards at the Black Thunder Mine from 2001 through 2006. All six exceedances were associated with elevated wind speeds exceeding 20 mph, which could have qualified as a high wind event under the NEAP. There was one exceedance reported in 2007, which is currently under review by EPA and may be designated as an exceptional event under the NEAP. There have been no exceedances of the annual PM_{10} NAAQS. TBCC estimates that the Black Thunder Mine would produce at an average annual rate of 135 mmtpy if it acquires and mines the North, South, and/or West Hilight Field LBA Tracts, but fugitive dust emissions are projected to remain within daily and annual AAQS limits.

Public exposure to particulate emissions from surface mining operations is most likely to occur along publicly accessible roads and highways that pass near and through the areas of mining operations. Occupants of dwellings in the area could also be affected. Roads, highways, currently occupied dwellings,

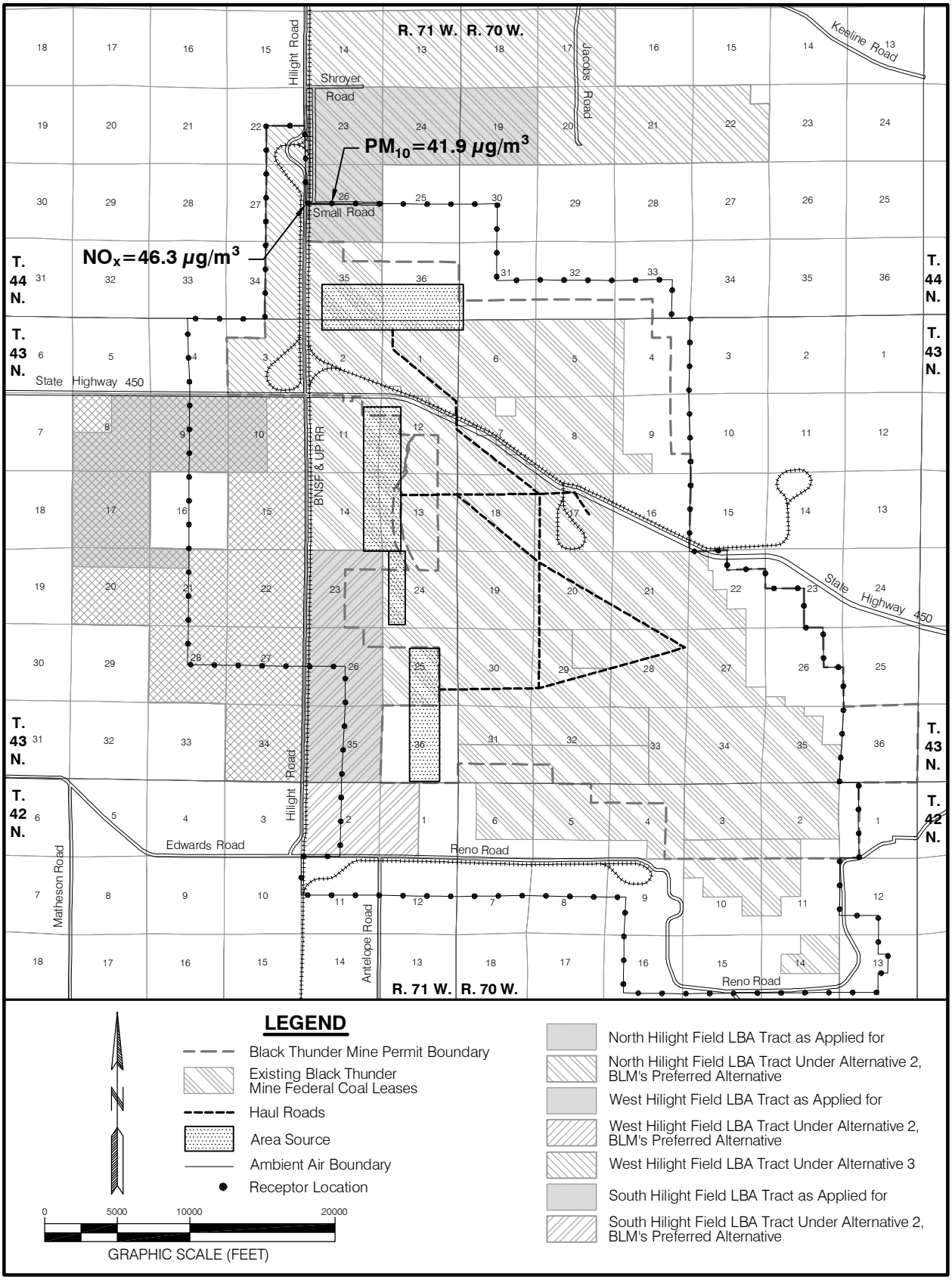


Figure 3-7. Maximum Modeled PM_{10} and NO_X Concentrations at the Black Thunder Mine Ambient Air Boundary for the Year 2015.

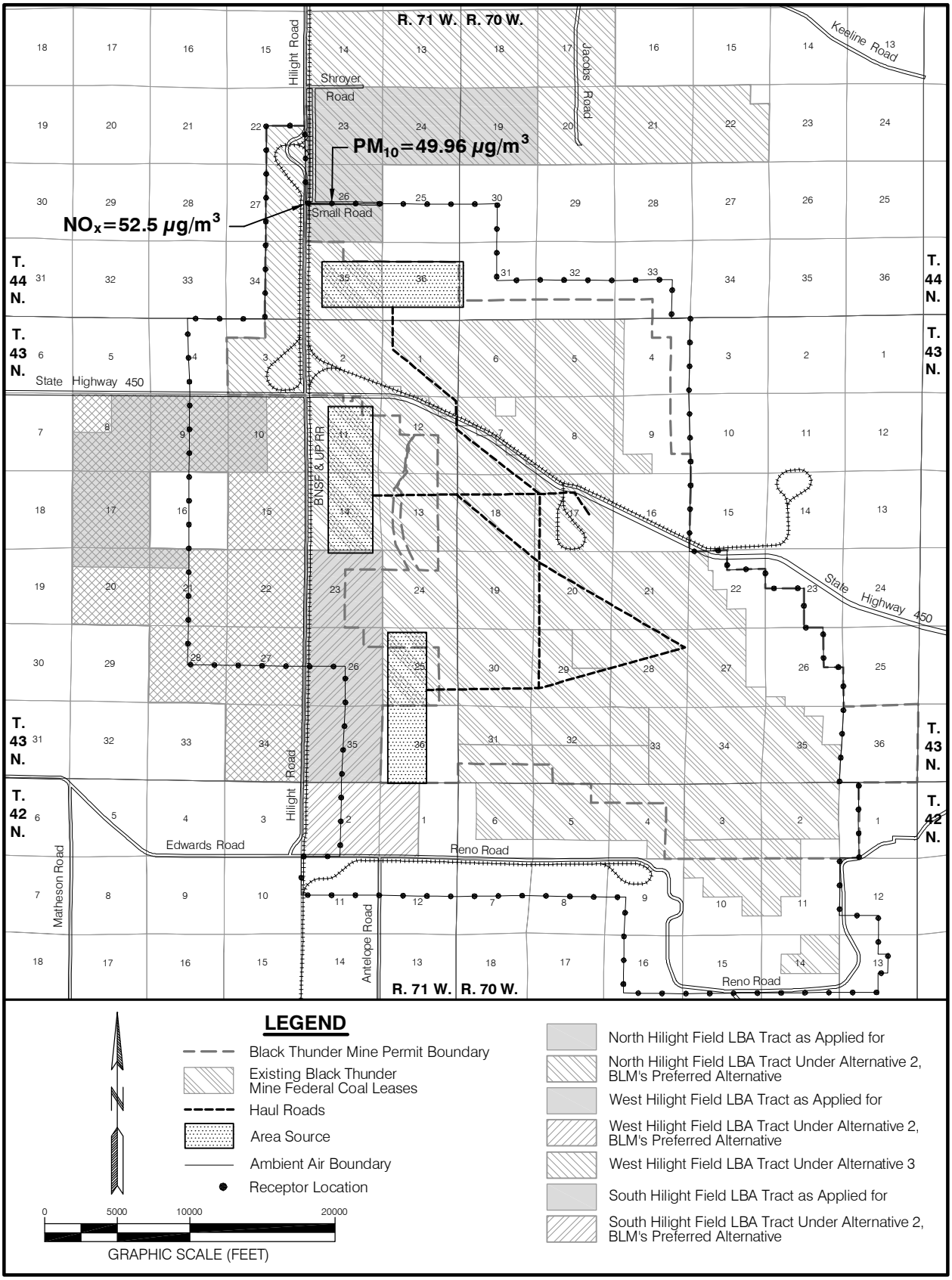


Figure 3-8. Maximum Modeled PM_{10} and NO_X Concentrations at the Black Thunder Mine Ambient Air Boundary for the Year 2017.

businesses, and school bus stops in the vicinity of the North, South, and West Hilight Field LBA Tracts are shown in Figures 3-9 through 3-11, respectively.

3.4.2.2.1.2 West Jacobs Ranch LBA Tract

The West Jacobs Ranch LBA Tract would be mined as an integral part of the Jacobs Ranch Mine under the Proposed Action and Alternative 2.

JRCC projects that the annual coal production is expected to average 40 million tons, with or without the West Jacobs Ranch LBA Tract. Jacobs Ranch Mine's currently approved air quality permit from the WDEQ/AQD limits annual coal production to 55 million tons of coal. According to JRCC, if they acquire the additional coal in the LBA tract as applied for, production would continue at the present average rate of 40 mmtpy for approximately 16.7 years under the Proposed Action, or for about 22.8 years under Alternative 2, BLM's preferred configuration for the tract. As discussed in Section 3.0, the estimates of recoverable coal, associated disturbance, and mine life shown in Table 3-4 assume that Hilight Road and State Highway 450 are not moved. As indicated in Table 2-9, approximately 229.5 million additional tons of coal could be recovered if these public roads are moved, which would extend operations at the mine for a total of about 5.8 additional years under Alternative 2.

WDEQ/AQD issued air quality permit MD-1005 for the Jacobs Ranch Mine on August 6, 2004. This air quality permit was issued based on an analysis using emission factors, estimation methods, and model selection consistent with WDEQ/AQD policy. WDEQ/AQD issued air quality permit MD-1005A on December 1, 2004 to modify operations at the Jacobs Ranch Mine to add a dragline for overburden removal. WDEQ/AQD issued air quality permit MD-1005A2 on January 22, 2007 to revise the LNCM boundary. Material movement currently utilizes direct cast blasting, draglines, and/or truck and shovel fleets for overburden and truck and shovel fleets and overland conveyors for coal (JRM 2007).

Particulate emission inventories for the mining activities at Jacobs Ranch Mine were prepared for all years in the currently anticipated life of the mine. Two years were then selected for worst-case dispersion modeling of PM_{10} based on mine plan parameters and emission inventories. Fugitive emission sources and point sources were modeled using the ISCLT3 Model to estimate average annual PM_{10} concentrations.

Long-term modeling indicates the currently projected mine activities will be in compliance with the annual PM_{10} ambient air standard for the life of the Jacobs Ranch Mine. Based on mine plan parameters and highest emissions inventories, the years 2013 and 2015 were selected as the worst-case years. The dispersion model showed a maximum concentration on the Jacobs Ranch Mine LNCM boundary of 44.70 $\mu g/m^3$ in 2013 and 49.61 $\mu g/m^3$ in 2015. Coal production in both years was modeled at the maximum permitted production

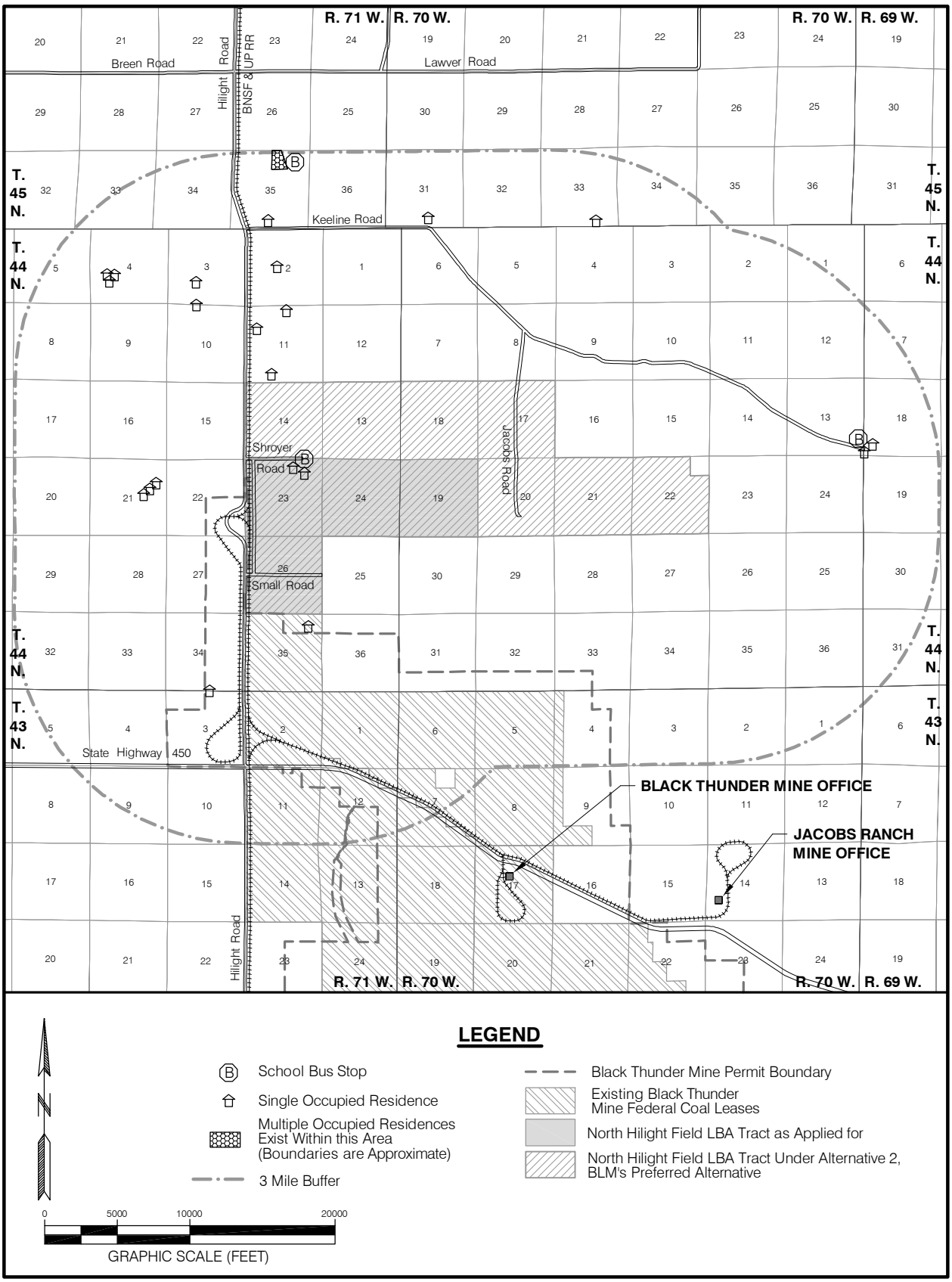


Figure 3-9. Residences, School Bus Stops, Public Roads, and Other Publicly Accessible Facilities Within 3 Miles of the North Hilight Field LBA Tract Under Alternative 2.

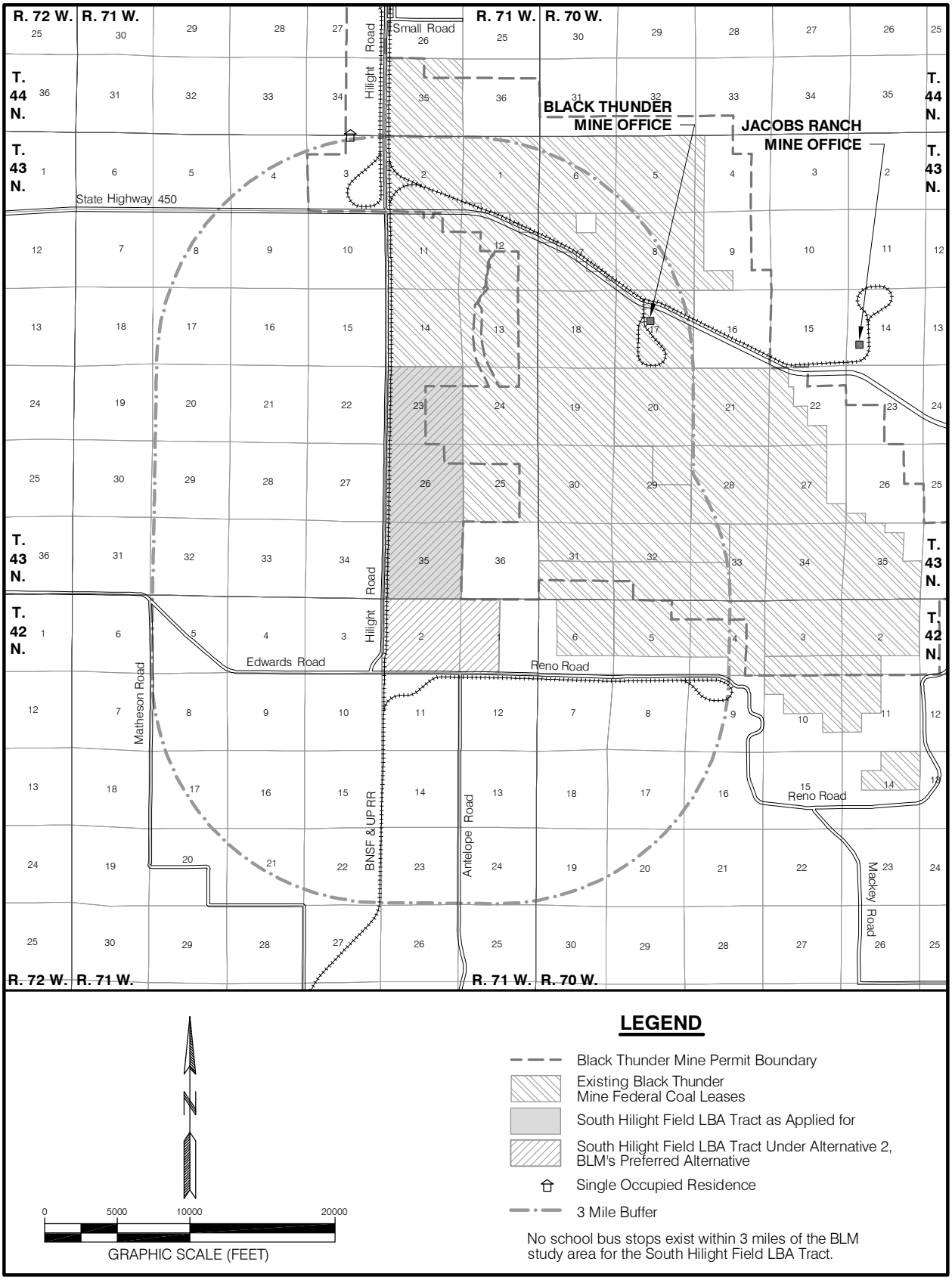


Figure 3-10. Residences, School Bus Stops, Public Roads, and Other Publicly Accessible Facilities Within 3 Miles of the South Hilight Field LBA Tract Under Alternative 2.

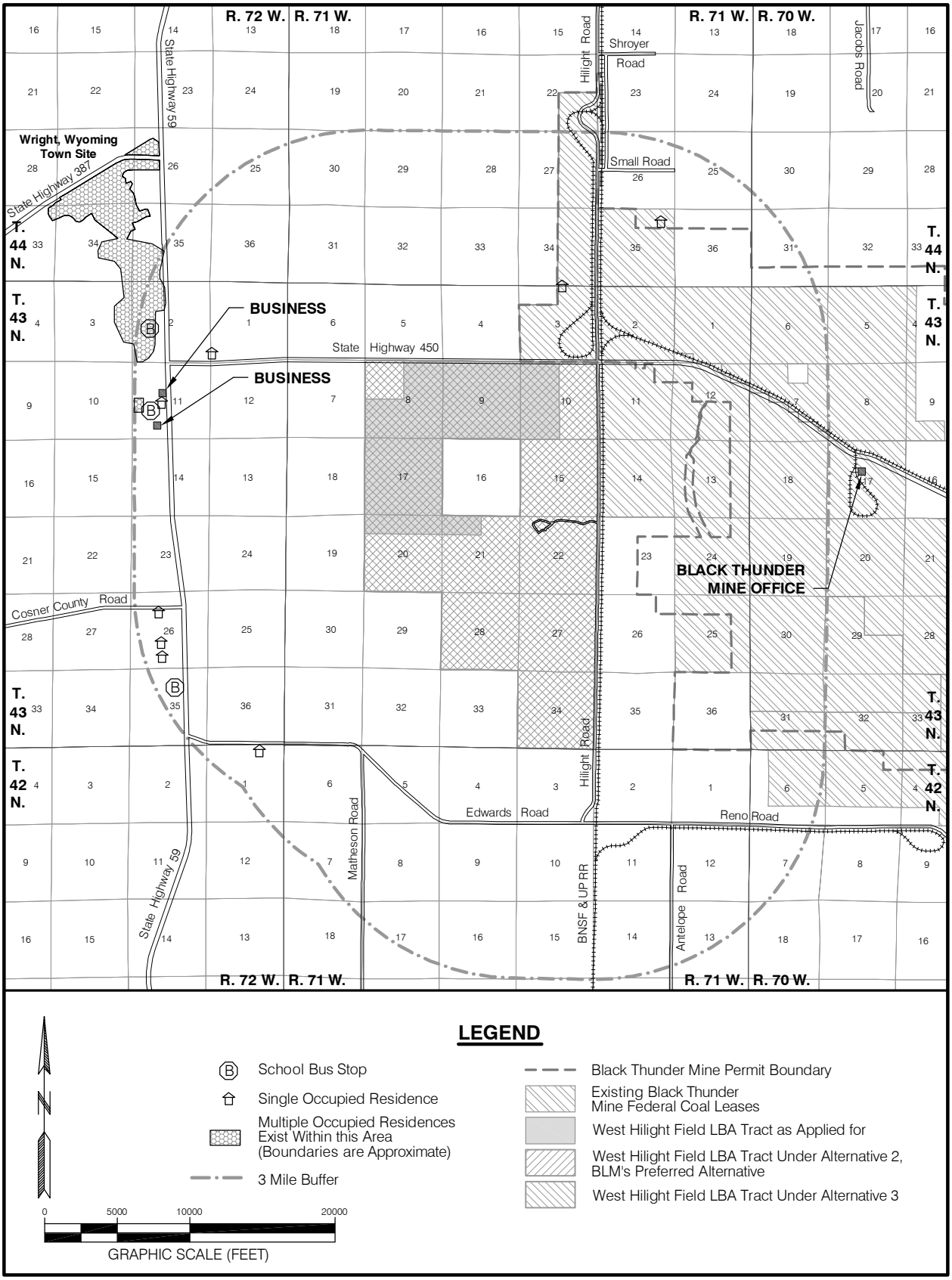


Figure 3-11. Residences, School Bus Stops, Public Roads, and Other Publicly Accessible Facilities Within 3 Miles of the West Hilight Field LBA Tract Under Alternative 2 .

level of 55 million tons (JRM 2007). The locations of the maximum-modeled PM_{10} concentrations for 2013 and 2015 are shown on Figure 3-12.

An inventory of all point sources, controls, and emissions for air quality permit MD-1005A2 showed a potential to emit of 21.9 tpy; therefore, a PSD increment consumption analysis was not necessary, and because this value is below the 100 tpy major source threshold limit specified in Chapter 6, Section 3 of the WAQSR, Jacobs Ranch Mine will not be subject to the Title V Operating Permit program (JRM 2007).

Modeling conducted for the current Jacobs Ranch Mine air quality permit predicted no exceedances of the annual PM_{10} NAAQS at a 55-mmtpy production rate. There has been one exceedance of the 24-hour PM_{10} NAAQS since PM_{10} monitoring began at the mine and no exceedances of the annual PM_{10} NAAQS. JRCC estimates that the Jacobs Ranch Mine would continue to produce at an average annual rate of 40 mmtpy if it acquires and mines the West Jacobs Ranch LBA Tract, but fugitive dust emissions are projected to remain within daily and annual AAQS limits.

Public exposure to particulate emissions from surface mining operations is most likely to occur along publicly accessible roads and highways that pass near and through the areas of mining operations. Occupants of dwellings in the area could also be affected. Roads, highways, currently occupied dwellings, businesses, and school bus stops in the vicinity of the West Jacobs Ranch LBA Tract are shown in Figure 3-13.

3.4.2.2.1.3 North and South Porcupine LBA Tracts

The North and South Porcupine LBA Tracts would be mined as integral parts of the North Antelope Rochelle Mine under the Proposed Action and Alternative 2. PRC projects that the annual coal production is expected to average 95 million tons, with or without the North or South Porcupine LBA Tracts. North Antelope Rochelle Mine's currently approved air quality permits from the WDEQ/AQD limit annual coal production to 99 million tons of coal. According to PRC, if they acquire the additional coal in the LBA tracts, production would continue at an average rate of 95 mmtpy for approximately 9.9 years under the Proposed Action, or for about 11.4 years under Alternative 2, BLM's preferred configuration for both tracts. As discussed in Section 3.0, the estimates of recoverable coal, associated disturbance, and mine life shown in Tables 3-5 and 3-6 assume that Mackey Road and the remaining 2.25-mile section of Antelope Road are not moved. As indicated in Tables 2-11 and 2-13, approximately 98.1 million additional tons of coal could be recovered if these public roads are moved, which would extend operations at the mine for a total of about one additional year under Alternative 2 for both tracts.

WDEQ/AQD issued air quality permit MD-1309 for the North Antelope Rochelle Mine on January 24, 2006. This air quality permit was issued based on an analysis using emission factors, estimation methods, and model selection

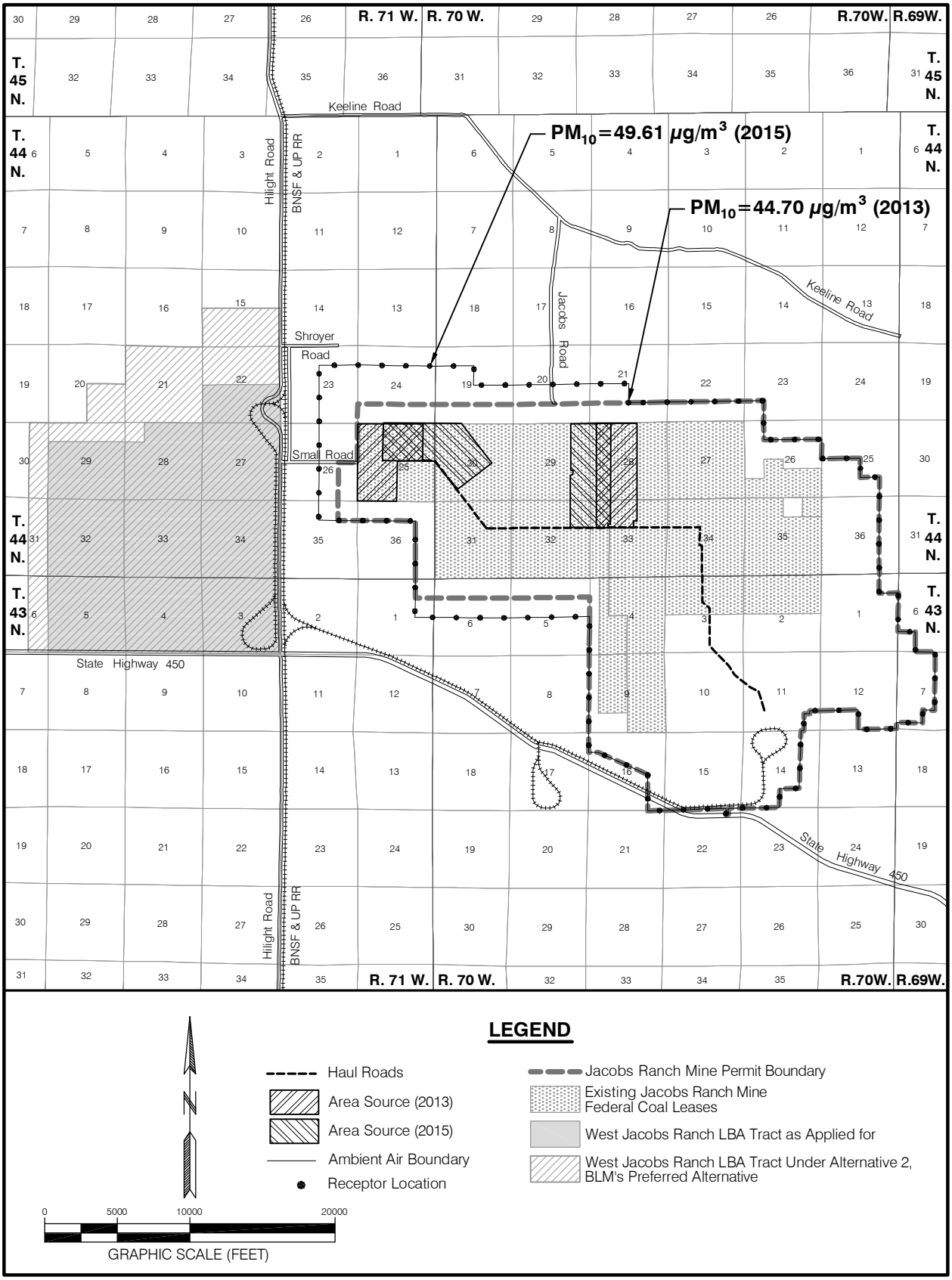


Figure 3-12. Maximum Modeled PM_{10} Concentrations at the Jacobs Ranch Mine Ambient Air Boundary for the Years 2013 and 2015.

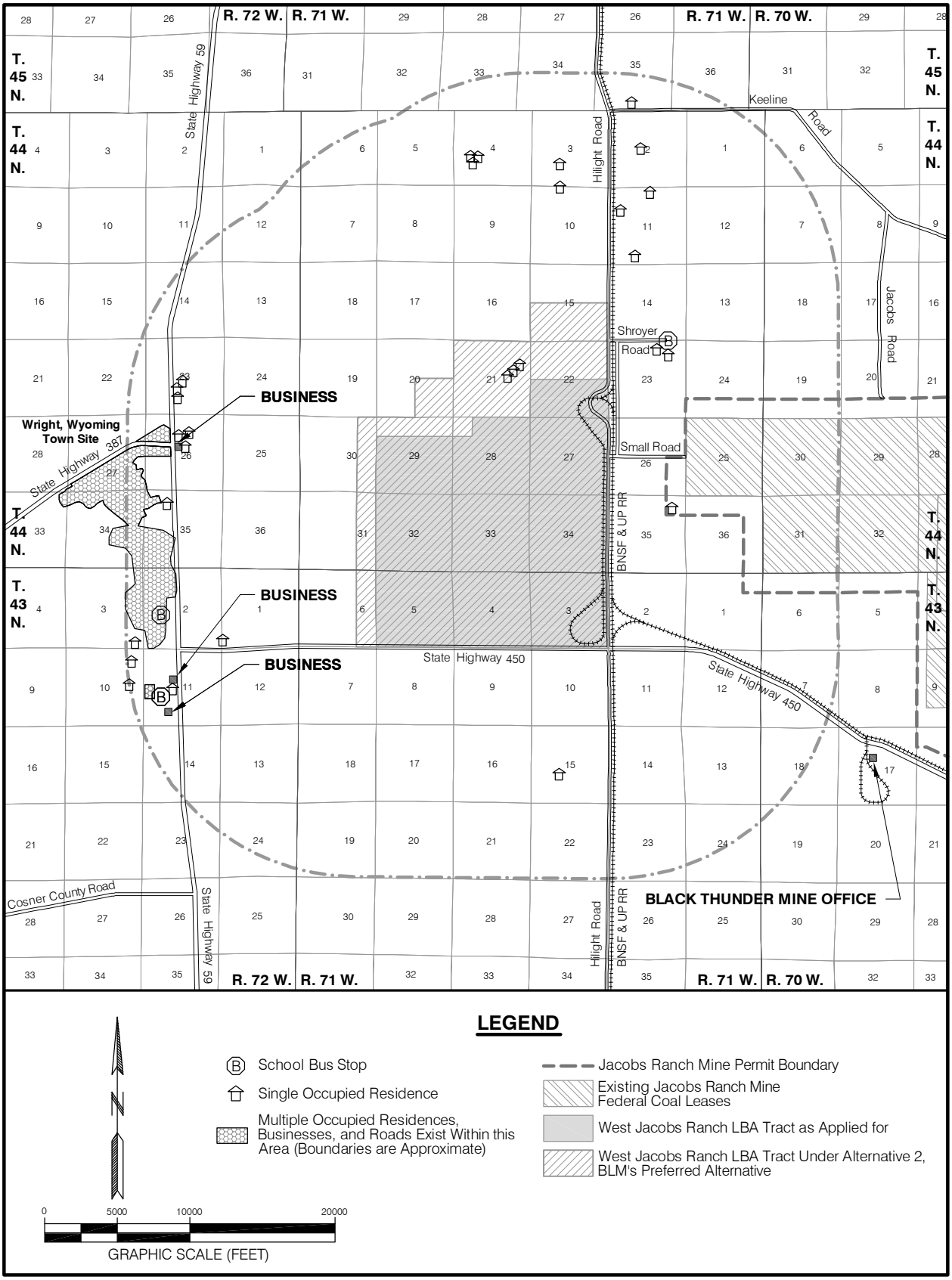


Figure 3-13. Residences, School Bus Stops, Public Roads, and Other Publicly Accessible Facilities Within 3 Miles of the West Jacobs Ranch LBA Tract Under Alternative 2 .

consistent with WDEQ/AQD policy. WDEQ/AQD issued air quality permit MD-1331 on March 7, 2006 to modify operations at the North Antelope Rochelle Mine. Material movement utilizes direct cast blasting, draglines, and/or truck and shovel fleets for overburden and truck and shovel fleets and overland conveyors for coal (PRC 2006).

Particulate emission inventories for the mining activities at North Antelope Rochelle Mine were prepared for all years in the currently anticipated life of the mine. Two years were then selected for worst-case dispersion modeling of PM_{10} based on mine plan parameters and emission inventories. Fugitive emission sources and point sources were modeled using the ISCLT3 Model to estimate average annual PM_{10} concentrations.

Long-term modeling for North Antelope Rochelle Mine's air quality permit MD-1309 indicates the currently projected mine activities will be in compliance with the annual PM_{10} ambient air standard for the life of the mine. Based on mine plan parameters and highest emissions inventories, the years 2012 and 2015 were selected as the worst-case years. The dispersion model showed a maximum concentration on the North Antelope Rochelle LNCM boundary of 30.40 $\mu g/m^3$ in 2012 and 38.00 $\mu g/m^3$ in 2015. Coal production in both years was modeled at a maximum production level of 99 million tons (PRC 2006). The locations of the maximum-modeled PM_{10} concentrations for 2012 and 2015 are shown on Figures 3-14 and 3-15, respectively.

An initial inventory of all point sources, controls, and emissions for the North Antelope Rochelle Mine air quality permit showed a maximum potential to emit 30.1 tpy. Therefore, a PSD increment consumption analysis was not necessary and because this value is below the 100 tpy major source threshold limit specified in Chapter 6, Section 3 of the WAQSR, North Antelope Rochelle Mine will not be subject to the Title V Operating Permit program (PRC 2006).

Modeling conducted for the current air quality permit predicted no exceedances of the annual PM_{10} NAAQS at a 99-mmtpy production rate. There were two exceedances of the 24-hour PM_{10} particulate standards at the North Antelope Rochelle Mine from 2001 through 2006. Both exceedances were associated with elevated wind speeds exceeding 20 mph, which could have qualified as a high wind event under the NEAP. There were two exceedances reported in 2007, both of which have been designated by EPA as exceptional events under the NEAP and will not be considered when determining the region's air quality designation. There have been no exceedances of the annual PM_{10} NAAQS. PRC estimates that the mine would produce at an average annual rate of 95 mmtpy if it acquires and mines the North and/or South Porcupine LBA Tracts, but fugitive dust emissions are projected to remain within daily and annual AAQS limits.

Public exposure to particulate emissions from surface mining operations is most likely to occur along publicly accessible roads and highways that pass near and through the areas of mining operations. Occupants of dwellings in

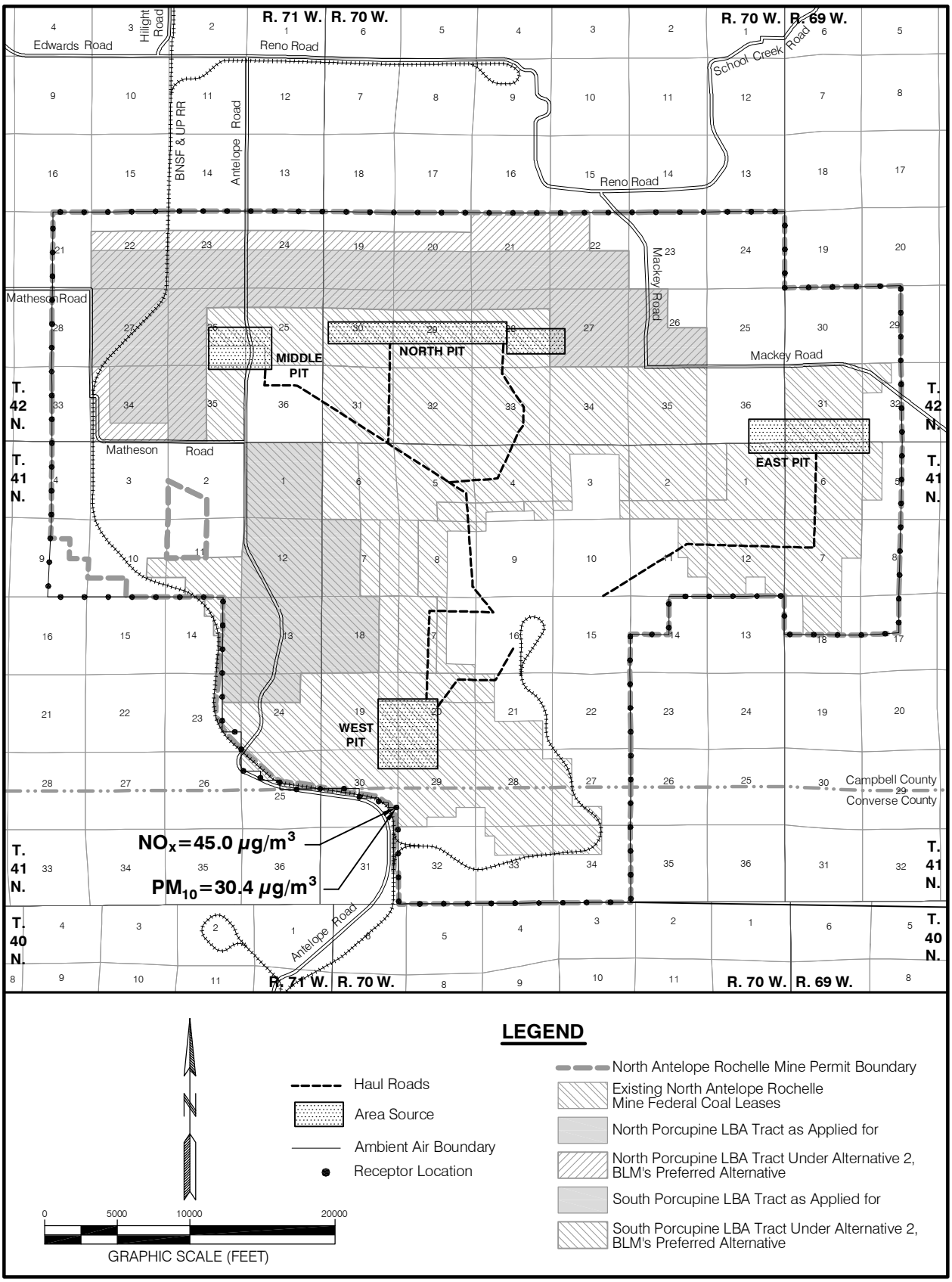


Figure 3-14. Maximum Modeled PM_{10} and NO_X Concentrations at the North Antelope Rochelle Mine Ambient Air Boundary for the Year 2012.

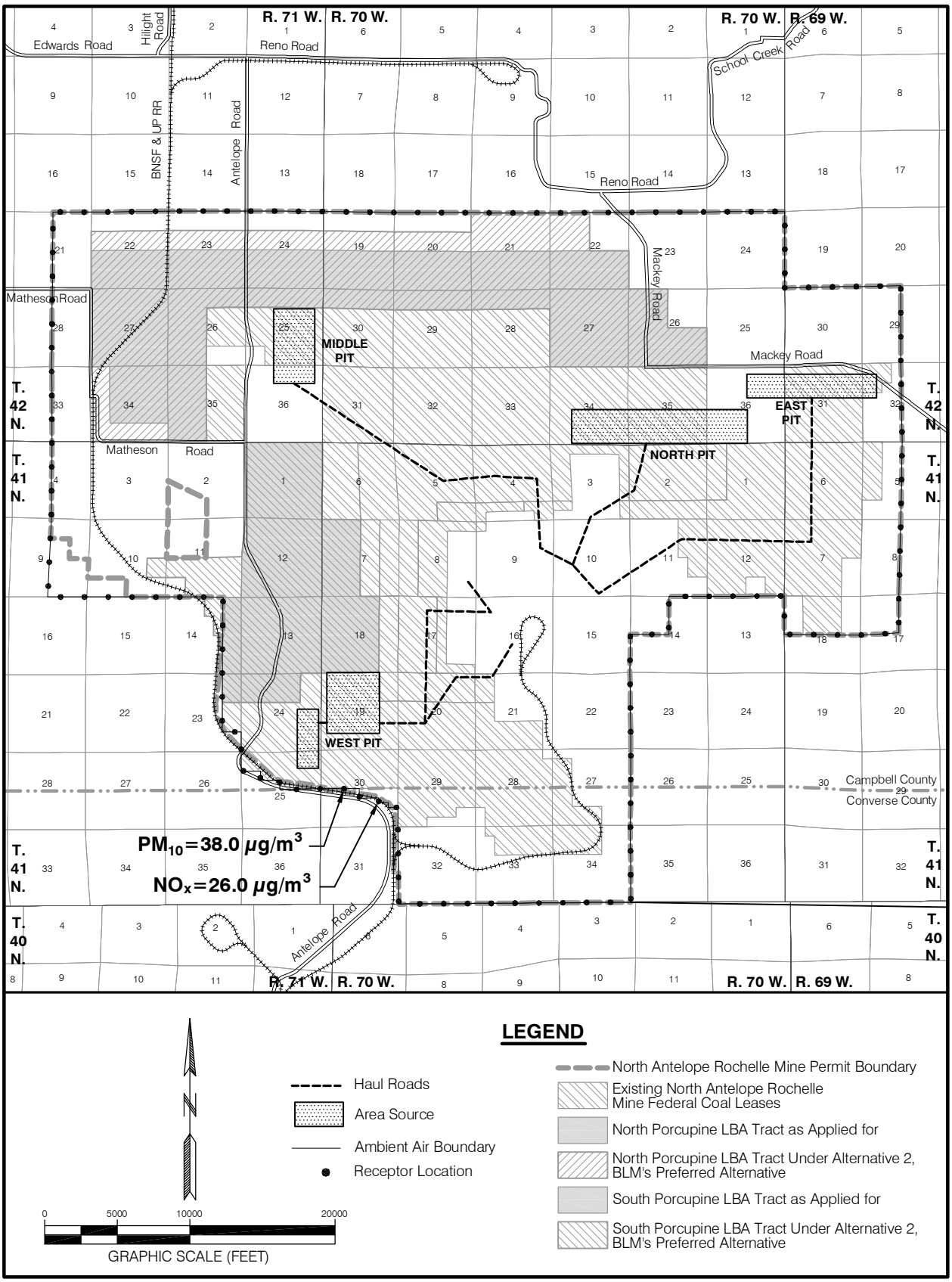


Figure 3-15. Maximum Modeled PM_{10} and NO_X Concentrations at the North Antelope Rochelle Mine Ambient Air Boundary for the Year 2015.

the area could also be affected. Roads, highways, businesses, and currently occupied dwellings in the vicinity of the North and South Porcupine LBA Tracts are shown in Figures 3-16 and 3-17, respectively.

3.4.2.2.2 No Action Alternative

Under the No Action Alternative, the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine coal lease applications would be rejected and coal removal and projected impacts related to PM_{10} emissions discussed above would not occur on the portions of the LBA tracts as applied for or the LBA tracts configured under Alternative 2 that will not be disturbed under the currently approved mining and air quality permits. Mining operations would continue as currently permitted on the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle Mine coal leases. Projected impacts related to PM_{10} emissions would not be extended onto those portions of the LBA tracts that will not be affected under the mines' current mining and reclamation plans.

As discussed in Section 2.2, a decision to reject one or more of these six coal lease applications at this time would not preclude an application to lease that respective tract in the future.

3.4.2.3 Regulatory Compliance, Mitigation, and Monitoring for Particulate Emissions

Control of particulate emissions at all PRB coal mines is accomplished with a variety of measures. The WDEQ/AQD permits for all of the surface coal mines in the PRB require the following dust control measures, which are considered to be BACT measures:

1. No mines are allowed to have out-of-pit open coal stockpiles. All coal removed from the mine pits must be stored in totally enclosed coal silos or barns.
2. Unless specifically exempted, all coal mine main access roads must be paved.
3. As use and condition warrant, the minor access roads at coal mines that are unpaved must be watered or treated with dust suppressants.
4. All coal conveyor transfer points must be shrouded or otherwise enclosed to direct coal fines from one belt to the next.
5. The transfer point and crushers within coal processing plants must be equipped with control devices and measures specified in individual permits. These control devices and measures may include, but are not limited to, the use of dust collection baghouses, cyclones, scrubbers, fog systems, and controlled flow transfer chutes.
6. All out-of-pit conveyors must be hooded or contained in a conveyor gallery.
7. All out-of-pit coal dump hoppers must be fitted with a dust control stilling shed, water sprays, or a baghouse dust collector.

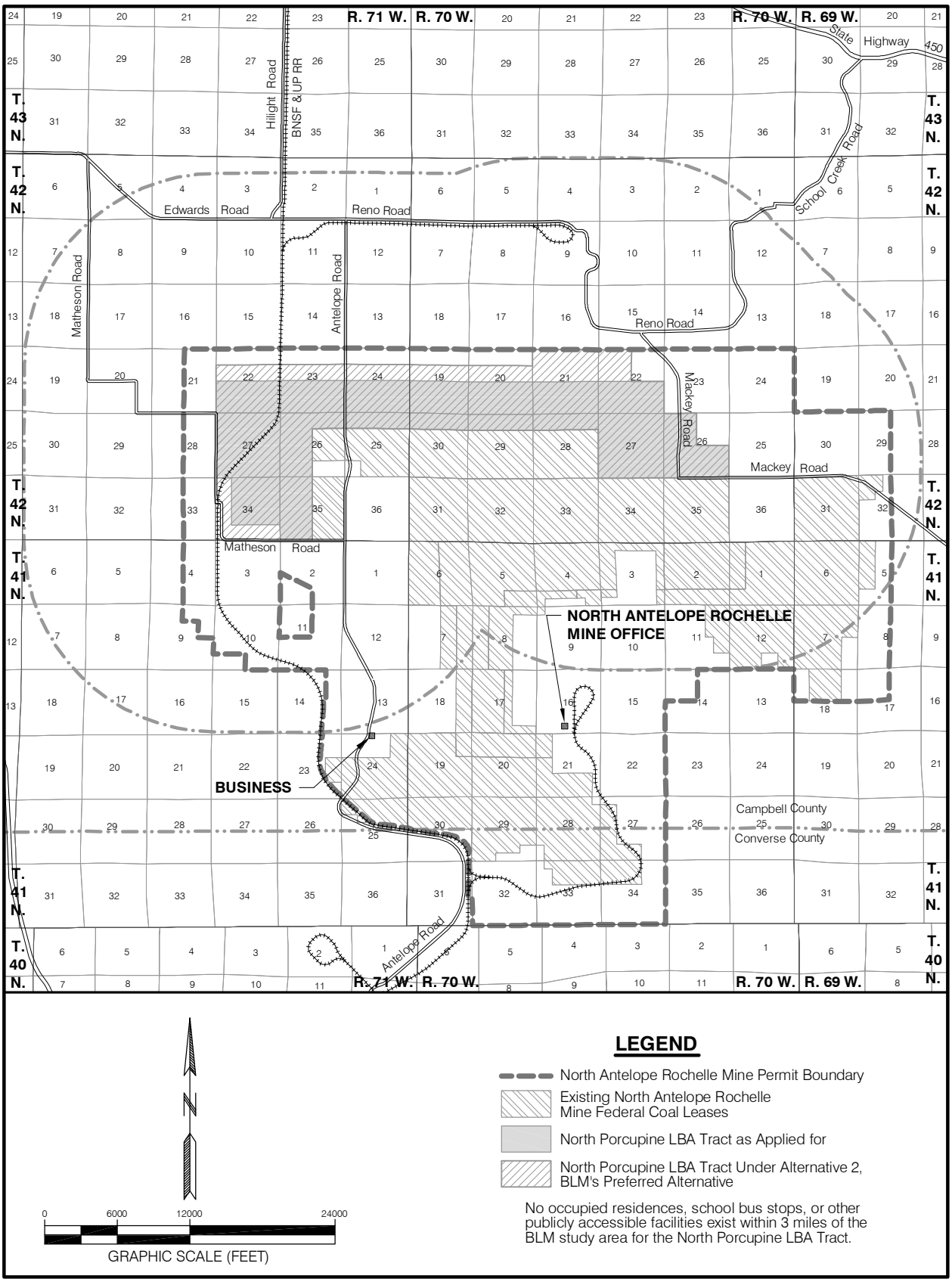


Figure 3-16. Residences, School Bus Stops, Public Roads, and Other Publicly Accessible Facilities Within 3 Miles of the North Porcupine LBA Tract Under Alternative 2.

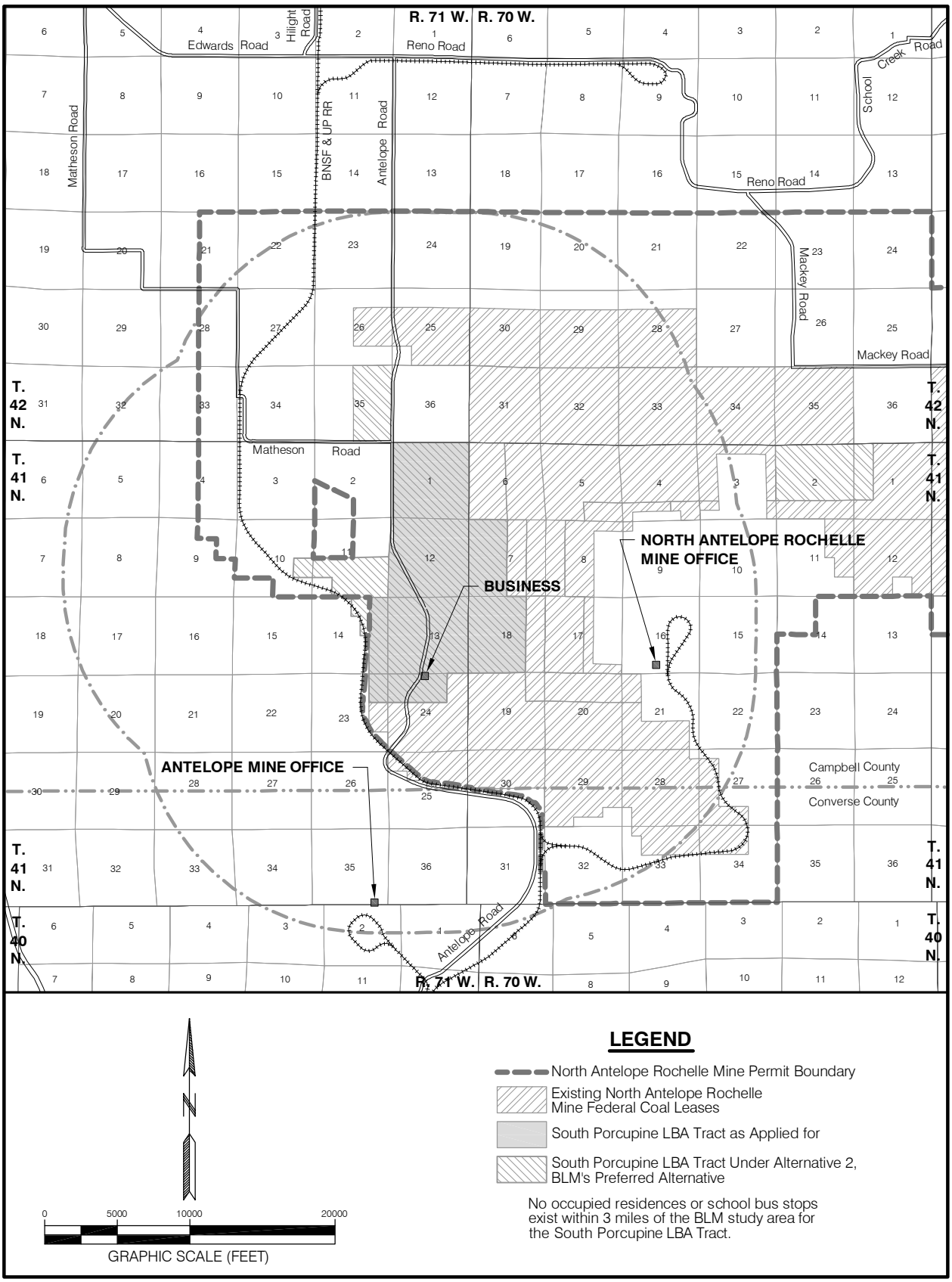


Figure 3-17. Residences, School Bus Stops, Public Roads, and Other Publicly Accessible Facilities Within 3 Miles of the South Porcupine LBA Tract Under Alternative 2.

8. Active longer-term coal haul roads must be treated with dust control chemicals and/or water.
9. Active short-term mine haul roads which must be continuously relocated are maintained and watered while in use.
10. All haul roads must be regularly maintained to reduce the amount of dust re-entrained by haulage equipment (WDEQ/AQD 2007).

Additional site-specific requirements related to mine-specific layout and mining practices may be included in individual mine permits.

Fugitive emissions are also controlled with a variety of other measures that the WDEQ/AQD considers BACT. Haul truck speed limits are voluntarily set to further help to reduce fugitive emissions from roads. Material drop heights for shovels and draglines (bucket to truck bed or backfill) are voluntarily limited to the minimum necessary to conduct the mining operations. Timely temporary and permanent revegetation of disturbed areas is utilized to minimize wind erosion. All of these control measures are employed at the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines.

In response to the measured exceedances of the PM_{10} NAAQS in certain areas of the PRB and in anticipation of possible future exceedances, the WDEQ/AQD in a joint effort with PRB mining stakeholders, developed a Natural Events Action Plan, or NEAP, for the coal mines of the Campbell and Converse counties, Wyoming, in April 2006 (revised January 2007). The NEAP was developed under the framework afforded by EPA's Natural Events Policy of May 30, 1996. While PRB mining operators have already implemented these measures in practice, formal approval of the NEAP by EPA Region VIII is still pending. The PRB mine operators are presently complying with the NEAP that was developed jointly by them WDEQ/AQD. A report describing the plan in detail can be accessed on the WDEQ/AQD's website on the Internet (WDEQ/AQD 2007), and the NEAP is discussed in Appendix F.

If a NEAP is designed and implemented to minimize PM_{10} concentrations, EPA will exercise its discretion, under Section 107(d)(3) of the CAA, not to redesignate areas as nonattainment, provided that the exceedances are demonstrated to be the result of natural events under the following conditions: 1) the dust originated from non-anthropogenic sources, or 2) the dust originated from anthropogenic sources controlled with the best available control measures (BACM).

WDEQ/AQD may require implementation of the control steps outlined in the NEAP and may require continual evaluation of activity plans when exceedances are monitored at surface coal mines. Some of these measures have been formally implemented at the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines through the establishment of a formal, site-specific mitigative response plan at each of those mines. A mitigative response plan will be developed by any mine that records an exceedance or violation of the NAAQS downwind of its mining operations.

Other operational control measures that WDEQ/AQD may require at specific mines when exceedances occur include, but are not limited to, site-specific watering of inactive areas and problem areas; relocation of overburden truck-dumping operations and deferring blasting. The mines are experimenting with dust control treatments, including magnesium chloride, surfactants, and petroleum-based products. In addition, WDEQ/AQD may require additional monitoring, action levels based on continuous monitoring, expedited reporting of monitored exceedances, detailed reporting of contributing factors (e.g., meteorological conditions), and continual evaluation of activity plans when exceedances are monitored at surface coal mines.

The WDEQ/AQD is continually reviewing the data and considering regulatory options, such as increasing the frequency of monitoring, to be used as tools to mitigate dust problems. Where elevated emissions have occurred, WDEQ/AQD has increased monitoring frequency requirements including installation of continuous PM_{10} monitors, or TEOMs, which allow monitoring of emissions on a real-time basis. Other regulatory options may include enforcement actions such as Notices of Violation resulting in a consent decree and/or modified permit conditions. WDEQ/AQD is also coordinating with EPA to develop additional monitoring requirements in CBNG development areas, high PM_{10} mitigation action plans in permits, and additional mitigation measures under the SIP.

The PRB has one of the most extensive networks of monitoring sites for PM_{10} in the nation; most of these monitoring sites are funded and operated by the mines. WDEQ/AQD requires the collection of information documenting the quality of the air resource at each of the PRB mines. A discussion of the monitoring network, monitoring requirements, the data that have been collected, and PM_{10} concentration trends since monitoring began are included in Appendix F.

WDEQ/AQD's Ambient Air Monitoring Annual Network Plan provides an overview of the number and types of air quality monitors AQD runs or oversees within the state of Wyoming, and is available for review on its website at: http://deq.state.wy.us/aqd/downloads/AirMonitor/Network%20Plan_2008.pdf

3.4.3 Emissions of Nitrogen Oxides (NO_X) and Ozone (O_3)

3.4.3.1 Affected Environment for NO_X and O_3 Emissions

Gases that contain nitrogen and oxygen in varying amounts are referred to as nitrogen oxides (NO_X). One type of NO_X, nitrogen dioxide (NO_2), is a highly reactive, reddish brown gas that is heavier than air and has a pungent odor. NO_2 is by far the most toxic of several species of NO_X. NO_2 can combine with atmospheric moisture to form nitric acid and nitric oxide. Because several NO_X species can be chemically converted to NO_2 in the atmosphere, NO_2 emissions control is focused on all NO_X species, while the ambient standard is expressed in terms of NO_2. O_3 has been included in discussions on emissions of NO_X

since NO_X is one of the main ingredients involved in the formation of ground level O_3. Ground-level O_3 is not emitted directly into the air, but is created by chemical reactions between NO_X and VOCs in the presence of sunlight.

According to the EPA (EPA 2001a):

- NO_2 may cause significant toxicity because of its ability to form nitric acid with water in the eye, lung, mucous membranes, and skin.
- Acute exposure to NO_2 may cause death by damaging the pulmonary system.
- Chronic or repeated exposure to lower concentrations of NO_2 may exacerbate pre-existing respiratory conditions, or increase the incidence of respiratory infections.

Nitrogen oxides form when fuel is burned at high temperatures. They can be formed naturally or by human activities. The primary manmade sources are motor vehicles, electric utilities, and other fuel-burning sources. According to EPA, in 2002, all motor vehicles (including non-road equipment) produced about 60 percent of the manmade NO_X emissions, utilities produced approximately 22 percent of the emissions, industrial/commercial/residential activities produced about 17 percent of the manmade NO_X emissions, and other sources accounted for the remaining 1 percent of the manmade emissions (EPA 2009a).

The primary direct source of emissions of nitrogen oxides during coal mining operations is tailpipe emissions from large mining equipment and other vehicle traffic inside the mine permit area. Blasting that is done to assist in the removal of material overlying the coal (the overburden) can result in emissions of several products, including NO_2, as a result of the incomplete combustion of nitrogen-based explosives used in the blasting process. When this occurs, gaseous, orange-colored clouds may be formed and they can drift or be blown off mine permit areas.

Incomplete combustion during blasting may be caused by wet conditions in the overburden, incompetent or fractured geological formations, deformation of boreholes, and blasting agent factors. The rate of release is not well known but is believed to be dependent on a wide number of factors that likely include, but are not necessarily limited to: downhole confinement; downhole moisture; type/blend of ammonium nitrate, fuel oil (ANFO) and emulsion; and detonation velocity. Generally, blasting-related NO_X emissions are more prevalent at operations that use the blasting technique referred to as cast blasting. Cast blasting refers to a type of blasting in which the blast is designed to directly cast the overburden from on top of the coal into the previously mined area. All three of the applicant mines employ cast blasting.

O_3 has the same chemical structure whether it occurs miles above the earth or at ground level and can be “good” or “bad”, depending on its location in the atmosphere. In the earth’s lower atmosphere, ground-level O_3 is considered

"bad." Motor vehicle exhaust and industrial emissions, gasoline vapors, and chemical solvents as well as natural sources emit NO_X and VOCs that help form O_3 in the presence of sunlight. Ground-level O_3 is the primary constituent of smog. Many urban areas tend to have high levels of "bad" O_3, but even rural areas are also subject to increased O_3 levels because wind carries O_3 and pollutants that form it hundreds of miles away from their original sources.

Under the Clean Air Act, EPA has set protective health-based standards for O_3 in the air we breathe. Prior to May 27, 2008, the NAAQS 8-hour standard for O_3 was 0.080 parts per million (ppm) (157 µg/m^3). Effective May 27, 2008, the 8-hour standard was revised by EPA to 0.075 ppm (147 µg/m^3). Ozone monitoring is not required by WDEQ/AQD at the PRB coal mines, but levels have been monitored by WDEQ/AQD at its ambient air quality monitoring sites in the PRB since 2001 (Table 3-9). An exceedance of the O_3 8-hour standard occurs if the 4th-highest daily maximum value is above the level of the standard.

Table 3-9. 2001 Through 2008 Annual 4th Max, 8-Hour Average Ozone Values (ppm).

Site Address	2001	2002	2003	2004	2005	2006	2007	2008
TBNG	0.069	0.071	0.074	0.065	0.063	0.072	0.072	0.074
Campbell County	--	--	0.077	0.061	0.063	0.065	0.072	0.064

Monitor values from EPA (2009b)
Pre May 27,2008 8-Hour O_3 NAAQS = 0.080 ppm
Post May 27, 2008 8-Hour O_3 NAAQS = 0.075 ppm

3.4.3.1.1 Site Specific NO_X Emissions

Sources of fugitive NO_X emissions at the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines include overburden and coal blasting events, tailpipe emissions from the mining equipment, and emissions from the trains used to transport the coal away from the mines. NO_X point sources at the mines could include stationary engines, coal-fired hot water generators, and natural-gas fired heaters.

To date, there have been no reported events of public exposure to NO_2 from blasting activities at the Jacobs Ranch and North Antelope Rochelle mines. The WDEQ has not required the mines to implement any specific measures to control or limit public exposure to NO_2 from blasting, although the mines have instituted voluntary blasting restrictions to avoid NO_X impact to the public, which are discussed in more detail in Section 3.4.3.3. Black Thunder Mine received several reports of public exposure to NO_2 from blasting prior to 2001. Measures to control or limit future such incidences, which are part of Black Thunder Mine's settlement agreement, have been instituted when large overburden blasts are planned at that mine, and those measures are discussed in Section 3.4.3.3.

Table 3-9 shows that no exceedances of the O_3 standard have occurred at either of the two monitoring sites if evaluated under the standard in place at the time the values were recorded. If the strengthened 2008 standard was applied retroactively, one exceedance would have occurred in 2003 at Campbell County site.

3.4.3.2 Environmental Consequences Related to Short-Term NO_X Emissions

There are various compounds and derivatives in the family of nitrogen oxides, including NO_2, nitric acid, nitrous oxide, nitrates, and nitric oxide, which may cause a wide variety of health and environmental impacts. According to EPA, the main causes of concern with respect to NO_X are:

- it is one of the main ingredients involved in the formation of ground level ozone, which can trigger serious respiratory problems;
- it reacts to form nitrate particles, acid aerosols, as well as NO_2, which also cause respiratory problems;
- it contributes to the formation of acid rain;
- it contributes to nutrient overload that deteriorates water quality;
- it contributes to atmospheric particles that cause visibility impairment, most noticeably in national parks;
- it reacts to form toxic chemicals;
- one member of the NO_X family, nitrous oxide or N_2O, is a greenhouse gas that contributes to global warming; and
- it can be transported over long distances (EPA 2009a).

Potential health risks associated with inhalation of ground level ozone and NO_X related particles include acute respiratory problems, aggravated asthma, decreases in lung capacity in some healthy adults, inflammation of lung tissue, respiratory-related hospital admissions and emergency room visits, and increased susceptibility to respiratory illnesses, including bronchitis and pneumonia (EPA 2007b).

Neither the EPA nor the WDEQ have established NAAQS for NO_2 for averaging times shorter than one year. According to EPA, "…the exact concentrations at which NO_2 will cause various health effects cannot be predicted with complete accuracy because the effects are a function of air concentration and time of exposure, and precise measurements have not been made in association with human toxicity. The information that is available from human exposures also suggests that there is some variation in individual response" (EPA 2001a).

While extensive expert testimony was provided to the Wyoming Environmental Quality Council (EQC) during hearings in 2002 arguing for the establishment of a de facto "standard" ranging from 0.5 to 5.0 parts per million (ppm) for a 10-minute exposure, the EQC determined there was insufficient evidence to establish a short-term exposure limit and concluded additional study was required. The primary control measure for mitigating exposures to offsite residences is to avoid overburden cast blasting when wind direction or

atmospheric conditions are unfavorable. Such approaches are employed at the Black Thunder, Jacobs Ranch, and North Antelope Rochelle Mines and will continue to be employed. Studies that have been conducted to evaluate NO_2 exposures from blast clouds in the PRB are described in Appendix F.

Although there is no NAAQS that regulates short-term NO_2 levels, there is concern about the potential health risk associated with short-term exposure to NO_2 from blasting emissions. The National Institute of Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), and EPA have identified the following short-term exposure criteria for NO_2:

- NIOSH's recommended Immediately Dangerous to Life and Health level is 20.0 ppm (37,600 $\mu g/m^3$);
- EPA's Significant Harm Level, a 1-hour average, is 2.0 ppm (3,760 $\mu g/m^3$);
- OSHA's Short-Term Exposure Limit, a 15-minute time-weighted average, which was developed for workers, is 5.0 ppm (9,400 $\mu g/m^3$), which must not be exceeded during any part of the workday, as measured instantaneously);
- NIOSH's recommendation for workers is a limit of 1.0 ppm (1,880 $\mu g/m^3$) based on a 15-minute exposure that should not be exceeded at any time during the workday; and
- EPA recommends that concentrations not exceed 0.5 ppm (940 $\mu g/m^3$) for a 10-minute exposure to protect sensitive members of the public (EPA 2003a).

The Black Thunder Mine also conducted a study designed to provide information on safe setback distances for blasting activities at that mine (TBCC 2002). Monitors for that study were located close to blasts in order to collect data for a modeling project; they were located within the mine permit boundary in areas that are not and would not be accessible to the public during mining operations and these areas are also cleared of employees during blasting. The measured NO_X levels ranged from non-detectable to 21.4 ppm. The highest value was measured 361 feet from the blast.

Blast clouds are of a short-term, transient nature. While disagreement still exists regarding acceptable exposure levels, a large amount of actual data are now available from which informed decisions can be made regarding blasting practices. The data show clearly that reduction in blast (agent) size and increases in setback distances are effective methods for mitigating the frequency and extent of public exposure to blasting clouds. See Appendix F for additional information about studies that were conducted to evaluate the levels of public exposure to NO_X.

3.4.3.2.1 Proposed Action and Alternatives 2 and 3

Potential NO_X emissions related to mining operations at the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines are described

below. Due to the similarities in mining rates and mining operations, the potential impacts of mining the LBA tracts have been inferred from the projected impacts of mining the existing coal leases as currently permitted.

WDEQ/AQD has determined that an assessment of annual NO_X impacts must be included as part of an air quality permitting analysis for new surface coal mines and existing mine plan revisions. As discussed in Section 3.4.2.2.1, the applicant mines conducted modeling analyses for PM_{10} and NO_X for a maximum projected coal production rate as part of their air quality permit applications. Receptor locations were placed at approximately 500-meter intervals along the mines' LNCM boundaries. The regional background NO_X annual concentration used for the Black Thunder and Jacobs Ranch Mines was 14.0 µg/m^3, while the North Antelope Rochelle Mine used a regional background concentration of 20.0 µg/m^3. Pursuant to WDEQ/AQD requirements, emissions from all stationary engines, coal-fired hot water generators, and natural-gas fired heaters, which are considered to be NO_X point sources at the mine, were considered in the inventory. Additional mobile sources were added to describe the railroad locomotives and large mining equipment on each mine site.

The estimated average overburden thickness is generally greater in each of the LBA tracts than within the current leases, but the thickness of the coal is about the same as in the existing mine areas (Table 3-7). If the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines acquire the LBA tracts, there are no plans to change blasting procedures or blast sizes associated with the mining of the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts. However, if the average annual rates of production are maintained, there would potentially be an increase in the frequency of blasting in order to remove the additional volume of overburden overlying the coal.

If the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines acquire the LBA tracts, they will have to amend their current air quality permits to include the new leases before mining activities can proceed into the new lease areas. Current mining and mitigation methods to recover the coal in the LBA tracts would be expected to continue for a longer period of time than is shown in the mines' current air quality permits. The mines would continue to use cast blasting, and there are currently no plans to change blasting procedures or blast sizes associated with mining of the LBA tracts. According to WDEQ, permit conditions designed to control or limit public exposure to NO_2 and flyrock from blasting operations would be no less stringent for mining operations on the LBA tracts than the permit conditions that are in place for blasting operations on the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle Mine leases (Emme 2007).

3.4.3.2.1.1 North, South, and West Hilight Field LBA Tracts

The North, South, and West Hilight Field LBA Tracts would be mined as integral parts of the Black Thunder Mine under the Proposed Action and Alternatives 2 and 3.

As discussed in Section 3.4.2.2, WDEQ/AQD issued the most recent air quality permit, MD-3851, for the Black Thunder Mine on August 18, 2008, and the mine was required to conduct NO_2 dispersion modeling similar in scope to the PM_{10} analysis. Emission rates were determined for the same worst-case years used in the PM_{10} modeling. The amount of NO_2 emissions from blasting is related to the amount of ANFO utilized. NO_2 emission rates for 2015 and 2017 are expected to be 4,507 tpy and 4,743 tpy, respectively. NO_X modeling closely followed many of the same procedures used in the PM_{10} analysis. Emissions were apportioned in a similar manner and the same meteorological data set was used. Area source, haul road, and point source information for the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines and information for railroads, roads, power plants, and regional sources provided by WDEQ/AQD were included in the model. Long-term modeling indicated the currently projected mine activities will be in compliance with the annual NO_X AAQS for the life of the Black Thunder Mine. For year 2015, the maximum annual NO_X concentration along the Black Thunder Mine LNCM boundary was 46.3 $\mu g/m^3$ and for year 2017, the maximum annual NO_X concentration along the Black Thunder Mine LNCM boundary was 52.5 $\mu g/m^3$ (BTM 2008b). Coal production in both years was assumed to be the maximum permitted production level of 135 million tons. The locations of the maximum-modeled NO_X concentrations along the Black Thunder Mine LNCM boundary for 2015 and 2017 are shown on Figures 3-7 and 3-8, respectively.

Modeling conducted for the current Black Thunder Mine air quality permit projected no exceedances of the annual NO_2 NAAQS at the permitted production rate. TBCC estimates that the Black Thunder Mine would produce at an average rate of 135 mmtpy if it acquires and mines the North, South, and/or West Hilight Field LBA Tracts; therefore, air quality impacts that result from mining the LBA tracts should also be within annual NAAQS limits.

Public exposure to NO_X emissions caused by surface mining operations is most likely to occur along publicly accessible roads and highways that pass near and through the areas of mining operations. Occupants of dwellings in the area could also be affected. Roads, highways, currently occupied dwellings, businesses, and school bus stops in the vicinity of the North, South, and West Hilight Field LBA Tracts are shown in Figures 3-9 through 3-11, respectively.

3.4.3.2.1.2 West Jacobs Ranch LBA Tract

The West Jacobs Ranch LBA Tract would be mined as an integral part of the Jacobs Ranch Mine under the Proposed Action and Alternative 2.

As discussed in Section 3.4.2.2, WDEQ/AQD issued the most recent air quality permit, MD-1005A2, for the Jacobs Ranch Mine on January 22, 2007; however, NO_2 dispersion modeling for the mine is included in air quality permit MD-1005, issued August 6, 2004. Based on mine plan parameters and highest emissions inventories, the worst-case years of 2006 and 2013 were selected. The amount of NO_X emissions from blasting is related to the amount of ANFO utilized. NO_X emission rates for 2006 and 2013 were expected to be 1,447 tpy and 1,450 tpy, respectively. NO_X modeling closely followed many of the same procedures used in the PM_{10} analysis except for selecting different modeling years and different source areas. Area source, haul road, and point source information for the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines and information for railroads, roads, power plants, and regional sources provided by WDEQ/AQD were included in the model. Long-term modeling indicated the currently projected mine activities will be in compliance with the annual NO_X AAQS for the life of the Jacobs Ranch Mine. For year 2006, the maximum annual NO_X concentration along the Jacobs Ranch Mine LNCM boundary was 50.0 $\mu g/m^3$ and for year 2013, the maximum annual NO_X concentration along the Jacobs Ranch Mine LNCM boundary was 55.0 $\mu g/m^3$ (JRM 2004). Coal production in both years was assumed to be the maximum permitted production level of 55 million tons. The locations of the maximum-modeled NO_X concentrations along the Jacobs Ranch Mine LNCM boundary for 2006 and 2013 are shown on Figure 3-18.

Modeling conducted for the current Jacobs Ranch Mine air quality permit projected no exceedances of the annual NO_X NAAQS at the permitted production rate. JRCC estimates that the Jacobs Ranch Mine would produce at the current average rate of 40 mmtpy if it acquires and mines the West Jacobs Ranch LBA Tract; therefore, air quality impacts that result from mining the LBA tract should also be within annual NAAQS limits.

Public exposure to NO_X emissions caused by surface mining operations is most likely to occur along publicly accessible roads and highways that pass near and through the areas of mining operations. Occupants of dwellings in the area could also be affected. Roads, highways, currently occupied dwellings, businesses, and school bus stops in the vicinity of the West Jacobs Ranch LBA Tract are shown in Figure 3-13.

3.4.3.2.1.3 North and South Porcupine LBA Tracts

The North and South Porcupine LBA Tracts would be mined as integral parts of the North Antelope Rochelle Mine under the Proposed Action and Alternative 2.

As discussed in Section 3.4.2.2, WDEQ/AQD issued the most recent air quality permit, MD-1331, for the North Antelope Rochelle Mine on March 7, 2006, which modified air quality permit MD-1309 that was issued on January 24, 2006. The mine was required to conduct NO_2 dispersion modeling similar in scope to the PM_{10} analysis. Emission rates were determined for the same worst-case years used in the PM_{10} modeling. The amount of NO_X emissions

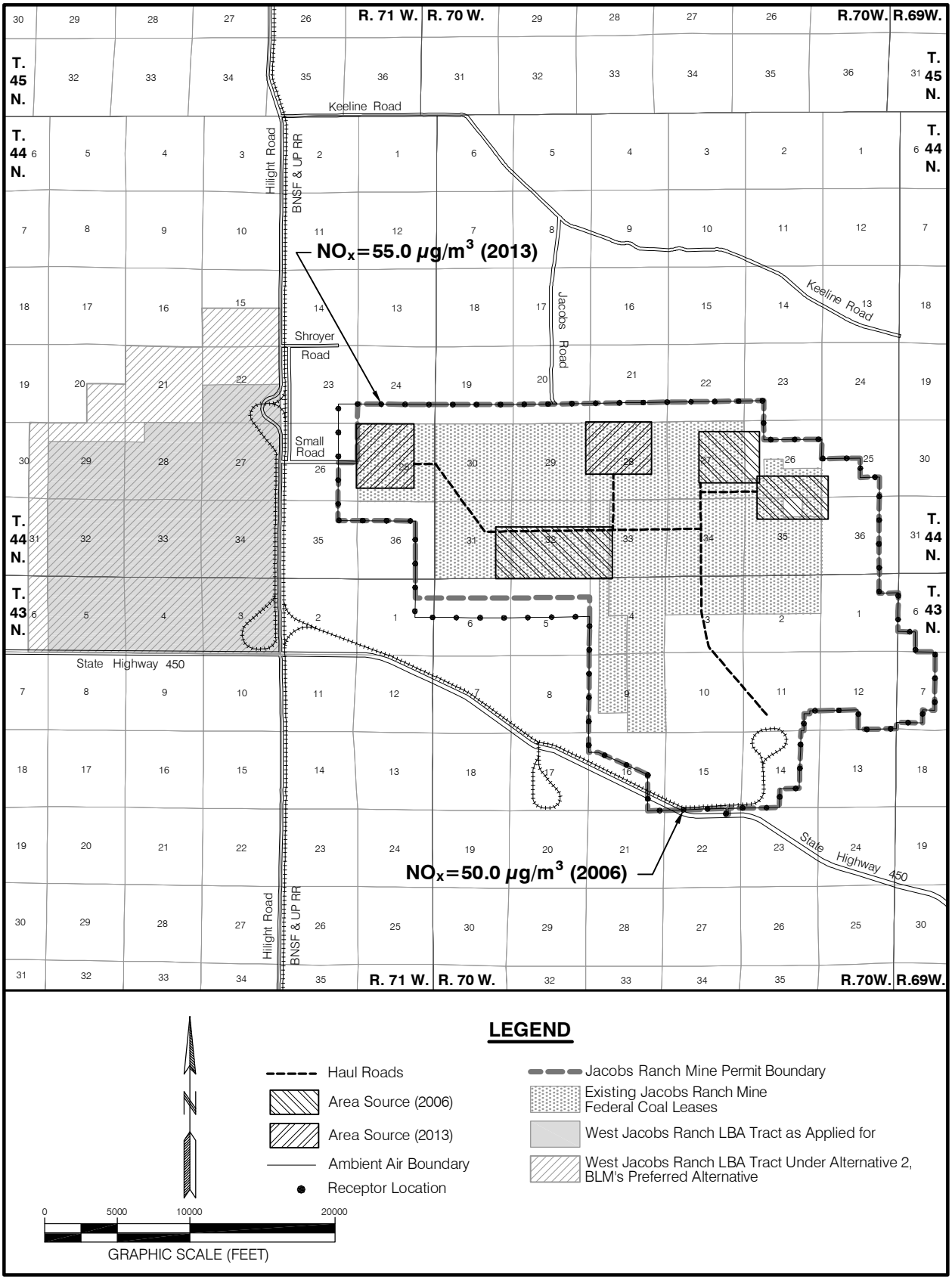


Figure 3-18. Maximum Modeled NO_X Concentrations at the Jacobs Ranch Mine Ambient Air Boundary for the Years 2006 and 2013.

from blasting is related to the amount of ANFO utilized. NO_X emission rates for 2012 and 2015 are expected to be 3,068 tpy and 2,988 tpy, respectively. NO_X modeling closely followed many of the same procedures used in the PM_{10} analysis. Emissions were apportioned in a similar manner and the same meteorological data set was used. Area source, haul road, and point source information for the North Antelope Rochelle, Black Thunder, Jacobs Ranch, North Rochelle (now part of the North Antelope Rochelle and Black Thunder mines), and Antelope mines and information for railroads, roads, power plants, and regional sources provided by WDEQ/AQD were included in the model. Long-term modeling indicated the currently projected mine activities will be in compliance with the annual NO_X AAQS for the life of the North Antelope Rochelle Mine. For year 2012, the maximum annual NO_X concentration along the North Antelope Rochelle Mine LNCM boundary was 45.0 $\mu g/m^3$ and for year 2015, the maximum annual NO_X concentration along the North Antelope Rochelle Mine LNCM boundary was 46.0 $\mu g/m^3$ (PRC 2006). Coal production in both years was assumed to be the maximum permitted production level of 99 million tons. The locations of the maximum-modeled NO_X concentrations for 2012 and 2015 are shown on Figures 3-14 and 3-15, respectively. The potential NO_X impacts from mining the North and South Porcupine LBA Tracts have been inferred to be similar to the currently permitted impacts of mining the existing coal leases at the North Antelope Rochelle Mine because of the similarities in mining rates and mining operations.

Modeling conducted for the current North Antelope Rochelle Mine air quality permit projected no exceedances of the annual NO_X NAAQS at the permitted production rate. PRC estimates that the North Antelope Rochelle Mine would continue to produce at the an average rate of 95 mmtpy if it acquires and mines the North and/or South Porcupine LBA Tracts; therefore, air quality impacts that result from mining the LBA tract should also be within annual NAAQS limits.

Public exposure to NO_X emissions caused by surface mining operations is most likely to occur along publicly accessible roads and highways that pass near and through the areas of mining operations. Occupants of dwellings in the area could also be affected. Roads, highways, currently occupied dwellings, and businesses in the vicinity of the North and South Porcupine LBA Tract are shown in Figures 3-16 and 3-17, respectively.

3.4.3.2.2 No Action Alternative

Under the No Action Alternative, the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine coal lease applications would be rejected and coal removal and projected impacts related to NO_X emissions discussed above would not occur on the portions of the LBA tracts as applied for or the LBA tracts configured under Alternative 2 that will not be disturbed under the currently approved mining and air quality permits. Mining operations would continue as currently permitted on the existing Black Thunder, Jacobs Ranch, and North Antelope

Rochelle Mine coal leases. Projected impacts related to NO_X emissions would not be extended onto those portions of the LBA tracts that will not be affected under the mines' current mining and reclamation plans.

As discussed in Section 2.2, a decision to reject one or more of these six coal lease applications at this time would not preclude an application to lease that respective tract in the future.

3.4.3.3 Regulatory Compliance, Mitigation, and Monitoring for NO_X Emissions

Several of the surface coal mines in the PRB have undertaken voluntary blasting restrictions to avoid NO_X emissions impact to the public. Voluntary measures that have been instituted, particularly when large blasts are planned include:

- telephone notification of neighbors (both private parties and other mining operations) in the general area of the mine prior to large blasts;
- monitoring of weather and atmospheric conditions prior to the decision to detonate a large blast;
- minimizing blast size to the extent possible;
- posting of signs on major public roads that enter the general mine area and on all locked gates accessing the active mine area;
- closing public roads that enter the general mine area, depending on wind conditions and blast location with respect to the road; and
- providing post-blast notification to neighbors of potential exposure to the blasting cloud.

To date, there have been no reported events of public exposure to NO_2 from blasting activities at the Jacobs Ranch and North Antelope Rochelle mines. The WDEQ has not required those mines to implement any specific measures to control or limit public exposure to NO_2 from blasting, although the mines have instituted voluntary blasting restrictions to avoid NO_X impact to the public. WDEQ received reports of public exposure to NO_2 from blasting operations at some of the PRB mines prior to 2001, including the Black Thunder Mine. Measures to control or limit future such incidences when large overburden blasts are planned, have been instituted at the Black Thunder Mine. There have been no incidents in the southern PRB reported by the public to the WDEQ for the past 4 years. Measures to avoid impacts to the public are requirements for the Black Thunder Mine as part of a settlement agreement reached in 2000. Many of the other mines have voluntarily implemented similar administrative controls to avoid impacts to the public, as discussed above. Measures that have been implemented include:

- notification of neighbors and workers in the general area of the mine prior to a blast;
- blast detonation between 12:00 p.m. and 3:00 p.m. whenever possible to avoid temperature inversions and minimize inconvenience to neighbors;

- monitoring of weather and atmospheric conditions prior to the decision to detonate a blast;
- posting of signs on major public roads that enter the general mine area and on all locked gates accessing the active mine area; and
- closing public roads when appropriate to protect the public.

The Wyoming EQC has issued orders that address procedures and notification protocols related to providing protections from overburden blasting within PRB mine areas. The conditions state that specific procedures would be used when overburden blasting occurs within a certain distance of residences and businesses adjacent to the mines. Orders have also placed limits on the size of the blasting that can be conducted within the mine areas and restricted blasting under certain atmospheric conditions.

WDEQ has required several PRB surface coal mines, including North Antelope Rochelle, Black Thunder, Belle Ayr, Eagle Butte, and Wyodak (Figure 1-1), to stop traffic on public roads during blasting due to concerns with fly rock and the "startle factor". During blasting operations, public access to some of the roads in the area, including the Antelope Road and State Highway 450, are currently blocked and will continue to be blocked when wind directions or proximity to the road warrant such closure.

Significant research has been conducted at the mines to reduce NO_X emissions from blasting activities. Efforts to eliminate NO_X production have included working with blasting agent manufacturers to reduce NO_X emissions by the use of different blasting agents, different blends of blasting agents, different additives, different initiation systems and sequencing, borehole liners, and smaller cast blasts. Operators have tried adding substances like microspheres and rice hulls, using different blends of ANFO and slurries and gels, using electronic detonation systems that can vary shot timing, different shot hole patterns, and using plastic liners within the shot holes. No one single procedure or variation has proven consistently successful due to the numerous factors that are believed to contribute to the production of NO_2. The most successful control measure has been reducing the size of the cast blasting shots (Emme 2003, Chancellor 2003). The North Antelope Rochelle Mine has had success in eliminating NO_X in over 75 percent of their cast blasting through the use of borehole liners and changing their blasting agent blends (Chancellor 2003).

Mitigation measures implemented to reduce mine-related NO_X emissions should also reduce the potential for the formation of ground-level O_3 in the PRB.

Annual mean NO_2 concentrations have been periodically measured in the PRB since 1975. NO_2 was monitored from 1975 through 1983 in Gillette and from March 1996 through April 1997 at four locations in the PRB, including Gillette. Table 3-10 summarizes the results of that monitoring.

Table 3-10. Annual Ambient NO_2 Concentration Data.

Site	Gillette, WY	**Black Thunder Mine**	**Belle Ayr Mine**	**Bill, WY**
Year	**Percent of Standard[1]**	**Percent of Standard[1]**	**Percent of Standard[1]**	**Percent of Standard[1]**
1975	6*			
1976	4*			1*
1977	4*			5*
1978	11*			
1979	11			
1980	12			
1981	14			
1982	11			
1983[2]	17			
1996-97[3]	16	16	22	22

[1] Based on arithmetic averaging of data.
[2] Monitoring discontinued December 1983, reactivated March 1996 to April 1997.
[3] Arithmetic average – actual sampling ran from March 1996 to April 1997.
* Inadequate number of samples for a valid annual average.
Source: (McVehil-Monnett 1997)

Due to public concerns about emissions of nitrogen dioxides as a result of blasting and a general concern of the WDEQ about levels of nitrogen dioxides due to development of all types in the eastern PRB, the coal mining industry instituted a monitoring network in cooperation with WDEQ/AQD to gather data on NO_2 beginning in 2001. Through a cooperative agreement between AQD and the Wyoming Mining Association, the PRB NOx network began operation in January 2001 (WDEQ/AQD 2008). Industry funded and operated the network for approximately 3 years. Ownership of some of the monitoring equipment was transferred to WDEQ by the mines and WDEQ now funds and operates that NO_2 monitoring equipment. The mines have been given ongoing access to all of the monitoring sites and provide electrical power for the instrumentation. WDEQ/AQD and the mines now share maintenance of these monitoring stations, and the AQD is relying on the ongoing monitoring data and emission inventories in the mines' air quality permit applications to demonstrate compliance with the annual NO_2 ambient air standard (Table 3-8). The 2002 through 2007 data from this regional network are summarized in Table 3-11. With respect to the general Wright analysis area, the Tracy Site is located roughly in the center of the area (TBCC owns and operates that site), the Thunder Basin National Grassland Site is approximately 67 miles north, and the Campbell County Site is approximately 33 miles northwest. As noted in Tables 3-9 and 3-10, the mean annual NO_2 concentrations for all monitoring sites have historically been significantly below the WAAQS and NAAQS annual standard (100 $\mu g/m^3$).

Table 3-11. 2002 Through 2008 Annual Mean NO_2 Concentration Data ($\mu g/m^3$).

Site Address	2002	2003	2004	2005	2006	2007	2008
TBNG[1]	5.7	5.7	3.8	3.8	3.8	3.8	3.8
Belle Ayr Mine[1]	--	13.2	13.2	15.1	17.0	--	--
Antelope Mine[1]	--	7.5	7.5	9.4	7.5	--	--
Campbell County[1]	--	13.2	9.4	7.5	5.7	7.5	5.6
Tracy Ranch[2]	6.2	5.6	5.8	7.7	11.8	8.2	6.1
Average	5.95	9.04	7.94	8.70	9.16	6.50	5.17

[1] Monitor values from EPA (2009b)
[2] Monitor values from TBCC (2009)

The WDEQ/AQD's Ambient Air Monitoring Annual Network Plan provides an overview of the number and types of air quality monitors AQD runs or oversees within the state of Wyoming, and is available for review on its website at: http://deq.state.wy.us/aqd/downloads/AirMonitor/Network%20Plan_2008.pdf

3.4.4 Air Quality Related Values (AQRVs)

AQRVs are evaluated by the land management agency responsible for a Class I area, according to the agency's level of acceptable change (LAC). These AQRVs include potential air pollutant effects on visibility and the acidification of lakes and streams. The AQRVs, and the associated LAC, are applied to PSD Class I and sensitive Class II areas and are the land management agency's policy and are not legally enforceable as a standard.

3.4.4.1 Visibility

Visibility refers to the clarity with which scenic vistas and landscape features are perceived at great distances. Visibility can be defined as the distance one can see and the ability to perceive color, contrast, and detail. Fine particulate matter ($PM_{2.5}$) is the main cause of visibility impairment. Visual range, one of several ways to express visibility, is the furthest distance a person can see a landscape feature. Without the effects of human-caused air pollution, a natural visual range is estimated to be about 140 miles in the western U.S. and 90 miles in the eastern U.S. (EPA 2001b).

Visibility is also expressed in terms of deciview (dv). The dv index was developed as a linear perceived visual change (Pitchford and Malm 1994), and is the unit of measure used in the EPA's Regional Haze Rule to achieve the National Visibility Goal. The National Visibility Goal was established as part of the CAA in order to prevent any future, and remedy any existing, impairment of visibility in mandatory Federal Class I areas that result from manmade air pollution. The deciview index is a scale related to visual perception that has a value near zero for a pristine atmosphere. A change in visibility of 1.0 dv represents a "just noticeable change" by an average person under most

circumstances. Increasing dv values represent proportionately larger perceived visibility impairment.

3.4.4.1.1 Affected Environment for Visibility

AQRVs, including the potential air pollutant effects on visibility, are applied to PSD Class I and Class II areas. The land management agency responsible for the Class I area sets an LAC for each AQRV. The AQRVs reflect the land management agency's policy and are not legally enforceable standards. Table 3-12 shows the distances from 31 PSD Class I and Class II areas in the vicinity of the PRB to the general Wright analysis area.

The *Wyoming State Implementation Plan for Class I Visibility Protection* states: "Wyoming's long term strategy will focus on the prevention of any future visibility impairment in Class I areas that can be attributed to a source or small group of sources as the Federal Land Managers have not identified any current impairment in the State's Class I areas due to such sources". WDEQ/AQD prepared the *2003 Review Report on Wyoming's Long Term Strategy for Visibility Protection in Class I Areas*, as required by WAQSR, which calls for AQD to review and revise, if appropriate, the Long Term Strategy every 3 years. The 2003 Review Report is available on the WDEQ/AQD visibility monitoring website at http://www.wyvisnet.com (WDEQ/AQD 2009).

The Regional Haze Rule calls for improved visibility on the most-impaired days and no additional impairment on the least-impaired days. EPA participates in the Interagency Management of Protected Visual Environments (IMPROVE) visibility monitoring program as part of its visibility protection program. The IMPROVE monitoring sites were established to be representative of all Class I areas. On December 20, 2005, the IMPROVE Steering Committee approved a new algorithm for calculating current and natural background visibility. Figure 3-19 shows annual averages, based on the new algorithm, for the 20 percent best (clearest), average, and worst (haziest) visibility days at Badlands National Park in South Dakota and Bridger Wilderness Area in Wyoming from1989 through 2005 (IMPROVE 2008). Through 2005 (the most recent data available on IMPROVE website), Badlands National Park has statistically shown a trend toward improved visibility on the least, average, and most-impaired days. The Bridger Wilderness has statistically shown a trend toward improved visibility on the average and least-impaired days and no change in visibility on the most-impaired days.

3.4.4.1.2 Environmental Consequences for Visibility

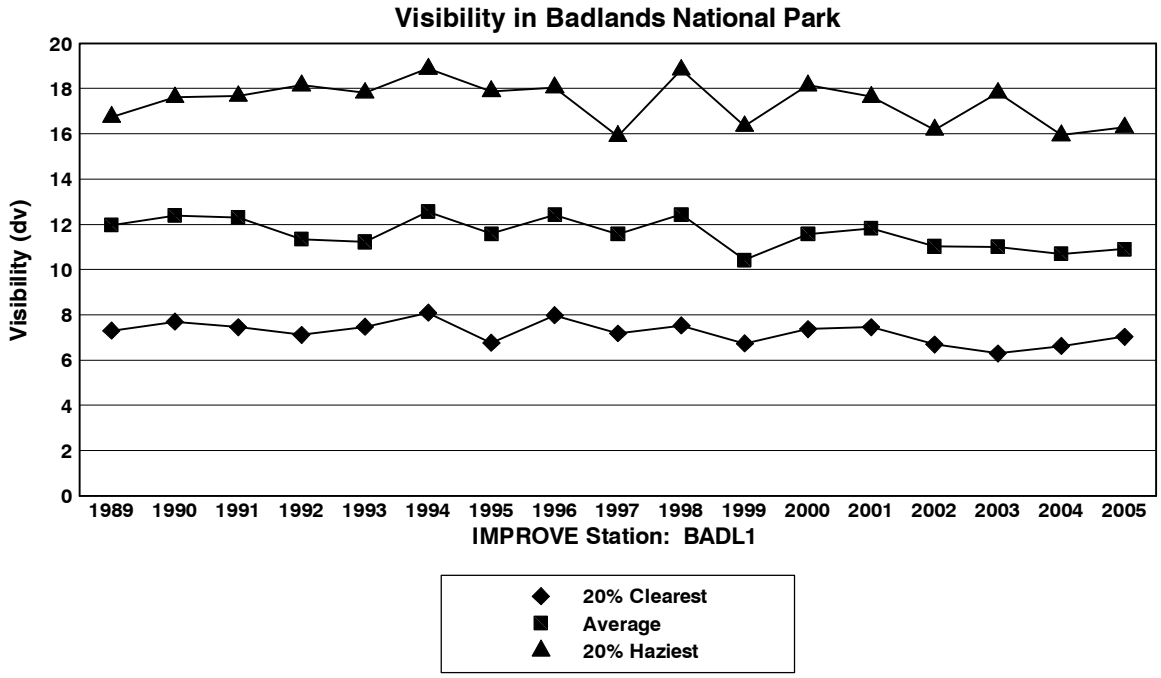
3.4.4.1.2.1 Proposed Action and Alternatives 2 and 3

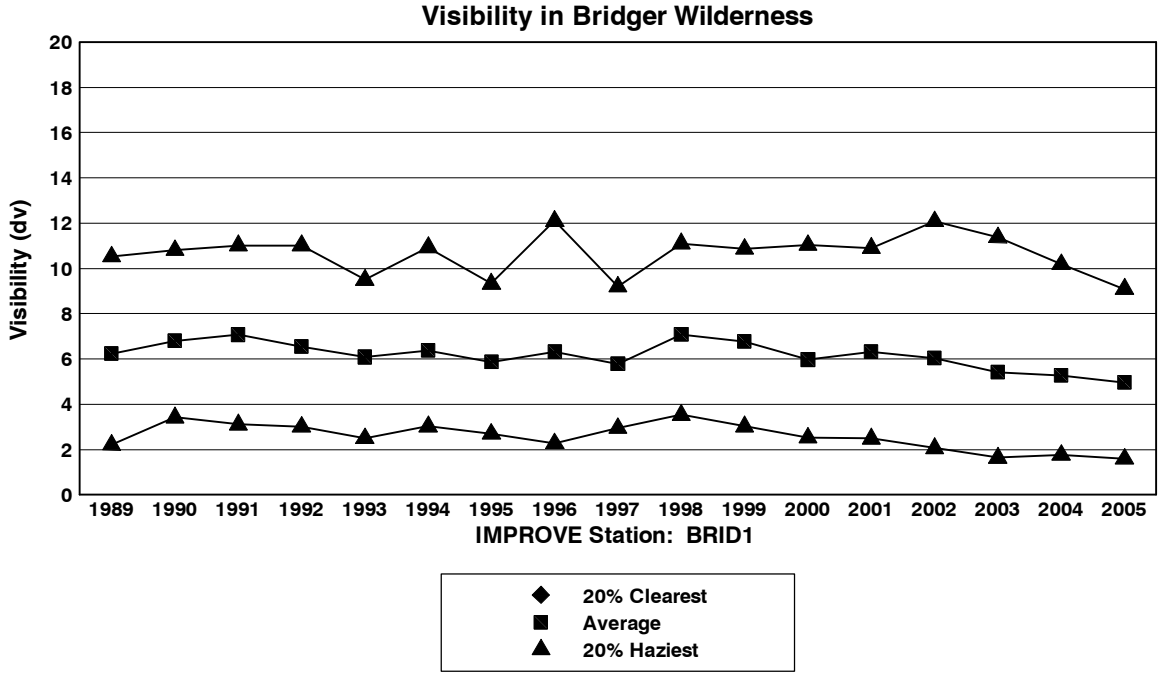
The impacts to visibility from mining the North, South, and West Hilight Field LBA Tracts have been inferred from the currently permitted impacts of mining the existing coal leases at the Black Thunder Mine. The impacts to visibility from mining the West Jacobs Ranch LBA Tract have been inferred from the

Table 3-12. Approximate Distances and Directions from the General Wright Analysis Area to Mandatory Federal PSD Class I, Tribal Federal PSD Class I, and Federal PSD Class II Areas.

Receptor Area	Distance (miles)	Direction to Receptor
Mandatory Federal PSD Class I Area		
Badlands Wilderness Area[1]	143	E
Bridger Wilderness Area	199	WSW
Fitzpatrick Wilderness Area	207	W
Gates of the Mountain Wilderness Area	382	NW
Grand Teton National Park	254	W
North Absaroka Wilderness Area	213	WNW
Red Rocks Lake Wilderness Area	320	WNW
Scapegoat Wilderness Area	426	NW
Teton Wilderness Area	221	W
Theodore Roosevelt National Park (North Unit)	290	NNE
Theodore Roosevelt National Park (South Unit)	242	NNE
U.L. Bend Wilderness Area	290	NNW
Washakie Wilderness Area	187	W
Wind Cave National Park	91	E
Yellowstone National Park	235	WNW
Tribal Federal PSD Class I		
Fort Peck Indian Reservation	301	N
Northern Cheyenne Indian Reservation	132	NNW
Federal PSD Class II		
Absaroka-Beartooth Wilderness Area	224	WNW
Agate Fossil Beds National Monument	114	SE
Badlands National Park	121	E
Bighorn Canyon National Recreation Area	166	NW
Black Elk Wilderness Area	88	E
Cloud Peak Wilderness Area	93	WNW
Crow Indian Reservation	124	NW
Devils Tower National Monument	70	NNE
Fort Belknap Indian Reservation	327	NNW
Fort Laramie National Historic Site	108	SSE
Jewel Cave National Monument	74	E
Mount Rushmore National Memorial	94	E
Popo Agie Wilderness Area	194	WSW
Soldier Creek Wilderness Area	106	SE

[1] The U.S. Congress designated the Wilderness Area portion of Badlands National Park as a mandatory Federal PSD Class I area. The remainder of Badlands National Park is a PSD Class II area.





Source: IMPROVE (2008)

Figure 3-19. Visibility in the Badlands and Bridger Wilderness Areas.

currently permitted impacts of mining the existing coal leases at the Jacobs Ranch Mine. The impacts to visibility from mining the North and South Porcupine LBA Tracts have been inferred from the currently permitted impacts of mining the existing coal leases at the North Antelope Rochelle Mine. If the mines acquire the additional coal in the LBA tracts, the LBA tracts would be mined as an integral part of the applicant mines. The average annual coal production for each applicant mine is anticipated to remain at the projected post-2008 rates, with or without the LBA tracts. Therefore, impacts to visibility under the Proposed Action and Alternative 2, BLM's preferred alternative for each tract, would be similar to the impacts under the No Action Alternative, except they would be extended by 1.6 years (for the South Hilight Field LBA Tract as applied for) up to as many as 22.8 years (for the West Jacobs Ranch LBA Tract under Alternative 2).

Current techniques for blasting, coal removal, and coal processing would be expected to continue for a longer period of time than is shown in the applicant mines' currently approved air quality permits. Material movement would continue to utilize direct cast blasting, draglines, and/or truck and shovel fleets for overburden and truck and shovel fleets and overland conveyors for coal. The applicant mines would not propose significant changes to the facilities shown in the current air quality permits or the blasting procedures or blast sizes if they acquire the tracts. However, when the mining permits are amended to include the new lease areas, the techniques proposed for coal and overburden removal, coal processing, and blasting processes would be reviewed and modified if necessary to incorporate the BACT protection measures that are in effect at that time. Overburden is generally thicker in the LBA tracts than the current lease areas; therefore, state of the art methods to minimize any increases in blast sizes and/or blasting agents will be employed. Thus, emissions from blasting are not expected to increase significantly, notwithstanding the increased thicknesses of overburden that would be excavated in these LBA tracts.

Surface coal mines are not considered to be major emitting facilities in accordance with Chapter 6, Section 4 of WDEQ/AQD Rules and Regulations. Therefore, the State of Wyoming does not require mines to evaluate their impacts on Class I areas; however, BLM considers such issues during leasing.

3.4.4.1.2.2 No Action Alternative

Under the No Action Alternative, the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine coal lease applications would be rejected and coal removal and related visibility impacts would not occur on the portions of the LBA tracts as applied for or the LBA tracts configured under Alternative 2 that will not be disturbed under the currently approve surface coal mining permits. Mining operations would continue as permitted on the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle Mine coal leases. Visibility impacts related to mining operations at these three applicant mines would not be extended onto portions

of the LBA tracts that will not be affected under the mines' current mining and reclamation plans.

As discussed in Section 2.2, a decision to reject one or more of these six coal lease applications at this time would not preclude an application to lease that respective tract in the future.

3.4.4.1.3 Regulatory Compliance, Mitigation, and Monitoring for Visibility Impacts

As discussed above, fine particulate matter ($PM_{2.5}$) is the main cause of visibility impairment. Mitigation measures being used to limit emissions of particulate matter are discussed in Section 3.4.2.3.

Visibility monitoring within the State of Wyoming consists of both the WDEQ/AQD sponsored Wyoming Visibility Monitoring Network and the IMPROVE program. WDEQ has sited two visibility monitoring stations in the PRB. One of these sites (the Thunder Basin National Grasslands site) is 32 miles north of Gillette and includes a nephelometer, a transmissometer, an IMPROVE aerosol sampler, instruments to measure meteorological parameters (temperature, RH, wind speed, wind direction), a digital camera, instruments to measure ozone, and instruments to measure oxides of nitrogen (NO, NO_2, NO_X). The second visibility monitoring station (the Cloud Peak Wilderness Area site) is located 14 miles west of Buffalo and includes a nephelometer, a transmissometer, an IMPROVE aerosol sampler, instruments to measure meteorological parameters, and a digital camera.

These sites are being utilized to characterize the extent, frequency of occurrence, and magnitude of visual air quality impacts. The IMPROVE Steering Committee approved the incorporation of the TBNG and Cloud Peak sites into the IMPROVE network in June 2002. Although these stations are not located in areas classified as Class I areas, the collected data will be comparable to monitoring data available from the state's Class I areas. This information can help scientists determine the types and concentrations of air pollutants and their direction of travel in order to project visibility impacts to Class I areas. The Wyoming Visibility Monitoring Network was recently supplemented with the development of a website on the Internet at http://www.wyvisnet.com/all.html to allow public access to real-time monitored visibility and air quality conditions (WDEQ/AQD 2009).

3.4.4.2 Acidification of Lakes

The acidification of freshwater lakes and streams is caused by atmospheric deposition of acid pollutants (acid rain). According to EPA, SO_2 and NO_X, primarily derived from the burning of fossil fuels, are the primary causes of acid rain. Most lakes and streams have a pH between 6 and 8, although some lakes are naturally acidic even without the effects of acid rain. Acid rain primarily affects sensitive bodies of water, which are located in watersheds

whose soils have a limited ability to neutralize acidic compounds (called "buffering capacity"). Lakes and streams become acidic (pH value goes down below a value of 7 on a scale of 1 to 14) when the water itself and its surrounding soil cannot buffer the acid rain enough to neutralize it. Lakes and streams that are generally regarded as acidified are typically very nutrient poor waters draining unreactive geology such as granitic mountainous areas. In areas where buffering capacity is low, acid rain also releases toxic metals such as aluminum from soils into lakes and streams. Both the lower pH and higher aluminum concentrations in surface water can cause damage to fish and many other species of aquatic organisms. The plants and animals living within an ecosystem are highly interdependent, and because of the connections between the organisms living in an aquatic ecosystem, changes in pH or aluminum levels affect biodiversity as well. Thus, as lakes and streams become more acidic, the numbers and types of fish and other aquatic plants and animals that live in these waters decrease.

Several regions in the U.S. were identified in a national surface water survey as containing many of the surface waters sensitive to acidification. They include the Adirondacks and Catskill Mountains in the State of New York, the mid-Appalachian highlands along the east coast, the upper Midwest, and mountainous areas of the western U.S.

Scientists predict that the decrease in SO_2 emissions required by the Acid Rain Program will significantly reduce acidification due to atmospheric sulfur. Without the reductions in SO_2 emissions, the proportions of acidic aquatic ecosystems would remain high or dramatically worsen (EPA 2005a). The USFS has been monitoring air quality in the Wind River Mountain Range in Wyoming since 1984 and is seeing a general trend of decreasing sulfates. Nitrates, on the other hand, have been increasing globally (EPA 2007b).

3.4.4.2.1 Affected Environment

AQRVs, including the potential air pollutant effects on the acidification of lakes and streams, are applied to PSD Class I and Class II areas. The land management agency responsible for the Class I area sets an LAC for each AQRV. The AQRVs reflect the land management agency's policy and are not legally enforceable standards. Lake acidification is expressed as the change in acid neutralizing capacity (ANC), measured in microequivalents per liter (µeq/L); the lake's capacity to resist acidification from acid rain. The USFS considers lakes with ANC values between 25 and 100 µeq/L to be very sensitive to atmospheric deposition and lakes with ANC values less than or equal to 25 µeq/L to be extremely sensitive to atmospheric deposition. Table 3-13 shows the existing ANC monitored in some mountain lakes and their distance from the general Wright analysis area.

Table 3-13. Existing Acid Neutralizing Capacity in Sensitive Lakes.

Wilderness Area	Lake	Background ANC (µeq/L)	Distance from General Wright Analysis Area (miles)
Bridger	BlackJoe	69.0	203
	Deep	61.0	204
	Hobbs	68.0	222
	Upper Frozen	5.8[1]	204
Cloud Peak	Emerald	55.3	113
	Florence	32.7	104
Fitzpatrick	Ross	61.4	218
Popo Agie	Lower Saddlebag	55.5	198

[1] The background ANC is based on only six samples taken between 1997 and 2001.
Source: Argonne (2002)

3.4.4.2.2 Environmental Consequences

3.4.4.2.2.1 Proposed Action and Alternatives 2 and 3

The North Hilight Field, South Hilight Field, and West Hilight Field LBA Tracts would be mined as integral parts of the Black Thunder Mine. The West Jacobs Ranch LBA Tract would be mined as an integral part of the Jacobs Ranch Mine. The North Porcupine and South Porcupine LBA Tracts would be mined as integrals part of the North Antelope Rochelle Mine. Therefore, the impacts to air quality from mining the LBA tracts have been inferred from the impacts at the currently permitted mining operations.

The applicant mines anticipate that coal production would remain unchanged from the projected post-2008 levels if the LBA tracts are acquired. Impacts to air quality related to lake acidification under the Proposed Action or Alternative 2, BLM's preferred alternatives for each tract, would therefore be similar to the impacts under the No Action Alternative, except they would be extended by 1.6 years (for the South Hilight Field LBA Tract as applied for) up to as many as 22.8 years (for the West Jacobs Ranch LBA Tract under Alternative 2).

The Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines would employ the best measures available to mitigate any potential emission increases associated with mining the LBA tracts. These would include, but would not necessarily be limited to, extension of overland conveyors to minimize haul distances and associated particulate and gaseous (i.e., nitrogen oxides, carbon oxides and sulfur dioxides) emissions from coal haulage, as well as state-of-the-art blasting practices to mitigate any potential increases in nitrogen oxide emissions, which can also contribute to acidification.

3.4.4.2.2.2 No Action Alternative

Under the No Action Alternative, the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine coal lease applications would be rejected and coal removal and the associated disturbance would not occur on the portions of the LBA tracts as applied for or the LBA tracts configured under Alternative 2 that will not be disturbed under the currently approved surface coal mining permits. Mining operations would continue as currently permitted on the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle Mine coal leases. Mining operations and associated emissions that contribute to the acidification of lakes would not be extended onto those portions of the LBA tracts that will not be affected under the mines' current mining and reclamation plans.

As discussed in Section 2.2, a decision to reject one or more of these six coal lease applications at this time would not preclude an application to lease that respective tract in the future.

3.4.4.2.3 Regulatory Compliance, Mitigation, and Monitoring

Mitigation and monitoring for coal mine emissions, including the emissions that contribute to the acidification of lakes, are discussed in Sections 3.4.2.3, 3.4.3.3, and 3.4.4.1.3. Other air quality monitoring programs that are in place in the PRB include Wyoming Air Resources Monitoring System (WARMS) monitoring of sulfur and nitrogen concentrations near Buffalo, Sheridan, and Newcastle, and the National Atmospheric Deposition Program (NADP) monitoring of precipitation chemistry in Newcastle. The WDEQ/AQD's Ambient Air Monitoring Annual Network Plan provides an overview of the number and types of air quality monitors AQD runs or oversees within the state of Wyoming, and is available for review on its website at: http://deq.state.wy.us/aqd/downloads/AirMonitor/Network%20Plan_2008.pdf.

3.4.5 Residual Impacts to Air Quality

No residual impacts to air quality would occur following mining and reclamation.

3.5 Water Resources

3.5.1 Groundwater

3.5.1.1 Affected Environment

The general Wright analysis area contains three water-bearing geologic units that have been directly affected by existing mining activities and would be directly affected by mining the six LBA tracts. In descending order, these units are the recent alluvial deposits, the Wasatch Formation overburden, and the mineable coal seam(s) in the Tongue River Member of the Fort Union

Formation, which is referred to as the Wyodak or Wyodak-Anderson. The underlying, sub-coal Fort Union Formation and the Lance-Fox Hills aquifer are utilized for water supply at the existing coal mines within the general Wright analysis area, but these units are not physically disturbed by mining activities. Both regional and site-specific baseline hydrogeologic environments within and around the general Wright analysis area are extensively characterized in the WDEQ/LQD mine permits for the three applicant mines included in this analysis (TBCC 2005, JRM 2004, and PRC 2004). Figures 3-20, 3-21, and 3-22 depict the locations of the groundwater monitoring wells that are actively being monitored by TBCC, JRCC, and PRC at the Black Thunder, Jacobs Ranch, and North Antelope Rochelle Mines, respectively. Figure 3-2 presents the stratigraphic relationships and hydrologic characteristics of the units underlying the general Wright analysis area.

3.5.1.1.1 Recent Alluvium

Alluvial (unconsolidated stream laid) deposits will form localized aquifers where they are extensive enough and provided they receive recharge from precipitation infiltration, surface water flows, or in some cases, discharge from the adjacent overburden. Alluvial groundwater flow is typically in the same direction as the surface drainage. Discharge is typically to the surface, to the adjacent overburden sediments, or to evapotranspiration (Ogle and Calle 2006).

Within the general Wright analysis area, alluvial deposits are present and primarily occupy the valleys of the larger drainages, namely Little Thunder Creek, North Prong Little Thunder Creek, and Porcupine Creek. Less extensive alluvial deposits are also found along the lower reaches of the tributaries to these larger streams. The alluvial, colluvial, sheetwash and playa deposits associated with minor surface drainages are typically very thin and not laterally extensive enough to be considered aquifers. In addition, these less extensive unconsolidated stream laid deposits are generally very fine-grained and have very limited permeabilities, precluding any significant storage and movement of groundwater. Alluvial groundwater quality in this area is highly variable spatially and generally poor but suitable for livestock and wildlife use. However, the concentrations of individual constituents may exceed livestock use standards at some locations. Based on the analyses of 793 alluvial groundwater samples collected in the southern PRB, the median concentration of total dissolved solids (TDS) was 2,110 milligrams per liter (mg/L) and the predominant chemical constituents were calcium and sulfate, although significant quantities of sodium, magnesium and bicarbonate were also present (Ogle and Calle 2006).

Within the BLM study area for the North Hilight Field LBA Tract, alluvial deposits are associated primarily with Springen Draw, a relatively large closed basin (over 8,000 acres in size) into which several ephemeral draws drain. These unconsolidated stream laid deposits have been mapped by the U.S. Geological Survey (USGS) as overbank, fan, apron and sheetwash deposits, and consist of intermixed silt and sand locally interbedded with thin clay or gravel

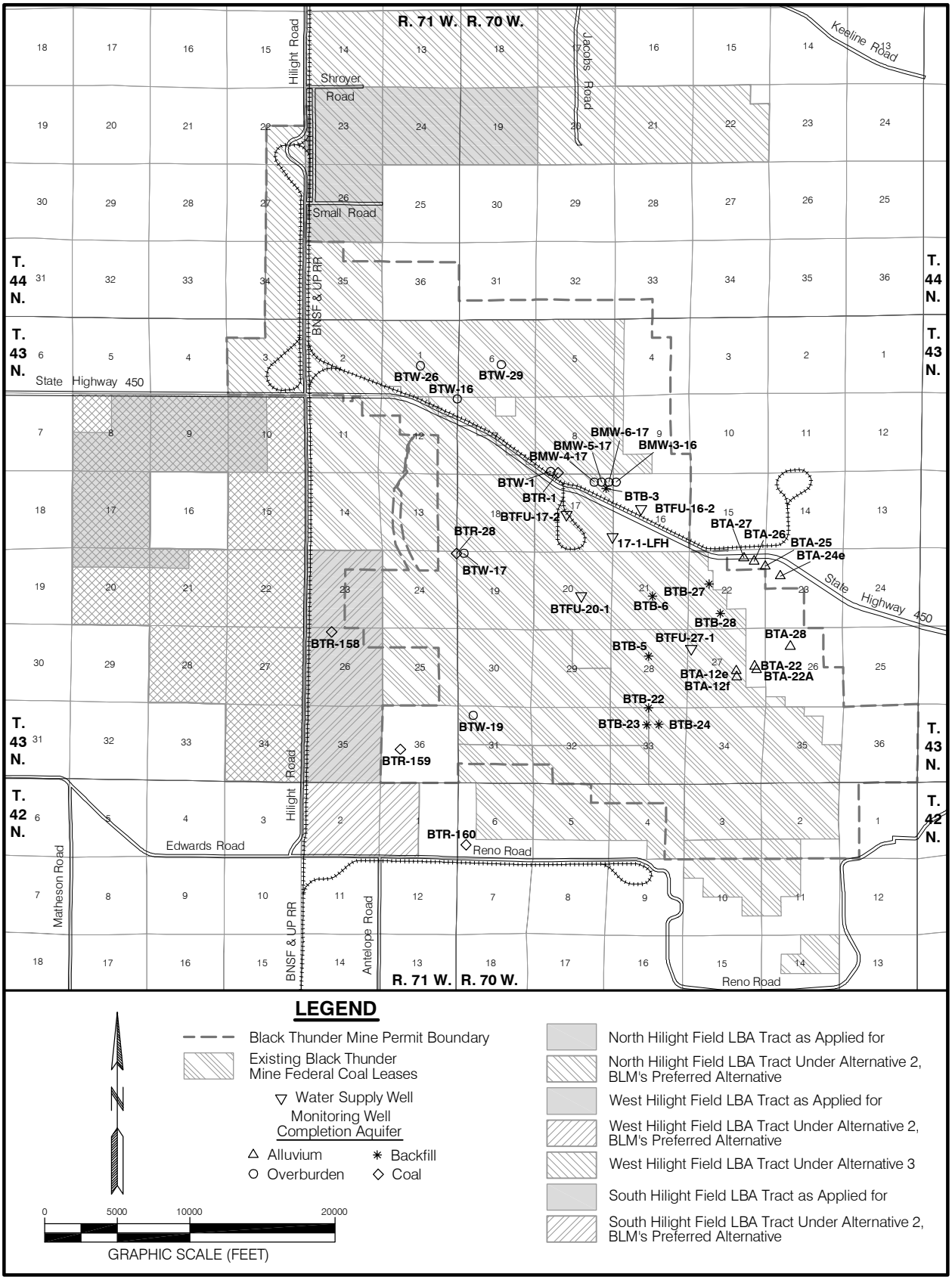


Figure 3-20. Locations of Currently Active Groundwater Monitoring and Water Supply Wells at the Black Thunder Mine.

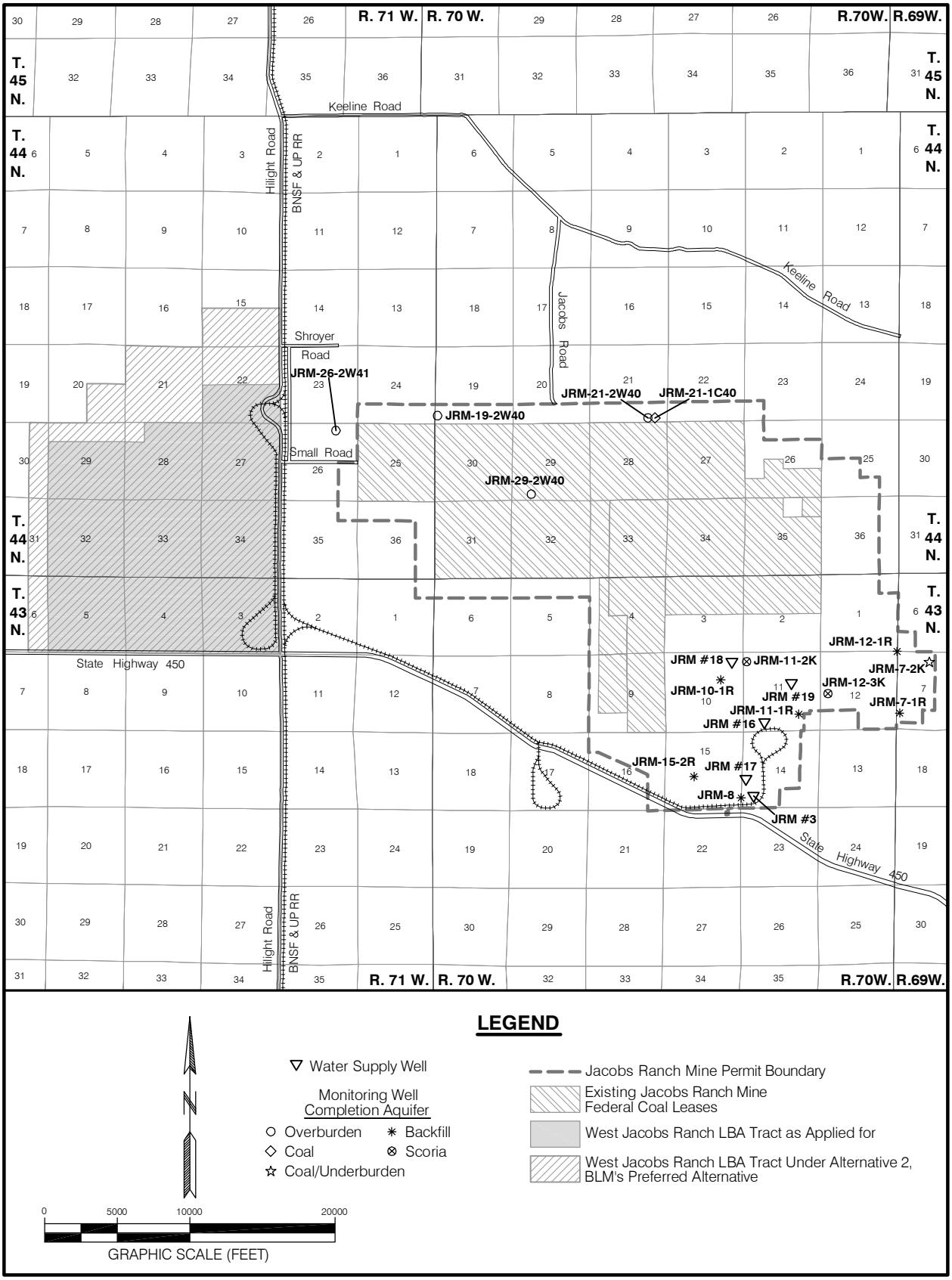


Figure 3-21. Locations of Currently Active Groundwater Monitoring and Water Supply Wells at the Jacobs Ranch Mine.

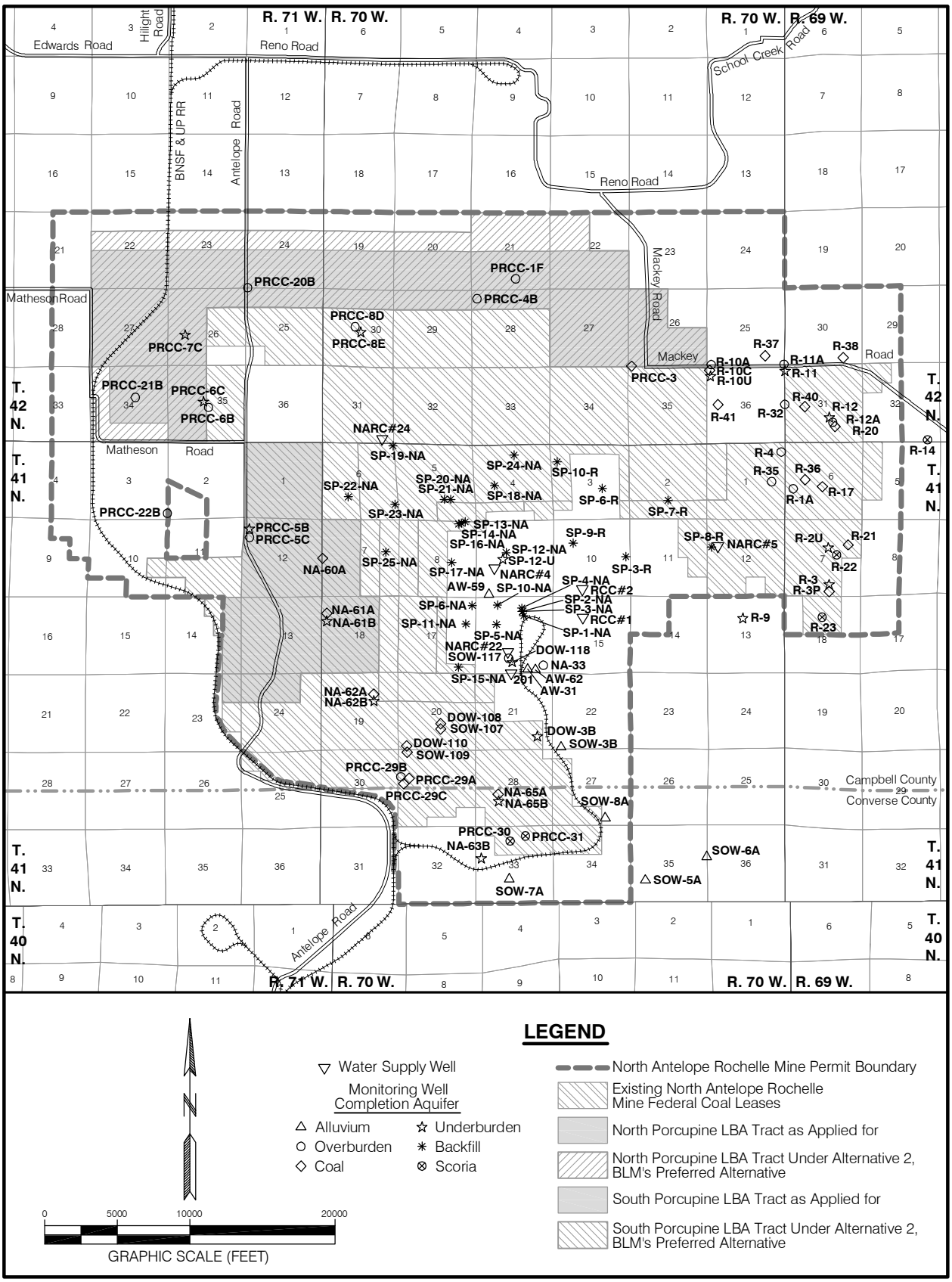


Figure 3-22. Locations of Currently Active Groundwater Monitoring and Water Supply Wells at the North Antelope Rochelle Mine.

lenses ranging from about 1.0 to 10.0 feet thick (Reheis and Coates 1987, Moore and Coates 1978, Coates 1977). No aquifer tests have been conducted in the alluvial deposits that occur within the BLM study area for the North Hilight Field LBA Tract due to the minimal saturated thickness and low transmissivity of the deposits. Based on the comparison of soil texture and type with permeability values presented in the literature (Cedergren 1977), the average hydraulic conductivity for the valley fill stream laid deposits and colluvium is estimated to range from 0.2 to 20 feet per day (ft/day). Hydraulic conductivity values compiled from all alluvial aquifer tests conducted by the Black Thunder, North Antelope Rochelle, and Antelope mines range from 0.035 ft/day to 136.5 ft/day, with the median value of 3.8 ft/day, which is comparable to that of silty sand (Ogle and Calle 2006). Available water quality data from the Black Thunder Mine's alluvial monitoring wells (Figure 3-20) indicate that groundwater from the valley fill deposits of North Prong Little Thunder Creek and Mills Draw is generally of poor quality and does not meet all of the WDEQ Water Quality Division (WQD) standards (WDEQ/WQD 2009) for domestic and agricultural uses and is marginal for livestock and wildlife use (TBCC 2007).

Within the BLM study area for the South Hilight Field LBA Tract, alluvial deposits are associated with only Little Thunder Creek, an ephemeral tributary of Black Thunder Creek. These unconsolidated stream laid deposits have been mapped by the USGS as stream-channel and overbank deposits, and they consist of intermixed silt and sand locally interbedded with thin clay or gravel lenses and range from about 1.0 to 10.0 feet thick (Reheis and Coates 1987, Moore and Coates 1978, Coates 1977, Coates 1978a). No aquifer tests have been conducted in the valley fill deposits that occur within the BLM study area for the South Hilight Field LBA Tract due to the minimal saturated thickness and low transmissivity of the deposits. Available water quality data indicate that groundwater from the valley fill deposits of Little Thunder Creek and North Prong Little Thunder Creek does not meet the WDEQ/WQD standards for domestic and agricultural uses and is marginal or fails to meet the standards for livestock and wildlife use , depending on the location (TBCC 2007).

Within the BLM study area for the West Hilight Field LBA Tract, alluvial deposits are primarily associated with Little Thunder Creek. These unconsolidated stream laid deposits have been mapped by the USGS as stream-channel and overbank deposits, and they consist of intermixed silt and sand locally interbedded with thin clay or gravel lenses and range from about 1.0 to 10.0 feet thick (Reheis and Coates 1987, Moore and Coates 1978, Coates 1978a). Lesser quantities of alluvial, colluvial, sheetwash, and playa deposits are also associated with tributaries to Little Thunder Creek (e.g., Black Butte Draw and Briggs Draw), Dry Fork Little Thunder Creek, and numerous internally-drained playas (e.g., Rochelle Lake) that occur in the area. No aquifer tests have been conducted in the alluvial deposits that occur within the BLM study area for the West Hilight Field LBA Tract due to the minimal saturated thickness and low transmissivity of the deposits. Likewise, alluvial groundwater quality data are not available for this area, although a general

description of Little Thunder Creek's alluvial groundwater quality is given above.

Within the BLM study area for the West Jacobs Ranch LBA Tract, the recent alluvium exhibiting any potential of yielding groundwater is limited to those unconsolidated stream laid deposits associated with the larger streams (all of which are ephemeral) that drain this area. Surficial geology mapping by JRCC (1994) and the USGS (Reheis and Coates 1987, Coates 1978a and 1978b) shows that the only alluvial deposits within the LBA tract's general analysis area occur along the channels of Dry Fork Little Thunder Creek and its tributary, Brater Draw. These alluvial deposits consist of intermixed silt and sand locally interbedded with thin clay or gravel lenses and range from about 1.0 to 10.0 feet thick. Groundwater occurrence in the alluvium is generally unknown in this area, but some limited occurrence may be expected as bank storage from ephemeral stream flows. No aquifer tests have been conducted in the alluvial deposits that occur within the BLM study area for the West Jacobs Ranch LBA Tract, but tests conducted by TBCC on North Prong Little Thunder Creek alluvial monitoring wells located downstream of the LBA tract revealed hydraulic conductivity values ranging from 0.52 to 6.42 ft/day (TBCC 2005). Water quality samples collected from North Prong Little Thunder Creek alluvial monitoring wells located in the existing Black Thunder Mine permit area exhibit an average TDS concentration of 1,600 mg/L, which is suitable for agricultural and livestock use.

The BLM study area for the North Porcupine LBA Tract is drained by Porcupine Creek and its tributaries, all of which are ephemeral streams. The most significant alluvial aquifer in the general Wright analysis area is that associated with Porcupine Creek. The valley floor of Porcupine Creek contains appreciable amounts of alluvium both in width and depth, and the alluvial deposits contain more coarse material than the other smaller ephemeral streams that drain most of the general Wright analysis area. Downstream of the North Porcupine tract, where the stream has been disturbed by the North Antelope Rochelle Mine, the alluvium was up to 1,000 feet wide, up to 12 feet thick, and composed primarily of coarse-grained sand (BLM 1998). Mapping of the surficial geology within the LBA tract's general analysis area shows that alluvial deposits occur along the channels of Porcupine Creek and its tributaries, Gray Creek and Rat Draw (Reheis and Coates 1987, PRC 2004). These materials are comprised of stream-channel and overbank deposits of sand and silt interbedded with gravel lenses. Isolated, thin deposits of sheetwash alluvium consisting of sands, silts, and clays also occur in areas of unchanneled flow on hillslopes and in depressions. Studies conducted by PRC on the alluvium of Porcupine and Corder creeks downstream of the North Porcupine tract indicate that the hydraulic conductivity of Porcupine Creek alluvium is variable, ranging from 1.1 to 13.0 ft/day (BLM 1998). The Porcupine Creek alluvial aquifer receives recharge from the infiltration of precipitation, from the lateral movement of groundwater that discharges from the adjacent Wasatch Formation overburden, and from the infiltration of surface flow within the stream channel. Lesser quantities of colluvial,

sheetwash, and playa deposits associated with other smaller drainages and internally-drained basins in the area also occur, but these materials are generally thin, fine grained, and not laterally extensive enough to store or yield groundwater. The quality of Porcupine Creek alluvial groundwater is generally suitable for livestock and wildlife use, but the concentration of sulfate typically exceeds the agricultural use standard. The TDS concentrations of water quality samples collected by the North Antelope Rochelle Mine downstream of the LBA tract range from about 1,000 mg/L to 37,000 mg/L with an average of approximately 5,350 mg/L (Ogle and Calle 2006).

The South Porcupine LBA Tract's general analysis area is drained by minor tributaries of Porcupine Creek, Horse Creek, and Antelope Creek. Mapping of the surficial geology within the tract's general analysis area (Reheis and Coates 1987, PRC 2004) shows that some alluvial deposits occur only along Mike's Draw, a north-flowing, third order ephemeral tributary of Porcupine Creek. These recent alluvial deposits are comprised of stream-channel and overbank deposits of sand and silt. Because the thickness and areal extent of these materials are very limited, and they infrequently receive recharge from the infiltration of precipitation and surface flow within the stream channel, they do not yield groundwater.

3.5.1.1.2 Wasatch Formation

Within the PRB, the Wasatch Formation (the strata lying above the mineable coal, also called the overburden) consists of various non-marine, fluvial and eolian deposits of interbedded sands, silts, and clays with occasional discontinuous deposits of coal and carbonaceous material. The Wasatch strata range in cohesion from unconsolidated (i.e., loose sands and silts) to lithified (i.e., sandstones, siltstones, shales, and coal stringers). Any of the deposits may be water bearing, although the sands and sandstones possess a greater, but laterally limited, potential for groundwater yield. These sands are generally discontinuous and separated laterally and vertically by finer-grained silts and clays. Perched groundwater can occur locally within the surficial deposits of Wasatch residuum and Wasatch-derived eolian deposits that overlie an impermeable stratum. This basic description generally holds true for all of the general Wright analysis area.

The discontinuous nature of the sediments produces considerable variability in the occurrence of groundwater in the overburden both laterally and vertically. The hydraulic connection between water-bearing units is tenuous due to intervening shale aquitards; thus, groundwater movement through the Wasatch Formation overburden is limited. Due to the discontinuous nature of the permeable overburden sediments, premine overburden groundwater movement generally follows the topography. Because the water-bearing units within the Wasatch Formation are not continuous, the Wasatch is not considered to be a regional aquifer. However, Wasatch sands and sandstones do provide limited amounts of groundwater for livestock and domestic uses on a local scale, provided the water quality is suitable. Channel-like deposits of

unconsolidated sand (paleochannel sands) with up to about 60 feet of saturation occasionally occur in the Wasatch overburden, and wells developed in these sands may individually yield up to 50 gallons per minute (gpm). Paleochannels are typically less than 500 feet wide and are isolated laterally and vertically by silt and clay deposits of very low permeabilities.

Another geologic unit that may be considered a part of the Wasatch Formation is scoria, also called clinker or burn. It consists of sediments that were baked, fused, and melted in place when the underlying coal burned spontaneously. These burned sediments collapsed into the void left by the burned coal. Scoria deposits can be a very permeable aquifer and can extend laterally for miles in the eastern PRB. The occurrence of scoria is site specific, typically occurring in areas where coal seams crop out at the surface. The hydrologic function of scoria includes providing infiltration of precipitation and recharge to laterally contiguous overburden and coal beds. The West Jacobs Ranch LBA Tract is the only tract included in this analysis that contains scoria deposits; however, the outcrops in Sections 21 and 31 of T.44N., R.71W. are erosionally isolated, small in areal extent, and not documented as aquifers or a source of recharge.

Recharge to the Wasatch Formation is from the infiltration of precipitation, infiltration of surface water stored in playas and in-channel reservoirs, and lateral movement of water from adjacent scoria bodies. Regionally, groundwater is discharged from the Wasatch Formation by evaporation and transpiration, by pumping wells, by drainage into mine excavations, and by seepage into the alluvium along stream courses. Overburden groundwater is not generally connected to the underlying Wyodak coal seam due to a low-permeability stratum at the base of the overburden, which is fairly widespread in the general Wright analysis area. However, there is likely some leakage between the aquifers that provides vertical recharge to the coal aquifer.

For the Wasatch Formation as a whole in the PRB, the discontinuous nature of the water bearing units results in low overall hydraulic conductivity and low groundwater flow rates. Groundwater encountered in the Wasatch overburden is usually unconfined or perched, and water levels generally vary from 10 to over 100 feet below the ground surface (Ogle and Calle 2006). The overburden's hydraulic properties are variable due to the varied nature of the stratigraphic units, although the hydraulic conductivity is relatively low. Martin et al. (1988) reported that hydraulic conductivities within the Wasatch ranged from 10^{-4} ft/day to 10^{2} ft/day, and the geometric mean hydraulic conductivity based on 203 tests conducted near the PRB coal mines was 0.2 ft/day. Fifty-nine overburden monitoring wells located in the permit areas of the mines in the general Wright analysis area have been aquifer tested and the hydraulic conductivity values ranged from 0.001 ft/day to 27.0 ft/day with a the median of 0.11 ft/day.

The quality of groundwater in the Wasatch Formation is extremely variable and generally poor. In the general Wright analysis area, TDS concentrations range from 500 mg/L to 6,157 mg/L and the water type is typically a sodium-sulfate.

Based on the analyses of over 1,000 water quality samples collected by the southern PRB coal mines, including the three applicant mines, the median TDS concentration was 2,000 mg/L and the predominant constituents were sodium and sulfate (Ogle and Calle 2006). Overburden groundwater is considered to be unsuitable for domestic and irrigation uses, but is generally suitable for livestock and wildlife use although, at some locations, concentrations of individual constituents may exceed livestock standards.

3.5.1.1.3 Wyodak/Wyodak-Anderson Coal

The Tongue River Member of the Fort Union Formation contains the mineable coal zone, which is often divided by partings that separate it into two or more units. Operators of the mines in the general Wright analysis area refer to the mineable coal zone as either the Wyodak (Upper Wyodak, Middle Wyodak and Lower Wyodak) or the Wyodak-Anderson. A general discussion of the coal seam aquifer is presented as follows.

Due to its continuity, the Wyodak coal seam is considered a regional aquifer because it is water bearing and is laterally continuous throughout the area. Historically, the Fort Union coal seams have been a source of groundwater for domestic and livestock uses in the eastern PRB. However, due to the 1 to 3 degree west-northwest dip of the coal beds, the coal generally becomes too deep to be an economical source of water within a couple of miles west of the PRB surface coal mines.

Hydraulic conductivity within the Wyodak coal seam is highly variable and reflective of the amount of fracturing the coal has undergone, as non-fractured coal is virtually impermeable. Field aquifer tests indicate that the coal has a low to moderate transmissivity with a range of roughly three orders of magnitude. The yield of groundwater to wells and mine pits is smallest where the permeability of the coal is derived primarily from localized unloading fractures. These fractures, which are the most common, are created by the expansion of the coal as the weight of overlying sediments is slowly removed by erosion. Localized zones of moderately high transmissivity occur due to increased fracturing, and the highest permeability is imparted to the coal by tectonic fractures. These are through-going fractures of areal importance created during deformation of the Powder River structural basin. The presence of these fractures can be recognized by their linear expression at the ground surface, controlling the orientation of stream drainages and topographic depressions. Due to their pronounced surface expression, these tectonic fractures are often referred to as “lineaments”. Coal permeability along lineaments can be increased by orders of magnitude over that in the coal fractured by unloading only. For example, aquifer testing conducted by PRC within North Antelope Rochelle Mine’s permit area indicates that the coal possesses higher permeability in a northwest-southeast direction.

Field aquifer tests conducted by the Jacobs Ranch, Black Thunder, North Rochelle, North Antelope Rochelle, and Antelope mines were examined by

WDEQ/LQD (Ogle and Calle 2006) and the hydraulic conductivities of the coal ranged from 0.005 ft/day to 1,167 ft/day; the variability most likely due to the fractured nature of the coal. The median hydraulic conductivity of the coal aquifer based on 101 aquifer tests is 1.8 ft/day, and the median storage coefficient is 5.8×10^{-4}, indicative of a confined aquifer.

Recharge to the coal occurs principally by infiltration of precipitation in the clinker outcrop areas along the flank of the eastern Powder River structural basin. Secondary vertical recharge from the overburden also occurs, but is highly variable. Prior to mining, the direction of groundwater flow within the areally continuous coal aquifer was generally from recharge areas at the coal seam's outcrop westward into the PRB, following the dip of the coal. Groundwater conditions varied from unconfined to confined, depending on the coal elevation and proximity to the outcrop area. Water levels were generally above the top of the coal away from the outcrop.

Site-specific water-level data collected from coal monitoring wells by mining companies and the BLM in the general Wright analysis area and presented in the Gillette Area Groundwater Monitoring Organization (GAGMO) 25-year report (Hydro-Engineering 2007) indicate that the groundwater flow directions in the Wyodak coal have been greatly influenced by surface mine dewatering and groundwater discharge associated with CBNG development. Groundwater levels observed near active mining areas prior to 1997 were likely due to mine dewatering alone and the groundwater flow direction within the coal aquifer was typically toward the mine pits. By year 2000, groundwater level decline rates had dramatically increased because drawdown caused by widespread CBNG development west of the mines was overlapping with drawdown caused by mining operations. A continuous cone of depression currently exists around the Jacobs Ranch, Black Thunder, North Antelope Rochelle and Antelope mines due to their proximity to each other and the cumulative drawdown effects from pit dewatering and nearby CBNG discharges. The extent of drawdown west of the mines that is specifically attributable to mine dewatering can no longer be defined due to much greater and areally extensive drawdown caused by CBNG development. Roughly 30 years of surface mining and the more recent CBNG development have resulted in complete dewatering of the coal aquifer in localized areas, particularly near the mines' pits and where the coal seams are structurally highest.

Coal groundwater is typically only suitable for livestock and wildlife watering purposes because certain constituent concentrations commonly exceed many suitability criteria for domestic uses, and the water may have a high salinity and sodium hazard, which makes it unsuitable for agricultural uses. Within the general Wright analysis area, Wyodak coal groundwater quality is generally poor, but exhibits lower TDS concentrations than alluvial or overburden groundwater. The composition of groundwater in the coal is fairly uniform and there are no seasonal or long-term trends in composition. The composition of groundwater in the coal is generally characterized as a calcium/magnesium-sulfate type near the scoria outcrop recharge areas and transitions to a

sodium-bicarbonate type as the groundwater moves downgradient. A median TDS concentration of 952 mg/L was calculated by the WDEQ/LQD for the coal aquifer, based on 832 samples collected from the southern group of PRB mines, including North Antelope Rochelle (Ogle and Calle 2006).

3.5.1.1.4 Subcoal Fort Union Formation

The Fort Union Formation is divided into three members, which are, in descending order: the Tongue River Member, the Lebo Member, and the Tullock Member. The mineable coal seams occur within the Tongue River Member. The subcoal Fort Union Formation consists primarily of lithified sands and shales, and is divided into three hydrogeologic units: the upper Tongue River aquifer, the Lebo confining layer, and the Tullock aquifer (Law 1976). Of the three units, the Tullock is the most prolific in terms of groundwater yield.

Mining does not directly disturb the hydrogeologic units below the mineable coal, but many PRB mines use them for industrial water supply wells. In a few cases there have been drawdowns in the subcoal aquifer due to leakage into mine pits, dewatering, and CBNG development (BLM 2001). The upper Tongue River aquifer consists of lenticular, fine-grained sandstone interbedded with mudstone. The Lebo confining layer is typically more fine-grained than the other two members and generally retards the movement of water (Lewis and Hotchkiss 1981). The Lebo confining layer typically separates the Tongue River and Tullock aquifers hydraulically. The Tullock aquifer consists of discontinuous lenses of sandstone separated by interbedded shale and siltstone.

Transmissivity is equal to an aquifer's hydraulic conductivity, or permeability, times the aquifer's saturated thickness, and is commonly used when discussing the hydraulic properties of the subcoal Fort Union Formation where wells are completed by exposing many discrete sand lenses to the well bore. Transmissivities are generally higher in the deeper Tullock aquifer than in the shallower Tongue River aquifer, and many mines in the PRB have water-supply wells completed in this interval (Martin et al. 1988). The City of Gillette and the Town of Wright also utilize the Tullock aquifer to meet part of their municipal water requirements. The average transmissivity for the Tullock, as reported by OSM (1984), is 290 ft^2/day. The three applicant mines located within the general Wright analysis area use a total of 15 wells completed in the subcoal Fort Union Formation for water supply, and they range in depth from approximately 250 feet to 3,200 feet.

The water quality of the subcoal Fort Union Formation is generally good. TDS concentrations measured in various subcoal Fort Union Formation water supply wells in the eastern PRB range from 230 mg/L to 520 mg/L. Water from the subcoal Fort Union Formation is typically of the sodium-bicarbonate type. This water is generally suitable for livestock and wildlife watering and may be suitable for domestic use. Depending upon site-specific TDS

concentrations and SAR values, groundwater from Fort Union Formation supply wells may also be suitable for irrigation.

3.5.1.1.5 Lance Formation-Fox Hills Sandstone

Underlying the Fort Union Formation is the Lance Formation of Cretaceous age. The Lance Formation is comprised of an upper confining layer and a lower aquifer. Individual sandstone beds of the lower aquifer sequence are up to about 100 feet thick, are fine-grained, and contain variable amounts of interbedded clay and silt. The Fox Hills Sandstone underlies the Lance Formation and is usually difficult to distinguish from the Lance. The Fox Hills is described as well-developed, fine- to medium-grained, marine sandstone that contains thin beds of sandy shale and probably averages around 250 feet thick beneath the general Wright analysis area.

The lower Lance Formation and Fox Hills sandstone, which is called the Lance-Fox Hills aquifer in the eastern PRB, is used for an industrial water supply at the North Antelope Rochelle and Black Thunder mines. North Antelope Rochelle Mine's two Lance-Fox Hills wells are approximately 5,400 feet deep and Black Thunder Mine's well is 4,850 feet deep. The City of Gillette also utilizes the Lance-Fox Hills aquifer to meet part of its municipal water requirements, as do the Wyodak Power Plant and various other eastern PRB surface coal mines. The quality of groundwater from the Lance-Fox Hills aquifer is generally good enough to meet the standards for domestic use, depending upon the concentrations of TDS and various constituents such as fluoride. Sodium and bicarbonate are typically the predominant ionic constituents.

3.5.1.2 Environmental Consequences

3.5.1.2.1 Proposed Action and Alternatives 2 and 3

Surface coal mining impacts the quantity of the groundwater resource in two ways: 1) the coal aquifer and any water-bearing overburden strata on the mined land are removed and replaced with unconsolidated backfill, and 2) water levels in the coal and overburden aquifers adjacent to the mine pits are depressed as a result of seepage into and dewatering from the open excavations in the area of coal and overburden removal.

If the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts are leased under the Proposed Actions or Alternatives 2 or 3 and mined, the overall regional extent of coal removal and reclamation would increase, which would result in an increase in the area of impacts to groundwater quantity. As mining expands, additional water-bearing bedrock strata would be exposed and groundwater would drain by gravity into the active pits. The overburden and coal aquifers within the leased tracts would be completely dewatered and removed, and the area of drawdown caused by overburden and coal removal would be extended

further to the northwest, west and southwest of the active mine areas. While there would be variations in the affected aquifers' hydraulic properties, the duration of time that the pits are open, the distance from mining and dewatering that has occurred as a result of previous mining and CBNG development, the area subject to lower groundwater levels would be extended roughly in proportion to the increase in areas affected by mining. The extent that drawdown would propagate away from the mine pits is a function of the affected aquifer's hydraulic properties (i.e., hydraulic conductivity, storativity, and current saturated thickness). The amount and extent of additional drawdown may not be great however, as current drawdown associated with mining the existing leases combined with drawdown associated with CBNG development has nearly dewatered the coal aquifer within and immediately west of the general Wright analysis area.

Currently approved mining will continue to remove the overburden, interburden (where present), and coal on the existing leases at the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines and replace these separate units with backfill material composed of an unlayered mixture of the shale, siltstone, and sandstone that makes up the existing Wasatch Formation overburden and Fort Union Formation interburden (if present). The applicant mines' existing leases currently include approximately 48,442 acres. Mining each of the LBA tracts as maintenance leases would extend the area of overburden and coal removal by about 21,887 acres under the Proposed Actions up to about 36,264 acres under BLM's preferred tract configurations for Alternative 2.

The 25-year GAGMO Report (Hydro-Engineering 2007) presents drawdowns that have developed in the last 25 years as a result of coal mining activity or other stresses to the groundwater system. The 25-year drawdown map for the general Wright analysis area is included within the 25-year GAGMO Report, and it shows a continuous cone of depression exists around the Black Thunder, Jacobs Ranch, North Antelope Rochelle, and Antelope mines due to their proximity to each other and due to the large drawdowns caused to the west by CBNG development. Hydro-Engineering (2007) states that the extent of drawdown caused by mining alone to the west of the mines can no longer be defined due to the much larger drawdown caused by CBNG development. Drawdowns to the west of the Black Thunder, Jacobs Ranch, North Antelope Rochelle, and Antelope mines are very large, mainly due to the discharge of groundwater from the Wyodak coal aquifer that is associated with the production of CBNG. Greater drawdowns exist west of these mines than near their present western boundaries. The present drawdown of the Wyodak coal potentiometric surface has made the comparison between the 25-year drawdowns and the modeled groundwater drawdown predictions using the conservative, worst-case scenario for each mine to be unrealistic. Drawdowns in all areas have greatly increased in the last few years due to water production from the coal aquifer by CBNG production. Potential overlapping impacts of the existing mining activities with other proposed activities are addressed further in Chapter 4 of this EIS.

Due to the inconsistent lithologic makeup of the Wasatch Formation overburden (discontinuous sandstone and sand lenses in a matrix of siltstone and shale), drawdowns in the overburden are variable and do not extend great distances from the active mine pits. Due to the varied nature of the water-bearing units within the Wasatch Formation overburden, the extent of water level drawdowns are variable as well. Water level drawdowns propagate much farther and in a more consistent manner in the coal seam aquifers than in the overburden due to the regional continuity and higher transmissivity of the coal seam. Prior to CBNG development, drawdown in the coal aquifer was primarily a function of distance from the mine's open pit, although geologic and hydrologic barriers and boundaries such as crop lines, fracture zones, and recharge sources can also influence drawdowns. As discussed below, each mine evaluated groundwater level drawdowns resulting from their existing operations based on site-specific characteristics such as hydraulic conductivity, mining sequence, and local geology. Mines usually model groundwater level drawdown using the conservative, worst-case scenario. Therefore, it is unlikely that the actual drawdown will extend as far from the mine pits as predicted. It is also difficult to predict the time for groundwater recovery since each mine uses different predictive modeling techniques and assumptions, and reports different recovery time periods. In general, and excluding the dewatering and drawdown effects associated with CBNG development, drawdown in groundwater levels in both the coal and overburden that are associated with mining alone are greatest adjacent to the mine pits and decrease with distance from the pits (Ogle and Calle 2006).

The subcoal aquifers (i.e., Tullock Member of the Fort Union Formation and Lance-Fox Hills aquifer) are not removed or disturbed by mining, so they are not directly impacted by coal mining activity. All three of the applicant mines located within the general Wright analysis area utilize water supply wells completed in aquifers stratigraphically below the Wyodak coal. If these six LBA tracts are leased and mined by the applicants, water would be produced from these wells for a longer period of time but the mines do not anticipate requiring additional sub-coal wells for industrial water supply to continue mining and reclaiming, including the LBA tracts.

As noted above, the existing layers of sediment and rock in the area of coal removal would be replaced by generally homogeneous, unconsolidated backfill material, which would recover as a single hydrostratigraphic unit. The backfill unit created in the LBA tract areas would be in hydraulic communication with the undisturbed coal, overburden, and the existing backfill aquifer units. Mining would not disturb premining recharge areas. Surface infiltration recharge rates for the backfill materials should be equivalent to or somewhat greater than infiltration recharge through undisturbed overburden, due primarily to the swelling of the mined strata attendant with excavating the strata, and due to generally flatter postmining topography resulting in less surface runoff. Water levels in the affected aquifers would remain depressed below premining levels for a long period of time, since groundwater discharge rates from the affected aquifers into the proposed mine pits are expected to be

low. Groundwater would accumulate in the backfill and eventually discharge to hydrostratigraphic units contiguous to the backfilled pit, at which time, groundwater levels and flow patterns are expected to be similar to premining condition. Groundwater flow through the backfill and undisturbed bedrock near the pits would be interrupted until saturation levels in the backfilled pits have increased, and the rates of recharge to and discharge from the backfill have equilibrated. Postmining groundwater levels should approach steady state conditions some time after mine reclamation and impacts from CBNG development in the cumulative impact areas are completed. The rate at which the mine backfill resaturates and the postmining potentiometric surface reaches equilibrium is dependent upon the hydraulic conductivity of the backfill and on sources of recharge water.

The hydraulic properties of the backfill aquifer based on the results of aquifer testing at mines in the PRB are quite variable, although generally equal to or greater than the undisturbed overburden and coal aquifers (Van Voast et al. 1978 and Rahn 1976). It is early in the process of full reclamation and to date, not all of the backfilled materials have reached an adequate saturated thickness to be aquifer tested at the three applicant mines in the general Wright analysis area. The composition of the backfilled overburden materials at these three adjacent mines is quite similar; therefore, the hydraulic characteristics of the backfill at these three mines are also expected to be similar. Hydraulic conductivity values measured in existing monitoring wells completed in the saturated backfill at the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines range from 0.12 ft/day to 90.0 ft/day (TBCC 2005, JRC 2004, PRC 2004, and Ogle and Calle 2006), which is comparable to the reported hydraulic conductivity values determined for the Wasatch overburden and Wyodak coal seam. These data therefore provide an indication that the backfill would readily resaturate as postmining potentiometric elevations recover in the surrounding undisturbed aquifers, and that wells completed in the backfill (including in these six LBA tracts) would be capable of supplying sufficient yields to wells constructed for livestock watering uses.

Mining and reclamation also impacts groundwater quality; the TDS concentration in the water resaturating the backfill is generally higher than the TDS concentration in groundwater from the overburden and coal seam aquifers prior to mining. This is due to the increased porosity and exposure of fresh mineral surfaces to groundwater that moves through the backfill and increased oxidation. Scientific tests in the laboratory and in the field show the predominant cause for high dissolved-solids contents in mine backfill is the availability of highly soluble salts in the overburden sediments. The soluble salts that are exposed to groundwater are readily mobilized; therefore, groundwater quality in recently backfilled mine pits is highly diverse due to the variable distribution of soluble salts and the variable permeability of the backfill. As the backfill is resaturated and groundwater flow patterns are reestablished, the soluble salts are leached by groundwater inflow. Groundwater quality in the backfill then depends on a balance between the introduction of new salts by groundwater that recharges the backfill and the

flushing of the newly exposed soluble salts by groundwater flow. Studies of backfill groundwater quality are not yet conclusive due to a relatively short period of monitoring available in the PRB. A general observation is that the content of TDS, calcium, magnesium, and sodium sulfates, when compared to the undisturbed aquifers, is roughly two to three times as high at present. However, these elevated levels should decline as flushing and leaching of soluble salts reaches equilibrium. Even at a two to three fold increase in TDS concentration, the water in the backfill will, in most cases, be suitable for its predominant premining use, stock watering (Straskraba 1986).

Using data compiled from 10 surface coal mines in the eastern PRB, Martin et al. (1988) concluded that backfill groundwater quality improves markedly after the backfill is leached with one pore volume of water. Van Voast and Reiten (1988) reached the same conclusions after analyzing data from the Decker and Colstrip mines located in the northern PRB. Their research indicates that upon initial saturation, mine backfill is generally high in TDS concentration and contains soluble salts of calcium, magnesium and sodium sulfates. TDS concentrations tend to decrease with time, indicating that the long-term groundwater quality in mined and off-site lands would return to approximate pre-mine conditions (Van Voast and Reiten 1988). Clark (1995) conducted a study to determine if the decreases predicted by laboratory studies actually occurred onsite. In the area of the West Decker Mine near Decker, Montana, Clark's study found that dissolved solids concentrations increased when water from an upgradient coal aquifer flowed into a backfill aquifer, and apparently decreased along an inferred flow path from a backfill aquifer to a downgradient coal aquifer. WDEQ/LQD calculated a median TDS concentration of 3,670 mg/L based on 869 samples collected from monitoring wells with at least 15 years of data that are completed in the backfill at the three applicant mines included in this analysis, and concluded that the recovered concentrations will be suitable for post-mining land use (Ogle and Calle 2006).

Changes to the premining hydraulic characteristics of the alluvial aquifer and the quality of alluvial groundwater are expected to be minor after final reclamation, because the applicant mines would be required to maintain the essential hydrologic functions of the alluvial valley floors (AVFs) declared in the general Wright analysis area and their alluvial aquifer systems (as is currently required for the already-approved mining operations). See additional discussion in Sections 3.5.1.3 and 3.6.

Direct and indirect impacts to the groundwater system resulting from mining the LBA tracts included in this analysis would add to the cumulative impacts that will occur due to mining existing leases. As discussed above, there have been drawdowns in the coal and overlying aquifers as a result of this existing approved mining and the existing CBNG development in the vicinity of the LBA tracts. The probable groundwater impacts from the leasing and subsequent mining of each of the LBA tracts under the Proposed Actions or Alternatives 2 and 3 are described in the following paragraphs. Some or all of the impacts to the groundwater levels in the coal aquifer described below may occur prior to

the mining of the LBA tracts, if they are leased, as a result of currently approved surface coal mining adjacent to the LBA tracts and development of CBNG resources on and adjacent to the LBA tracts.

3.5.1.2.1.1 North, South, and West Hilight Field LBA Tracts

The existing leases at the Black Thunder Mine currently include approximately 20,656 acres. Mining the North Hilight Field LBA Tract as a maintenance lease would extend the area of overburden and coal removal by about 2,613.5 acres under the Proposed Action up to about 7,139.4 acres under Alternative 2, BLM's preferred tract configuration. Mining the South Hilight Field LBA Tract as a maintenance lease would extend the area of overburden and coal removal by about 1,976.7 acres under the Proposed Action up to about 2,922.4 acres under Alternative 2, BLM's preferred tract configuration. Mining the West Hilight Field LBA Tract as a maintenance lease would extend the area of overburden and coal removal by about 2,370.5 acres under the Proposed Action up to about 7,191.3 acres under Alternative 2, BLM's preferred tract configuration.

Mining has affected alluvial groundwater level elevations only where the alluvial aquifer has been mined out. If the North, South, and West Hilight Field tracts were leased, mining would dewater (if saturated) and physically remove the shallow alluvial materials within the tracts. Black Thunder Mine is required to maintain the essential hydrologic functions of affected alluvial aquifer systems. Unless it is determined that the recent alluvial deposits provide essential hydrologic functions, it is unlikely that WDEQ/LQD would require BTCC to selectively remove and replace the alluvial deposits within these three tracts. Should WDEQ/LQD require alluvial aquifer reclamation, changes to the premining hydraulic characteristics of the aquifer and the quality of the alluvial groundwater are expected to be minor after final reclamation. See additional discussions in Sections 3.5.1.3 and 3.6.

Overburden thickness in the North Hilight Field LBA Tract averages around 246 feet and the interburden thickness averages about 1 foot. Overburden thickness in the South Hilight Field LBA Tract averages around 292 feet and the interburden thickness averages about 94 feet. Overburden thickness in the West Hilight Field LBA Tract averages around 428 feet and the interburden thickness averages about 32 feet. Most of these materials are composed of massive silty and clayey shales of very low permeability, and the interbedded sandstone units are typically thin and discontinuous. Discontinuous, lenticular-shaped sand bodies also occur locally in the general Wright analysis area. Some of these isolated sandstone units and sand bodies in the overburden are saturated, but groundwater yields from them are generally low. Due to the discontinuous nature of the permeable overburden sediments, premining overburden groundwater movement generally followed the topography, and before mining, overburden groundwater flow in the vicinity of the Black Thunder Mine was generally toward, and discharged to Little Thunder and North Prong Little Thunder Creek valleys. Groundwater flow has

since been affected by the removal of overburden by mining in the area. Monitor well data indicate that overburden groundwater, where present, in the general Wright analysis area now flows toward the Black Thunder Mine and neighboring mines' open pits. Mining has and will continue to depress water levels in the overburden, although the historical monitoring data do not indicate a direct correlation between water level drawdown in the overburden to distance and direction from the open pits. In general, overburden groundwater levels will begin to show steady decline in areas that are within about one-half mile of the mine pits as mining progresses. Future drawdown in the overburden is expected to be similar to that measured to date, and would be expected to continue to have a limited impact outside of the mined area.

Water level drawdowns have propagated much farther and in a more consistent manner in the Wyodak coal seam aquifer than in the overburden. Groundwater level monitoring data collected by the Black Thunder Mine and the other mines located in the general Wright analysis area and presented in the GAGMO 25-year report (Hydro-Engineering 2007) indicate that the groundwater flow directions in the Wyodak coal have been greatly influenced by surface mine dewatering and groundwater discharge associated with CBNG development. Groundwater levels observed near active mining areas prior to 1997 were likely due to mine dewatering alone and the groundwater flow direction within the coal aquifer was typically toward the mine where it would drain by gravity into the open pits. By year 2000, groundwater level decline rates had dramatically increased because drawdown caused by widespread CBNG development west of the mines was overlapping with drawdown caused by mining operations. A continuous cone of depression currently exists around the Black Thunder, Jacobs Ranch, North Antelope Rochelle, and Antelope mines due to their proximity to each other and the cumulative drawdown effects from pit dewatering and nearby CBNG discharges.

The extent of drawdown west of the mines that is specifically attributable to mine dewatering can no longer be defined due to much greater and regionally extensive drawdown caused by CBNG development. Wyodak coal groundwater level data for year 2005, presented in the 25-year GAGMO report, illustrate that approximately 160 feet of drawdown has occurred near the western edge of the North Hilight Field LBA Tract, and approximately 40 feet of drawdown has occurred near the tract's eastern edge. The 2005 data show that approximately 210 feet of drawdown has occurred near the western edge of the South Hilight Field LBA Tract, and approximately 180 feet of drawdown has occurred near the tract's eastern edge. The 2005 data show that approximately 350 feet of drawdown has occurred near the western edge of the West Hilight Field LBA Tract as applied for, and approximately 220 feet of drawdown has occurred near the tract's eastern edge. The 2005 coal seam water level contours in the area of the Black Thunder, Jacobs Ranch, North Antelope Rochelle, and Antelope mines depict the groundwater flow direction to be entirely to the west, away from the open pits (Hydro-Engineering 2007). Roughly 30 years of surface mining and CBNG development has resulted in

nearly complete dewatering of the coal seams in localized areas, particularly near the mines' pits and where the coal seams are structurally highest.

In 2006, the extent of water level drawdown in the coal aquifer attributable to mining the existing leases at the Black Thunder Mine was estimated using the analytical line slot (or sink) method. The results of the line sink analysis are reported in Addendum MP-3.3.5 of the WDEQ/LQD Black Thunder Mine Permit 233-T7 (TBCC 2005). For the purpose of this analysis, the extent of coal-mining related drawdown (5-foot contour) in the Wyodak seam over the life of the Black Thunder Mine if the North, South, and West Hilight Field LBA Tracts are mined was extrapolated by extending TBCC's predicted life of mine, line sink drawdown contour to the north, south and west by the dimensions of the North, South, and West Hilight Field LBA Tracts, each configured under BLM's preferred tract configuration (Figure 3-23). The area subject to lower water levels would increase roughly in proportion to the increase in area mined. This extrapolation serves as a general approximation of the potential impacts, based on experience, but it does not take variations in hydrologic properties, the time the pits are open, and the distance from previous mining and CBNG development into account.

The rate and extent of the actual drawdown in the coal is currently much greater than the predicted life-of-mine drawdown. This has occurred as drawdown caused by extensive CBNG development west of the current Black Thunder Mine permit area has overlapped with drawdown caused by mining operations. Continued drawdown effects from CBNG withdrawals will be likely; therefore, future drawdown to the Wyodak coal aquifer from mining the approved leases and the North, South and West Hilight Field LBA Tracts would be expected to be negligible due to the fact that the coal seam has essentially been dewatered in the general Wright analysis area. Groundwater elevation data collected by the Black Thunder Mine since 1973 have formed the basis for quantifying groundwater level drawdowns since mining began and provide a reasonable and reliable means to predict trends in groundwater elevations associated with dewatering due to future mining. These data will continue to be recorded according to the mine's WDEQ-approved groundwater monitoring program and included in the annual progress report that the Black Thunder Mine submits to the WDEQ/LQD, as well as the GAGMO Annual Reports. If TBCC acquires the North, South and West Hilight Field LBA Tracts, WDEQ/LQD would require that future drawdown impacts due to mining alone be predicted in order to amend the tracts into the Black Thunder Mine permit area (Section 3.5.1.3).

The subcoal aquifers (i.e., Tullock Member of the Fort Union Formation and Lance-Fox Hills aquifer) are not removed or disturbed by mining, so they are not directly impacted by coal mining activity. Figure 3-20 depicts the locations of Black Thunder Mine's five water supply wells, all of which are completed in aquifers below the Wyodak coal. If the applicant leases the North, South and West Hilight Field LBA Tracts, water would be produced from these wells for a

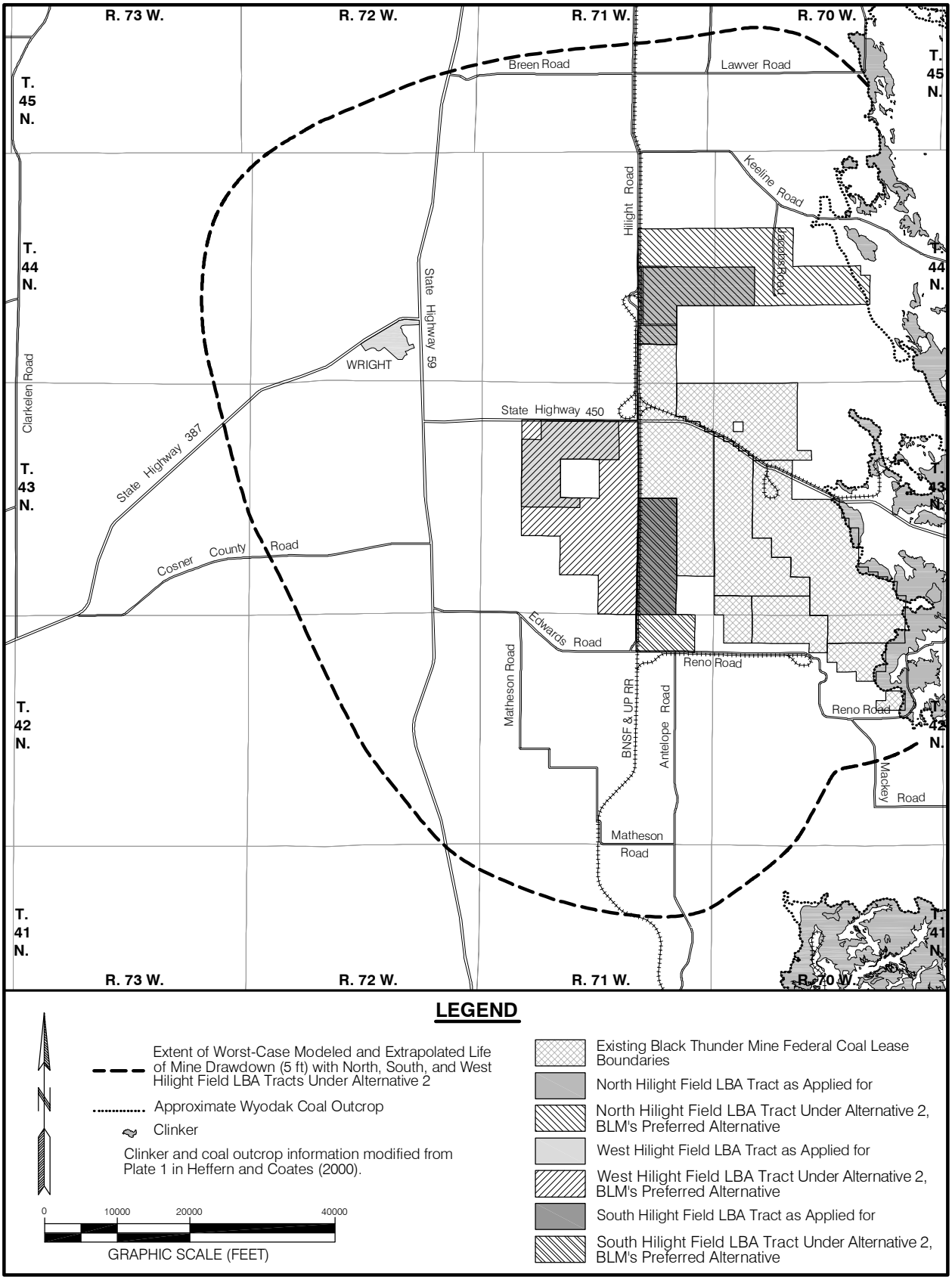


Figure 3-23. Black Thunder Mine Life of Mine Drawdown, Resulting from Currently Approved Mining with the Addition of the North, South, and West Hilight Field LBA Tracts.

longer period of time, but TBCC does not anticipate requiring additional sub-coal wells to mine the LBA tracts.

To date, 17 wells have been installed to monitor water levels and water quality in the backfill at Black Thunder Mine. Six of these wells were constructed between 1987 and 1991, eight wells were constructed in 1994, one was installed in 1995, and the remaining two were installed in 2008. Eight of these backfill wells were included in the mine's current (2008) groundwater monitoring network, which is depicted in Figure 3-20. The groundwater level hydrographs recorded by these wells over the period of record indicate that the level of saturation in the backfill has fluctuated considerably and is largely dependant upon the well's location with respect to the thickness of backfill, the physical characteristics of the backfill materials, and the source of groundwater recharge. At the present time, groundwater levels have increased by 1 to 23 feet at four well locations, remained stable at two locations, and declined 4 to 5 feet at the remaining well locations (Hydro-Engineering 2007).

Aquifer tests performed to date on backfill well BTB-1 (Figure 3-20) at the Black Thunder Mine indicate the hydraulic conductivity ranges from 0.12-ft/day to 0.86-ft/day. The values of hydraulic conductivity for well BTB-1 appear to be reasonable for a recently dumped backfill. The reported values should be considered the highest that will exist in the backfill at the well location. The hydraulic conductivity values will decrease as the backfill undergoes further compaction and densification. It is estimated that after saturation and re-densification, the final hydraulic conductivity of the backfill will be in the range of 0.00003 ft/day to 0.003 ft/day (TBCC 2005). These data therefore provide an indication that the backfill will readily resaturate as postmining potentiometric elevations recover in the surrounding undisturbed aquifers (including the North, South and West Hilight Field LBA Tracts). The exact configuration and hydraulic gradient of the postmining potentiometric surface may vary from premine conditions; however, postmining equilibrium groundwater movement should exhibit a hydraulic gradient similar to that which existed prior to mining (TBCC 2005).

TDS concentrations observed in the Black Thunder Mine backfill monitoring wells to date are similar to those found in the undisturbed alluvial and overburden aquifers, but greater than those found in the Wyodak coal aquifer. Postmining groundwater quality is expected to improve after one pore volume of water moves through the backfill. In general, the mine's backfill groundwater quality can be expected to be similar to the premining overburden aquifer and meet Wyoming Class III standards (livestock and wildlife use); however, there could be localized areas in the backfill that yield groundwater that does not meet Wyoming Class III standards. Groundwater quality within the backfill at the North, South and West Hilight Field LBA Tracts would be expected to be similar to groundwater quality measured in existing wells completed in the Black Thunder Mine backfill.

3.5.1.2.1.2 West Jacobs Ranch LBA Tract

The existing leases at the Jacobs Ranch Mine currently include approximately 9,720 acres. Mining the West Jacobs Ranch LBA Tract as a maintenance lease would extend the area of overburden and coal removal by about 5,944.4 acres under the Proposed Action up to about 8,076.2 acres under Alternative 2, BLM preferred tract configuration.

Mining has affected alluvial groundwater level elevations only where the alluvial aquifer has been mined out. If the West Jacobs Ranch LBA Tract were leased, mining would dewater (if saturated) and physically remove the shallow alluvial materials within the tract. Jacobs Ranch Mine is required to maintain the essential hydrologic functions of affected alluvial aquifer systems. Unless it is determined that the recent alluvial deposits provide essential hydrologic functions, it is unlikely that WDEQ/LQD would require JRCC to selectively remove and replace the alluvial deposits within this tract. Should WDEQ/LQD require alluvial aquifer reclamation, changes to the premining hydraulic characteristics of the aquifer and the quality of the alluvial groundwater are expected to be minor after final reclamation. See additional discussions in Sections 3.5.1.3 and 3.6.

Overburden thickness in the West Jacobs Ranch LBA Tract averages around 475 feet and there is no interburden present. Most of the overburden is composed of massive silty and clayey shales of very low permeability, and the interbedded sandstone units are typically thin and discontinuous. Discontinuous, lenticular-shaped sand bodies also occur locally in the general Wright analysis area. Some of these isolated sandstone units and sand bodies in the overburden are saturated, but groundwater yields from them are generally low. Due to the discontinuous nature of the permeable overburden sediments, premining overburden groundwater movement generally followed the topography, and before mining, overburden groundwater flow in the vicinity of the Jacobs Ranch Mine was generally toward, and discharged to North Prong Little Thunder Creek. Groundwater flow has since been affected by the removal of overburden by mining in the area. Monitor well data indicate that overburden groundwater, where present, in the general Wright analysis area now flows toward the Jacobs Ranch Mine and neighboring mines' open pits. Mining has and will continue to depress water levels in the overburden, although the historical monitoring data do not indicate a direct correlation between water level drawdown in the overburden to distance and direction from the open pits. In general, overburden groundwater levels will begin to show steady decline in areas that are within about one-half mile of the mine pits as mining progresses. Future drawdown in the overburden is expected to be similar to that measured to date, and would be expected to continue to have a limited impact outside of the mined area.

Water level drawdowns have propagated much farther and in a more consistent manner in the Wyodak coal seam aquifer than in the overburden. Groundwater level monitoring data collected by the Jacobs Ranch Mine and the

other mines located in the general Wright analysis area and presented in the GAGMO 25-year report (Hydro-Engineering 2007) indicate that the groundwater flow directions in the Wyodak coal have been greatly influenced by surface mine dewatering and groundwater discharge associated with CBNG development. Groundwater levels observed near active mining areas prior to 1997 were likely due to mine dewatering alone and the groundwater flow direction within the coal aquifer was typically toward the mine where it would drain by gravity into the open pits. By year 2000, groundwater level decline rates had dramatically increased because drawdown caused by widespread CBNG development west of the mines was overlapping with drawdown caused by mining operations. A continuous cone of depression currently exists around the Black Thunder, Jacobs Ranch, North Antelope Rochelle, and Antelope mines due to their closeness to each other and the cumulative drawdown effects from pit dewatering and nearby CBNG discharges.

The extent of drawdown west of the mines that is specifically attributable to mine dewatering can no longer be defined due to much greater and areally extensive drawdown caused by CBNG development. Wyodak coal groundwater level data for year 2005, presented in the 25-year GAGMO report, illustrate that approximately 350 feet of drawdown has occurred near the western edge of the West Jacobs Ranch LBA Tract, and approximately 220 feet of drawdown has occurred near the tract's eastern edge. The 2005 coal seam water level contours in the area of the Black Thunder, Jacobs Ranch, North Antelope Rochelle, and Antelope mines depict the groundwater flow direction to be entirely to the west, away from the open pits (Hydro-Engineering 2007). Roughly 30 years of surface mining and CBNG development has resulted in nearly complete dewatering of the coal seams in localized areas, particularly near the mines' pits and where the coal seams are structurally highest.

In 2003, the extent of water level drawdown in the coal aquifer attributable to mining the existing leases at the Jacobs Ranch Mine was estimated using the analytical line slot (or sink) method. The results of the line sink analysis are reported in Addendum MP-E of the WDEQ/LQD Jacobs Ranch Mine Permit 271-T5 (JRCC 2004). For the purpose of this analysis, the extent of coal-mining related drawdown (5-foot contour) in the Wyodak seam over the life of the Jacobs Ranch Mine if the West Jacobs Ranch LBA Tract is mined was extrapolated by extending JRCC's predicted life of mine, line sink drawdown contour to the north, south, and west by the dimensions of the West Jacobs Ranch LBA Tract under Alternative 2, BLM preferred tract configuration (Figure 3-24). The area subject to lower water levels would increase roughly in proportion to the increase in area mined. This extrapolation serves as a general approximation of the potential impacts, based on experience, but it does not take variations in hydrologic properties, the time the pits are open, and the distance from previous mining and CBNG development into account.

The rate and extent of the actual drawdown in the coal is currently much greater than the predicted life-of-mine drawdown. This has occurred as drawdown caused by extensive CBNG development west of the current Jacobs

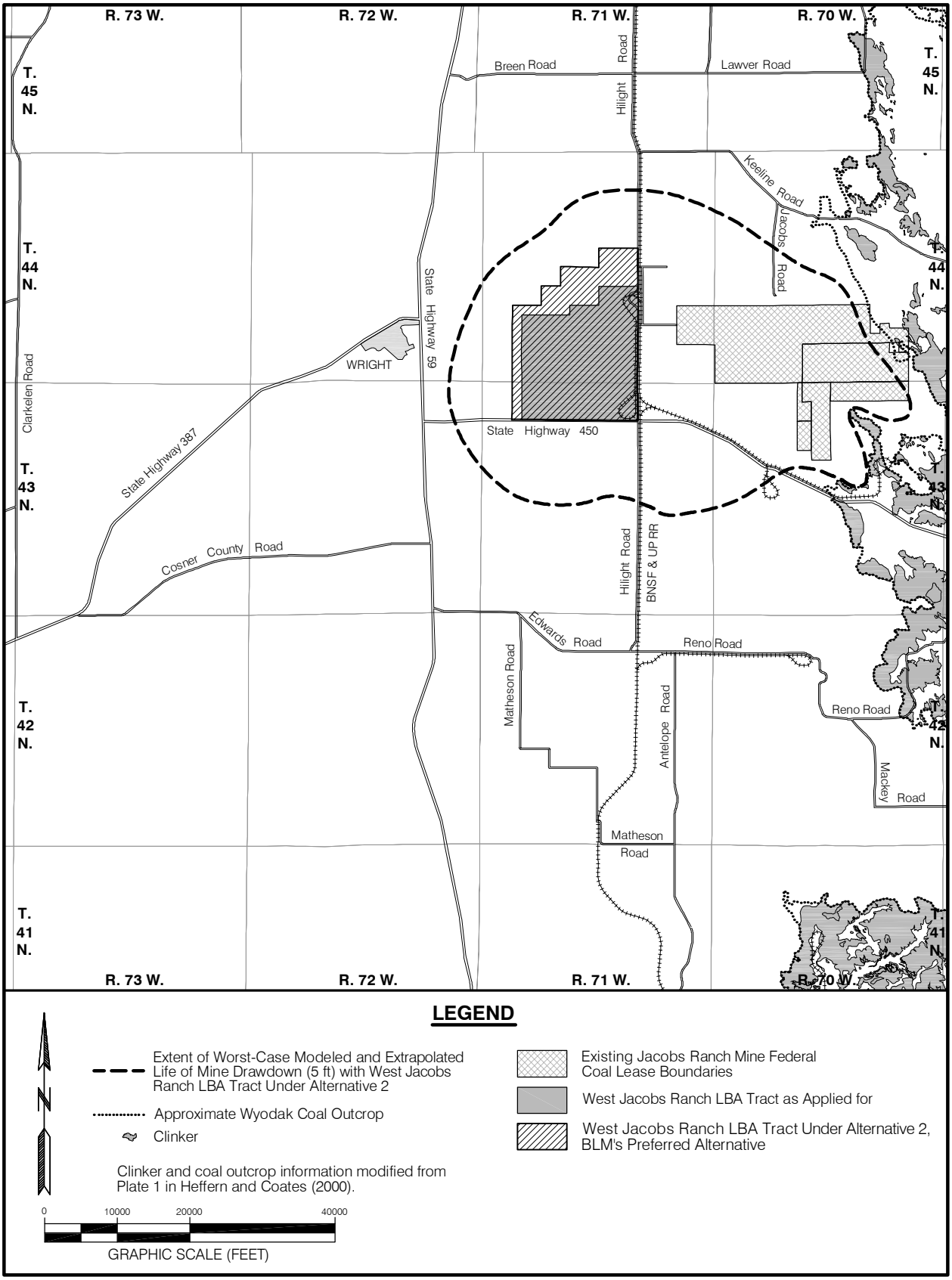


Figure 3-24. Jacobs Ranch Mine Life of Mine Drawdown, Resulting from Currently Approved Mining with the Addition of the West Jacobs Ranch LBA Tract.

Ranch Mine permit area has overlapped with drawdown caused by mining operations. Continued drawdown effects from CBNG withdrawals will be likely; therefore, future drawdown to the Wyodak coal aquifer from mining the approved leases and the West Jacobs Ranch LBA Tract would be expected to be negligible due to the fact that the coal seam has essentially been dewatered in the general Wright analysis area. Groundwater elevation data collected by the Jacobs Ranch Mine since 1980 have formed the basis for quantifying groundwater level drawdowns since mining began and provide a reasonable and reliable means to predict trends in groundwater elevations associated with dewatering due to future mining. These data will continue to be recorded according to the mine's WDEQ-approved groundwater monitoring program and included in the annual progress report that the Jacobs Ranch Mine submits to the WDEQ/LQD, as well as the GAGMO Annual Reports. If JRCC acquires the West Jacobs Ranch LBA Tract, WDEQ/LQD would require that future drawdown impacts due to mining alone be predicted in order to amend the tract into the Jacobs Ranch Mine permit area (Section 3.5.1.3).

The subcoal aquifers (i.e., Tullock Member of the Fort Union Formation and Lance-Fox Hills aquifer) are not removed or disturbed by mining, so they are not directly impacted by coal mining activity. Figure 3-21 depicts the locations of Jacobs Ranch Mine's five water supply wells, all of which are completed in aquifers below the Wyodak coal. If the applicant leases the West Jacobs Ranch LBA Tract, water would be produced from these wells for a longer period of time, but JRCC does not anticipate requiring additional sub-coal wells to mine the LBA tract.

To date, five wells have been installed to monitor water levels and water quality in the backfill at Jacobs Ranch Mine. Two of these wells were constructed in 1981 and 1984, one well was constructed in 1994, and the remaining two wells were constructed in 2001. All of these backfill wells were included in the mine's current (2008) groundwater monitoring network, which is depicted in Figure 3-21. The groundwater level hydrographs recorded by these wells over the period of record indicate that the level of saturation in the backfill has either increased steadily or has remained unchanged. Jacobs Ranch Mine's backfill monitoring wells are located near the eastern extent of mining, and the relatively rapid groundwater level recovery suggests that the backfill is receiving recharge from the undisturbed scoria areas located adjacent to the eastern and southern edges of the mine (JRCC 2008).

To date, no aquifer tests have been conducted on the backfill monitoring wells at the Jacobs Ranch Mine. Therefore, no site-specific data are available for the hydraulic properties of the applicant mine's backfill. The composition of backfill materials at the adjacent Black Thunder Mine is quite similar to that of the Jacobs Ranch Mine, and the hydraulic properties of the backfill at both mines, as well as the West Jacobs Ranch LBA Tract, are also expected to be quite similar. Refer to Section 3.5.1.2.1.1 for a discussion on the hydraulic conductivity of the backfill measured at Black Thunder Mine. These data provide an indication that the Jacobs Ranch Mine backfill will readily

resaturate as postmining potentiometric elevations recover in the surrounding undisturbed aquifers, and that wells completed in the backfill (including in the West Jacobs Ranch LBA Tract) would be capable of supplying sufficient yields to wells constructed for livestock watering uses.

TDS concentrations observed in the Jacobs Ranch Mine backfill monitoring wells to date are similar to those found in the undisturbed alluvial and overburden aquifers, but greater than those found in the Wyodak coal aquifer. The TDS concentrations in all of the mine's backfill wells have steadily increased from the first samples taken, likely due to an increase in water levels toward equilibrium conditions and a corresponding increased contact with the recently backfilled overburden materials (JRCC 2008). Postmining groundwater quality is expected to improve after one pore volume of water moves through the backfill. In general, the mine's backfill groundwater quality can be expected to be similar to the premining overburden aquifer and meet Wyoming Class III standards (livestock and wildlife use); however, there could be localized areas in the backfill that yield groundwater that does not meet Wyoming Class III standards. Groundwater quality within the backfill at the West Jacobs Ranch LBA Tract would be expected to be similar to groundwater quality measured in existing wells completed in the Jacobs Ranch Mine backfill.

3.5.1.2.1.3 North and South Porcupine LBA Tracts

The existing leases at the North Antelope Rochelle Mine currently include approximately 18,066 acres. Mining the North Porcupine LBA Tract as a maintenance lease would extend the area of overburden and coal removal by about 5,795.8 acres under the Proposed Action up to about 7,366.8 acres under Alternative 2, BLM's preferred tract configuration. Mining the South Porcupine LBA Tract as a maintenance lease would extend the area of overburden and coal removal by about 3,186.0 acres under the Proposed Action up to about 3,568.0 acres under Alternative 2, BLM's preferred tract configuration.

Mining has affected alluvial groundwater level elevations only where the alluvial aquifer has been mined out. If the North Porcupine tract were leased, mining would dewater (if saturated) and physically remove the generally thin, fine-grained shallow alluvial materials within the tract. No alluvial deposits occur within the South Porcupine tract. North Antelope Rochelle Mine is required to maintain the essential hydrologic functions of affected alluvial aquifer systems. Unless it is determined that the recent alluvial deposits present within the North Porcupine tract provide essential hydrologic functions, it is unlikely that WDEQ/LQD would require PRC to selectively remove and replace those alluvial deposits. Should WDEQ/LQD require alluvial aquifer reclamation, changes to the premining hydraulic characteristics of the alluvial materials and the quality of the alluvial groundwater are expected to be minor after final reclamation. See additional discussions in Sections 3.5.1.3 and 3.6.

Overburden thickness in the North Porcupine LBA Tract averages around 343 feet and there is no interburden present. Overburden thickness in the South Porcupine LBA Tract averages around 346 feet and the interburden thickness averages about 11 feet. Most of these materials are composed of massive silty and clayey shales of very low permeability, and the interbedded sandstone units are typically thin and discontinuous. Discontinuous, lenticular-shaped sand bodies also occur locally in the general Wright analysis area. Some of these isolated sandstone units and sand bodies in the overburden are saturated, but groundwater yields from them are generally low. Due to the discontinuous nature of the permeable overburden sediments, premining overburden groundwater movement generally followed the topography, and before mining, overburden groundwater flow in the vicinity of the North Antelope Rochelle Mine was generally toward, and discharged to Porcupine Creek valley. Groundwater flow has since been affected by the removal of overburden by mining in the area. Monitor well data indicate that overburden groundwater, where present, in the general Wright analysis area now flows toward the North Antelope Rochelle Mine and neighboring mines' open pits. Mining has and will continue to depress water levels in the overburden, although the historical monitoring data do not indicate a direct correlation between water level drawdown in the overburden to distance and direction from the open pits. In general, overburden groundwater levels will begin to show steady decline in areas that are within about one-half mile of the mine pits as mining progresses. Future drawdown in the overburden is expected to be similar to that measured to date, and would be expected to continue to have a limited impact outside of the mined area.

Water level drawdowns have propagated much farther and in a more consistent manner in the Wyodak coal seam aquifer than in the overburden. Groundwater level monitoring data collected by the North Antelope Rochelle Mine and other mines located in the general Wright analysis area and presented in the GAGMO 25-year report (Hydro-Engineering 2007) indicate that the groundwater flow directions in the Wyodak-Anderson coal have been greatly influenced by surface mine dewatering and groundwater discharge associated with CBNG development. Groundwater levels observed near active mining areas prior to 1997 were likely due to mine dewatering alone and the groundwater flow direction within the coal aquifer was typically toward the mine where it would drain by gravity into the open pits. By year 2000, groundwater level decline rates had dramatically increased because drawdown caused by widespread CBNG development west of the mines was overlapping with drawdown caused by mining operations. A continuous cone of depression currently exists around the Black Thunder, Jacobs Ranch, North Antelope Rochelle, and Antelope mines due to their closeness to each other and the cumulative drawdown effects from pit dewatering and nearby CBNG discharges.

The extent of drawdown west of the mines that is specifically attributable to mine dewatering can no longer be defined due to much greater and areally extensive drawdown caused by CBNG development. Wyodak-Anderson coal

groundwater level data for year 2005, presented in the 25-year GAGMO report, illustrate that approximately 240 feet of drawdown has occurred near the western edge of the North Porcupine LBA Tract, and approximately 5 feet of drawdown has occurred near the tract's eastern edge. The 2005 data show that approximately 100 feet of drawdown has occurred near the western edge of the South Porcupine LBA Tract, and approximately 160 feet of drawdown has occurred near the tract's eastern edge. The 2005 coal seam water level contours in the area of the Black Thunder, Jacobs Ranch, North Antelope Rochelle, and Antelope mines depict the groundwater flow direction to be entirely to the west, away from the open pits (Hydro-Engineering 2007). Roughly 30 years of surface mining and CBNG development has resulted in nearly complete dewatering of the coal seams in localized areas, particularly near the mines' pits and where the coal seams are structurally highest.

In 2006, the extent of water level drawdown in the coal aquifer attributable to mining the existing leases at the North Antelope Rochelle Mine was estimated using the analytical line slot (or sink) method. The results of the line sink analysis are reported in Addendum D6-G2 of the WDEQ/LQD North Antelope Rochelle Mine Permit 569-T6 (PRC 2004). For the purpose of this analysis, the extent of coal-mining related drawdown (5-foot contour) in the Wyodak-Anderson seam over the life of the North Antelope Rochelle Mine if the North and South Porcupine LBA Tracts are mined was extrapolated by extending PRC's predicted life of mine, line sink drawdown contour to the north, south, and west by the dimensions of the North and South Porcupine LBA Tracts under Alternative 2, BLM's preferred tract configuration (Figure 3-25). The area subject to lower water levels would increase roughly in proportion to the increase in area mined. This extrapolation serves as a general approximation of the potential impacts, based on experience, but it does not take variations in hydrologic properties, the time the pits are open, and the distance from previous mining and CBNG development into account.

The rate and extent of the actual drawdown in the coal is currently much greater than the predicted life-of-mine drawdown. This has occurred as drawdown caused by extensive CBNG development west of the North Antelope Rochelle Mine permit area has overlapped with drawdown caused by mining operations. Continued drawdown effects from CBNG withdrawals will be likely; therefore, future drawdown to the Wyodak-Anderson coal aquifer from mining the approved leases and the North and South Porcupine tracts would be expected to be negligible due to the fact that the coal seam has essentially been dewatered in the general Wright analysis area. Groundwater elevation data collected by the North Antelope Rochelle Mine since 1973 have formed the basis for quantifying groundwater level drawdowns since mining began and provide a reasonable and reliable means to predict trends in groundwater elevations associated with dewatering due to future mining. These data will continue to be recorded according to the mine's WDEQ-approved groundwater monitoring program and included in the annual progress report that the North Antelope Rochelle Mine submits to the WDEQ/LQD, as well as the GAGMO Annual Reports. If PRC acquires the North and South Porcupine LBA Tracts,

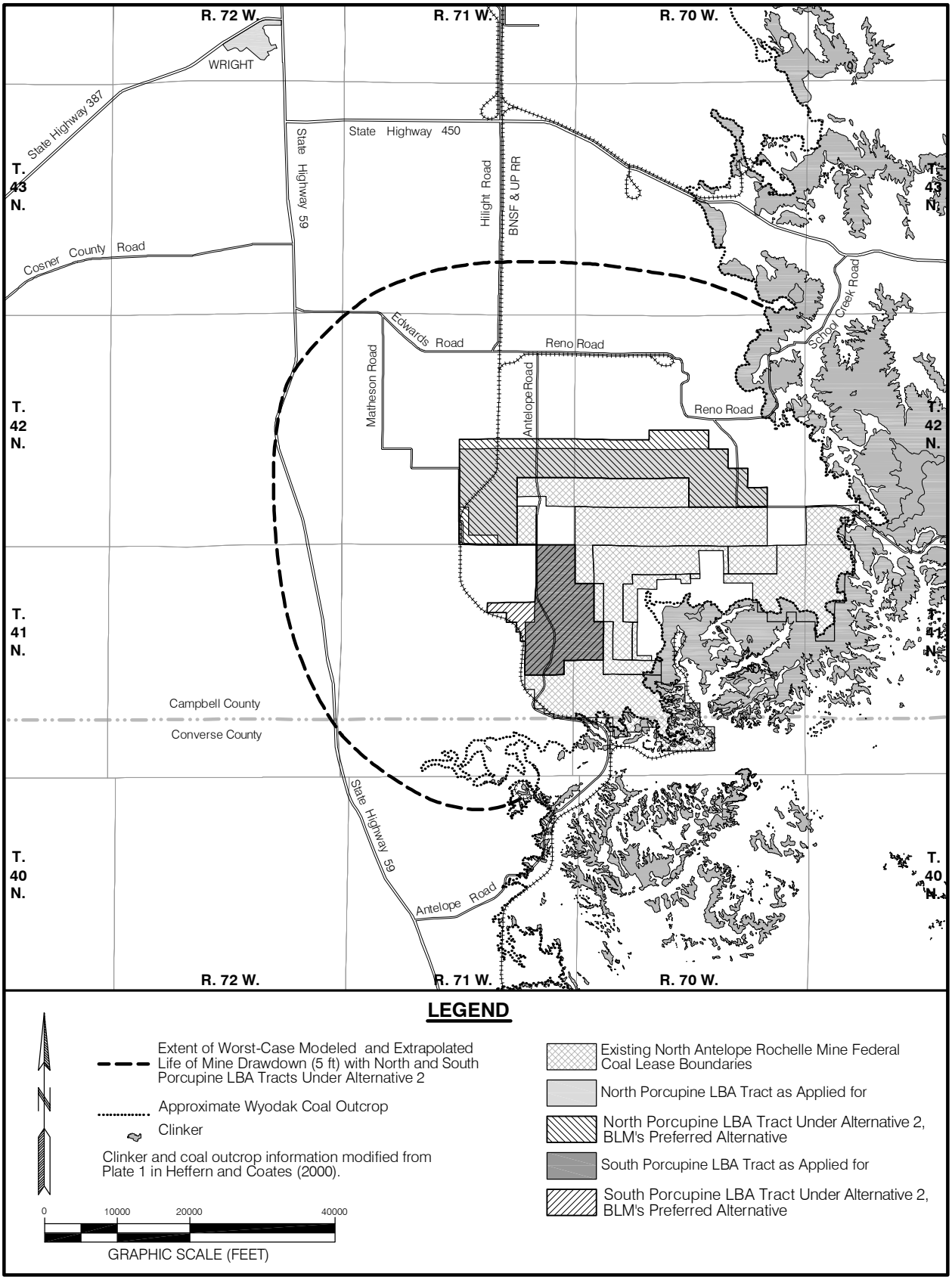


Figure 3-25. North Antelope Rochelle Mine Life of Mine Drawdown, Resulting from Currently Approved Mining with the Addition of the North and South Porcupine LBA Tracts.

WDEQ/LQD would require that future drawdown impacts due to mining alone be predicted in order to amend the tracts into the North Antelope Rochelle Mine permit area (Section 3.5.1.3).

The subcoal aquifers (i.e., Tullock Member of the Fort Union Formation and Lance-Fox Hills aquifer) are not removed or disturbed by mining, so they are not directly impacted by coal mining activity. Figure 3-22 depicts the locations of North Antelope Rochelle Mine's seven water supply wells, all of which are completed in aquifers below the Wyodak coal. If the applicant leases the North and South Porcupine LBA Tracts, water would be produced from these wells for a longer period of time, but PRC does not anticipate requiring additional sub-coal wells to mine the LBA tract.

To date, 28 wells have been installed to monitor water levels and water quality in the backfill at North Antelope Rochelle Mine. As depicted in Figure 3-22, all 28 wells were included in the mine's current (2008) groundwater monitoring network. The groundwater level hydrographs recorded by these wells over the period of record indicate that the level of saturation in the backfill is largely dependant upon the well's location with respect to the thickness of backfill, the physical characteristics of the backfill materials, and the source of groundwater recharge. For example, those monitoring wells completed in reclaimed alluvial materials emplaced beneath the reclaimed Porcupine Creek stream channel recorded relatively rapid resaturation followed by seasonal water level fluctuations similar to the stream's undisturbed alluvial aquifer. Most of the other wells completed in the mine's backfill have recorded either steadily increasing or relatively constant water levels, while some have shown that the backfill remains essentially dry in some areas (PRC 2007).

The hydraulic properties of the backfill aquifer at the North and South Porcupine LBA Tracts would be expected to be similar to the hydraulic properties measured in existing wells completed in the backfill at the North Antelope Rochelle Mine. The backfill aquifer has been tested at four wells, and the average hydraulic conductivity of 36 ft/day exceeds the median hydraulic conductivity (1.8 ft/day) reported by WDEQ/LQD (Ogle and Calle 2006) for the Wyodak-Anderson coal aquifer in the vicinity of the general Wright analysis area. This data therefore provide an indication that the backfill will readily resaturate as postmining potentiometric elevations recover in the surrounding undisturbed aquifers (including the North and South Porcupine LBA Tracts). The exact configuration and hydraulic gradient of the postmining potentiometric surface may vary from premine conditions; however, postmining equilibrium groundwater movement should exhibit a hydraulic gradient similar to that which existed prior to mining (PRC 2004).

TDS concentrations observed in the North Antelope Rochelle Mine backfill to date are similar to those found in the undisturbed alluvial and Wasatch Formation overburden aquifers, but greater than those found in the Wyodak coal aquifer. TDS concentrations in the most recent samples collected from 14 of the mine's backfill monitoring wells that were reported in the GAGMO 25-

year report (Hydro-Engineering 2007) ranged from 817 mg/L to 12,819 mg/L, with a geometric mean of 3,173 mg/L and an average of 4,455 mg/L. In general, the mine's backfill groundwater quality can be expected to be similar to the premining overburden aquifer and meet Wyoming Class III standards; however, there could be localized areas in the backfill that yield groundwater that does not meet Wyoming Class III standards, particularly where the poorer quality alluvial materials happen to be concentrated. Groundwater quality within the backfill at the North and South Porcupine LBA Tracts would be expected to be similar to groundwater quality measured in existing wells completed in the North Antelope Rochelle Mine backfill.

3.5.1.2.2 No Action Alternative

Under the No Action Alternative, the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine coal lease applications would be rejected and coal removal and the associated impacts to groundwater resources would not occur on the portions of the LBA tracts as applied for or the LBA tracts configured under Alternative 2 that will not be disturbed under the currently approved surface coal mining permits. Coal removal and associated impacts to groundwater resources related to existing approved mining (as well as CBNG development, as described above) would continue as currently permitted within the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle Mine permit areas. Impacts to groundwater resources related to mining operations at these three applicant mines would not be extended onto portions of the LBA tracts that will not be affected under the currently approved mining and reclamation plans.

As discussed in Section 2.2, a decision to reject one or more of these six coal lease applications at this time would not preclude an application to lease that respective tract in the future.

3.5.1.3 Regulatory Compliance, Mitigation, and Monitoring

In order to obtain a surface coal mining permit, the Surface Mine Control and Reclamation Act (SMCRA) and state law require surface coal mine operators to evaluate regional and site-specific baseline hydrogeologic environments within and around their mines. Prior to the cumulative drawdown effects of CBNG development and mining on the Wyodak/Wyodak-Anderson coal seam aquifer, WDEQ required each mine to use a numerical groundwater flow model (i.e., MODFLOW) to predict the extent of water level drawdown that would occur as a result of mining its existing leases. Current mine permit requirements require that future drawdown impacts due to mining alone be addressed, although less rigorous methods such as historical groundwater level trend analyses and simple analytical models (i.e., line-sink analysis) can and are being used rather than complex numerical groundwater flow models. Results of these studies are included in the WDEQ/LQD mine permits for the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines (TBCC 2005, JRM 2004, and PRC 2004). These studies would be revised accordingly

and included in the mine permit amendment that would be required for each respective LBA tract that is leased. Permit revisions must be approved before mining could occur on each tract that is leased, regardless of who acquires the tract.

As discussed in Section 3.5.3.3, SMCRA and Wyoming regulations require mine operators to provide the owner of a water right whose water source is interrupted, discontinued, or diminished by mining with water of equivalent quantity and quality.

The surface coal mines are also required to monitor water levels and water quality in the overburden, coal, interburden, underburden, and backfill. Operational groundwater monitoring programs are dynamic and modified through time as wells are removed by mining, discontinued from monitoring to eliminate redundancy, or added to replace those removed by mining and to facilitate monitoring of future mine expansion areas as mining has progressed. Through the years, some of the monitoring wells have become gaseous and were removed from the monitoring plan for safety reasons. Additional wells have also been installed in the reclaimed backfill to monitor recovering, postmine groundwater conditions. Many groundwater monitoring wells installed by Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines within and around their current permit areas have been used to evaluate groundwater conditions in the general Wright analysis area since the early 1970s and continue to be monitored to reveal a long-term record of groundwater conditions. Wells for which monitoring has been discontinued are still in place and may be reincorporated into the monitoring network in the future. The data gathered from the actively monitored wells are included in the annual reports prepared by the mines and submitted to the WDEQ/LQD. The locations of the current groundwater monitoring networks at the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines are depicted in Figures 3-20, 3-21, and 3-22, respectively.

SMCRA and state regulations require surface coal mines to maintain the essential hydrologic functions of the streams and their alluvial groundwater systems that are disturbed by mining. In order to meet this requirement, the mines are typically required to salvage and stockpile the stream laid alluvial materials during mining and replace them upon final reclamation.

3.5.2 Surface Water

3.5.2.1 Affected Environment

The Cheyenne River and its tributaries drain the general Wright analysis area. For the purpose of this analysis, the general Wright analysis area encompasses the three applicant mines, the BLM study areas for the six LBA tracts that are proposed for leasing, and the adjacent lands that would be disturbed by mining the BLM study areas. From north to south, the general Wright analysis area is drained by Black Thunder Creek, North Prong Little Thunder Creek, Little

Thunder Creek, Porcupine Creek, Horse Creek, and Antelope Creek (Figure 3-26). North Prong Little Thunder Creek is a tributary of Little Thunder Creek, which is a tributary of Black Thunder Creek. Porcupine Creek and Horse Creek are tributaries of the Antelope Creek. Black Thunder Creek and Antelope Creek are both major tributaries of the Cheyenne River.

The general Wright analysis area lies within the southeastern part of the Powder River Structural Basin and within the Cheyenne River drainage basin (Hydrologic Unit Code [HUC] 101201).

The North Hilight Field general analysis area and the existing Black Thunder Mine permit area are located in the Little Thunder Creek watershed. Typical of this semi-arid area, Little Thunder Creek and its tributaries are all ephemeral streams. The Black Thunder Mine disturbs Little Thunder Creek and several of its tributaries, including North Prong Little Thunder Creek, and is currently permitted to disturb approximately 4 percent of the Little Thunder Creek watershed. The mine's existing permit area is located entirely within the Little Thunder Creek drainage. The northeastern portion of the BLM study area for the North Hilight Field LBA Tract (the tract as applied for and the additional area evaluated under Alternative 2) is drained by Keeline Draw, a northerly-flowing ephemeral tributary of Black Thunder Creek. Mills Draw, a southerly-flowing ephemeral tributary of North Prong Little Thunder Creek, drains a small portion of the North Hilight Field general analysis area. Approximately 3,031 acres (or about 43 percent) of the 7,139-acre BLM study area for the North Hilight Field tract drain toward playas that are formed by natural topographic depressions; the largest of which are the Hansen Lakes; and Springen Draw, an internally drained closed basin, drains the entire western portion of the tract's general analysis area. Figure 3-27 depicts the surface water features within and adjacent to the North Hilight Field LBA Tract.

The South Hilight Field general analysis area and the existing Black Thunder Mine permit area are located in the Little Thunder Creek watershed. Little Thunder Creek flows easterly through and drains the northern portion of the BLM study area for the South Hilight Field LBA Tract (the tract as applied for and the additional area evaluated under Alternative 2). Approximately 1,364 acres (or about 47 percent) of the 2,922-acre BLM study area for the South Hilight Field tract drain toward playas that are formed by natural topographic depressions. The southwestern corner of the tract's general analysis area is drained by Briggs Draw, an ephemeral tributary of Little Thunder Creek. Figure 3-28 depicts the surface water features within and adjacent to the South Hilight Field LBA Tract.

The West Hilight Field general analysis area and the existing Black Thunder Mine permit area are located in the Little Thunder Creek watershed. Ephemeral tributaries of Dry Fork Little Thunder Creek (e.g., Brater Draw) drain a small northern portion of the BLM study area for the West Hilight Field LBA Tract (the tract as applied for and the additional area evaluated under Alternative 2). Approximately 1,708 acres (or about 24 percent) of the 9,189-

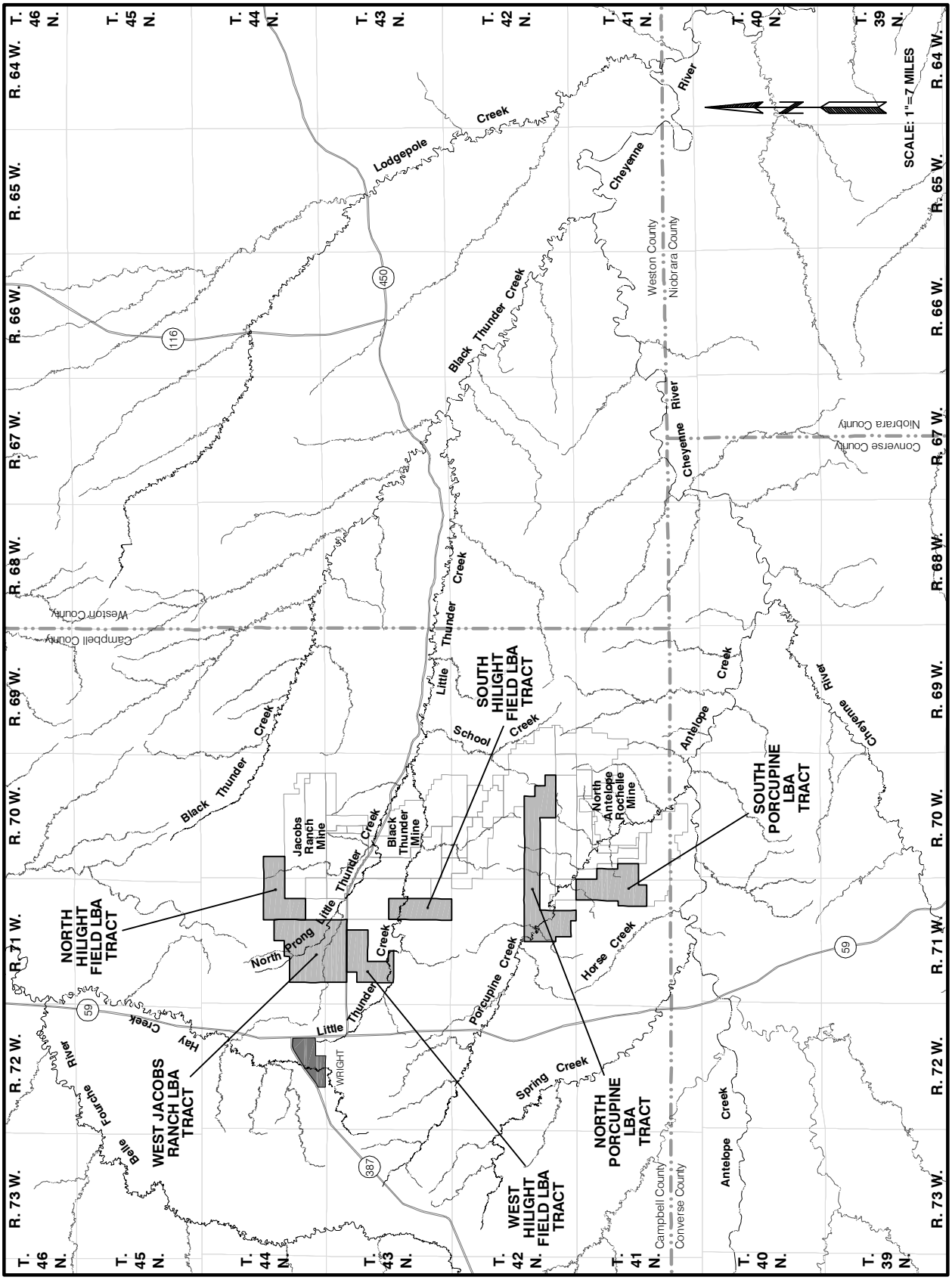


Figure 3-26. Surface Drainage in the General Wright Analysis Area.

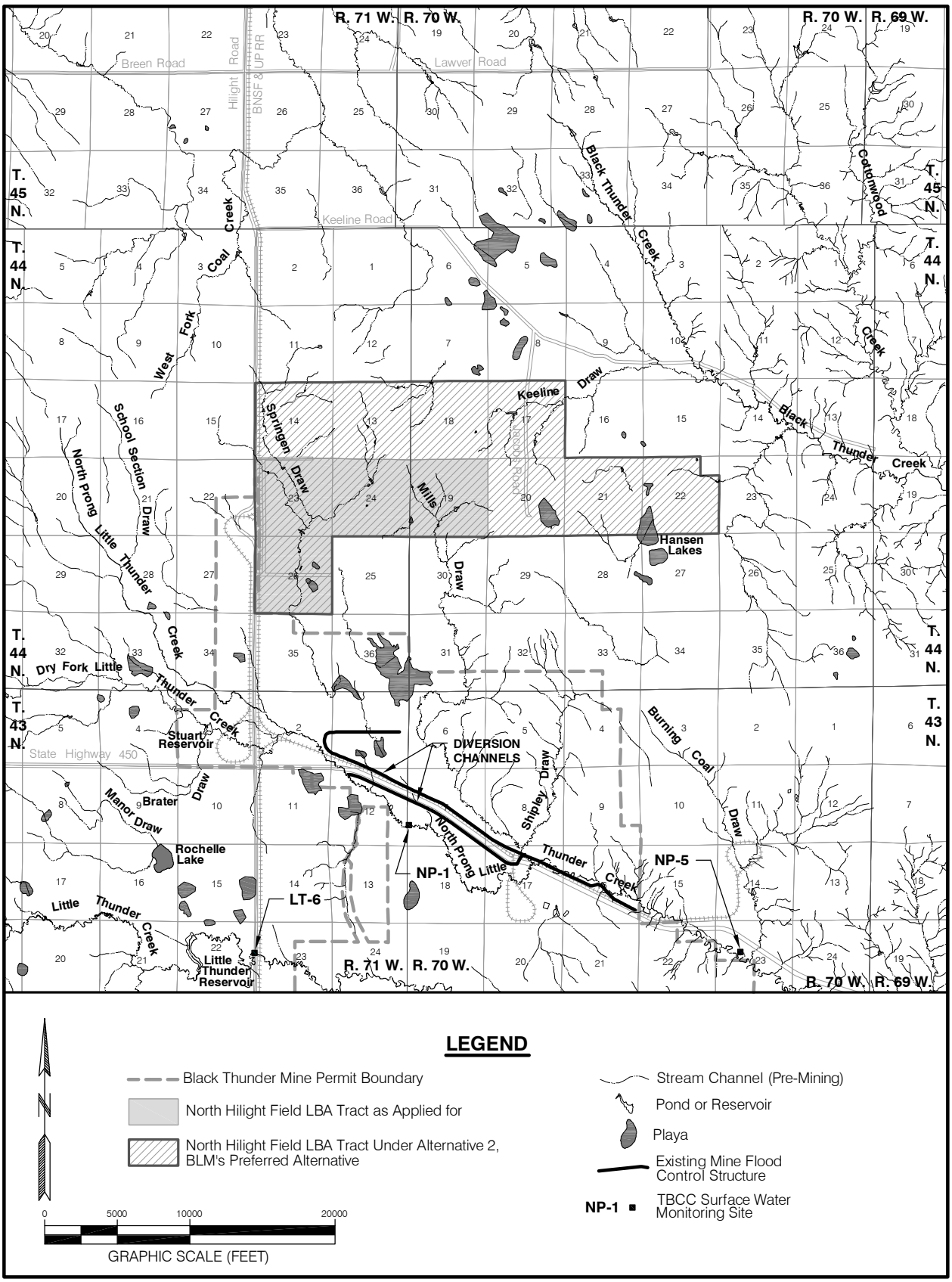


Figure 3-27. Surface Water Features Within and Adjacent to the North Hilight Field LBA Tract Alternatives.

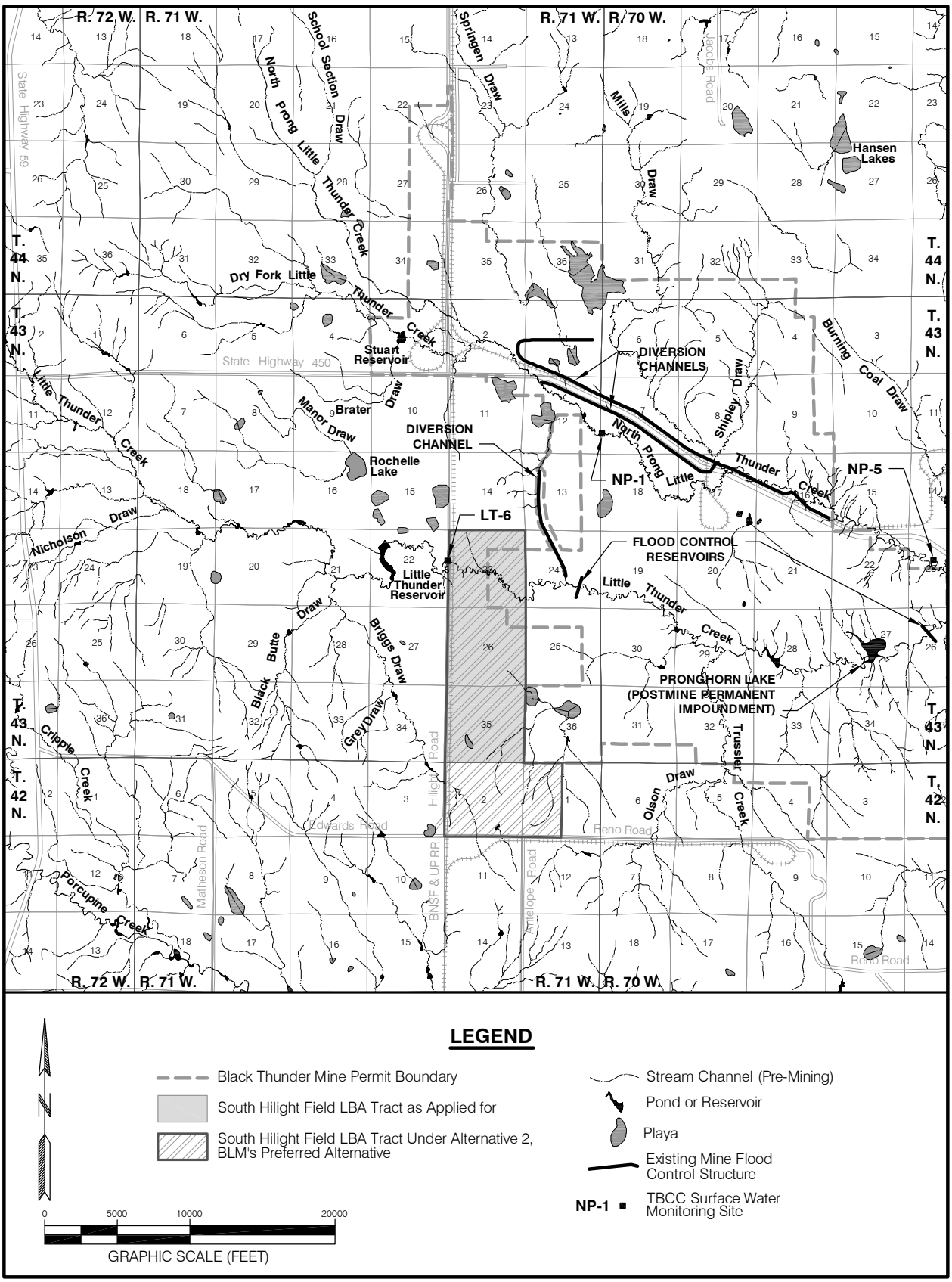


Figure 3-28. Surface Water Features Within and Adjacent to the South Hilight Field LBA Tract Alternatives.

acre BLM study area for the West Hilight Field LBA Tract drain to playas that are formed by natural topographic depressions, the largest of which is called Rochelle Lake. Most of the internally-drained areas located within the West Hilight Field general analysis area occur north of Little Thunder Creek. Little Thunder Creek flows easterly through the central portion of the West Hilight Field general analysis area, and its ephemeral tributaries, Briggs Draw and Black Butte Draw, drain the southern portion of the general analysis area. Figure 3-29 depicts the surface water features within and adjacent to the West Hilight Field LBA Tract.

The existing Jacobs Ranch Mine permit area and the West Jacobs Ranch general analysis area are located in the North Prong Little Thunder Creek watershed. North Prong Little Thunder Creek and its tributaries, Dry Fork Little Thunder Creek and School Section Draw, drain the general analysis area for the West Jacobs Ranch LBA Tract. North Prong Little Thunder Creek flows from the northwest to the southeast across the LBA tract. All of the West Jacobs Ranch LBA Tract is outside of the mine's existing permit area. Springen Draw, an ephemeral tributary to an internally-drained playa, drains a small area in the northeastern corner of the West Jacobs Ranch general analysis area. Figure 3-30 depicts the surface water features within and adjacent to the West Jacobs Ranch LBA Tract.

The North Porcupine general analysis area and the majority of the existing North Antelope Rochelle Mine's permit area are located in the Porcupine Creek watershed. Porcupine Creek is an ephemeral stream in its upper reaches and an intermittent stream in its lower reaches. Porcupine Creek is a major tributary to Antelope Creek, which is an intermittent stream that, prior to mining, received a small degree of baseflow from subcropping coal seams. The North Antelope Rochelle Mine disturbs Porcupine Creek and several of its tributaries. Only the extreme southern and southwestern portions of the mine's permit area drain directly to Antelope Creek and Horse Creek. The North Antelope Rochelle Mine is currently permitted to disturb approximately 25 percent of the Porcupine Creek watershed. The entire BLM study area for the North Porcupine LBA Tract (the tract as applied for and the additional area evaluated under Alternative 2) is within the mine's existing permit area. Approximately 6,221 acres, or about 84 percent of the 7,367-acre BLM study area for the North Porcupine LBA Tract, drain to Porcupine Creek. A short reach of Porcupine Creek, which is a meandering ephemeral stream in this area, flows southeastward across the western portion of the North Porcupine LBA Tract. Several ephemeral tributaries of Porcupine Creek (e.g., Corder Creek, Boss Draw, Rat Draw, Gray Creek, and Chipmunk Draw) also cross the North Porcupine general analysis area. The northeastern portion of the North Porcupine general analysis area is drained by Trussler and School creeks, ephemeral tributaries of Little Thunder Creek. There are also some areas in the eastern portion of the general analysis area that do not contribute runoff to any stream and playas have formed in the lowest portions of these non-contributing drainage areas. Figure 3-31 depicts the surface water features within and adjacent to the North Porcupine LBA Tract.

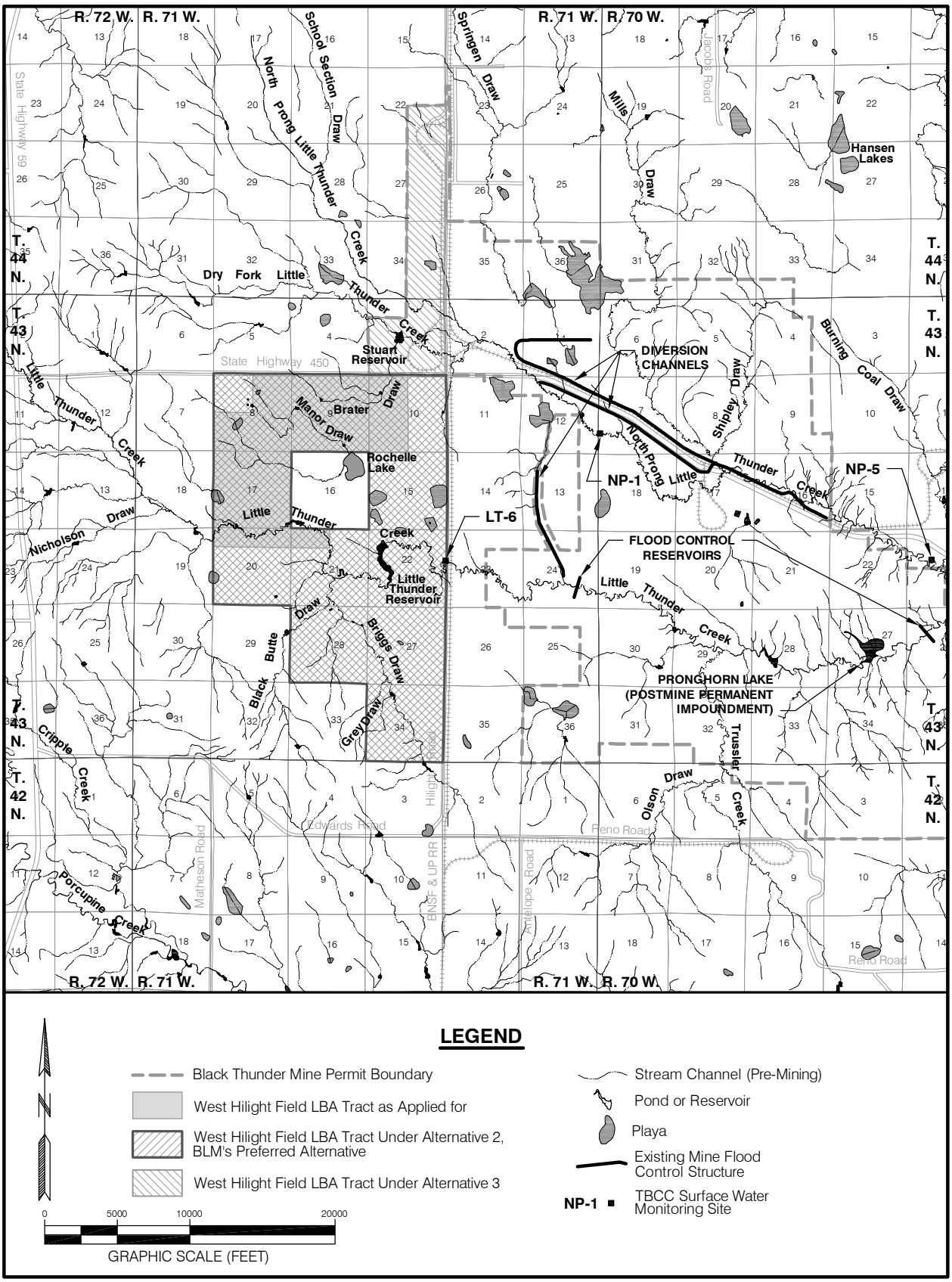


Figure 3-29. Surface Water Features Within and Adjacent to the West Hilight Field LBA Tract Alternatives.

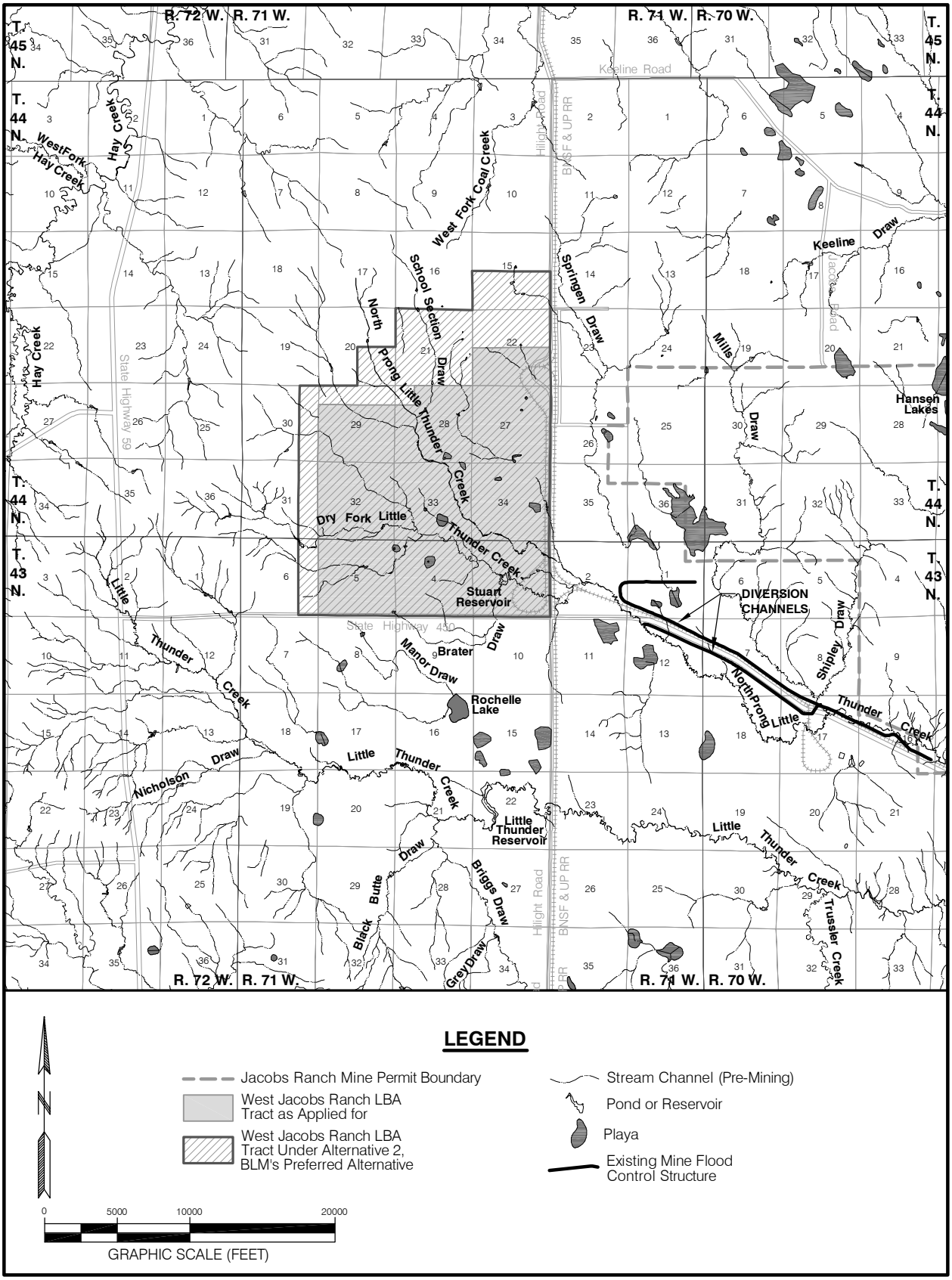


Figure 3-30. Surface Water Features Within and Adjacent to the West Jacobs Ranch LBA Tract Alternatives.

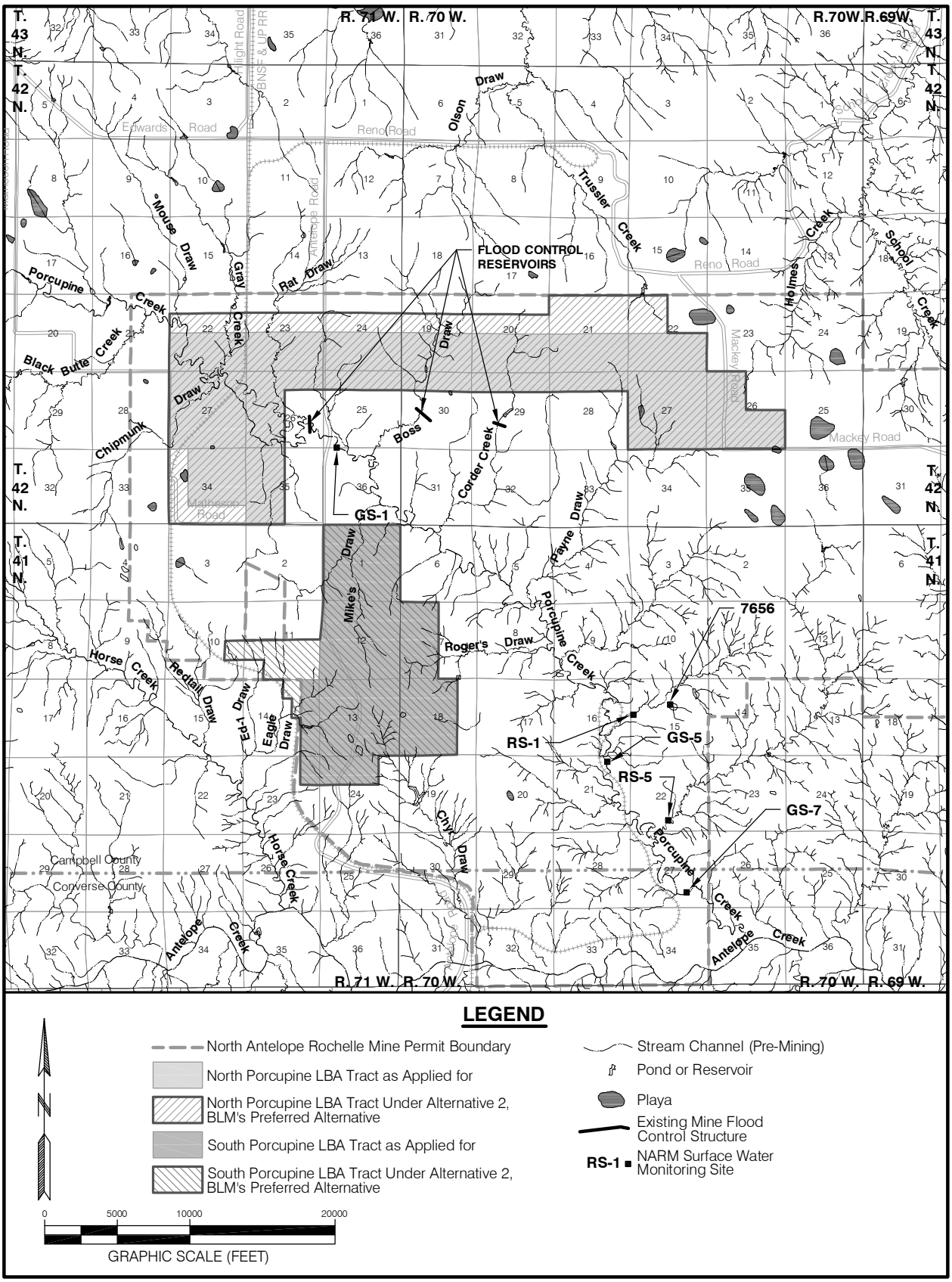


Figure 3-31. Surface Water Features Within and Adjacent to the North and South Porcupine LBA Tract Alternatives.

Surface water drainage in the South Porcupine LBA Tract is divided, in that the northern and eastern portions of the tract drain north and east to Porcupine Creek via several ephemeral tributaries, the southern portion of the tract drains south to Antelope Creek via several ephemeral tributaries, and the western portion of the tract drains west to Horse Creek via several ephemeral tributaries. With the exception of about 60 acres, the entire BLM study area for the South Porcupine LBA Tract (the tract as applied for and the additional area evaluated under Alternative 2) is within the existing mine permit area. Figure 3-31 depicts the surface water features within and adjacent to the South Porcupine LBA Tract.

As mentioned above, streams in the general Wright analysis area are ephemeral, receiving flow contributions primarily from convective thunderstorm runoff and, to a lesser extent, from snowmelt runoff in the spring (Ogle and Calle 2006). Black Thunder Creek and Antelope Creek demonstrate characteristics of both ephemeral and intermittent streams. Streamflow monitoring stations have been operated by the U.S. Geological Survey (USGS) and the applicant mines on streams in the general Wright analysis area since the mid-1970s. Figures 3-27 through 3-31 show the locations of the three applicant mines' current surface water monitoring stations. Currently, and for some indefinite time into the future, CBNG discharge water is adding flow to surface drainages in the Cheyenne River watershed. Streamflow is still very much a function of the amount and timing of precipitation and snowmelt runoff; however, since 1999, the PRB of northeastern Wyoming has experienced extreme drought conditions. Therefore, the mean annual streamflow rate and annual discharge volume has not significantly increased in these streams as a result of the discharge of CBNG-produced waters into surface drainages west of and generally upstream of the applicant mines, although extended periods of no flow are less common (Clark and Mason 2007).

Water quality in each of these streams is highly dependent on flow. Dissolved solids concentrations and specific conductance generally have an inverse relationship with streamflow; thus, the highest concentrations occur during low flows and lowest concentrations occur during high flows. Total suspended solids (TSS) show a direct relationship with streamflow; TSS concentrations are typically high during high flow and low during low flows. Due to the sparse vegetative cover and the infrequent occurrence of surface water runoff in this semi-arid environment, high TSS concentrations can be expected, especially from floods caused by thunderstorms.

Surface water monitoring programs required by WDEQ/LQD are included in the three applicant mines' WDEQ/LQD permits and annual reports, which ensures that streamflows are measured and water quality samples are collected on a regular basis from Little Thunder Creek, North Prong Little Thunder Creek, Porcupine Creek, and Antelope Creek at sites located upstream and downstream of the respective mine operation. As a result, comprehensive flow and water quality records are submitted to the WDEQ/LQD in the mines'

existing permits and annual reports that are on file and available for public review at WDEQ's offices in Cheyenne and Sheridan, Wyoming.

A study by the USGS within an area of CBNG development in the PRB was conducted from 2000 to 2005 to characterize the water quality of streams and assess change through time. That study concluded that annual runoff in all major drainage basins was less than average during 2001-2005 due to drought conditions, and that water-quality characteristics were highly variable generally because of streamflow variability, geologic controls, and potential land-use effects. No significant trends in water quality were determined for sites in the Cheyenne River drainage basin; however, drought conditions during the study period may not represent long-term water quality conditions for all sites studied (Clark and Mason 2007).

In the Surface Water Classification List, the WDEQ/WQD has classified Little Thunder Creek upstream of its confluence with the North Prong Little Thunder Creek as Class 3B water (WDEQ/WQD 2009). The North Prong Little Thunder Creek is also listed as a Class 3B stream that is not known to support fish populations or drinking water supplies and where those uses are not attainable. As defined by WDEQ/WQD, Class 3B waters are intermittent or ephemeral streams with sufficient water present to normally support other aquatic life (i.e., invertebrates and amphibians) at some life stage and are protected for other aquatic life, recreation, wildlife, agriculture, and other uses. Downstream of the North Prong Little Thunder Creek confluence, Little Thunder Creek is listed as a 2ABww stream that is protected for drinking water, aquatic life (a "ww" notation indicates a warm water fishery), recreation, wildlife, agriculture, industry and scenic value. Class 2AB waters are those known to support game fish populations at least seasonally and unless shown otherwise, are presumed to have sufficient water quantity and quality to support drinking water supplies and are protected for that use.

The WDEQ/WQD has classified Antelope Creek, Porcupine Creek, and Horse Creek as Class 3B waters. The Cheyenne River is listed in the WDEQ/WQD Surface Water Classification List as a Class 2ABww stream. All other ephemeral streams draining the general Wright analysis area are listed as Class 4 streams (where it has been determined that aquatic life uses are not attainable) (WDEQ/WQD 2009).

Springs are uncommon and none have been identified within the general analysis areas of these six LBA tracts.

A number of small in-channel reservoirs used for livestock water are located in the six LBA tracts' general analysis areas. Most of these stock ponds are many decades old and have not been permitted with the Wyoming State Engineer's Office (SEO). The SEO records have been searched for surface water rights within a three-mile radius of the six LBA tracts and listed in Section 3.5.3 and the supplementary information document for this EIS. Little Thunder Reservoir, a large in-channel reservoir on Little Thunder Creek that is located

within the BLM study area for the West Hilight Field tract, was constructed by the USFS for recreational uses (i.e., fishing) prior to development of the PRB surface coal mines. Little Thunder Reservoir is located within the Thunder Basin National Grassland (TBNG) and currently accessible for public recreation uses.

3.5.2.2 Environmental Consequences

3.5.2.2.1 Proposed Action and Alternatives 2 and 3

Changes in surface runoff characteristics and sediment discharges would occur during mining of each of the LBA tracts as a result of the destruction and reconstruction of drainage channels and the use of sediment control structures to manage discharges of surface water from the mine permit areas. Since the LBA tracts would be mined as extensions of the existing mines under the Proposed Actions or Alternatives 2 or 3, there would not be a large increase in the size of the area that is disturbed and not reclaimed at any given time as a result of leasing these tracts. Impacts would be similar for both the Proposed Actions and Alternatives 2 and 3 to the expected impacts for the currently permitted mining operations. Reclamation would be ongoing and concurrent with mining.

Erosion rates could be high on the disturbed areas due to lack of vegetation. However, both state and federal regulations require treatment of surface runoff from mined lands to meet Wyoming Pollutant Discharge Elimination System (WYPDES) and/or National Pollutant Discharge Elimination System (NPDES) effluent standards before it is released downstream. Generally, the surface runoff sediment is deposited in ponds or alternative sediment control measures (ASCMs) constructed inside the mine's permit area before the surface runoff water is allowed to leave the permit area. While mining is in progress, surface water quality would continue to be protected by directing surface runoff from affected areas to various sediment control structures, including sediment ponds, traps, ditches, sumps, and/or mine pits. Surface runoff water from the mine permit area would be detained until testing has shown that effluent limitations would be met for water to be discharged. Discharge limitations are contained in the mine's discharge permit. Under normal conditions, exceedances of effluent limitations are not expected in the future as mining extends into new drainages and additional sediment control facilities are added. The presence of disturbed areas creates a potential that sediment produced by large storms (i.e., greater than the 10-year, 24-hour storm) could potentially adversely impact areas downstream of the mining operations. This potential for adverse downstream impacts would be extended if the LBA tracts were leased and mined.

The temporary diversion and impoundment of runoff water for sediment control may reduce stream flow volumes and peak flows downstream of the mined lands. Impounded water may be used on the mine site for dust control or lost due to infiltration and evaporation and therefore may not be release

downstream. However, in order to maintain adequate available storage volume in sedimentation ponds, the impounded water is discharged when it meets effluent limitations that are contained in the mine's discharge permit. The WDEQ/LQD encourages the use of ASCMs to trap sediment and allow runoff to continue downstream (Ogle and Calle 2006).

Immediately following reclamation, the loss of soil structure would act to increase runoff rates on the LBA tracts. However, the general decrease in average slope in reclaimed areas, as discussed in Section 3.2.2, and drainage densities common in reclamation would tend to outweigh the potential for an increase in runoff due to a loss of soil structure. Soil structure would gradually recover over time, and vegetation (after successful reclamation) would provide erosion protection from raindrop impact, retard surface flows, and control runoff at approximately premining levels. All surface drainage from reclaimed areas would be controlled using best management practices (BMPs), such as contour furrows, ponds or small depressions for sediment traps, and vegetation buffers, until the area is sufficiently stable that drainage control is no longer required. Sedimentation rates are expected to be similar to premining conditions. Surface water monitoring would continue to be conducted to evaluate and identify anomalous variations in surface water quantity and quality and ensure that runoff leaving the site meets specific water quality criteria.

Once mining is completed the pits would be backfilled and drainage would be reestablished. Surface water drainages would be designed and reconstructed to approximate the premining drainage basin and channel characteristics. The reclaimed drainageways would be constructed to approximate the premine condition and blend with the existing drainage system above and below the area disturbed by the mining operation, providing a complete drainage system with hydrologic functions similar to premining conditions. After mining and reclamation are complete, surface water flow and quality would approximate premining conditions. The impacts described above would be similar to the expected impacts for currently permitted mining operations.

The impacts described above would be similar for both the Proposed Actions and BLM's preferred tract configurations under Alternative 2, and they are similar to the expected impacts for the currently permitted mining operations. Direct and indirect impacts to the surface water system resulting from mining the six LBA tracts would add to the cumulative impacts that would occur due to mining existing leases. These cumulative impacts are discussed in Chapter 4 of this EIS. Following is a description of surface water impacts from the leasing and subsequent mining of each of the LBA tracts under the Proposed Action or Alternative 2, BLM's preferred alternative.

<u>3.5.2.2.1.1 North, South, and West Hilight Field LBA Tracts</u>

Due to the North Hilight Field tract's location at the headwater areas of two ephemeral tributaries to Black Thunder Creek and North Prong Little Thunder

Creek (Keeline Draw and Mills Draw, respectively), and due to the fact that the balance of the general analysis area for the North Hilight Field tract drains to playas with no nexus (continuous surface connection) to tributaries of either Black Thunder Creek or North Prong Little Thunder Creek, runoff within the tract would not be expected to be significant. During mining, hydrologic control would most likely consist of allowing runoff to accrue to the open mine pits where it would be evacuated by pumping to sedimentation ponds, then used for dust abatement or treated and discharged outside the mine's permit area if the water meets effluent limitations. A need for large flood control reservoirs is not anticipated for the North Hilight Field LBA Tract.

There may periodically be substantial streamflow in Little Thunder Creek within the South Hilight Field LBA Tract. Little Thunder Creek has been diverted around active pits within the existing Black Thunder Mine permit area. A large flood control reservoir is located on Little Thunder Creek upstream of the current mining activities, and overflow from the reservoir is then diverted north around the open pits to a blocking dike that diverts water into the diversion system constructed on North Prong Little Thunder Creek (Figure 3-28). Diverted flows from Little Thunder Creek, being native water and not treated, are routed through the diversion system and discharged outside and downstream of the mine's permit area. During mining of the South Hilight Field tract, hydrologic control would most likely consist of building another flood control reservoir and diversion channel for the main stream around the open pit areas. These structures would be located west of the tract to provide adequate flood protection of the downstream mining activities. In addition to diverting Little Thunder Creek flows, hydrologic control during mining would most likely consist of allowing surface runoff to accrue to the mine pits where it would be evacuated by pumping to sedimentation ponds, then used for dust abatement or treated and discharged outside the mine's permit area if the water meets effluent limitations. Nearly half of the BLM study area for the South Hilight Field LBA Tract is internally drained and runoff has no nexus (or continuous surface connection) to Little Thunder Creek; therefore, it would not be necessary for additional flood control structures to be constructed.

The West Hilight Field LBA Tract is located near the headwaters of Little Thunder Creek, and because much of the general analysis area for West Hilight Field tract is drained by Little Thunder Creek and its tributaries (e.g., Briggs Draw), which are all ephemeral streams, runoff within the tract would not be expected to be substantial. As discussed above, most of the surface of the LBA tract north of Little Thunder Creek is internally drained and runoff has no nexus to Little Thunder Creek. Playas, such as Rochelle Lake, occur in the lowest portions of these non-contributing drainages. Therefore, a need for large flood control reservoirs during mining is not anticipated for the LBA tract. Hydrologic control during mining would most likely consist of allowing runoff to accrue to the mine pits where it would evacuated by pumping to sedimentation ponds and then used for dust control or treated and discharged outside the mine's permit area if the water meets effluent limitations.

3.5.2.2.1.2 West Jacobs Ranch LBA Tract

North Prong Little Thunder Creek and its tributaries, Dry Fork Little Thunder Creek and School Section Draw, drain essentially all of the general analysis area for the West Jacobs Ranch LBA Tract. The balance of the general analysis area is drained by non-contributing, internal drainage basins containing playas (Figure 3-30). The West Jacobs Ranch LBA Tract is located near the headwaters of these ephemeral streams; therefore, runoff within the tract would not be expected to be substantial and a need for large flood control reservoirs is not anticipated for the LBA tract. Hydrologic control during mining would most likely consist of containing flows from these ephemeral streams in small flood control reservoirs, routing flows in small channel diversions around active pits, or allowing runoff to accrue to the mine pits where it would evacuated by pumping to sedimentation ponds and then used for dust control or treated and discharged outside the mine's permit area if the water meets effluent limitations. The exact plan for hydrologic control would depend on the mining sequence.

3.5.2.2.1.3 North and South Porcupine LBA Tracts

There may periodically be substantial streamflow in Porcupine Creek in the vicinity of the North Porcupine LBA Tract. Flood control reservoirs are presently located on Porcupine Creek and its larger tributaries, Boss Draw and Corder Creek, upstream of the current mining activities (Figure 3-31). Overflow from these reservoirs is allowed to accrue to the open mine pits where it is evacuated by pumping to sedimentation ponds and then used for dust abatement or discharged outside the mine's permit area if the water meets effluent limitations. During mining of the North Porcupine LBA Tract, hydrologic control would most likely consist of building another flood control reservoir on Porcupine Creek. The remainder of the general analysis area is located near the headwaters of ephemeral tributaries to Porcupine Creek and is also drained by non-contributing, internal drainage basins; therefore, runoff within the tract would not be expected to be substantial. Hydrologic control during mining would most likely consist of containing flows from these ephemeral tributary streams in small flood control reservoirs, routing flows in small channel diversions around active pits, and/or allowing runoff to accrue to the mine pits where it would be evacuated by pumping to sedimentation ponds and then used for dust control or treated and discharged outside the mine's permit area if the water meets effluent limitations. The exact plan for hydrologic control would depend on the mining sequence.

As discussed above, the entire South Porcupine LBA Tract is drained by ephemeral tributaries of Porcupine Creek, Horse Creek, and Antelope Creek (Figure 3-31). Due to its location at the headwaters of these drainages, runoff would not be expected to be significant. During mining, hydrologic control would most likely consist of allowing runoff to accrue to the mine pits where it would be evacuated by pumping to sedimentation ponds and then used for

dust control or treated and discharged outside the mine's permit area if the water meets effluent limitations.

3.5.2.2.2 No Action Alternative

Under the No Action Alternatives, the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine coal lease applications would be rejected and coal removal and the associated impacts to surface water resources would not occur on the portions of the LBA tracts as applied for or the LBA tracts configured under Alternative 2 that will not be disturbed under the currently approved surface coal mining permits. Coal removal and the associated impacts to surface water resources related to currently approved mining (and CBNG development, described above) would continue as currently permitted within the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle Mine permit areas. Impacts to surface water resources related to mining operations at these three applicant mines would not be extended onto portions of the LBA tracts that will not be affected under the current mining and reclamation plans.

As discussed in Section 2.2, a decision to reject one or more of these six coal lease applications at this time would not preclude an application to lease that respective tract in the future.

3.5.2.3 Regulatory Compliance, Mitigation, and Monitoring

In accordance with SMCRA and Wyoming State Statutes, major stream channels that are disturbed by surface coal mining operations on these six LBA tracts would be restored. Surface water flow, quality, and sediment discharge would approximate premining conditions. The drainages that are disturbed when the coal is recovered would be reclaimed to exhibit channel geometry characteristics similar to the premining characteristics. The major channels would be restored in approximately the same location as the natural channel and hydrologic functions would be restored. (See additional discussion in Section 3.5.1.3.)

Other WDEQ/LQD permit requirements for the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines include constructing sediment control structures to manage discharges of surface water from the current mine permit areas; treatment of all surface runoff from mined lands as necessary to meet effluent standards; and restoration of stock ponds, playas, and in-channel impoundments disturbed during mining. These requirements would be extended to include the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts during the permitting process, if the tracts are leased.

Monitoring requirements for each of the existing applicant mines include a program to assure that sediment ponds always have adequate space reserved for sediment accumulation and for collection of streamflow and water quality

data from North Prong Little Thunder Creek, Little Thunder Creek, and Porcupine Creek (Figures 3-27 through 3-31). These requirements would be extended accordingly and included in the mine permit amendment that would be required for each respective LBA tract that is leased. Mine permit revisions must be approved before mining could occur on each tract that is leased, regardless of who acquires the tract.

3.5.3 Water Rights

3.5.3.1 Affected Environment

The Wyoming State Engineer's Office (SEO) administers water rights in Wyoming. Water rights are granted for both groundwater and surface water. Prior to development of water resources associated with energy development, water appropriations (either groundwater or surface water) in the PRB were typically for livestock use. Currently, mining companies and CBNG development companies hold the majority of the water rights in the general Wright analysis area.

Records of the SEO were searched for groundwater rights within a 3-mile radius of the BLM study area for each of these six LBA tracts. This information is required by the WDEQ/LQD for surface coal mine permitting. Summaries of the most recent search for each tract are provided below. A more detailed listing of the non-coal mine related groundwater rights within a 3-mile radius of each LBA tract is presented in the supplementary information document for this EIS, which is available on request.

For the North Hilight Field LBA Tract, SEO data indicate that, as of October 9, 2007, there were 609 permitted water wells within 3 miles of the BLM study area for the tract, of which, 191 wells are owned by coal mining companies. The other 418 non-coal mine related, permitted water wells, which include 314 wells permitted for uses related to CBNG development, are permitted for the following uses:

- 314 CBNG
- 61 livestock
- 16 domestic
- 14 monitoring
- 5 industrial
- 8 miscellaneous

For the South Hilight Field LBA Tract, SEO data indicate that, as of October 8, 2007, there were 694 permitted water wells within 3 miles of the BLM study area for the tract, of which, 211 wells are owned by coal mining companies. The other 483 non-coal mine related, permitted water wells, which include 425 wells permitted for uses related to CBNG development, are permitted for the following uses:

- 425 CBNG
- 39 livestock
- 2 domestic
- 17 monitoring

For the West Hilight Field LBA Tract, SEO data indicate that, as of October 8, 2007, there were 1,011 permitted water wells within 3 miles of the BLM study area for the tract, of which, 149 wells are owned by coal mining companies. The other 862 non-coal mine related, permitted water wells, which include 750 wells permitted for uses related to CBNG development, are permitted for the following uses:

- 750 CBNG
- 69 livestock
- 20 domestic
- 19 monitoring
- 1 miscellaneous
- 3 municipal

For the West Jacobs Ranch LBA Tract, SEO data indicate that, as of September 30, 2007, there were 1,171 permitted water wells within 3 miles of the BLM study area for the tract, of which, 231 wells are owned by coal mining companies. The remaining 940 non-coal mine related, permitted water wells, which include 645 wells permitted for uses related to CBNG development, are permitted for the following uses:

- 440 CBNG only
- 181 livestock and CBNG
- 117 monitoring only
- 76 livestock only
- 34 miscellaneous
- 17 domestic and livestock
- 14 domestic only
- 9 livestock, CBNG, and reservoir supply
- 8 livestock, CBNG, and miscellaneous
- 7 miscellaneous and CBNG
- 7 municipal only
- 6 industrial only
- 6 miscellaneous and reservoir supply
- 6 livestock, miscellaneous, dewatering, and reservoir supply
- 3 irrigation only
- 3 miscellaneous and municipal
- 1 dewatering
- 1 miscellaneous, industrial and temporary
- 1 livestock, industrial and miscellaneous
- 1 livestock, miscellaneous and monitoring
- 1 industrial and miscellaneous
- 1 testing

For the North Porcupine LBA Tract, SEO data indicate that, as of August 1, 2008, there were 982 permitted water wells within 3 miles of the BLM study area for the tract, of which, 354 wells are owned by coal mining companies. The other 628 non-coal mine related, permitted water wells, which include 547 wells permitted for uses related to CBNG development, are permitted for the following uses:

- 260 CBNG only
- 173 livestock and CBNG
- 84 CBNG and miscellaneous
- 48 livestock only
- 23 monitoring only
- 20 CBNG and reservoir supply
- 5 domestic and livestock
- 4 livestock, CBNG, and miscellaneous
- 3 dewatering and CBNG
- 2 industrial only
- 1 CBNG, reservoir supply and livestock
- 1 domestic only
- 1 miscellaneous
- 1 livestock, CBNG, and reservoir supply
- 1 livestock and miscellaneous
- 1 livestock, miscellaneous and CBNG

For the South Porcupine LBA Tract, SEO data indicate that, as of August 1, 2008, there were 779 permitted water wells within 3 miles of the tract, of which, 388 wells are owned by coal mining companies. The other 391 non-coal mine related, permitted water wells, which include 324 wells permitted for uses related to CBNG development, are permitted for the following uses:

- 173 CBNG only
- 70 CBNG and miscellaneous
- 57 livestock and CBNG
- 37 livestock only
- 20 CBNG and reservoir supply
- 18 monitoring
- 6 domestic and livestock
- 3 dewatering and CBNG
- 3 industrial only
- 2 miscellaneous
- 1 livestock and miscellaneous
- 1 livestock, miscellaneous and CBNG

SEO records have been searched for surface water rights within a 3-mile radius of the BLM study area for each of the six LBA tracts. Like the groundwater rights, this information is also required for WDEQ permitting. The results of the most recent searches are provided below for each tract. A more detailed listing of the non-coal mine related surface water rights is presented in the

supplementary information document for this EIS, which is available on request.

For the North Hilight Field LBA Tract, SEO records indicate that as of October 10, 2007, there were 104 permitted surface water rights within the search area, of which 46 are owned by coal mining companies. The other 58 non-coal mine related permitted surface water rights are permitted for the following uses:

- 3 livestock
- 1 irrigation and domestic
- 54 not designated

For the South Hilight Field LBA Tract, SEO records indicate that as of October 10, 2007, there were 143 permitted surface water rights within the search area, of which 70 are owned by coal mining companies. The other 73 non-coal mine related permitted surface water rights are permitted for the following uses:

- 21 livestock
- 2 irrigation
- 50 not designated

For the West Hilight Field LBA Tract, SEO records indicate that as of October 9, 2007, there were 141 permitted surface water rights within the search area, of which 36 are owned by coal mining companies. The other 105 non-coal mine related permitted surface water rights are permitted for the following uses:

- 19 livestock
- 3 irrigation
- 83 not designated

For the West Jacobs Ranch LBA Tract, SEO records indicate that as of September 30, 2007, there were 150 permitted surface water rights within the search area, of which 33 are owned by coal mining companies. The remaining 117 surface water rights were permitted for the following uses:

- 73 livestock
- 3 livestock and irrigation
- 2 industrial and temporary
- 1 fish propagation
- 1 reservoir supply
- 37 not designated

For the North Porcupine LBA Tract, SEO records indicate that as of August 1, 2008, there were 345 non-coal mine related, permitted surface water rights within the search area. These surface water rights were permitted for the following uses:

- 260 livestock
- 33 irrigation
- 3 irrigation and domestic
- 16 livestock, irrigation and domestic
- 5 undefined
- 4 temporary, industrial and miscellaneous
- 3 fish propagation and recreation
- 3 recreation, livestock, and fish propagation
- 2 industrial and pollution control
- 2 livestock and irrigation
- 2 wetlands
- 1 industrial
- 1 industrial and temporary

For the South Porcupine LBA Tract, SEO records indicate that as of August 1, 2008, there were 223 non-coal mine related, permitted surface water rights within the search area. These surface water rights are permitted for the following uses:

- 157 livestock
- 37 irrigation
- 7 undefined
- 4 industrial and flood control
- 4 temporary and industrial
- 4 temporary, industrial and miscellaneous
- 3 irrigation and livestock
- 3 livestock and irrigation
- 2 industrial and pollution control
- 1 industrial
- 1 industrial and temporary

3.5.3.2 Environmental Consequences

3.5.3.2.1 Proposed Action and Alternatives 2 and 3

As discussed above, there have already been significant drawdowns in the Wyodak coal and overlying aquifers (where present) as a result of the past and existing mining activities and CBNG development in the general Wright analysis area. As a result, private water supply wells that are completed in the Wyodak coal seam listed in Section 3.5.3.1 have already been impacted. Continued effects from groundwater withdrawals associated with CBNG development activities will be likely, and future drawdown to the Wyodak coal aquifer resulting from mining the approved coal leases by the three applicant mines is expected to be negligible due to the fact that the coal seam has essentially been dewatered in proximity to the mines. Therefore, it is unlikely that any of these privately permitted water wells would be indirectly impacted by water level drawdown to a greater extent than current conditions; however,

private wells may be physically removed by activities associated with mining the proposed LBA tracts.

Only a slight reduction in streamflow downstream of the applicant mines during mining is expected due to the containment of runoff from the disturbed areas by mine pits and other runoff control structures. Downstream surface water rights would be protected by minimizing detention of surface runoff for sediment control in North Prong Little Thunder Creek, Little Thunder Creek and Porcupine Creek. Changes to the overall flow and water quality of these streams and their receiving streams, Black Thunder Creek, Antelope Creek, and Cheyenne River) during mining are expected to be negligible. Any surface water rights listed in Section 3.5.3.1 that are located within the proposed mining disturbance areas would be interrupted until the disturbance area is reclaimed.

3.5.3.2.1.1 North Hilight Field LBA Tract

In October 2007, Wyoming SEO records indicated that a total of 609 permitted water wells were located within 3 miles of the BLM study area for the North Hilight Field LBA Tract. As discussed above, 191, or approximately 31 percent of these wells are owned by coal mining companies and are used for groundwater monitoring and water supply. Approximately 75 percent of the remaining 418 non-coal mine related wells are permitted for uses related to CBNG development; 15 percent are permitted for livestock use; 4 percent are permitted for domestic use; 3 percent are permitted for monitoring uses; 1 percent are permitted for industrial uses; and about 2 percent are permitted for miscellaneous uses.

As discussed above, some of these privately permitted water wells have been or will likely be impacted (either directly by removal of the well or indirectly by water level drawdown) by approved mining at the Black Thunder and adjacent mines and CBNG development. Future drawdowns to the Wyodak coal aquifer are expected to be negligible due to the fact that the coal seam has essentially been dewatered. Therefore, it is unlikely that any of these privately permitted water wells would be impacted by water level drawdown to a greater extent than they currently are if the North Hilight LBA Field Tract is leased and mined.

3.5.3.2.1.2 South Hilight Field LBA Tract

In October 2007, Wyoming SEO records indicated that a total of 694 permitted water wells were located within 3 miles of the BLM study area for the South Hilight Field LBA Tract. As discussed above, 211, or approximately 30 percent of these wells are owned by coal mining companies and are used for groundwater monitoring and water supply. Approximately 88 percent of the remaining 483 non-coal mine related wells are permitted for uses related to CBNG development; 8 percent are permitted for livestock use; 0.5 percent are permitted for domestic use; and 3.5 percent are permitted for monitoring uses.

As discussed above, some of these privately permitted water wells have been or will likely be impacted (either directly by removal of the well or indirectly by water level drawdown) by approved mining at the Black Thunder and adjacent mines and CBNG development. Future drawdowns to the Wyodak coal aquifer are expected to be negligible due to the fact that the coal seam has essentially been dewatered. Therefore, it is unlikely that any of these privately permitted water wells would be impacted by water level drawdown to a greater extent than they currently are if the South Hilight Field LBA Tract is leased and mined.

3.5.3.2.1.3 West Hilight Field LBA Tract

In October 2007, Wyoming SEO records indicated that a total of 1,011 permitted water wells were located within 3 miles of the BLM study area for the West Hilight Field LBA Tract. As discussed above, 149, or approximately 15 percent of these wells are owned by coal mining companies and are used for groundwater monitoring and water supply. Approximately 87 percent of the remaining 862 non-coal mine related wells are permitted for uses related to CBNG development; 8 percent are permitted for livestock use; 2.3 percent are permitted for domestic use; 2.2 percent are permitted for monitoring; and about 0.5 percent are permitted for miscellaneous and municipal uses.

As discussed above, some of these privately permitted water wells have been or will likely be impacted (either directly by removal of the well or indirectly by water level drawdown) by approved mining at the Black Thunder and adjacent mines and CBNG development. Future drawdowns to the Wyodak coal aquifer are expected to be negligible due to the fact that the coal seam has essentially been dewatered. Therefore, it is unlikely that any of these privately permitted water wells would be impacted by water level drawdown to a greater extent than they currently are if the West Hilight Field LBA Tract is leased and mined.

3.5.3.2.1.4 West Jacobs Ranch LBA Tract

In September 2007, Wyoming SEO records indicated that a total of 1,171 permitted water wells were located within 3 miles of the BLM study area for the West Jacobs Ranch LBA Tract. As discussed above, 231, or approximately 20 percent of these wells are owned by coal mining companies and are used for groundwater monitoring and water supply. Approximately 69 percent of the remaining 940 non-coal mine related wells are permitted for uses related to CBNG development; 11 percent are permitted either for livestock use only or for livestock and other uses; 12 percent are permitted for monitoring; 5 percent are permitted for miscellaneous uses; about 1.5 percent are permitted for domestic use; and about 1.5 percent are permitted for municipal, industrial, irrigation, dewatering and testing.

As discussed above, some of these privately permitted water wells have been or will likely be impacted (either directly by removal of the well or indirectly by water level drawdown) by approved mining at the Jacobs Ranch and adjacent

mines and CBNG development. Future drawdowns to the Wyodak coal aquifer are expected to be negligible due to the fact that the coal seam has essentially been dewatered. Therefore, it is unlikely that any of these privately permitted water wells would be impacted by water level drawdown to a greater extent than they currently are if the West Jacobs Ranch LBA Tract is leased and mined.

3.5.3.2.1.5 North Porcupine LBA Tract

In August 2008, Wyoming SEO records indicated that a total of 982 permitted water wells were located within 3 miles of the BLM study area for the North Porcupine LBA Tract. As discussed above, 354, or approximately 20 percent of these wells are owned by coal mining companies and are used for groundwater monitoring and water supply. Approximately 87 percent of the remaining 628 non-coal mine related wells are permitted for uses related to CBNG development; about 8 percent are permitted for livestock use only; about 4 percent are permitted for monitoring; and about 1 percent are permitted for domestic, livestock, industrial and miscellaneous uses.

As discussed above, some of these privately permitted water wells have been or will likely be impacted (either directly by removal of the well or indirectly by water level drawdown) by approved mining at the North Antelope Rochelle and adjacent mines and CBNG development. Future drawdowns to the Wyodak coal aquifer are expected to be negligible due to the fact that the coal seam has essentially been dewatered. Therefore, it is unlikely that any of these privately permitted water wells would be impacted by water level drawdown to a greater extent than they currently are if the North Porcupine LBA Tract is leased and mined.

3.5.3.2.1.6 South Porcupine LBA Tract

In August 2008, Wyoming SEO records indicated that a total of 779 permitted water wells were located within 3 miles of the BLM study area for the South Porcupine LBA Tract. As discussed above, 388, or approximately 50 percent of these wells are owned by coal mining companies and are used for groundwater monitoring and water supply. Approximately 83 percent of the remaining 391 non-coal mine related wells are permitted for uses related to CBNG development; about 9.5 percent are permitted for livestock use only; about 4.5 percent are permitted for monitoring; and about 3 percent are permitted for domestic, livestock, industrial and miscellaneous uses.

As discussed above, some of these privately permitted water wells have been or will likely be impacted (either directly by removal of the well or indirectly by water level drawdown) by approved mining at the North Antelope Rochelle and adjacent mines and CBNG development. Future drawdowns to the Wyodak coal aquifer are expected to be negligible due to the fact that the coal seam has essentially been dewatered. Therefore, it is unlikely that any of these privately permitted water wells would be impacted by water level drawdown to a greater

extent than they currently are if the South Porcupine LBA Tract is leased and mined.

3.5.3.2.2 No Action Alternative

Under the No Action Alternative, the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine coal lease applications would be rejected and coal removal and associated disturbance and impacts to water rights would not occur on the portions of the LBA tracts as applied for or the LBA tracts configured under Alternative 2 that will not be disturbed under the currently approved surface coal mining permits. Coal removal and the impacts to water rights associated with existing approved mining and CBNG development as described above would continue to occur. Impacts to water rights related to mining operations at these three applicant mines would not be extended onto portions of the LBA tracts that will not be affected under the current mining and reclamation plans.

As discussed in Section 2.2, a decision to reject one or more of these six lease applications at this time would not preclude an application to lease that respective tract in the future.

3.5.3.3 Regulatory Compliance, Mitigation and Monitoring

In compliance with SMCRA and Wyoming regulations, mine operators are required to provide the owner of a water right whose water source is interrupted, discontinued, or diminished by mining with water of equivalent quantity and quality; this mitigation is thus part of the Proposed Action and Alternatives 2 and 3. The most probable source of replacement water would be one of the aquifers underlying the mineable coal (Wyodak or Wyodak-Anderson). For example, the subcoal Fort Union Formation aquifers are not removed or disturbed by coal mining, and would therefore be a potential source of replacement water.

If the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts are leased, the mine operator would be required to update the list of potentially impacted private water supply wells and predict impacts to those wells within the 5-foot drawdown contour as part of the WDEQ/LQD mine permitting process. The operator would be required to commit to replacing those water supplies with water of equivalent quality and quantity if they are predicted to be affected by mining

3.5.4 Residual Impacts

The area of coal and overburden removal and replacement of overburden and associated groundwater drawdowns would be increased under the Proposed Action and Alternatives 2 and 3 compared with the area of coal and overburden removal and overburden replacement and associated groundwater drawdowns

for each of the three existing applicant mines. The postmining backfill may take in excess of 100 years to fully resaturate and reach equilibrium water levels and water quality. Less time would be required near the mining boundaries. Monitoring data from wells completed in existing backfilled areas in the PRB suggest that there would be an adequate quantity of water in the backfill to replace current use, which is generally for livestock. Water quality in the backfill would generally be expected to meet the Wyoming Class III standards for livestock and wildlife use, which was the primary premining use of water from the coal seams. The hydraulic properties and water quality characteristics of the backfill may be somewhat different than that of the undisturbed overburden and Wyodak coal, although groundwater at comparable depth, yield, and quality would be available for the same premining uses within the general analysis areas of these six LBA tracts.

3.6 Alluvial Valley Floors

3.6.1 Affected Environment

WDEQ regulations define alluvial valley floors (AVFs) as unconsolidated stream laid deposits where water availability is sufficient for subirrigation or flood irrigation agricultural activities. Guidelines established by OSM and WDEQ/LQD for the identification of AVFs require detailed studies of geomorphology, soils, hydrology, vegetation, and land use. These studies are used to identify 1) the presence of unconsolidated stream laid deposits, 2) the possibility for artificial flood irrigation, 3) past and/or present flood irrigation, and 4) apparent subirrigated areas and the possibility for natural flood irrigation. Following these studies, areas passing the limiting criteria that are identified as AVFs are evaluated for their significance to farming by WDEQ/LQD.

SMCRA prohibits surface coal mining operations that would interrupt, discontinue, or preclude farming on AVFs or cause material damage to the quantity or quality of water systems that supply AVFs. However, if the premining land use of the affected AVF is undeveloped rangeland that is not significant to farming or if the affected AVF is of such small acreage that it would have a negligible impact on a farm's agricultural production, these prohibitions would not apply and mining would be allowed. The prohibitions also apply if AVFs that are downstream of the area proposed for mining would be affected by disruptions in streamflow. Provided WDEQ determines that an AVF is not significant to agriculture, it can be disturbed by mining but must be restored as part of the reclamation process. For any designated AVF, regardless of its significance to agriculture, it must be demonstrated that the essential hydrologic functions of the AVF, both within and outside the mine area, will be protected.

In a decision by the U.S. District Court for the District of Columbia, Civil Action Number 69-1144 (1980) (known as the Flannery Decision), the court noted that an AVF must satisfy both geologic criteria (unconsolidated stream laid deposits)

and hydrologic criteria (water sufficient to sustain agriculture). Therefore, the court emphasized that the key to the existence of an AVF is the presence of both geologic and water availability characteristics, which together sustain agricultural activities.

Investigations have been conducted by TBCC, JRCC, and PRC to determine the presence of AVFs within and surrounding the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines, respectively. AVF investigations conducted within and near the general Wright analysis area have identified AVFs that occur along Little Thunder Creek, North Prong Little Thunder Creek, and Porcupine Creek; however, those lands are located at considerable distances downstream of the six LBA tracts included in this analysis. Refer to Figure 3-26 for the location of the major streams with respect to the applicant mines and LBA tracts in the general Wright analysis area.

The investigations concluded, and WDEQ concurred, that an AVF that is significant to agriculture exists at the confluence of North Prong Little Thunder Creek and Little Thunder Creek. WDEQ/LQD declared 194 acres along the lower reach of North Prong Little Thunder Creek and 143 acres along Little Thunder Creek, and the declared AVF extends from near the eastern edge of the Black Thunder Mine permit boundary downstream (eastward) to the streams' confluence.

AVF investigations concluded, and WDEQ concurred, that an AVF exists along the lower reach of Porcupine Creek. WDEQ/LQD declared that a narrow area adjacent to the Porcupine Creek channel, totaling 39 acres, is an AVF not significant to agriculture. North Antelope Rochelle Mine was allowed to mine this area after WDEQ approved the mine's plan to preserve the essential hydrologic functions of the AVF along Porcupine Creek. Sections of Porcupine Creek have been mined and reclaimed in this area since 1984. In addition, a 250-acre flood-irrigated hay meadow that exists near the confluence of Porcupine Creek and Antelope Creek has been determined by WDEQ/LQD to be an AVF significant to agriculture. This hay meadow, which is irrigated by surface water diverted from Antelope Creek and stored in a nearby reservoir (Porcupine Reservoir), is the only flood-irrigated land that has been identified in and near the general Wright analysis area. Special measures have been designated to ensure that the North Antelope Rochelle Mine will not interrupt or preclude farming on the flood-irrigated lands, and Porcupine Creek downstream from the mine's facilities will not be affected by mining. No other AVFs identified in this area have been determined by WDEQ/LQD to be significant to agriculture.

3.6.1.1 North Hilight Field LBA Tract

Numerous ephemeral drainages occur within the general analysis area for the North Hilight Field LBA Tract, although the stream laid deposits associated with these drainages are very limited in areal extent and not capable of supporting subirrigation or flood irrigation agricultural activities. Surface

water quantity is insufficient to support natural or artificial flood irrigation practices, and historic flood irrigation attempts have not been identified along Mills Draw, Keeline Draw, or Springen Draw. Due to its limited areal extent, limited saturated thickness, and low hydraulic conductivity, alluvial deposits associated with these streams do not consistently produce enough water to be put to beneficial use. Furthermore, the alluvial groundwater is generally of such poor quality that it does not meet WDEQ/WQD standards for agricultural use (refer to Section 3.5.1.1.1). The soils that dominate the drainage bottoms within the general analysis area for the tract are classified by the Natural Resource Conservation Service (NRCS) as unsuitable for irrigation.

If the North Hilight Field LBA Tract is leased and proposed for mining, an AVF assessment would be part of the mine permitting process, and formal declarations of the presence or absence of an AVF, its significance to agriculture, and the appropriate perimeter (areal extent) would be made by the WDEQ/LQD as part of the permitting process. Based on previous non-AVF declarations made on Mills Draw and Springen Draw within and adjacent to the existing Jacobs Ranch Mine permit area, which includes a portion of the BLM study area for the North Hilight Field LBA Tract, it is unlikely that WDEQ/LQD would declare that any AVFs exist in the general analysis area for the North Hilight Field tract.

3.6.1.2 South Hilight Field LBA Tract

As discussed in Section 3.5.1.1.1, within the BLM study area for the South Hilight Field LBA Tract, alluvial deposits are primarily associated with Little Thunder Creek. Little Thunder Creek and its tributaries within and extending a half mile beyond Black Thunder Mine's existing permit boundary have been formally investigated for the presence of AVFs by TBCC. Therefore, the entire length of Little Thunder Creek within the South Hilight Field LBA Tract has been investigated, and the reports of these studies are contained in Black Thunder Mine's WDEQ/LQD mine permit (TBCC 2005). These investigations concluded, and WDEQ has concurred, that no AVFs exist along Little Thunder Creek within the South Hilight Field LBA Tract. The declared AVF at the North Prong Little Thunder Creek and Little Thunder Creek confluence is located several miles downstream from the LBA tract and would not be affected by mining and reclamation within the tract.

Other drainages on the South Hilight Field tract are much smaller and AVF characteristics are negligible. Few stream laid deposits are present, the streams do not consistently produce enough runoff to be put to beneficial use, and the soils that dominate the drainage bottoms within the general analysis area are classified by the NRCS as unsuitable for irrigation. In addition, there are no present or historical records of agricultural use, other than undeveloped range land, of the stream channels and associated stream laid deposits within the general analysis area for the tract. If the South Hilight Field LBA Tract is leased and proposed for mining, an AVF assessment would be part of the mine permitting process. Based on previous non-AVF declarations made on Little

Thunder Creek within and adjacent to the South Hilight Field LBA Tract, it is unlikely that the WDEQ/LQD would declare that an AVF is present within the general analysis area for the tract.

3.6.1.3 West Hilight Field LBA Tract

Alluvial deposits within the BLM study area for the West Hilight Field LBA Tract are, like the adjacent South Hilight Field tract, primarily associated with Little Thunder Creek. As discussed above, Little Thunder Creek and its tributaries within and extending a half mile beyond Black Thunder Mine's existing permit boundary have been investigated for the presence of AVFs by TBCC. Therefore, Little Thunder Creek has not been formally investigated for the presence of AVFs within the general analysis area for the West Hilight Field LBA Tract. Based on previous non-AVF declarations made on Little Thunder Creek downstream of the West Hilight Field LBA Tract, it is unlikely that the stream would be declared an AVF in this area where the stream is smaller and AVF characteristics (i.e., extent of alluvial deposits, water availability, and water quality) are negligible. The declared AVF at the North Prong Little Thunder Creek and Little Thunder Creek confluence is located several miles downstream from the West Hilight Field LBA Tract and would not be affected by mining and reclamation within the tract.

Other drainages on the West Hilight Field tract are tributaries of Little Thunder Creek and AVF characteristics are negligible. Few stream laid deposits are present, the streams do not consistently produce enough runoff to be put to beneficial use, and the soils that dominate the drainage bottoms within the general analysis area are classified by the NRCS as unsuitable for irrigation. In addition, there are no present or historical records of agricultural use, other than undeveloped range land, of the stream channels and associated stream laid deposits within the general analysis area for the tract. If the West Hilight Field LBA Tract is leased and proposed for mining, an AVF assessment would be part of the mine permitting process, although it is unlikely that the WDEQ/LQD would declare that an AVF is present.

3.6.1.4 West Jacobs Ranch LBA Tract

As discussed in Section 3.5.1.1.1, in the general analysis area for the West Jacobs Ranch LBA Tract, alluvial deposits have been mapped only along Dry Fork Little Thunder Creek and one of its unnamed tributaries; no stream laid deposits have been mapped within any other drainage in the area. If the West Jacobs Ranch LBA Tract is leased and proposed for mining, an AVF assessment would be part of the mine permitting process, and formal declarations of the presence or absence of an AVF, its significance to agriculture, and the appropriate perimeter (areal extent) would be made by the WDEQ/LQD as part of the permitting process. Based on previous non-AVF declarations made on North Prong Little Thunder Creek and Dry Fork Little Thunder Creek downstream within the existing Black Thunder Mine permit area, which includes a portion of the West Jacobs Ranch LBA Tract, it is

unlikely that WDEQ/LQD would declare that any AVF characteristics exist in the general analysis area for the West Jacobs Ranch tract. The declared AVF at the North Prong Little Thunder Creek and Little Thunder Creek confluence is located several miles downstream from the West Jacobs Ranch LBA Tract and would not be affected by mining and reclamation within the tract.

3.6.1.5 North Porcupine LBA Tract

As discussed in Section 3.5.1.1.1, alluvial deposits are primarily associated with Porcupine Creek within the BLM study area for the North Porcupine LBA Tract. The BLM study area for the North Porcupine tract is completely within North Antelope Rochelle Mine's existing mine permit area; therefore, the entire lengths of Porcupine Creek and its tributaries (e.g., Payne Draw, Corder Creek, Boss Draw, Rat Draw, Chipmunk Draw, and Gray Creek) that cross the North Porcupine LBA Tract have been formally investigated for the presence of AVFs, and the reports of these studies are contained in North Antelope Rochelle Mine's WDEQ/LQD mine permit (PRC 2004). These investigations concluded, and WDEQ has concurred, that no AVFs exist along Porcupine Creek or its tributaries within the general analysis area for the North Porcupine LBA Tract. The declared AVF areas on Porcupine Creek are located several miles downstream from the LBA tract and would not be affected by mining and reclamation within the tract.

3.6.1.6 South Porcupine LBA Tract

As discussed in Section 3.5.1.1.1, no unconsolidated stream laid deposits have been mapped within the BLM study area for the South Porcupine LBA Tract. The South Porcupine tract is completely within North Antelope Rochelle Mine's existing mine permit area, although the streams draining the tract's general analysis area have not all been formally evaluated for the presence of AVFs. If the South Porcupine LBA Tract is leased and proposed for mining, it is unlikely that WDEQ would require that an AVF assessment be part of the mine permitting process in consideration of the absence of any alluvial deposits on the tract.

3.6.2 Environmental Consequences

3.6.2.1 Proposed Action and Alternatives 2 and 3

AVF investigations conducted within and near the general Wright analysis area have identified AVFs that occur along Little Thunder Creek, North Prong Little Thunder Creek, and Porcupine Creek; however, those lands are located at considerable distances downstream of the six LBA tracts included in this analysis.

As indicated above, the entire general analysis area for the North Hilight Field LBA Tract has not yet been formally evaluated for the presence of AVFs. AVF investigations conducted within and adjacent to the existing Black Thunder

and Jacobs Ranch Mine permit areas have determined that the AVF characteristics of Mills Draw and Springen Draw are negligible and do not meet the regulatory definition of an AVF. The paucity of alluvial deposits, insufficient surface water runoff to support natural or artificial flood irrigation, insufficient or poor quality alluvial groundwater, and unsuitable soils for irrigation all indicate it is unlikely that mining the North Hilight Field tract as applied for or BLM's preferred tract configuration under Alternative 2 by the applicant as an extension of the existing Black Thunder Mine would directly or indirectly affect any AVFs in those areas.

As indicated above, TBCC has investigated for the presence of AVFs on Little Thunder Creek within and a half mile outside of Black Thunder Mine's existing permit area, which included the entire length of the stream within the South Hilight Field LBA Tract. Based on the non-AVF declarations that have been made on Little Thunder Creek within and adjacent to the LBA tract, and because there are essentially no other alluvial deposits in the tract's general analysis area outside of Little Thunder Creek's valley, it is unlikely that mining the South Hilight Field tract as applied for or BLM's preferred tract configuration under Alternative 2 by the applicant as an extension of the existing Black Thunder Mine would have any direct or indirect impacts on AVFs in those areas.

Based on previous non-AVF declarations made on Little Thunder Creek downstream of and adjacent to the West Hilight Field LBA Tract, it is unlikely that this stream would receive an AVF declaration upstream on this LBA tract where the drainage is smaller and AVF characteristics are negligible. As indicated above, few stream laid deposits are present in the tract's general analysis area outside the valley of Little Thunder Creek, the streams do not consistently produce enough runoff to be put to beneficial use, and the soils that dominate the drainage bottoms within the general analysis area are classified by the NRCS as unsuitable for irrigation. In addition, there are no present or historical records of agricultural use, other than undeveloped range land, of the stream channels and associated stream laid deposits within the general analysis area for the tract. It is therefore unlikely that mining the West Hilight Field tract as applied for or BLM's preferred tract configuration under Alternative 2 by the applicant as an extension of the existing Black Thunder Mine would have any direct or indirect impacts on AVFs in those areas.

If the West Jacobs Ranch LBA Tract is mined by the applicant as an extension of the existing Jacobs Ranch Mine operations under the Proposed Action or Alternative 2, BLM's preferred tract configuration, the mining operations would remove stream laid deposits from an area totaling about 35 acres along Dry Fork Little Thunder Creek and one of its unnamed tributaries. Although the published geologic mapping of the remainder of the general analysis area for the West Jacobs Ranch LBA Tract indicates that there are no other areas where stream laid deposits occur, detailed AVF investigations, including mapping of alluvial deposits, would be completed as part of the permitting process. Based on previous non-AVF declarations made on North Prong Little Thunder Creek

and Dry Fork Little Thunder Creek downstream within the existing Black Thunder Mine permit area, which includes a portion of the West Jacobs Ranch LBA Tract, it is unlikely that mining the West Jacobs Ranch tract as applied for or BLM's preferred tract configuration under Alternative 2 by the applicant as an extension of the existing Jacobs Ranch Mine would have any direct or indirect impacts on AVFs in those areas.

Porcupine Creek and its tributaries within the existing North Antelope Mine permit area has been evaluated and declared non-AVF by WDEQ/LQD. The BLM study area for the North Porcupine LBA Tract is entirely within the mine's existing permit area; therefore, no AVFs would be directly or indirectly impacted by mining the North Porcupine tract as applied for or BLM's preferred tract configuration under Alternative 2 by the applicant as an extension of the existing North Antelope Rochelle Mine.

No unconsolidated stream laid deposits are found within the South Porcupine LBA Tract. The entire general analysis area for the South Porcupine tract has not been formally evaluated for the presence of AVFs; however, it is unlikely an AVF declaration would be made. It is unlikely that mining the South Porcupine LBA Tract as applied for or BLM's preferred tract configuration under Alternative 2 by the applicant as an extension of the existing North Antelope Rochelle Mine would have any direct or indirect impacts on AVFs in those areas.

It is reasonable to assume that if the WDEQ/LQD would determine that no AVFs are present within any of the LBA tracts that are leased. Should declarations be made within any LBA tracts that are leased, it is reasonable to assume that mining would be permitted because all of the proposed lease areas consist entirely of undeveloped rangeland. If the LBA tracts that are leased are mined as an extension of existing operations, the mining would generally extend upstream on streams already in active mine areas.

No direct, indirect, or cumulative impacts are anticipated to off-site AVFs through mining of the six LBA tracts included in this analysis. Streamflows in Little Thunder Creek, North Prong Little Thunder Creek, and Porcupine Creek and their tributaries would be diverted around the active mining areas in a temporary diversion ditches, captured in various flood control structures above the pits, or allowed to accrue to the mine pits. Therefore, during normal runoff events, a slight reduction in downstream flow rates would be expected. Following major runoff events, it would be necessary to evacuate the pit sumps and flood control structures to provide storage volume for the next runoff event. Runoff waters would then be discharged outside the mine permit area after sufficient time for settling of suspended solids has passed. Consequently, disruptions to streamflow that might supply downstream AVFs during mining are expected to be negligible. Groundwater and surface runoff intercepted by the mine pits would be routed through settling ponds to meet state and federal quality criteria, and the pond discharges would likely increase the frequency

and amount of flow in these streams, thereby increasing surface water supplies to downstream AVFs.

3.6.2.2 No Action Alternative

Under the No Action Alternative, the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine coal lease applications would be rejected and coal removal and associated disturbance and impacts to AVFs would not occur on the portions of the LBA tracts as applied for or the LBA tracts configured under Alternative 2 that will not be disturbed under the currently approved surface coal mining permits. Coal removal and associated impacts to AVFs would continue as currently permitted on the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle Mine permit areas. Impacts to AVFs related to mining operations at these three applicant mines would not be extended onto portions of the LBA tracts that will not be affected under the current mining and reclamation plans.

As discussed in Section 2.2, a decision to reject one or more of these six coal lease applications at this time would not preclude an application to lease that respective tract in the future.

3.6.3 Regulatory Compliance, Mitigation and Monitoring

As discussed above, AVFs must be identified because SMCRA restricts mining activities that would affect AVFs that are determined to be significant to agriculture. Impacts to lands that are declared an AVF are generally not permitted if the AVF is determined to be significant to agriculture. If the AVF is determined not to be significant to agriculture, or if the permit to affect the AVF was issued prior to the effective date of SMCRA, the AVF can be disturbed during mining but must be restored as part of the reclamation process. In the State of Wyoming, the determination of significance to agriculture is made by WDEQ/LQD, and it is based on specific calculations related to the production of crops or forage on the AVF and the size of the existing agricultural operations on the land of which the AVF is a part. For any designated AVF, regardless of its significance to agriculture, it must be demonstrated that the essential hydrologic functions of the stream valley will be protected. Mines are required to restore the essential hydrologic functions of any affected AVF and preserve the hydrologic functions of AVFs on adjacent lands.

Downstream AVFs must also be protected during mining. The effects of mining on downstream AVFs are required by regulation by monitoring discharges of surface water from the current mine permit areas for quantity and quality during mining. These requirements would be extended to include the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts during the permitting process, if the tracts are leased. These requirements would be extended accordingly and included in the mine permit amendment that would be required for each

respective LBA tract that is leased. Mine permit revisions must be approved before mining could occur on each tract that is leased, regardless of who acquires the tract.

3.6.4 Residual Impacts

No residual impacts to AVFs would occur following mining.

3.7 Wetlands

3.7.1 Affected Environment

Wetlands are aquatic features defined as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas" (33 CFR 328.3[a][7][b]). The prolonged presence of water creates conditions that favor the growth of specially adapted plants and promote the development of characteristic wetland (hydric) soils (EPA 2007c). Vegetation in wetland environments is highly productive and diverse and provides habitat for many wildlife species. These systems as a whole play important roles in controlling floodwaters, recharging groundwater, and filtering pollutants (Niering 1985).

Wetlands must contain three components: hydric soils, a dominance of hydrophytic plants, and wetland hydrology. When the upper part of the soil is saturated with water at growing season temperatures, soil organisms consume the oxygen in the soil and cause conditions unsuitable for most plants. Such conditions also cause the development of soil characteristics (such as color and texture) of so-called "hydric soils." The plants that can grow in such conditions, such as marsh grasses, are called "hydrophytes." Together, hydric soils and hydrophytes give clues that a wetlands area is present. The presence of water by ponding, flooding, or soil saturation is not always a good indicator of wetlands. Except for wetlands flooded by ocean tides, the amount of water present in wetlands fluctuates as a result of rainfall patterns, snow melt, dry seasons and longer droughts (EPA 2007c, Niering 1985, COE 1987).

Waters of the U.S. (WoUS) is a collective term for those water bodies subject to regulation pursuant to the Clean Water Act (CWA). The U.S. Army Corps of Engineers (COE) administers a regulatory program under Section 404 of the CWA, which requires a permit for the discharge of dredged or fill materials into WoUS, including jurisdictional wetlands. This regulatory program requires that an inventory of WoUS, including wetlands, be performed, permits be acquired prior to dredging or filling jurisdictional wetlands, and that impacts to jurisdictional wetlands and Other Waters of the U.S. (OWUS) be adequately mitigated. WDEQ/LQD regulations require that wetlands and other high value wildlife habitat that is to be disturbed by proposed mining activities be reclaimed following mining operations.

WoUS include all areas subject to regulation by the COE pursuant to the CWA, to include special aquatic sites, of which wetlands is a subset. The definition of WoUS has been broadly interpreted to include most major water bodies, streams, intermittent drainages, mud flats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, and natural ponds. Special aquatic sites are defined as "geographic areas, large or small, possessing special ecological characteristics and productivity, habitat, wildlife protection, or other important and easily disrupted ecological values" (40 CFR 230.3[q-1]). Special aquatic sites include "sanctuaries and refuges, wetlands, mud flats, vegetated shallows, coral reefs, and riffle and pool complexes" (40 CFR 230, Subpart E).

Wetlands subject to CWA jurisdiction are known as "jurisdictional wetlands", while those wetlands not subject to CWA jurisdiction are known as "non-jurisdictional" wetlands. Compliance with Section 404 and its implementing regulations requires a sequence of avoidance, minimization of impact, and mitigation of wetlands. Precise definitions of WoUS or navigability are ultimately dependent on judicial interpretation and cannot be made conclusively by administrative agencies (33 CFR 329). Rules, regulations, policies, and procedures used in determining the extent of jurisdiction have changed and evolved with time. Many ephemeral channels and playas in the PRB have, in the past, been classified as WoUS. However, several changes have occurred to the COE regulatory program over the past several years that will have a bearing on the current status of numerous areas historically classified as jurisdictional. For example, in 2001 the U.S. Supreme Court ruled that isolated waters and playas are not WoUS. A U.S. Supreme Court decision (*Rapanos v. United States* and *Carabell v. United States*, collectively referred to as the "Rapanos" decision) in 2006 attempted to address federal jurisdiction over waters of the U.S. under the CWA (EPA 2007d). According to the Court's decision, the EPA and COE must ensure that jurisdictional determinations, permitting actions, and other relevant actions are consistent with the Rapanos decision. The decision addressed where the federal government can apply the CWA, specifically by determining whether a wetland or tributary is a "Water of the U.S.", being "relatively permanent, standing or continuously flowing bodies of water" connected to traditional navigable waters, and to "wetlands with a continuous surface connection (nexus) to" such relatively permanent waters. As a result of that decision, the COE has placed a moratorium on the issuance of approved jurisdictional determinations that will be in place until the COE headquarters, the EPA, and the Department of Justice determines how to proceed and issues appropriate legal guidance.

Federal regulations limit jurisdiction to the Ordinary High Water Mark (OHWM) (33 CFR 328.4). Previous delineations used the very general criteria that stated "drainages must have an active channel that exhibits relatively stable fluviogeomorphic character (i.e., the channel has a well-defined bed and grade) to be classified as WoUS." Regulatory Guidance Letter 05-05 now provides a specific list of the physical characteristics that are to be evaluated to identify the presence or location of an OHWM. Evaluation of these specific physical

characteristics may now lead to a determination that many of the ephemeral drainages in the PRB are not jurisdictional.

Briefly, the agencies will assert jurisdiction over the following waters:

- Traditional navigable waters;
- Wetlands adjacent to traditional navigable waters;
- Non-navigable tributaries of traditional navigable waters that are relatively permanent where the tributaries typically flow year-round or have continuous flow at least seasonally (e.g., typically three months); and
- Wetlands that directly abut such tributaries.

The agencies will decide jurisdiction over the following waters based on a fact-specific analysis to determine whether they have a significant nexus with a traditional navigable water:

- Non-navigable tributaries that are not relatively permanent;
- Wetlands adjacent to non-navigable tributaries that are not relatively permanent; and
- Wetlands adjacent to, but do not directly abut, a relatively permanent non-navigable tributary.

The agencies will generally not assert jurisdiction over the following features:

- Swales or erosional features (e.g., gullies, small washes characterized by low volume, infrequent, or short duration flow); and
- Ditches (including roadside ditches) excavated wholly in and draining only uplands and that do not carry a relatively permanent flow of water.

In describing wetlands, three very different types, from a permitting perspective, may be identified, those being jurisdictional, non-jurisdictional, and functional. Functional wetlands are areas that may contain only one or two of the three wetland criteria (presence of hydric soils, a dominance of hydrophytic plants, and wetland hydrology). The United States Fish and Wildlife Service (USFWS) uses this third categorization in producing National Wetland Inventory (NWI) maps, which are based on aerial photo interpretation with limited or no field verification.

Wetlands can occur in a variety of forms and are somewhat limited in size within the general Wright analysis area; however, the vegetation in these environments is relatively productive and diverse, and provides habitat for a number of wildlife species. Riverine wetlands, typically defined by their close association with stream channels, occur sporadically along drainages. In this area, these wetlands are generally supported by periodic flooding events. Common vegetation species in these riverine settings can include willows (*Salix* spp.), scouring rush (*Equisetum* spp.), sedges (*Carex* spp.), and rushes (*Juncus* spp.). Palustrine wetlands, defined by their close association with emergent

herbaceous marshes, swales, and wet meadows, support a variety of lush plant life and occur sporadically along major drainages and where topographic depression areas (playas) are naturally subirrigated and/or sporadically flooded. These wetlands are the most common and abundant in the general Wright analysis area. Common vegetation species in these palustrine settings can include sedges, rushes, cordgrass (*Spartina* spp.), mint (*Mentha* spp.), and buttercup (*Ranunculus* spp.). Naturally occurring depressions (playas) that flooded more frequently and/or hold deeper water may support lacustrine wetlands. Manmade structures such as stock ponds may also support lacustrine wetlands. The most common species in these lacustrine settings include cattails (*Typha* spp.) and bulrush (*Scirpus* spp.), although lady's thumb (*Polygonum* spp.), verbena (*Verbena* spp.), and milkweed (*Asclepias* spp.) may also occur (USFS 1987).

In addition to wetlands, the general Wright analysis area may include Other Waters of the U.S. (OWUS), as defined by 33 CFR 328.3. These OWUS are primarily ephemeral stream channels, open water, and other stream channels that carry water but do not meet the criteria for classification as wetlands.

3.7.1.1 North Hilight Field LBA Tract

A preliminary wetland inventory of the general analysis area for the North Hilight Field LBA Tract, based on USFWS NWI mapping (1980), review of color infrared aerial photographs (WGCS 2002), and a field survey reconnaissance, was conducted in 2007. Some wetland areas previously mapped by the USFWS NWI have been recently altered due to CBNG-related water production within and upstream of the general analysis area. The NWI maps were consulted prior to the initiation of the preliminary wetland field survey; however, the boundaries of the existing potential wetlands vary to a greater or lesser extent from the boundaries shown on the NWI maps. Due to the ephemeral nature of CBNG dewatering activities, the boundaries, and therefore wetland areas, are likewise ephemeral. A formal jurisdictional wetland delineation survey for the North Hilight Field LBA Tract would be conducted and submitted to the COE for verification as part of the mine permitting process, if the LBA tract is leased.

Within the entire general analysis area for the North Hilight Field LBA Tract (8,476.4 acres), the preliminary wetland inventory identified a total of 177.5 acres of wetlands and OWUS. These wetlands and OWUS were found within five general land categories: ephemeral streams, playas, ponds/reservoirs, isolated depressions, and excavated upland areas. These 177.5 acres are vegetated wetlands that consist of approximately 172.0 acres of palustrine emergent herbaceous wet meadow or marsh and approximately 5.5 acres of palustrine aquatic beds located along ephemeral stream channels and around ponds, playas and depressions. No areas of open water (pond or channel OWUS) were observed during this preliminary wetland inventory.

At this time, a distinction has not been made between jurisdictional and non-jurisdictional acreages of wetlands and OWUS since only the COE has the authorization to make such determination following the submittal and review of a formal wetland delineation as part of the permitting process.

3.7.1.2 South Hilight Field LBA Tract

A preliminary wetland inventory of the general analysis area for the South Hilight Field LBA Tract, based on USFWS NWI mapping (1980), review of color infrared aerial photographs (WGCS 2002), and a field survey reconnaissance, was conducted in 2007. Some wetland areas previously mapped by the USFWS NWI have been recently altered due to CBNG-related water production within and upstream of the general analysis area. The NWI maps were consulted prior to the initiation of the preliminary wetland field survey; however, the boundaries of the existing potential wetlands vary to a greater or lesser extent from the boundaries shown on the NWI maps. Due to the ephemeral nature of CBNG dewatering activities, the boundaries, and therefore wetland areas, are likewise ephemeral. A formal jurisdictional wetland delineation survey for the South Hilight Field LBA Tract would be conducted and submitted to the COE for verification as part of the mine permitting process, if the LBA tract is leased.

Within the entire general analysis area for the South Hilight Field LBA Tract (3,367.9 acres), the preliminary wetland inventory identified a total of 55.1 acres of wetlands and OWUS. These wetlands and OWUS were found within five general land categories: ephemeral streams, playas, ponds/reservoirs, isolated depressions, and excavated upland areas. Of these 55.1 acres, approximately 52.3 acres are vegetated wetlands that consist of approximately 51.2 acres of palustrine emergent herbaceous wet meadow or marsh and approximately 1.1 acres of palustrine aquatic beds located along ephemeral stream channels and around ponds, playas and depressions. The remaining 2.8 acres are channel OWUS (open water in Little Thunder Creek). Little Thunder Creek was initially classified as a palustrine wetland by NWI, but currently meets the classification of a riverine, streambed system and is heavily influenced by CBNG discharge water.

At this time, a distinction has not been made between jurisdictional and non-jurisdictional acreages of wetlands and OWUS since only the COE has the authorization to make such determination following the submittal and review of a formal wetland delineation as part of the permitting process.

3.7.1.3 West Hilight Field LBA Tract

A preliminary wetland inventory of the general analysis area for the West Hilight Field LBA Tract, based on USFWS NWI mapping (1980), review of color infrared aerial photographs (WGCS 2002), and a field survey reconnaissance, was conducted in 2007. Some wetland areas previously mapped by the USFWS NWI have been recently altered due to CBNG-related water production

within and upstream of the general analysis area. The NWI maps were consulted prior to the initiation of the preliminary wetland field survey; however, the boundaries of the existing potential wetlands vary to a greater or lesser extent from the boundaries shown on the NWI maps. Due to the ephemeral nature of CBNG dewatering activities, the boundaries, and therefore wetland areas, are likewise ephemeral. A formal jurisdictional wetland delineation survey for the West Hilight Field LBA Tract would be conducted and submitted to the COE for verification as part of the mine permitting process, if the LBA tract is leased.

Within the entire general analysis area for the West Hilight Field LBA Tract (9,188.6 acres), the preliminary wetland inventory identified a total of 262.7 acres of wetlands and OWUS. These wetlands and OWUS were found within five general land categories: ephemeral streams, playas, ponds/reservoirs, isolated depressions, and excavated upland areas. Of these 262.7 acres, approximately 252.8 acres are vegetated wetlands that consist of approximately 240.6 acres of palustrine emergent herbaceous wet meadow or marsh and approximately 12.2 acres of palustrine aquatic beds located along ephemeral stream channels and around ponds, playas and depressions. The remaining 9.9 acres are channel and pond OWUS (open water in Little Thunder Creek and Little Thunder Reservoir). Little Thunder Creek was initially classified as a palustrine wetland by NWI, but currently meets the classification of a riverine, streambed system and is heavily influenced by CBNG discharge water.

At this time, a distinction has not been made between jurisdictional and non-jurisdictional acreages of wetlands and OWUS since only the COE has the authorization to make such determination following the submittal and review of a formal wetland delineation as part of the permitting process.

3.7.1.4 West Jacobs Ranch LBA Tract

A preliminary wetland inventory of the general analysis area for the West Jacobs Ranch LBA Tract, based on USFWS NWI mapping (1980) and a field survey reconnaissance, was conducted in 2007 and 2008. Information was also obtained from previous formal wetland inventories completed on the eastern portion of the general analysis area by TBCC (TBCC 2005). Some wetland areas previously mapped by the USFWS NWI and other inventories have been recently altered due to CBNG-related water production within and upstream of the general analysis area. The NWI maps were consulted prior to the initiation of the preliminary wetland field survey; however, the boundaries of the existing potential wetlands vary to a greater or lesser extent from the boundaries shown on the NWI maps. Due to the ephemeral nature of CBNG dewatering activities, the boundaries, and therefore wetland areas, are likewise ephemeral. A formal jurisdictional wetland delineation survey for the West Jacobs Ranch LBA Tract would be conducted and submitted to the COE for verification as part of the mine permitting process, if the LBA tract is leased.

Within the entire general analysis area for the West Jacobs Ranch LBA Tract (9,370.4 acres), the preliminary wetland inventory identified a total of 68.4 acres of wetlands and OWUS. These wetlands and OWUS were found within four general land categories: ponds, ephemeral streams, playas, and depressions. Of this 68.4 acres, approximately 16.7 acres are vegetated wetlands, which include 4.7 acres around ponds, 7.8 acres along ephemeral streams, 1.7 acres on playas, and 2.5 acres in other depressions. The remaining 50.7 acres are pond or channel other waters (i.e., open water in reservoirs/stockponds, along ephemeral streams, and in playas). The vegetated wetlands are located primarily along the stream channels associated with Dry Fork and North Prong Little Thunder Creek. All of these wetlands and OWUS are classified as palustrine.

At this time, a distinction has not been made between jurisdictional and non-jurisdictional acreages of wetlands and OWUS since only the COE has the authorization to make such determination following the submittal and review of a formal wetland delineation as part of the permitting process.

3.7.1.5 North Porcupine LBA Tract

Formal jurisdictional wetland delineation surveys covering North Antelope Rochelle Mine's current permit area and some additional adjacent lands were completed by PRC and submitted to the COE for verification in 1996, 1997, 2000 and 2004. These wetland delineations and the COE's respective letters of verification summarizing the acreage figures of approved jurisdictional determinations are included in Appendix D-10 of the mine's permit (PRC 2004). According to the COE's latest (October 12, 2004) jurisdictional determination, there is a total of 219.71 acres of jurisdictional wetlands and OWUS within the mine's current permit area. Of those 219.71 acres, there are 77.84 acres of riverine wetlands, 26.99 acres of stockpond wetlands, 11.42 acres of riverine open water OWUS, 44.62 acres of stockpond open water OWUS, and 58.84 acres of ephemeral stream channel OWUS. There are also 20.92 wetland acres and 1.33 open water acres of non-jurisdictional playa/depressional features.

The general analysis area for the North Porcupine LBA Tract lies completely within North Antelope Rochelle Mine's current mine permit area. Therefore, these previous wetland delineation surveys provide an estimate of the acreages of wetlands and OWUS that exist within the LBA tract's general analysis area, with the caveat that some wetland areas previously mapped may have been altered by CBNG-related water production within and upstream of the general analysis area. In addition to the effects from CBNG-related water discharges, the PRB has experienced a moderate to severe drought cycle that has persisted since 2000, which may have also altered previously-mapped wetland and OWUS areas. The boundaries of some wetlands and OWUS could, therefore, vary to a greater or lesser extent from the boundaries that existed at the time that the formal wetland delineation surveys were conducted.

Within the general analysis area for the North Porcupine LBA Tract (9,021.4 acres), there are an estimated 25.8 acres of jurisdictional wetlands and OWUS. Of those 25.8 acres, there are approximately 9.3 acres of riverine wetlands, approximately 0.9 acres of stockpond wetlands, approximately 0.9 acres of stockpond open water OWUS, and approximately 8.6 acres of ephemeral stream channel OWUS. There are also approximately 4.9 wetland acres and 1.2 open water acres of non-jurisdictional playa/depressional features. The vegetated wetland areas consist primarily of palustrine emergent herbaceous wet meadow or marsh and palustrine aquatic beds located along ephemeral stream channels and around ponds, playas and depressions, whereas the OWUS consist of dry ephemeral drainages and open water.

3.7.1.6 South Porcupine LBA Tract

The general analysis area for the South Porcupine LBA Tract lies completely within North Antelope Rochelle Mine's current mine permit area. Therefore, the mine's wetland delineation surveys described above provide an estimate of the acreages of wetlands and OWUS that exist within the LBA tract's general analysis area, with the caveat that some wetland areas previously mapped may have been altered by CBNG-related water production within and upstream of the general analysis area. In addition to the effects from CBNG-related water discharges, the PRB has experienced a moderate to severe drought cycle that has persisted since 2000, which may have also altered previously-mapped wetland and OWUS areas. The boundaries of some wetlands and OWUS could, therefore, vary to a greater or lesser extent from the boundaries that existed at the time that the formal wetland delineation surveys were conducted.

Within the general analysis area for the South Porcupine LBA Tract (4,020.5 acres), there are an estimated 12.5 acres of jurisdictional wetlands and OWUS. Of those 12.5 acres, there are approximately 6.8 acres of riverine wetlands, approximately 0.4 acres of stockpond wetlands, approximately 0.2 acres of stockpond open water OWUS, and approximately 4.9 acres of ephemeral stream channel OWUS. There are also approximately 0.2 wetland acres of non-jurisdictional playa/depressional features. The vegetated wetland areas consist primarily of palustrine emergent herbaceous wet meadow or marsh along ephemeral stream channels and around ponds, playas and depressions, whereas the OWUS consist of dry ephemeral drainages and open water.

3.7.2 Environmental Consequences

3.7.2.1 Proposed Action and Alternatives 2 and 3

Formal wetland delineations have been confirmed by the COE for wetlands and OWUS included in the proposed LBA tracts that lie within the three applicant mines' existing permit areas. Based on those previous wetland delineation surveys and the preliminary wetland inventories conducted in 2007 and 2008 of the general analysis areas for the six LBA tracts included in this EIS, a maximum of approximately 602 acres of wetlands and OWUS would be

disturbed if each of the six LBA tracts is leased and subsequently mined under Alternative 2, BLM's preferred alternative for each of the six tracts. Formal wetland inventories covering the remainder of the general analysis areas for the LBA tracts that are leased would be conducted and submitted to the COE for verification as part of the process of obtaining a surface coal mining permit. In Wyoming, once the delineation has been verified, it is made a part of the mine permit document. The reclamation plan is then revised to incorporate the replacement of at least equal types and number of jurisdictional wetland acreages.

Disturbed non-jurisdictional wetlands would be restored as required by the authorized federal or state agency or private surface land owner as specified in the mine permit, which would have to be approved by WDEQ/LQD before mining operations could be conducted on the LBA tracts that are leased.

During the period of time after mining and before replacement of wetlands, all wetland functions would be lost. The replaced wetlands may not duplicate the exact function and landscape features of the premine wetlands, but replacement plans would be evaluated by the COE and replacement would be in accordance with the requirements of Section 404 of the CWA as determined by the COE.

3.7.2.2 No Action Alternative

Under the No Action Alternative, the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine coal lease applications would be rejected and coal removal and associated disturbance and impacts to wetlands and OWUS would not occur on the portions of the LBA tracts as applied for or the LBA tracts configured under Alternative 2 that will not be disturbed under the currently approved surface coal mining permits. Coal removal and associated impacts to wetlands and OWUS would continue as currently permitted on the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle Mine permit areas. Impacts to AVFs and OWUS related to mining operations at these three applicant mines would not be extended onto portions of the LBA tracts that will not be affected under the current mining and reclamation plans.

As discussed in Section 2.2, a decision to reject one or more of these six coal lease applications at this time would not preclude an application to lease that respective tract in the future.

3.7.3 Regulatory Compliance, Mitigation and Monitoring

A formal wetland delineation survey must be conducted prior to mining according to approved procedures (COE 1987) and submitted to the COE for verification as to the amounts and types of jurisdictional wetlands and other waters present. Once the delineation has been verified, it is made part of the mine and reclamation permit.

The presence of jurisdictional wetlands and OWUS on a mine property does not preclude mining. There are special required permitting procedures to assure that after mining there will be no net loss of wetlands. The COE requires replacement of all impacted jurisdictional wetlands in accordance with Section 404 of the CWA, and all wetland replacement plans have to be approved by the COE. As such, a formal jurisdictional wetland delineation survey would be conducted and submitted to the COE for verification as part of the mining and reclamation permit process for each of these six LBA tracts that are leased and proposed for mining.

Section 404 of the CWA does not cover non-jurisdictional or functional wetlands; however, Executive Order (EO) No. 11990 – Protection of Wetlands (May 24, 1977) – requires that all federal agencies protect all wetlands. Mitigation for impacts to non-jurisdictional wetlands located on these six LBA tracts will be specified during the permitting process as required by the authorized state or federal agency (which may include the WDEQ, OSM, or the federal surface managing agency, if any federal surface is included in the tract) or the private surface owner. Surface land ownership on the general analysis areas for the Wright area LBA tracts is private and federal (see Section 3.11). The federal surface is administered by the USFS. WDEQ/LQD allows and sometimes requires mitigation of non-jurisdictional wetlands affected by mining, depending on the values associated with the wetland features. WDEQ/LQD may also require replacement of sites with hydrologic significance. If any playas with hydrologic significance are located on the tract that is leased, WDEQ/LQD would also require their replacement.

Finally, the surface mining regulatory authorities (WDEQ/LQD and OSM) typically require replacement of non-jurisdictional and functional wetlands as a measure to protect and enhance wildlife.

Reclaimed wetlands are monitored using the same procedures used to identify pre-mining jurisdictional wetlands.

3.7.4 Residual Impacts

Replaced wetlands (jurisdictional or functional) may not duplicate the exact function and landscape features of the premining wetland, but all wetland replacement plans would be approved by the COE, which has special required permitting procedures to assure that there will be no net loss of wetlands after reclamation.

3.8 Soils

3.8.1 Affected Environment

Numerous baseline soil surveys associated with surface mining operations and oil and gas field development have been conducted in the eastern PRB. Soil surveys of Campbell County, Wyoming, including the general analysis areas for

the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts, have also recently been conducted by the National Resource Conservation Service (NRCS) (Prink et al. 2004).

Soils vary depending upon where and how they were formed. Major factors involved in the formation of soils include whether or not the material was transported and how the material was weathered during transportation. Four primary soil formation processes causing different soil types were noted in the general Wright analysis area: 1) soils developing predominantly in thin residuum from sandstone or shale on upland ridges, 2) soils developing predominantly in slopewash, colluvium, or alluvial fan deposits from mixed sources on gently sloping uplands, 3) soils developing predominantly in coarse-textured alluvium or sandy eolian deposits on rolling uplands, and 4) drainage soils developing in mixed stream laid alluvium on terraces and channels, and in fine-textured playa deposits in depressions and closed basins.

The soil depths and types on the general analysis areas for these six LBA tracts are similar to soils currently being salvaged and utilized for reclamation at the adjacent Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines and other mines in the eastern PRB. Additional detailed information about the soil types on these six LBA tracts is included in the supplemental information document, which is available on request. The site-specific soil surveys have located hydric soils and/or inclusions of hydric soils, which are one component used in identifying wetlands. Areas with soils that are not suitable to support plant growth include sites with high alkalinity, salinity, or clay content.

As described in Section 3.0, the general analysis area for each tract is defined as the BLM study area (the LBA tract as applied for and the additional area evaluated under Alternative 2) plus the ¼-mile disturbance buffer. Baseline soil surveys cover the general analysis areas for these six LBA tracts. All soil surveys were completed to the Order 1-2 or Order 3 level of intensity in accordance with criteria contained in WDEQ/LQD Guideline No. 1, Soils and Overburden (WDEQ 1996), which outlines the required soils information necessary for a coal mining operation. The WDEQ Order 1-2 inventories included soils field sampling, profile descriptions and observations at the requisite number of individual sites, and laboratory analysis of representative collected samples. Soils within the tracts' general analysis areas were identified by series, which consist of soils that have similar horizons in their profile. Horizons are soil layers having similar color, texture, structure, reaction, consistency, mineral and chemical composition, and arrangement in the profile.

3.8.1.1 North Hilight Field, South Hilight Field, and West Hilight Field LBA Tracts

The general analysis area for the North Hilight Field tract (8,476.4 total acres) has been covered by baseline soil surveys completed to an Order 1-2 resolution

for the adjacent Jacobs Ranch Mine and the Little Thunder Amendment Area of the Black Thunder Mine, both of which are included in the approved WDEQ/LQD mine permits. In addition, the entire general analysis area has been covered by the NRCS Order 3 survey of southern Campbell County (Prink et al. 2004).

A portion of the general analysis area for the South Hilight Field tract (3,367.9 total acres) has been covered by baseline soil surveys completed to an Order 1-2 resolution for the Little Thunder and West Black Thunder Amendment Areas of the Black Thunder Mine, and for the West Roundup Amendment of the North Rochelle Mine. All three of these soils surveys of permit amendment areas are included in the approved WDEQ/LQD mine permits. In addition, the entire general analysis area has been covered by the NRCS Order 3 survey of southern Campbell County (Prink et al. 2004).

A portion of the general analysis area for the West Hilight Field tract (9,188.6 total acres) has been covered by a baseline soil survey completed to an Order 1-2 resolution for the Little Thunder Amendment Area of the Black Thunder Mine, which is included in the approved WDEQ/LQD mine permit. In addition, the entire general analysis area has been covered by the NRCS Order 3 survey of southern Campbell County (Prink et al. 2004).

3.8.1.2 West Jacobs Ranch LBA Tract

A portion of the general analysis area for the West Jacobs Ranch tract (9,370.4 total acres) has been covered by a baseline soil survey completed to an Order 1-2 resolution for the Little Thunder Amendment Area of the Black Thunder Mine, which is included in the approved WDEQ/LQD mine permit. In addition, the entire general analysis area has been covered by the NRCS Order 3 survey of southern Campbell County (Prink et al. 2004). The baseline soils survey of the general analysis area for the West Jacobs Ranch tract was completed in 2007 by Intermountain Resources of Laramie, Wyoming to an Order 2 resolution. The inventory included a listing of all soil types within the general analysis area along with a brief description of those types.

3.8.1.3 North and South Porcupine LBA Tracts

The general analysis area for the North Porcupine tract (9,021.4 total acres) has been covered by three separate baseline soil surveys completed to an Order 1-2 resolution; two of which are for the North Antelope Rochelle Mine and are included in the approved WDEQ/LQD mine permit. The third Order 1-2 survey is included in the School Creek Baseline Soils Assessment (BKS 2005) that was submitted as part of the adjacent proposed School Creek Mine permit application, currently under review by the WDEQ/LQD. The entire general analysis area for the North Porcupine tract has also been covered by the NRCS Order 3 survey of southern Campbell County (Prink et al. 2004).

The general analysis area for the South Porcupine tract (4,020.5 total acres) has been subjected to three separate Order 1-2 soil surveys completed for the North Antelope Rochelle Mine, which are part of its approved WDEQ/LQD mine permit. In addition, the entire general analysis area for the South Porcupine tract has been covered by the NRCS Order 3 survey of southern Campbell County (Prink et al. 2004).

3.8.2 Environmental Consequences

3.8.2.1 Proposed Action and Alternatives 2 and 3

Salvage and redistribution of soils during mining and reclamation would cause changes in the soil resources. In reclaimed areas, soil chemistry and soil nutrient distribution would generally be more uniform and average topsoil quality would be improved because soil material that is not suitable to support plant growth would not be salvaged for use in reclamation. This would result in more uniform vegetative productivity on the reclaimed land.

The baseline soils analyses for these six LBA tracts indicate that the amount of suitable topsoil that would be available for redistribution on all disturbed acres within the six general analysis areas during reclamation would vary from an average depth of 2.0 feet to an average depth of 3.0 feet. The replaced topsoil should support a stable and productive vegetation community adequate in quality and quantity to support the planned postmining land uses of rangeland and wildlife habitat.

There would most likely be an increase in the near-surface bulk density of the reclaimed soil resources on the reclaimed areas due to loss of soil aggregates. As a result, the average soil infiltration rates would generally decrease, which would increase the potential for runoff and soil erosion. Roughening the regraded backfill surface prior to soil redistribution, and soil preparation by disking or plowing prior to seeding would mitigate surface compaction.

Topographic moderation following reclamation would potentially decrease runoff, which would tend to offset the effects of decreased soil infiltration capacity. The change in soil infiltration rates would not be permanent because revegetation and natural weathering action would form a new soil structure in the reclaimed soils, and infiltration rates would gradually return to premining levels. The reclaimed landscape would contain stable landforms and drainage systems that would support the postmining land uses. Ephemeral stream channels and floodplains would be designed and reclaimed to be erosionally stable, thereby conserving the soil resource.

Direct biological impacts to soil resources would include short-term to long-term reduction in soil organic matter, microbial populations, seeds, bulbs, rhizomes, and live plant parts for soil resources that are stockpiled before placement. The sections that follow describe the potential impacts to soil

resources on each LBA tract following reclamation under the Action Alternatives.

3.8.2.1.1 North Hilight Field LBA Tract

Potential impacts to soil resources on the LBA tract after final reclamation under the Proposed Action or Alternative 2 are quantified as follows. Under the currently approved mining and reclamation plan, approximately 26,812.0 acres of soil resources will be disturbed in order to mine the coal in the existing leases at the Black Thunder Mine (Table 3-1). If the North Hilight Field LBA Tract is leased, TBCC estimates disturbance related to coal mining would directly affect from approximately 5,053.0 to 12,908.8 additional acres of soil resources on and adjacent to the LBA tract under the Proposed Action or under Alternative 2, BLM's preferred alternative, respectively (Table 3-1). There are approximately 3,304.7 additional acres of soil resources within the North Hilight Field LBA Tract as applied for plus a ¼-mile disturbance buffer and approximately 8,476.4 additional acres of soil resources within the BLM study area (the LBA tract as applied for and the additional area evaluated under Alternative 2) plus the ¼-mile disturbance buffer. Preliminary estimates indicate the average redistributed soil thickness would be about 33 inches (2.7 feet) across the entire reclaimed surface; however, soil redistribution depths would vary to mimic the premine conditions. The types of soils and the quantities of the soil resource included in the North Hilight Field LBA Tract as applied for and in Alternative 2, BLM's preferred tract configuration, are similar to the soils on the existing leases at the adjacent Jacobs Ranch and Black Thunder mines. As discussed in Section 3.0, the estimates of recoverable coal, associated disturbance, and mine life shown in Table 3-1 assume that Shroyer Road is not moved.

3.8.2.1.2 South Hilight Field LBA Tract

Potential impacts to soil resources on the LBA tract after final reclamation under the Proposed Action or Alternative 2 are quantified as follows. Under the currently approved mining and reclamation plan, approximately 26,812.0 acres of soil resources will be disturbed in order to mine the coal in the existing leases at the Black Thunder Mine (Table 3-2). If the South Hilight Field LBA Tract is leased, TBCC estimates disturbance related to coal mining would directly affect from approximately 1,126.0 to 2,731.4 additional acres of soil resources on and adjacent to the LBA tract under the Proposed Action or under Alternative 2, BLM's preferred alternative, respectively (Table 3-2). There are approximately 2,332.4 additional acres of soil resources within the South Hilight Field LBA Tract as applied for plus a ¼-mile disturbance buffer and approximately 3,367.9 additional acres of soil resources within the BLM study area (the LBA tract as applied for and the additional area evaluated under Alternative 2) plus the ¼-mile disturbance buffer. Preliminary estimates indicate the average redistributed soil thickness would be about 35 inches (2.9 feet) across the entire reclaimed surface; however, soil redistribution depths would vary to mimic the premine conditions. The types of soils and the

quantities of the soil resource included in the South Hilight Field LBA Tract as applied for and in Alternative 2, BLM's preferred tract configuration, are similar to the soils on the existing leases at the adjacent Black Thunder Mine. As discussed in Section 3.0, the estimates of recoverable coal, associated disturbance, and mine life shown in Table 3-2 assume that Reno Road is not moved.

3.8.2.1.3 West Hilight Field LBA Tract

Potential impacts to soil resources on the LBA tract after final reclamation under the Proposed Action or Alternative 2 are quantified as follows. Under the currently approved mining and reclamation plan, approximately 26,812.0 acres of soil resources will be disturbed in order to mine the coal in the existing leases at the Black Thunder Mine (Table 3-3). If the West Hilight Field LBA Tract is leased, TBCC estimates disturbance related to coal mining would directly affect from approximately 6,351.4 to 10,250.8 additional acres of soil resources on and adjacent to the LBA tract under the Proposed Action or under Alternative 2, BLM's preferred alternative, respectively (Table 3-3). There are approximately 3,843.5 additional acres of soil resources within the West Hilight Field LBA Tract as applied for plus a ¼-mile disturbance buffer and approximately 9,188.6 additional acres of soil resources within the BLM study area (the LBA tract as applied for and the additional area evaluated under Alternative 2) plus the ¼-mile disturbance buffer. Preliminary estimates indicate the average redistributed soil thickness would be about 28 inches (2.3 feet) across the entire reclaimed surface; however, soil redistribution depths would vary to mimic the premine conditions. The types of soils and the quantities of the soil resource included in the West Hilight Field LBA Tract as applied for and in Alternative 2, BLM's preferred tract configuration, are similar to the soils on the existing leases at the adjacent Black Thunder Mine. As discussed in Section 3.0, the estimates of recoverable coal, associated disturbance, and mine life shown in Table 3-3 assume that State Highway 450 and Hilight Road are not moved.

3.8.2.1.4 West Jacobs Ranch LBA Tract

Potential impacts to soil resources on the LBA tract after final reclamation under the Proposed Action or Alternative 2 are quantified as follows. Under the currently approved mining and reclamation plan, approximately 14,853.0 acres of soil resources will be disturbed in order to mine the coal in the existing leases at the Jacobs Ranch Mine (Table 3-4). If the West Jacobs Ranch LBA Tract is leased, JRCC estimates disturbance related to coal mining would directly affect from approximately 7,023.0 to 9,370.0 additional acres of soil resources on and adjacent to the LBA tract under the Proposed Action or under Alternative 2, BLM's preferred alternative, respectively (Table 3-4). Preliminary estimates indicate the redistributed soil thickness would average between about 26 inches (2.2 feet) and 36 inches (3.0 feet) across the entire reclaimed surface; varying redistribution depths to mimic the premine conditions. The types of soils and the quantities of the soil resource included in the West

Jacobs Ranch LBA Tract as applied for and in Alternative 2, BLM's preferred tract configuration, are similar to the soils on the existing leases at the adjacent Jacobs Ranch and Black Thunder mines. As discussed in Section 3.0, the estimates of recoverable coal, associated disturbance, and mine life shown in Table 3-4 assume that State Highway 450 and Hilight Road are not moved.

3.8.2.1.5 North Porcupine LBA Tract

Potential impacts to soil resources on the LBA tract after final reclamation under the Proposed Action or Alternative 2 are quantified as follows. Under the currently approved mining and reclamation plan, approximately 27,443.0 acres of soil resources will be disturbed in order to mine the coal in the existing leases at the North Antelope Rochelle Mine (Table 3-5). If the North Porcupine LBA Tract is leased, PRC estimates disturbance related to coal mining would directly affect from approximately 9,864.0 to 11,444.0 additional acres of soil resources on and adjacent to the LBA tract under the Proposed Action or under Alternative 2, BLM's preferred alternative, respectively (Table 3-5). There are approximately 7,602.6 additional acres of soil resources within the North Porcupine LBA Tract as applied for plus a ¼-mile disturbance buffer and approximately 9,021.4 additional acres of soil resources within the BLM study area (the LBA tract as applied for and the additional area evaluated under Alternative 2) plus the ¼-mile disturbance buffer. Preliminary estimates indicate the average redistributed soil thickness would be about 35 inches (2.9 feet) across the entire reclaimed surface; however, soil redistribution depths would vary to mimic the premine conditions. The types of soils and the quantities of the soil resource included in the North Porcupine LBA Tract as applied for and in Alternative 2, BLM's preferred tract configuration, are similar to the soils on the existing leases at the adjacent North Antelope Rochelle Mine. As discussed in Section 3.0, the estimates of recoverable coal, associated disturbance, and mine life shown in Table 3-5 assume that Mackey Road is not moved.

3.8.2.1.6 South Porcupine LBA Tract

Potential impacts to soil resources on the LBA tract after final reclamation under the Proposed Action or Alternative 2 are quantified as follows. Under the currently approved mining and reclamation plan, approximately 27,443.0 acres of soil resources will be disturbed in order to mine the coal in the existing leases at the North Antelope Rochelle Mine (Table 3-6). If the South Porcupine LBA Tract is leased, PRC estimates disturbance related to coal mining would directly affect from approximately 3,366.0 to 4,068.0 additional acres of soil resources on and adjacent to the LBA tract under the Proposed Action or under Alternative 2, BLM's preferred alternative, respectively (Table 3-6). There are approximately 3,598.3 additional acres of soil resources within the South Porcupine LBA Tract as applied for plus a ¼-mile disturbance buffer and approximately 4,020.5 additional acres of soil resources within the BLM study area (the LBA tract as applied for and the additional area evaluated under

Alternative 2) plus the ¼-mile disturbance buffer. Preliminary estimates indicate the average redistributed soil thickness would be about 24 inches (2.0 feet) across the entire reclaimed surface; however, soil redistribution depths would vary to mimic the premine conditions. The types of soils and the quantities of the soil resource included in the South Porcupine LBA Tract as applied for and in Alternative 2, BLM's preferred tract configuration, are similar to the soils on the existing leases at the adjacent North Antelope Rochelle Mine. As discussed in Section 3.0, the estimates of recoverable coal, associated disturbance, and mine life shown in Table 3-6 assume that the remaining 2.25-mile section of Antelope Road is not moved.

3.8.2.2 No Action Alternative

Under the No Action Alternative, the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine coal lease applications would be rejected and coal removal and the associated disturbance and impacts to soils would not occur on the portions of the LBA tracts as applied for or the LBA tracts configured under Alternative 2 that will not be disturbed under the currently approved surface coal mining permits. Coal removal and associated soil removal and replacement would continue as currently permitted on the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle Mine coal leases. Impacts to soils related to mining operations at these three applicant mines would not be extended onto portions of the LBA tracts that will not be affected under the current mining and reclamation plans.

As discussed in Section 2.2, a decision to reject one or more of these six coal lease applications at this time would not preclude an application to lease that respective tract in the future.

3.8.3 Regulatory Compliance, Mitigation and Monitoring

Soils suitable to support plant growth would be salvaged for use in reclamation. Soil stockpiles would be protected from disturbance and erosional influences. Soil material that is not suitable to support plant growth would not be salvaged. Soil or overburden materials containing potentially harmful chemical constituents (such as selenium) would be specially handled.

Unsuitable materials would be buried under adequate fill (at least 4 feet of suitable overburden) prior to soil redistribution to meet guidelines for vegetation root zones. After topsoil is redistributed on reclaimed surfaces, revegetation would reduce wind erosion. Sediment control structures would be constructed as needed to detain sediments.

Regraded overburden would be sampled to verify suitability as subsoil for compliance with root zone criteria. Redistributed soil would be sampled to document redistribution depths. Vegetation growth would be monitored on reclaimed areas to confirm vegetation establishment and acceptability for bond

release. Appropriate normal husbandry practices may be implemented to achieve specific reclamation goals.

These measures are required by regulation and are therefore considered to be part of the Proposed Action and Alternative 2 for the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts.

3.8.4 Residual Impacts

Existing soils would be mixed and redistributed, and soil-forming processes would be disturbed by mining. This would result in long-term alteration of soil characteristics.

3.9 Vegetation

3.9.1 Affected Environment

The vegetation analysis area for each of the six LBA tracts included in this analysis is the respective tract's general analysis area. As described in Section 3.0, the general analysis area is defined as the LBA tract as applied for and the additional area evaluated under Alternative 2 (BLM's study area) plus the ¼-mile buffer that would be disturbed in order to recover the coal in the BLM study area. The ¼-mile buffer includes only those lands that are not already approved for disturbance under currently approved coal leases and mine plans. These vegetation analysis areas are either partially located within, contiguous to, or completely within current applicant mines' permit boundaries. Consequently, portions or all of these vegetation analysis areas were previously mapped and sampled in accordance with the current WDEQ/LQD mine permitting requirements. The balance of the vegetation assessments were completed in 2007. The vegetation communities in these areas were appraised and mapped to provide a preliminary baseline assessment.

The vegetation within the six vegetation analysis areas consists of species common to eastern Wyoming and consistent with vegetation that occurs within the adjacent mine permit areas. Water and disturbed areas were also mapped. The following vegetation types were identified in the combined vegetation analysis areas:

- Crested Wheatgrass/Agricultural Pastureland
- Pasture/Hayland
- Undeveloped Pastureland
- Upland/Mixed Prairie Grassland
- Big Sage Shrubland
- Bottomland/Streamside Grassland/Meadow
- Disturbed Lands
- Reclaimed Lands
- Playa/Playa Grassland

- Rough Breaks/Breaks Grassland
- Reservoir/Water
- Salt Grassland/Saline Bottomland/Alkali Bottomland

Table 3-14 presents the acreage and percent of the combined vegetation analysis areas encompassed by each vegetation type. Additional information about the vegetation types within each of these six LBA tracts is included in the supplementary information document, which is available on request.

Table 3-14. Vegetation Types Identified and Mapped Within the Combined Vegetation Analysis Areas.

Vegetation Type	Acres	Percent of Area
Big Sage Shrubland	18,329.1	42.2
Upland/Mixed Prairie Grassland	12,079.5	27.8
Crested Wheatgrass/Agricultural Pastureland	6,657.8	15.3
Salt Grassland/Saline	1,730.1	4.0
Rough Breaks/Breaks Grassland	1,533.8	3.5
Disturbed Lands	940.5	2.2
Bottomland/Streamside	699.1	1.6
Playa/Playa Grassland	613.6	1.0
Pasture/Hayland	317.5	0.7
Reclaimed Lands	223.0	0.5
Undeveloped Pastureland	192.6	0.4
Reservoir/Water	105.6	0.2
Total	**43,422.2**	**100.0**

In terms of total acres of occurrence within the combined vegetation analysis areas, the predominant vegetation types are the Big Sage Shrubland (42.2 percent), Upland/Mixed Prairie Grassland (27.8 percent), and Crested Wheatgrass/Agricultural Pastureland (15.3 percent). The most common plant species on these types include Wyoming big sagebrush, western wheatgrass, needleandthread, blue grama, crested wheatgrass, red threeawn, Sandberg bluegrass, prairie junegrass, cheatgrass brome, sixweeksgrass, and upland sedges. Wyoming big sagebrush is the dominant shrub in the Big Sage Shrubland and Upland/Mixed Prairie Grassland vegetation communities. Annual grasses and forbs, lichens, and manyspine plains pricklypear cactus are frequently large components of the vegetation cover.

The predominant vegetation type on approximately 15 percent of the combined vegetation analysis area is the crested wheatgrass pastureland. This vegetation type occurs on relatively flat areas to rolling plains with moderately deep to deep soils that have been converted (at least originally and intentionally) from native vegetation to crested wheatgrass that is being used for haying or grazing purposes. Through time, those areas that have not been actively managed are likely to experience invasion by native plant species from adjacent areas. This vegetation type therefore ranges from areas that are generally a crested wheatgrass monoculture to areas with a greater component of graminoid,

shrub and subshrub species. Blue grama, purple and red threeawn, Junegrass, cheatgrass brome, and needleandthread are among the more commonly invading grasses.

The various categories of disturbance (topsoil stockpiles, reclaimed areas, disturbed areas, pre-mining disturbance, and developed areas) account for approximately 2.7 percent of the combined vegetation analysis area. Areas mapped as disturbed are mostly associated with advancing excavation associated with the backslopes of mine pits, disturbance associated with CBNG development activity (roads to drill pads, wellpads, and pipeline and powerline construction), areas recently excavated and contoured as part of the construction of a flood control structure, and rights-of-way for public roads.

In addition to these major vegetation types identified in the combined vegetation analysis area, trees are found primarily in a few shelterbelts/windbreaks planted adjacent to ranching facilities. Very few other small trees are present due to the lack of water and suitable habitats. Prior to mining disturbance, detailed tree inventories would be conducted as required by state and federal agencies.

There are few occurrences of noxious weeds within the three applicant mine areas; however, there are native areas (primarily drainage bottoms) adjacent to mine permit areas that are infested with noxious weeds, primarily Canada thistle.

3.9.2 Environmental Consequences

3.9.2.1 Proposed Action and Alternatives 2 and 3

Under the currently approved mining and reclamation plans, approximately 69,108.0 acres of vegetation will be disturbed in order to mine the coal in the existing leases at the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines. Surface disturbance would occur on the six LBA tracts under all of the alternatives. Under the Proposed Actions, mining of the six LBA tracts would progressively remove the existing vegetation on approximately 32,783 additional acres on and near the LBA tracts. Under Alternative 2, BLM's preferred alternative for each tract, mining of the six LBA tracts would progressively remove the existing vegetation on up to 50,773 additional acres. Vegetation removal at each LBA tract under the Action Alternatives is presented as the additional mine disturbance areas in Tables 3-1 through 3-6. Under Alternative 2, the combined vegetation analysis area of 43,422.2 acres (Table 3-13) would be disturbed, and potentially 7,350.8 additional acres, which would be included in additional baseline vegetation inventories as part of the mine permitting processes if the LBA tracts are leased and proposed for mining.

Short-term impacts associated with the removal of vegetation from the LBA tracts would include increased erosion, interrupted livestock grazing, and

habitat loss for wildlife. Potential long-term impacts include habitat modification or reduction of habitat carrying capacity for some wildlife species as a result of reduced plant species diversity or reduced plant density for some species, particularly big sagebrush, on reclaimed lands. However, grassland-dependent wildlife species and livestock would benefit from the increased grass cover and production.

Grazing restrictions prior to mining and during reclamation would remove up to 100 percent of the areas proposed for mining from livestock grazing. This reduction in vegetative production would not seriously affect livestock production in the region, and long-term productivity on the reclaimed land would return to premining levels within several years following seeding with the approved final seed mixture. The applicant mines' historical wildlife monitoring indicates that there would not be a substantial restriction of wildlife use of the area throughout the operations (refer to Section 3.10).

Reclamation, including revegetation of these lands, would occur contemporaneously with mining on adjacent lands, i.e., reclamation would begin once an area is mined. Estimates of the time elapsed from soil salvage through reseeding of any given area range from 2 to 4 years, longer for areas occupied by stockpiles, haulroads, sediment-control structures, and other mine facilities. No new life-of-mine facilities would be located on the LBA tracts under the Proposed Action or Alternatives 2 or 3 because the LBA tracts would be mined as an extension of an existing mine using existing facilities. Some roads and facilities would not be reclaimed until the end of mining. Reclamation of the final pits, certain roads, sediment control structures, and life-of-mine facilities would extend beyond the completion of coal removal. By the time mining ceases, over 75 percent of the disturbed lands would have been reseeded. The remaining 25 percent would be reseeded during the following 2 to 3 years as the life-of-mine facilities areas are reclaimed.

In an effort to approximate premining conditions, the applicants would plan to reestablish vegetation types to reflect premine types and land uses during the reclamation operation. Reestablished vegetation would be dominated by species mandated in the reclamation seed mixtures (to be approved by WDEQ). The majority of the approved species are native to the area. Initially, the reclaimed lands would be primarily a mixture of prairie grasslands with graminoid/forb-dominated areas. An overall reduction in species diversity, especially for the shrub component, would occur. At least 20 percent of the native vegetation area would be reclaimed to native shrubs at a density of one per square meter as required by current regulations. Estimates for the time it would take to restore shrubs, including sagebrush, to premining density levels range from 20 to 100 years. As indicated previously, sagebrush is a component of the Big Sagebrush Shrubland and Upland/Mixed Prairie Grassland vegetation communities, which together occupy about 70 percent of the combined vegetation analysis area (Table 3-13). The reduction in sagebrush would result in a long term reduction of habitat for some species and may delay use of the reclaimed area by shrub-dependent species, such as

the sage-grouse. An indirect impact of the vegetation change could be decreased big game habitat carrying capacity. Following completion of reclamation (seeding with the final seed mixture) and before release of the reclamation bond (a minimum of 10 years), a diverse, productive, and permanent vegetative cover would be established on the LBA tracts. Following reclamation bond release, management of the privately owned surface areas would revert back to the private surface owners, who would have the right to manipulate the reclaimed vegetation.

The reclamation plans for the existing mines include steps to control invasion by weedy (invasive nonnative) plant species because WDEQ/LQD rules and regulations require surface coal mine operators to control and minimize the introduction of noxious weeds until bond release, in accordance with federal and state regulatory requirements. Section 3.9.4 includes a discussion of the steps the mines use to control noxious weeds. As a result, there are few occurrences of noxious weeds in the mine areas. The reclamation plan for each LBA tract would also include steps to control invasion from such species.

Wyoming, including the PRB, has experienced drought conditions since around 2000. The climatic record of the western U.S. suggests that droughts could occur periodically during the life of the applicant mines. Such droughts would severely hamper revegetation efforts, since lack of sufficient moisture would reduce germination and could damage newly established plants. In such instances, reseeding may be necessary. Same-aged vegetation would be more susceptible to disease than would plants of various ages. Droughts could also result in stands of vegetation in which less gregarious plants like warm season grasses are better established. Severe thunderstorms could also adversely affect newly seeded areas. However, these events would have similar impacts as would occur on native vegetation once a stable vegetative cover is established.

Changes expected in the surface water network on each LBA tract as a result of mining and reclamation would affect the reestablishment of vegetation patterns on the reclaimed areas to some extent. The postmining maximum overland slope would be 20 percent, in accordance with WDEQ policy. The average reclaimed overland slope on each LBA tract would not be known until WDEQ's technical review of each mine permit revision application is complete. No significant changes in the average overland slope are predicted.

There would be no net loss of jurisdictional wetlands. They would be restored under the jurisdiction of the COE (Section 3.7). Non-jurisdictional and functional wetlands would be restored in accordance with the requirements of the surface landowner or as required by WDEQ/LQD.

The decrease in plant diversity would not seriously affect the potential productivity of the reclaimed areas, regardless of the alternative selected. The proposed postmining land use (wildlife habitat and rangeland) would generally be achieved even with the changes in vegetative species composition and

diversity, although there would be some long term reduction in habitat for some species. Native vegetation from surrounding areas would gradually invade and eventually become established on the reclaimed land.

3.9.2.2 No Action Alternative

Under the No Action Alternative, the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine coal lease applications would be rejected and coal removal and the associated disturbance and impacts to vegetation would not occur on the portions of the LBA tracts as applied for or the LBA tracts configured under Alternative 2 that will not be disturbed under the currently approved surface coal mining permits. Coal removal and the associated vegetation removal and replacement would continue as currently permitted on the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle Mine coal leases. Impacts to vegetation related to mining operations at these three applicant mines would not be extended onto portions of the LBA tracts that will not be affected under the current mining and reclamation plans.

As discussed in Section 2.2, a decision to reject one or more of these six coal lease applications at this time would not preclude an application to lease that respective tract in the future.

3.9.3 Threatened, Endangered, Proposed, and Candidate Plant Species, and BLM and USFS Sensitive Plant Species

Refer to Appendices G and H.

3.9.4 Regulatory Compliance, Mitigation and Monitoring

Reclaimed areas would be revegetated as specified in the approved mine plans using reclamation seed mixtures that would be approved by WDEQ. The majority of the species would be native to the LBA tracts. At least 20 percent of the native vegetation area would be reclaimed to native shrubs at a density of one per square meter or as required by current regulations. Shrubs would be selectively planted in riparian areas and trees would be replaced in a one-to-one ratio.

WDEQ/LQD Rules and Regulations require that:

- Permit applications for surface coal mines include a description of any weeds or other plants listed by the local Weed and Pest Control District as harmful (Chapter 2, Section 2(a)(vi)(C)(2)); and
- Surface coal mine operators control and minimize the introduction of noxious weeds in accordance with federal or state requirements (Chapter 4, Section 2(d)(xiv)).

In accordance with these requirements, the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines work with the Campbell County Weed and Pest Department and conduct active noxious weed control programs on their existing coal leases and mine permit areas. If these LBA tracts are leased and proposed for mining, the mines would be required to continue to utilize those practices on their new lease areas as part of the mine permitting processes.

The COE would ensure no net loss of jurisdictional wetlands and their associated vegetation occurs within the total disturbance area. Detailed wetland mitigation plans would be developed and approved by the COE during the permitting stage. Non-jurisdictional and functional wetlands would be reestablished in accordance with the requirements of the surface landowner or as required by WDEQ/LQD (Section 3.7).

Revegetation growth and diversity would be monitored until the final reclamation bond is released (a minimum of 10 years following seeding with the approved seed mixture). Erosion would be monitored to determine if there is a need for corrective action during establishment of vegetation. Controlled grazing would be used following revegetation to manage the vegetation and determine the suitability and effectiveness of the reclaimed land for the post-mining land uses.

3.9.5 Residual Impacts

Reclaimed vegetative communities may never completely match the surrounding native plant community.

3.10 Wildlife

3.10.1 General Setting

This section discusses the affected environment and potential environmental consequences to wildlife in general. The subsequent sections address the potential impacts to specific groups of wildlife species.

3.10.1.1 Affected Environment

Background information on wildlife in the general Wright analysis area was drawn from several sources, including Wyoming Game and Fish Department (WGFD) and U.S. Fish and Wildlife Service (USFWS) records, the Wyoming Natural Diversity Database (WYNDD), recent PRB federal coal lease application EIS documents (available for public review on Wyoming BLM's website at http://www.blm.gov/wy/st/en.html), and personal contacts with WGFD and USFWS biologists. Site-specific data for the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts were obtained from several sources, including baseline information contained in WDEQ/LQD mine permit applications and annual wildlife monitoring reports for the applicant mines and nearby coal mines. In

accordance with the current WDEQ/LQD mine permitting requirements, wildlife baseline surveys and annual monitoring surveys extend 1 to 2 miles beyond the mine permit area, depending on the mine and the species.

The general analysis area for each of the six LBA tracts included in this analysis is defined as the respective tracts' BLM study area plus surrounding lands within a ¼-mile perimeter that could be disturbed by mining the coal within the BLM study area. The wildlife survey area typically overlaps significant portions of the general analysis area for all of the LBA tracts, providing long-term wildlife data for those areas. The wildlife survey areas for this analysis includes the general analysis areas plus a surrounding perimeter that varies in extent depending on the species. The general Wright analysis area represents the entire area covered by all of the general analysis areas for these six LBA tracts.

Due to the proximity of the proposed lease areas to the adjacent applicant mine permit areas, the general analysis areas for these six LBA tracts have received some level of coverage annually since the early 1980s. Increasing percentages of the general analysis areas were included in annual monitoring efforts as survey areas for the adjacent mines have been expanding due to previous coal lease acquisitions and subsequent permit area amendments. In addition, TBCC conducted baseline investigations during 2006 and early 2007 specifically for the West Hilight Field LBA Tract with additional surveys targeting the North and South Hilight Field LBA Tracts in 2007 and 2008; JRCC conducted baseline investigations in 2007 and 2008 expressly for the West Jacobs Ranch LBA Tract; and PRC conducted baseline investigations during 2007 and early 2008 specifically for the North and South Porcupine LBA Tracts. These surveys covered the respective general analysis areas, and surveys for selected wildlife information such as raptor nest and greater sage-grouse lek locations included in a 2-mile perimeter surrounding the general analysis areas. Site-specific surveys for each lease area and appropriate perimeters would be part of the mine permitting process if the tracts are leased.

The topography within the general Wright analysis area (discussed in Section 3.2) is mainly of gently rolling upland terrain broken by minor drainages and internally-drained playa areas. Most of the land surface (between 75 and 90 percent, depending on the particular LBA tract) seldom exceeds a 5 percent slope. The steepest slopes typically occur near the highest elevations along the ridge lines and drainage divides, at the breaks or the broken land dissected by small ravines and gullies, or at the transitions between uplands and bottom lands. Surface mine lands, both active and reclaimed, dominate the landscape generally east and south of the LBA tracts. Elevations range from approximately 4,690 to 5,170 feet above sea level.

In an undisturbed condition, the major vegetation types in the general Wright analysis area (discussed in Section 3.9) provide high quality habitats for many species. Vegetation types tend to occur in a mosaic across the landscape;

therefore, many wildlife species can be expected to utilize more than one habitat type. Predominant wildlife habitat types classified on the LBA tracts and adjacent areas generally correspond with the major vegetation communities defined during the vegetation baseline surveys; they consist primarily of Big Sage Shrubland, Upland/Mixed Prairie Grassland, and Crested Wheatgrass/Agricultural Pastureland.

The predominant wildlife habitat type within the general Wright analysis area is shrubland (approximately 42 percent), which consists mostly of Wyoming big sagebrush. The native upland/mixed prairie grasslands is the next largest habitat type (approximately 28 percent) and it consists mostly of western wheatgrass, needleandthread, prairie junegrass, blue grama, Sandberg bluegrass, and cheatgrass brome. The seeded grassland/agricultural pastureland (approximately 15 percent) is dominated by crested wheatgrass, but older seedings have a mixture of less dominant native plant species including, needleandthread, prairie junegrass, red threeawn, sixweeksgrass, big sagebrush, and upland sedges. No designated critical, crucial, or unique habitats are present.

Mesic (requiring a moderate amount of moisture) habitats are limited to narrow corridors along primary drainages (Porcupine Creek, Little Thunder Creek, North Prong Little Thunder Creek, and some of the larger tributaries of these streams). Several playas dominated by western wheatgrass are scattered throughout the general Wright analysis area. Very few trees are present, the majority of which were planted in shelterbelts/windbreaks around ranch buildings. A few other isolated trees exist along some drainages. An occasional rough breaks habitat occurs and is distinguished by the irregularity of vegetation, slopes, and soils. Vegetation on the rough breaks is typically sparse, although the diversity of vascular plant species is greater than in the Big Sage Shrubland and Upland/Mixed Prairie Grassland communities. As a result of oil and gas development, there are networks of road and well-pad disturbance areas overlaying much of the areas, as well as tank batteries and miles of pipeline disturbance with varying degrees of recovering vegetative cover.

From north to south, the general Wright analysis area is drained by Black Thunder Creek, North Prong Little Thunder Creek, Little Thunder Creek, Porcupine Creek, Horse Creek, and Antelope Creek (discussed in Section 3.5). Under natural conditions, all water courses in the general Wright analysis area are ephemeral, receiving flow contributions primarily from convective thunderstorm runoff and, to a lesser extent, from snowmelt runoff in the spring (Ogle and Calle 2006). Limited portions of the streams may receive recharge from bank storage, making them locally intermittent. Historically, water was often present in the main stream channels only as small, shallow, isolated pools. Currently, and for an indefinite time into the future, some of the water courses and internally-drained playas are receiving discharge water from CBNG development; however, streamflow is still very much a function of the amount and timing of precipitation and snowmelt runoff. Therefore, the mean annual

streamflow rates and discharge volumes have not significantly increased, although extended periods of no flow are less common (Clark and Mason 2007). Despite the recent influx of water into the general Wright analysis area, many channels are still reduced to isolated, shallow pools in the summer. Seventeen stock reservoirs (over 1 acre in size) and 41 playa areas exist within the six wildlife general analysis areas. Those water bodies provide short-term habitat for migrating waterfowl, shorebirds, and other aquatic species during spring, but are less reliable, and often dry, during other seasons.

3.10.1.2 Environmental Consequences

3.10.1.2.1 Proposed Action and Alternatives 2 and 3

If the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts are leased under the Proposed Action or Alternative 2 or 3, the areal extent of coal mining operations would increase. Estimated disturbance areas for each of these six LBA tracts under the respective Proposed Action and Alternative 2, BLM's preferred alternative configuration for each tract, are presented in Tables 3-1 through 3-6. At the Black Thunder Mine, mining operations would be extended by up to about 4.8 additional years for the North Hilight Field tract, 2.3 additional years for the South Hilight Field tract, and 7.1 additional years for the West Hilight Field tract under Alternative 2, BLM's preferred alternative, for each LBA tract. At the Jacobs Ranch Mine, mining operations would be extended by up to about 22.8 additional years under Alternative 2, BLM's preferred alternative, for the West Jacobs Ranch LBA Tract. At the North Antelope Rochelle Mine, mining operations would be extended by up to about 7.8 additional years for the North Porcupine tract and 3.6 additional years for the South Porcupine tract under Alternative 2, BLM's preferred alternative for each LBA tract. Wildlife habitat outside of tracts' general analysis areas may be removed by adjacent mining activities unrelated to the LBA tracts. Impacts to wildlife that would be caused by mining the LBA tracts would be addressed as part of the review of the mine permit applications by the WGFD, USFWS, and the WDEQ/LQD when the mining and reclamation permits are amended to include the LBA tracts.

Mining directly and indirectly impacts local wildlife populations. These impacts are both short-term (until successful reclamation is achieved) and long-term (persisting beyond successful completion of reclamation). The direct impacts of surface coal mining on wildlife occur during mining and are therefore short-term. They include injury and mortalities caused by collisions with mine-related traffic or mortalities due to loss of habitat (especially for species with limited mobility such as fish and some herptiles); restrictions on wildlife movement created by fences, spoil piles, and mine pits; and displacement of wildlife from active mining areas. Displaced animals may find suitable habitat that is not occupied by other animals, occupy suitable habitat that is already being used by other individuals, or occupy poorer quality habitat than that from which they were displaced. In the latter two situations, the animals may

suffer from increased competition with other animals and are less likely to survive and reproduce. If the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts were leased and mined, the direct impacts related to mine traffic and mine operations would be extended within the general Wright analysis area by up to as many as 22.8 years (for the West Jacobs Ranch LBA Tract under Alternative 2).

The indirect impacts are longer term than the direct impacts. Results from long-term surveys conducted in both native and reclaimed habitats at the three applicant mines, and from those completed at other surface mines in the region, demonstrated that some reclaimed habitat types can support levels of species diversity and abundance equal to or greater than their native counterparts. However, wildlife species composition can be quite different between pre- and post-mining habitats, depending on the structure and composition of native habitats prior to disturbance.

After the LBA tracts are leased, mined, and reclaimed, alterations in the topography and vegetative communities would likely result in such changes in species composition from pre-mine conditions. Some vegetative communities currently present in the tracts, such as low-growth species (e.g., blue grama, and birdsfoot sagebrush) and big sagebrush, are often difficult to reestablish through artificial plantings. Wildlife species associated with pre-mining vegetative communities would be replaced by species that are typically associated with the taller and/or denser vegetation that is often present in reclaimed areas, especially until reclamation matures to its target mix.

Topographic changes would be permanent, and microhabitats may be reduced on reclaimed land due to flatter topography, less diverse vegetative cover, and reduction in sagebrush density. Changes in the composition between pre- and post-mining vegetation and wildlife species may be reduced if special efforts are made to reestablish low-growth and shrub habitat types.

3.10.1.2.2 No Action Alternative

Under the No Action Alternative, the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine coal lease applications would be rejected and the impacts to wildlife and wildlife habitat associated with coal removal as described above would not occur on the portions of the LBA tracts as applied for or the LBA tracts configured under Alternative 2 that will not be disturbed under the currently approved surface coal mining permits. Mining operations and the associated impacts to wildlife and wildlife habitat would continue as currently permitted on the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle Mine coal leases, but would not be extended onto portions of the LBA tracts that will not be affected under the current mining and reclamation plans. Impacts to wildlife and wildlife habitat associated with CBNG development

would continue where those activities overlap with the six LBA tracts included in this analysis.

As discussed in Section 2.2, a decision to reject one or more of these six coal lease applications at this time would not preclude an application to lease that respective tract in the future.

3.10.2 Big Game

3.10.2.1 Affected Environment

The two big game species that are common in suitable habitat throughout the general Wright analysis area are pronghorn (*Antilocapra americana*) and mule deer (*Odocoileus hemionus*). Elk (*Cervus elaphus*) are frequent winter residents in the area, but spend most of the year in the Rochelle Hills east of the general Wright analysis area. White-tailed deer (*Odocoileus virginianus*) are seldom observed within the general Wright analysis area due to their preference for riparian woodlands and irrigated agricultural lands. No crucial big game habitat or migration corridors are recognized by the WGFD in this area.

Pronghorn are by far the most common big game species in the general Wright analysis area. Pronghorn were observed using all habitat types, although this species is most abundant in the shrubland and native upland/mixed prairie grassland habitats. Reclaimed grassland constitutes only a small portion of the available habitat around the PRB mines, although pronghorn are observed during all seasonal surveys in these areas. Home range for pronghorn can vary between 400 acres to 5,600 acres, according to several factors including season, habitat quality, population characteristics, and local livestock occurrence. Typically, daily movements do not exceed 6 miles. Pronghorn may make seasonal migrations between summer and winter habitats, but migrations are often triggered by availability of preferred forage availability and not local weather conditions (Fitzgerald et al. 1994). The WGFD has classified the general Wright analysis area as primarily yearlong pronghorn range (a population or substantial portion of a population of animals makes general use of this habitat on a year-round basis, but may leave the area under severe conditions on occasion) and winter/yearlong pronghorn range (a population or a portion of a population of animals makes general use of this habitat on a year-round basis, with a significant influx of additional animals onto this habitat from other seasonal ranges in the winter). The general Wright analysis area spans two pronghorn WGFD herd units: the Hilight Herd Unit (antelope Hunt Area 24) north of State Highway 450 and the Cheyenne River Herd Unit (antelope Hunt Area 27) south of the State Highway 450. In post-season 2007, the WGFD estimated the Hilight Herd Unit population to be 12,397 animals, with an objective of 11,000; the Cheyenne River Herd Unit estimate was 55,287, which is 45 percent above the objective of 38,000 animals (WGFD 2007a).

Mule deer use nearly all habitats, but prefer sagebrush grassland, rough breaks, and riparian bottomland. Browse is an important component of the mule deer's diet throughout the year, comprising as much as 60 percent of total intake during autumn, while forbs and grasses typically make up the rest of their diet (Fitzgerald et al. 1994). Mule deer are frequently observed in native habitats and on mine reclaimed lands within existing mine permit areas. In certain areas of the state this species tends to be more migratory than white-tailed deer, traveling from higher elevations in the summer to winter ranges that provide more food and cover. However, monitoring has indicated that mule deer are not very migratory in the vicinity of the general Wright analysis area. The WGFD has classified a majority of the general Wright analysis area as being out of the normal mule deer use range, although areas that roughly follow the predominant stream channels are classified as being yearlong range, which means that a population or substantial portion of a population of animals makes general use of this habitat on a year-round basis, but may leave the area under severe conditions on occasion. The entire general Wright analysis area is located within the WGFD Thunder Basin Mule Deer Herd Unit (mule deer Hunt Areas 10 and 21). No crucial or critical mule deer ranges or migration corridors occur on or within several miles of the general Wright analysis area. Crucial range is defined as any particular seasonal range or habitat component that has been documented as the determining factor in a population's ability to maintain and reproduce itself at a certain level. The WGFD estimated the 2007 post-season mule deer population in this herd unit at 20,980, which is about 5 percent above the current objective of 20,000 deer (WGFD 2007a).

White-tailed deer are not managed separately by the WGFD, but are managed and hunted in conjunction with mule deer. White-tailed deer prefer riparian habitats and are therefore seldom observed in the general Wright analysis area due to the lack of that particular habitat. The WGFD classifies the entire general Wright analysis area, with the exception of a narrow corridor along Antelope Creek, as out of the normal white-tailed deer use range. The Antelope Creek corridor is classified as yearlong range. The entire general Wright analysis area is located within the WGFD Central White-tailed Deer Herd Unit (white-tailed deer Hunt Areas 10 and 21). The WGFD does not have population estimates for this herd unit due to the challenges of obtaining adequate classifications in many hunt areas within the herd unit given the preponderance of private land and the poor visibility of deer in riparian areas. Another factor preventing reasonable population estimates is that these white-tailed deer are highly mobile and their movements in central and northeastern Wyoming are not well understood (WGFD 2007a).

A resident elk herd resides in the Rochelle Hills east of the general Wright analysis area. Elk do wander from the protection of the Rochelle Hills to forage in native and reclaimed grasslands in the vicinity of the general Wright analysis area. None of the general Wright analysis area is classified by the WGFD as within normal elk use range. As more lands are reclaimed from mining, elk are shifting their winter use to these areas. The WGFD has designated an

approximately 5 square mile area on reclaimed lands within the Jacobs Ranch Mine permit area as crucial winter habitat for the Rochelle Hills elk herd (Oedekoven 1994). Rio Tinto Energy America (RTEA) (owner of the Jacobs Ranch Mine) and the Rocky Mountain Elk Foundation (RMEF) finalized a formal agreement that created the Rochelle Hills Conservation Easement. The easement contains nearly 1,000 acres, with 75 percent of that total comprised of reclaimed mine lands within the Jacobs Ranch Mine permit area. The easement acreage was donated to RMEF by RTEA to ensure that the reclaimed land continues to be used as grazing land and wildlife habitat for the extended future (RMEF 2007). Elk have occasionally been observed within the general Wright analysis area in recent years, but they are typically restricted to the pine breaks of the Rochelle Hills, which are located immediately east of the three applicant mines. The WGFD estimated the 2007 post-season elk population for the Rochelle Hills Herd Unit at 600, which is 50 percent above the current objective of 400 animals (WGFD 2007a).

3.10.2.2 Environmental Consequences

3.10.2.2.1 Proposed Action and Alternatives 2 and 3

Under the respective Proposed Action and Alternative 2, BLM's preferred alternative configuration for each LBA tract, big game would be displaced from portions of the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts to adjacent ranges during mining. Pronghorn would be most affected due to their greater abundance in the area; however, no areas classified as crucial pronghorn habitat occur on or within 2 miles of these LBA tracts. Mule deer would not be substantially impacted, given their infrequent use of these lands and the availability of suitable habitat in adjacent areas. White-tailed deer are not usually found in the area but are occasionally observed to the south along Antelope Creek. None of the land within the general Wright analysis area is considered by WGFD to be an elk use area, although the Rochelle Hills Elk Herd are shifting their winter use to reclaimed lands within the general Wright analysis area. Big game displacement would be incremental, occurring over several years and allowing for gradual changes in distribution patterns. Big game residing in the adjacent areas could be impacted by increased competition with displaced animals. Noise, dust, and associated human presence would cause some localized avoidance of foraging areas adjacent to mining activities. On the existing coal leases, however, big game have continued to occupy areas adjacent to and within active mining operations, suggesting that some animals may become habituated to such disturbances.

Big game animals are highly mobile and can move to undisturbed areas. However, there would be more restrictions on big game movement on or through these six LBA tracts due to the construction of additional fences, spoil piles, and open pits related to mining. During winter storms, pronghorn may not be able to negotiate these barriers. WDEQ guidelines require fencing to be

designed to permit passage pronghorn and other big game species, to the extent possible.

Following reclamation, topographic moderation and changes in vegetation may result in a long-term reduction in big game carrying capacity, with effects varying by species. Eventual restoration of important shrub habitats would allow for the return of some animals to reclaimed mine lands over time.

3.10.2.2.2 No Action Alternative

The impacts to big game under the No Action Alternative would be similar to the impacts described in Section 3.10.1.2.2.

3.10.3 Other Mammals

3.10.3.1 Affected Environment

A variety of small and medium-sized mammal species occur in the vicinity of the general Wright analysis area, although not all have been observed on the LBA tracts themselves. These include predators and furbearers, such as the coyote (*Canis latrans*), red fox (*Vulpes vulpes*), bobcat (*Lynx rufus*), striped skunk (*Mephitis mephitis*), long-tailed weasel (*Mustela frenata*), badger (*Taxidea taxus*), muskrat (*Ondatra zibethicus*), raccoon (*Procyon lotor*), and beaver (*Castor canadensis*). Prey species include rodents [such as mice, rats, voles, gophers, ground squirrels, black-tailed prairie dogs (*Cynomys ludovicianus*), muskrats, and chipmunks] and lagomorphs (jackrabbits and cottontails). These prey species are cyclically common and widespread throughout the region. Porcupines (*Erethizon dorsatum*) and bats (such as hoary [*Lasiurus cinereus*] and big brown [*Eptesicus fuscus*]) also have habitat in the vicinity, primarily in forested habitats of the Rochelle Hills east of the general Wright analysis area. The prey species are important for raptors and other predators.

The black-tailed prairie dog was added to the list of candidates for federal listing as a threatened or endangered species under the Endangered Species Act on February 4, 2000. The USFWS then removed the black-tailed prairie dog from the list of candidate species on August 12, 2004. On December 2, 2008, the USFWS announced a 90-day finding on a petition seeking federal protection of the black-tailed prairie dog under the ESA. The USFWS subsequently announced that it will conduct a 12-month finding, which will end February 2, 2009, to determine if listing of the species is warranted (USFWS 2009). The USFWS continues to encourage the protection of prairie dog colonies for their value to the prairie ecosystem and the myriad of species that rely on them (USFWS 2004a). The black-tailed prairie dog is a BLM Sensitive Species and a USFS Sensitive Species (see Appendix H).

The black-tailed prairie dog is a highly social, diurnally active, burrowing mammal. Aggregations of individual burrows, known as colonies, form the basic unit of prairie dog populations. Found throughout the Great Plains in

short-grass and mixed-grass prairie areas (Fitzgerald et al. 1994), the black-tailed prairie dog has declined in population numbers and extent of colonies in recent years. The three major impacts that have influenced black-tailed prairie dog populations are the initial conversion of prairie grasslands to cropland in the eastern portion of its range from approximately the 1880s through the 1920s; large-scale control efforts conducted from approximately 1918 through 1972, when an Executive Order was issued banning the use of Compound 1080 (a predacide and rodenticide); and the introduction of sylvatic plague into North American ecosystems in 1908 (USFWS 2000 and 2009).

Currently, this species is primarily found in isolated populations in the eastern half of Wyoming (Clark and Stromberg 1987). Prairie dogs are considered a common resident in eastern Wyoming, utilizing short-grass and mid-grass habitats (Cerovski et al. 2004). Prairie dogs construct extensive burrow systems in fine- to medium-textured upland soil types. The USFWS's most recent estimate of occupied black-tailed prairie dog habitat in Wyoming, which was made in 2004, is approximately 125,000 acres (USFWS 2004b). Many other wildlife species, such as the black-footed ferret (*Mustela nigripes*), swift fox (*Vulpes velox*), mountain plover (*Charadrius montanus*), ferruginous hawk (*Buteo regalis*), and burrowing owl (*Athene cunicularia*) may be dependent on the black-tailed prairie dog for some portion of their life cycle (USFWS 2000 and 2009).

According to USFS observations on the Thunder Basin National Grassland (TBNG), which overlaps portions of the general Wright analysis area, the largest concentrations of prairie dog colonies in the vicinity of the eastern PRB surface coal mines are found east of the coal burnline, which is outside and east of the area of surface coal mining (Byer 2003). The large prairie dog complexes in this area east of the coal burnline have been drastically impacted by outbreaks of plague at irregular intervals over the years. The colonies west of the burnline, including those within the general Wright analysis area, are generally smaller and less densely concentrated. These colonies have not been affected by plague to the same degree as those located east of the burnline, likely due to their reduced size and density.

Qualified wildlife biologists with Intermountain Resources (of Laramie, Wyoming) and Thunderbird-Jones & Stokes (of Gillette, Wyoming) have mapped the current acreage of prairie dog colonies on and within 2 miles of the general analysis areas for each of these six LBA tracts. Biologists walked the perimeters of colonies and delineated them using hand-held global positioning system receivers and/or visually mapped them on topographic maps. Figures 3-32 through 3-37 depict the location and extent of prairie dog colonies that are completely and partially within the 2-mile perimeter that encompasses the general analysis area for the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tract, respectively. There are overlaps between the six prairie dog survey area boundaries, and as such, there are overlaps in the depiction of colonies on these figures and in the individual tract discussions that follow below. A total

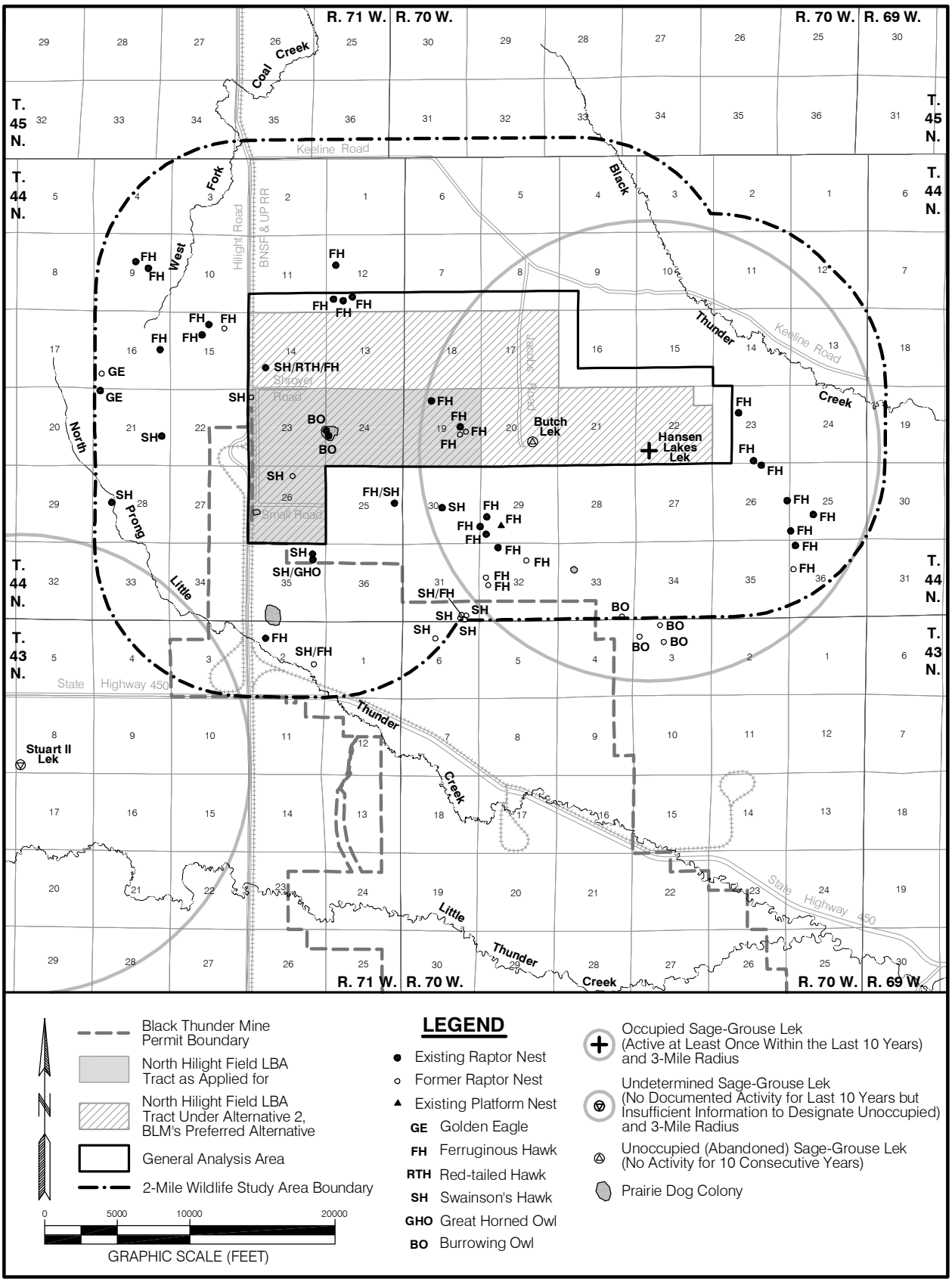


Figure 3-32. Raptor Nest Sites, Sage-Grouse Leks, and Prairie Dog Colonies Within and Adjacent to the North Hilight Field LBA Tract.

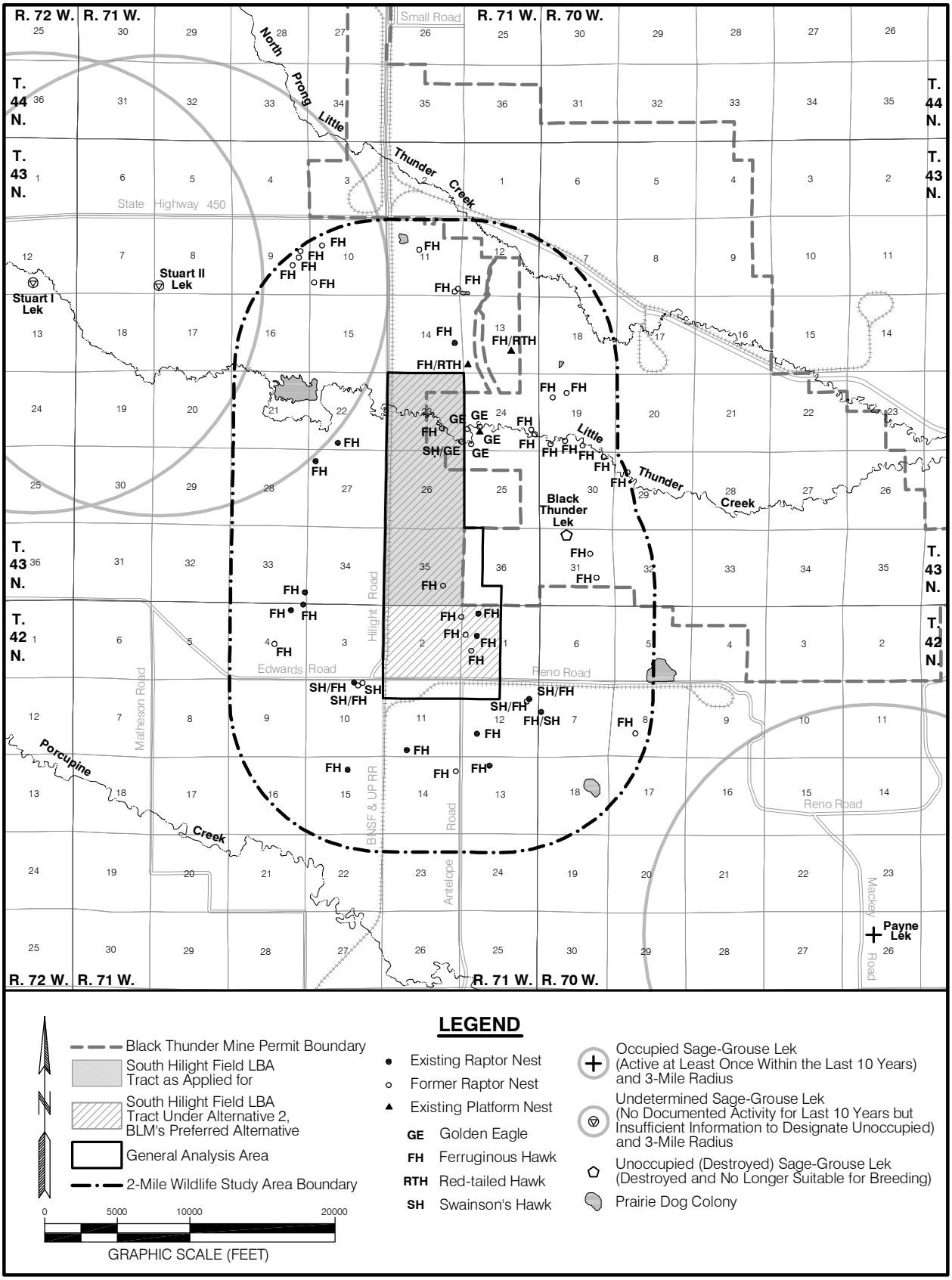


Figure 3-33. Raptor Nest Sites, Sage-Grouse Leks, and Prairie Dog Colonies Within and Adjacent to the South Hilight Field LBA Tract.

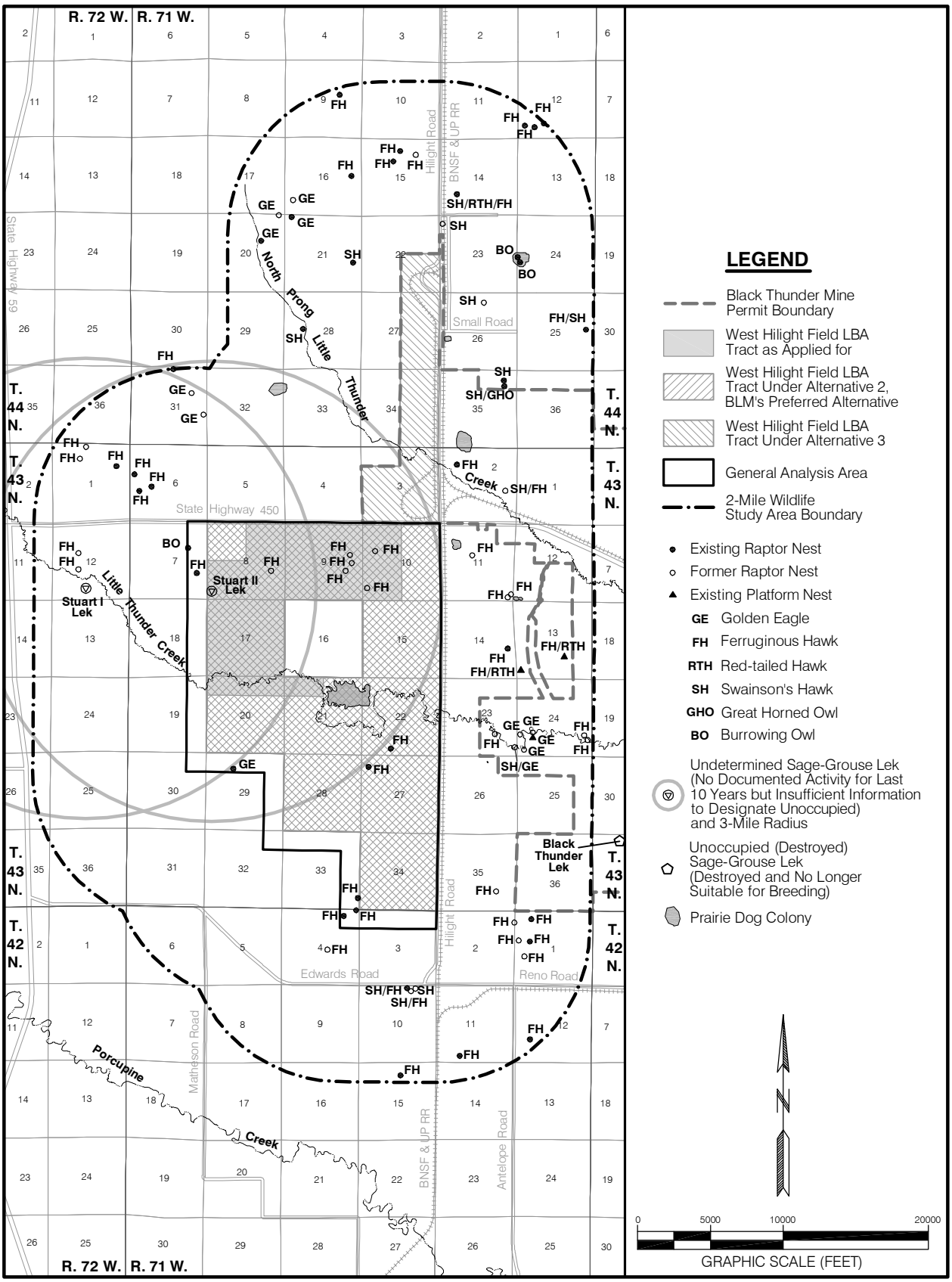


Figure 3-34. Raptor Nest Sites, Sage-Grouse Leks, and Prairie Dog Colonies Within and Adjacent to the West Hilight Field LBA Tract.

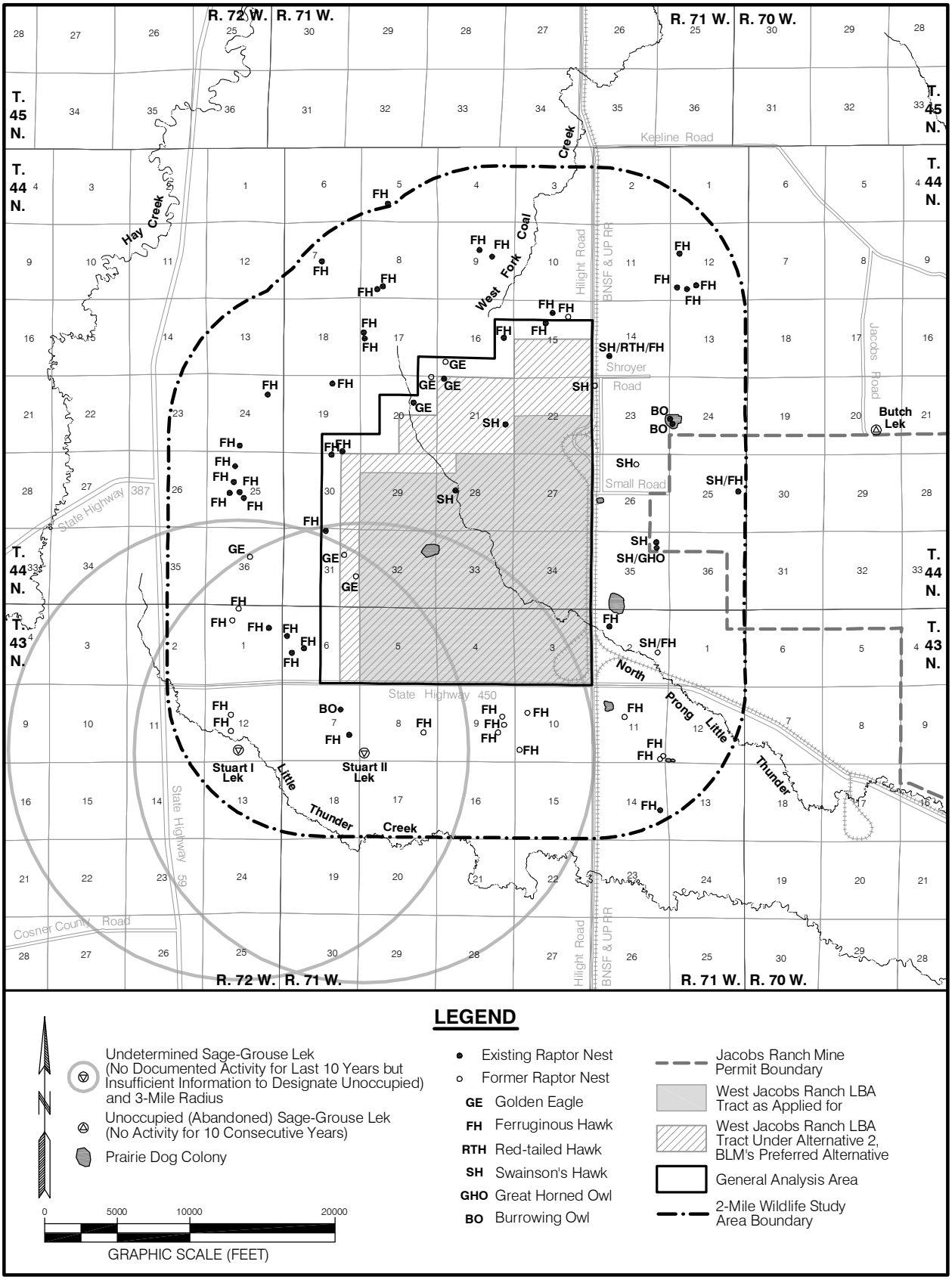


Figure 3-35. Raptor Nest Sites, Sage-Grouse Leks, and Prairie Dog Colonies Within and Adjacent to the West Jacobs Ranch LBA Tract.

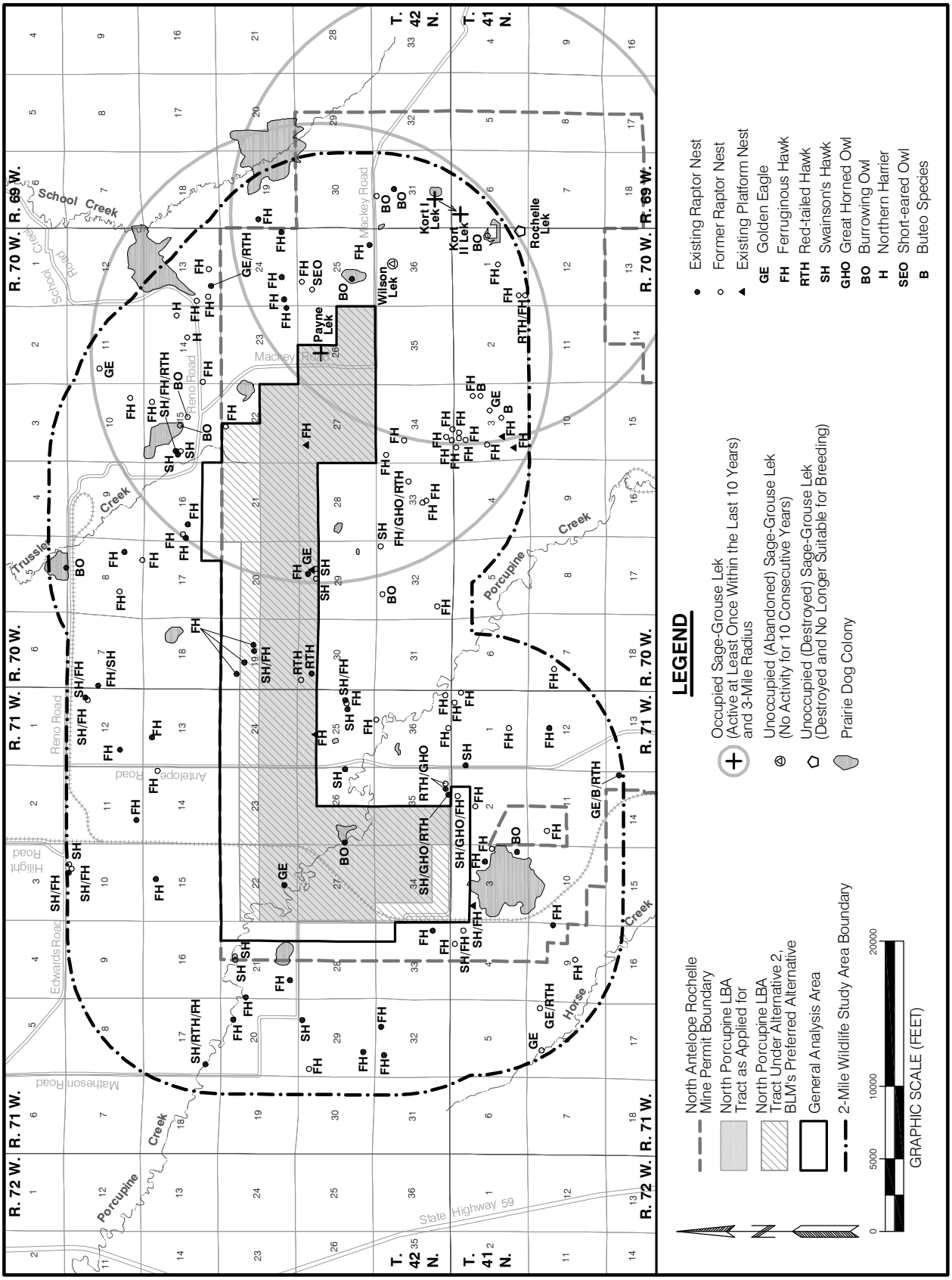


Figure 3-36. Raptor Nest Sites, Sage-Grouse Leks, and Prairie Dog Colonies Within and Adjacent to the North Porcupine LBA Tract.

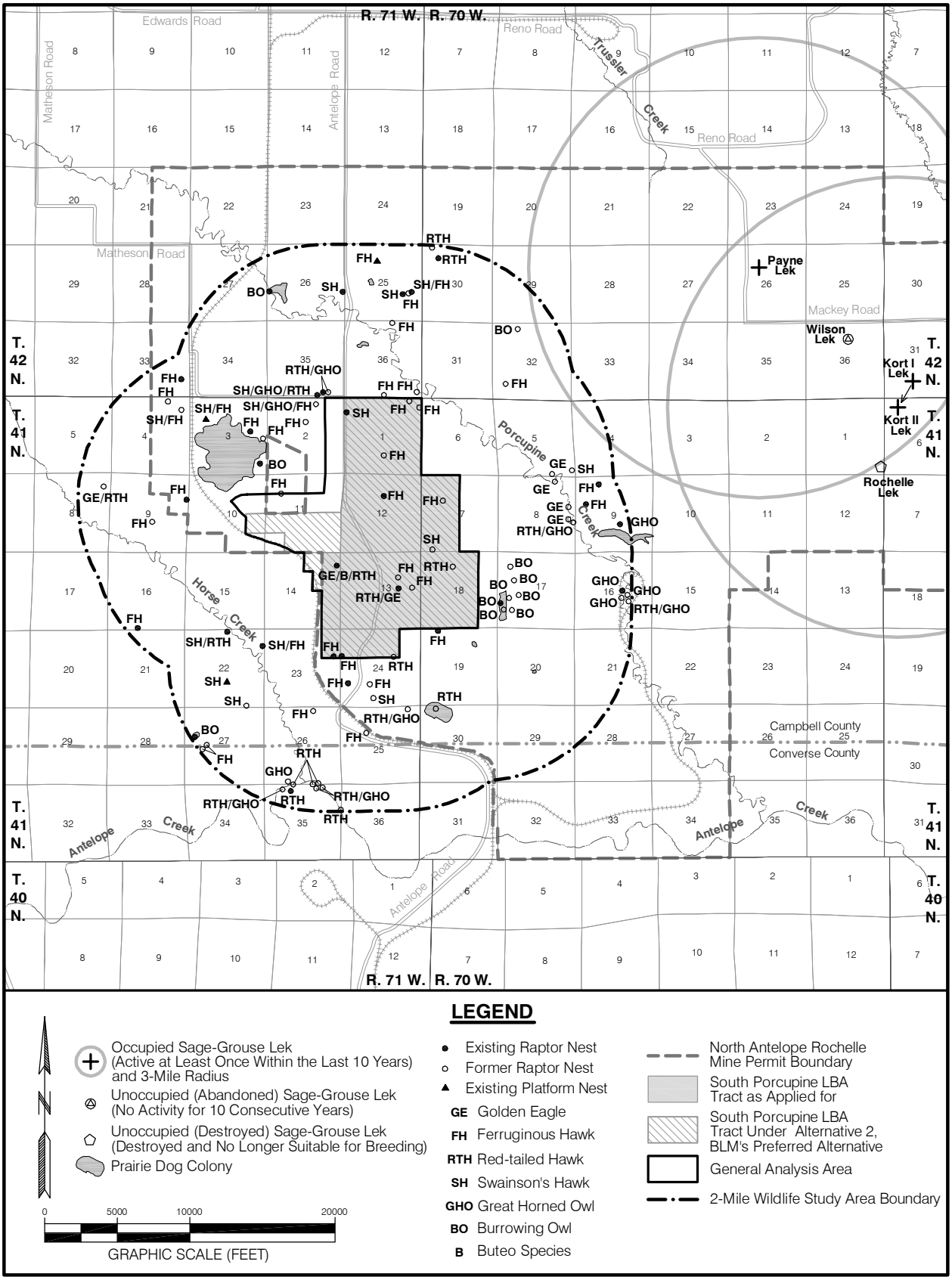


Figure 3-37. Raptor Nest Sites, Sage-Grouse Leks, and Prairie Dog Colonies Within and Adjacent to the South Porcupine LBA Tract.

of 33 occupied prairie dog colonies encompassing approximately 1,490.2 non-contiguous acres were present on and within 2 miles of the general analysis areas for these six LBA tracts in 2007. A total of six prairie dog colonies encompassing approximately 148.6 acres are located entirely within the six combined general analysis areas.

The black-tailed prairie dog is recognized as a USFS and BLM Sensitive Species and is further discussed in the Sensitive Species Evaluation (Appendix H) of this EIS.

3.10.3.1.1 North, South, and West Hilight Field LBA Tracts

Four prairie dog colonies (approximately 53.8 total acres) were found within 2 miles of the general analysis area for the North Hilight Field tract (Figure 3-32). Two colonies of which are within the general analysis area for the tract (the area likely to be affected under Alternative 2, BLM's preferred alternative) and are approximately 3.4 to 19.5 acres in size. The two other colonies are approximately 3.7 and 27.2 acres in size.

Seven prairie dog colonies (approximately 177.2 total acres) were found within 2 miles of the general analysis area for the South Hilight Field tract (Figure 3-33). Only one colony (approximately 0.1 acre in size) is within the general analysis area for the tract (the area likely to be affected under Alternative 2, BLM's preferred alternative). The other six colonies are approximately 2.0, 2.6, 7.7, 21.8, 53.9, and 89.1 acres in size.

Eight prairie dog colonies (approximately 159.0 total acres) were found within 2 miles of the general analysis area for the West Hilight Field tract (Figure 3-34). One colony (approximately 89.1 acres in size) is within the general analysis area for the tract (the area likely to be affected under Alternative 2, BLM's preferred alternative). The other seven colonies are approximately 0.1, 2.6, 3.4, 7.7, 17.9, 19.5, and 27.2 acres in size.

3.10.3.1.2 West Jacobs Ranch LBA Tract

Six prairie dog colonies (approximately 78.3 total acres) were found within 2 miles of the general analysis area for the West Jacobs Ranch tract (Figure 3-35). Only one colony (approximately 17.9 acre in size) of which is within the general analysis area for the tract (the area likely to be affected under Alternative 2, BLM's preferred alternative). The other five colonies are approximately 2.6, 3.4, 7.7, 19.5, and 27.2 acres in size.

3.10.3.1.3 North and South Porcupine LBA Tracts

Seventeen prairie dog colonies (approximately 1,317.0 total acres) were found within or overlapped the 2-mile perimeter around the general analysis area for the North Porcupine tract (Figure 3-36). Only one colony (approximately 18.6 acres in size) of which is within the general analysis area for the tract (the area

likely to be affected under Alternative 2, BLM's preferred alternative). The other 16 colonies range in size from approximately 1 to 345 acres; the largest of which occurs within both the North and South Porcupine wildlife survey areas.

Ten prairie dog colonies (approximately 476.3 total acres) were found within or overlapped the 2-mile perimeter around the general analysis area for the South Porcupine tract (Figure 3-37). No colonies are within the general analysis area for the tract (the area likely to be affected under Alternative 2, BLM's preferred alternative). The largest colony was approximately 345 acres; this colony is within both the North and South Porcupine wildlife survey areas. The remaining nine colonies were all less than 40 acres, with an average size of about 15 acres.

3.10.3.2 Environmental Consequences

3.10.3.2.1 Proposed Action and Alternatives 2 and 3

Medium-sized mammals (such as lagomorphs, coyotes, and foxes) would be temporarily displaced to other habitats by mining, potentially resulting in increased competition and mortality. However, these animals would rebound as forage is developed or small mammal prey species recolonize the reclaimed areas. Direct losses of small mammals would be higher than for other wildlife, since the mobility of small mammals is limited and many will retreat into burrows when disturbed. Therefore, populations of such prey animals as voles, ground squirrels and mice would decline during mining. However, these animals have a high reproductive potential and tend to re-occupy and adapt to reclaimed areas quickly. Research projects on habitat reclamation on mined lands within the PRB for small mammals and birds concluded that objectives to encourage recolonization of reclamation by small mammal communities are being achieved (Shelley 1992). That study evaluated sites at five separate mines. Black–tailed prairie dogs have recolonized reclaimed lands on the Jacobs Ranch Mine and are expanding their colonies east of that mine's current permit area (IR 2007).

Six prairie dog colonies encompassing approximately 148.6 non-contiguous acres in the combined general analysis areas for the North Hilight Field tract (two colonies totaling about 22.9 acres), South Hilight Field tract (one colony of roughly 0.1 acre), West Hilight Field tract (one colony of approximately 89.1 acres), West Jacobs Ranch tract (one colony of about 17.9 acres), and North Porcupine tract (one colony of roughly 18.6 acres) would be affected by leasing and mining these six LBA tracts, each under Alternative 2, BLM's preferred tract configuration. This represents approximately 10 percent of the total colony acreage (approximately 1,490.2 acres) that currently exists within the combined prairie dog survey areas. The other 90 percent (27 additional colonies) within the combined prairie dog survey areas may be affected by adjacent mining activities unrelated to the LBA tracts. Refer to the Biological Assessments (Appendix G) for each tract for further discussion of impacts to prairie dog colonies in the general analysis areas.

3.10.3.2.2 No Action Alternative

Impacts to small mammals under the No Action Alternative would be similar to the impacts described in Section 3.10.1.2.2.

3.10.4 Raptors

3.10.4.1 Affected Environment

The raptor species known or expected to occur in suitable habitats in the general Wright analysis area include the golden eagle (*Aquila chrysaetos*), ferruginous hawk, red-tailed hawk (*Buteo jamaicensis*), Swainson's hawk (*Buteo swainsoni*), rough-legged hawk (*Buteo lagopus*), northern harrier (*Circus cyaneus*), American kestrel (*Falco sparverius*), prairie falcon (*Falco mexicanus*), great horned owl (*Bubo virginianus*), burrowing owl, and short-eared owl (*Asio flammeus*). Some of these species are USFS and/or BLM Sensitive Species (see Appendix H).

The bald eagle (*Haliaeetus leucocephalus*) is a migrant and common winter resident of the Wyoming PRB region. On July 9, 2007, the USFWS published a Federal Register notice (72 FR 37346) announcing that the bald eagle would be removed from the list of threatened and endangered (T&E) species under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et* seq.); de-listing was effective as of August 8, 2007. However, the protections provided to the bald eagle under the Bald and Golden Eagle Protection Act (BGEPA), 16 U.S.C. 668, and the Migratory Bird Treaty Act (MBTA), 16 U.S.C. 703, will remain in place. The bald eagle is now recognized as a USFS Sensitive Species and BLM Sensitive Species and is further discussed in Appendix H of this EIS.

Those species that commonly nest in the general Wright analysis area are the golden eagle, ferruginous hawk, red-tailed hawk, Swainson's hawk, burrowing owl, and great horned owl. American kestrels, northern harriers, and short-eared owls intermittently nest in the area, as occasional sightings of recently fledged young indicate that such activities do occur within the general Wright analysis area for one or more of those species. Habitat is limited for those species that nest exclusively in trees or on cliffs, but several species have adapted to nesting on the ground, creek banks, buttes, mine highwalls, or rock outcrops. Rough-legged hawks are winter residents in northeast Wyoming, and breed in the arctic regions.

The raptor monitoring areas for the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines include their respective permit areas and a surrounding 1- or 2-mile perimeter. Due to the proximity of the LBA tracts to those adjacent applicant mines, all or portions of the general analysis area and respective 2-mile perimeter for each of these six LBA tracts have been included in the mines' annual raptor monitoring surveys since the early 1980s. Specific details regarding those surveys are available in the mines' annual wildlife monitoring reports, which are on file with the WDEQ/LQD.

Figures 3-32 through 3-37 show the locations of raptor nests identified within the 2-mile perimeter that encompasses the general analysis area for each of the six WAC LBA tracts (North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tract, respectively), in 2007 and 2008. There are overlaps between the six raptor survey area boundaries, and as such, there are overlaps in the depiction of raptor nests on these figures and in the individual tract discussions that follow below. Over time, raptors have built new nests, natural forces have destroyed many nests, and others have been relocated for mitigation or removed by mining activities. In some cases, nests have been created to mitigate other nest sites impacted by mining operations. A total of 143 intact raptor nests were documented on and within 2 miles of the general analysis areas for these six LBA tracts in 2007 and 2008. A total of 44 of these 143 nests are located within the six general analysis areas (the areas likely to be affected under Alternative 2, BLM's preferred alternative for each tract).

3.10.4.1.1 North, South, and West Hilight Field LBA Tracts

During surveys completed in 2007 by Thunderbird-Jones & Stokes (J&S), a total of 34 intact raptor nests (one golden eagle nest, 23 ferruginous hawk nests, four Swainson's hawk nests, two burrowing owl nest sites, one platform nest erected for ferruginous hawks, and three nests that have been used by multiple raptor species) were present within 2 miles of the general analysis area for the North Hilight Field LBA Tract (Figure 3-32). Eight intact nests were within the general analysis area for the tract (the area likely to be affected under Alternative 2, BLM's preferred alternative): four intact nests (two burrowing owl and two ferruginous hawk) were present within the tract as applied for, one intact nest (used by multiple species) was present on the additional lands evaluated by BLM under Alternative 2, and three more intact nests (all ferruginous hawk) were present on the ¼-mile disturbance buffer. Only one of the eight intact nests within the general analysis area for the North Hilight Field tract was active (eggs laid) during 2007. The remaining 26 intact nests were within 2 miles of the tract's general analysis area.

Surveys completed in 2007 by J&S identified a total of 18 intact raptor nests (12 ferruginous hawk nests, two platform nests erected for ferruginous/Swainson's hawks, and one platform nest erected for golden eagles, and three nests that have been used by multiple raptor species) within 2 miles of the general analysis area for the South Hilight Field LBA Tract (Figure 3-33). Two intact nests were within the general analysis area for the tract (the area likely to be affected under Alternative 2, BLM's preferred alternative): no intact nests were present within the tract as applied for, and two intact ferruginous hawk nests were present on the additional lands evaluated by BLM under Alternative 2. Both of those nests were in the same territory. No intact nests within the general analysis area for the South Hilight Field tract were active during 2007. The remaining 16 intact nests were within 2 miles of the tract's general analysis area.

During surveys completed in 2007 by J&S, a total of 42 intact raptor nests (26 ferruginous hawk nests, three Swainson's hawk nests, three burrowing owl nest sites, two platform nests erected for ferruginous/red-tailed hawks, one platform nest erected for golden eagles, and four nests that have been used by multiple raptor species) were present within 2 miles of the general analysis area for the West Hilight Field LBA Tract (Figure 3-34). Eight intact nests were within the general analysis area for the tract (the area likely to be affected under Alternative 2, BLM's preferred alternative): no intact nests were present within the tract as applied for, two intact nests (ferruginous hawk) were present on the additional lands evaluated by BLM under Alternative 2, and six more intact nests (four ferruginous hawk, one burrowing owl, and one golden eagle) were present within the ¼-mile disturbance buffer. Three of the eight intact nests within the general analysis area for the West Hilight Field tract were active (eggs laid) during 2007. The remaining 34 intact nests were within 2 miles of the tract's general analysis area.

3.10.4.1.2 West Jacobs Ranch LBA Tract

During raptor nest surveys completed in 2007 and 2008 by Intermountain Resources (IR), a total of 44 intact raptor nests (33 ferruginous hawks nests, three Swainson's hawk nests, three burrowing owl nest sites, two golden eagle nests, and three nests that have been used by multiple raptor species) were present within 2 miles of the general analysis area for the West Jacobs Ranch LBA Tract (Figure 3-35). Nine intact nests were within the general analysis area for the tract (the area likely to be affected under Alternative 2, BLM's preferred alternative): one intact nest (Swainson's hawk) was present within the tract as applied for, two intact nests (one golden eagle and one Swainson's hawk) were present on the additional lands evaluated by BLM under Alternative 2, and six more intact nests (five ferruginous hawk and one golden eagle) were present within the ¼-mile disturbance buffer. Three of the nine intact nests (one golden eagle, one Swainson's hawk, and one ferruginous hawk) within the general analysis area for the West Jacobs Ranch tract were active during 2007 and 2008. The remaining 35 intact nests were within 2 miles of the tract's general analysis area.

3.10.4.1.3 North and South Porcupine LBA Tracts

During raptor nest surveys completed in 2007 by J&S, a total of 56 intact raptor nests (31 ferruginous hawk nests, five burrowing owl nest sites, five Swainson's hawk nests, two golden eagle nests, one red-tailed hawk nest, 12 nests that have been used by multiple raptor species, which includes four platform nests erected for ferruginous hawks, one platform nest erected for golden eagles, and one platform nest erected for ferruginous/Swainson's hawks) were present within 2 miles of the general analysis area for the North Porcupine LBA Tract (Figure 3-36). Eleven intact nests were within the general analysis area for the tract (the area likely to be affected under Alternative 2, BLM's preferred alternative): seven intact nests (one burrowing owl, three ferruginous hawk, two golden eagle, and one red-tailed hawk) were present

within the tract as applied for, three intact ferruginous nests were present on the additional lands evaluated by BLM under Alternative 2, and one additional intact ferruginous hawk nest was present on the ¼-mile disturbance buffer. Nineteen of the 56 intact nests were active (eggs laid) during 2007, and five of the 11 nests within the general analysis area were active that year.

Surveys completed in 2007 by J&S identified a total of 32 intact raptor nests (12 ferruginous hawk nests, four Swainson's hawk nests, two red-tailed hawk nests, four burrowing owl nest sites, two great horned owl nests, and eight nests that have been used by multiple raptor species, including one platform nest erected for ferruginous/Swainson's hawks, one platform nest erected for ferruginous hawks, and one platform nest erected for Swainson's hawks) present within 2 miles of the general analysis area for the South Porcupine LBA Tract (Figure 3-37). Six intact nests were within the general analysis area for the tract (the area likely to be affected under Alternative 2, BLM's preferred alternative), all six of which (three ferruginous hawk, one Swainson's hawk, and two multiple species nests) were present within the LBA tract as applied for. No additional intact nests were present on the additional lands evaluated by BLM under Alternative 2 or the ¼-mile disturbance buffer. Thirteen of the 32 intact nests were active during 2007, three of which were within the general analysis area.

3.10.4.2 Environmental Consequences

3.10.4.2.1 Proposed Action and Alternatives 2 and 3

Mining the LBA tracts would not impact overall regional raptor populations; however, individual birds or pairs may be impacted. Mining activity could cause raptors to abandon nests proximate to disturbance, particularly if mining encroaches on active nests during a given breeding season. USFWS recommends a 1-mile buffer around all active ferruginous hawk nests. Active nests (incubating/brooding adults, eggs, or young present) of most other raptor species are typically buffered by a ½-mile radius. Monitoring data collected since the early 1980s within the general Wright analysis area indicate that several of the raptor pairs that breed within this area have alternate nesting sites elsewhere within their territories that are beyond the boundaries of the 2-mile perimeter that encompasses the general analysis areas for the West Hilight Field, South Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts.

USFWS, WGFD, WDEQ/LQD, and/or USFS approval would be required before mining could occur within standard buffer zones for active raptor nests. The Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines annually monitor territorial occupancy and nest productivity on and around their existing leases. Several raptor pairs representing multiple species have successfully nested in close proximity to mining operations at surface coal mines in the PRB, including golden eagles (approximately 600 feet), Swainson's hawks (approximately 400 feet), red-tailed hawks (approximately 200 feet), and

great horned owls (on active coal processing facilities, such as crushers and silos). Those same raptor species have been documented within the general Wright analysis area. Those nesting efforts have succeeded due to a combination of raptors becoming acclimated to the gradual encroachment of mine operations and successfully implemented progressive mitigation techniques to maintain viable raptor territories and protect nest productivity. Details documenting raptor nesting efforts and success near mine operations are available in the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines' Annual Wildlife Reports, as well as those for other regional PRB coal mines, on file with the WDEQ/LQD.

Mining within or near raptor territories would impact availability of foraging habitat for nesting birds. However, increased acreage of reclamation within the permit areas would offset new habitat loss as mining progresses. Equipment enclosures associated with mining provide additional habitat for prey species such as cottontail rabbits, and several raptor pairs have voluntarily nested near those areas. As at other surface mines throughout the region, raptor nesting efforts at the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines have typically been influenced primarily by natural factors such as prey abundance and availability of nesting substrates. Due to the lack of woody vegetation, raptors that nest in trees or on cliffs are not as abundant as those that either nest on the ground or are adaptable to nesting on mine facilities or other man-made structures (platform nests, etc.). During mining, new nesting habitat can be created through enhancement efforts like nest platforms, nest boxes, and tree plantings.

A total of 44 intact raptor nests were present in 2007 and 2008 within the general analysis areas for these six LBA tracts and could be impacted if the tracts were leased and mined under Alternative 2, BLM's preferred alternative.

3.10.4.2.1.1 North, South, and West Hilight Field LBA Tracts

Eighteen intact raptor nests that were present within the combined general analysis areas for the North Hilight Field (8 nests), South Hilight Field (2 nests), and West Hilight Field (8 nests) LBA Tracts in 2007 would be affected by leasing and mining these three tracts, each under Alternative 2, BLM's preferred tract configuration. Thirteen of these 18 intact raptor nests were ferruginous hawk nests representing seven territories within the combined general analysis areas for the North Hilight Field (five nests), South Hilight Field (two nests), and West Hilight Field (six nests) LBA Tracts. However, ferruginous hawks have actively nested (laid eggs) at only two of those 13 nests in recent years.

3.10.4.2.1.2 West Jacobs Ranch LBA Tract

Nine intact raptor nests were present within the general analysis area for the West Jacobs Ranch LBA Tract in 2007 and 2008. Five of these nine intact raptor nests were ferruginous hawk nests. Ferruginous hawks actively nested

(laid eggs) at only one of those five sites in recent years. Only two raptor species (Swainson's hawk and golden eagle) have been recorded nesting on the BLM study area for the West Jacobs Ranch LBA Tract (the tract as applied for and the additional area evaluated by BLM under Alternative 2, BLM's preferred alternative).

3.10.4.2.1.3 North and South Porcupine LBA Tracts

Seventeen intact raptor nests that were present within the combined general analysis areas for the North Porcupine (11 nests) and South Porcupine (six nests) LBA Tracts in 2007 would be affected by leasing and mining these two tracts, each under Alternative 2, BLM's preferred tract configuration. Ten of these 17 intact raptor nests were ferruginous hawk nests representing 3 territories within the combined general analysis areas for the North Porcupine (7 nests) and South Porcupine (3 nests) LBA Tracts.

All intact nests within the general analysis areas for both North and South Porcupine tracts are encompassed by the current permit area for the North Antelope Rochelle Mine (Figures 3-36 and 3-37) and could therefore be impacted by mine-related operations regardless of whether the LBA tracts are leased. Although individual birds or pairs could be impacted by those activities, the continued use of effective mitigation measures will minimize impacts to overall regional raptor populations. Mining activity could cause raptors to abandon nests proximate to disturbance, particularly if mining encroaches on active nests during a given breeding season. Monitoring data collected over the last 20 plus years, has indicated that some of the raptor pairs that breed within these two general analysis areas have alternate nesting sites elsewhere within their territories, but beyond the two-mile wildlife survey area.

3.10.4.2.2 No Action Alternative

Impacts to raptor species under the No Action Alternative would be similar to the impacts described in Section 3.10.1.2.2.

3.10.5 Upland Game Birds

3.10.5.1 Affected Environment

Four upland game bird species have historically been documented within the general Wright analysis area. These species are the mourning dove (*Zenaida macroura*), gray partridge (*Perdix perdix*), wild turkey (*Meleagris gallopavo*), and Greater sage-grouse (*Centrocercus urophasianus*). The mourning dove, however, is the most prevalent upland game bird in this area, and the only species known to occur with any regularity. Based on annual lek searches since the late 1970's, sharp-tailed grouse do not appear to inhabit the surface coal mine region of the southern PRB. The nearest sharp-tailed grouse lek is located over 40 miles northwest of the general Wright analysis area.

Mourning doves are a migrant and are relatively common in the area during spring and fall with fewer observations during the nesting season. This species is a relatively common breeding bird in Campbell County and may be found in a variety of habitat types. Doves are most often seen near sites with water sources and trees, though they are occasionally observed in sagebrush and greasewood stands. Mourning doves were observed within the general Wright analysis area in 2007 and 2008.

The gray partridge (a.k.a. Hungarian partridge or Hun) is an introduced, non-migratory game bird species that form flocks (or coveys) outside the breeding season. Gray partridge have been infrequently observed on reclaimed areas, sagebrush shrublands, upland grassland, and cultivated lands in the general Wright analysis area. In some years, this species is occasionally encountered, while in other years, partridge appear to be totally absent. Gray partridge were not observed in the general Wright analysis area in 2007 or 2008.

Wild turkeys have been seen infrequently over time in the general Wright analysis area, with spans of several years between observations. All historical observations have occurred during spring, when males were gobbling. This species is most often observed along Antelope Creek, generally south of the North and South Porcupine LBA Tracts. Wild turkeys were not observed in the general Wright analysis area in 2007 or 2008.

The Greater sage-grouse, hereafter referred to as sage-grouse, is a species of concern throughout the West and is considered a “landscape species”, which means that large expanses of unfragmented land are required in order to provide all the habitat components for their annual life cycle. Relying on sagebrush for food, cover, and shelter, sage-grouse require sagebrush habitat year-round and for every phase of their life cycle, and exhibit seasonal movements to utilize discrete sagebrush habitats.

Sage-grouse breeding occurs on strutting grounds (leks) during late March and April. Leks are generally established in open areas surrounded by Wyoming big sagebrush, which is used for escape and protection from predators. Generally, lek sites are used year after year and are considered to be the center of year-round activity for resident sage-grouse populations. On average, approximately two-thirds of sage-grouse hens nest within 3 miles of the lek where they were bred. New spring plant growth, residual cover, and understory are important habitat components for nesting sage-grouse hens.

Areas near nests are used for several weeks by hens for brood rearing. The habitats used during the first few weeks after hatching must provide good cover to conceal the chicks and must provide essential nutritional requirements during this period of rapid development. Brood-rearing habitats that have a healthy and wide diversity of plant species, particularly grasses and forbs, tend to provide a variety and abundance of insects that are an essential protein supply for the young.

Summer habitat consists of sagebrush mixed with areas of wet meadows, riparian, or irrigated agricultural fields. As summer progresses and forbs mature and dry up, sage-grouse broods must move to more mesic, wet meadow-type habitats where succulent plants and insects are still available. This can be especially important in drier years and during long drought periods. As the fall season nears, sage-grouse form flocks as brood groups break up. As fall progresses, sage-grouse move toward their winter ranges.

During winter, sage-grouse feed almost exclusively on sagebrush leaves and buds. Suitable winter habitat requires sagebrush above snow. It is crucial that sagebrush be exposed at least 10 to 12 inches above snow level as this provides food and cover for wintering sage-grouse. Population and habitat analyses suggest that wintering habitat can be as limiting as breeding habitats. These seasonal movements are related to severity of winter weather, topography, and vegetative cover.

Since 1999, the USFWS has received eight petitions requesting that the sage-grouse be listed under the Endangered Species Act as threatened or endangered. Three of the petitions requested that sage-grouse be listed as endangered across its entire range. On January 12, 2005, following a 12-month status review on the species, the USFWS concluded that listing was not warranted at that time. On December 4, 2007, U.S. District Court, District of Idaho, ruled that the USFWS 12-month petition finding on sage-grouse was in error and remanded the case back to the Service for further reconsideration. On February 26, 2008, the USFWS announced the initiation of another status review for the Greater sage-grouse.

USFWS has indicated the need for continued efforts to conserve sage-grouse and sagebrush habitat on a long-term basis, and has encouraged continued development and implementation of conservation strategies throughout the species' range. The sage-grouse is also a BLM Sensitive Species and a USFS Region 2 Sensitive Species and Management Indicator Species (see Appendix H).

On September 11, 2003, the Wyoming Game and Fish Commission announced that the 2003 hunting season for sage-grouse in Johnson, Sheridan, and Campbell counties would be closed, following the deaths of 11 sage-grouse in northeastern Wyoming from West Nile Virus in August and early September of that year. According to WGFD's September 11, 2003 press release, the commission took this action because the incidence of infection was much higher in northeastern Wyoming than the rest of the state and the area is on the fringe of sage-grouse range with marginal, fragmented habitat. Recent lek count data indicate that Wyoming's sage-grouse populations increased slightly from 2004 through 2007. Lower incidences of West Nile Virus mortalities were also documented in those years, primarily due to cooler temperatures that reduced mosquito populations. Sage-grouse hunting seasons were consequently reopened in 2004 (Christiansen 2004).

In 2007, Wyoming Governor Dave Freudenthal commissioned a Statewide Sage-grouse Implementation Team which emerged from the Governor's 2007 Sage-Grouse Summit. On March 17, 2008, the Implementation Team preliminarily identified and mapped recommended sage-grouse core breeding areas in Wyoming in an effort to better understand what types of habitat the grouse prefer and what areas should be protected. The general Wright analysis area is not located within the mapped core breeding areas.

On August 1, 2008, the Governor of Wyoming released an executive order regarding sage-grouse core area protection (Office of the Governor of Wyoming 2008). The sage-grouse focus area protection concept came about as a result of work by the Sage-grouse Implementation Team. The Implementation Team developed a Core Population Strategy for the State of Wyoming "to maintain habitats and viable populations of sage-grouse in areas where they are most abundant" and delineated approximately 40 areas around the state with a focus of maintenance and enhancement of grouse habitats and populations within the focus areas. The areas were delineated by evaluating habitats within a 4-mile radius of selected sage-grouse leks in high lek-density areas. The BLM Wyoming State Office is in the process of developing a state-wide sage-grouse management policy and has incorporated sage-grouse focus areas based on the core area concept in the draft management policy. BLM has indicated that the sage-grouse management strategy for management of future surface disturbance (including actions proposed in this EIS) will likely be based on the sage-grouse focus areas (BLM 2008c).

WGFD has adopted definitions for the purposes of collecting and reporting sage-grouse data (WGFD 2007b). The definitions contain an assessment of the annual status and a management status of sage-grouse leks. The annual status is assessed annually based on the following definitions:

- Active – Any lek that has been attended by male sage-grouse during the strutting season.

- Inactive – Any lek where sufficient data suggests that there was no strutting activity throughout a strutting season.

- Unknown – Leks for which status as active or inactive has not been documented during the course of a strutting season.

The management status is based on a lek's annual status; a lek is assigned to one of the following categories for management purposes:

- Occupied – A lek that has been active during at least one strutting season within the prior ten years. Occupied leks are protected through prescribed management actions during surface disturbing activities.

- Unoccupied (formerly "historical lek".) – There are two types of unoccupied leks, "destroyed" and "abandoned." Unoccupied leks are not protected during surface disturbing activities.

  – destroyed – A formerly active lek site and surrounding sagebrush habitat that has been destroyed and is no longer suitable for sage-grouse breeding.

  – abandoned – A lek in otherwise suitable habitat that has not been active during a period of 10 consecutive years. To be designated abandoned, a lek must be "inactive" (see above criteria) in at least four non-consecutive strutting seasons spanning the 10 years. The Forest Service defines "abandoned" as leks that have been documented as inactive for five consecutive years.

- Undetermined – Any lek that has not been documented active in the last 10 years, but survey information is insufficient to designate the lek as unoccupied. Undetermined leks will be protected through prescribed management actions during surface disturbing activities until sufficient documentation is obtained to confirm the lek is unoccupied.

The Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines have conducted surveys of known sage-grouse leks and searches for new leks as part of their wildlife baseline inventories and wildlife monitoring programs since the early 1980s. Baseline inventories, which have occurred prior to initial permitting and subsequent permit amendments, encompassed the respective mine's permit area and a 2-mile perimeter. The mines continued annual surveys that included the respective mine permit area and a 1-mile perimeter and began when each mine was initially permitted. Those surveys became mandatory with the implementation of Appendix B of the WDEQ/LQD Coal Rules and Regulations in 1993. Each occupied and undetermined lek is generally surveyed three times within a given breeding season. As a result, most of the general analysis areas for the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts have been included in previous regular survey efforts.

In May 2002, the USFWS office in Cheyenne, Wyoming, released a list entitled *Coal Mine List of 40 Migratory Bird Species of Management Concern in Wyoming*, which replaced the previous *Migratory Birds of High Federal Interest List*. The sage-grouse is included on the updated list, giving further impetus to ongoing annual survey efforts.

Figures 3-32 through 3-37 depict the locations of sage-grouse leks identified within the 2-mile perimeter that encompasses the general analysis area for the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tract, respectively, in 2007 and 2008. There are overlaps between the six sage-grouse survey area boundaries, and as such, there are overlaps in the depiction of sage-grouse leks on these

figures and in the tract discussions that follow below. A total of 10 sage-grouse leks have been documented on and within 2 miles of the general analysis areas for these six LBA tracts. Two leks, Kort I and Kort II, likely represent a shift in lekking activity rather than two distinct leks (Figures 3-36 and 3-37). Four of the leks have been active during recent survey years and are classified as occupied; two leks have not been attended by displaying grouse for at least the last 10 years and are classified as unoccupied/abandoned; two leks have been removed by mining activities and are classified as unoccupied/destroyed; there has been no documented activity for the last 10 years at two leks, but survey information is insufficient to designate them as unoccupied, so they are classified as undetermined.

Sage-grouse populations are generally considered to be cyclic, with periodic intervals between peaks in region-wide male lek attendance. However, sage-grouse populations and their distribution in Wyoming have declined over the last five decades (WGFD long-term data, provided by L. Jahnke, 2008) despite higher counts in some years.

No sage-grouse broods were recorded within the BLM study area for each LBA tract (the tract as applied for and the additional area evaluated by BLM under Alternative 2) during specific surveys or incidental to other wildlife surveys conducted in those areas annually since at least 1993.

Although nesting and winter surveys for sage-grouse are not required as part of the annual wildlife monitoring programs for the three applicant mines, winter surveys have been conducted as part of the required baseline inventories for previously planned mine expansions. Additionally, winter surveys for other species (e.g., big game, bald eagle roosts, and other wintering raptors) have been conducted at the three mines in recent years. Due to their proximity to existing mine permit areas, the general analysis areas for these six LBA tracts have been included in a minimum of seven consecutive years of big game winter surveys (from 1993 through 1999) and no sage-grouse were ever documented in or near the LBA tracts during those surveys. Radio-telemetry data gathered from grouse collared at the North Antelope Rochelle Mine during a voluntary, multi-year (2001 through 2007) study have, however, demonstrated that most birds in the North Porcupine wildlife survey area reside near the mine year-round. Few grouse were recorded within 2 miles of the South Porcupine LBA Tract during that telemetry monitoring.

3.10.5.1.1 Sage-Grouse Use Associated With the North, South, and West Hilight Field LBA Tracts

The sage-grouse is a year-round resident throughout much of the PRB, but has declined dramatically on and within 2 miles of the general analysis areas for the North, South, and West Hilight Field LBA Tracts over the last 30 years. The lack of sage-grouse use in that region has been well documented from the late 1970s through 2008. Sage-grouse were last confirmed in these study areas in 2003 (Hansen Lakes lek located within the BLM study area for the

North Hilight Field tract), though some leks in these areas were not checked annually by the WGFD prior to the 2007 and 2008 surveys associated with this EIS.

Five sage-grouse leks are located on and within 2 miles of the North, South, and West Hilight Field general analysis areas: Stuart I, Stuart II, Black Thunder, Butch, and Hansen Lakes Leks (Figures 3-32 through 3-34). Three of the five leks (Butch, Hansen Lakes, and Stuart II) fall within one of the three general analysis areas, with the remaining two (Black Thunder and Stuart I) located in the 2-mile wildlife survey perimeter (Figures 3-32 through 3-34). The Black Thunder lek was eclipsed by mining activities in 2007 after 12 consecutive years of inactivity. The remaining four leks have experienced lengthy periods of little or not activity over at least the last 16 years (1992-2007). As described above, no lek activity has been documented in these three wildlife survey areas since 2003, though the Butch and Hansen Lakes leks were not checked every year.

The wildlife study areas for the North, South, and West Hilight Field LBA Tracts are not within a sage-grouse focus area.

Two sage-grouse leks have been documented within the general analysis area for the North Hilight Field LBA Tract: Hansen Lakes and Butch (Figure 3-32). The Butch lek was discovered in 1990, and was active every year through 1993. That was the same year that the Hansen Lakes lek was discovered; it was active each year from 1993 through 2003 and is therefore considered active. The Hansen Lakes lek is located approximately 1.5 miles east of Butch lek, and could potentially represent a shift in the lek's location. The Butch lek was checked annually from 1994 through 2001, with no records of grouse during that period. The lek was not checked again until 2007; it was also inactive that year and is therefore now classified unoccupied/abandoned. The Hansen Lakes lek was checked in 3 of the last 4 four years and no grouse were present. No other leks have been documented within the wildlife study area for the North Hilight Field LBA Tract.

One sage-grouse lek has been documented approximately 1 mile east of the general analysis area for the South Hilight Field LBA Tract: Black Thunder (Figure 3-33). In 2005, the Black Thunder lek was classified as historical after 12 consecutive years of inactivity. Surveys were no longer required at that lek after that year, and it was eclipsed by mining in 2007. The Black Thunder lek is now classified unoccupied/destroyed. No other leks have been documented within the wildlife study area for the South Hilight Field LBA Tract.

Two sage-grouse leks have been documented on and within 2 miles of the West Hilight Field general analysis area: Stuart I and Stuart II (Figure 3-34). The Stuart II lek is located within the LBA tract as applied for, and the Stuart I lek is located approximately 1.3 miles west of the general analysis area for the West Hilight Field LBA Tract. The Stuart II lek was monitored by the WGFD and/or USFS at approximately three-year increments from 1979 through 2004.

The highest number of grouse ever recorded during that period was seven in 1991. That was also the last year when grouse were confirmed at the lek. The Stuart II lek has been monitored by private consultants in each of the last four years (2005 through 2008) and no grouse were observed. The Stuart I lek was discovered in 1977. The lek was monitored in three of the following four years, and was active in each survey year. Monitoring efforts were reduced to every third year (WGFD standard timing) from 1982 through 2003; annual monitoring began in 2004. Grouse were observed in only one of the monitoring years from 1982 through 2007. Two males were recorded at the Stuart I lek in 1991 and that was the last year when grouse or sign were confirmed at the lek.

No sage-grouse have been recorded at the Stuart I and II leks for over 10 years; however, not enough consistent data have been collected to classify either as abandoned. Both Stuart I and Stuart II leks are now classified undetermined (insufficient information to designate the leks as unoccupied). No other leks have been documented within the wildlife study area for the West Hilight Field LBA Tract.

3.10.5.1.2 Sage-Grouse Use Associated With the West Jacobs Ranch LBA Tract

Two sage-grouse leks have been documented within 2 miles of the West Jacobs Ranch general analysis area: Stuart I and Stuart II (Figure 3-35). The Stuart II lek is located approximately 1 mile south of the LBA tract as applied for, and the Stuart I lek is located approximately 1.3 miles southwest of the general analysis area for the West Jacobs Ranch LBA Tract.

While displaying males have not been recorded at either of these two leks for over ten years (not since 1991 at both sites), there is insufficient data to indicate that they are abandoned; therefore, both leks are presently classified undetermined. The Stuart I lek would probably not be re-occupied in the near future due to the presence of a CBNG compression station and other CBNG development facilities within ¼ mile of the lek site. The Stuart II lek would probably not be re-occupied in the near future due to the presence of CBNG access roads and other CBNG facilities within ¼ mile of the lek site (IR 2008).

No other leks have been documented within the wildlife study area for the West Jacobs Ranch LBA Tract, and this area is not within a sage-grouse focus area.

3.10.5.1.3 Sage-Grouse Use Associated With the North and South Porcupine LBA Tracts

Five sage-grouse leks have been documented within 2 miles of the North Porcupine general analysis area: Payne, Wilson, Kort I, Kort II, and Rochelle (Figure 3-36). Payne lek is located on the LBA tract as applied for and is close to the tract's eastern edge. The Wilson, Kort I, and Kort II lek sites are within 2 miles of the LBA tract's general analysis area and are all southeast of the tract's southeastern corner. The Rochelle lek site is also located southeast of

the tract's general analysis area, although it is just outside of the 2-mile wildlife study area boundary.

The Rochelle lek was discovered in 1990 but experienced reduced attendance after 1992, with birds present in only 3 of the subsequent 11 years. The site may have been a satellite to the Wilson lek; used only when the local grouse population was relatively high or increasing. The Rochelle lek was mined through in 2004, and is now classified as unoccupied/destroyed. The Kort I lek was first identified in spring 1998 when, for unknown reasons, grouse apparently shifted their breeding activities from the Wilson lek. Male attendance at the Kort I lek gradually declined through 2004 (low of three males), and the birds shifted their display location to the Kort II lek site in 2005. The Kort I and Kort II leks are currently classified as occupied. The Wilson Lek is classified as unoccupied/abandoned. The Payne lek was first discovered in spring 2001. The peak male count (21) recorded that year was higher than that of any subsequent year. Grouse counts at the Payne lek have fluctuated over the last seven years, with numbers increasing each year from 2005 through 2007 (peak of 14 males in 2007). The management status of the Payne lek is currently listed as occupied. No other leks have been documented within the wildlife study areas for the North Porcupine LBA Tract.

No leks have been documented within the wildlife study area for the South Porcupine LBA Tract (Figure 3-37). The Payne lek, which is nearly 5 miles to the northeast, is the closest sage-grouse lek to the South Porcupine LBA Tract.

The wildlife study areas for the North and South Porcupine LBA Tracts are not within a sage-grouse focus area.

Peak male counts at leks located within 2 miles of the general analysis areas for the North and South Porcupine tracts have been well documented from the mid-1980s through 2007. Annual grouse counts fluctuated during that period, with new leks discovered in some years and declining counts recorded in others. Although sage-grouse numbers have generally been low in these areas over the years, known or potential grouse habitat is present. However, the most suitable sage-grouse habitat exists in the North Porcupine area, as suggested by the distribution of grouse leks between the two areas and confirmed through the information gleaned from the last 7 years of radio-telemetry data collected in the general vicinity. Results from that project have demonstrated that grouse are most commonly recorded in the eastern quarter of the 2-mile wildlife survey area for the North Porcupine tract, east of the Payne County Road. Detailed reports and long-term maps documenting grouse locations in the area have been submitted to WDEQ/LQD and other agencies in each study year.

Annual surveys for sage-grouse broods were conducted in native and reclaimed stream channels at the North Antelope Rochelle Mine and adjacent mines from 1994 through 1999; such surveys were no longer required by WGFD and WDEQ/LQD after that year due to the consistent lack of grouse broods

observed at coal mines throughout the PRB. Likewise, no sage-grouse broods were seen during recent baseline inventories conducted for the two Porcupine tracts. All grouse broods that have been recorded over the years occurred as incidental sightings during other wildlife surveys

3.10.5.2 Environmental Consequences

3.10.5.2.1 Proposed Action and Alternatives 2 and 3

Leasing and mining the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts would affect some potential habitat for mourning doves, wild turkeys, and gray partridge. While woody corridors are not abundant in the general Wright 205analysis area, they also are not unique to the LBA tracts. Similar habitat is present in other areas near the tracts, where mining is not projected to occur in the near future. Additionally, sightings of turkeys and partridge are infrequent in the area, and doves are not restricted to wooded habitats.

Overall, the sage-grouse population has been steadily declining in Wyoming and across the rest of the west. A study prepared by the Western Association of Fish and Wildlife Agencies estimated that sage-grouse populations in western North America declined at an overall rate of 2.0 percent per year from 1965 to 2003 (Connelly et al. 2004). The decline rate was greater from 1965 to 1985, with populations stabilizing and some increasing from 1986 to 2003. For Wyoming, this study estimated that sage-grouse populations declined at an average rate of 9.66 percent from 1968 to 1986 (0.51 percent per year), and at an average rate of 0.33 percent per year from 1987 to 2003. Population lows were reached in the mid-1990s and there has been some gradual increase in numbers since that time (Connelly et al. 2004).

The North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts are within the Northeast Wyoming Local Sage-Grouse Working Group (NWLSWG) area. It includes portions of the WGFD Sheridan and Casper regions and the USFS Thunder Basin National Grassland (TBNG). Sage-grouse monitoring has occurred within the NWLSWG since 1967. Within this area, sage-grouse population trends have exhibited a cyclical pattern, although the overall trend indicates declining numbers since at least 1967 (Figure 3-38).

Population trends within the NWLSWG Area appear to be mirroring statewide trends in Wyoming, although the average number of males per lek in the NWLSWG Area, including in the TBNG, has typically been lower than those observed statewide (Figure 3-39). Since 1996, sage-grouse populations within the state and in northeast Wyoming have fluctuated but exhibited an overall increase, with a recent peak in male lek attendance occurring in 2006.

The causes of the range-wide decline in sage-grouse population levels are not fully understood, but they may be influenced by local conditions. However,

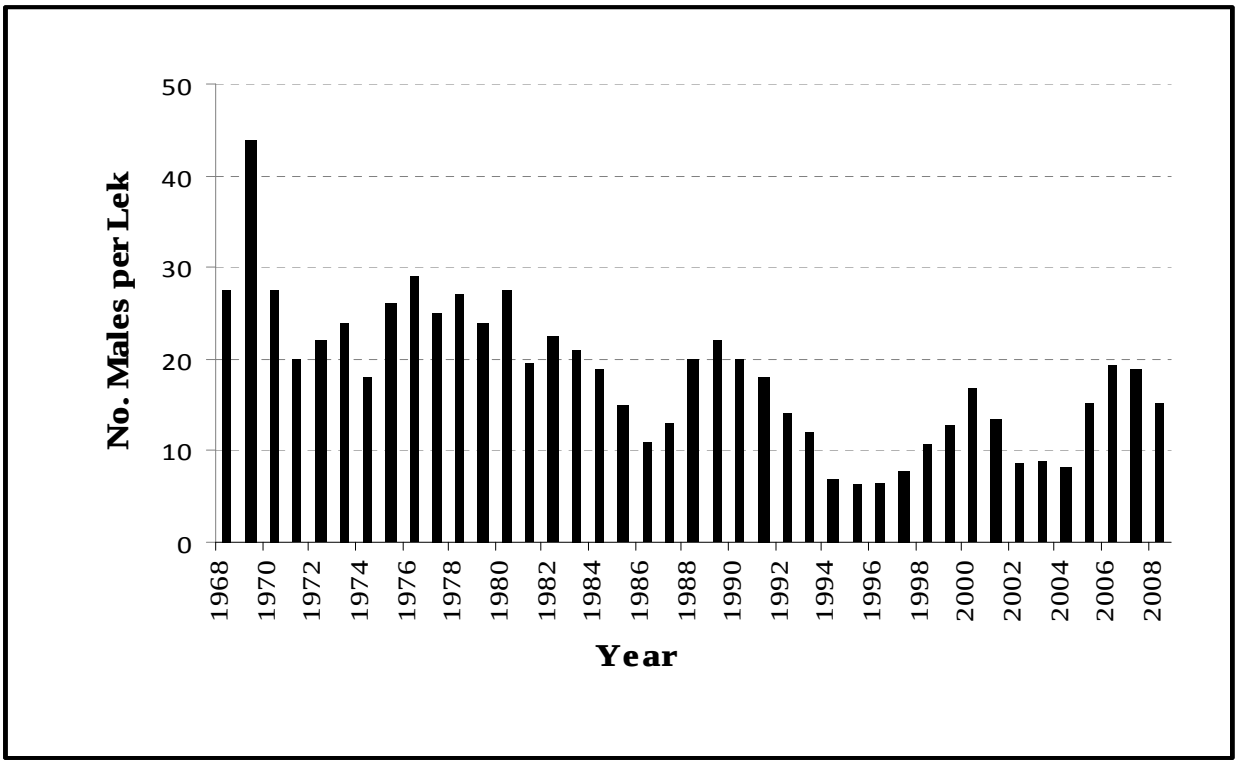


Figure 3-38. Average Male Sage-grouse Lek Attendance Within the Northeast Wyoming Local Working Group Area (1968-2008)
Source: USFS (2006), Thiele (2009)

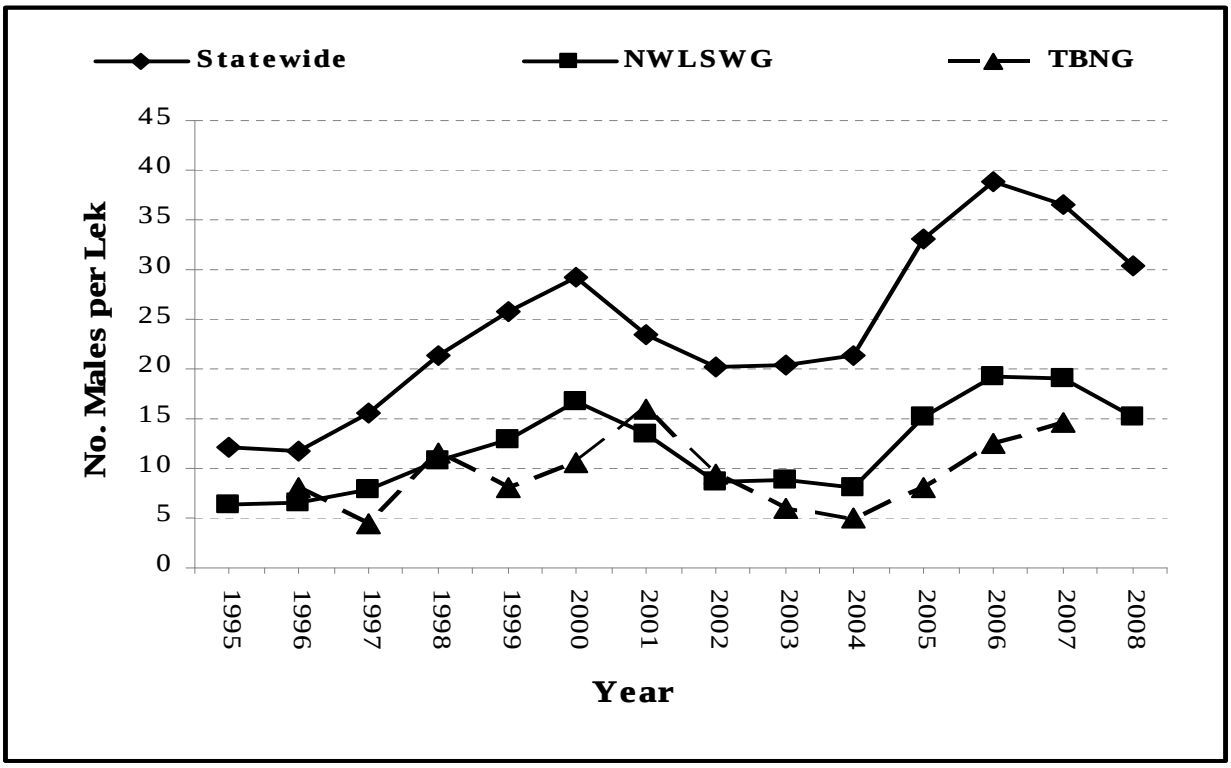


Figure 3-39. Average Male Sage-grouse Lek Attendance Statewide and Within the Northeast Wyoming Local Sage-grouse Working Group Area and the Thunder Basin National Grasslands (1995-2008).
Source: USFS (2006), Thiele (2009), Painter (2009)

habitat loss due to disturbance of leks, nesting and brood-rearing areas as a result of increasing development, drought, and the potential for West Nile Virus, as well as loss of population connectivity are key threats to this species (Wisdom et al. 2002, Naugle et al. 2004).

Some potential impacts of mineral development (including coal mining and oil and gas development) on sage-grouse include: 1) direct habitat loss and fragmentation from mine, well, road, pipeline, transmission and power line construction, 2) alteration of plant and animal communities, 3) increased human activity, which could cause animals to avoid the area, 4) increased noise, which could cause animals to avoid an area or reduce their breeding efficiency, 5) increased motorized access by the public leading to legal and illegal harvest, 6) direct mortality associated with water evaporation ponds and production pits, and 7) reduced water tables resulting in the loss of herbaceous vegetation. Some of these impacts are short-term and related to specific periods of activity. In some cases, mineral development may result in positive effects, which may include increased forb production, habitat diversity, and additional water sources. Some impacts may be long-term (30 years or more), and rehabilitation of impacted habitats may take many years to complete (WGFD 2003). In the case of sage-grouse lek attendance near the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines, the decline in attendance preceded physical mining disturbance and thus may not be attributable to mine-related activities (Orpet 2007, J&S 2007).

Areas of suitable habitat for nesting and strutting grounds are needed to sustain sage-grouse populations. One recent study suggests that availability of winter habitat may also affect sage-grouse populations (Naugle et al. 2006). When mining occurs in potential sage-grouse habitat, there is a short term loss of potential nesting habitat and potential disturbance to breeding activities, especially when mining operations occur in proximity to sage-grouse leks. Following reclamation, there may be a long term loss of nesting and winter habitat, depending on the amount of sagebrush that is restored relative to the amount of sagebrush that is present before mining. Should these six BLM study areas (the six LBA tracts as applied for and the additional areas evaluated by BLM under Alternative 2, BLM preferred alternative for each tract) be leased, mined and reclaimed, alterations in the topography and vegetative communities would likely result in such changes in species composition from pre-mine conditions. Some vegetative communities currently present in the BLM study areas, such as low-growth species (e.g., blue grama, and birdsfoot sagebrush) and big sagebrush, are often difficult to reestablish through artificial plantings. Until sagebrush returns to its premining density levels, there would be a reduction in potential habitat for wildlife species associated with the habitat in the general Wright analysis area. However, given the limited presence of sage stands in the area, it is not likely that many sagebrush obligates would be affected.

If mining activities disturbed a lek, sage-grouse would have to use an alternative lek or establish a new lek site for breeding activities. Fidelity to lek

sites has been well documented (WGFD 2003), but monitoring of sage-grouse activities has indicated that the birds may change lek sites.

As discussed in Section 3.10.5.1, ten sage-grouse leks have been documented within the six combined sage-grouse survey areas. Four of the leks have been active during recent survey years and are classified as occupied (Hansen Lakes, Payne, and Kort I and Kort II, which likely represent a shift in lekking activity rather than two distinct leks). Two of the leks have not been attended by displaying grouse for at least the last 10 years and are classified as unoccupied/abandoned (Butch and Wilson). There is insufficient data on two leks, therefore they have been classified as undetermined (Stuart I and Stuart II). Two leks have been eclipsed by mining activities at the adjacent Black Thunder and North Antelope Rochelle mines (Black Thunder and Rochelle, respectively).

The occupied leks, Hansen Lakes and Payne, are within the BLM study areas for the North Hilight Field and North Porcupine LBA Tracts, respectively, and are therefore likely to be directly impacted if these two tracts are leased and mined under the Proposed Action and/or Alternative 2, BLM's preferred alternative. The 3-mile radii of concern for the two other occupied leks (Kort I and Kort II, which are likely only one strutting ground that has been relocated slightly), overlap the North Porcupine LBA Tract. If the North Porcupine LBA Tracts as applied for and/or the additional areas evaluated by BLM under Alternative 2, the BLM's preferred alternative, is leased and mined, potential nesting habitat for grouse that were bred at the Kort I and II leks would likely be affected by mining activity in those areas.

Stuart II, one of the two undetermined leks, is within the West Hilight Field LBA Tract as applied for, and the 3-mile radii of both undetermined leks (Stuart I and Stuart II) overlap both the West Hilight Field and West Jacobs Ranch LBA Tracts as applied for. The 3-mile radius is the area in which two-thirds of the hens that were bred at those leks would be expected to nest. As previously discussed, the Stuart I and Stuart II leks are classified undetermined, but they are likely unoccupied/abandoned and will probably not be re-occupied in the near future due to the presence of nearby CBNG development activities and facilities. Therefore, if the West Hilight Field and West Jacobs Ranch LBA Tracts as applied for and the additional areas evaluated by BLM under Alternative 2 are leased and mined, it is unlikely that those two undetermined leks would be affected. However, as also previously discussed, few sage-grouse nests and no broods have been recorded on any of the six LBA tracts as applied for or on lands added under Alternative 2, BLM's preferred alternative for each tract, during specific surveys or incidental to other wildlife surveys conducted in those areas annually since at least 1994. The noise associated with mining operations may disrupt sage-grouse breeding and nesting activities that might occur in those areas.

There is some limited evidence that sage-grouse do repopulate areas after reclamation for the species. However, there is no evidence that populations

attain their previous levels, and reestablishment in reclaimed areas may take 20 to 30 years or longer (Braun 1998). Estimates for the time it would take to restore shrubs, including sagebrush, to pre-mine density levels range from 20 to 100 years, which may delay sage-grouse repopulation in the reclaimed areas.

3.10.5.3 No Action Alternative

Impacts to upland game birds under the No Action Alternative would be similar to the impacts described in Section 3.10.1.2.2.

3.10.6 Other Birds

3.10.6.1 Affected Environment

USFWS uses a list entitled *Migratory Bird Species of Management Concern in Wyoming*, specifically the *Coal Mine List of 40 Migratory Bird Species of Management Concern in Wyoming*, for reviews related to existing and proposed coal mine leased land (USFWS 2002). This list was taken directly from the Wyoming Bird Conservation Plan (Cerovski et al. 2001). The *Migratory Bird Species of Management Concern in Wyoming* replaced the *Migratory Birds of High Federal Interest* (MBHFI) list. The Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines have conducted specific surveys for migratory birds of concern annually since at least 1993, incorporating new lists and survey protocols as they were issued. The surveys, which are conducted in the spring and summer, include the existing permit area and a surrounding ½-mile perimeter for most species. Species of added concern such as the sage-grouse and bald eagle may require expanded survey perimeters.

Due to the proximity of the North Hilight Field, South Hilight Field, West Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts to the existing mine permit areas, significant portions of the general analysis areas for these six LBA tracts have been included in annual surveys for avian species of concern since at least 1993. Results from surveys for migratory birds at the three applicant mines are available in baseline and annual wildlife reports, on file with WDEQ/LQD. Those reports include a tabulation of the regional status, expected occurrence, historical observations, and breeding records for each species on the current list of avian species of concern for a given report year, as well as two or more preceding years. Additional information for each species observed within the given year is provided in the text of those reports.

The Wildlife Section of the supplemental information document to this EIS, which is available on request, includes a tabulation of the regional status and expected occurrence, historical observations, and breeding records for each of the species on the *Coal Mine List of 40 Migratory Bird Species of Management Concern in Wyoming*, based on a compilation of the results of the annual

surveys conducted on and near the respective LBA tract's general analysis area.

Non-raptor avian species that have been documented within the PRB and are included on both the *Coal Mine List of 40 Migratory Bird Species of Management Concern in Wyoming* and at least one more list of special status species include the mountain plover (*Charadrius montanus*), long-billed curlew (*Numenius americanus*), yellow-billed cuckoo (*Coccyzus americanus*), sage thrasher (*Oreoscoptes montanus*), loggerhead shrike (*Lanius ludovicianus*), Baird's sparrow (*Ammodramus bairdii*), sage sparrow (*Amphispiza belli*), Brewer's sparrow (*Spizella breweri*), and Greater sage-grouse. Of those species, the long-billed curlew, sage thrasher, loggerhead shrike, sage sparrow, Brewer's sparrow, and sage-grouse have been recorded within the combined general analysis areas for these six LBA tracts; only the sage thrasher, loggerhead shrike, Brewer's sparrow, and sage-grouse are known or suspected to nest in those vicinities.

Raptor species that have been documented in the PRB and are on the *Coal Mine List of 40 Migratory Bird Species of Management Concern in Wyoming* and on at least one other list of special status species include the bald eagle, ferruginous hawk, burrowing owl, and short-eared owl. Each of those species has been documented in the combined general analysis areas for these six LBA tracts, with all but the bald eagle known or suspected to nest there. Those species are discussed at length in Appendix H of this EIS.

In sum, 23 of the 40 listed species have historically been observed within the combined general analysis areas for these six LBA tracts. Species that historically have been recorded nesting in these areas or are suspected of nesting, based on their presence and behavior during the breeding season, include the burrowing owl, Brewer's sparrow, Swainson's hawk, short-eared owl, ferruginous hawk, lark bunting (*Calamospiza melanocorys*), grasshopper sparrow (*Ammodramus savannarum*), upland sandpiper (*Bartramia longicauda*), loggerhead shrike, lark sparrow (*Chondestes grammacus*), sage thrasher, chestnut-collared longspur (*Calcarius ornatus*), McCown's longspur (*Calcarius mccownii*), greater sage-grouse, and the vesper sparrow (*Pooecetes gramineus*). Other species observed in the areas less often include the peregrine falcon (*Falcon peregrinus*), bald eagle, bobolink (*Dolichonyx oryzivorus*), common loon (*Gavia immer*), long-billed curlew, red-headed woodpecker (*Melanerpes erthrocephalus*), sage sparrow, and merlin (*Falco coumbarius*). The bald eagle is only observed in the winter or as a migrant. The other non-nesting species have been observed infrequently as migrants.

The mountain plover is included on the list of *Migratory Bird Species of Management Concern in Wyoming*. The mountain plover was designated as a proposed threatened species by the USFWS in October, 2001 (USFWS 2001). USFWS subsequently published a withdrawal of the proposed rule to list the mountain plover as threatened on September 9, 2003 (USFWS 2003). The USFWS continues to encourage provisions in mine reclamation plans that

would provide protection for this species, as it continues to be protected under the Migratory Bird Treaty Act, and as a USFS Region 2 Sensitive Species and as a Sensitive Species under BLM policy (Bureau Manual 6840.06 E., Sensitive Species).

Wildlife surveys conducted at the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines since the late 1970s have detected the presence of very few mountain plovers with only one confirmed nesting attempt, which was an active nest discovered inside the current mine permit area for the North Antelope Rochelle Mine in 2004, fledging two young. The survey areas, which include the mines' permit areas and a ½-mile perimeter around each, are inventoried for suitable mountain plover habitat annually. No other mountain plovers have been documented in the general Wright analysis area before or after that year.

The bald eagle, a USFS Region 2 Sensitive Species and a BLM Sensitive Species, is seasonally common and most frequently observed during the winter months. Bald eagles are relatively common winter residents and migrants in northeastern Wyoming's PRB, but only rarely nest in that region. No bald eagle nests or winter roosts have been documented on and within 1 mile of the general analysis areas for these six LBA tracts during either baseline or annual monitoring studies since they began in the late 1970s. Aside from a few isolated and small (fewer than five trees) stands of cottonwoods that occur along major drainages, little potential bald eagle nesting and winter roosting habitat is present in the general Wright analysis area. In addition, the area does not generally contain consistent yearly, concentrated, prey or carrion sources (e.g., fisheries, large groups of big game, waterfowl, sheep, etc.) that would be expected to attract bald eagles. This species is infrequently seen in the general Wright analysis area, perched or foraging only during winter. Additional information about the observed occurrence of the bald eagle on these six LBA tracts can be found in the Sensitive Species Evaluation (Appendix H) of this EIS document.

Swainson's hawks have nested in the general Wright analysis area for the last few years. However, because of the restricted number of trees in the area, and the fact that Swainson's hawks return to the region relatively late (mid-April) in the spring after most other raptor species have initiated nesting, the potential for increased numbers of nesting Swainson's hawks may be limited.

The burrowing owl is uncommon and is observed as an occasional or uncommon breeder in the general Wright analysis area.

Sage-grouse, recently added to the Level I list of avian species of concern at coal mines, have declined in the general Wright analysis area but are still classified as a common breeder on and within 3 miles of the general analysis areas for the North Hilight Field, West Hilight Field, West Jacobs Ranch, and North Porcupine LBA Tracts (see Section 3.10.5 above). The USFWS considers

Level I species as in need of conservation action, which includes having a monitoring and mitigation plan for those birds.

Lark buntings and vesper sparrows have been recorded in the general Wright analysis area during each of the last 15 years (1994-2008). Lark buntings generally return to the area from migration in early May, while vesper sparrows are typically present in April. Results from general surveys and breeding bird point counts over time indicate that the lark bunting is the most abundant breeding bird of management concern in the area. The vesper sparrow is also quite common in most years. Both species are typically observed in all habitats in the general Wright analysis area throughout spring and summer, and are presumed to nest in the vicinity.

Lark sparrows have been recorded periodically in the general Wright analysis area over the years. Lark sparrows inhabit a wide variety of habitats (Rising 1997), but were most often observed in relatively rugged terrain. It may be that some features associated with this species' breeding habitat, such as open areas of low scrub or scattered trees (Harrison 1984, Peterson 1990), are more prevalent in those areas having relatively rugged breaks, thus the higher number of sightings there. Grasshopper sparrows have occasionally been recorded in the general Wright analysis area, but most sightings have been in the relatively mature stands of reclaimed grassland associated with the nearby existing mines. In the Great Plains region, including the PRB, grasshopper sparrows are typically associated with taller grassland vegetation, such as that found in mature reclamation areas (Vickery 1996).

Short-eared owls and upland sandpipers have occasionally been recorded in the general Wright analysis area. Most observations of these species consisted of migrants and non-breeding adults. Although potential nesting habitat is present, neither species has been known to nest in the general Wright analysis area.

The remaining 17 migratory bird species of management concern have never been recorded in the general Wright analysis area. Suitable habitat that would support these species like coniferous woodlands, large expanses of native prairie, lush riparian corridors, and large persistent bodies of water are scarce if not absent in the general Wright analysis area.

Under natural conditions, the general analysis areas for the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts provide limited and marginal habitat for waterfowl and shorebirds. The natural aquatic habitat, prior to CBNG development within and adjacent to the general Wright analysis area, was mainly available during spring migration as ponds (primarily stock reservoirs and playa areas) and intermittent and ephemeral streams. Many of these water features generally were reduced to small, isolated pools or were completely dry during the remainder of the year. However, the relatively recent development of CBNG within and upstream of the general Wright analysis area

has enhanced the available water resources, resulting in somewhat improved habitat for waterfowl and shorebirds. Waterfowl and shorebird observations have primarily consisted of relatively low numbers of common species, often restricted to spring migration. Few broods have been recorded in the area during baseline or annual monitoring studies due to limited and unreliable water resources in the area. Avian species typically associated with aquatic habitats in the general Wright analysis area include, but are not limited to, the mallard duck (*Anas platyrhynchos*), killdeer (*Charadrius vociferus*), and red-winged blackbird (*Agelaius phoeniceus*).

3.10.6.2 Environmental Consequences

3.10.6.2.1 Proposed Action and Alternatives 2 and 3

Of the 23 *Migratory Bird Species of Management Concern in Wyoming* that have historically been observed in the general Wright analysis area at least once, 12 species are classified as Level I (those identified as needing conservation action). Eight of those 12 species are known or presumed to nest in and near the general Wright analysis area: ferruginous hawk, burrowing owl, sage-grouse, Brewer's sparrow, Swainson's hawk, McCown's longspur, short-eared owl, and upland sandpiper. The raptors and sparrow have nested with some regularity in the area over the last two decades of annual monitoring. In contrast, the other three species are presumed to have nested less frequently, in part due to dwindling populations (sage-grouse) and more limited nesting habitat (McCown's longspur and upland sandpiper). The other four Level I species historically observed in the general Wright analysis area include the long-billed curlew, peregrine falcon, sage sparrow, and bald eagle. Bald eagles are seasonally present and have been observed perched or foraging in the area in many years during winter. No bald eagle nests have ever been documented within several miles of the general Wright analysis area, and none of the other three species have ever been documented to display breeding behaviors or nest in the general Wright analysis area.

Leasing and subsequently mining these six BLM study areas (the LBA tracts as applied for and the additional areas evaluated by BLM under Alternative 2, the BLM's preferred alternative for each LBA tract) would fragment, impair, or destroy current existing habitat within the general analysis areas for these 12 Level I species. The habitat loss would be relatively short-term for some grassland species, but would last much longer for shrub-dependent species and other species requiring more specialized habitats. The current reclamation plans and practices for the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines are designed to provide a mosaic of upland grass and sagebrush habitats that would potentially host most of these species.

Natural regrowth of some habitats (e.g., birdsfoot sagebrush) and recolonization of others (prairie dog colonies) would contribute to those reclamation efforts. Only a few native trees are present within the general Wright analysis area and limited primarily to reaches along Little Thunder

Creek, North Prong Little Thunder Creek, and Porcupine Creek. Some domestic trees were planted in shelterbelts adjacent to ranch buildings located within the West Jacobs Ranch LBA Tract. Any naturally-occurring trees that are removed by mining would be inventoried and replaced with the same number of new trees on the postmine landscape, as required by state and federal law.

Specific impacts to and mitigation measures for avian species of management concern such as bald eagles, sage-grouse, ferruginous hawks, and others are included in the preceding discussions or in Appendix H of this EIS document. In addition to those efforts, the availability of existing suitable habitat beyond the general Wright analysis area may provide off-site options for displaced species and individuals, provided that those areas are not already at carrying capacity for the various species. No impacts to mountain plovers are anticipated because they have not been observed in the vicinity of the general analysis areas for these six LBA tracts during wildlife surveys conducted for the adjacent applicant mines that began in the 1970s, and the typical suitable habitat for this species is not currently present in these areas.

Mining the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts as applied for and the additional areas evaluated by BLM under Alternative 2, the BLM's preferred alternative for each LBA tract, would have a negligible effect on migrating and breeding waterfowl and shorebirds. Sedimentation ponds created during mining would provide interim habitat for these fauna; such ponds are readily used by these species at other coal mines in the region. Any diverted stream channels (i.e., Little Thunder Creek, North Prong Little Thunder Creek, and Porcupine Creek) would provide similar, but not identical, habitat compared to the natural stream channels, though natural stream flow and the presence of CBNG discharge water in some areas would not be affected. Active mining adjacent to those drainages could inhibit use by aquatic avian species.

The current reclamation plans for the three applicant mines require that any portion of a stream channel affected by currently permitted mining be reclaimed to restore its pre-mining hydrologic functions. If these six LBA tracts are leased and mined, these reclamation efforts would be extended into the portion of the streams affected by mining the new tracts. Replacement of all impacted jurisdictional wetlands would be required in accordance with Section 404 of the CWA (Section 3.7). If the replaced wetlands on the tracts do not duplicate the exact function and/or landscape features of the pre-mine wetlands, waterfowl and shorebirds could potentially be positively or adversely affected as a result.

3.10.6.2.2 No Action Alternative

Impacts to migratory bird species, waterfowl, and shorebirds under the No Action Alternative would be similar to the impacts described in Section 3.10.1.2.2.

3.10.7 Amphibians, Reptiles, and Aquatic Species

3.10.7.1 Affected Environment

Monitoring of amphibians, reptiles, and aquatic species is not required at the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines. Likewise, fish surveys were not required or conducted specifically for the associated proposed lease areas included in this analysis. Nevertheless, wildlife surveys completed specifically for the applicant mines and other mines in the PRB, as well as biological research projects in the eastern PRB, have documented numerous other wildlife species that inhabit the region, including various amphibians, reptiles, and aquatic species. All of these species are locally common inhabitants of the area, depending on the quantity and quality of aquatic habitats present.

Under natural conditions, aquatic habitat in the general Wright analysis area is limited by the ephemeral nature of surface waters. The lack of deepwater habitat, extensive and persistent water sources, and mesic habitat in general limits the presence and diversity of fish, amphibians, and other aquatic or semi-aquatic species within most of the general Wright analysis area. As discussed above, all water courses are ephemeral, receiving flow contributions primarily from convective thunderstorm runoff and, to a lesser extent, from snowmelt runoff in the spring (Ogle and Calle 2006). Limited portions of the streams may receive recharge from bank storage, making them locally intermittent. Historically, water was often present in the main stream channels only as small, shallow, isolated pools. Currently, and for an indefinite time into the future, some of the water courses and internally-drained playas are receiving discharge water from CBNG development; however, streamflow is still very much a function of the amount and timing of precipitation and snowmelt runoff. Therefore, the mean annual streamflow rates and discharge volumes have not significantly increased, although extended periods of no flow are less common (Clark and Mason 2007). Despite the recent influx of water into the general Wright analysis area, many channels are still reduced to isolated, shallow pools in the summer. Little Thunder Creek, North Prong Little Thunder Creek, and Porcupine Creek have not become perennial, even with the addition of CBNG discharge water. Seventeen in-channel stock reservoirs (over 1 acre in size) and 41 playa areas exist within the six combined general analysis areas. Water discharged from CBNG wells has enhanced the water supply within some of those water bodies, resulting in improved habitat for amphibian and aquatic species. However, those enhanced areas are still relatively limited and/or isolated in nature. The upland areas provide habitat for reptile species.

Numerous amphibian and reptile species have been recorded during the various wildlife surveys conducted on the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mine areas and adjacent lands, including the LBA tracts. These species include the tiger salamander (*Ambystoma tigrinum*), plains spadefoot (*Scaohiopus bombifrons*), great plains toad (*Bufo cognatus*), boreal chorus frog (*Pseudacris triseriata maculata*), northern leopard frog (*Rana pipiens*), short-horned lizard (*Phrynosoma douglassi*), northern sagebrush lizard (*Sceloporus graciosus graciosus*), plains hognose snake (*Heterondon nasicus nasicus*), wandering garter snake (*Thamnophis elegans vagrans*), red-sided garter snake (*Thamnophis sirtalis parietalis*), prairie rattlesnake (*Crotalus viridis viridis*), bullsnake (*Pituophis melanoleucas sayi*), western plains garter snake (*Thamnophis radix haydeni*), and eastern yellowbelly racer (*Coluber constrictor flaviventris*).

The relatively low quantity and quality of aquatic habitat in the general Wright analysis area reduces its potential to attract these species, particularly amphibians and turtles. The boreal chorus frog has been the most common herptile observed in the area over the last two decades. These frogs have been heard in creeks and ponds throughout the area during spring. Other less common species observed on or near the general analysis areas for these six LBA tracts over time include the northern leopard frog, tiger salamander, and wandering garter snake. Prairie rattlesnakes, short-horned lizards, and sagebrush lizards have been observed infrequently in sagebrush stands throughout the area. Other dryland species, such as the bullsnake, are likely to occur but are seldom observed. The northern leopard frog is listed as a USFS and BLM Sensitive Species (see Appendix H).

Fish sampling was conducted on the TBNG in the Cheyenne River, Little Thunder River, Black Thunder Creek, and Antelope Creek in 2003 and 2004 by USFS personnel. Species observations included the following: black bullhead (*Ameiurus melas*), plains killifish (*Fundulus zebrinus*), carp (*Cyprinus* spp.), brassy minnow (*Hybognathus hankinsoni*), plains minnow (*Hybognathus placitus*), green sunfish (*Lepomis cyanellus*), bluegill (*Lepomis macrochirus*), fathead minnow (*Pimephales promelas*), sand shiner (*Notropis stramineus*), sucker spp. (*Catostomus* spp.), plains top minnow (*Fundulus sciadicus*), and flathead chub (*Platygobio gracilis*). The flathead chub and plains minnow are considered a USFS Region 2 sensitive species. Plains minnows were observed in Little Thunder Creek and the Cheyenne River. Flathead chubs were observed in the Cheyenne River.

Based on WGFD gill net sampling conducted in 2000 and 2004, black bullhead, largemouth bass (*Micropterus salmoides*), and rainbow trout (*Onchorhynchus mykiss*) were present in the Little Thunder Reservoir, which is located on the West Hilight Field tract. There are no historical monitoring records of Little Thunder Reservoir's water levels. Anecdotally, local residents and mine personnel recall this reservoir held only a fraction of its volume capacity prior to CBNG discharges in the Little Thunder Creek drainage above the impoundment, which began in the mid- to late-1990s. Anecdotal evidence

also indicates that the reservoir was rarely used for recreational fishing prior to CBNG development in the area. The stocking of catchable rainbow trout began at the Little Thunder Reservoir in 2004, and WGFD has not restocked the reservoir since 2006.

3.10.7.2 Environmental Consequences

3.10.7.2.1 Proposed Action and Alternatives 2 and 3

Mining activities in the general analysis areas for the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts would remove habitat for amphibians, reptiles and aquatic species, particularly in portions of the ephemeral drainages (Little Thunder Creek, North Prong Little Thunder Creek, and/or Porcupine Creek) during active mining. Under natural conditions, habitat for amphibians and aquatic species is limited on these six LBA tracts as applied for and the additional area evaluated by BLM under Alternative 2, BLM's preferred alternative, for each tract. Additionally, reclamation of the primary stream channels and restoration of surface water flow quantity and quality after mining to approximate pre-mining conditions would restore the naturally-occurring mesic and aquatic habitats of those water courses.

10.7.2.2 No Action Alternative

Impacts to amphibians, reptiles, and aquatic species under the No Action Alternative would be similar to the impacts described in Section 3.10.1.2.2.

3.10.8 Threatened, Endangered, Proposed, and Candidate Species; BLM Sensitive Species; and USFS Sensitive Species and Management Indicator Species

Refer to Appendices G and H.

3.10.9 Regulatory Compliance, Mitigation and Monitoring

Regulatory guidelines and requirements designed to prevent or reduce surface coal mining impacts to wildlife include:

- fencing designed to permit passage of pronghorn and other big game species to the extent possible;
- development of a Monitoring and Mitigation Plan for raptors and other migratory bird species of management concern that must be approved by the USFWS, including the following provisions:
  - creation of raptor nests and nesting habitat through enhancement efforts (nest platforms, tree plantings) to mitigate other nest sites impacted by mining operations;

  - relocation of raptor nests that would be impacted by mining in accordance with the approved raptor monitoring and mitigation plan;

  - obtaining a permit for removal and mitigation of golden eagle nests and those of other raptor species;

  - restriction of mine-related disturbances from encroaching within stipulated buffers of active raptor nests from egg-laying until fledging to prevent nest abandonment and injury to eggs or young;

  - reestablishment of the ground cover necessary for the return of a suitable raptor prey base after mining;

  - required use of raptor-safe construction for overhead power lines;

- development of a *Migratory Bird Species of Management Concern for Coal Mines in Wyoming Monitoring and Mitigation Plan*, which must be approved by USFWS;

- restoration of sage-grouse habitat after mining including reestablishment of sagebrush and other shrubs on reclaimed lands and grading of reclaimed lands to create swales and depressions suitable for sagebrush obligates and their young;

- restoration of diverse landforms, direct topsoil replacement, and the construction of brush piles, snags, and rock piles to enhance habitat for wildlife;

- restoration of short-grass habitat for species that nest and forage in those habitat types;

- restoration of habitat provided by jurisdictional and functional wetlands; and

- reclamation of the stream channels and restoration of surface water flow quantity and quality after mining to approximate pre-mining conditions.

The current mine permits for the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines require reconstruction of bed form features, such as pools and runs, in major stream channels. Those efforts should help restore the channels' natural form and function, as well as provide habitat. Future restoration will continue to be achieved by salvaging sufficient material from original channel and terrace alluvium, or other materials having the same physical characteristics, to reconstruct naturally-occurring channel features. These measures are included in the existing mining and reclamation permits and would be included in any amended mining and reclamation plans, if one or more of the LBA tracts are leased and proposed for mining.

Baseline wildlife surveys were conducted for all three applicant mines before mining operations began. Annual wildlife monitoring has been ongoing since the late 1970s or early 1980s. These surveys are required by state and federal regulations. The wildlife monitoring surveys cover the lands within the approved mine permit area and a surrounding perimeter that varies in size according to the species being considered. As a result, a majority of the respective general analysis area for each of these six LBA tracts have been encompassed during the required monitoring efforts for the neighboring three mines.

The required annual wildlife monitoring programs currently consists of the following:

- early spring surveys for new and/or occupied raptor territories and/or nests, upland game bird lek locations, T&E species, and migratory birds on and around the existing leases;

- late spring surveys for migratory birds and raptor production at occupied nests, opportunistic observations of all wildlife species, and T&E species;

- summer surveys for raptor production at occupied nests, migratory birds, and lagomorph density;

- raptor territorial occupancy and nest productivity is surveyed annually on and within a 1- or 2-mile perimeter surrounding the existing permit areas, depending on the mine; and

- winter surveys for bald eagle winter roosts on and within 1 mile of the permit area (conducted as needed base on proximity of disturbance to potential roosting habitat).

Surface coal mines in the PRB were required to conduct seasonal surveys for big game species and brood surveys for upland game birds annually from 1994-1999. At the end of that period, the WGFD reviewed monitoring data and requirements for those species on mine properties. WGFD biologists concluded that the monitoring had demonstrated a lack of impacts to big game on existing mine sites, and that the brood surveys were not providing meaningful data. Additionally, no severe mine-related big game mortalities had occurred and no long-lasting impacts to big game had been documented on existing mine sites. The WGFD therefore recommended in late 1999 that big game monitoring and upland game bird brood surveys be discontinued on all existing mine sites. New mines will be required to conduct big game monitoring if located in crucial winter range or in significant migration corridors, neither of which are present within the general Wright analysis area.

Although big game surveys are no longer required, the Black Thunder and North Antelope Rochelle mines (as well as the neighboring Antelope Mine) voluntarily elected to continue winter aerial and ground counts in alternate

years to enhance previous annual data for those species. Numerous other mines in the PRB also conduct these voluntary surveys on the same schedule as these mines.

All three applicant mines operate under a current USFWS approved Monitoring and Mitigation Plan for raptors and other migratory bird species of management concern. Their respective plans would be amended to include the associated LBA tracts if they are leased and permitted for mining. The amended plans would be subject to review and approval by the USFWS before the amended mine plans are approved.

If the current *Coal Mine List of 40 Migratory Bird Species of Management Concern in Wyoming* is updated, or if additional species are documented nesting or using the area regularly, the current Monitoring and Mitigation Plans for each mine would be amended to incorporate and protect those birds and their habitats.

3.10.10 Residual Impacts

Although the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts would be reclaimed in accordance with the requirements of SMCRA and Wyoming statutes, there would still be some residual wildlife impacts. The topographic moderation would result in a permanent loss of habitat diversity and a potential decrease in slope-dependent shrub communities. This would reduce the carrying capacity of the land for shrub-dependent species. Reclamation standards for bond release may also limit replacement of habitat for some species that occupy somewhat specialized, low-growth form habitats. Those species may repopulate reclaimed areas, but populations may not attain pre-mining levels without special variances to accommodate those specific needs. For example, every effort would be made to preserve source populations of prairie dogs in the vicinity of development, as these animals can be valuable in restoring similar structural characteristics of pre-mine grassland species through regular clipping and harvesting of vegetation.

Limited riparian habitat is present in the general Wright analysis area. Areas that currently support sagebrush would be altered to a grassland community, perhaps for decades, during the interim between sage plantings and maturity in reclamation. Until pre-mining habitats have been fully reestablished, such habitat transformations would likely result in a change in wildlife species composition. Minimal residual impacts to T&E, candidate, or proposed plant and animal species are expected to occur, because state and federal regulations require reclamation of specific habitats.

3.11 Land Use and Recreation

3.11.1 Affected Environment

Surface ownership within the general Wright analysis area consists primarily of private lands with intermingled federal lands. Table 3-15 summarizes the distribution of surface ownership for each LBA tract configured under Alternative 2, BLM's preferred alternative. Federally owned lands included in the general Wright analysis area include portions of the Thunder Basin National Grasslands (TBNG) administered by the USFS. As indicated in Table 3-14, approximately 162 acres of state owned land is included in the North Porcupine LBA Tract configured under Alternative 2, and no federally owned land is included in the West Jacobs Ranch LBA Tract configured under Alternative 2. Surface ownership within the BLM study area (the Alternative 2 configuration) for the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts, is shown in Figures 3-40 through 3-45, respectively.

Table 3-15. Distribution of Surface Ownership Within Each LBA Tract Configured Under Alternative 2, BLM's Preferred Alternative.

	Federal Ownership		State Ownership		Private Ownership	
LBA Tract	**(Acres)**	**(Percent)**	**(Acres)**	**(Percent)**	**(Acres)**	**(Percent)**
North Hilight Field	80.9	1.1	0.0	0.0	7,058.5	98.9
South Hilight Field	2,572.6	88.0	0.0	0.0	349.8	12.0
West Hilight Field	2,900.0	40.3	0.0	0.0	4,291.4	59.7
West Jacobs Ranch	0.0	0.0	0.0	0.0	8,076.2	100.0
North Porcupine	5,289.6	71.8	162.1	2.2	1,915.1	26.0
South Porcupine	1,637.6	45.9	0.0	0.0	1,930.4	54.1
Total	**12,480.7**	**34.4**	**162.1**	**0.5**	**23,621.4**	**65.1**

Livestock grazing on native rangeland is the primary land use, while oil and gas production, wildlife habitat, communication and power lines, transportation, and recreation are secondary land uses for both public and private lands. As indicated in Table 3-14, approximately 12,481 acres of federal surface administered by the USFS is included in the North, South and West Hilight Field tracts and the North and South Porcupine tracts under Alternative 2, BLM's preferred alternative. This federal land is within Grazing Allotments #270 (located in the North Hilight Field tract), #256 (located in the South and West Hilight Field tracts), #266 (located in the West Hilight Field tract), #280, #223, #240, #298, #264, #282 (located in the North Porcupine tract), and #278 and #281 (located in the South Porcupine tract), all of which are currently held by Thunder Basin Grazing Association (TBGA 2008).

Areas of disturbance within and near the six proposed lease areas include roads, oil and gas wells and associated production facilities, surface mine-

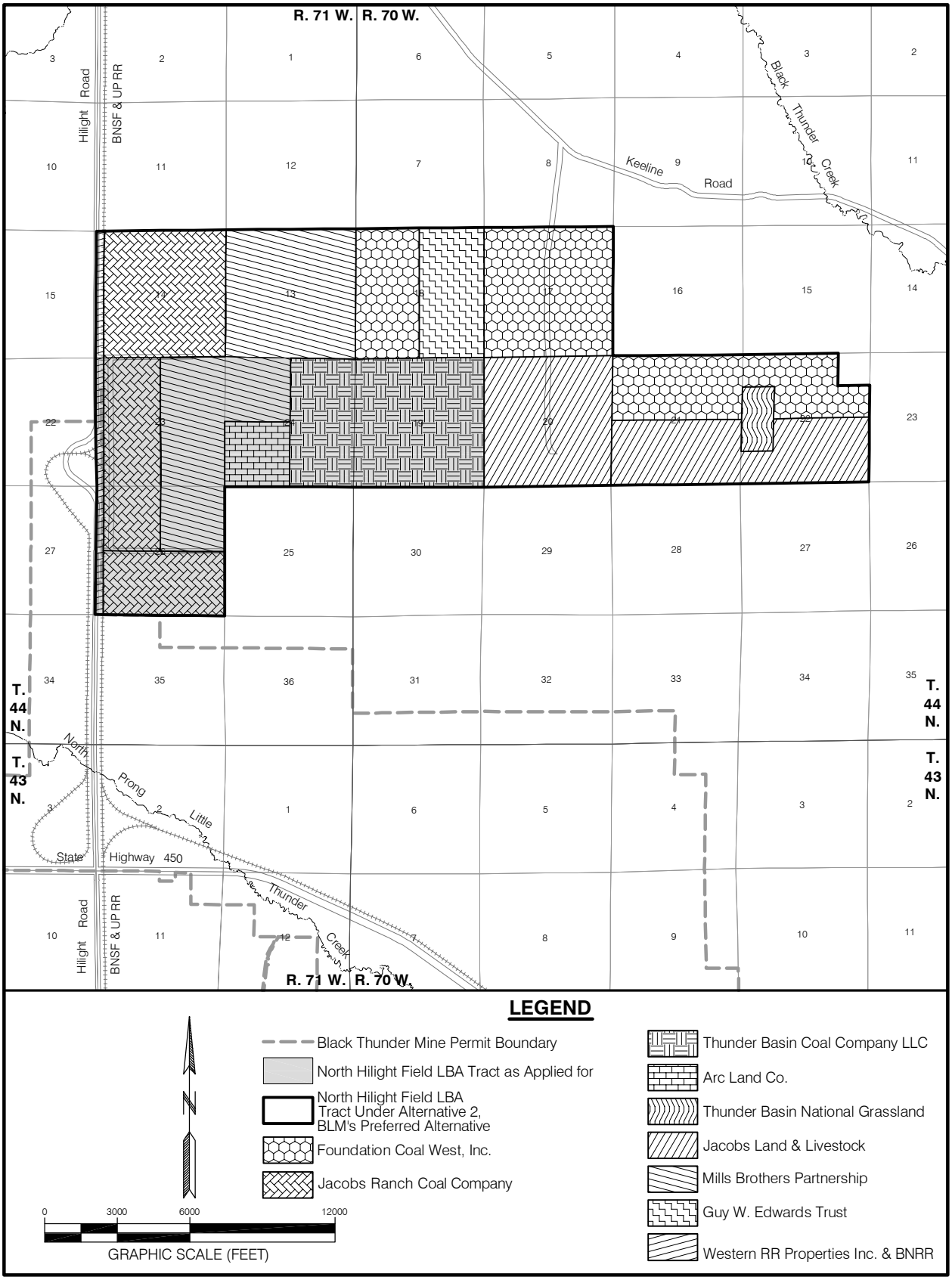


Figure 3-40. Surface Ownership Within the North Hilight Field LBA Tract Alternatives.

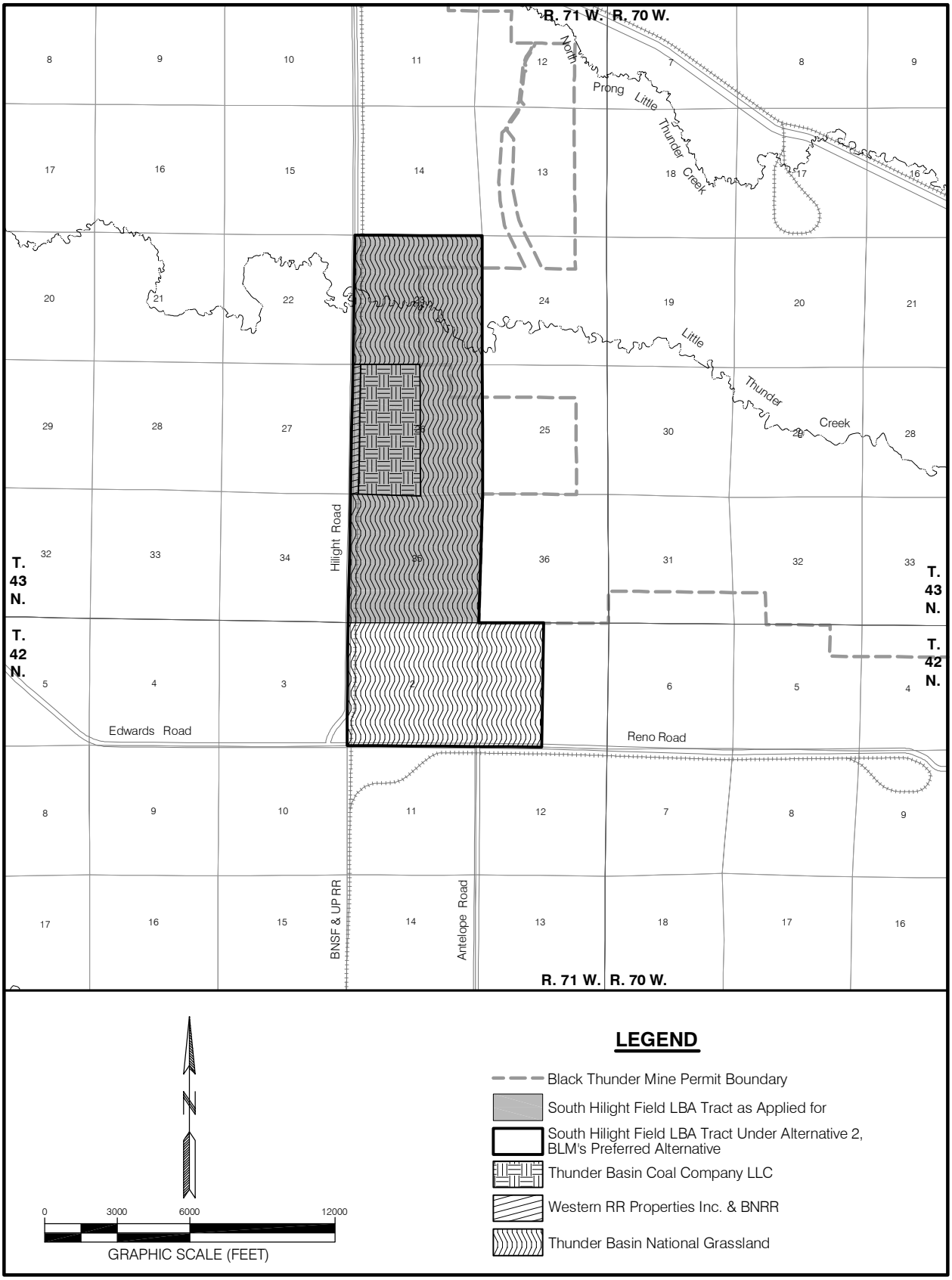


Figure 3-41. Surface Ownership Within the South Hilight Field LBA Tract Alternatives.

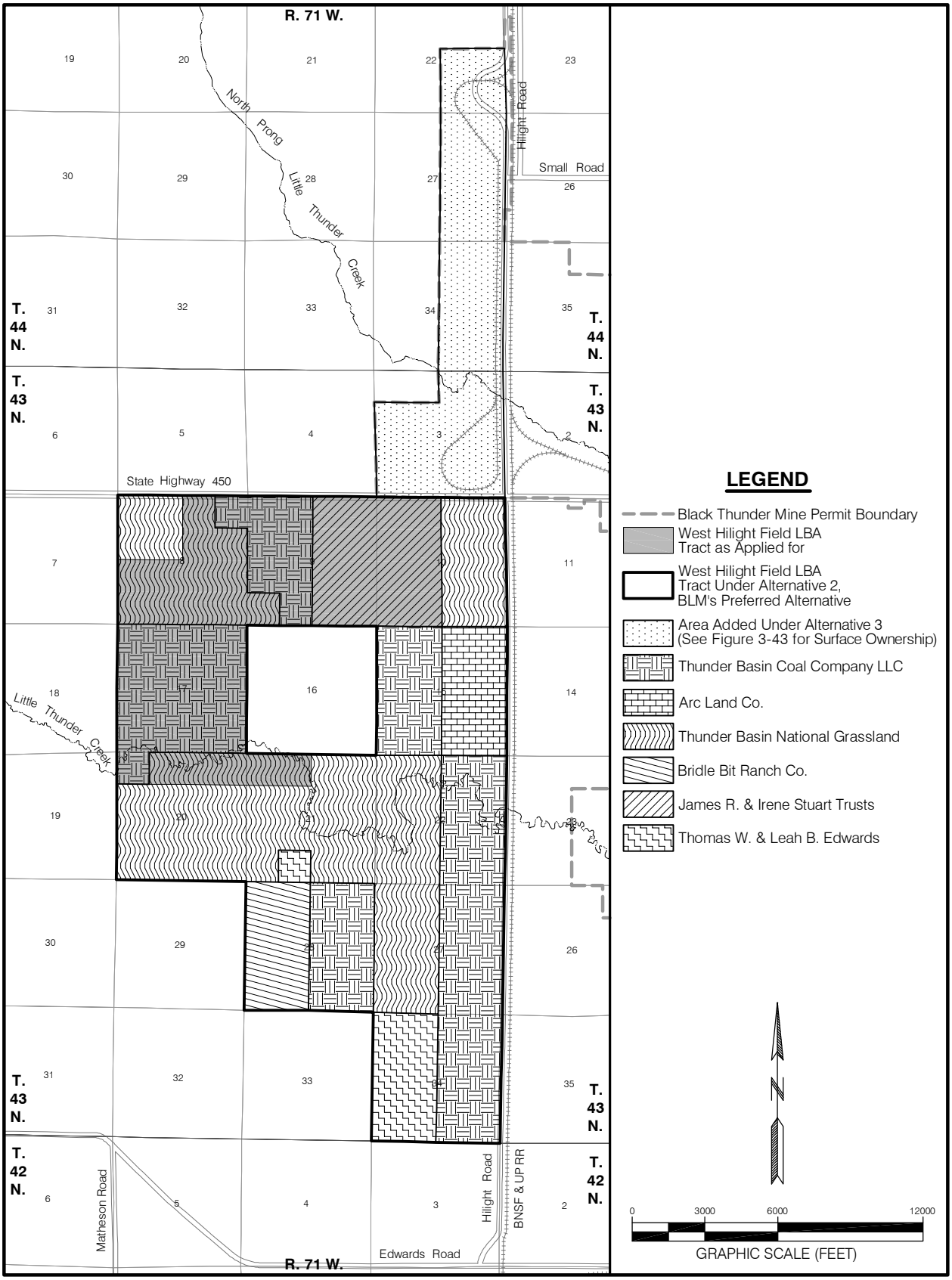


Figure 3-42. Surface Ownership Within the West Hilight Field LBA Tract Alternatives.

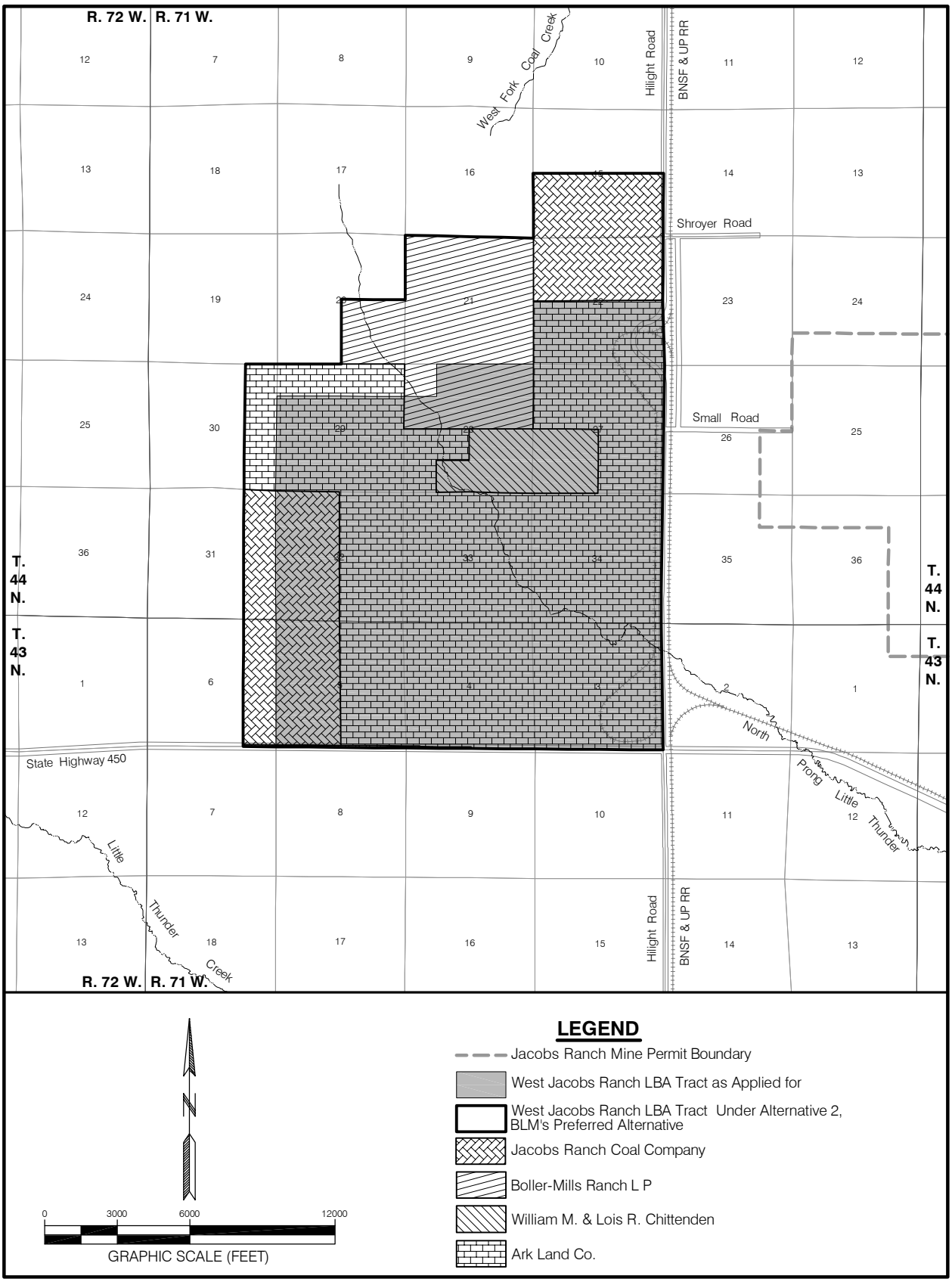


Figure 3-43. Surface Ownership Within the West Jacobs Ranch LBA Tract Alternatives.

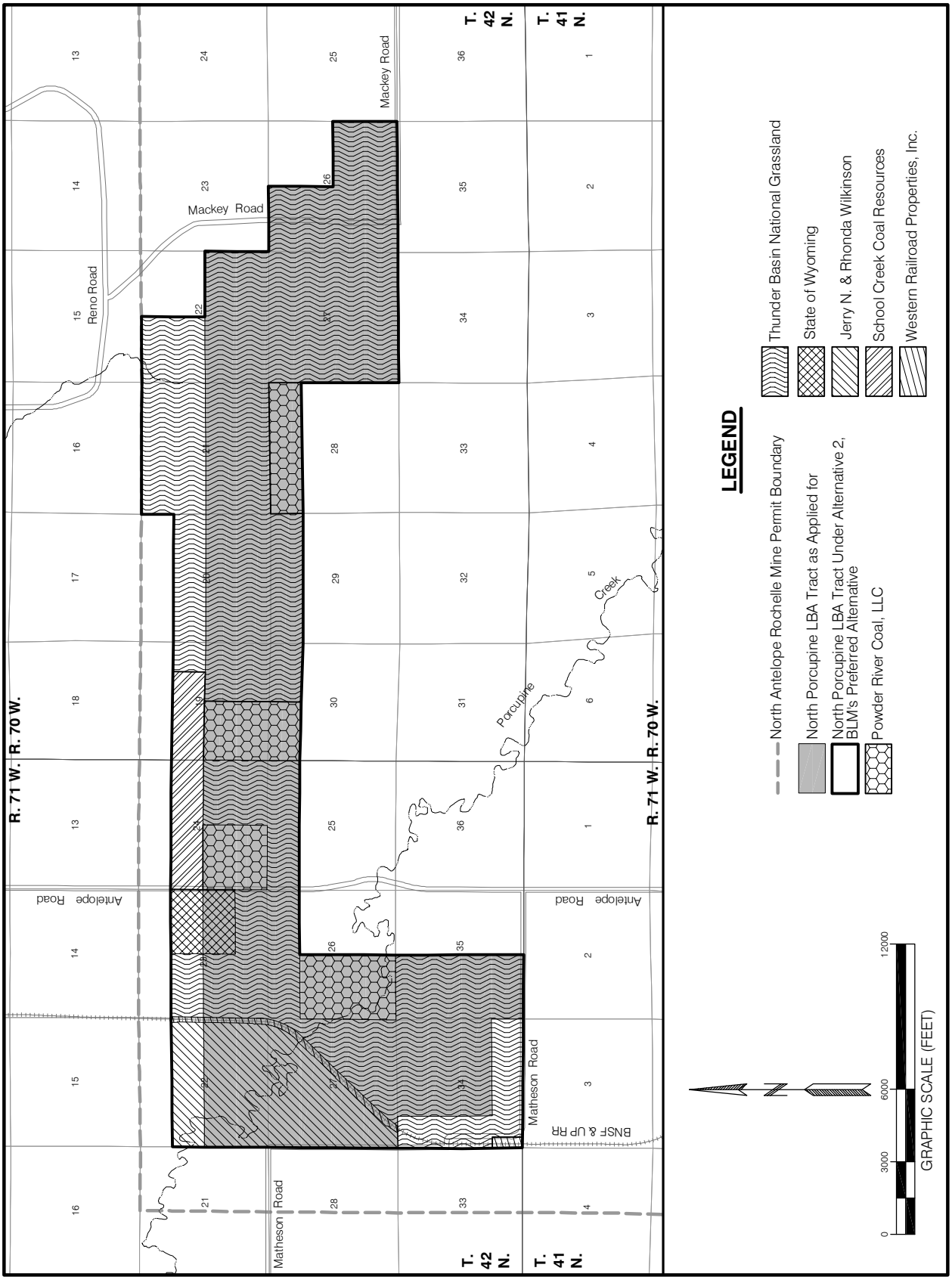


Figure 3-44. Surface Ownership Within the North Porcupine LBA Tract Alternatives.

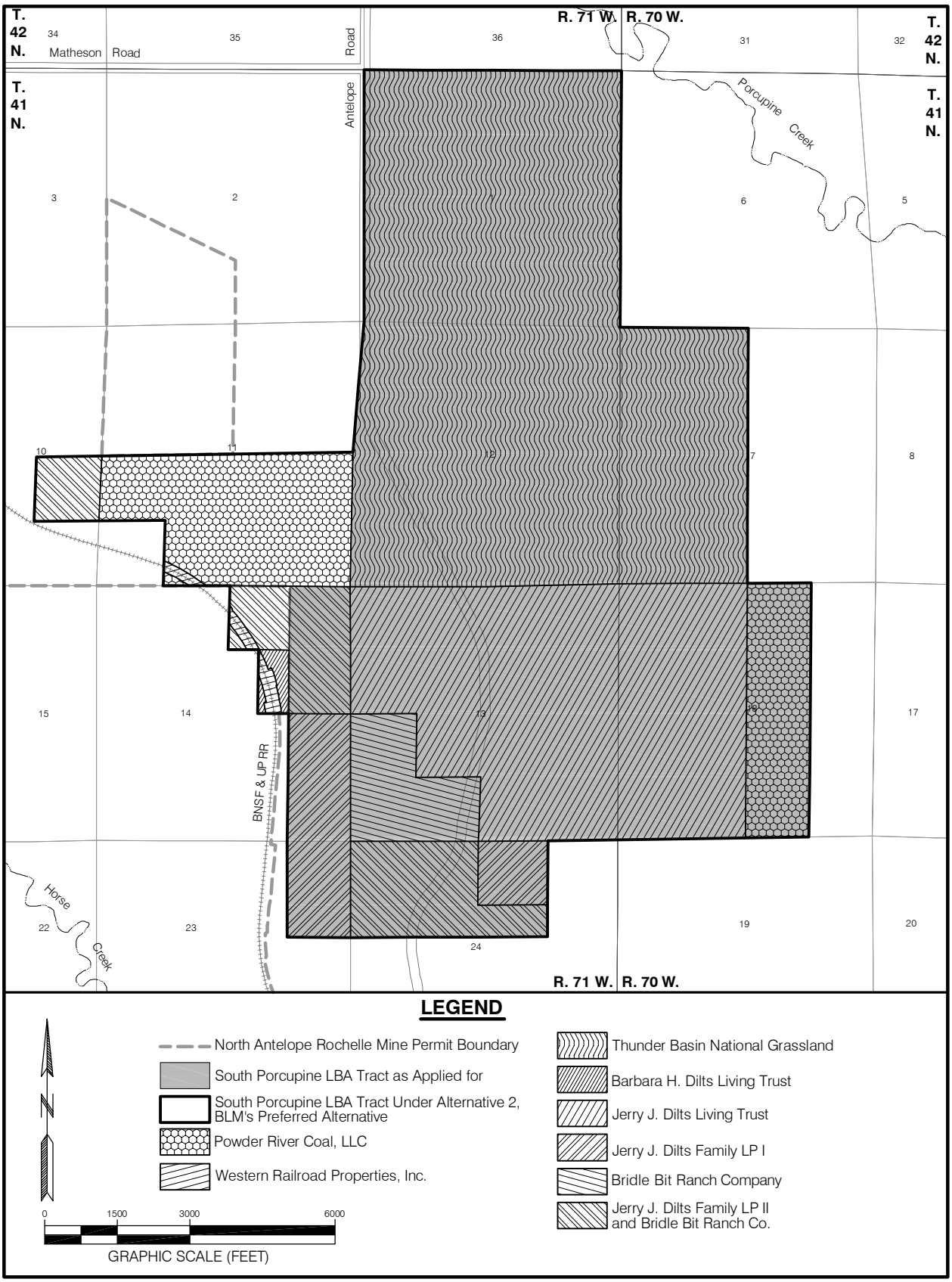


Figure 3-45. Surface Ownership Within the South Porcupine LBA Tract Alternatives.

related facilities and activities, and activities associated with ranching operations. State Highway 59, which runs north-south, is located west of all six LBA tracts, and State Highway 450, which runs east-west, borders the southern edge of the West Jacobs Ranch tract and the northern edge of the West Hilight Field tract (Figure 1-1). County roads that border or traverse the LBA tracts and provide public and private access within and near the general Wright analysis area include Shroyer Road (County Road 116), Hilight Road (County Road 52), Reno Road (County Road 83), Mackey Road (County Road 69), Antelope Road (County Road 4), and Matheson Road (County Road 70). Several unnamed two-track roads also traverse and provide private access within and near the proposed lease areas. The Burlington Northern Santa Fe & Union Pacific (BNSF & UP) railroad right-of-way (ROW) crosses portions of, or is adjacent to all six of the LBA tracts configured under Alternative 2 (Figures 3-40 through 3-45).

The oil and gas estate within the general Wright analysis area is federally and privately owned, with the majority (approximately 67 percent) being federally owned. Most, although not entirely all, of the federally owned oil and gas estate is currently leased. The ownership of the oil and gas estate for each LBA tract is shown on Figures 3-46 through 3-51. Lists of the current federal oil and gas lessees within the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts are listed in Tables 3-16 through 3-21, respectively.

According to the Wyoming Oil and Gas Conservation Commission (WOGCC) records as of May 14, 2008, there were 74 permitted conventional oil and gas wells on lands included within the BLM study areas (the tracts as applied for and the additional areas evaluated by BLM under Alternative 2) for these six LBA tracts (Figures 3-46 through 3-51). Of these 74 wells, 28 were permanently abandoned, 33 were still producing, nine were shut in, three were permanently abandoned injector holes, and one was a dry hole. Of the 42 wells capable of producing (inclusive of the nine shut-in wells), 16 have economically recoverable reserves. Seven of these 16 wells are located on private leases. Within these six LBA tract study areas, approximately 79 percent of the 74 permitted conventional oil and gas wells were drilled between 1967 and 1980, and no conventional oil or gas wells have been drilled since 1990. The conventional oil and gas wells located in the BLM study areas for these six LBA tracts that are capable of production are listed in Appendix E.

The Supreme Court has ruled that the coal bed natural gas (CBNG) belongs to the owner of the oil and gas estate (98-830). Therefore, the oil and gas lessees have the right to develop CBNG as well as conventional oil and gas on the LBA tracts. According to the WOGCC records as of May 14, 2008, there were 287 permitted CBNG wells on lands included within the BLM study areas for these six LBA tracts (Figures 3-46 through 3-51). Of these, 287 CBNG wells, 212 were producing, 36 were shut-in, 32 were permanently abandoned, and seven were dry holes. Extensive CBNG development has also occurred on lands surrounding the LBA tracts, especially to the west. CBNG wells capable of

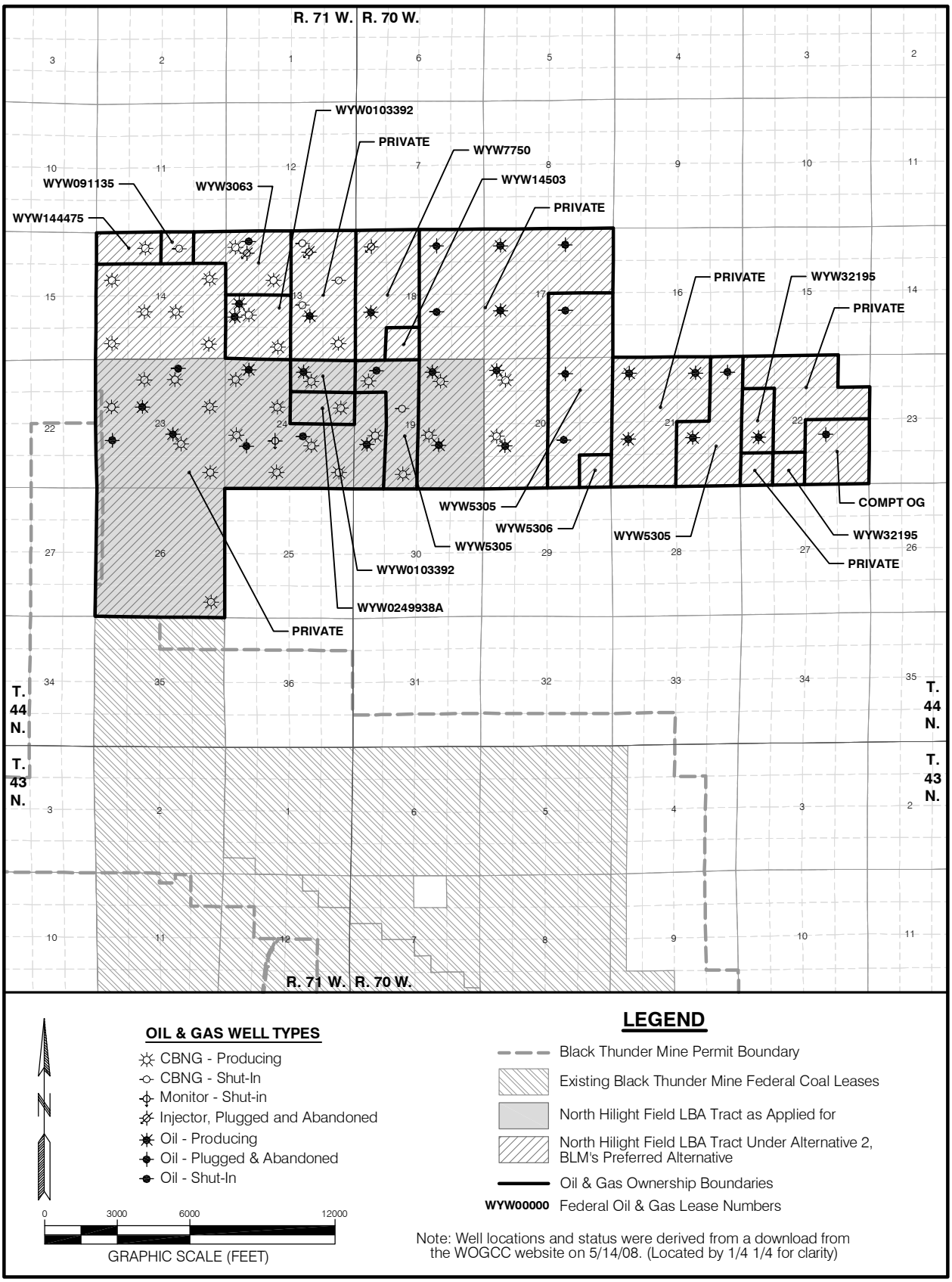


Figure 3-46. Oil and Gas Wells and Oil and Gas Ownership Within the North Hilight Field LBA Tract Alternatives.

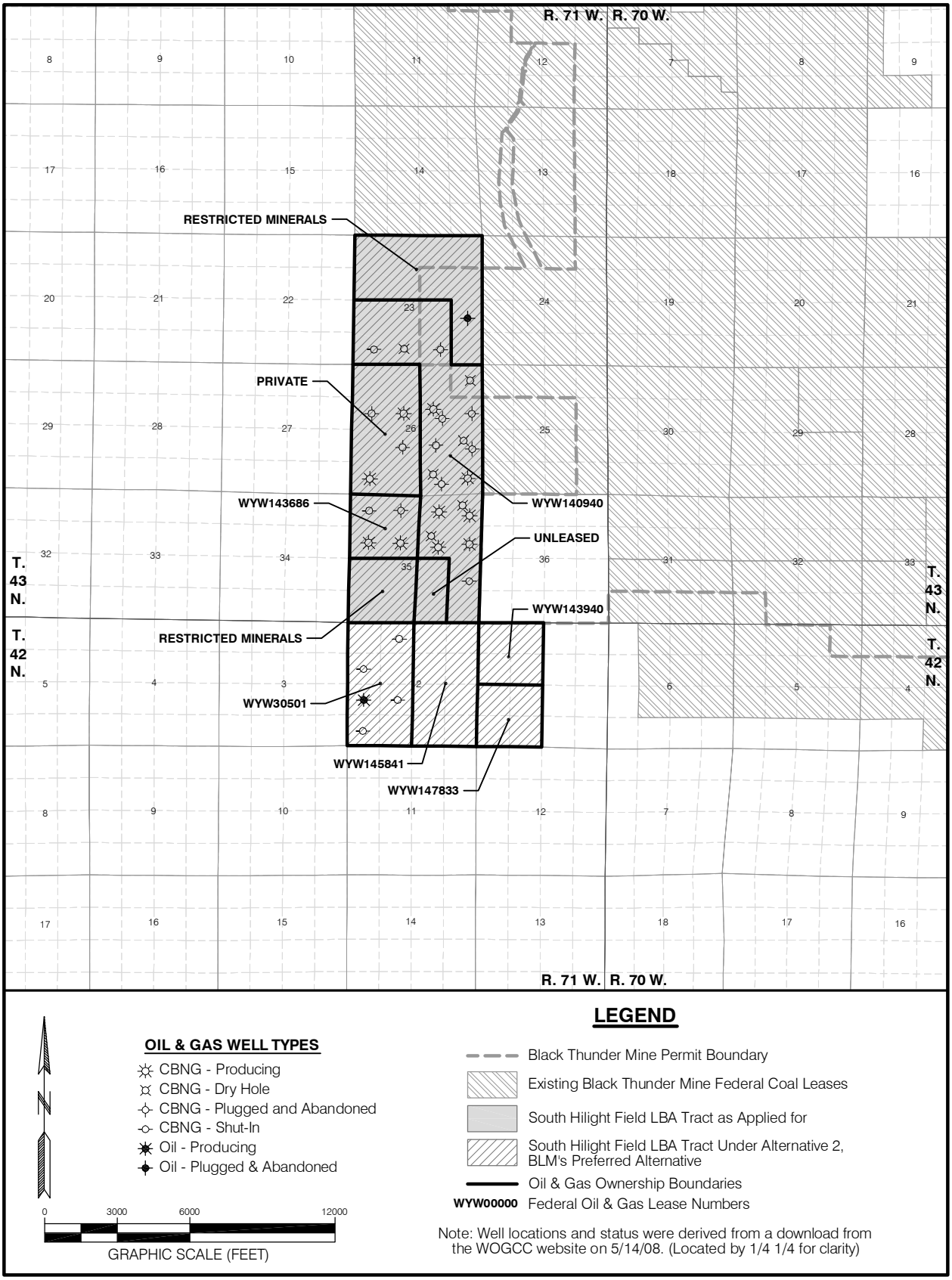


Figure 3-47. Oil and Gas Wells and Oil and Gas Ownership Within the South Hilight Field LBA Tract Alternatives.

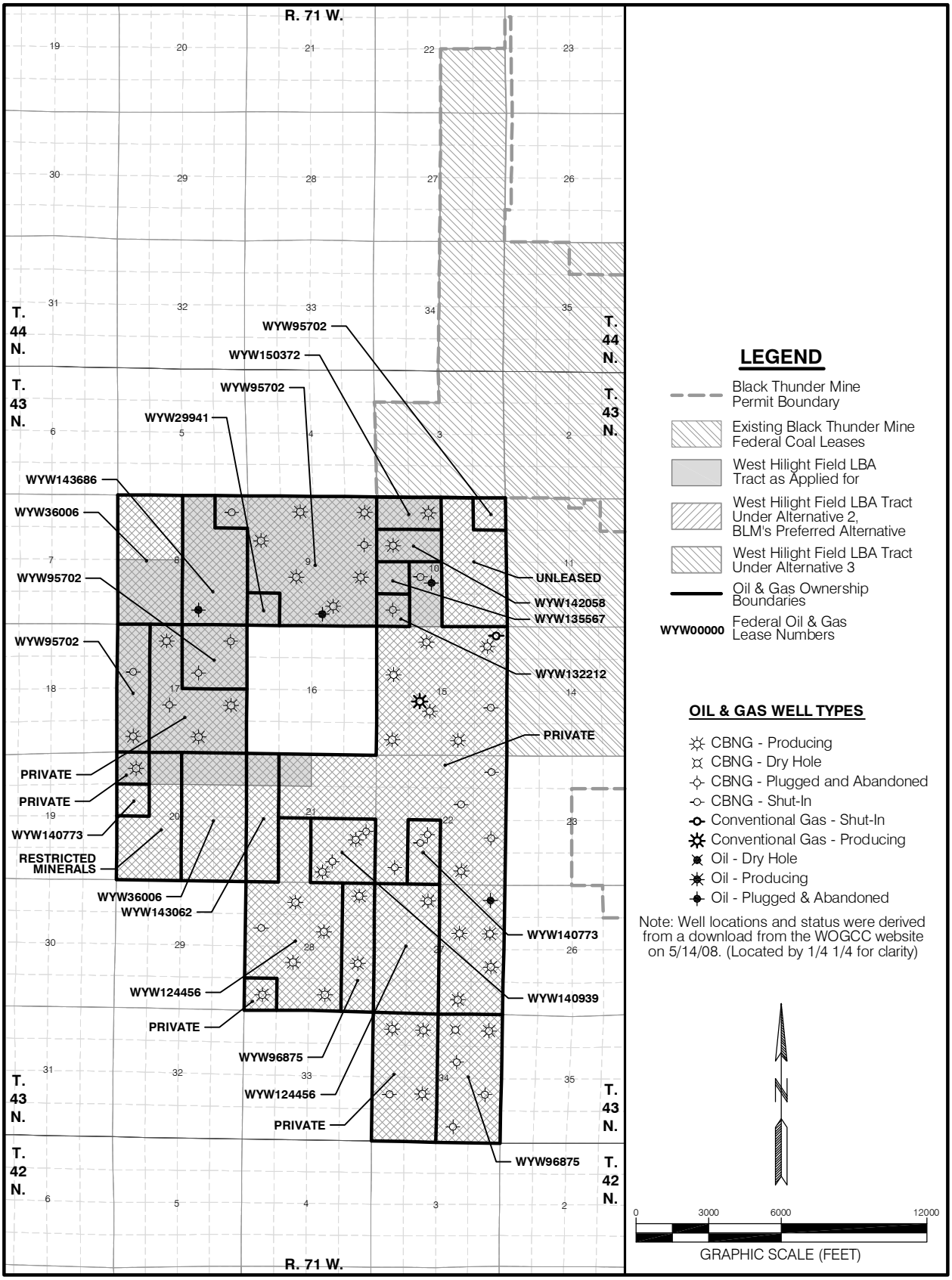


Figure 3-48. Oil and Gas Wells and Oil and Gas Ownership Within the West Hilight Field LBA Tract Alternatives.

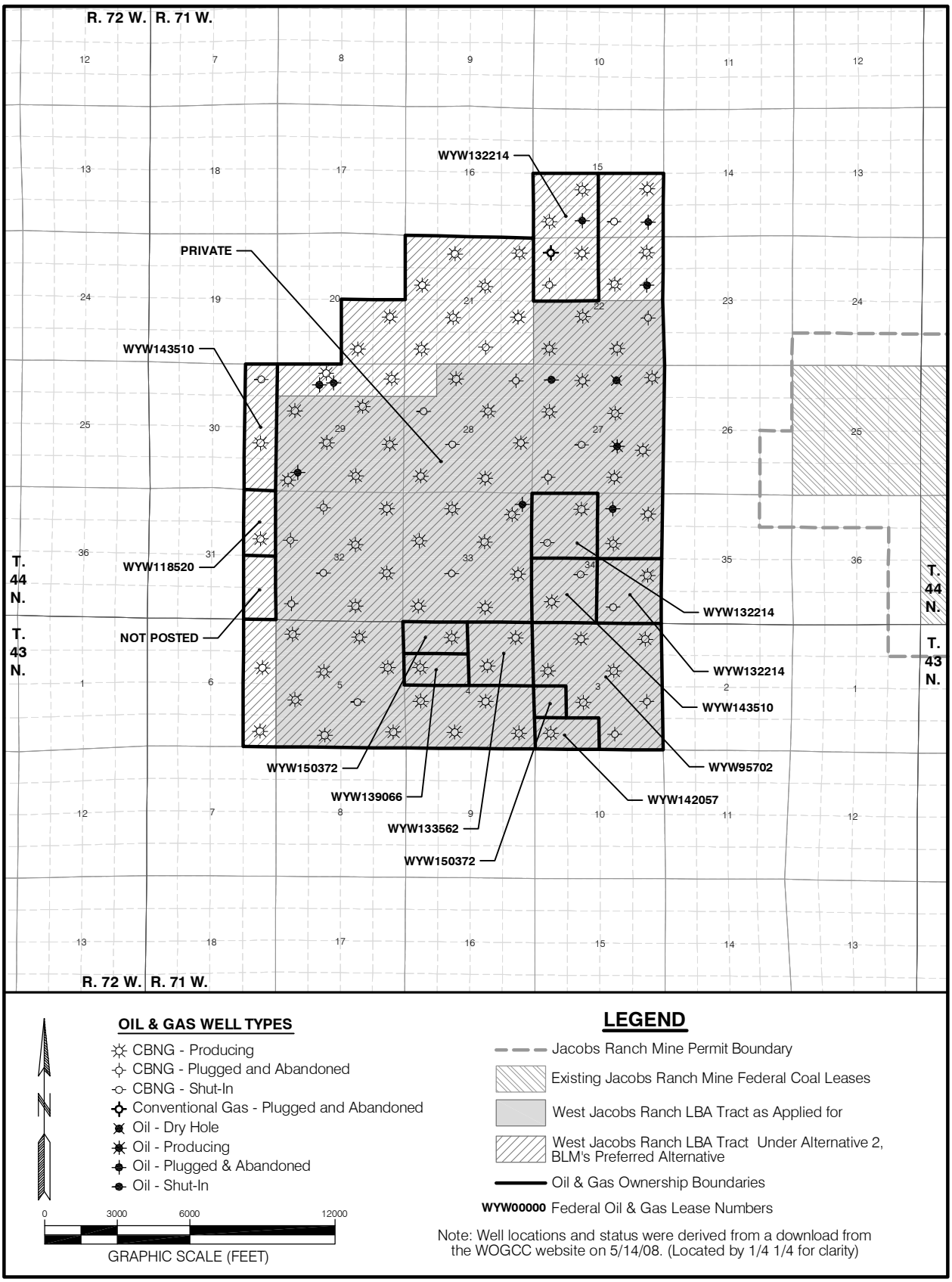


Figure 3-49. Oil and Gas Wells and Oil and Gas Ownership Within the West Jacobs Ranch LBA Tract Alternatives.

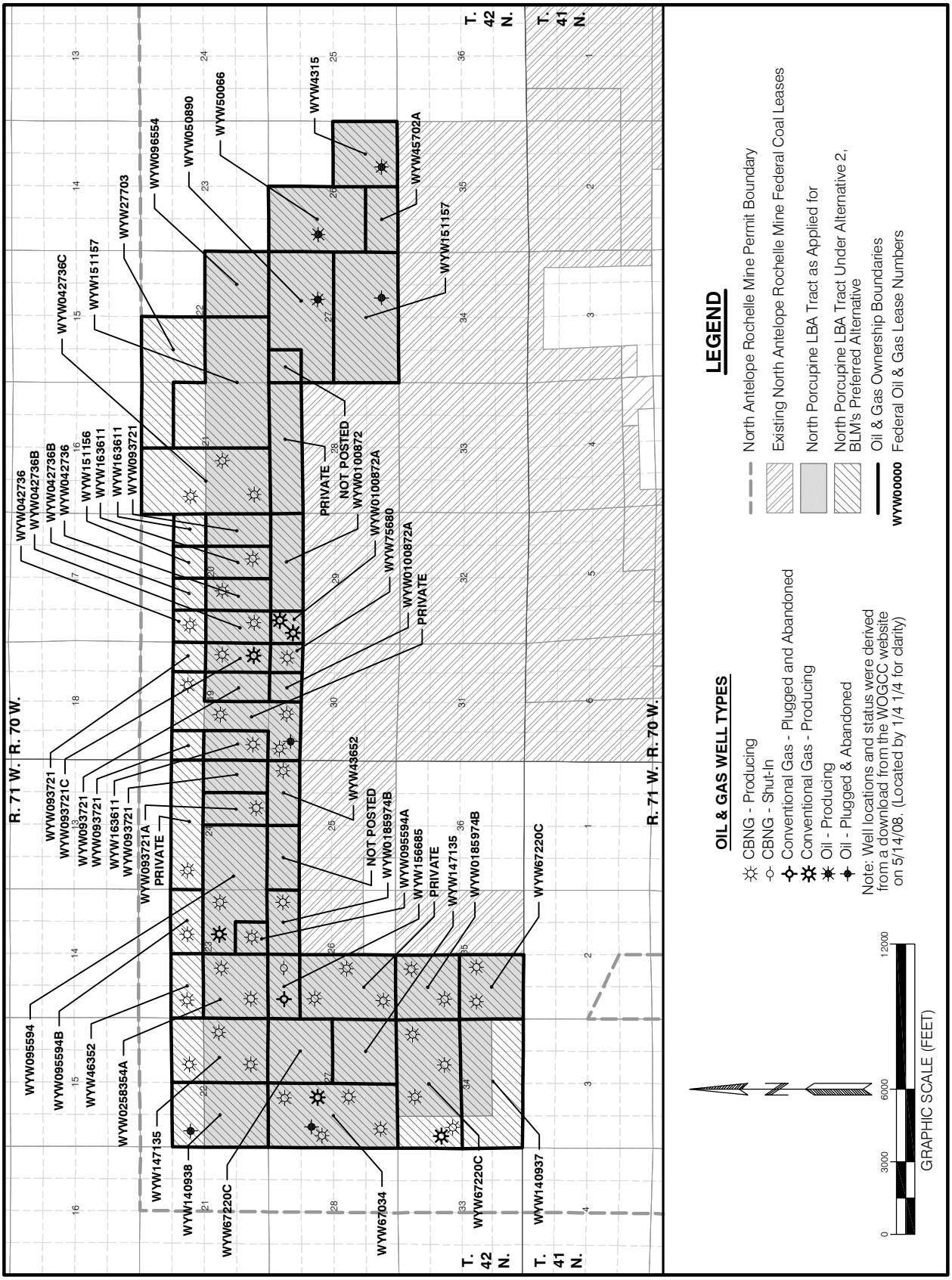


Figure 3-50. Oil and Gas Wells and Oil and Gas Ownership Within the North Porcupine LBA Tract Alternatives.

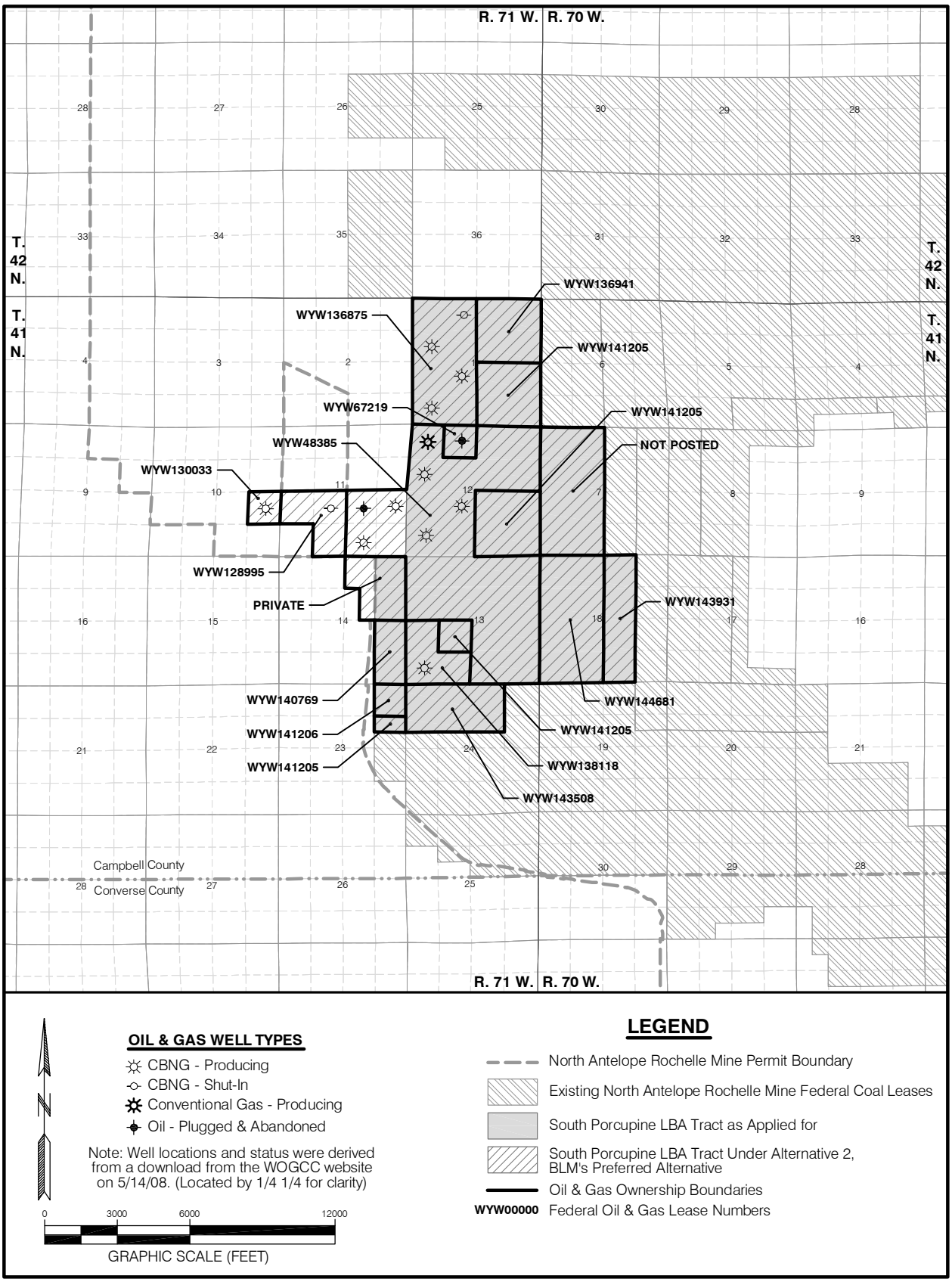


Figure 3-51. Oil and Gas Wells and Oil and Gas Ownership Within the South Porcupine LBA Tract Alternatives.

Table 3-16. North Hilight Field LBA Tract Federal Oil and Gas Lessees of Record.

Location	LeaseNumber	Lessees of Record
T.44N., R.70W.		
Section 17; Lots 9, 10, 15, 16 Section 19; Lots 7, 8, 10, 15, 18 Section 20; Lots 1, 2, 7-10, 15 Section 21; Lots 1, 8-10, 15, 16	WYW005305	Citation 2002 Investment LP Key Production Co., Inc. M&K Oil Co., Inc.
Section 18; Lots 7-10, 15-17	WYW007750	ExxonMobil Oil Corp. Kerr McGee O&G Onshore LP Marathon Oil Co.
Section 18; Lot 18	WYW014503	Patina Oklahoma Corp. Primary Natural Resources, Inc.
Section 20; Lot 16	WYW005306	Citation 2002 Investment LP Key Production Co., Inc. M&K Oil Co., Inc.
Section 22; Lots 4, 11, 13	WYW032195	APD Energy Co., LP Citation 2002 Investment LP Derby Energy LLC Kennedy, George C. Key Production Co., Inc. Langham Petrol Expl Meagher O&G Properties, Inc. Oilfield Salvage & Service Co. Pip Energy IV-80 Unruh, Dean
Section 22; Lots 8, 9, 14, 15	Compt. OG	--
T.44N., R.71W.		
Section 13; Lots 3-6 Section 14; Lot 1	WYW003063	Inexco Oil Co. Merit Energy Partners III Merit MGMT Partners I LP
Section 13; Lots 11-14 Section 24; Lots 1, 2	WYW103392	CTV O&G Multi-State, LLC Inexco Oil Co. Key Production Co., Inc. M&K Oil Co., Inc. Questar Expl and Prod Co.
Section 14; Lot 2	WYW091135	Primary Natural Resources, Inc.
Section 14; Lots 3-4	WYW144475	Bill Barrett CBM, LLC
Section 24; Lots 7, 8	WYW0249938A	CTV O&G Multi-State, LLC M&K Oil Co., Inc. Questar Expl and Prod Co.

Note: From BLM Oil and Gas Plats (dated 09/07/07 & 12/17/07). The oil and gas rights (including CBNG) and coal rights for the above locations are owned by the federal government. For the rest of the LBA tract, the oil and gas rights (including CBNG) are privately owned, and the coal rights are federally owned.

Table 3-17. South Hilight Field LBA Tract Federal Oil and Gas Lessees of Record.

Location	LeaseNumber	Lessees of Record
T.42N., R.71W.		
Section 1; Lots 7-10	WYW143940	Lance O&G Co., Inc. Williams Prod RMT Co.
Section 1; Lots 15-18	WYW147833	Five Star Energy, LLC Lance O&G Co., Inc. Williams Prod RMT Co.
Section 2; Lots 5, 6, 11-14, 19, 20	WYW145841	Petro Canada Res (USA) Inc.
Section 2; Lots 7-10, 15-18	WYW030501	Coleman Oil & Gas, Inc.
T.43N., R.71W.		
Section 23; Lots 10-15 Section 26; Lots 1, 2, 7-10, 15, 16 Section 35; Lots 1, 2, 7-9, 16	WYW140940	Western Gas Resources, Inc.
Section 23; Lots 1-9, 16 Section 35; Lots 11-14	Restricted Minerals	--
Section 35; Lots 10, 15	Unleased Oil & Gas	--
Section 35; Lots 3-6	WYW143686	Jolen Operating Co. Lance O&G Co., Inc. Williams Prod RMT Co.

Note: From BLM Oil and Gas Plats (dated 09/07/07 & 12/14/07). The oil and gas rights (including CBNG) and coal rights for the above locations are owned by the federal government. For the rest of the LBA tract, the oil and gas rights (including CBNG) are privately owned, and the coal rights are federally owned.

production on or in sections adjacent to the LBA tracts are listed in Appendix E.

Additional information on the conventional oil and gas and CBNG development in the general Wright analysis area and surrounding area is included in Section 3.3.2.

Certain ancillary facilities are needed to support oil and gas production. These support facilities may include well access roads; well pads; production equipment at the wellhead (which may be located on the surface and/or underground); well production casing (which extends from the surface to the zone of production); underground pipelines (which gather the oil, gas, and/or water produced by the individual wells and carry it to a larger transmission pipeline or collection facility); facilities for treating, discharging, disposing of, containing, or injecting produced water; central metering facilities; electrical power utilities; gas compressor stations; and high-pressure transmission pipelines for delivering the gas to market. Currently, there are some oil and gas production facilities, primarily oil and gas pipelines, on the LBA tracts, as discussed in Section 3.15 of this EIS. Additional support facilities might not be constructed on the LBA tracts because conventional oil and gas and CBNG well

Table 3-18. West Hilight Field LBA Tract Federal Oil and Gas Lessees of Record.

Location	LeaseNumber	Lessees of Record
T.43N., R.71W.		
Section 8; Lots 2, 7-10, 15, 16	WYW143686	Jolen Operating Co. Lance O&G Co., Inc. Williams Prod RMT Co.
Section 8; Lots 1 Section 9; Lots 1-12, 14-16 Section 10; Lot 1 Section 17; Lots 1, 2, 4, 5, 7, 8, 12, 13	WYW095702	Explorers Petro Corp. Harvey E. Yates Co. Heyco Employees LTD. Spiral, Inc.
Section 8; Lots 3-6, 11-14 Section 20; Lots 1, 2, 7-10, 15, 16	WYW036006	CTV O&G Multi-State, LLC Deputy Robert W. Devon Energy Prod Co. Farley, Thomas H. Jr. GF Collins Jr. Trust Key Production Co., Inc. Questar Expl and Prod Co. RBC Expl & Product Co. Ryder Stilwell Oil St Mary Land & Exploration Co. Stadelman, Diana L. Stadelman, Joseph R. WP Properties Corp.
Section 9; Lot 13	WYW029941	Hilcorp Energy, LP
Section 10; Lots 2, 7-10, 15, 16	Unleased Oil & Gas	--
Section 10; Lots 3, 4	WYW150372	Lance O&G Co., Inc. Williams Prod RMT Co.
Section 10; Lots 5, 6	WYW142058	Bill Barrett CBM, LLC
Section 10; Lot 12	WYW135567	Western Gas Resources, Inc.
Section 10; Lot 13	WYW132212	EOG Resources, Inc.
Section 20; Lots 3, 6, 11-14	Restricted Minerals	--
Section 20; Lot 5 Section 22; Lots 11, 14	WYW140773	Western Gas Resources, Inc.
Section 21; Lots 11, 14 Section 27; Lots 3-6, 11-14 Section 28; Lots 2-7, 10-12, 14, 15	WYW124456	Explorers Petro Corp. Harvey E. Yates Co. Heyco Employees LTD Spiral, Inc.
Section 21; Lots 9, 10, 15, 16	WYW140939	Western Gas Resources, Inc.
Section 21; Lots 4, 5, 12, 13	WYW143062	CH4 Energy, LLC Western Gas Resources, Inc. Williams Prod RMT Co.
Section 28; Lots 1, 8, 9, 16 Section 34; Lots 1, 2, 7-10, 15, 16	WYW096875	Lance O&G Co. Inc.

Note: From BLM Oil and Gas Plat (dated 12/14/07). The oil and gas rights (including CBNG) and coal rights for the above locations are owned by the federal government. For the rest of the LBA tract, the oil and gas rights (including CBNG) are privately owned, and the coal rights are federally owned.

Table 3-19. West Jacobs Ranch LBA Tract Federal Oil and Gas Lessees of Record.

Location	LeaseNumber	Lessees of Record
T.43N., R.71W.		
Section 3; Lots 2, 5-14, 18, 19	WYW095702	Explorers Petro Corp. Harvey E. Yates Co. Heyco Employees LTD Spiral, Inc.
Section 3; Lots 16, 17	WYW142057	Bill Barrett CBM, LLC
Section 3; Lot 15 Section 4; Lots 7, 8	WYW150372	Lance O&G Co., Inc. Williams Prod RMT Co.
Section 4; Lots 5, 6, 11, 12	WYW133562	EOG Resources, Inc.
Section 4; Lots 9, 10	WYW139066	Western Gas Resources, Inc. Williams Prod RMT Co.
T.44N., R.71W.		
Section 15; Lots 11-14 Section 22; Lots 3-6 Section 34; Lots 3-6, 9, 10, 15, 16	WYW132214	Western Gas Resources, Inc.
Section 30; Lots 5, 12, 13, 20 Section 34; Lots 11-14	WYW143510	Jolen Operating Co. Lance O&G Co., Inc. Williams Prod RMT Co.
Section 31; Lots 5, 12	WYW118520	Sawyer, Paul F.
Section 31; Lots 13, 20	Not Posted	

Note: From BLM Oil and Gas Plats (dated 09/07/07 & 12/14/07). The oil and gas rights (including CBNG) and coal rights for the above locations are owned by the federal government. For the rest of the LBA tract, the oil and gas rights (including CBNG) are privately owned, and the coal rights are federally owned.

development has likely reached a peak due to exhausted reserves and diminished production.

Coal mining is the predominant land use in the general Wright analysis area. The applicant mines (Black Thunder, Jacobs Ranch, and North Antelope Rochelle) are part of a group of contiguous surface coal mines located in Campbell County (Figure 1-1). Coal production from the three applicant mines increased by 58 percent between 1998 and 2007 (from approximately 136.4 million tons in 1998 to 215.8 million tons in 2007). Of the 19 federal coal leases issued in the PRB since decertification of the federal coal region, nine (Jacobs Ranch, West Black Thunder, North Antelope/Rochelle, Powder River, Thundercloud, North Jacobs Ranch, NARO South, Little Thunder, and NARO North) have been issued within this group of three mines. The currently pending North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine lease applications evaluated in this EIS are in this group of mines (Tables 1-1 and 1-2).

The *City of Gillette/Campbell County Comprehensive Planning Program* (City of Gillette 1978) was finalized by the City of Gillette and Campbell County in June

Table 3-20. North Porcupine LBA Tract Federal Oil and Gas Lessees of Record.

Location	LeaseNumber	Lessees of Record
T.42N., R.70W.		
Section 19; Lots 13, 20	WYW093721C	Bill Barrett Corp. Darius Oil Properties, LLC Powder River Coal, LLC
Section 19; Lots 9, 12, 14, 19 Section 20; Lots 9, 16	WYW093721	Bill Barrett Corp. El Paso E&P Co., LP Kaiser-Francis Oil Kerr McGee O&G Onshore LP Merit Energy Partners III Merit Partners LP
Section 19; Lots 16, 17 Section 20; Lots 8, 10, 15	WYW163611	Bill Barrett Corp.
Section 20; Lots 5, 11, 14	WYW042736	Bill Barrett Corp. Darius Oil Properties, LLC Powder River Coal, LLC
Section 20; Lots 6, 12, 13	WYW042736B	El Paso E&P Co., LP Mach Petro, Inc. Powder River Coal, LLC
Section 20; Lot 7	WYW151156	ABO Petro Corp. Myco Industries, Inc. Sharbro Oil LTD Co. Yates Drilling Co. Yates Petroleum Corp.
Section 21; Lots 3-6, 11-14	WYW042736C	Bill Barrett Corp.
Section 21; Lots 1, 2 Section 22; Lots 3-6	WYW027703	Bill Barrett Corp. Conrad, Clayton Jouflas, George P.
Section 22; Lots 9, 10, 15, 16	WYW096554	Mobil Expl & Prod
Section 21; Lots 7-10, 15, 16 Section 22; Lots 11-14 Section 27;Lots 9-16	WYW151157	ABO Petro Corp. Myco Industries, Inc. Sharbro Oil LTD Co. Yates Drilling Co. Yates Petroleum Corp.
Section 26; Lots 13, 14	WYW045702A	Brazos LTD Partnership Petroleum, Inc. Whiting Oil & Gas
Section 26; Lots 3-6, 11, 12	WYW050066	DNR O&G, Inc.
Section 26; Lots 9, 10, 15, 16	WYW004315	Berenergy Corp. Daven Corp. Sport Resources, Inc. Zab, Inc. Zalman Res, Inc.
Section 27; Lot 4	Not Posted	--
Section 27; Lots 1-3, 5-8	WYW050890	Mobil Expl & Prod
Section 29; Lots 1-3	WYW0100872	Powder River Coal, LLC
Section 29; Lot 4 Section 30; Lot 6	WYW0100872A	Damson Oil Corp. Powder River Coal, LLC Stalls, Clark F.
Section 30; Lot 5	WYW075680	Powder River Coal, LLC

Table 3-20. North Porcupine LBA Tract Federal Oil and Gas Lessees of Record (Continued).

Location	LeaseNumber	Lessees of Record
T.42N., R.71W.		
Section 22; Lots 5, 6, 11-14	WYW140938	Bill Barrett Corp.
Section 22; Lots 7-10, 15, 16 Section 27; Lots 9, 10, 15, 16	WYW147135	Bill Barrett Corp.
Section 23; Lots 7, 8	WYW095594B	Bill Barrett Corp. Klabzuba Oil and Gas
Section 23; Lots 9, 10, 16 Section 24; Lots 11-14	WYW095594	Devon Energy Prod Co. LP F&H Schultz Trst Klabzuba, Robert Schultz Mgmt LTD
Section 23; Lots 11-14	WYW0258354A	Bill Barrett Corp.
Section 23; Lot 15	WYW095594A	Bill Barrett Corp.
Section 23; Lots 5, 6 Section 25; Lots 1, 2	WYW043652	Citadel Energy, Inc. Key Production Co., Inc. Powder River Coal, LLC St Mary Land & Exploration, Co.
Section 24; Lots 10, 15	WYW093721A	Independent Prod Co.
Section 24; Lots 11-14	WYW095594	Devon Energy Prod Co. LP F&H Schultz Trst Klabzuba, Robert Schultz Mgmt LTD
Section 24; Lots 9, 16	WYW093721	Bill Barrett Corp. El Paso E&P Co., LP Kaiser-Francis Oil Kerr McGee O&G Onshore LP Merit Energy Partners III Merit Partners LP
Section 25; Lots 3, 4	Not Posted	--
Section 26; Lots 1, 2 Section 35; Lots 3-6	WYW185974B	Devon Energy Prod Co. LP Powder River Coal, LLC Reunion Energy Co.
Section 26; Lots 3, 4	WYW156685	Powder River Coal, LLC
Section 27; Lots 3-6, 11-14	WYW067034	ExxonMobil Oil Corp.
Section 27; Lots 1, 2, 7, 8 Section 34; Lots 1-8 Section 35; Lots 11-14	WYW67220C	Axel Johnson Expl. Black Hills Expl & Prod Inc. DeLoyd Cook Estate Ladd, Jerry D. Meyer Oil Co Inc. Whiting Oil & Gas Corp. Wright, Dale O.
Section 34; Lots 9-16	WYW140937	Bill Barrett Corp.

Note: From BLM Oil and Gas Plats (dated 09/07/07 & 09/20/07). The oil and gas rights (including CBNG) and coal rights for the above locations are owned by the federal government. For the rest of the LBA tract, the oil and gas rights (including CBNG) are state or privately owned, and the coal rights are federally owned.

Table 3-21. South Porcupine LBA Tract Federal Oil and Gas Lessees of Record.

Location	LeaseNumber	Lessees of Record
T.41N., R.70W.		
Section 7; Lots 7-10, 15-18	Not Posted	--
Section 18; Lots 6, 11, 14, 19	WYW143931	Powder River Coal, LLC
Section 18; Lots 7-10, 15-18	WYW144681	Powder River Coal, LLC
T.41N., R.71W.		
Section 1; Lots 7-10, 15-18	WYW136875	Rubenstein, Kathleen A.
Section 1; Lots 5, 6, 11, 12	WYW136941	Powder River Coal, LLC
Section 10; Lot 9	WYW130033	ABO Petro Corp. Lance O&G Co., Inc. Myco Industries, Inc. Sharbro Oil LTD Co. Williams Prod RMT Co. Yates Drilling Co. Yates Petroleum Corp.
Section 11; Lots 11, 12, 14	WYW128995	ABO Petro Corp. Lance O&G Co., Inc. Myco Industries, Inc. Williams Prod RMT Co. Yates Drilling Co. Yates Petroleum Corp.
Section 11; Lots 9, 10, 15, 16 Section 12; Lots 1, 2, 4-8, 11-14 Section 13; Lots 1-10, 15, 16	WYW048385	Key Production Co., Inc. St. Mary Land & Exploration Co.
Section 12; Lot 3	WYW067219	Liberty Petroleum Corp. Universal Fuels Co. West Trend Res Corp.
Section 13; Lots 12-14	WYW138118	Yates Petroleum Corp.
Section 14; Lots 9, 16	WYW140769	Lance O&G Co., Inc. Williams Production RMT Co.
Section 1; Lots 13, 14, 19, 20 Section 12; Lots 9, 10, 15, 16 Section 13; Lot 11 Section 23; N½ Lot 8	WYW141205	Williams Production RMT Co.
Section 23; Lot 1	WYW141206	Williams Production RMT Co.
Section 24; Lots 2-4, N½ Lots 5-7	WYW143508	Five Star Energy, LLC Williams Production RMT Co.

Note: From BLM Oil and Gas Plats (dated 09/06/07 & 02/27/08). The oil and gas rights (including CBNG) and coal rights for the above locations are owned by the federal government. For the rest of the LBA tract, the oil and gas rights (including CBNG) are privately owned, and the coal rights are federally owned.

1978. The 1978 plan was updated in March 1994 and both plans provide general land use goals and polices for state and federal coal leases in the county. These documents emphasized local government involvement in state

and federal government decisions and plans. On August 21, 2007, the *Campbell County Natural Resource and Land Use Plan* (the Plan) was adopted. The Plan was developed by a diverse cross section of county residents appointed by the Board of Campbell County Commissioners and it focuses on planning for growth and development in the county (Campbell County 2007). The Plan describes the local environment, natural resources, and industries within the county. It defines the social and economic conditions, and the Plan's intent is for Campbell County's values to be taken into consideration in any state or federal agency action which falls under NEPA requirements. There are no provisions for zoning in the Plan, and the proposed lease areas do not have designated zoning classifications.

Big game hunting is the principal recreational land use within the general Wright analysis area, and pronghorn, mule deer, and white-tailed deer are present within the area (Section 3.10.2). On private lands, hunting is allowed only with landowner permission. Land ownership within the PRB is largely private (approximately 80 percent), with some private landowners permitting sportsmen to cross and/or hunt on their land. There has been a trend over the past 2 to 3 decades towards a substantial reduction in private lands that are open and reasonably available for hunting. Access fees continue to rise and many resident hunters feel these access fees are unreasonable. This trend has created problems for the WGFD in their attempt to distribute and control harvest at optimal levels, as well as for sportsmen who desire access to these animals (WGFD 2007a).

In general, publicly owned lands (i.e., USFS or BLM-administered federal lands and state school sections) are open to hunting if legal access is available. Due to safety concerns, however, public surface lands contained within an active mining area are generally closed to the public, further limiting recreational use. There are approximately 12,642.8 acres of public surface lands within the BLM study areas for the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts (Figures 3-40 through 3-45 and Table 3-14). A majority of the public surface lands (12,480.7 acres) are associated with the TBNG, which is administered by the USFS. Approximately 7,288 acres of the public surface lands within the BLM study areas for these six LBA tracts are within the current mine permit boundaries or are surrounded by private lands and thus may be inaccessible to the public.

Specific details regarding big game herd management objectives within and near the general Wright analysis area are contained in Wyoming Game and Fish Department's (WGFD's) 2007 Big Game Herd Unit Job Completion Reports for the Casper and Sheridan Regions (WGFD 2007a). The WGFD classifies the entire general Wright analysis area as yearlong and winter/yearlong habitat for antelope. No crucial or critical pronghorn habitat is recognized by the WGFD in this area. WGFD definitions of big game ranges are included in Section 3.10.2.1. The proposed lease areas are within pronghorn Hunt Area 24 (north of Highway 450), which is contained in the Hilight Herd Unit, and pronghorn

Hunt Area 27 (south of Highway 450), which is contained in the Cheyenne River Herd Unit. In post-season 2007, the population of the Hilight Herd Unit was estimated to be approximately 12,397 animals, which is above the WGFD objective of 11,000, and the population of the Cheyenne River Herd Unit was estimated to be 55,287, which is above 45 percent above the WGFD objective of 38,000 animals (WFGD 2007a).

Historical problems associated with the management of the Hilight Herd Unit include hunter access, over harvest on limited public lands, and quantifying landowner preferences and desires. Prior to 1997, the herd population was fairly stable and near the objective of 11,000 antelope. Losses from severe winters, poor production rates, and disease subsequently decreased the population; however, the herd has recently recovered and since 2005 it has been slightly above the objective level. Hunt Area 24 contains mostly privately owned surface lands with poor hunter access to limited publicly owned lands; therefore, the number of antelope is expected to steadily increase. If the population exceeds objective levels, more licenses will be needed and these may be difficult to sell in this mostly private land area. Nearly all landowners charge access fees for hunting and private land access is based on the desires and perceptions of the landowners. Some portions of the herd unit are leased to outfitters, which makes areas more expensive and restrictive with regards to access. Increased harvest may also be difficult to achieve because of the increased CBNG development, which is limiting rifle hunting on associated lands. Assuming most licenses are sold and given the predicted harvest, the 2008 post-season population was expected to be 12,129 antelope (WGFD 2007a).

Between 1995 and 2001, the Cheyenne River Herd Unit population was fairly stable at about 15 percent below the objective population. Pronghorn populations in this herd unit dropped in 2001, primarily because of lower productivity and survival caused by climatic factors. Population recovery began in the following years, with an increase of approximately 2,000 additional pronghorn each year between 2002 and 2005. The herd objective was surpassed in 2005 and continues to grow. Hunt Area 27 contains mostly privately owned surface lands (roughly 77 percent of the herd unit is private land) with poor hunter access to limited publicly owned lands. Given inadequate access to private lands, WGFD's inability to sell all issued licenses, and the uneven distribution of animals throughout the area, managing this herd is difficult and the number of pronghorn is expected to steadily increase. Nearly all landowners either charge access fees for hunting or lease their land to outfitters. In addition, an increased harvest may be difficult to achieve because of the increased CBNG development, which is limiting rifle hunting on associated lands. The 2007 post-season population estimate was 45 percent above the objective. While WGFD significantly increased license issuance in 2008, the estimated harvest assumes many remain unsold and the 2008 post-season population was expected to be 53,142 antelope (WGFD 2007a).

The WGFD has classified the general Wright analysis area as yearlong and "OUT" mule deer use range (the OUT designated areas do no contain enough animals to be important habitat, or the habitat is of limited importance to a species). Crucial or critical mule deer habitat does not occur on or within several miles of the general Wright analysis area. The general Wright analysis area is located within WGFD mule deer Hunt Areas 10 and 21, part of the Thunder Basin Mule Deer Herd Unit, which also includes mule deer Hunt Areas 7, 8, 9, and 11. The Thunder Basin Herd Unit encompasses 3,642 square miles, of this, 71 percent is privately owned. Hunt Area 10, however, contains substantial blocks of public land. According to WGFD, there has been an increase in the number of landowners leasing to outfitters, which is increasing hunting pressure on public lands and decreasing hunting opportunity on private lands. Reducing the number of licenses issued and length of hunting season in Hunt Area 10 has reduced hunter pressure on public lands within this herd unit. The population of this herd reached objective in 2000 and since 2002 it has grown on average 9 percent per year. The 2007 post-season objective for this mule deer herd was 20,000 and the population was estimated at 20,980. WGFD believes the herd should be reduced to or below the objective population because of drought-related forage conditions; however, limited sales and use of certain types of licenses and insufficient harvest of deer from private land may hamper the ability to reduce the population through hunting. Given average herd productivity and climatic conditions, the 2008 post-season population is expected to increase to 22,265 animals (WGFD 2007a).

White-tailed deer are not managed separately by WGFD, but are managed and hunted in conjunction with mule deer. The population occupying Hunt Areas 10 and 21 is part of the Central White-tailed Deer Herd Unit. White-tailed deer are seldom observed within the general Wright analysis area due to their preference for riparian woodlands and irrigated agricultural lands. WGFD classifies the entire general Wright analysis area, with the exception of a narrow corridor along Antelope Creek, as OUT white-tailed deer use range. The narrow corridor along the Antelope Creek is classified as yearlong range. There is no population model for this herd.

The general Wright analysis area is within Elk Hunt Areas 113 and 123 of the Rochelle Hills Herd Unit. The Rochelle Hills Elk Herd resides in the Rochelle Hills, which are located immediately east of the three applicant mines. The herd favors the ponderosa pine/juniper woodlands, savanna, and steeper terrain habitat offered by the Rochelle Hills. As more lands are reclaimed from coal mining adjacent to the Rochelle Hills, elk are shifting their winter use to these areas. Such lands typically offer excellent winter grass supplies, especially during more severe winters when other sites are less accessible. Elk are presently using the reclaimed mine lands of the Jacobs Ranch, Black Thunder, and North Antelope Rochelle mines. The WGFD has designated an approximately five square mile area on reclaimed lands within the Jacobs Ranch Mine permit area as crucial winter habitat for the Rochelle Hills elk herd (Odekoven 1994). Rio Tinto Energy America (RTEA), owner of the Jacobs

Ranch Mine, and the Rocky Mountain Elk Foundation (RMEF) finalized a formal agreement that created the Rochelle Hills Conservation Easement. The easement contains nearly 1,000 acres, with 75 percent of that area comprised of reclaimed mining lands on RTEA's Jacobs Ranch Mine. The easement acreage was donated to RMEF by RTEA to ensure that the reclaimed land continues to be used as grazing land and wildlife habitat for the extended future (RMEF 2007).

Much of the occupied range of the Rochelle Hills Elk Herd is located on the TBNG, which is administered by the USFS. Elk Hunt Areas 113 and 123 contain crucial winter, parturition, winter-yearlong, yearlong, OUT, and undecided/unknown use ranges. Hunting in Areas 113 and 123 has been permitted every two or three years, allowing very good bull quality for this herd; many of which have scored in the official record books. Some landowners within Hunt Areas 113 and 123 had, in previous years, allowed free public access for much of the season, although in more recent years, trespass or outfitting fees have become more common, particularly for antlered elk. The current postseason population objective for this herd is 400 elk. For post-season 2007, the estimated herd size was approximately 600, with a probable range of between 600 and 800 animals. Elk have been observed dispersing from the designated herd boundary, due to behavioral or habitat limitations. Habitat conditions in recent years have been poor throughout this herd unit and elk appear to have moved out of the rougher hills habitats and into the lowlands habitat in search of adequate forage. As a result, the majority of the elk in Hunt Area 123 are found in the northeastern portions of the area and almost entirely on private land (WGFD 2007a). No elk have been observed recently within any of the LBA tracts, but have been reported near the Hilight Road by area landowners. The public enjoy observing these elk along Highway 450 and within accessible USFS lands; thus they also provide for non-consumptive recreational use opportunities.

Under natural conditions, aquatic habitat is very limited by the ephemeral nature of surface waters in the general Wright analysis area; therefore, public fishing opportunities are likewise very limited. The lack of deep-water habitat and extensive and persistent water sources limits the presence and diversity of fish and other aquatic species. There are currently no fisheries on the as-applied-for LBA tracts. However, Little Thunder Reservoir, an in-channel impoundment on Little Thunder Creek, is located within the BLM's West Hilight Field study area (Figure 3-29). The reservoir is located on TBNG surface and is managed as a warm water sport fishery by the USFS. Local residents use the reservoir year-round for fishing, camping, and recreational shooting. WGFD stocked the reservoir with catchable rainbow trout from 2004 through 2006. Upon an evaluation, they found that is was well-stocked with bullheads and small mouth bass that could maintain themselves. They plan another evaluation in the summer of 2009 with the idea of maintaining active management of the fishery. Access to the reservoir is across private surface owned by TBCC (Figures 3-29 and 3-42); however, USFS has an easement over this land that allows legal public access to the reservoir.

Water discharged from CBNG wells from within and upstream of the general Wright analysis area has temporarily enhanced the water supply within some drainages, particularly Little Thunder Creek, North Prong Little Thunder Creek, and Porcupine Creek, and increased potential habitat for some aquatic species. For example, there are no historical monitoring records of Little Thunder Reservoir's water levels. Anecdotally, local residents and mine personnel recall this reservoir held only a fraction of its volume capacity prior to CBNG discharges in the Little Thunder Creek drainage above the impoundment, which began in the mid- to late-1990s. Anecdotal evidence also indicates that the reservoir was rarely used for recreational fishing prior to CBNG development in the area. CBNG production and the related surface discharge of groundwater are expected to decrease over time. As a result, regular inflow of water to the Little Thunder Reservoir will diminish over time, the naturally-occurring low water volume stored in the reservoir will resume, and the impoundment may not function as it currently does as a fishery.

Sage-grouse, mourning dove, waterfowl, rabbit, and coyote are hunted in the general vicinity, and some coyote and red fox trapping may occur.

3.11.2 Environmental Consequences

3.11.2.1 Proposed Action and Alternatives 2 and 3

The major adverse environmental consequences of leasing and mining the West Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts with respect to land use would be the temporary reduction of livestock grazing, incremental loss of wildlife habitat (particularly big game), and curtailment of oil and gas development while the areas are being mined and reclaimed. This would include removal of all existing oil and gas surface and downhole production and transportation equipment and facilities. Livestock grazing, and to a lesser extent wildlife use, would be displaced while the tracts are being mined and reclaimed. Access for recreational and other activities (i.e., ranching, oil and gas development) would be restricted during mining operations. The loss of accessibility to lands successfully leased and proposed for mining is long term (during mining and reclamation), but not permanent. Access to approximately 12,481 acres of federal grazing leases on TBNG surface that are currently held by the Thunder Basin Grazing Association would be suspended during mining and reclamation operations. Estimated disturbance areas for the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts under the Proposed Action and Alternative 2, BLM's preferred alternative configuration for each tract, are presented in Tables 3-1 through 3-6, respectively.

Sections 3.3.2 and 3.11.1 and Appendix E of this document address producing, abandoned, and shut in oil and gas (conventional and CBNG) wells that presently exist in the BLM study areas for these six LBA tracts. Well location information, federal oil and gas ownership, and federal oil and gas lessee

information are presented in Figures 3-46 through 3-51 and Tables 3-15 through 3-20. BLM manages federal lands on a multiple use basis, in accordance with the regulations. In response to conflicts between oil and gas and coal lease holders, BLM policy advocates optimizing the recovery of both coal and CBNG resources to ensure that the public receives a reasonable return for these publicly owned resources. Optimal recovery of both coal and oil and gas resources requires negotiation and cooperation between the oil and gas lessees and the coal lessees. In the past, negotiations between some of the applicant mines and some of the existing oil and gas lessees have resulted in agreements that allow development of both resources on portions of the LBA tract. Producing conventional oil and gas and CBNG wells are present on all six of these LBA tracts. In the PRB, royalties have been and would be lost to both the state and federal governments if conventional oil and gas wells are abandoned prematurely, if the federal CBNG is not recovered prior to mining, or if federal coal is not recovered due to conflicts. State and federal governments can also lose bonus money when the costs of the agreements between the lessees are factored into the fair market value determinations.

As discussed above, the North Hilight Field, South Hilight Field, West Hilight Field, North Porcupine, and South Porcupine LBA Tracts configured under Alternative 2, BLM's preferred alternative, include approximately 12,481 acres of TBNG surface, which is administered by the USFS; approximately 7,288 acres of which are currently accessible to the public. According to the USFS Douglas Ranger District, each mine can close access in areas that are actively mined for human health and safety reasons (Homuth 2003). The loss of access to federal lands is long term (during mining and reclamation), but is not permanent. Public access to federal lands would be restored after mining and reclamation are complete.

Hunting on the LBA tracts, including the federal surface discussed above, would be eliminated during mining and reclamation. Pronghorn and mule deer have been observed on and adjacent to the LBA tracts, as have sage-grouse, mourning doves, waterfowl, rabbits, and coyotes. The federal lands actually represent a relatively small portion of the currently accessible public surface lands for recreational opportunity within the respective animal hunt areas. None of the lands included in the West Jacobs Ranch LBA Tract under Alternative 2 are managed by the USFS; thus, no federal lands would be removed from public access if this LBA tract were leased.

Public access to Little Thunder Reservoir, which is located on federal surface, would be eliminated during mining and reclamation of the West Hilight Field LBA Tract configured under Alternative 2. Hunting, fishing, camping and recreational activities afforded by the impoundment would be suspended during mining and reclamation operations.

TBCC permitted and constructed Pronghorn Lake, located in T.43N., R.70W., Section 27 (Figure 3-29), as a postmining public recreational facility. This permanent postmining impoundment, which is located on land owned by USFS

and TBCC, currently functions as storage for dust suppression water used on the Black Thunder Mine site. Pronghorn Lake is located within an active portion of the mine's permit area, and as such, safety concerns for the general public preclude access to the reservoir for the current time and the foreseeable future. Plans are for Pronghorn Lake to become available as a public recreation area for fishing and other activities once it no longer serves a function for the mining operation. The recreational activities provided by Little Thunder Reservoir could be replaced by those provided by Pronghorn Lake; however, the time at which Pronghorn Lake becomes accessible to the general public may not coincide with the time at which Little Thunder Reservoir becomes inaccessible.

Following reclamation, the land would be suitable for grazing by domestic livestock and wildlife uses, which are the historic land uses. The reclamation standards required by the federal Surface Mining Control and Reclamation Act of 1977 (SMCRA) and Wyoming State Law meet the standards and guidelines for healthy rangelands for public lands administered by the BLM in Wyoming. Following reclamation bond release, management of the privately owned surface would revert to the private surface owner and management of the federally owned surface would revert to the federal surface managing agency (USFS).

3.11.2.2 No Action Alternative

Under the No Action Alternative, the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine coal lease applications would be rejected and coal removal and associated disturbance and impacts to land use and recreation would not occur on the portions of the LBA tracts as applied for or the LBA tracts configured under Alternative 2 that will not be disturbed under the currently approved surface coal mining permits. Coal removal and associated surface disturbance and impacts to land use and recreation would continue as currently permitted on the existing Black Thunder, Jacobs Ranch and North Antelope Rochelle Mine permit areas. Impacts to land use related to mining operations at these three applicant mines would not be extended onto portions of the LBA tracts that will not be affected under the current mining and reclamation plans.

As discussed in Section 2.2, a decision to reject one or more of these six coal lease applications at this time would not preclude an application to lease that respective tract in the future.

3.11.3 Regulatory Compliance, Mitigation and Monitoring

Mined areas would be reclaimed as specified in the approved mine and reclamation plan to support the anticipated post-mining land uses of rangeland and wildlife habitat, which are premining land uses. The reclamation procedures would include stockpiling and redistributing soil, using reclamation

seed mixtures approved by WDEQ, and replacing recreational and livestock reservoirs.

Steps to control invasion by weedy (invasive nonnative) plant species using chemical and mechanical methods would be included in the amended mine plan. Revegetation growth and diversity would be monitored until the final reclamation bond is released (a minimum of 10 years following seeding with the approved final seed mixture). Erosion would be monitored to determine if there is a need for corrective action during establishment of vegetation. Controlled grazing would be used during revegetation to determine the suitability of the reclaimed land for anticipated post-mining land uses.

Section 3.3.2.3 includes the discussion of regulatory requirements, mitigation and monitoring related to oil and gas development.

3.11.4 Residual Impacts

No residual impacts to land use and recreation are expected.

3.12 Cultural Resources

3.12.1 Affected Environment

Cultural resources, which are protected under the National Historic Preservation Act of 1966, are nonrenewable remains of past human activity. The PRB, including the general Wright analysis area, appears to have been inhabited by aboriginal hunting and gathering people for more than 13,000 years. Throughout the prehistoric past, the area was used by highly mobile hunters and gatherers who exploited a wide variety of resources. Several thousand cultural sites have been recorded within the PRB.

Frison's (1978, 1991) chronology for the Northwestern Plains divides occupations from early to late into the Paleoindian, Early Plains Archaic, Middle Plains Archaic, Late Plains Archaic, Late Prehistoric, and Protohistoric periods. These periods are defined by the years before the present time (B.P.). Frison's chronology is listed below. The Plains designation within the Early, Middle, and Late Archaic periods has been omitted from the list.

- Paleoindian period (13,000 to 7,000 years B.P.)
- Early Archaic period (7,000 to 5,000-4,500 years B.P.)
- Middle Archaic period (5,000-4,500 to 3,000 years B.P.)
- Late Archaic period (3,000 to 1,850 years B.P.)
- Late Prehistoric period (1,850 to 400 years B.P.)
- Protohistoric period (400 to 250 years B.P.)
- Historic period (250 to 120 years B.P.)

The Paleoindian period dates from about 13,000 to 7,000 years ago and includes various complexes (Frison 1978). Each of these complexes is

correlated with a distinctive projectile point style derived from a general large lanceolate and/or stemmed point morphology. The Paleoindian period is traditionally thought to be synonymous with "big game hunters" who exploited megafauna such as bison and mammoth (plains Paleoindian groups), although evidence of the use of vegetal resources is noted at a few Paleoindian sites (foothill-mountain groups).

The Early Archaic period dates from about 7,000 to 5,000-4,500 years ago. Projectile point styles reflect the change from large lanceolate types that characterize the earlier Paleoindian complexes to large side- or corner-notched types. Subsistence patterns reflect exploitation of a broad spectrum of resources, with a much-diminished utilization of large mammals.

The onset of the Middle Archaic period (4,500 to 3,000 years B.P.) has been defined on the basis of the appearance of the McKean Complex as the predominant complex on the Northwestern Plains around 4,900 years B.P. (Frison 1978, 1991, 2001). McKean Complex projectile points are stemmed variants of the lanceolate point. These projectile point types continued until 3,100 years B.P. when they were replaced by a variety of large corner-notched points (i.e., Pelican Lake points) (Martin 1999). Sites dating to this period exhibit a new emphasis on plant procurement and processing.

The Late Archaic period (3,000 to 1,850 years B.P.) is generally defined by the appearance of corner-notched dart points. These projectile points dominate most assemblages until the introduction of the bow and arrow around 1,500 years B.P. (Frison 1991). The period witnessed a continual expansion of occupations into the interior grasslands and basins, as well as the foothills and mountains.

The Late Prehistoric period (1,850 to 400 years B.P.) is marked by a transition in projectile point technology around 1,500 years B.P. The large corner-notched dart points characteristic of the Late Archaic period are replaced by smaller corner- and side-notched points for use with the bow and arrow. Around approximately 1,000 years B.P., the entire Northwestern Plains appears to have suffered an abrupt collapse or shift in population (Frison 1991). This population shift appears to reflect a narrower subsistence base focused mainly on communal procurement of pronghorn and bison.

The Protohistoric period (400 to 250 years B.P.) witnesses the beginning of European influence on prehistoric cultures of the Northwestern Plains. Additions to the material culture include most notably the horse and European trade goods, including glass beads, metal, and firearms. Projectile points of this period include side-notched, tri-notched, and unnotched points, with the addition of metal points. The occupants appear to have practiced a highly mobile and unstable residential mobility strategy.

The historic period (250 to 120 years B.P.) is summarized from Schneider et al. (2000). The use of the Oregon Trail by emigrants migrating to the fertile lands

of Oregon, California, and the Salt Lake Valley brought numerous pioneers through the State of Wyoming, but few stayed. It was not until the fertile land in the West became highly populated, along with the development of the cattle industry in the late 1860s, that the region currently comprising the State of Wyoming became attractive for settlement. The region offered cattlemen vast grazing land for the fattening of livestock, which could then be shipped across the country via the recently completed (1867-1868) transcontinental railroad in southern Wyoming.

The settling of the region surrounding Gillette, Wyoming began in the late 1800s, after a government treaty in 1876 placed the Sioux Indians on reservations outside the territory. Cattlemen were the first settlers to establish themselves in the area, with dryland farmers entering the area after 1900. The town of Gillette was established by the railroad in 1891 in an effort to promote the settling of undeveloped areas along their rail lines. The presence of the railroad allowed for the greater development of the cattle industry because it facilitated shipping cattle from the area. Several early ranches established in the region include the 4J Ranch (1875), Half Circle L Ranch (1880s), I Bar U Ranch (1888), and the T7 Ranch (1881). Early ranches established in the region surrounding the general Wright analysis area as of 1883 include the Ritchie Ranch, the McCray Ranch, and the 6 Ranch. Later arrivals to the area (as of 1908) include the Grant Ranch on Hay Creek, the Rooney Ranch on Rawhide Creek, and the Gardner and Wilson Ranches on the Little Powder River. The specific project area of Site 48CA3378 was homesteaded by George Oedekoven in 1917, and his family still maintains the property today. Site 48CA1918 was homesteaded by Bert Herrod in 1919. This homestead has been abandoned since at least 1983.

The Dry Land Farming movement of the late 19th and early 20th centuries had a profound effect on the settlement of the PRB during the years around World War I. Although the principles of dry land farming were sound, success still required a certain amount of precipitation each year. Wyoming encouraged dry land settlement of its semi-arid lands through a Board of Immigration created in 1911. Newspapers extolled the virtues of dry land farming, and railroads conducted well-organized advertising campaigns on a nationwide basis to settle the regions through which they passed.

The most intensive period of homesteading activity in the Eastern PRB occurred in the late 1910s and early 1920s. Promotional efforts by the state and the railroads, the prosperous war years for agriculture in 1917 and 1918, and the Stock Raising Act of 1916 with its increased acreage (but lack of mineral rights) all contributed to this boom period. A large amount of land filings consisted of existing farms and ranches expanding their holdings in an optimistic economic climate. However, an equally large number of homesteaders had been misled by promotional advertising and were not adequately prepared for the experiences that awaited them in the PRB. It soon became apparent to the would-be dry land farmer that he could not make a living by raising only crops. Some were initially successful in growing wheat, oats, barley and other small grains, along

with hay, alfalfa, sweet clover and other grasses for the increased number of cattle.

A drought in 1919 was followed by a severe winter. The spring of 1920 saw market prices fall. Those homesteaders who were not ruined by the turn in events often became small livestock ranchers and limited their farming to the growing of forage crops and family garden plots. Some were able to obtain cheap land as it was foreclosed or sold for taxes. During the 1920s the size of homesteads in Wyoming nearly doubled and the number of homesteads decreased, indicating the shift to livestock raising (LeCompte and Anderson 1982).

With serious drought beginning in 1932, several federal actions were taken. In April of 1932, Weston, Campbell, and Converse counties were eligible for a drought relief program. The Northeast Wyoming Land Utilization Project began repurchasing the sub-marginal homestead lands and making the additional acres of government land available for lease. This helped the small operator to expand the usable grazing land. Cropland taken out of production could be reclaimed and then added to the grazing lease program. Grazing associations were formed to regulate the grazing permits. In 1934, the Agricultural Adjustment Administration began studying portions of Converse, Campbell, Weston, Niobrara, and Crook counties. In all, 2 million acres, including about 560,000 acres of federal owned lands, were included in the Thunder Basin Project (LA-WY-1) to alter land use and to relocate settlers onto viable farmland. Nationally, the program hoped to shift land use from farms to forest, parks, wildlife refuges or grazing districts. In marginal areas cash crops were to be replaced by forage crops, the kind and intensity of grazing would be changed and the size of operating units would be expanded (USFS n.d.). Land purchase work on the Thunder Basin Project began late 1934 and the purchasing of units started in 1935.

During the development program to rehabilitate the range, impounding dams were erected, wells were repaired, springs developed, and homestead fences were obliterated while division fences were constructed for the new community pastures. Farmsteads were obliterated and the range reseeded. Remaining homesteaders and ranchers often purchased or scavenged materials from the repurchased farmsteads. Pits were dug on some homesteads and machinery and demolished buildings buried (many of these were dug up during the World War II scrap drives). Ironically, the rehabilitation project utilized a labor pool of former farmers who had spent years building what the government paid them to destroy. Their efforts were so successful that almost no trace remains of many homesteads.

While counties lost much of their population base as a result of the Resettlement Administration relocation program, they were strengthened financially: schools were closed, maintenance of rural roads was restricted to main arterioles, and delinquent taxes were paid. The remaining subsidized ranches were significantly larger and provided a stabilizing effect on the local economies. Three grazing

associations were formed: the Thunder Basin Grazing Association, the Spring Creek Association, and the Inyan Kara Grazing Association. These associations provided responsible management of the common rangeland.

Class III Cultural Resources Survey

A Class III cultural resources survey is an intensive and comprehensive inventory of a proposed project area conducted by professional archaeologists and consultants. The survey is designed to locate and identify all prehistoric and historic cultural properties 50 years and older that have exposed surface manifestations. The goal of the survey is to locate and evaluate for the National Register of Historic Places (NRHP) all cultural resources within the project area. Cultural properties are recorded at a sufficient level to allow for evaluation for possible inclusion to the NRHP. Determinations of eligibility are made by the managing federal agency in consultation with the State Historic Preservation Office (SHPO). Consultation with the SHPO must be completed prior to the approval of the mining plan.

After completion of a Class III cultural resources survey, additional investigations may be undertaken to complete an individual site record. If necessary, site-specific testing or limited excavation may be utilized to collect additional data which will: 1) determine the final evaluation status of a site; and/or 2) form the basis of additional work to be conducted during implementation of a treatment plan if the site is determined eligible for the NRHP. A treatment plan is then developed for those sites that are eligible for the NRHP and are within the area of potential effect. Treatment plans are implemented prior to mining and can include such mitigation measures as avoidance (if possible), large scale excavation, complete recording, Historical American Building Survey/Historic American Engineering Record documentation, archival research, and other acceptable scientific practices.

Data recovery plans are required for sites that cannot be avoided by project development and are recommended as eligible for the NRHP following testing and consultation with the SHPO. Until consultation has occurred and agreement regarding NRHP eligibility has been reached, all sites recommended as eligible or undetermined eligibility must be protected from disturbance. If an LBA tract is leased, full consultation with the SHPO will be completed prior to approval of the mining plans. Those sites determined to be unevaluated or eligible for the NRHP through consultation would receive further protection or treatment.

Numerous Class I (survey records review) and Class III cultural resource surveys associated with oil and gas field development, as well as with surface mining operations, have been conducted in the general Wright analysis area. The general analysis areas of the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts (defined as the LBA tract as applied for, the additional area evaluated under Alternative 2, plus a ¼-mile disturbance buffer) have been entirely

surveyed for cultural resources at a Class III level. These areas include all anticipated areas of disturbance assuming the coal is mined by the existing adjacent mines. Additional information about the surveys and the cultural sites that were documented in the survey areas is included in the supplementary information document for this EIS, which is available upon request.

3.12.1.1 North, South, and West Hilight Field LBA Tracts

Cultural resource inventories in this area began in the early 1980s and continued with numerous projects associated with oil and gas field development as well as surface mining operations throughout the 1990s and 2000s. TBCC contracted with GCM Services, Inc. of Butte, Montana to perform Class I and Class III surveys of the North, South, and West Hilight Field LBA Tracts and surrounding areas in the summer of 2007, which completed the Class III level inventory of the entire general analysis areas for the North, South, and West Hilight Field LBA Tracts.

A total of 52 cultural sites have been documented in the North Hilight Field general analysis area. Of these, 39 are prehistoric and 13 are historic. Prehistoric sites consist primarily of lithic scatters and campsites. Historic sites consist primarily of homesteads and trash dumps. Twelve of the prehistoric sites and five of the historic sites have been determined *not eligible* for the NRHP by the SHPO. Eight of the prehistoric sites have been determined to be *eligible* for the NRHP by the SHPO. Nineteen of the prehistoric sites and eight historic sites are considered *unevaluated* for eligibility by the SHPO; of which many have never been reviewed, while at least eight will require additional documentation, testing or evaluation in order for the SHPO to make an eligibility determination.

A total of 21 cultural sites have been documented in the South Hilight Field general analysis area. Of these, 14 are prehistoric and seven are historic. Prehistoric sites consist primarily of lithic scatters and campsites. Historic sites consist primarily of trash dumps. Twelve of the prehistoric sites and four of the historic sites have been determined *not eligible* for the NRHP by the SHPO. Two of the prehistoric sites and three historic sites are considered *unevaluated* or not reviewed for eligibility by the SHPO. There are no NRHP-*eligible* sites documented in the general analysis area for the South Hilight Field LBA Tract at this time.

A total of 74 cultural sites have been documented in the West Hilight Field general analysis area. Of these, 59 are prehistoric and 15 are historic. Prehistoric sites consist primarily of lithic scatters and campsites. Historic sites consist primarily of trash dumps. Thirty of the prehistoric sites and two of the historic sites have been determined *not eligible* for the NRHP by the SHPO. Six of the prehistoric sites and none of the historic sites have been determined to be *eligible* for the NRHP by the SHPO. Twenty-three of the prehistoric sites and 13 historic sites are considered *unevaluated* for eligibility

by the SHPO, most of which have never been reviewed, while at least 13 will require additional documentation, testing or evaluation in order for the SHPO to make an eligibility determination.

In summary, a total of 147 cultural sites have been documented in the general analysis areas for the North, South, and West Hilight Field LBA Tracts. Of these, 108 sites were previously recorded and were identified during record searches (Class I inventories). An additional 39 sites were located during the 2007 inventories of the remaining unsurveyed lands in the entire general analysis areas for the North, South, and West Hilight Field LBA Tracts. Of the 147 total cultural sites, 112 are prehistoric cultural remains and 35 are historic cultural remains. Of the 147 total cultural sites, 14 sites have been determined to be *eligible* for the NRHP by SHPO, which will have to be avoided or a mitigation plan approved and implemented prior to any disturbance. There are a total of 68 sites currently considered *unevaluated* by SHPO; which are given the same protections as *eligible* sites and are to be avoided until a determination of eligibility have been made. At least 26 of the unevaluated sites will require additional documentation, formal testing, or evaluation in order for the SHPO to make an eligibility determination. There are 65 sites that have been determined *not eligible* for the NRHP and no further work is required at these sites.

3.12.1.2 West Jacobs Ranch LBA Tract

Cultural resource inventories in this area began in 1975 and continued with numerous projects associated with oil and gas field development as well as surface mining operations throughout the 1990s and 2000s. JRCC contracted with GCM Services, Inc. of Butte, Montana to perform Class I and Class III surveys of the West Jacobs Ranch LBA Tract and surrounding areas in 2006 and 2007, which completed the Class III level inventory of the entire general analysis area for the West Jacobs Ranch LBA Tract.

The Class I review of the general analysis area for the West Jacobs Ranch LBA Tract identified 13 previously recorded, documented cultural sites, while 18 new cultural properties were identified during the Class III surveys. Of these 31 total sites, 16 are historic, seven are prehistoric, one contains both historic and prehistoric components, and seven sites are rock cairns of indeterminate age and cultural affiliation. The historic sites consist primarily of homesteads and include a ranch complex and a stock herder's camp. The prehistoric sites consist of lithic scatters, stone circles or tipi ring sites, and rock cairns. The multi-component site consists of an historic corral complex and a prehistoric rock alignment.

Twenty-five of these 31 recorded cultural properties have not been reviewed and evaluated by the SHPO in terms of their NRHP eligibility. Of these, 23 sites are recommended *not eligible* by the recorders and are unlikely to be determined significant. The other two unevaluated cultural properties are prehistoric sites that may lack sufficient information for the SHPO to make an

eligibility determination. Of the 31 total sites, six have been reviewed and determined *not eligible* for the NRHP by the SHPO. There are no sites within the general analysis area for the West Jacobs Ranch LBA Tract considered eligible for the NRHP; however, significance determinations for these sites will have to be made by the lead agency and SHPO.

3.12.1.3 North and South Porcupine LBA Tracts

Cultural resource inventories in this area began in the early 1990s and continued with numerous projects associated primarily with surface mining operations, as well as with oil and gas field development, through 2005. The entire general analysis areas for the North and South Porcupine LBA Tracts have been previously surveyed for cultural resources at a Class III level.

A total of 48 cultural sites have been documented in the North Porcupine general analysis area. Of these, 27 are prehistoric, 11 are historic, and 10 are multi-component (contains both historic and prehistoric components) sites. Prehistoric sites consist primarily of lithic scatters and campsites. Historic sites consist primarily of homesteads and associated remains. All inventory results have been reviewed by either BLM or OSM and submitted to SHPO, who concurred with the recommendations on site eligibility for the NRHP. Test excavations were carried out at some sites. A total of four prehistoric sites (campsites) and two of the multi-component sites have been determined *eligible* for the NRHP by the SHPO.

A total of 20 cultural sites have been documented in the South Porcupine general analysis area. Of these, eight are prehistoric, 11 are historic, and one is multi-component. Prehistoric sites consist primarily of lithic scatters and campsites. Historic sites consist primarily of homesteads and associated remains. All inventory results have been reviewed by either BLM or OSM and submitted to SHPO, who concurred with the recommendations on site eligibility for the NRHP. One of the 20 cultural sites, a homestead, is recommended *eligible* to the NRHP based on testing and evaluation.

In summary, a total of 67 cultural sites have been documented in the general analysis areas for the North and South Porcupine LBA Tracts. All 67 sites were previously recorded and were identified during record searches (Class I inventories) that were conducted by PRC in 2008. Of the 67 cultural sites documented in the entire general analysis areas for the North and South Porcupine LBA Tracts, 35 are prehistoric, 21 are historic, and 11 are multi-component sites. A total of 16 homestead sites, all dating back to the early 1900s, are located within the general analysis areas for the North and South Porcupine LBA Tracts. Ten of the homestead sites are located within the North Porcupine general analysis area, seven are located within the South Porcupine general analysis area, and portions of one homestead are located on both the general analysis areas. Either BLM or OSM have reviewed the cultural resource inventories covering the general analysis areas for the North and South Porcupine LBA Tracts and have submitted the results to the SHPO.

SHPO has concurred with the recommendations finding seven sites (six in the North Porcupine tract general analysis area and one in the South Porcupine tract general analysis area) eligible for the NRHP.

3.12.2 Environmental Consequences

3.12.2.1 Proposed Action and Alternatives 2 and 3

Data recovery plans are required for all sites recommended eligible to the National Register following testing and consultation with the SHPO. Until full consultation with the SHPO has been completed and agreement regarding NRHP eligibility has been reached, all sites would be protected from disturbance.

Full consultation with the SHPO must be completed prior to approval of a mining plan. At that time, those sites determined to be unevaluated or eligible for the NRHP through consultation would receive further protection or treatment. Impacts to eligible or unevaluated cultural resources cannot be permitted. If unevaluated sites cannot be avoided, they must be evaluated prior to disturbance. If eligible sites cannot be avoided, a data recovery plan must be implemented prior to disturbance. Ineligible cultural sites may be destroyed without further work.

Any eligible sites on the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts that cannot be avoided or that have not already been subjected to data recovery action would be carried forward in the mining and reclamation plans as requiring protective stipulations until a testing, mitigation, or data recovery plan is developed to address the impacts to the sites. The lead federal and state agencies would consult with Wyoming SHPO on the development of such plans and the manner in which they are carried out.

Cultural resources adjacent to the mine areas may be impacted as a result of increased access to the areas. There may be increased vandalism and unauthorized collecting associated with recreational activity and other pursuits outside of but adjacent to mine permit areas. Unintended or uninformed impacts related to increased off-road traffic outside of but adjacent to mine permit areas during mine related activities are the most frequent impacts to cultural resources.

3.12.2.2 No Action Alternative

Under the No Action Alternative, the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine coal lease applications would be rejected and coal removal and the associated disturbance and impacts would not occur on the portions of the LBA tracts as applied for or the LBA tracts configured under Alternative 2 that will not be disturbed under the currently approved surface coal mining permits. Coal

removal and associated surface disturbances would continue as currently permitted on the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle Mine permit areas. Potential impacts to cultural resources related to mining operations at these three applicant mines would not be extended onto portions of the LBA tracts that will not be affected as a result of recovering the remaining coal in the existing leases under the current mining and reclamation plans.

As discussed in Section 2.2, a decision to reject one or more of these six coal lease applications at this time would not preclude an application to lease that respective tract in the future.

3.12.3 Native American Consultation

Native American heritage sites can be classified as prehistoric or historic. Some may be presently in use as offering, fasting, or vision quest sites.

Other sites of cultural interest and importance may include rock art, stone circles, various rock features, fortifications or battle sites, burials, and locations that are sacred or part of the oral history and heritage but have no man-made features.

No Native American heritage, special interest, or sacred sites have been formally identified and recorded to date within the general Wright analysis area. However, the geographic position of the general Wright analysis area between mountains considered sacred by various Native American cultures (the Big Horn Mountains to the west, the Black Hills to the east, and Devils Tower to the north) creates the possibility that existing locations may have special religious or sacred significance to Native American groups. If such sites or localities are identified, appropriate action must be taken to address concerns related to those sites.

Tribes that have been identified as potentially having concerns about actions in the PRB include the Crow, Northern Cheyenne, Shoshone, Arapaho, Oglala Sioux, Rosebud Sioux, Crow Creek Sioux, Lower Brule Sioux, Standing Rock Sioux, Cheyenne River Sioux, Apache Tribe of Oklahoma, Comanche Tribe of Oklahoma, and Kiowa Tribe of Oklahoma. These tribal governments and representatives have been sent copies of the EIS. They are also being provided with more specific information about the known cultural sites on the tract in this analysis. Their help has been requested in identifying potentially significant religious or cultural sites in the general analysis areas for the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts before a leasing decision is made on any tract.

Native American tribes were consulted at a general level in 1995-1996 as part of an update to the BLM *Buffalo Resource Area RMP*. Some of the Sioux tribes

were consulted by BLM on coal leasing and mining activity in the PRB at briefings held in Rapid City, South Dakota in March 2002.

3.12.4 Regulatory Compliance, Mitigation and Monitoring

Class I and III surveys are conducted to identify cultural properties on all lands affected by federal undertakings. Prior to mining, the SHPO is consulted to evaluate the eligibility of the cultural properties for inclusion in the NRHP. Cultural properties that are determined to be eligible for the NRHP are avoided or, if avoidance is not possible, a recovery plan is implemented prior to disturbance.

Mining activities are monitored during topsoil stripping operations. If a lease is issued for the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts, BLM would attach a stipulation to each lease requiring the lessee to notify appropriate federal personnel if cultural materials are uncovered during mining operations (Appendix D).

3.12.5 Residual Impacts

Cultural sites that are determined to be eligible for the NRHP would be avoided if possible. Eligible sites that cannot be avoided would be destroyed by surface coal mining after data from those sites is recovered. Sites that are not eligible for the NRHP would be lost.

Cultural sites are permanently destroyed by surface coal mining operations but, as a result of the intensive pedestrian inventories, site evaluations and excavation and analysis of prehistoric cultural resources discussed above, there is a more informed understanding of what types of resources exist in the region and a better understanding of local prehistory.

3.13 Visual Resources

3.13.1 Affected Environment

Visual sensitivity levels are determined by people's concern for what they see and the frequency of travel through an area. Landscapes within and around the general Wright analysis area are characterized by a gently rolling topography and large, open expanses of sagebrush and short-grass prairie, which are common throughout the PRB. There are also areas of altered landscape, such as oil and gas fields and surface coal mines. The existing active surface mines that are located on the eastern side of the PRB form three geographic groups that are separated by areas with no mining operations (Figure 1-1). Two of the groups of surface mines are located east of Highway 59 from south of Gillette to south of Wright, a distance of about 50 miles; the third mine group is located on the east side of U.S. Highway 14-16 from Gillette north for about 13 miles. Other man-made intrusions on the natural

landscape in the general Wright analysis area include oil and gas development (oil well pumpjacks, pipeline and utility ROWs, water storage reservoirs, access roads, CBNG well shelters, and natural gas compressor stations), transportation facilities (public and private roads, road signage, power and utility transmission lines, and railroads), ranching activities (fences, ranch buildings, livestock, and abandoned homesteads), and environmental monitoring installations. The natural scenic quality in and near the general Wright analysis area is fairly low because of the industrial nature of the adjacent existing mining operations and oil and gas field development.

The Visual Resource Management (VRM) system is the basic tool used by BLM to inventory and manage visual resources on public lands. Prior to 1986, the five VRM classes defined below were used to describe increasing levels of change within the characteristic landscape. The number of VRM classes was reduced from five to four in 1986 (BLM 2007), but the new resource management class objectives remain very similar to the original objectives of VRM Classes I through IV.

The pre-1986 VRM Classes are summarized as follows:

Class I: Natural ecologic changes and very limited management activity is allowed. Any contrast (activity) within this class must not attract attention.

Class II: Changes in any of the basic elements (form, line, color, texture) caused by an activity should not be evident in the landscape.

Class III: Contrasts to the basic elements caused by an activity are evident but should remain subordinate to the existing landscape.

Class IV: Activity attracts attention and is a dominant feature of the landscape in terms of scale.

Class V: This classification is applied to areas where the natural character of the landscape has been disturbed up to a point where rehabilitation is needed to bring it up to the level of one of the other four classifications.

The 2001 Buffalo Resource Management Plan (RMP) revision (BLM 2001) covers the general Wright analysis area. It retained and carried forward the VRM inventory from the 1985 Buffalo RMP (BLM 1985). At this time, the lands included in the general Wright analysis area continue to be managed in accordance with the VRM classes established in 1981, and the predominant VRM class is Class IV.

Approximately 12,481 acres (or 34 percent) of the surface of these LBA tracts configured under Alternative 2, BLM's preferred alternative for each tract, is part of the TBNG, which is administered by the USFS. The USFS has established scenic integrity objectives for the TBNG. In the general Wright analysis area, the scenic integrity objective is low. A low scenic integrity

objective refers to landscapes where the value landscape character appears moderately altered. In this area, facilities and landscape modifications may be visible but should be reasonably mitigated to blend and harmonize with natural features according to USFS's revised Land and Resource Management Plan (LRMP) for the TBNG (USFS 2001).

Currently, mine facilities and mining activities at the Jacobs Ranch, Black Thunder, North Antelope Rochelle, and Antelope mines are visible from various public-use roads in the general Wright analysis area, including State Highway 450, Jacobs Road, Shroyer Road, Keeline Road, Hilight Road, Edwards Road, Reno Road, Antelope Road, Mackey Road, and Matheson Road.

3.13.2 Environmental Consequences

3.13.2.1 Proposed Action and Alternatives 2 and 3

Some mining activities on the North, South and West Hilight Field LBA Tracts would be visible from State Highway 450, a major travel route that borders the West Hilight Field tract. Some of the existing mining operations at the Black Thunder and Jacobs Ranch mines are currently visible from this highway. Some mining activities on the West Jacobs Ranch LBA Tract would be visible from State Highway 450, which borders the tract. Portions of the West Hilight Field and West Jacobs Ranch tracts may also be visible from State Highway 59, which is from about 2 to 5 miles east of the tracts. Not all of the mining activities on these four LBA tracts would be visible from these major highways because of the rolling terrain. Portions of these four LBA tracts would also be visible from Keeline Road, Jacobs Road, Shroyer Road, Hilight Road, Edwards Road, Reno Road, and Matheson Road.

Some mining activities on both the North and South Porcupine LBA Tracts would be visible from Antelope Road and Matheson Road. Some mining activities on the North Porcupine tract would also be visible from the Edwards Road, Reno Road, and Mackey Road. Some of the existing mining operations at the North Antelope Rochelle Mine are currently visible from these public roads.

Due to the existing mining activities in the general Wright analysis area, the predominant BLM VRM class is Class IV. This classification would not be altered by the leasing and subsequent mining of the six LBA tracts under any of the Action Alternatives. After reclamation of the LBA tracts and adjoining mines, the VRM Class IV conditions would be improved and the reclaimed land would resemble the surrounding undisturbed terrain. The USFS scenic integrity objectives for the general Wright analysis area allow facilities and landscape modifications to be visible, but call for reasonable mitigation to blend and harmonize with natural features. No visual resources that are unique to this area have been identified on or near the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts.

Reclaimed terrain would be almost indistinguishable from the surrounding undisturbed terrain. Slopes might appear smoother (less intricately dissected) and gentler (less steep) than undisturbed terrain and sagebrush would not be as abundant for several years; however, within a few years after reclamation, the mined land would not be distinguishable from the surrounding undisturbed terrain except by someone very familiar with landforms and vegetation.

3.13.2.2 No Action Alternative

Under the No Action Alternative, the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine coal lease applications would be rejected and coal removal and associated disturbance and impacts to visual resources would not occur on potions of the LBA tracts as applied for or the LBA tracts configured under Alternatives 2 or 3 that will not be disturbed under the currently approved surface coal mining permits. The additional acres that would be disturbed under the Proposed Action or Alternative 2, BLM's preferred alternative for each tract, would not change the current VRM Class IV designation for those lands. Currently approved mining operations would continue on the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle Mine leases. Impacts to visual resources related to mining operations at these mines would not be extended onto portions of the LBA tracts that will not be affected under the current mining and reclamation plan.

As discussed in Section 2.2, a decision to reject one or more of these six coal lease applications at this time would not preclude an application to lease that respective tract in the future.

3.13.3 Regulatory Compliance, Mitigation and Monitoring

Landscape character would be restored during reclamation to approximate original contour and would be reseeded with an approved seed mixture, including native species.

See Sections 3.2 and 3.9 for additional discussion of the regulatory requirements, mitigation, and monitoring for topography and vegetation, respectively.

3.13.4 Residual Impacts

No residual impacts to visual resources are expected.

3.14 Noise

3.14.1 Affected Environment

Existing noise sources in the general Wright analysis area include coal mining activities, rail traffic, traffic on nearby state highways, county roads and access roads, natural gas compressor stations, and wind. Noise originating from CBNG development equipment (e.g., drilling rigs and construction vehicles) is apparent locally over the short term (i.e., 30 to 60 days) where well drilling and associated construction activities are occurring. The amount of noise overlap between well sites is variable and depends on the timing of drilling activities on adjacent sites and the distance between the site locations. Studies of background noise levels at PRB mines indicate that ambient sound levels generally are low, owing to the isolated nature of the area.

The unit of measure used to represent sound pressure levels (decibels) using the A-weighted scale is a dBA (A-weighted decibel). It is a measure designed to simulate human hearing by placing less emphasis on lower frequency noise because the human ear does not perceive sounds at low frequency in the same manner as sounds at higher frequencies. Figure 3-52 presents noise levels associated with some commonly heard sounds.

In 2004, Matheson Mining Consultants, Inc. conducted a noise survey at the two occupied locations closest to the existing Antelope Mine operations. The Antelope Mine is located adjacent to the South Porcupine LBA Tract (Figure 1-1). Measurements were taken at a residence located directly west of the Antelope Mine on State Highway 59 and at the Dyno Nobel West Region office located northeast of the Antelope Mine on Campbell County Road 4 (Antelope Road). The Dyno Nobel office is located within the southern portion of the South Porcupine LBA Tract (Figure 3-18). The maximum daily time weighted (L_{eq}) noise reading at the residence was 51 dBA, which is comparable to that of a normal office, 50 feet in the distance. The maximum measured L_{eq} at the Dyno Nobel office was 52.6 dBA, which is equivalent to the noise level of an average office environment (BLM 2008d).

No site-specific noise level data are available for the other proposed coal lease areas included in this analysis; therefore, the current median noise level is estimated to be 40-60 dBA for day and night, with the noise level increasing with proximity to the currently active mining operations. Mining activities are characterized by noise levels of 85-95 dBA at 50 feet from actual mining operations and activities (BLM 1992).

OSM prepared a noise impact report for the Caballo Rojo Mine (OSM 1980) that determined that the noise level from crushers and a conveyor would not exceed 45 dBA at a distance of 1,500 feet. The air overpressure created by blasting is estimated to be 123 dBA at the location of the blast. At a distance of approximately 2,500 feet (0.47 mile), the intensity of this blast would be reduced to 55 dBA. Under the authority of the Noise Control Act of 1972, EPA

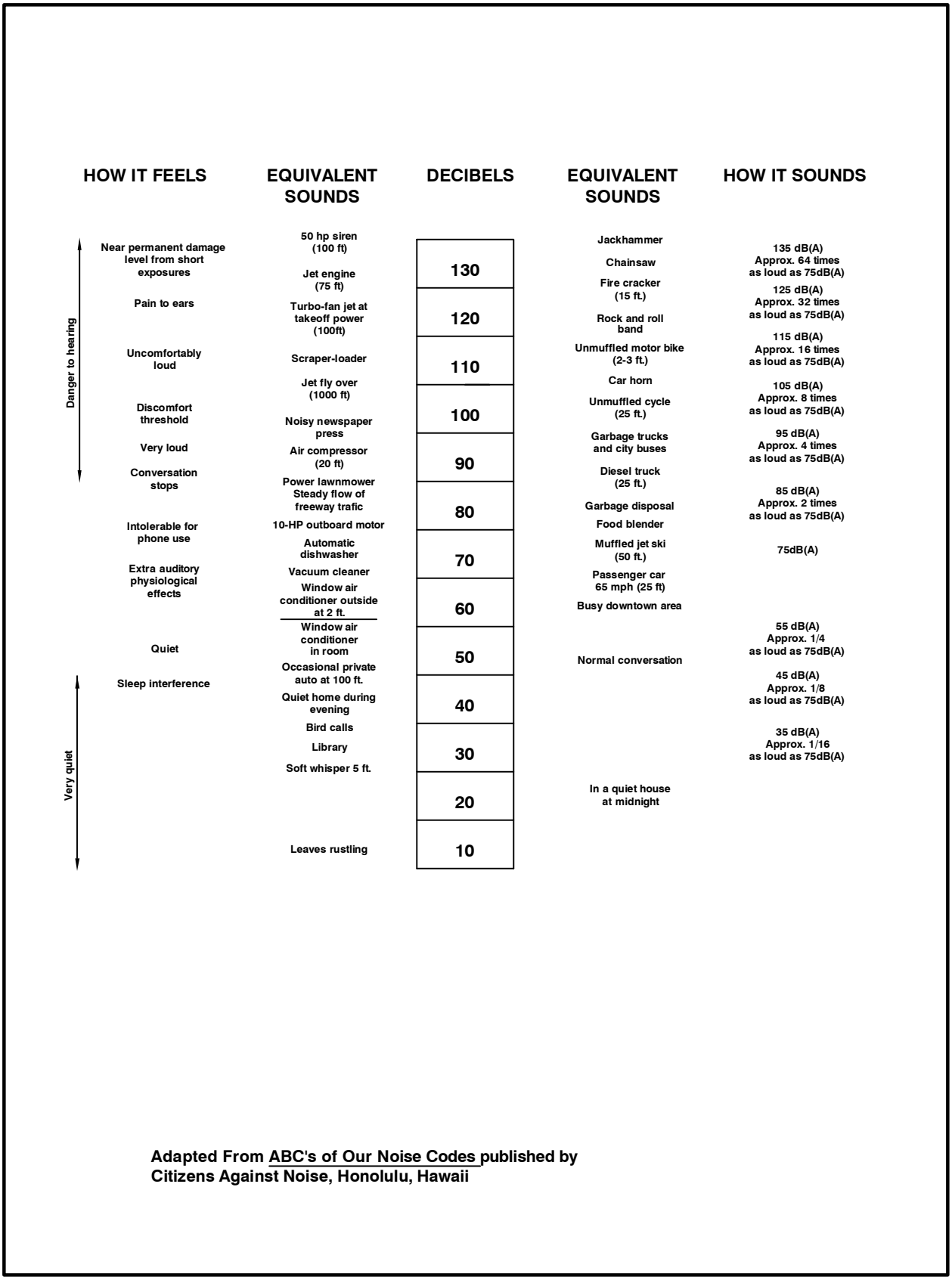


Figure 3-52. Relationship Between A-Scale Decibel Readings and Sounds of Daily Life.

designates that a 24-hour equivalent level of less than 70 dBA prevents hearing loss and that a level below 55 dBA, in general, does not constitute an adverse impact (EPA 1974).

Figures 3-9 through 3-11 depict the occupied residences and active businesses located within 3 miles of the North, South, and West Hilight Field LBA Tracts, respectively. Figure 3-14 depicts the occupied residences and active businesses within 3 miles of the West Jacobs Ranch LBA Tract. Figures 3-17 and 3-18 depict the locations of active businesses (no occupied residences exist) within 3 miles of the North Porcupine and South Porcupine LBA Tracts, respectively. The distances from each LBA tract to the nearest occupied dwelling are given in Table 3-22.

3.14.2 Environmental Consequences

3.14.2.1 Proposed Action and Alternatives 2 and 3

Noise levels on the LBA tracts would be increased considerably by mining activities such as blasting, loading, hauling, and possibly in-pit crushing. The BNSF & UP rail line currently borders and/or traverses all six LBA tracts; therefore, rail traffic noise on the tracts would continue to be proportionate to the rate of coal production from the PRB mines in the future. Due to the remoteness of the LBA tracts and because mining is already ongoing in the area, noise would have few off-site impacts.

A noise level below 55 dBA does not constitute an adverse impact (EPA 1974). Any occupied dwelling within 2,500 feet of active mining (particularly blasting) would experience adverse noise impacts. If the tracts are leased under Alternative 2, BLM's preferred alternative for each tract, the potential blasting related noise impacts associated with mining are presented in Table 3-21. The five occupied dwellings that are located within the tracts (two within the North Hilight Field LBA Tract and three within the West Jacobs Ranch tract) would be vacated prior to advancing mining activities. No occupied dwellings would experience adverse noise impacts from mining activities if the South Hilight Field, West Hilight Field, North Porcupine, and South Porcupine LBA Tracts are leased as applied for or under Alternative 2. The two occupied dwellings that are located immediately adjacent to the North Hilight Field tract (Figure 3-9), would experience adverse noise impacts if mining activities (particularly blasting) occur within 2,500 feet of them.

Wildlife in the immediate vicinity of mining may be adversely affected; however, anecdotal observations at surface coal mines in the area indicate that some wildlife may adapt to increased noise associated with coal mining activity. Guidelines were developed by the FS to prevent or limit noise impacts to wildlife on the TBNG, which include the following:

Table 3-22. Noise Impacts Associated with Mine Blasting on the Wright Area LBA Tracts.

LBA Tract[1]	Number of Dwellings Within 3 Miles		Number of Dwellings Within 2,500 Feet		Distance to Closest Dwelling (feet)	Max Noise Level to Closest (dBA)	Potential Impact[3]
	Single Family	Multiple Residences[2]	Single Family	Multiple Residences[2]			
North Hilight Field	20	2	4[5]	0	0	123.0	I
South Hilight Field	1	0	0	0	15,840	39.0	N
West Hilight Field	8	2[4]	0	0	5,280	48.5	N
West Jacobs Ranch	29	2[4]	[6]	0	0	123.0	I
North Porcupine	0	0	0	0	--	--	N
South Porcupine	0	0	0	0	--	--	N

[1] Configured under Alternative 2, BLM's preferred alternative.
[2] Multiple occupied residences and/or businesses exist closely together.
[3] I: Impacts anticipated.
N: No impact anticipated (24-hour equivalent level of less than 55 dBA).
[4] Includes the developed area around the town of Wright.
[5] Two residences are located within the LBA tract and two are located adjacent to the LBA tract.
[6] All three residences are located within the LBA tract.

- To help prevent reproductive failure, limit noise on sage-grouse display grounds from nearby facilities and activities to 49 dBA (10 dBA above background noise) from March 1 to June 15.

- Prohibit development or operations of facilities within 2 miles of a sage-grouse display ground if these activities would exceed a noise level of more than 10 dBA above the background noise level (39 dBA), at 800 feet from the source, from March 1 to June 15.

The occurrence of sage-grouse within the 2-mile wildlife study areas for each of the Wright area LBA tracts, and the effects of mining the proposed lease areas are discussed in Section 3.10.5 and Appendix H of this EIS. Two of the currently occupied sage-grouse leks that have been documented within the six combined wildlife survey areas are located on the BLM study areas for the North Hilight Field and North Porcupine LBA Tracts and are therefore likely to be directly impacted if these two tracts are leased and mined under the Proposed Action and/or Alternative 2, BLM's preferred alternative. Noise impacts to those two leks (Hansen Lakes and Payne) would occur prior to surface disturbance of the display grounds by mining operations (topsoil salvage). The only other currently occupied leks in the general Wright analysis area (Kort I and Kort II) are located roughly 1.5 miles southeast of the North Porcupine LBA Tract and would therefore likely experience noise impacts from blasting if the tract is leased and mined. However, active mining operations at the North Antelope Rochelle Mine are presently closer to these two active leks than the boundary of the North Porcupine LBA Tract. All other leks that have been documented in the general Wright analysis area are currently classified as either unoccupied or undetermined and will probably not be re-occupied due to the presence of nearby CBNG development and/or mining activities.

After mining and reclamation are completed, noise would return to premining levels.

3.14.2.2 No Action Alternative

Under the No Action Alternative, the North Hilight Field, South Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine coal lease applications would be rejected and coal removal and associated noise would not occur on the portions of the LBA tracts as applied for or the LBA tracts configured under Alternative 2 that will not be disturbed under the currently approved surface coal mining permits. Coal removal and the associated noise would continue on the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle Mine coal leases. Noise impacts related to mining operations at these mines would not be extended onto portions of the LBA tracts that will not be affected under the current mining and reclamation plans.

As discussed in Section 2.2, a decision to reject one or more of these six coal lease applications at this time would not preclude an application to lease that respective tract in the future.

3.14.3 Regulatory Compliance, Mitigation and Monitoring

Mine operators are required to comply with Mine Safety and Health Administration (MSHA) regulations concerning noise, which include protecting employees from hearing loss associated with noise levels at the mines. MSHA periodically conducts mine inspections to ensure compliance with the requirements of the Federal Mine Safety and Health Act of 1977.

3.14.4 Residual Impacts

No residual impacts to noise are expected.

3.15 Transportation

3.15.1 Affected Environment

Transportation resources within the general Wright analysis area include State Highways 450 and 59, numerous improved two-lane county roads, several improved and unimproved local roads and accesses, numerous two-track trails, the Gillette-Douglas rail line used jointly by BNSF & UP Railroads, mine railroad spurs, oil and gas pipelines, utility/power lines, telephone lines, and associated ROWs. Figures 3-53 through 3-55 depict the current transportation facilities, excluding pipelines, within and near the North, South, and, West Hilight Field LBA Tracts, the West Jacobs Ranch LBA Tract, and the North and South Porcupine LBA Tracts, respectively. Figure 3-56 through 3-58 depict the existing pipelines (oil, gas and water) within and near the North, South, and, West Hilight Field LBA Tracts, the West Jacobs Ranch LBA Tract, and the North and South Porcupine LBA Tracts, respectively.

The highways and improved county roads provide public and private access within the general Wright analysis area. State Highway 59, a paved two-lane highway located west of all six LBA tracts, is the major north-south transportation corridor, while State Highway 450, also a paved two-lane highway, is the principal east-west transportation corridor. Other paved county roads, including Hilight Road (Campbell County Road 52), Edwards Road (Campbell County Road 30), Reno Road (Campbell County Road 83), and Antelope Road (Campbell County Road 4), are also major public transportation routes. There are numerous other improved county roads, including Shroyer Road (Campbell County Road 116), Matheson Road (Campbell County Road 70), Mackey Road (Campbell County Road 69), and Keeline Road (Campbell County Road 62). Access to the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines, as well as the LBA tracts included in this analysis, is primarily from the west (from Highway 59) via State Highway 450 or the Edwards/Reno Road. Hilight Road and Antelope Road are the major north-south public transportation corridors closest to the applicant mines. Some improved county roads within active mine permit areas have been vacated by the Campbell County Commissioners (i.e., Jacobs Road and Small Road) and are therefore no longer accessible to the general public. Unimproved local

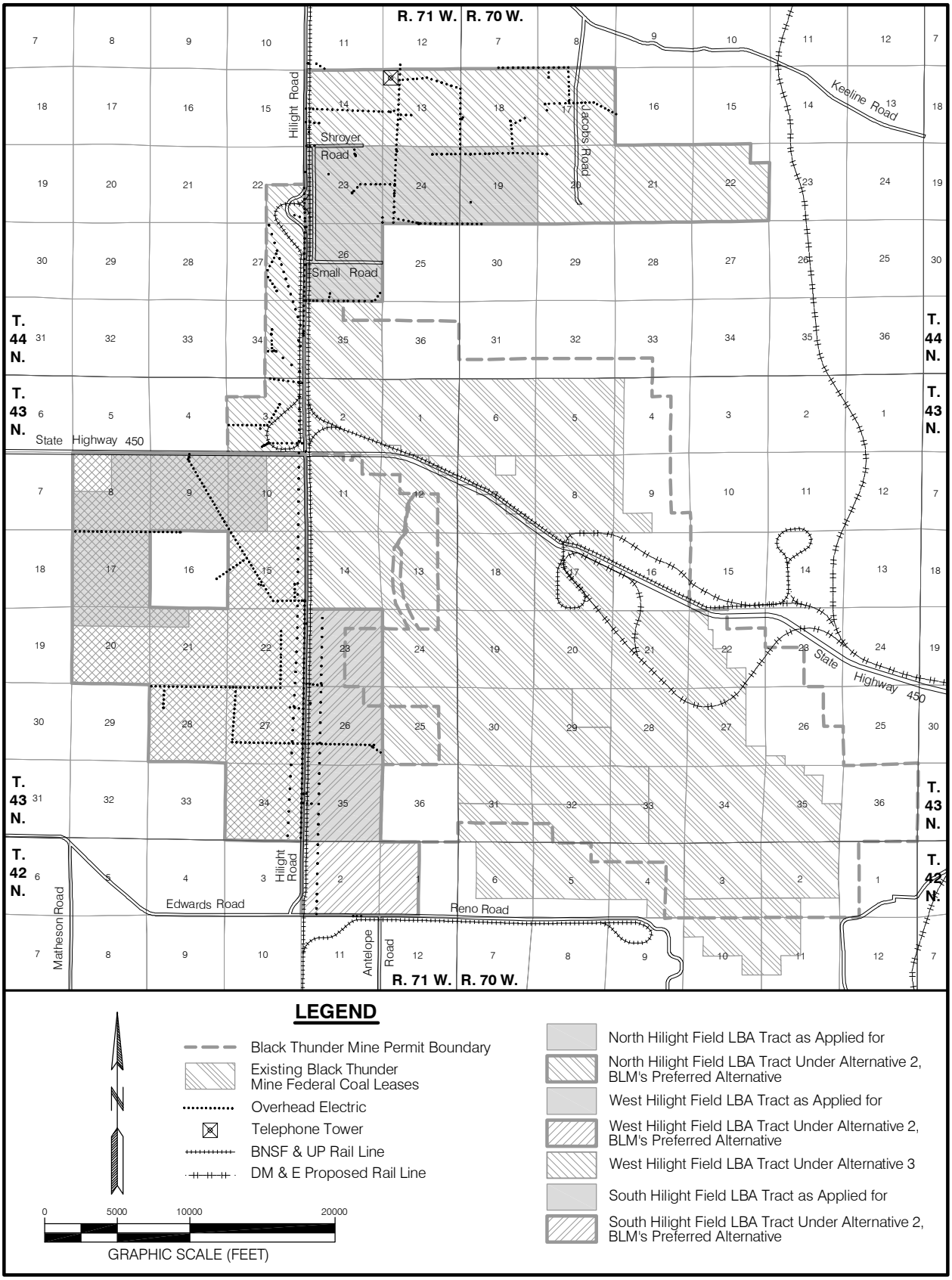


Figure 3-53. Transportation Facilities Within and Adjacent to the North, South, and West Hilight Field LBA Tracts.

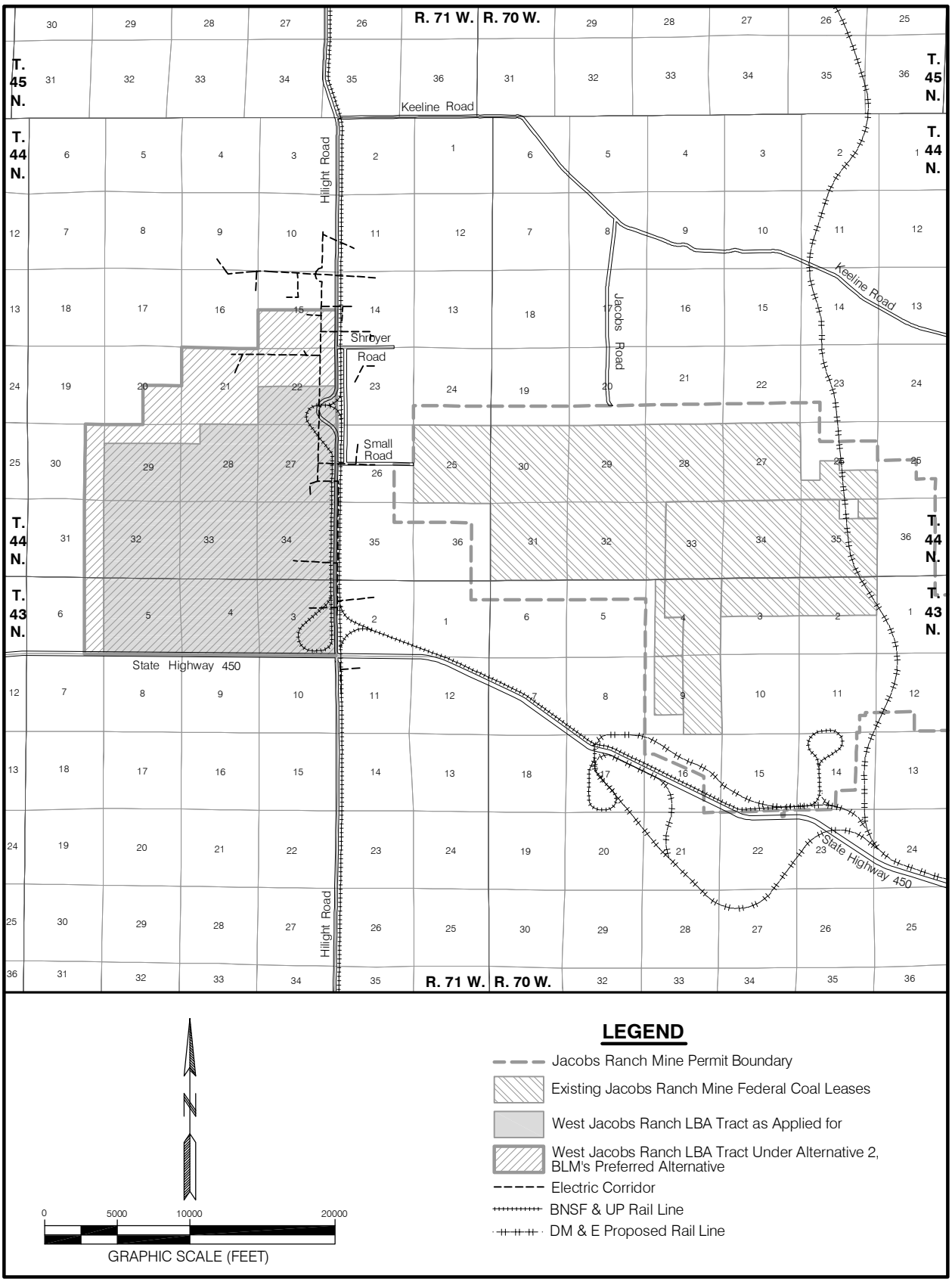


Figure 3-54. Transportation Facilities Within and Adjacent to the West Jacobs Ranch LBA Tract.

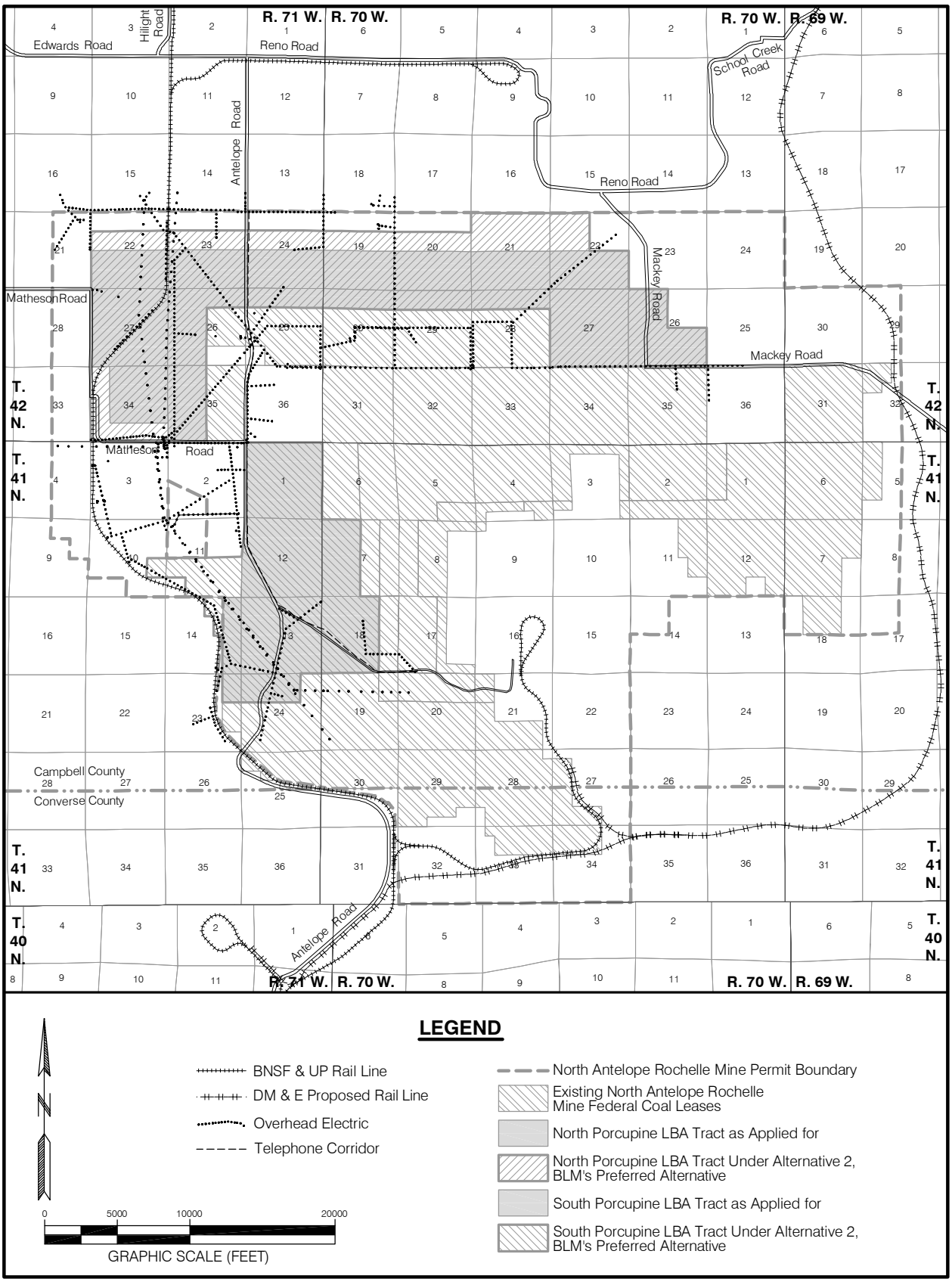


Figure 3-55. Transportation Facilities Within and Adjacent to the North and South Porcupine LBA Tracts.

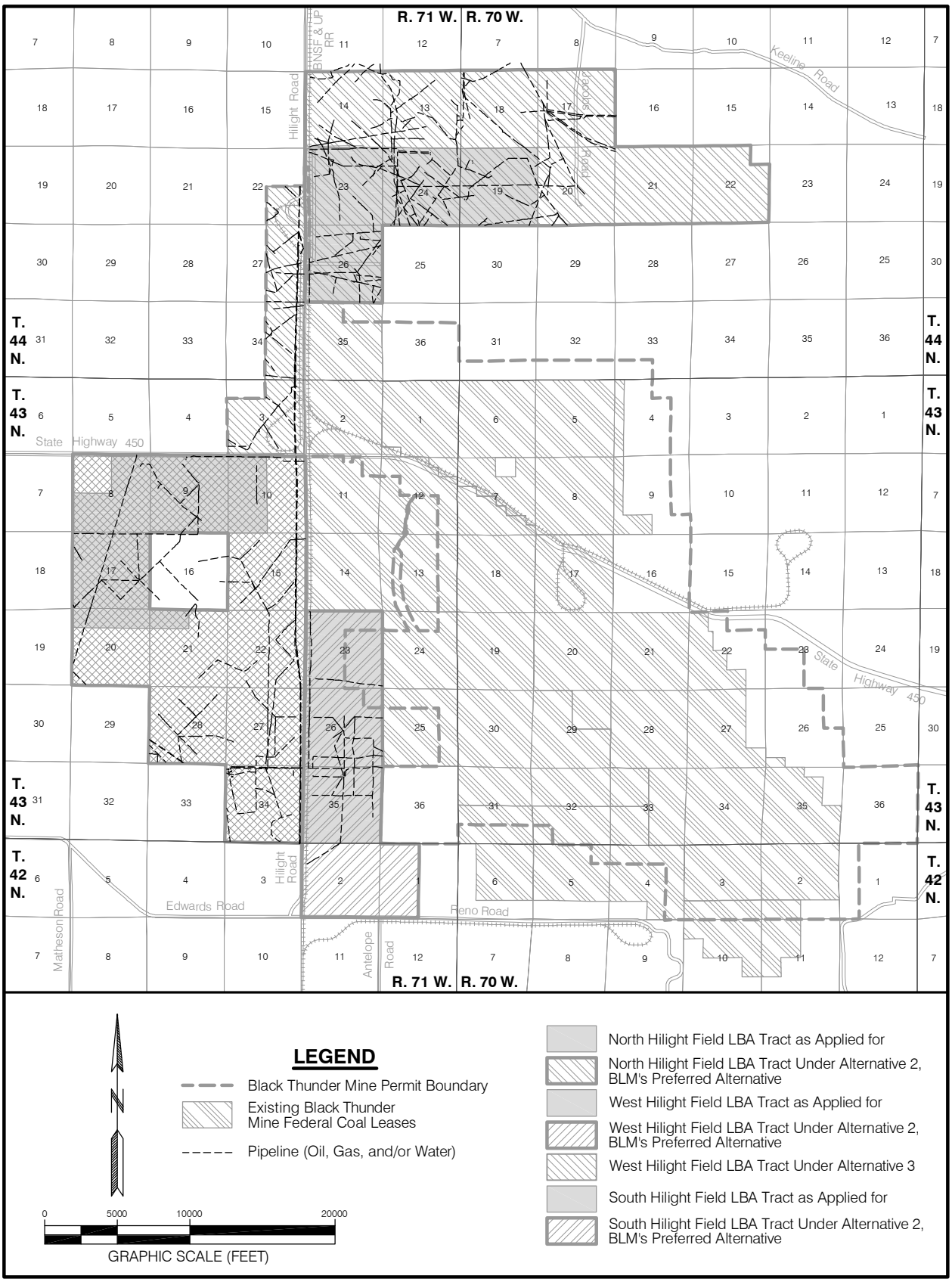


Figure 3-56. Pipelines Within and Adjacent to the North, South, and West Hilight Field LBA Tracts.

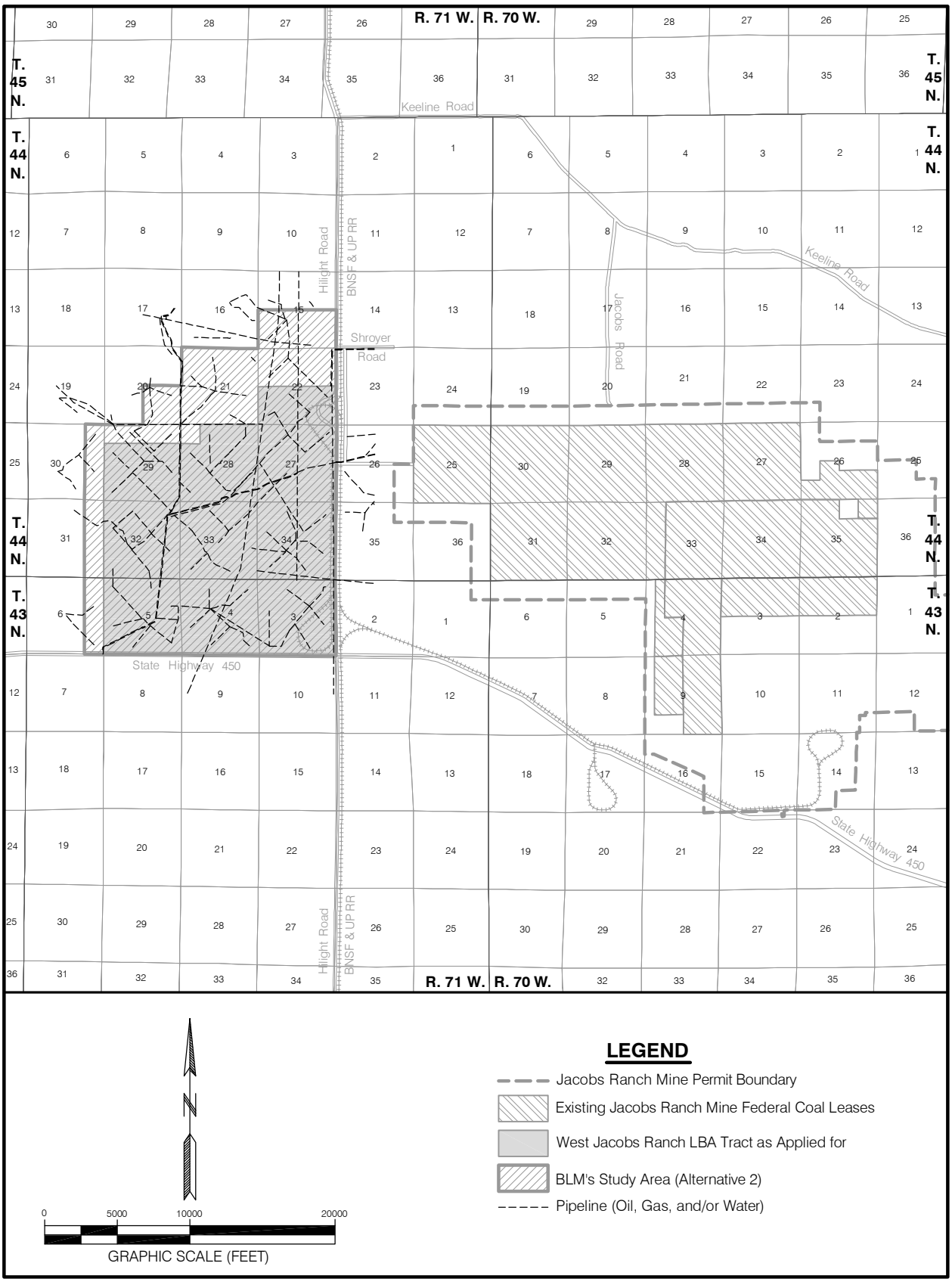


Figure 3-57. Pipelines Within and Adjacent to the West Jacobs Ranch LBA Tract.

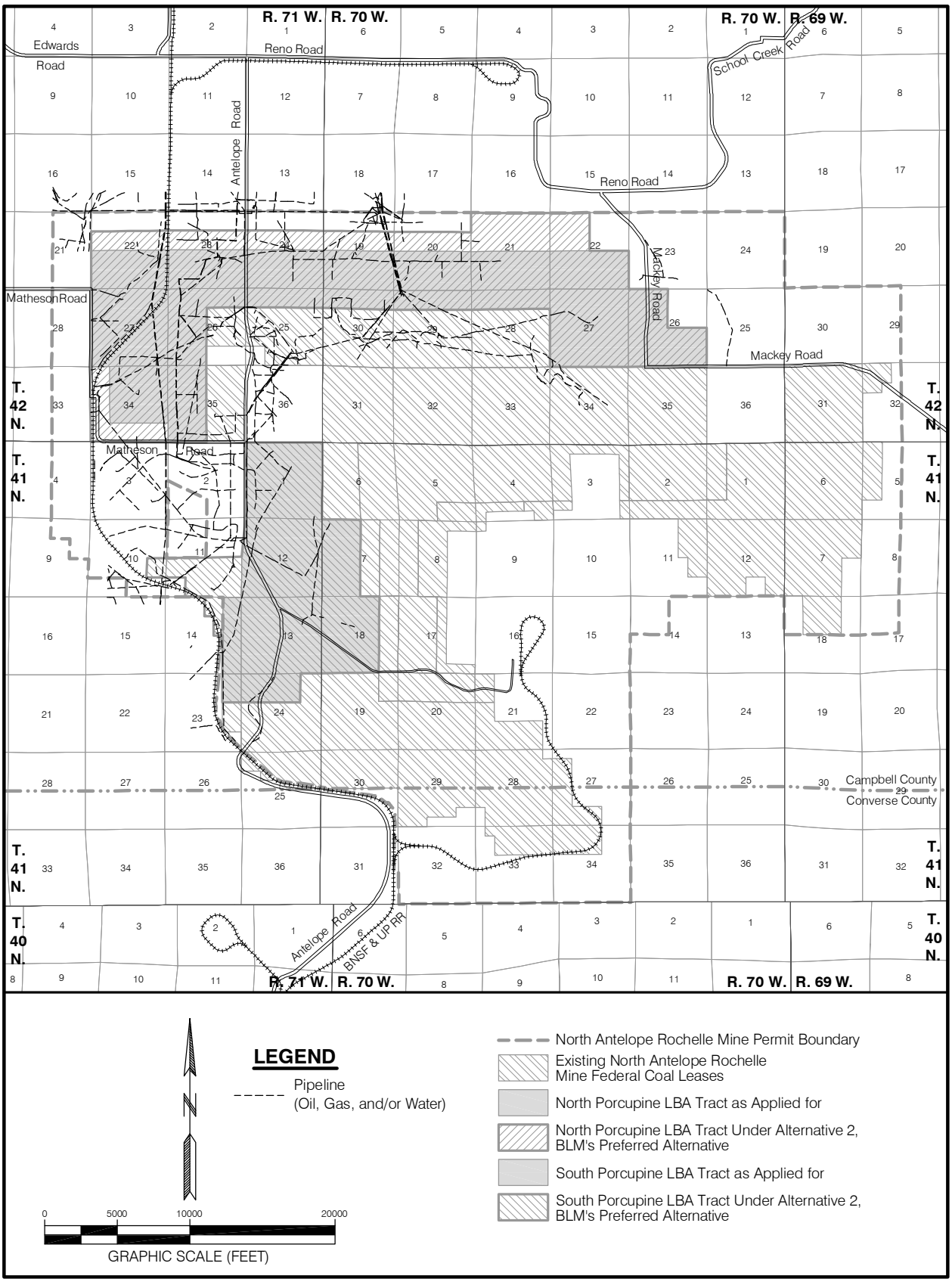


Figure 3-58. Pipelines Within and Adjacent to the North and South Porcupine LBA Tracts.

roads and accesses in the area are primarily for private use or public access to federal lands.

The general Wright analysis area presently has one major railroad. The BNSF & UP Gillette-Douglas rail line runs north-south along the eastern edge of the PRB, roughly parallel to and east of State Highway 59. The coal mines located north of Gillette ship most of their coal via the east-west BNSF rail line that runs through Gillette for destinations in the Midwest. The coal mines located south of Gillette and Wright ship most of their coal via the Gillette-Douglas BNSF & UP joint trackage that runs south through Campbell and Converse counties and then east over separate BNSF and UP mainlines for destinations in the Midwest. Individual spur lines connect each mine to the BNSF track or the joint BNSF & UP track.

The Dakota, Minnesota and Eastern (DM&E) Railroad has proposed an expansion into the PRB of Wyoming. If constructed, the DM&E Expansion Project would be the largest railroad construction project in the United States in the last 100 years (Sheridan Press 2006). If constructed as proposed, the DM&E railroad would provide additional rail capacity for those mines located south of Gillette. The Surface Transportation Board (STB) completed an EIS and gave final approval to the project in 2002. However, in response to a successful appeal, the 8th Circuit Court of Appeals directed the STB to give further consideration to four environmental issues that were raised. The STB issued a Final Supplemental EIS (SEIS) on the expansion project December 30, 2005, which addressed the four issues that were remanded back to the STB with input from various federal agencies, Tribes, organizations, environmental groups, businesses, and members of the general public (STB 2006). The issue-driven alignment has been determined and the DM&E rail line would potentially be in a position to haul coal produced by the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines. The STB granted final approval to construct the rail line on February 15, 2006. The Final SEIS was also appealed, but was upheld by the U.S. Court of Appeals for the Eighth Circuit in December 2006. In early September 2007, Canadian Pacific Railway Ltd announced the acquisition of DM&E and its subsidiaries (MSNBC 2007). The transaction was approved by STB on September 29, 2008.

3.15.2 Environmental Consequences

3.15.2.1 Proposed Action and Alternatives 2 and 3

Essentially all of the coal mined on the LBA tracts would be transported by rail system. Since the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts would be an extension of the operating applicant mines, the existing rail facilities and infrastructure would be used during mining of the proposed lease areas. BNSF & UP have upgraded and will continue to upgrade their rail capacities to handle the increasing coal volume projected from the PRB, with or without the leasing of the North Hilight Field, South Hilight Field, West Hilight Field, West

Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts. The construction of the proposed DM&E Railroad expansion into this area is not dependent on leasing one or more of the six LBA tracts.

As discussed in Chapters 1 and 2, some of the coal included in each of the six LBA tracts under both the Proposed Action and Alternative 2, BLM's preferred tract configuration, is overlain by portions of various public roads. SMCRA prohibits mining within 100 feet of the outside ROW line of any public road unless the appropriate public road authority allows the road to be relocated or closed after public notice, an opportunity for a public hearing, and a finding that the interests of the affected public and landowners will be protected [30 CFR 761.11(d)]. As a result, the coal underlying the public road ROWs and adjacent buffer zones has been determined to be unsuitable for mining according to coal leasing Unsuitability Criterion Number 3 [43 CFR 3461(c)]. The coal underlying portions of State Highway 450, Antelope Road, Hilight Road, Reno Road, Shroyer Road, Mackey Road, and Matheson Road is included in the LBA tracts being considered for leasing because the coal under the roads could be mined if the authorized public road authorities determine that the roads could be abandoned or relocated [see 43 CFR 3461.5(c)(2)(iii) and discussions in Section 2.1]. If the roads are not moved, including the coal underlying the public roads in the leases would allow maximum recovery of all the mineable coal adjacent to the road ROWs and buffer zones (100 feet on either side of the road ROW).

Stipulations stating that no mining activity may be conducted in the portion(s) of the lease within the public road ROW(s) and buffer zone(s) unless the authorized public road authorities determine that the road(s) could be abandoned or relocated will be attached if a lease is issued for an LBA tract. The exclusion from mining by lease stipulation honors the finding of unsuitability under Unsuitability Criterion Number 3. All mining related road abandonment and relocation option plans would be reviewed and approved by the Campbell County Board of Commissioners (for the Campbell County roads) and/or the Wyoming Department of Transportation (for State Highway 450) prior to road abandonment and relocation

Vehicular traffic to and from the mines would continue at existing or slightly higher levels for an extended period of time, depending on which LBA tracts are leased and which alternatives are selected.

Pipelines and utility/power transmission lines currently cross the LBA tracts. If the tracts are leased and proposed for mining, these pipelines and utility/power lines would have to be removed and relocated if they are currently active. Any relocation of these pipelines and utility lines would be handled according to specific agreements between the coal lessee and the pipeline and utility owners, if the need arises. There would be additional surface disturbance associated with construction when pipeline is relocated.

3.15.2.2 No Action Alternative

Under the No Action Alternative, the North Hilight Field, South Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine coal lease applications would be rejected and coal removal and associated effects to transportation resources would not occur on the portions of the LBA tracts as applied for or the LBA tracts configured under Alternative 2 that will not be disturbed under the currently approved surface coal mining permits. Coal removal and any associated impacts to transportation resources would continue on the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle Mine coal leases. Impacts to transportation resources related to mining operations at these mines would not be extended onto portions of the LBA tracts that will not be affected under the current mining and reclamation plans.

As discussed in Section 2.2, a decision to reject one or more of these six coal lease applications at this time would not preclude an application to lease that respective tract in the future.

3.15.3 Regulatory Compliance, Mitigation and Monitoring

The regulatory requirements regarding transportation facilities require that no public road be relocated unless the appropriate public road authority allows the road to be relocated or closed, and that existing pipelines and utility lines be relocated, if necessary, in accordance with specific agreements between the coal lessee and the pipeline and utility owners.

3.15.4 Residual Impacts

No residual impacts to transportation facilities are expected.

3.15.4.1 Coal Loss During Rail Transport

There are potential impacts from sifting and blowing coal dust and fines coming off freshly loaded, moving rail cars, which can accumulate along rail beds, railroad ROWs, and on adjacent lands. Coal dust can be washed into adjacent drainages where it accumulates. Accumulated coal dust has been linked to train derailments and can also spontaneously combust and cause rangeland wildfires.

With the opening of the PRB coal field in Wyoming in the late 1970s, U.S. coal shipments have grown dramatically from 4.8 million carloads back then to 8.4 million carloads in 2006 as the railroads deliver low sulfur coal to help electric utilities achieve Clean Air Standards (FRA 2008). The largest rail coal movements are from the PRB to generating power plants in Illinois, Missouri, and Texas (FRA 2008).

According to the 2001 Final EIS for the DM&E PRB Expansion Project, a 1996 study conducted in Virginia on metallurgical coal (which is finely crushed and has a low moisture content) indicated that 400 to 800 pounds of coal dust and fines are typically lost per rail car over a 500-mile trip (STB 2001). Although PRB coal is generally transported with larger particles sizes and is higher in moisture content, which reduces the amount of coal dust blowing off of moving rail cars (STB 2001), it is generally accepted that coal dust is accumulating along the rail lines, especially in the first portion of the journey as the loaded coal trains leave the mines (UPRR 2005).

Coal can be lost from rail cars through dust and fines sifting from the rail car discharge doors, spillage over the rail car sides, and by being blown from rail car tops during transit. In testing conducted by BNSF & UP Railroad and the National Coal Transportation Association (NCTA), the average loss of coal from an individual rail car's rapid discharge doors was about 19 pounds per 216 miles, or 0.09 pounds per mile (NCTA 2007). The same testing indicated that an average of 225 pounds of coal was lost from the top of a coal car through either top spillage or being blown off during a 567 mile test trip, which equated to about 0.40 pounds per mile (NCTA 2007).

The derailment of two trains in the PRB in 2005 resulted from track instability problems caused by a buildup of coal dust and other particles on the rail bed in combination with high concentrations of moisture (UPRR 2005). BNSF railway officials toured the PRB rail infrastructure in June, 2007. According to a BNSF official, when coal dust is blown off rail cars, it gets lodged in the rail bed, allowing moisture to intrude. The moisture then degrades the structural stability of the rail bed and leaves the rail more vulnerable to buckling under stress (Gillette News-Record 2007a). NCTA testing results suggested that rail car bottom spillage may have more of a negative impact on rail ballast stability than loss from the top of rail cars since the leakage is directly above and near the ballast. NCTA testing also showed that after the rapid discharge doors were adjusted, there was a 32 percent decrease in bottom spillage of coal (NCTA 2007).

Accumulating coal dust and deposition has become a concern in Converse County, Wyoming. The majority of coal mined in the PBR travels through Converse County on railroads. Coal dust blows off and sifts from the freshly loaded coal cars on their way from the PRB mine load-outs to Bill, Wyoming and through Converse County (Casper Star Tribune 2007). The Converse County Board of Commissioners is concerned with the coal dust piles that have accumulated in the county from coal being transported by rail.

Spontaneous combustion of accumulated coal dust can cause rangeland fires. Smoldering coal dust within a railroad right-of-way can ignite a wildfire and quickly spread to surrounding private lands if the fire is not immediately controlled. The Douglas, Wyoming Volunteer Fire Department Chief, Rick Andrews, estimates that coal fires account for at least 50 percent of the department's average summer call volume (Casper Star Tribune 2007). Water

often only temporarily extinguishes the flames and some fires repeatedly ignite over the course of several hours or days. While the county's rural fire district is compensated for some of the costs involved in putting out fires caused by coal dust accumulation, the compensation doesn't come close to the actual costs, according to the Douglas Volunteer Fire Department Chief. Coal fires along the railroad tracks are an ongoing problem for the Douglas Volunteer Fire Department (Casper Star Tribune 2007).

BLM was invited by a Converse County private land owner to examine and survey the coal deposition that has occurred from coal trains traveling through his land. On July 7, 2008, BLM personnel met with the private landowner and toured his rangeland adjacent to the railroad ROW between Bill and Douglas, Wyoming. It was observed that water runoff had washed lost coal from the rail bed into adjacent drainages and the amount of deposition varied along the railroad ROW. BLM surveyed coal accumulations in Box Creek, and one area was found to have an accumulation 1.8 feet thick (BLM 2008e).

In an effort to reduce the amount of small particles that are created in the coal crushing process, BNSF is encouraging the utility companies and the mines to not crush as finely (i.e., crushing to 3-inch diameter rather than 2-inch diameter) (Gillette News-Record 2007a). Another possibility that may help lessen blowing coal dust from trains is the use of a surfactant applied to the tops of loaded coal cars. When applied to coal, surfactant can stabilize and adhere fines and dust to larger pieces. Some tests have shown that coal dust on railroad tracks can be reduced by up to 95 percent with surfactant use (Gillette News-Record 2007a). In order for a surfactant to be used, it would need to meet utility companies' burning specifications.

A collaborative effort between the NCTA, PRB mines, and BNSF and UP railroads has resulted in an improved design for a coal loading chute that distributes coal more evenly and produces a lower profile load (UPRR 2006). Preliminary results have demonstrated that this new design may result in a 30 to 60 percent reduction in coal dust blowing off the top of cars during the early portion of the route (UPRR 2006). The collaborative team is also analyzing the value of crushing the coal to a 3-inch diameter rather than 2-inch diameter to reduce dust and fines sifting through the bottom gates of rail cars, and using a surfactant applied to the top of the load to reduce coal dust emissions (UPRR 2006).

Converse County Commissioners have formally expressed concerns to BLM in regard to fire, health, and safety issues associated with blowing coal dust from trains. The Commissioners have stated that the health and well-being of Converse County citizens downwind of the railroad tracks continue to be jeopardized due to lack of coal dust mitigation in the coal mining permit process (BLM 2008f). The Converse County Commissioners have urged that coal dust mitigation be applied as a standard condition of approval upfront in the mining permit (BLM 2008f).

BLM does not authorize mining permits nor regulate mining operations with the issuance of a BLM coal lease. WDEQ is the agency that permits mining operations and has authority to enforce mining regulations. In Wyoming, WDEQ has entered into a cooperative agreement with the Secretary of the Interior to regulate surface coal mining operations. Mitigation and other requirements are developed as part of the mining and reclamation permit. These must be approved by WDEQ before mining operations can occur on leased federal coal lands.

Other agencies that may be stakeholders in this issue include the Federal Railroad Administration, which implements U.S. Department of Transportation environmental policies related to U.S. railroads, and the NCTA whose mission includes facilitating the resolution of coal transportation issues in order to serve the needs of the general public and industry (NCTA 2008).

The leasing and mining of these six LBA tracts would not increase the rate of buildup of coal dust and fines but would prolong the issue.

3.16 Hazardous and Solid Waste

3.16.1 Affected Environment

Potential sources of hazardous or solid waste on the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts would include spilled, leaked or dumped hazardous substances, petroleum products, and/or solid waste associated with coal and oil and gas exploration, oil and gas development, the BNSF & UP railroad, utility line installation and maintenance, or agricultural activities. No such hazardous or solid wastes are known to be present on any of the six LBA tracts. Wastes produced by current mining activities at the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines are handled according to the procedures described in Section 2.9.

3.16.2 Environmental Consequences

3.16.2.1 Proposed Action and Alternatives 2 and 3

If the applicant mines acquire the six LBA tracts, the wastes that would be generated in the course of mining the tracts would be similar to those currently being generated by the existing mining operations. The procedures that are used for handling hazardous and solid wastes at the existing mines are described in Chapter 2, Section 2.9. Wastes generated by mining the LBA tracts would be handled in accordance with the existing regulations using the procedures currently in use and in accordance with WDEQ-approved waste disposal plans at the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines.

3.16.2.2 No Action Alternative

Under the No Action Alternative, the North Hilight Field, South Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine coal lease applications would be rejected and coal removal and associated disturbance and impacts would not occur on the portions of the LBA tracts as applied for or the LBA tracts configured under Alternative 2, BLM's preferred alternative, that will not be disturbed under the currently approved surface coal mining permits. Coal removal and any associated waste production would continue on the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle Mine coal leases. Impacts from mining operations at these mines would not be extended onto portions of the LBA tracts that will not be affected under the current mining and reclamation plans, and no waste materials would be generated as a result of coal removal on the tracts.

As discussed in Section 2.2, a decision to reject one or more of these six coal lease applications at this time would not preclude an application to lease that respective tract in the future.

3.16.3 Regulatory Compliance, Mitigation and Monitoring

The regulatory requirements regarding production, use, and/or disposal of hazardous or extremely hazardous materials are discussed in Chapter 2. All mining activities involving the hazardous materials are and would continue to be conducted so as to minimize potential environmental impacts.

3.16.4 Residual Impacts

No residual hazardous and solid waste impacts are expected.

3.17 Socioeconomics

The social and economic study area for the proposed project includes Campbell County and the communities of Wright and Gillette, Wyoming. These two communities are home to a majority of the three applicant mines' current workforce, as well as most of the mining services, retail and business and consumer service establishments in the area. Gillette, the county seat, would most likely attract the majority of any new residents due to its current population levels and the availability of services, shopping amenities, and educational institutions.

3.17.1 Local Economy

3.17.1.1 Affected Environment

Wyoming's coal mines produced 449.1 million tons in 2007, a new annual production record, according to the Wyoming State Inspector of Mines. This was an increase of more than 9 percent over the 444.9 million tons produced in

2006; itself a record. PRB coal production (from Campbell and Converse counties, 13 active mines) was over 436.5 million tons in 2007, which represented over 97 percent of the statewide coal production (Wyoming Department of Employment 2006 and 2007a).

Approximately 27 percent of the November 2007 total employment in Campbell County and 40 percent of the second quarter 2007 total payroll was attributed to the natural resources and mining sector, which includes oil and gas employment (Wyoming Department of Employment 2007a and 2008a). In 2007, Campbell County employment grew at a similar rate compared to the statewide average (3.7 percent versus 3.6 percent change, respectively). Job growth occurred in construction, trade, manufacturing, transportation and utilities, and local government, but the most dramatic increase was in the manufacturing sector (Wyoming Department of Employment 2008b).

Revenues to the federal government from the leasing and production of federal coal include retention of one-half of the lease bonus bids and federal mineral royalties. Lease bonus bids are paid to the federal government for the right to enter into lease agreements for federal coal. Bonus bids are paid in five annual installments; the state receives half of each installment. In 2004 and 2005, BLM held competitive sealed-bid lease sales for six federal coal tracts in the PRB (NARO South, West Antelope, West Hay Creek, Little Thunder, West Roundup, and NARO North). No coal lease sales were held for federal coal tracts in the PRB in 2006 or 2007. Three lease sales (Eagle Butte West, South Maysdorf, and North Maysdorf) were held in 2008.

The successful bonus bids for the six lease sales held in 2004 and 2005 ranged from 30 cents per ton to 97 cents per ton and totaled $1.69 billion (BLM 2009). Annual bonus bid payments from the six lease sales totaled $338.2 million in 2007 (BLM 2008g). Combined with remaining bonus bid payments from lease sales held in previous years of $90.1 million, the annual bonus bid payment total for 2004 was $428.3 million, derived directly from federal coal in Campbell and Converse counties. The Wyoming Consensus Revenue Estimating Group (CREG) is projecting that coal lease bonus bid revenues to the state from federal coal in the PRB will be $169.8 million for fiscal years 2007, 2008, and 2009. Presently, the bonus bid revenues received by the state are allocated to fund capital construction for cities and towns, the state's highway fund, community colleges, and school capital construction (Wyoming CREG 2007).

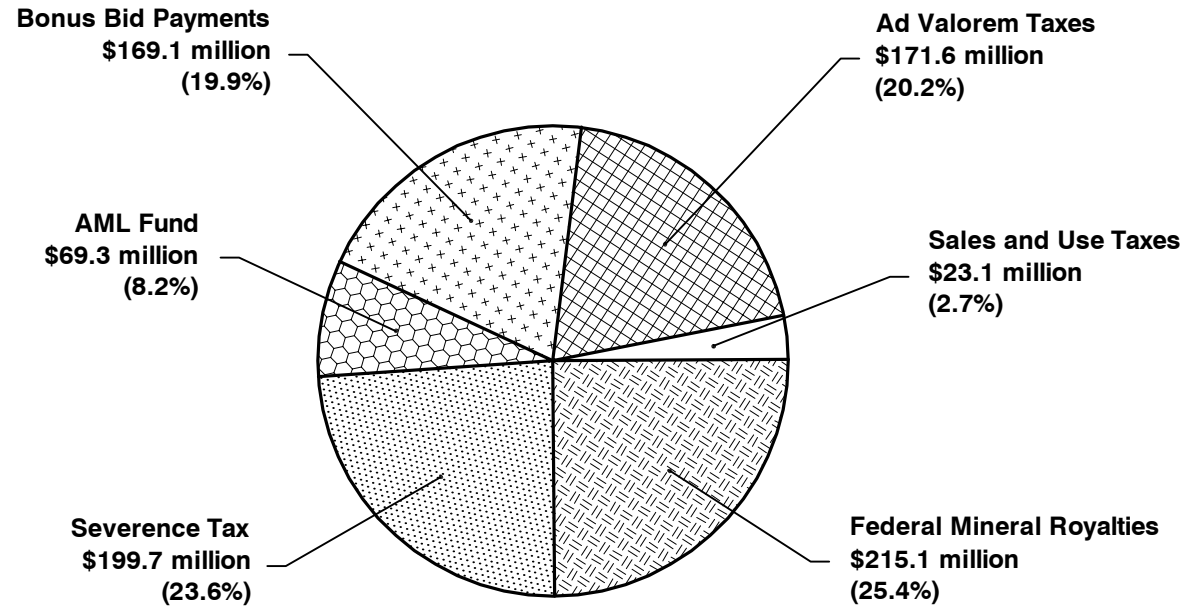
Wyoming, Campbell County, and the communities in the county receive revenue from a variety of taxes and royalties on the production of federal coal in addition to the bonus bids. These include ad valorem taxes, severance taxes, royalty payments, sales and use taxes on equipment and other taxable purchases, and portions of the required contributions to the federal Abandoned Mine Land (AML) program and the Black Lung Disability Trust Fund.

Federal mineral royalties are collected by the federal government at the time the produced coal is sold, with a royalty rate of 12.5 percent of the sale price. In the past, federal royalties and bonus bids had been divided equally with the State of Wyoming. A modification of the percentage distribution of federal royalties to 52 percent federal/48 percent state for fiscal year 2008 was attached to the Federal budget bill. The percentage of mineral royalty distribution will revert back to 50 percent/50 percent at the end of the 2008 fiscal year unless legislation is passed in the future to maintain or further modify the current percentage of distribution of royalties. Coal mines pay 28 cents per ton of surface coal produced to fund AML reclamation programs. Annual appropriations returned to the states vary depending on Congressional authorizations and AML program priorities. Additional sources of revenue include federal income tax and annual rentals that are paid to the government.

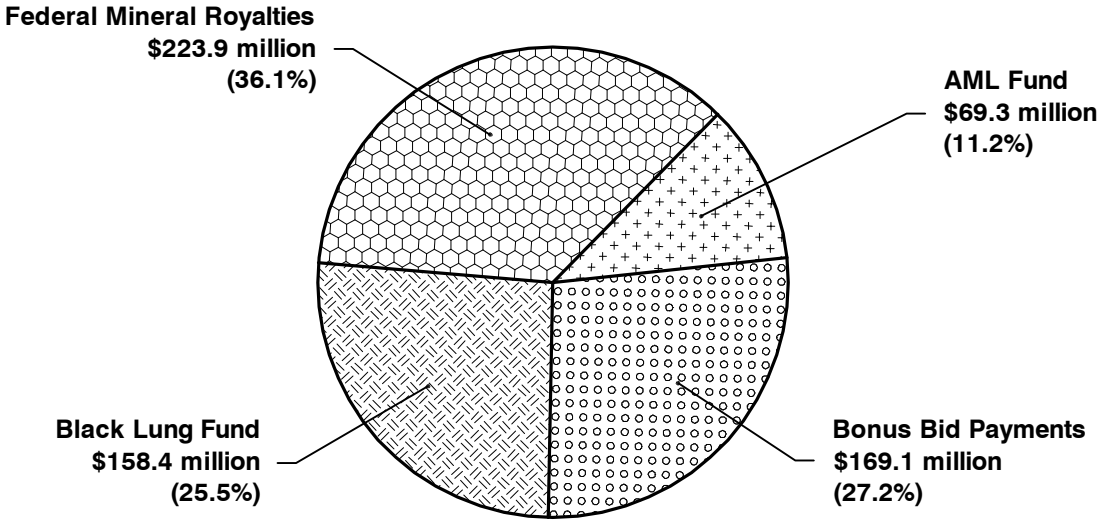
Sales and use taxes, which are levied by the state and local governments, are distributed to cities and towns within the county and to the county's general fund. Approximately 70 percent of the revenues generated from the statewide 4.0 percent levy are retained by the state, the remainder being distributed to the counties, cities and towns according to statutory formula. In addition, the Campbell County government imposes a 1.0 percent general purpose local option tax and a 0.25 percent specific county option tax. Sales and tax revenues are vital for local governments. According to the Excise Tax Division of the Wyoming Department of Revenue (2004), the sales and use taxes collected from coal mines and coal mining-related services in Campbell County in fiscal year (FY) 2004 was $8.2 million.

Ad valorem taxes comprise production and property taxes, with production taxes being far greater than property taxes for surface coal mines. Ad valorem taxes are collected by the county and disbursed to local governments and school districts that rely heavily on ad valorem taxes. Rising production and market values for oil and gas, and the increases in coal production tonnages have given rise to dramatic increases in the ad valorem tax bases of producing counties, particularly Campbell County. In 2005, Campbell County had an ad valorem tax base of $3.66 billion; more than 22 percent of the aggregate statewide assessed value on all real property and mineral production. The coal mining industry accounted for 59 percent of Campbell County's 2005 total assessed value (Wyoming Department of Revenue 2006 and Wyoming State Board of Equalization 2007).

In 1994, the University of Wyoming estimated that the total fiscal benefit to the State of Wyoming for coal produced in the PRB was $1.10 per ton (Borden et al. 1994). This study did not include AML fees or bonus bid payments in the calculation for fiscal benefits to the State of Wyoming. Calculating the estimated total fiscal benefit to the State of Wyoming in 2005 by including half of the bonus bid payments, half of the federal mineral royalties based on current prices, half of the AML fees, and all of the ad valorem taxes, severance taxes, and sales and use taxes for coal produced in Campbell County in 2005 results in an estimated $661 million, or $1.62 per ton. Figure 3-59 depicts the



Total Wyoming Revenue = $847.9 Million



Total Federal Revenue = $620.7 Million

Figure 3-59. Estimated Wyoming and Federal Revenues from 2007 Coal Production in Campbell County.

estimated total revenues to state and federal governments from 2007 coal production in Campbell County.

Recent (2004) Gross State Product (GSP) calculations for Wyoming indicate that the minerals industry (mining and oil and gas) accounted for about 21 percent of the state's total GSP of $24.1 billion, which made it the largest sector of the Wyoming economy. The contribution of mining was nearly twice that of government, the next largest sector, and more than three times the contribution of the real estate industry, the next largest private sector. Mining alone accounted for 8.3 percent of the Wyoming GSP (Wyoming Department of Administration and Information 2007).

3.17.1.2 Environmental Consequences

3.17.1.2.1 Proposed Action and Alternatives 2 and 3

The federal and state revenues that would be generated by the leasing and mining of these six LBA tracts would depend on which alternative for each tract is selected and the sale price of the coal. The Wyoming CREG forecasts all mineral revenues to the state, and is forecasting that the average gross sales prices for Wyoming coal production will range from $11.06 per ton in 2008 increasing to $12.50 per ton by 2011 (Wyoming CREG 2008). PRB coal prices are generally lower than prices for coal produced in other areas of Wyoming; however, most of the coal produced in Wyoming is from the PRB. For the purposes of this analysis, a conservative average sales price of $11.06 per ton is assumed for the coal included in the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts.

The projected federal and state revenues for each of the six Wright Area LBA Tracts presented in Table 3-23 are based on coal production tonnages shown in Tables 3-1 through 3-6, assuming an average coal price of $11.06 per ton and a potential range of bonus bid payments on the leased (mineable) coal of 30 to 97 cents per ton. As discussed in Section 3.0, the estimates of recoverable coal, associated mine life and employment assume that the public roads bordering or crossing the LBA tracts are not moved.

If the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts are leased and mined under the Proposed Actions or other action alternatives, potential state and federal revenues would vary by LBA tract as indicated below.

3.17.1.2.1.1 North Hilight Field LBA Tract

If this LBA tract is leased and mined under the Proposed Action, the potential additional federal revenues would range from approximately $390 million to $486 million. For the BLM's preferred alternative configuration under

Table 3-23. Projected Socioeconomic Impacts from Leasing the Wright Area LBA Tracts Under the Proposed Action and Alternatives 2 and 3.

LBA Tract and Item	No Action Alternative/ Existing Mine	Proposed Action	Alternatives 2 and 3
North Hilight Field			
State Revenues(mm)	$2,091.2	$488.5 to $584.4	$1,210.5 to $1,448.3
Federal Revenues(mm)	$1,629.4	$390.1 to $486.0	$966.8 to $1,204.5
Increased Mine Life (yrs)	0	2.0	4.8
Additional Employees	0	0	0
South Hilight Field			
State Revenues(mm)	$2,091.2	$396.1 to $473.9	$564.3 to $675.1
Federal Revenues(mm)	$1,629.4	$316.3 to $394.1	$450.7 to $561.5
Increased Mine Life (yrs)	0	1.6	2.3
Additional Employees	0	0	0
West Hilight Field			
State Revenues(mm)	$2,091.2	$700.8 to $838.4	$1,789.9 to $2,141.3
Federal Revenues(mm)	$1,629.4	$559.7 to $697.3	$1,429.4 to $1,780.8
Increased Mine Life (yrs)	0	2.8	7.1
Additional Employees	0	0	0
West Jacobs Ranch			
State Revenues(mm)	$715.4	$1,244.1 to $1,493.4	$1,695.6 to $2,035.3
Federal Revenues(mm)	$557.5	$994.1 to $1,243.3	$1,354.8 to $1,694.5
Increased Mine Life (yrs)	0	16.7	22.8
Additional Employees	0	155	155
North Porcupine			
State Revenues(mm)	$1,744.5	$1,114.9 to $1,333.8	$1,382.3 to $1,653.7
Federal Revenues(mm)	$1,359.3	$890.3 to $1,109.3	$1,103.9 to $1,375.3
Increased Mine Life (yrs)	0	6.3	7.8
Additional Employees	0	0	0
South Porcupine			
State Revenues(mm)	$1,744.5	$574.3 to $687.1	$629.2 to $752.7
Federal Revenues(mm)	$1,359.3	$458.6 to $571.4	$502.5 to $626.0
Increased Mine Life (yrs)	0	3.3	3.6
Additional Employees	0	0	0

Alternatives 2, the potential additional federal revenues would range from approximately $967 million to $1,205 million.

If the LBA tract is leased and mined under the Proposed Action, the potential additional state revenues would range from about $489 million to $585 million. For Alternative 2, BLM's preferred alternative, the potential additional state revenues would range from about $1,211 million to $1,448 million.

The base of economic activity provided by wages and local purchases would continue for up to about 4.8 additional years, depending on which alternative is selected.

3.17.1.2.1.2 South Hilight Field LBA Tract

If this LBA tract is leased and mined under the Proposed Action, the potential additional federal revenues would range from approximately $316 million to $394 million. For the BLM's preferred alternative configuration under Alternatives 2, the potential additional federal revenues would range from approximately $451 million to $562 million.

If the LBA tract is leased and mined under the Proposed Action, the potential additional state revenues would range from about $396 million to $474 million. For Alternative 2, BLM's preferred alternative, the potential additional state revenues would range from about $564 million to $675 million.

The base of economic activity provided by wages and local purchases would continue for up to about 2.3 additional years, depending on which alternative is selected.

3.17.1.2.1.3 West Hilight Field LBA Tract

If this LBA tract is leased and mined under the Proposed Action, the potential additional federal revenues would range from approximately $560 million to $697 million. For the BLM's preferred alternative configuration under Alternatives 2, the potential additional federal revenues would range from approximately $1,429 million to $1,781 million.

If the LBA tract is leased and mined under the Proposed Action, the potential additional state revenues would range from about $701 million to $838 million. For Alternative 2, BLM's preferred alternative, the potential additional state revenues would range from about $1,790 million to $2,141 million.

The base of economic activity provided by wages and local purchases would continue for up to about 7.1 additional years, depending on which alternative is selected.

3.17.1.2.1.4 West Jacobs Ranch LBA Tract

If this LBA tract is leased and mined under the Proposed Action, the potential additional federal revenues would range from approximately $994 million to $1,243 million. For the BLM's preferred alternative configuration under Alternatives 2, the potential additional federal revenues would range from approximately $1,355 million to $1,695 million.

If the LBA tract is leased and mined under the Proposed Action, the potential additional state revenues would range from about $1,244 million to $1,493

million. For Alternative 2, BLM's preferred alternative, the potential additional state revenues would range from about $1,696 million to $2,035 million.

The base of economic activity provided by wages and local purchases would continue for up to about 22.8 additional years, depending on which alternative is selected.

3.17.1.2.1.5 North Porcupine LBA Tract

If this LBA tract is leased and mined under the Proposed Action, the potential additional federal revenues would range from approximately $890 million to $1,109 million. For the BLM's preferred alternative configuration under Alternatives 2, the potential additional federal revenues would range from approximately $1,104 million to $1,375 million.

If the LBA tract is leased and mined under the Proposed Action, the potential additional state revenues would range from about $1,115 million to $1,334 million. For Alternative 2, BLM's preferred alternative, the potential additional state revenues would range from about $1,382 million to $1,654 million.

The base of economic activity provided by wages and local purchases would continue for up to about 7.8 additional years, depending on which alternative is selected.

3.17.1.2.1.6 South Porcupine LBA Tract

If this LBA tract is leased and mined under the Proposed Action, the potential additional federal revenues would range from approximately $459 million to $571 million. For the BLM's preferred alternative configuration under Alternatives 2, the potential additional federal revenues would range from approximately $503 million to $626 million.

If the LBA tract is leased and mined under the Proposed Action, the potential additional state revenues would range from about $574 million to $687 million. For Alternative 2, BLM's preferred alternative, the potential additional state revenues would range from about $629 million to $753 million.

The base of economic activity provided by wages and local purchases would continue for up to about 3.6 additional years, depending on which alternative is selected.

3.17.1.2.2 No Action Alternative

Under the No Action Alternatives, the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine coal lease applications would be rejected and the potentially recoverable coal included in an LBA tract under the Proposed Action or Alternative 2, BLM's preferred alternative, would not be recovered and the economic benefits

associated with mining that coal would not be realized by the state or federal government. Currently approved mining operations and associated economic benefits would continue on the existing Black Thunder Mine leases, but would cease between 1.6 and 7.1 years earlier than under the Proposed Actions or Alternative 2 for the North, South, and West Hilight Field LBA Tracts. Currently approved mining operations and associated economic benefits would continue on the existing Jacobs Ranch Mine leases, but would cease between 16.7 and 22.8 years earlier than under the Proposed Action or Alternative 2 for the West Jacobs Ranch LBA Tract. Currently approved mining operations and associated economic benefits would continue on the existing North Antelope Rochelle Mine leases, but would cease between 3.3 and 7.8 years earlier than under the Proposed Actions or Alternative 2 for the North and South Porcupine LBA Tracts. Job losses, both those directly associated with the mines, as well as those secondary jobs supported by the mines, would occur following the cessation of operations.

As discussed in Section 2.2, a decision to reject the LBA lease applications at this time would not preclude an application to lease the tracts in the future.

3.17.2 Population

3.17.2.1 Affected Environment

Campbell County's population rose from 33,698 in 2000 to an estimated 40,473 in July 2008. This represents a 23 percent growth since 2000 and makes Campbell County the second fastest growing county in the state (following only Sublette County, which ranked fifth in growth in the nation between July 2006 and July 2007). Campbell County's population ranks it as the third most populous of Wyoming's 23 counties (U.S. Census Bureau 2008).

The majority of the three applicant mines' employees and support services reside in Gillette and Wright. It is estimated that the total population in the City Limits of Gillette increased from 24,235 at the beginning of 2003 to 30,636 at the end of 2007; an increase of 26.4 percent over five years. Gillette accounts for roughly 62 percent of the county's residents (City of Gillette 2008a). Wright's population rose from 1,355 in July 2000 to an estimated 1,529 in July 2007, accounting for about 4 percent of the county's residents (U.S. Census Bureau 2007). Gillette is currently the fourth largest city in the state, following Cheyenne, Casper, and Laramie.

3.17.2.2 Environmental Consequences

3.17.2.2.1 Proposed Action and Alternatives 2 and 3

As indicated by Table 3-22, leasing and subsequently mining the six Wright Area LBA Tracts would extend the life of the three existing applicant mines and current employment at those mines by up to nearly 23 additional years (Jacobs Ranch Mine - Table 3-22) at the projected rates of production, under

Alternative 2, BLM's preferred alternative for each tract. Average yearly employment at the mines would increase by up to 155 positions under the Proposed Action and Alternative 2 (Jacobs Ranch Mine - Table 3-22). It is likely that the additional employees would be available from the existing workforce in Campbell County and no influx of new residents would occur as a result of filling these new positions.

3.17.2.2.2 No Action Alternative

Under the No Action Alternative, North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine coal lease applications would be rejected and the potentially recoverable coal included in an LBA tract under the Proposed Action or Alternative 2, BLM's preferred alternative, would not be mined. Population levels would not be affected by any additional employment at the existing mines. Currently approved mining operations and associated employment levels would continue on the existing mines leases for about 10.2 years at the Black Thunder Mine, about 10.6 years at the Jacobs Ranch Mine, and approximately 10.9 years at the North Antelope Rochelle Mine.

As discussed in Section 2.2, a decision to reject the LBA lease applications at this time would not preclude an application to lease the tracts in the future.

3.17.3 Employment

3.17.3.1 Affected Environment

The statewide total employment increased by more than 10 percent from 2003 to 2006, and nearly one-of-three of the new jobs created during that 3-year period was in the mining industry. During the same period, statewide coal mining employment increased by 762 jobs, a 16 percent increase. From 2003 to 2006, total employment in Campbell County grew by 3,384 jobs, a 16 percent increase. From 2000 through November 2007, the number of employees in Campbell County grew by about 33 percent (19,299 to 25,762) (City of Gillette 2008a). The average unemployment rate in Campbell County for 2006 was 2.1 percent and less than 2.0 percent for 2007 (City of Gillette 2008a), even as the local labor force has grown due to immigration and attraction of additional residents into the labor force (U.S. Bureau of Labor Statistics 2008).

Surface coal mining has changed substantially in recent times, largely as a result of new technologies and higher capacity equipment. The local coal mining labor force grew rapidly during the 1970s as more mines opened and production increased. Between 1980 and 1998, overall production rose while employee numbers generally decreased or remained constant. The employment declines followed large industry capital investments in facilities and production equipment, the majority of which were aimed at increasing productivity (BLM 2005b). Since 1998, direct employment in the PRB coal mines climbed as total

annual production increased by more than 45 percent (Wyoming Department of Employment 1998 and 2007b).

The mining sector, which includes oil and gas workers, accounts for nearly 28 percent of all employment in Campbell County, nearly four times the statewide percentage. In the fourth quarter of 2007, around 7,267 people were directly employed by surface coal mines or coal contractors in Campbell County, representing about 26 percent of the Campbell County employed labor force (Wyoming Department of Employment 2008a). Campbell County also has slightly higher percentages of construction and wholesale trade employment, which is keeping with the development demands of continuing growth and the county's position as a commercial center for northeast Wyoming.

3.17.3.2 Environmental Consequences

In January 2008, the unemployment rate in Campbell County was 2.5 percent (664 unemployed persons out of a total labor force of 26,295) (Wyoming Department of Employment 2008b). It is likely that additional employees would be available from the existing labor force in Campbell County, depending on the timing of the hiring at the mines as compared to the timing of hiring for other ongoing and proposed projects in the county, which are discussed in Section 4.1.

3.17.3.2.1 Proposed Action and Alternatives 2 and 3

3.17.3.2.1.1 North Hilight Field LBA Tract

Leasing and subsequently mining the North Hilight Field LBA Tract would extend the life of the Black Thunder Mine by up to about 2 years under the Proposed Action or 4.8 years under Alternative 2, BLM's preferred alternative, depending on which alternative is selected. As discussed above, TBCC is not projecting an increase in average yearly employment at the mine under either alternative (Table 3-22). The economic stability of the communities of Gillette and Wright would benefit by having the current Black Thunder Mine workforce living in the community and employed at the mine for up to about 4.8 additional years.

3.17.3.2.1.2 South Hilight Field LBA Tract

Leasing and subsequently mining the South Hilight Field LBA Tract would extend the life of the Black Thunder Mine by about 1.6 years under the Proposed Action or 2.3 additional years under Alternative 2, BLM's preferred alternative, depending on which alternative is selected. As discussed above, TBCC is not projecting an increase in average yearly employment at the mine under either alternative (Table 3-22). The economic stability of the communities of Gillette and Wright would benefit by having the current Black Thunder Mine workforce living in the community and employed at the mine for up to about 2.3 additional years.

3.17.3.2.1.3 West Hilight Field LBA Tract

Leasing and subsequently mining the West Hilight Field LBA Tract would extend the life of the Black Thunder Mine by about 2.8 years under the Proposed Action or 7.1 additional years under both Alternative 2 (BLM's preferred alternative) and Alternative 3, depending on which alternative is selected. As discussed above, TBCC is not projecting an increase in average yearly employment at the mine under any of the Action Alternatives (Table 3-22). The economic stability of the communities of Gillette and Wright would benefit by having the current Black Thunder Mine workforce living in the community and employed at the mine for up to about 7.1 additional years.

3.17.3.2.1.4 West Jacobs Ranch LBA Tract

Leasing and subsequently mining the West Jacobs Ranch LBA Tract would extend the life of the Jacobs Ranch Mine by up to about 16.7 years under the Proposed Action or 22.8 additional years under Alternative 2, BLM's preferred alternative, depending on which alternative is selected. As discussed above, JRCC is projecting that the average yearly employment at the mine would increase by up to 155 positions under both the Proposed Action and Alternative 2 (Table 3-22). The economic stability of the communities of Gillette and Wright would benefit by having the current Jacobs Ranch Mine workforce living in the community and employed at the mine for up to about 22.8 additional years.

3.17.3.2.1.5 North Porcupine LBA Tract

Leasing and subsequently mining the North Porcupine LBA Tract would extend the life of the North Antelope Rochelle Mine by about 6.3 additional years under the Proposed Action or 7.8 additional years under Alternative 2, BLM's preferred alternative, depending on which alternative is selected. As discussed above, PRC is not projecting an increase in average yearly employment at the mine under either alternative (Table 3-22). The economic stability of the communities of Gillette and Wright would benefit by having the current North Antelope Rochelle Mine workforce living in the community and employed at the mine for up to about 7.8 additional years.

3.17.3.2.1.6 South Porcupine LBA Tract

Leasing and subsequently mining the South Porcupine LBA Tract would extend the life of the North Antelope Rochelle Mine by about 3.3 additional years under the Proposed Action or 3.6 additional years under Alternative 2, BLM's preferred alternative, depending on which alternative is selected. As discussed above, PRC is not projecting an increase in average yearly employment at the mine under either alternative (Table 3-22). The economic stability of the communities of Gillette and Wright would benefit by having the current North Antelope Rochelle Mine workforce living in the community and employed at the mine for up to about 3.6 additional years.

3.17.3.2.2 No Action Alternative

Under the No Action Alternative, North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine coal lease applications would be rejected and the potentially recoverable coal included in an LBA tract under the Proposed Action or Alternative 2, BLM's preferred alternative, would not be mined. Mine life and existing employment levels would not be extended by up to nearly 23 additional years, though currently approved mining operations and associated employment would continue on the existing mines leases for about 10.2 years at the Black Thunder Mine, 10.6 years at the Jacobs Ranch Mine, and 10.9 years at the North Antelope Rochelle Mine. Direct jobs provided by the mines and those supported indirectly by those operations and the consumer expenditures of the mines' workforces would be lost sooner than if leasing were to occur.

As discussed in Section 2.2, a decision to reject the LBA lease applications at this time would not preclude an application to lease the tracts in the future.

3.17.4 Housing

3.17.4.1 Affected Environment

According to a 2001 report on housing needs in Campbell County, roughly 61 percent of PRB surface coal mining employees live in Gillette and surrounding areas, 14 percent live in Wright, and 25 percent live outside of Campbell County (Pederson Planning Consultants 2001).

There were 11,538 housing units in Campbell County reported in the 1990 census. The 2000 census counted 13,288 housing units in Campbell County, of which 12,207 (92 percent) were occupied; 74 percent by the owners. Of the 1,081 vacant units, 215 were held for seasonal or occasional use and 866 were for sale, rent or vacant for other reasons (U.S. Census Bureau 2000).

The number of housing units in Gillette increased from 7,078 in 1990 to 7,931 in 2000, an increase of 12 percent. The number of housing units increased in Wright from 528 in 1990 to 544 in 2000, an increase of slightly over 3 percent. The types of housing units counted in 2000 included 6,698 single-family detached units, 794 single-family attached units, 2,276 multi-family units, 3,432 mobile homes, and 88 RVs, vans, or similar types of units. Subsequent construction added 561 single-family detached, 61 single-family attached, 498 manufactured homes, and 352 multi-family units in Gillette and Wright, plus an unknown number of single-family and manufactured units in rural areas. The resulting totals are estimated at 7,259 single-family detached units (49.2 percent), 855 single-family attached units (5.8 percent), 2,628 multi-family units (17.8 percent), 3,930 mobile/manufactured units (26.6 percent), and 88 RV/vans (0.6 percent) (CSI 2005).

Population growth since 2000 has prompted new housing construction in the region. In Campbell County, net additions to the number of housing units from 2000 through 2005 total 797. Construction has not kept pace with demand. As a consequence, vacancy rates are near record lows and housing prices have climbed. In the second half of 2006, vacancy rates of rental units were 0.4 percent (6 units) in Campbell County (WCDA 2007). During 2006, there were 631 housing units permitted; a new record. During 2007, another new record was established at 1,112 housing units permitted. The housing inventory in Gillette increased from 10,194 units to 11,347 units over the 2007 calendar year; an increase of 11.3 percent (City of Gillette 2008a). The number of units added in unincorporated, rural areas of Campbell County is not known because the county does not require building permits or certificates of occupancy for residential development in unincorporated areas (Braunlin 2004).

A survey conducted in October 2004 estimated the vacancy rate of rental units to be 7.0 percent, based on a sample of approximately 40 percent of all rental units, mostly in larger complexes (CSI 2005). According to a 2006 housing survey, there was a 0.10 percent vacancy rate for rental property in 2007, while the average annual vacancy rate for manufactured home/mobile home rentals within the city limits was 5.2 percent (City of Gillette 2008a). Many apartments had long waiting lists.

In the second quarter of 2007, average housing rental costs in Campbell County were $691 for a two-bedroom, unfurnished apartment, $292 for a single-wide mobile home lot, and $1,127 for a two or three-bedroom single family home. In the second quarter of 2008, average housing rental costs in Campbell County were $717 (a 3.8 percent increase) for a two-bedroom, unfurnished apartment, $318 (a 9.1 percent increase) for a single-wide mobile home lot, and $1,314 (a 16.7 percent increase) for a two- or three-bedroom single family home (Wyoming Department of Administration and Information 2008).

The average selling price of homes in Campbell County, based on 528 sales, in 2007 was $247,150. That average represents a 23.6 percent increase over that in 2006 and sixth highest among Wyoming counties (WCDA 2008).

In addition to permanent housing, temporary or transient housing is a consideration for any project that might have a construction component. Temporary housing can include hotels or motels, campgrounds, and possibly mobile home parks. Given the tight housing market in Gillette, some such units are reportedly being used for longer-term occupancy by workers and families waiting for traditional housing to become available (Langston 2005).

There are 17 motels in Gillette with 1,346 guest rooms and a 27-room motel in Wright. Gillette has two year-round commercial campgrounds with 150 hookups for RVs plus tent areas (Gillette Convention and Visitor's Bureau 2004). Campbell County has a multi-event facility, the CAM-PLEX, located in

Gillette. It has 1,821 RV sites, which vary from 688 full service sites with rest rooms and shower facilities to electric only sites. The CAM-PLEX facilities are generally available only for scheduled special events, not for public camping (CAM-PLEX 2005).

Gillette also has approximately 1,595 mobile home park spaces. Mobile home parks are generally considered permanent housing resources, but they sometimes provide temporary spaces for RVs as well if there are vacant spaces available. As of early October 2004, the average vacancy rate in Gillette's mobile home parks was 35 percent, or 558 spaces (CSI 2005).

3.17.4.2 Environmental Consequences

3.17.4.2.1 Proposed Action and Alternatives 2 and 3

As discussed above, TBCC is not projecting an increase in average yearly employment at the Black Thunder Mine under any of the Action Alternatives for the North, South, and West Hilight Field LBA Tracts. The current employment level at the Black Thunder Mine would be extended by up to about 4.8 additional years for the North Hilight Field tract, 2.3 years for the South Hilight Field tract, and 7.1 additional years for the West Hilight Field tract under Alternative 2, BLM's preferred alternative, for each LBA tract.

As discussed above, JRCC is projecting an increase in average yearly employment by up to 155 positions and employment at the Jacobs Ranch Mine would be extended by up to 16.7 additional years under the Proposed Action and 22.8 years under Alternative 2, BLM's preferred alternative, for the West Jacobs Ranch LBA Tract.

As discussed above, PRC is not projecting an increase in average yearly employment at the North Antelope Rochelle Mine under the Action Alternatives for the North and South Porcupine LBA Tracts. The current employment level at the North Antelope Rochelle Mine would be extended by up to about 7.8 additional years for the North Porcupine tract and 3.6 additional years for the South Porcupine tract under Alternative 2, BLM's preferred alternative for each LBA tract.

No additional demands on the existing infrastructure or services in the community would be expected because little or no influx of new residents would be needed to fill new jobs. Although housing is tight in Gillette, it is likely that housing for the additional employees would be available from the existing and proposed units in Campbell County.

3.17.4.2.2 No Action Alternative

Under the No Action Alternative, the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine coal lease applications would be rejected and the coal included in an LBA tract

under the Proposed Action or Alternative 2, BLM's preferred alternative, would not be mined. Housing occupancy would not be affected by any additional employment at the three applicant mines. Currently approved mining operations and associated employment levels would continue on the existing coal leases for about 10.2 years at the Black Thunder Mine, 10.6 years at the Jacobs Ranch Mine, and for approximately 10.9 years at the North Antelope Rochelle Mine. When the existing leases are mined out, mining operations would cease, likely triggering population out-migration from the area and adversely affecting housing markets.

As discussed in Section 2.2, a decision to reject the LBA lease applications at this time would not preclude an application to lease the tracts in the future.

3.17.5 Local Government Facilities and Services

3.17.5.1 Affected Environment

The availability of revenues generated by mineral production has helped local government facilities and services keep pace with growth. Current facilities and services are generally adequate for the current population, although several service providers are engaged in expansion plans to accommodate future growth.

Campbell County School District No. 1's enrollment as of December 2007 is listed as stable at 7,569 students, making it the third largest school district in Wyoming. The district facilities include: one high school (with two campuses) and two junior high schools in Gillette, a junior-senior high school in Wright and 15 elementary schools (including one in Wright and three in rural areas). The district also operates an alternative high school and aquatic center in Gillette (CCSD 2007). The Campbell County School District is involved in a major five-year plan to replace several schools, modernize others and complete major systems maintenance and upgrades. The School District initiated a Capital Facilities Plan during 2007, and there are three new elementary schools under review at this time (City of Gillette 2008a).

Law enforcement services throughout the county are provided by the Campbell County Sheriff's Office, while the Gillette Police Department provides police protection within the City of Gillette. In addition to general law enforcement, the Sheriff's staff and city police officers provide court security, detention facilities, and animal control. The Campbell County Detention Center is a 24-hour supervised, 128-bed facility that includes separate modules for women and juveniles (BLM 2005c).

Fire suppression throughout Campbell County is provided by the Campbell County Fire Department, which is governed by a city-county joint powers board. The department maintains four stations in Gillette and six dispersed throughout the county. The department has 17 full-time staff and 150 trained volunteers. In addition, there are 30 to 40 volunteers in outlying areas who are

trained and equipped primarily to fight wildland fires. Campbell County coal mines generally provide equipment and trained staff to fight fires on mine property, and if called upon, the County Fire Department provides backup assistance with personnel and equipment (Vonsik 2005).

The primary medical care facility in Campbell County is Campbell County Memorial Hospital, a 90-bed acute care hospital, located in Gillette. The hospital has a medical staff of over 50 affiliated physicians in 20 specialties and a total staff of 800 (CCMH 2005). The hospital also operates the Wright Clinic, a satellite clinic with a full-time, family practice physician. Ambulance service for Campbell County is provided by the hospital, which has a 24-hour emergency service capability. The Campbell County Fire Department provides first responder service to emergency calls, but transport is the responsibility of the hospital affiliated ambulance service.

Water and wastewater treatment systems are provided by the City of Gillette. Gillette's water supply, which is a system of groundwater wells, has the capacity to serve approximately 30,600 people within the city limits and some nearby urbanized areas. Water use approaches capacity during the peak demand months in the summer when parks and private lawns are being irrigated (Morovits 2005). The City of Gillette and Campbell County have developed a long term water supply plan called the Gillette Regional Water Supply Project that includes an additional Madison Formation well field and pipeline with a capacity to serve approximately 50,000 people (City of Gillette 2008b). Projected completion is about 6 years. In the interim, the city has other wells it can pump if necessary, but high natural fluoride levels require careful monitoring if they are used (Morovits 2005). Gillette's sewer treatment system was designed for a service population of approximately 35,000 and improvements begun in the fall of 2004 were designed to increase treatment capacity to accommodate a projected population of 41,000. Currently, the system serves an estimated 25,000 people in the city and surrounding areas.

Water and wastewater treatment systems are provided to the community of Wright by the Wright Water and Sewer District. The Wright district's water and sewage treatment facilities were designed to serve a population of approximately 3,000, albeit with an additional sewage lagoon required when the service population reached about 2,500 people. The district is planning an additional well to increase its water supply capacity by about 30 percent. The district's facilities in Wright currently serve a population of approximately 1,400 people; essentially the entire town is served by the water system, and most lots are on the sewer system, although there are some private septic systems.

3.17.5.2 Environmental Consequences

3.17.5.2.1 Proposed Action and Alternatives 2 and 3

As discussed above, TBCC is not projecting an increase in average yearly employment at the Black Thunder Mine under the Proposed Action or Alternative 2, BLM's preferred tract configuration, for the North, South and West Hilight Field LBA Tracts. Current employment levels would continue for about 4.8 additional years under Alternative 2 for the North Hilight Field tract, 2.3 additional years under Alternative 2 for the South Hilight Field tract, and 7.1 additional years under Alternative 2 for the West Hilight Field tract.

As discussed above, JRCC is projecting that the average yearly employment at the Jacobs Ranch Mine would increase by up to 155 positions under both the Proposed Action and Alternative 2, BLM's preferred tract configuration, and mine life would be extended by up to 22.8 additional years under Alternative 2 for the West Jacobs Ranch tract.

As discussed above, PRC is not projecting an increase in average yearly employment at the North Antelope Rochelle Mine under the Proposed Action or Alternative 2, BLM's preferred tract configuration, for the North and South Porcupine LBA Tracts. Current employment levels would continue for about 7.8 additional years under Alternative 2 for the North Porcupine tract and 3.6 additional years under Alternative 2 for the South Porcupine tract.

No additional demands on the existing community facilities or services in the county would be expected because little or no influx of new residents would be needed to fill new jobs. It is likely that the demand for public facilities and services will be satisfied by the existing facilities and services currently in place in Campbell County.

3.17.5.2.2 No Action Alternative

Under the No Action Alternative, North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine coal lease applications would be rejected and the potentially recoverable coal included in an LBA tract under the Proposed Action or Alternative 2, BLM's preferred alternative, would not be mined. Local government facilities and services would not be affected by any additional employment at the Black Thunder, Jacobs Ranch or North Antelope Rochelle mines. Currently approved mining operations and associated employment levels would continue on the existing mine leases for about 10.2 years at the Black Thunder Mine, 10.6 years at the Jacobs Ranch Mine, and 10.9 years at the North Antelope Rochelle Mine.

As discussed in Section 2.2, a decision to reject the LBA lease applications at this time would not preclude an application to lease the tracts in the future.

3.17.6 Social Setting

3.17.6.1 Affected Environment

The social setting for coal development in the PRB, summarized in Section 4.2.12.9, is described in the Task IC Report for the PRB Coal Review (BLM 2005c). That report emphasizes Campbell County and its communities as the nucleus for coal development in the PRB. The three applicant mines included in this EIS went into production between 1977 and 1983. These mines and their employees contribute to the social and economic stability of Campbell County, the City of Gillette and the Town of Wright.

3.17.6.2 Environmental Consequences

3.17.6.2.1 Proposed Action and Alternatives 2 and 3

As discussed above, employment at the mines is not anticipated to increase substantially under the Proposed Action or Alternatives 2 and 3. Consequently, little or no change in the social setting of Campbell County or the communities of Gillette and Wright would be anticipated under these alternatives.

3.17.6.2.2 No Action Alternative

Implementation of the No Action Alternative would result in the eventual loss of approximately 3,104 relatively high paying mining jobs in the PRB, along with numerous support services and other jobs that depend on the mining industry. A majority of those losses would occur in Campbell County and the City of Gillette. Loss of the mine-related economic activity and tax revenues are described in preceding sections. These losses would likely result in a disruption in the social and economic stability of Campbell County and the City of Gillette and some population relocation, unless mine employees were able to find comparable employment within commuting distance of Gillette. Social effects of the No Action Alternative on the Town of Wright would be less substantial, because of the fewer number of employees involved and the potential for those employees to find other jobs in mines and other energy industries in Campbell County.

3.17.7 Environmental Justice

3.17.7.1 Affected Environment

Environmental Justice issues are concerned with actions that unequally impact a given segment of society either as a result of physical location, perception, design, noise, or other factors. On February 11, 1994, Executive Order 12898, “Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations”, was published in the *Federal Register* (59 FR 7629). The Executive Order requires federal agencies to

identify and address disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations (defined as those living below the poverty level). The Executive Order makes it clear that its provisions apply fully to Native American populations and Native American tribes, specifically to effects on tribal lands, treaty rights, trust responsibilities, and the health and environment of Native American communities.

Communities within Campbell County, entities with interests in the area, and individuals with ties to the area all may have concerns about the presence of surface coal mines in the area. Environmental Justice concerns are usually directly associated with impacts on the natural and physical environment, but these impacts are likely to be interrelated with social and economic impacts as well. Native American access to cultural and religious sites may fall under the umbrella of Environmental Justice concerns if the sites are on tribal lands or access to a specific location has been granted by treaty right.

Compliance with Executive Order 12898 concerning Environmental Justice was accomplished through opportunities for the public to receive information on this EIS in conjunction with consultation and coordination described in Section 1.6 of this document. This EIS and contributing socioeconomic analysis provide a consideration of the impacts with regard to disproportionately adverse impacts on minority and/or low-income groups, including Native Americans.

Campbell County's population in 2007 was comprised of 94.1 percent white non-Hispanic, 3.5 percent Hispanic, 1.7 percent Native American, 1.3 percent two or more races, and 1.1 percent other races (the total exceeds 100 percent because Hispanics could be counted in other races). In 2007, approximately 7.6 percent of Campbell County's residents had income below the poverty level and 3.0 percent of the county's residents had income below 50 percent of the poverty level (City-Data 2009).

3.17.7.2 Environmental Consequences

3.17.7.2.1 Proposed Action and Alternatives 2 and 3

Economic and demographic data indicate that neither minority populations nor people living at or below the poverty level make up a "meaningfully greater increment" of the total population in Gillette, Wright or Campbell County than they do in the state as a whole, or that they would be unequally impacted if North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts are leased under the Proposed Actions or Alternatives 2 or 3. Also, the Native American population is smaller than in the state as a whole, and there are no known Native American sacred sites on or near the BLM study areas for the proposed LBA tracts. Consequently, implementation of the Proposed Actions or Alternatives 2

or 3 would not adversely affect the environmental justice considerations in the area.

3.17.7.2.2 No Action Alternative

Economic and demographic data indicate that neither minority populations nor people living at or below the poverty level make up a "meaningfully greater increment" of the total population in Gillette, Wright or Campbell County than they do in the state as a whole, or that they would be unequally impacted if the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracks are leased under the Proposed Actions or Alternatives 2 or 3. Also, the Native American population is smaller than in the state as a whole, and there are no known Native American sacred sites on or near the three existing applicant mines. Consequently, the No Action Alternative would not adversely affect the environmental justice considerations in the area.

3.17.8 Regulatory Compliance, Mitigation and Monitoring

Surface coal mines are required to pay royalty and other taxes and fees as required by federal, state, and local regulations. BLM compares the amount of coal reported as produced with the estimated amount of unmined, in-place coal to verify that the federal coal is efficiently mined and that royalties are paid on all of the coal that is mined.

3.17.9 Residual Impacts

No socioeconomic residual impacts are expected.

3.18 Relationship Between Local Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity

The NEPA regulations at 40 CFR 1502.16 require a discussion of the "relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity" as part of an EIS. This requirement is duplicated in the BLM NEPA Handbook Chapter V, Section B.2.a.(3) and C.3.h.(2) (BLM 2008).

3.18.1 Local Area

If the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts are leased, almost all components of the present ecological system that have developed over a long period of time would be modified as the coal is mined. In the long term, the reclaimed land surface contours would resemble the original topography, although it would be slightly lower in elevation and lack some of the original diversity of geomorphic form.

Mining operations and associated activities would degrade the air quality and visual resources of the area on a short-term basis. Following coal removal, removal of surface facilities, and completion of reclamation, there would be no long-term impact on air quality. The long-term impact on visual resources would be minor.

The forage and associated grazing and wildlife habitat that these six LBA tracts currently provide would be temporarily and incrementally disturbed during mining and reclamation. If the LBA tracts are mined, there would be a loss of native vegetation on a total of 32,783.4 acres (total of all Proposed Actions) up to a maximum of 53,773.0 acres (total of all Alternatives 2 and 3) with an accompanying disturbance of grazing land and wildlife habitat. This disturbance would occur incrementally over a period of years. Soils would be replaced and vegetation would be restored, as required by the mining plan (see Sections 3.8 and 3.9). Plant communities may never return to their original compositions, although the reclaimed lands would be returned to equivalent or better forage production capacity for domestic livestock before the performance bond is released. Long-term productivity would depend largely on postmining range management practices, which to a large extent would be controlled by private landowners and the Forest Service.

Mining would disturb pronghorn and mule deer habitat. As discussed in Section 3.10.5, potential sage-grouse habitat is scarce throughout the general Wright analysis area. There would be loss and displacement of wildlife in the short term during mining, but based on monitoring of previously reclaimed lands, it is anticipated that the reclaimed habitat would support a diversity of wildlife species similar to premining conditions over the long term. The diversity of species found in undisturbed lands would not be completely restored on the mined lands for an estimated 50 years after the initiation of disturbance. Reestablishment of mature sagebrush habitat, which is crucial for pronghorn and sage-grouse, would be expected to take even longer.

If the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts are leased and mined, depths to groundwater in the overburden and coal would increase in an area extending further to the west and south of the existing mine areas in the short term. Groundwater flow through the undisturbed aquifers near the backfilled mine pits would be interrupted until saturation levels in the backfill have risen and the rates of recharge to and discharge from the backfill equilibrate. The water levels in the coal aquifer should return to premining levels at some time after mining and CBNG development in the vicinity have ceased because recharge areas would not be disturbed when recovering the coal in the LBA tracts. Groundwater quality in and near the backfilled mine pits would be different from pre-mining conditions after reclamation, although it would remain adequate for livestock and wildlife use.

CBNG is currently being recovered from within and near these six LBA tracts, and BLM's analysis suggests that a large portion of the CBNG resources on the

tracts has been recovered or would be recovered prior to mining. CBNG that is not recovered prior to mining would be vented to the atmosphere during the mining process. CBNG is composed primarily of methane, which is a greenhouse gas. A discussion of methane emissions from coal mining operations in the U.S. is included in Chapter 4, Section 4.2.14. Total U.S. methane emissions attributable to coal mining would not be likely to decrease if these six LBA tracts are not leased at this time. Likewise, it would not be likely that total U.S. methane emissions in the long term would measurably increase if these six LBA tracts are leased at this time.

Short-term impacts to recreation values may occur from a reduction in big game populations due to habitat disturbance and reduction in access to some public lands. These changes would primarily impact hunting in the lease areas. However, because reclamation would result in a wildlife habitat similar to that which presently exists and access to any public lands affected by mining would be restored, there should be no long-term adverse impacts on hunting opportunities. Another minor short-term impact to recreation values may occur due to the loss of public access to the Little Thunder Reservoir as a result of leasing and mining the West Hilight Field LBA Tract. Public access to Pronghorn Lake, a postmining final impoundment that is located within an active portion of Black Thunder Mine's current permit area, will occur once it no longer serves a function (storage for dust suppression water) for the mining operation. The recreational activities provided by Little Thunder Reservoir could be replaced by those provided by Pronghorn Lake; however, the time at which Pronghorn Lake becomes accessible to the general public may not coincide with the time at which Little Thunder Reservoir becomes inaccessible, but there should be no long-term adverse impacts on fishing opportunities.

The short- and long-term economy of the region would be enhanced as a result of the Action Alternatives. Leasing and subsequently mining the North, South, and West Hilight Field LBA Tracts under Alternative 2, BLM's preferred alternative for each tract, would extend the life of the existing Black Thunder Mine by up to a total of 14.2 additional years (Tables 2-2, 2-4, and 2-6). Leasing and subsequently mining the West Jacobs Ranch LBA Tract under Alternative 2, BLM's preferred alternative, would extend the life of the existing Jacobs Ranch Mine by up to 22.8 additional years (Table 2-8). Leasing and subsequently mining the North and South Porcupine LBA Tracts under Alternative 2, BLM's preferred alternative for each tract, would extend the life of the existing North Antelope Rochelle Mine by up to a total of 11.4 additional years (Tables 2-10 and 2-12).

3.18.1.1 Human Health Impact Assessment

In 2008, public concerns were brought to BLM's attention in regard to conducting human health impact assessments in the PRB where coal mining activities occur. A health impact assessment (HIA) is a method used in assessing potential impacts of a proposed project on human health. HIAs examine health on a broad scale, including social, emotional, and cultural

impacts as well as physical impacts. HIAs rely on available scientific data, public testimony, and modeling to predict potential health impacts.

Public concerns included emissions from coal mining activities like particulate matter and nitrogen oxide exposure and their potential impact on the health of people living in the vicinity of surface coal mines located in the eastern PRB.

BLM does not have jurisdiction in regard to conducting human health assessments. However, BLM has invited the Wyoming Department of Health/Environmental Health Section and the U.S. Center for Disease Control and Prevention to review and provide comment on the Wright Area Coal Lease Applications EIS.

Air pollution is controlled by state and federal air quality regulations and standards established under the federal Clean Air Act Amendments. State implementation plans are in place to ensure proposed actions like coal mining comply with all associated air quality regulations and criteria. The Wyoming Ambient Air Quality Standards (WAAQS) are stricter than the National Ambient Air Quality Standards (NAAQS) and are enforced by WDEQ.

As described in Section 3.4.2.3 of this EIS, the WDEQ/AQD developed a Natural Events Action Plan for the coal mines of the PRB. The plan, based on EPA Natural Event Policy guidance, identifies potential control measures for protecting public health and minimizing exceedences of the PM_{10} NAAQS.

All mines are required to conduct air quality modeling to show that their proposed operations will comply with the WAAQS and NAAQS, and they are required to monitor to demonstrate that their actual air emissions do not exceed the standards. The WDEQ/AQD coal mining permit process requires air quality modeling of the primary air pollutants PM_{10} and NO_2. Sections 3.4.2.3 and 3.4.3.3 in this EIS addresses air quality mitigation measures that WDEQ/AQD implemented in order to prevent exceedences of the WAAQS and NAAQS by PRB surface coal mines.

As stated above and as discussed in Section 3.4, mining operations and associated activities would effectively degrade the air quality in the vicinity on a short-term basis. Following coal removal, removal of all surface facilities, and completion of reclamation, there would be no long-term impact on air quality.

3.18.2 Greenhouse Gas Emissions

There has been, and continues to be, considerable scientific investigation and discussion as to the causes of recent historic rise in global mean temperatures and whether a warming trend will continue. This section will address greenhouse gas emissions as specifically related to the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines, the applicant mines adjacent to the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts.

Greenhouse gases (GHGs) have been raised as a concern due to the greenhouse effect. The greenhouse effect is a theory that certain gases in the atmosphere absorb thermal radiation emitted by the earth's surface and trap heat within the atmosphere like glass in a greenhouse. GHGs currently include carbon dioxide (CO_2), methane (CH_4), water vapor, ozone (O_3), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PRCs), and sulfur hexafluoride (SF_6). GHGs are not currently regulated, but there is a consensus in the international community that the global mean surface temperature is increasing and that most of the warming trend is likely due to the increase in anthropogenic (man-made) GHG concentrations. If the coal in the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts is leased and mined, additional GHGs would be released into the atmosphere.

As discussed in Chapter 1, BLM does not authorize mining through the issuance of a federal coal lease. WDEQ, with oversight from OSM, has regulatory authority in issuing permits to mine coal in Wyoming. However, BLM considers the impacts of mining coal in this EIS because it is a logical consequence of issuing a maintenance lease to an existing coal mine.

The use of the coal after it is mined is not determined at the time of leasing. However, almost all coal that is currently being mined in the Wyoming PRB is being used to generate electricity by coal-fired power plants. A discussion of emissions and by-products that are generated by burning coal to produce electricity is included in Chapter 4, Section 4.2.14, and a more complete discussion of the current status of global climate change and cumulative considerations is included Section 4.2.14.1.

As discussed in Chapter 2, under Black Thunder Mine's currently approved mining plan, which represents the No Action Alternative, TBCC anticipates that the mine would produce its remaining estimated 1,236.4 million tons of recoverable coal reserves in 10.2 years at an average annual production rate (post-2008) of approximately 135 million tons. Leasing and subsequently mining the North, South, and West Hilight Field LBA Tracts, each under the Proposed Action at an average annual production rate of 135 million tons, TBCC estimates that the life of the mine would be extended by about 2.0, 1.6, and 2.8 additional years, respectively. Leasing and subsequently mining the North, South, and West Hilight Field LBA Tracts at the same average annual production rate under Alternative 2, BLM's preferred alternative for each tract, TBCC estimates the life of the mine would be extended by 4.8, 2.3, and 7.1 years, respectively.

As discussed in Chapter 2, under Jacobs Ranch Mine's currently approved mining plan, which represents the No Action Alternative, JRCC anticipates that the mine would produce its remaining estimated 423.0 million tons of recoverable coal reserves in 10.6 years at an average annual production rate (post-2008) of approximately 40 million tons. Leasing and subsequently mining the West Jacobs Ranch LBA Tract under the Proposed Action, JRCC

estimates that the life of the mine would be extended by about 16.7 additional years at an average annual production rate of 40 million tons. Leasing and subsequently mining the West Jacobs Ranch LBA Tract under Alternative 2, BLM's preferred alternative, JRCC estimates the life of the mine would be extended by 22.8 years at the same average annual production rate.

As discussed in Chapter 2, under North Antelope Rochelle Mine's currently approved mining plan, which represents the No Action Alternative, PRC anticipates that the mine would produce its remaining estimated 1,013.4 million tons of recoverable coal reserves in 10.9 years at an average annual production rate (post-2008) of approximately 95 million tons. Leasing and subsequently mining the North and South Porcupine LBA Tracts, each under the Proposed Action at an average annual production rate of 95 million tons, PRC estimates that the life of the mine would be extended by about 6.3 and 3.3 additional years, respectively. Leasing and subsequently mining the North and South Porcupine LBA Tracts at the same average annual production rate under Alternative 2, BLM's preferred alternative for each tract, PRC estimates the life of the mine would be extended by 7.8 and 3.6 years, respectively.

Some PRB surface coal mines have completed GHG emissions inventories. Not all three applicant mines have completed a GHG emissions inventory, although mines both within and outside the general Wright analysis area conducted inventories of expected GHG emissions that occurred in 2007. These mines also projected emissions for a typical year of operations if additional lands are leased and mined. Emissions are measured as metric tons of CO_2 equivalents (CO_2e), which is the amount of gas emitted, multiplied by its warming potential relative to CO_2. The inventories included emissions from all sources, including all types of carbon fuels used in the mining operations, electricity used on site (i.e., lighting for facilities, roads, and operations and electrically powered equipment and conveyors) and mining processes (i.e., blasting, coal fires caused by spontaneous combustion and methane released from exposed coal seams). An additional category contributing to CO_2e emissions, which was not included in CO_2e emissions estimates for the three applicant mines due to a lack of information, includes rail transport, both on-site and in moving coal to the buyers.

The expected CO_2e emissions that occurred in 2007 for the mines that have not completed emissions inventories were estimated by assuming the CO_2e emission ratios (CO_2e/million tons of coal produced, CO_2e/million bank cubic yards of overburden moved, and CO_2e/acres of disturbance) for the mines that completed emissions inventories would be equivalent to those mines that have not. The correlations were based on the 2007 coal production, overburden production, and disturbance acres (facilities plus active pit acres) for three source types (fuel, electricity, and mining process) at the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines (WWC 2009). Since the combined CO_2e emission estimates for the three applicant mines are based on limited information, the estimated values are tentative. For the purpose of this analysis, these combined total values are only included here as a means of

obtaining a representation of potential CO_2e emissions, should the six LBA tracts be leased and mined.

CO_2e emissions are projected to increase at the Black Thunder, Jacobs Ranch and North Antelope Rochelle mines if the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts are added to the mining operations (Table 3-24). The increase in CO_2e emissions are expected to result from the additional fuels (especially diesel) that would be used in consideration of the increased coal and overburden haul distances, as well as increased use of electricity and explosives related to increasing overburden thicknesses. The incremental changes with the addition of these six LBA tracts to the applicant mines' operations represent the estimated CO_2e emissions for the Proposed Actions as well as Alternative 2, BLM's preferred alternative for each tract. Estimates assume that the combined annual production rate from these three mines is 270 million tons.

Table 3-24. Estimated Annual Equivalent CO_2 Emissions[1] at the Black Thunder, Jacobs Ranch, and North Antelope Rochelle Mines.

Source	**2007**	**With LBA Tracts**
Fuel	577,463	1,429,582
Electricity	465,908	777,141
Mining Process	201,871	296,166
Total of Three Sources	**1,245,241**	**2,502,889**

[1] CO_2e in tonnes
Source: WWC 2009

The Center for Climate Strategies estimates that activities in Wyoming will account for approximately 60.3 million metric tons (tonnes) of gross CO_2e emissions in 2010 and 69.4 million tonnes in 2020 (Center for Climate Strategies 2007). Using those projections, the 2007 emissions from the three applicant mines total (Table 3-23) represents 2.22 percent of the 2010 state-wide emissions. With the addition of the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts, the estimated total emissions at the three applicant mines would represent 3.61 percent of the projected 2020 state-wide emissions.

As mentioned above, the CO_2e estimates for the combined North Hilight Field, South Hilight Field West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts in Table 3-23 include projected methane emissions vented from exposed unmined coal. The estimated annual amount of CO_2e emissions from vented methane was approximately 483,600 metric tons, or about 19.3 percent of the estimated total annual CO_2e emissions from mining the six tracts (WWC 2009). The total methane emissions from anthropogenic sources in the U.S. in 2007 was 699.9 million metric tons (USDOE 2007a). Based on 2007 production from the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines, the estimated annual methane emissions vented from exposed unmined coal was 0.484 million metric tons

CO_2e (WWC 2009), or about 0.07 percent of the total 2007 U.S. methane emissions from anthropogenic sources.

Please see Section 4.2.14 for an assessment of cumulative impacts related to GHGs, and how the Action Alternatives considered in this EIS contribute.

3.19 Irreversible and Irretrievable Commitments of Resources

The major commitment of resources would be the mining and consumption of 2,435.4 million tons (Proposed Action for all six LBA tracts) up to a maximum of 3,910.6 million tons (Alternative 2, BLM's preferred alternative, for all six LBA tracts) of coal to be used for electrical power generation. CBNG that is not recovered prior to mining would also be irreversibly and irretrievably lost (see additional discussion of the impacts of venting CBNG to the atmosphere in Sections 3.18 and 4.2.14). It is estimated that 1 to 2 percent of the energy produced would be required to mine the coal, and this energy would also be irretrievably lost.

The characteristics of topsoil on approximately 32,783 acres (total for all six LBA tracts, each under the Proposed Action) up to a maximum of approximately 50,773 acres (total for all six LBA tracts, each under Alternative 2, BLM's preferred alternative) would be irreversibly changed. Soil formation processes, although continuing, would be irreversibly altered during mining-related activities. Newly formed soil material would be similar but not identical to that in the natural landscape.

Direct and indirect wildlife deaths caused by mining operations or associated activity would be an irreversible loss. No T&E species (animal or plant) that are listed for Campbell County are known to occur on the BLM study area for each of the six LBA tracts, therefore none would be lost as a result of the Proposed Actions or alternatives. The black-tailed prairie dog is the most common sensitive species in the area and it therefore has the most potential to be affected (killed or injured) by activities in or near their colonies, and habitat would be lost until reclamation takes place. Any activities that jeopardize prairie dogs and their habitat would also affect those sensitive species that are strongly associated with them, namely the mountain plover, burrowing owl, chestnut-collared longspur, and McCown's longspur. Despite their strong association with prairie dogs, these avian species can all utilize short-grass habitats other than prairie dog colonies; however, they would benefit from the presence of undisturbed prairie dog colonies. Direct and indirect deaths of other sensitive species that occur on the LBA tracts (refer to Appendix H) caused by mining operations or associated activity would be an irreversible loss.

Loss of human life may conceivably occur due to the mining operations and vehicular and train traffic. On the basis of surface coal mine accident rates in Wyoming as determined by the Mine Safety and Health Administration (MSHA) (1997) for the 10-year period 1987-1996, fatal accidents (excluding contractors)

occur at the rate of 0.003 per 200,000 man-hours worked. Disabling (lost-time) injuries occur at the rate of 1.46 per 200,000 man-hours worked. Any injury or loss of life would be an irretrievable commitment of human resources.

Disturbance of all known historic and prehistoric cultural sites eligible for the NRHP on the mine areas would be mitigated to the maximum extent possible. However, accidental destruction of presently unknown archeological or paleontological values would be irreversible.