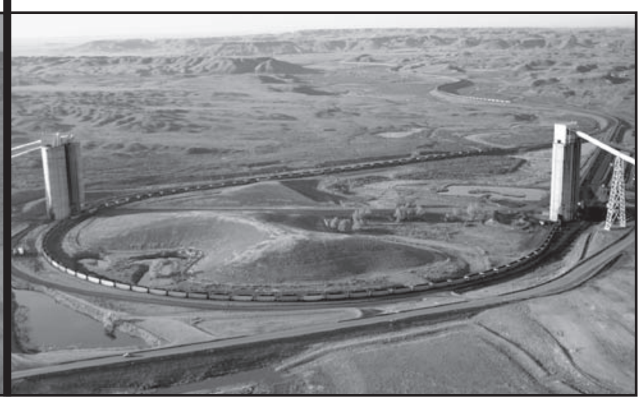
FINAL
Environmental Impact Statement for the Wright Area Coal Lease Applications

Volume 1 of 2
Chapters 1 - 4

West Loadout Facilities
Black Thunder Mine, Wyoming

Elk on Reclaimed Rangeland
Jacobs Ranch Mine, Wyoming

Elk on Reclaimed Rangeland
Black Thunder Mine, Wyoming



Loadout Facilities in Porcupine Creek Valley
North Antelope Rochelle Mine, Wyoming

BLM

Wyoming State Office – High Plains District

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
NATIONAL SYSTEM OF PUBLIC LANDS

July 2010

The BLM manages more land – 253 million acres – than any other Federal agency. This land, known as the National System of Public Lands, is primarily located in 12 Western States, including Alaska. The Bureau, with a budget of about $1 billion, also administers 700 million acres of sub-surface mineral estate throughout the nation. The BLM's multiple-use mission is to sustain the health and productivity of the public lands for the use and enjoyment of present and future generations. The Bureau accomplishes this by managing such activities as outdoor recreation, livestock grazing, mineral development, and energy production, and by conserving natural, historical, cultural, and other resources on public lands.

BLM/WY/PL-10/022+1320

WRIGHT AREA COAL LEASE APPLICATIONS
FINAL ENVIROMENTAL IMPACT STATEMENT

Prepared by

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Sheridan, Wyoming

Under the Direction of

U.S. Department of the Interior
Bureau of Land Management
High Plains District Office
Casper, Wyoming

and

Cooperating Agencies

U.S. Department of the Interior
Office of Surface Mining
Reclamation and Enforcement
Denver, Colorado

U.S. Department of Agriculture
Forest Service
Medicine Bow-Routt National Forests and
Thunder Basin National Grassland
Douglas, Wyoming

Wyoming Department of Environmental Quality
Land Quality and Air Quality Divisions
Cheyenne, Wyoming

Wyoming Department of Transportation
Cheyenne, Wyoming

Converse County Board of Commissioners
Douglas, Wyoming

July 2010

FINAL ENVIRONMENTAL IMPACT STATEMENT
WRIGHT AREA COAL LEASE APPLICATIONS
CAMPBELL COUNTY, WYOMING
ABSTRACT

Lead Agency: USDI, Bureau of Land Management, High Plains District Office, Casper, Wyoming

Cooperating Agencies: USDI, Office of Surface Mining Reclamation and Enforcement, Denver, Colorado

USDA, Forest Service, Medicine Bow-Routt National Forests and Thunder Basin National Grassland, Douglas, Wyoming

Wyoming Department of Environmental Quality, Land Quality and Air Quality Divisions, Cheyenne, Wyoming

Wyoming Department of Transportation, Cheyenne, Wyoming

Converse County Board of Commissioners, Douglas, Wyoming

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This Final Environmental Impact Statement (EIS) assesses the environmental consequences of decisions to hold competitive, sealed-bid sales and issue leases for six federal coal maintenance tracts in Campbell County, Wyoming as a result of coal lease applications submitted by Ark Land Company, Jacobs Ranch Coal Company, and BTU Western Resources, Inc. As applied for, the Wright area coal lease-by-application (LBA) tracts include approximately 18,021.73 acres containing approximately 2.570 billion tons of federal coal. The tracts are referred to as the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine. The applicants propose to mine the tracts as maintenance leases for the existing adjacent mines, if lease sales are held and the applicant mines acquire the leases. At the time of application, the adjacent mines included Black Thunder, Jacobs Ranch, and North Antelope Rochelle.

This Final EIS describes the physical, biological, cultural, historic, and socioeconomic resources in and around the existing mines and the LBA tracts. The alternatives in the Final EIS consider the impacts of leasing the tracts as applied for, leasing reconfigured tracts in order to avoid bypassing federal coal or to increase competitive interest in the tracts, and not leasing the tracts. The focus for the impact analysis was based on resource issues and concerns identified during previous coal leasing analyses and public scoping conducted for these lease applications. Recent concerns related to leasing coal and its subsequent development include: impacts to groundwater, air quality, wildlife, cultural resources, paleontological resources, socioeconomics, loss of livestock grazing areas, conflicts with oil and gas development, cumulative impacts related to ongoing surface coal mining and other proposed development in the Wyoming Powder River Basin, greenhouse gas emissions, ozone, and climate change.

This Final EIS, in compliance with Section 7(c) of the Endangered Species Act as amended, identifies any endangered or threatened species which are likely to be affected by the Proposed Action.

The Final EIS is open for a 30-day review period beginning on the date that the U.S. Environmental Protection Agency publishes the Notice of Availability in the *Federal Register*. Comments that are postmarked or received on or before the end of the 30-day review period will be considered in the preparation of the Record of Decision.

EXECUTIVE SUMMARY

This Environmental Impact Statement (EIS)[1] analyzes the environmental impacts of leasing six tracts of federal coal reserves adjacent to the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines. All are operating surface coal mines in the southern Powder River Basin (PRB) of Wyoming, near the town of Wright. The operators of the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines filed four applications to lease the six tracts of federal coal included in maintenance coal tracts under the regulations at 43 CFR 3425, Leasing On Application.

The Division of Minerals and Lands at the Bureau of Land Management (BLM) Wyoming State Office reviewed all four applications and determined that the lease applications met the regulatory requirements for Lease by Applications (LBAs). These maintenance coal tracts, which would continue or extend the life of the applicant mines, are referred to as the North Hilight Field LBA Tract, the South Hilight Field LBA Tract, the West Hilight Field LBA Tract, the West Jacobs Ranch LBA Tract, the North Porcupine LBA Tract, and the South Porcupine LBA Tract. Figure ES-1 shows these six Wright Area Coal (WAC) LBA tracts, other currently pending LBA tracts, and the existing federal leases, including previously leased LBA tracts, in the Wyoming PRB.

On October 7, 2005, Ark Land Company (ALC) filed an application with the BLM for federal coal reserves in two separate tracts located north and southwest of and immediately adjacent to the Black Thunder Mine in Campbell County, Wyoming. The tracts are referred to as the North Hilight Field and South Hilight Field LBA Tracts. The North Hilight Field tract is located approximately 5.5 miles east of Wright, Wyoming and the South Hilight Field tract is located approximately 7 miles southeast of Wright (Figures ES-1, ES-2 and ES-3). The federal coal reserves were applied for as maintenance tracts for the Black Thunder Mine. BLM determined that the two tracts in the application would be processed separately and, if the decision is made to conduct a lease sale, would be offered for sale separately. ALC is a wholly owned subsidiary of Arch Coal, Inc. The Black Thunder Mine is operated by Thunder Basin Coal Company (TBCC), a subsidiary of Arch Western Resources, LLC. In this EIS, ALC is referred to as the applicant and TBCC is referred to in discussions of mine operations. ALC's coal lease application was assigned case file numbers WYW164812 (North Hilight Field) and WYW174596 (South Hilight Field).

On January 17, 2006, ALC filed an application with the BLM for federal coal reserves in a tract located west of and immediately adjacent to the Black Thunder Mine in Campbell County, Wyoming, approximately 4 miles southeast of Wright, Wyoming (Figures ES-1 and ES-4). The tract, which is referred to as the West Hilight Field LBA Tract, was assigned case file number WYW172388.

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

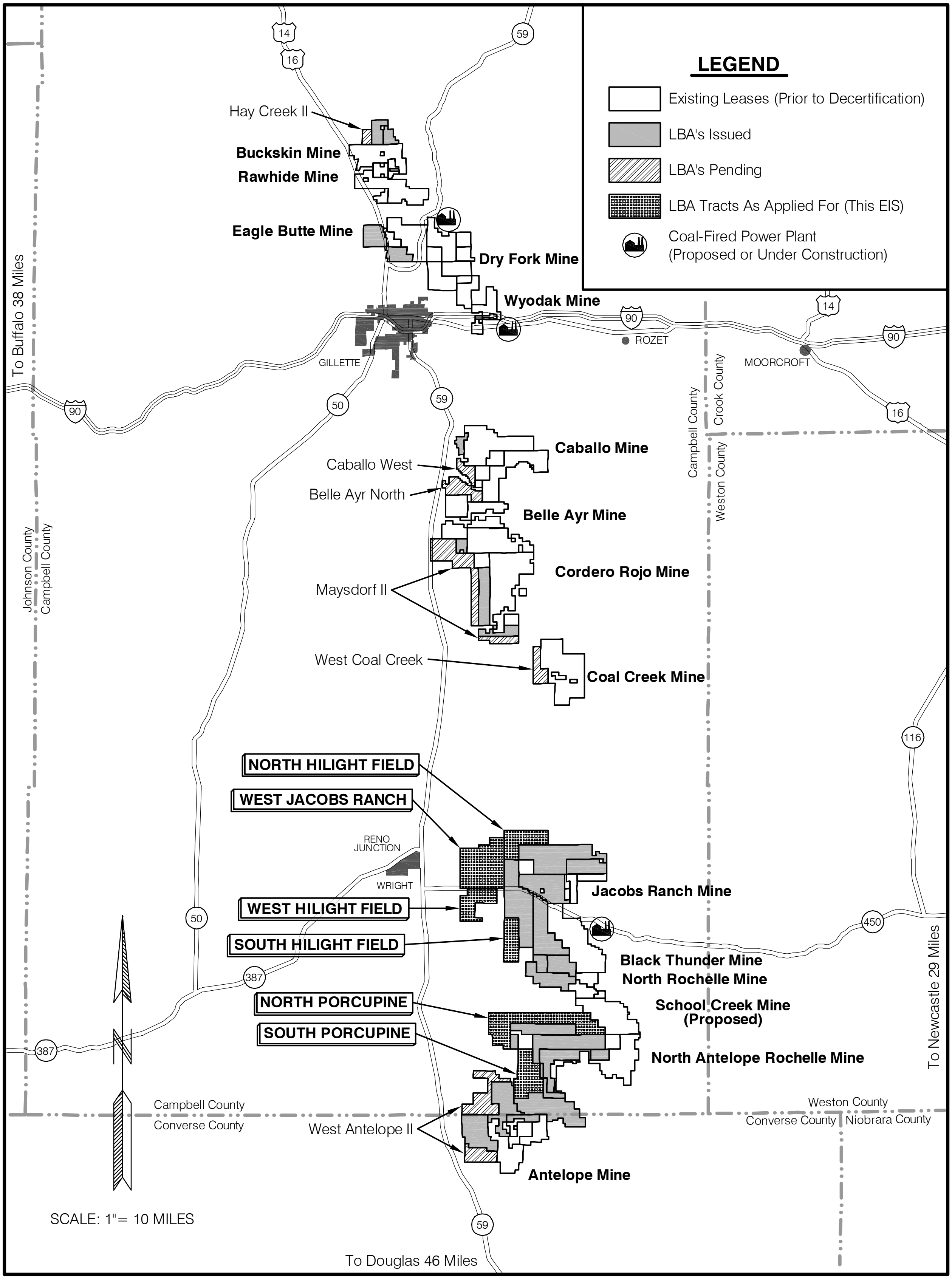

Figure ES-1. General Location Map with Federal Coal Leases and LBA Tracts.

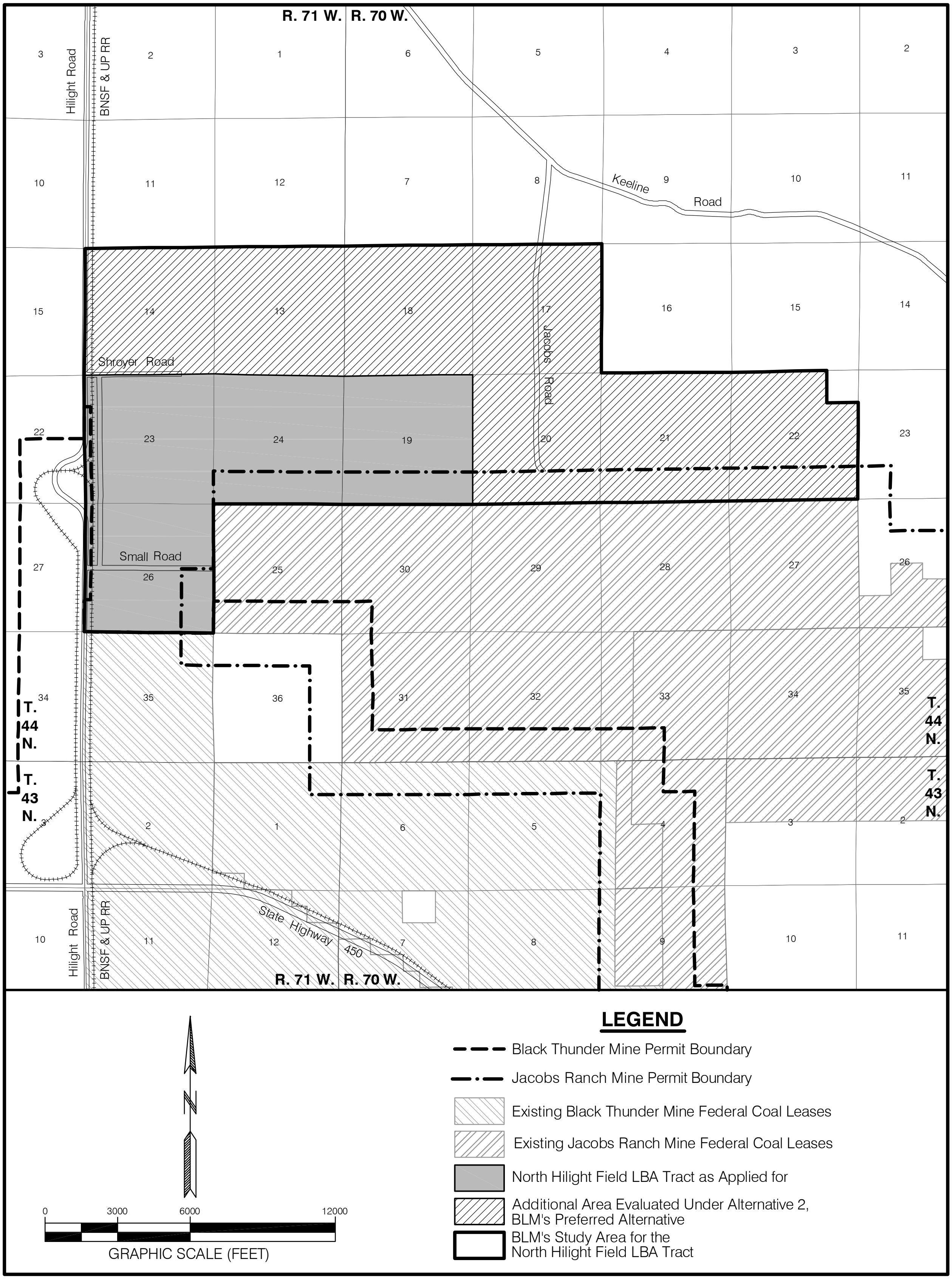

Figure ES-2. North Hilight Field LBA Tract Alternatives.

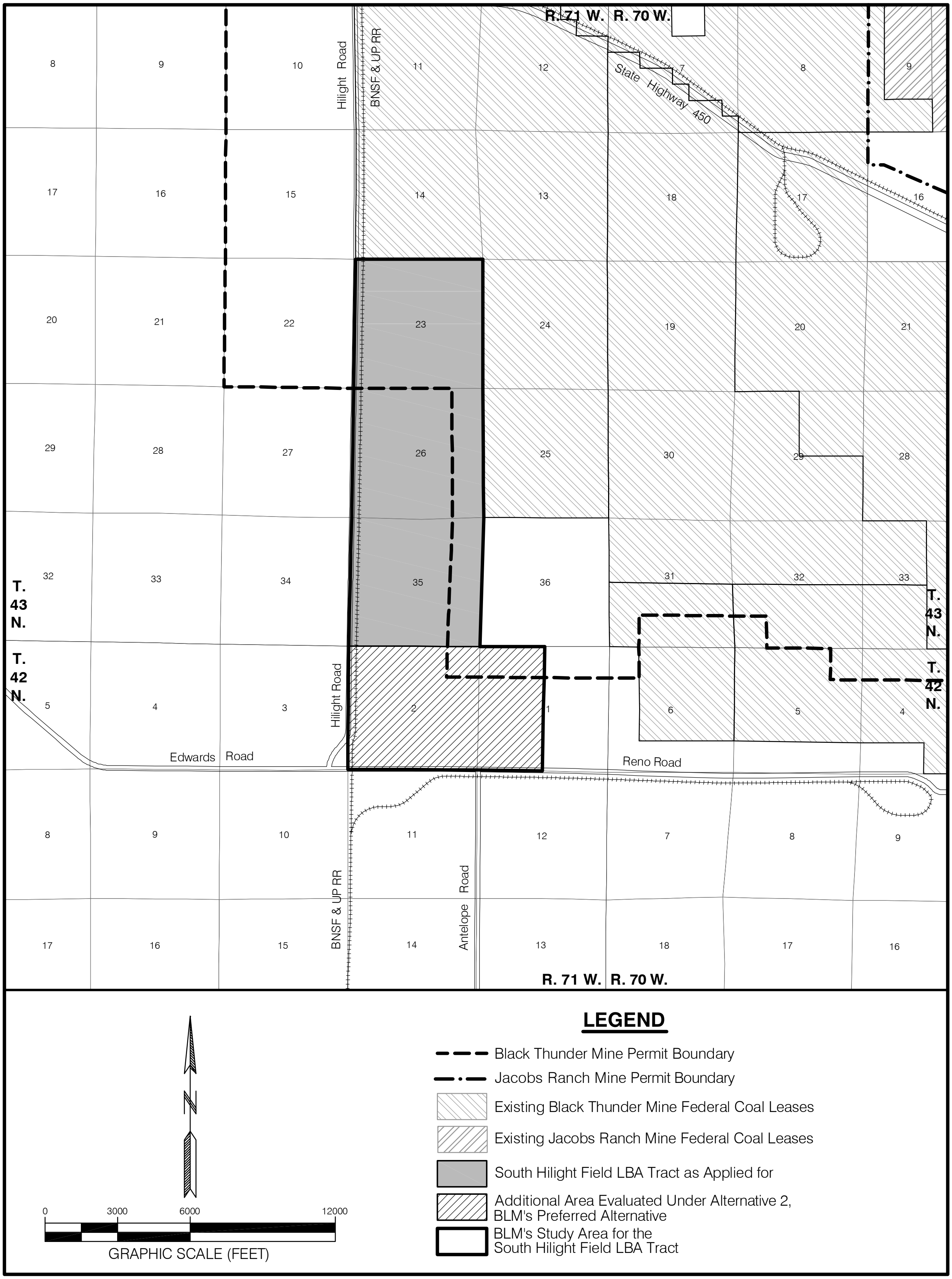

Figure ES-3. South Hilight Field LBA Tract Alternatives.

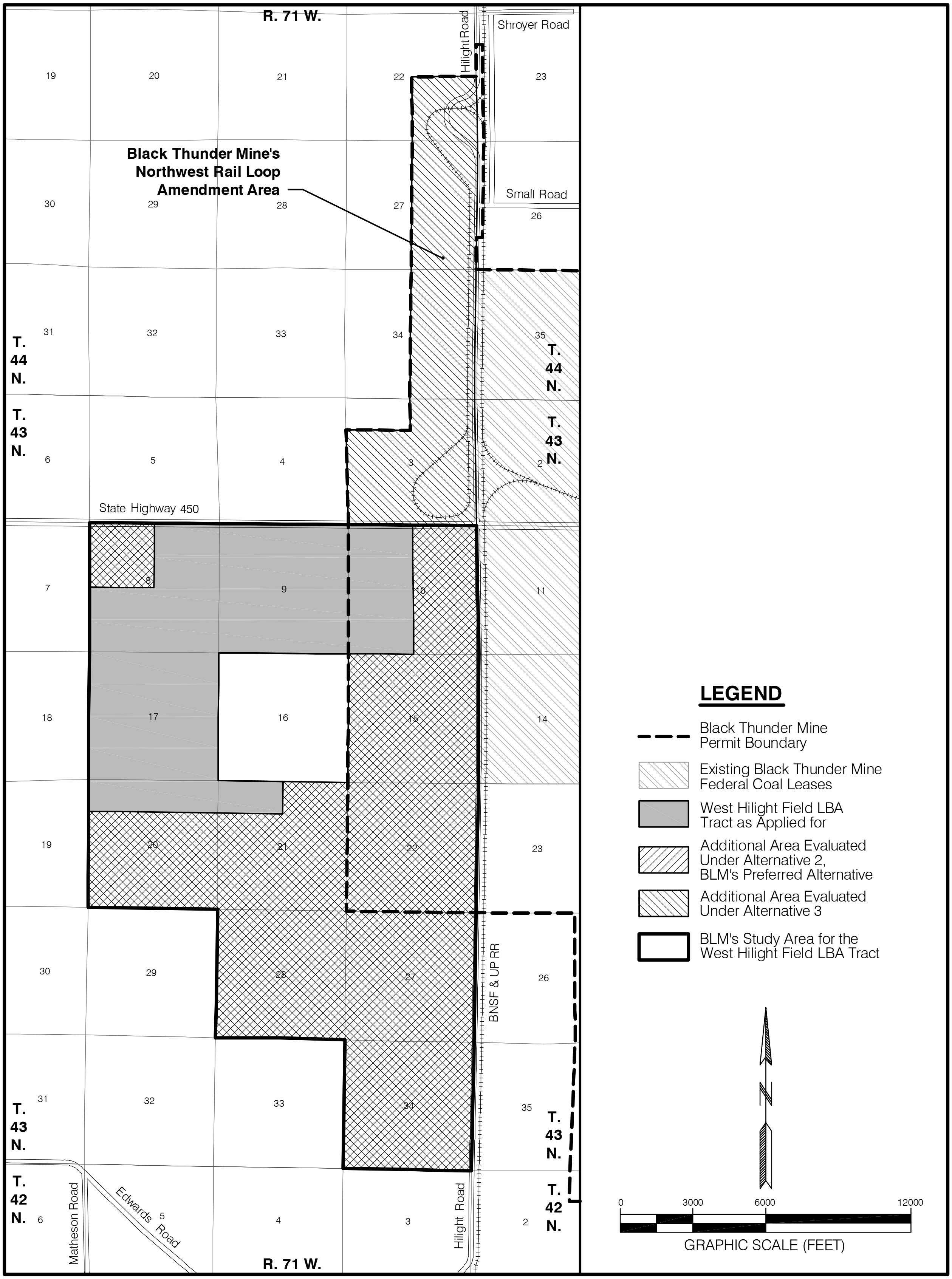

Figure ES-4. West Hilight Field LBA Tract Alternatives.

The federal coal reserves were applied for as a maintenance tract for the Black Thunder Mine.

On March 24, 2006, Jacobs Ranch Coal Company (JRCC) filed an application with the BLM for federal coal reserves in a tract located approximately 0.75 mile west of the Jacobs Ranch Mine in Campbell County, Wyoming. The tract, which is referred to as the West Jacobs Ranch LBA Tract, is located approximately 2.5 miles east of Wright, Wyoming (Figures ES-1 and ES-5). The federal coal reserves were applied for as a maintenance tract for the Jacobs Ranch Mine. On October 1, 2009, the Jacobs Ranch Mine was acquired by Arch Coal, Inc. ALC intends to consolidate the permits for the Jacobs Ranch Mine and the Black Thunder Mine in order to integrate the two separate mining operations. In this EIS, the applicant for the West Jacobs Ranch LBA Tract will be referred to as ALC. ALC's coal lease application was assigned case file number WYW172685.

On September 29, 2006, BTU Western Resources, Inc. (BTU) filed an application with the BLM for federal coal reserves in three separate tracts located west, northwest, and north of and immediately adjacent to the North Antelope Rochelle Mine in Campbell County, Wyoming. The two tracts on the north side of the mine were referred to as the North Porcupine LBA Tract, and the tract on the west side of the mine was referred to as the South Porcupine LBA Tract. On October 12, 2007, BTU filed a request with the BLM to modify the Porcupine LBA Tract configuration to increase the lease area and coal volume. The North Porcupine LBA Tract, which is located approximately 12 miles southeast of Wright, Wyoming, was combined into one tract and its size was increased with additional lands (Figures ES-1 and ES-6). The South Porcupine LBA Tract, which is located approximately 14 miles southeast of Wright, was also increased in size with additional lands (Figure ES-1 and ES-7). BLM reviewed the modified tract configuration and notified the company that their application had been modified. The federal coal reserves were applied for as maintenance tracts for the North Antelope Rochelle Mine. BLM determined that the two tracts in the application would be processed separately and, if the decision is made to conduct a lease sale, would be offered for sale separately. The North Antelope Rochelle Mine is operated by Powder River Coal, LLC (PRC), a subsidiary of Peabody Energy Corporation (PEC). BTU is also a subsidiary of PEC, and in this EIS, BTU is referred to as the applicant and PRC is referred to in discussions of mine operations. BTU's coal lease application was assigned case file numbers WYW173408 (North Porcupine) and WYW176095 (South Porcupine).

These federal coal lands are located within the Powder River Federal Coal Region, which was decertified in January, 1990. Although the Powder River Federal Coal Region is decertified, the Powder River Regional Coal Team (PRRCT), a federal/state advisory board established to develop recommendations concerning management of federal coal in the PRB, has continued to meet regularly and review all federal lease applications in the region. The PRRCT reviewed the North Hilight Field, South Hilight Field, West

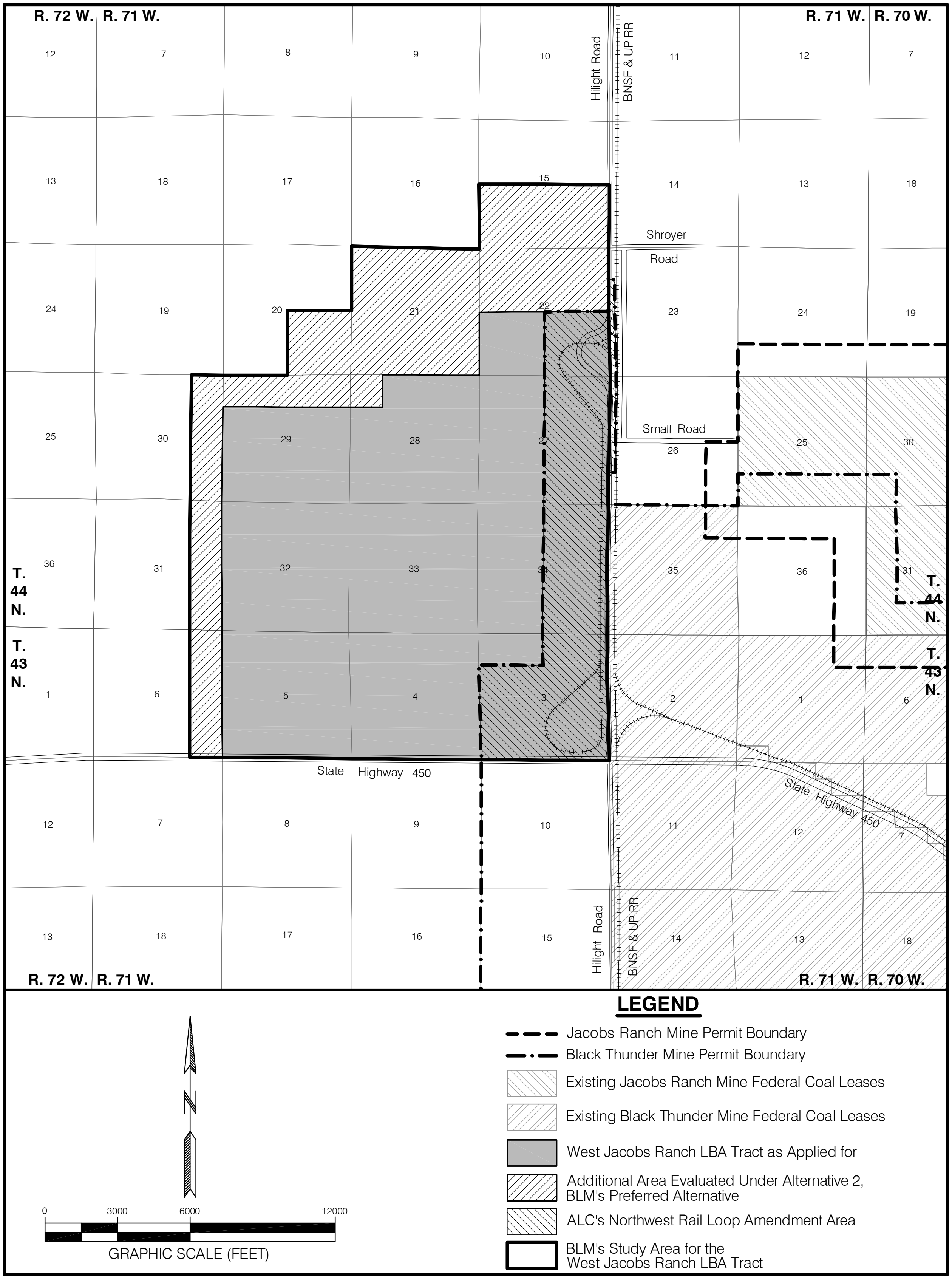

Figure ES-5. West Jacobs Ranch LBA Tract Alternatives.

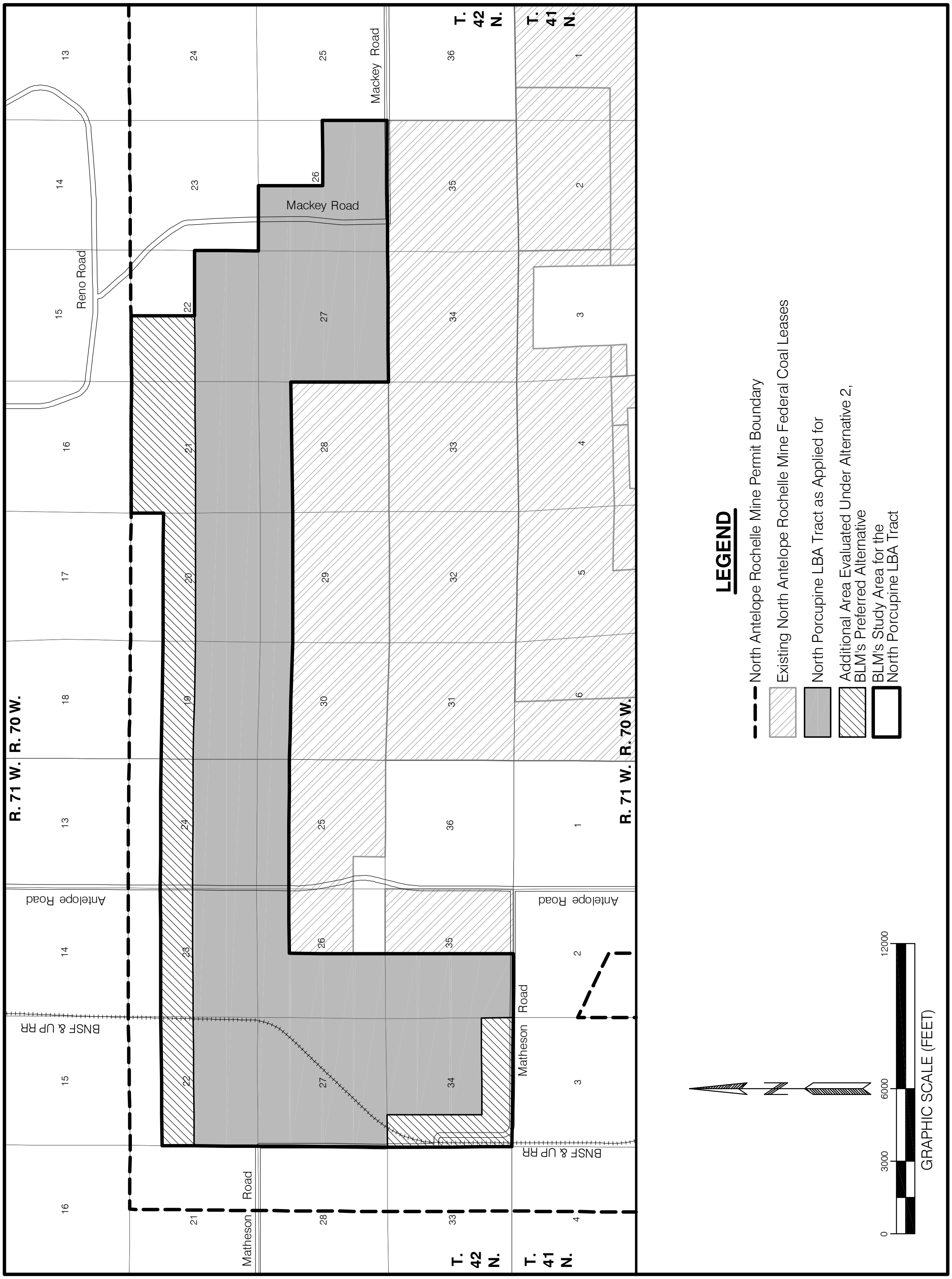

Figure ES-6. North Porcupine LBA Tract Alternatives.

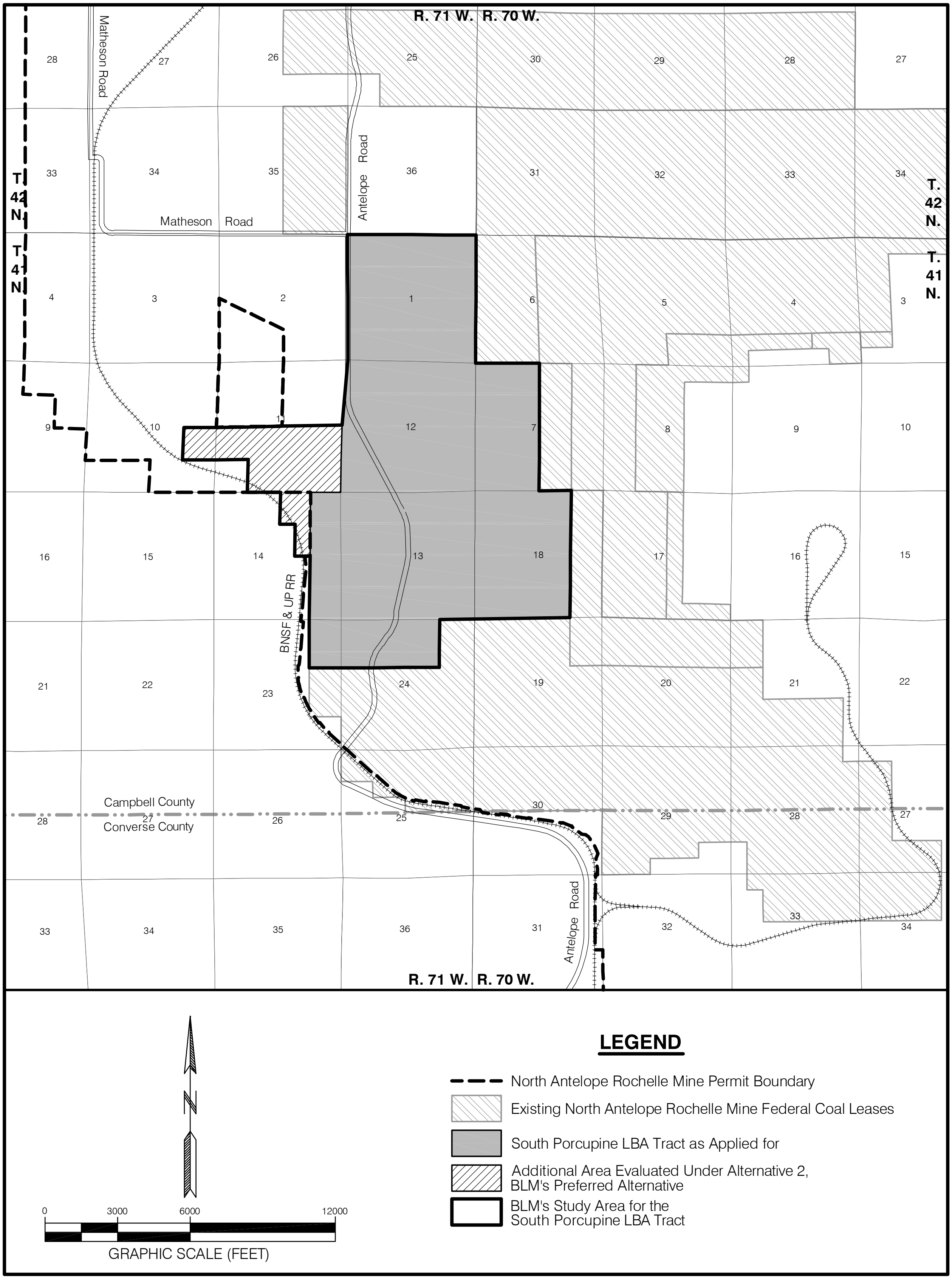

Figure ES-7. South Porcupine LBA Tract Alternatives.

Hilight Field, and West Jacobs Ranch maintenance coal lease applications at a public meeting held on April 19, 2006 in Casper, Wyoming. The PRRCT reviewed the Porcupine maintenance coal lease application at a public meeting held on January 18, 2007 in Casper, Wyoming. The PRRCT recommended that the BLM process all four lease applications at those respective meetings.

Evaluation Process

In order to process an LBA, BLM must evaluate the quantity, quality, maximum economic recovery, and fair market value of the federal coal and fulfill the requirements of the National Environmental Policy Act of 1969 (NEPA) by evaluating the environmental consequences of leasing the federal coal.

To evaluate the environmental impacts of leasing the coal, BLM must prepare an Environmental Assessment (EA) or an EIS to evaluate the site-specific and cumulative environmental and socioeconomic impacts of leasing and developing the federal coal in an application area. Due to the proximity of the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts, BLM made a decision to prepare a single EIS to evaluate the environmental impacts of coal mining that would be expected to result if leases are issued for these maintenance coal tracts. BLM does not authorize mining by issuing a lease for federal coal, but the impacts of mining the coal are considered in this EIS because it is a logical consequence of issuing a maintenance lease to an existing mine. Applicants must obtain permits from appropriate state and/or federal agencies to mine the coal.

The Environmental Protection Agency (EPA) published a notice announcing the availability of the Draft EIS in the *Federal Register* on June 26, 2009. The BLM published a Notice of Availability and Notice of Public Hearing for the Draft EIS in the *Federal Register* on July 8, 2009. The 60-day comment period on the Draft EIS ended 60 days following EPA's Notice of Availability (August 25, 2009). A public hearing was held on July 29 in Gillette, Wyoming to solicit public comments on the Draft EIS, the fair market value, the maximum economic recovery, and the proposed competitive sale of coal from the six LBA tracts. Two individuals representing organizations presented statements on the Draft EIS during the hearing, and written comments were received from 15 individuals, agencies, businesses, and organizations, as well as telephoned comments and hundreds of e-mails from interested individuals and entities during the comment period. A summary of the statements that were presented at the public hearing and the public comments, with agency responses, are included as Appendix I of this Final EIS.

BLM will use the analysis in this EIS to decide whether or not to hold a coal lease sale for each of the federal coal tracts and issue federal coal leases. The LBA sale process is, by law and regulation, an open, public, competitive sealed-bid process. If a sale is held for a tract, the bidding would be open to any qualified bidder; it would not be limited to the applicant. If a separate lease sale is held for each of these six LBA tracts (North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine), the applicants (ALC and BTU) may not be the successful high bidders. If a lease sale is held for the federal coal included in each of the six LBA tracts, a federal sale panel selects the highest bidder at the sale. In order to be awarded a federal coal lease, the highest bid must meet or exceed the fair market value of the coal as determined by the BLM's economic evaluation, and if the U.S. Department of Justice determines that no antitrust violations would result from assigning the lease to the high bidder. Additionally, the high bidder cannot have any antitrust violations.

The successful bidder would then be required to submit a mine permit application, including detailed mining, monitoring, mitigation, and reclamation plans to the Wyoming Department of Environmental Quality/Land Quality Division (WDEQ/LQD) for review. The operator would also be required to submit a Resource Recovery and Protection Plan (R2P2) to the BLM for review. Before mining operations could begin in the new tract, the mining permit must be approved by WDEQ/LQD, the R2P2 must be approved by the BLM, and a Mineral Leasing Act mining plan must be approved by the Assistant Secretary of the Interior. In addition, a new coal mine, or a modification to an existing mine, must be permitted by the WDEQ/Air Quality Division (AQD).

Other agencies, including OSM, will also use this analysis to make decisions related to leasing and mining the federal coal in these six tracts. Cooperating agencies in the preparation of this EIS include the WDEQ, Office of Surface Mining Reclamation and Enforcement (OSM), U.S. Department of Agriculture-Forest Service (USFS), Wyoming Department of Transportation (WYDOT), and Converse County Board of Commissioners.

Not all of the coal included in the North Hilight Field LBA Tract as applied for is considered mineable at this time. Some of the coal included in the tract is located within the Burlington Northern Santa Fe & Union Pacific (BNSF & UP) railroad right-of-way (ROW). TBCC does not consider the coal underlying the railroad ROW to be recoverable at this time because the cost that would be associated with moving the railroad would make it economically unfeasible to recover the underlying coal. In addition to the railroad, two county roads border or cross some of the coal included in the North Hilight Field LBA Tract. The Small Road (Campbell County Road 89) crosses the LBA tract, and the Shroyer Road (Campbell County Road 116) borders the LBA tract. The Surface Mining Control and Reclamation Act of 1977 (SMCRA) prohibits mining within 100 feet on either side of the ROW 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)). JRCC has obtained approval from the Campbell County Board of Commissioners, the authorized agency, to close the Small Road. The coal underlying the portion of Shroyer Road, its ROW and the 100-foot buffer zone within the North Hilight

Field LBA Tract is included for consideration for leasing because that coal could be mined if the Campbell County Commissioners determines that the road can be closed or relocated (43 CFR 3461.5(c)(2)(iii)). If the road is not moved, including the coal underlying the road in the lease would allow maximum recovery of all the mineable coal adjacent to the 100-foot buffer zone on either side of the road ROW.

Not all of the coal included in the South Hilight Field LBA Tract as applied for is considered mineable at this time. Some of the coal included in the tract is located within the BNSF & UP railroad ROW. TBCC does not consider the coal underlying the railroad ROW to be recoverable at this time because the cost that would be associated with moving the railroad would make it economically unfeasible to recover the underlying coal.

Not all of the coal included in the West Hilight Field LBA Tract as applied for is considered mineable at this time. A portion of Wyoming State Highway 450 borders the tract; therefore, the highway and its ROW overlie some of the coal included in the tract. SMCRA prohibits mining within 100 feet on either side of the ROW of any public road. However, the appropriate public road authority can allow 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)]. For State Highway 450 west of the BNSF & UP railroad mainline, an unsuitability decision (43 CFR 3461) is deferred subject to a finding under this process (BLM 2001a). The coal underlying the portion of Highway 450, its ROW, and the 100-foot buffer zone within the West Hilight Field LBA Tract is included for consideration for leasing. That coal could be mined if the Wyoming Department of Transportation (WYDOT), the authorized agency, determines that the road can be moved [43 CFR 3461.5(c)(2)(iii)]. Including the coal underlying the highway in the lease would allow maximum recovery of all the mineable coal adjacent to the 100-foot buffer zone beside the highway ROW if the highway is not moved.

Not all of the coal included in the West Jacobs Ranch LBA Tract as applied for is considered mineable at this time. A portion of Wyoming State Highway 450 and a portion of the Hilight Road (Campbell County Road 52) overlie some of the coal included in the tract. SMCRA prohibits mining within 100 feet on either side of the ROW of any public road. However, the appropriate public road authority can allow 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)]. For State Highway 450 west of the BNSF & UP railroad mainline (Figure ES-5), an unsuitability decision (43 CFR 3461) is deferred subject to a finding under this process (BLM 2001a). The coal underlying the portions of Highway 450 and the Hilight Road, their ROWs, and the associated 100-foot buffer zones within the West Jacobs Ranch LBA Tract is included for consideration for leasing. That coal could be mined if WYDOT and/or the Campbell County Board of Commissioners (authorized agencies), determine that the roads can be moved [43 CFR 3461.5(c)(2)(iii)]. Including the coal underlying the highway and

Hilight Road in the lease would allow maximum recovery of all the mineable coal adjacent to the 100-foot buffer zones beside the highway and road ROWs if the State Highway and Hilight Road are not moved.

Not all of the coal included in the North Porcupine LBA Tract as applied for is considered mineable at this time. Some of the coal included in the tract is located within the BNSF & UP railroad ROW. PRC does not consider the coal underlying the railroad ROW to be recoverable at this time because the cost that would be associated with moving the railroad would make it economically unfeasible to recover the underlying coal. Moreover, the coal beneath those portions of the BNSF & UP railroad ROW on federally administered surface lands in the North Porcupine tract was determined to be unsuitable for mining according to the coal mining Unsuitability Criteria (43 CFR 3461). Some of the coal included in the North Porcupine tract is located within the Teckla Substation layback buffer zone. Due to the requirement that no blasting operations be conducted within 500 feet of a substation, the coal underlying the substation buffer zone is not considered mineable at this time by PRC because the cost that would be associated with moving the substation would make it economically unfeasible to recover. In addition to the railroad and substation, three county roads cross or border some of the coal included in the North Porcupine LBA Tract. The Antelope Road (Campbell County Road 4) overlies the tract; the Matheson Road (Campbell County Road 70) borders the tract; and the Mackey Road (Campbell County Road 69, Alternate 1) crosses and borders the tract. SMCRA prohibits mining within 100 feet on either side of the ROW 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)). The coal underlying those portions of these roads, their ROWs, and the associated 100-foot buffer zones within the North Porcupine tract is included for consideration for leasing because that coal could be mined if the Campbell County Board of Commissioners, the authorized agency, determines that the roads can be closed or relocated (43 CFR 3461.5(c)(2)(iii)). PRC has obtained approval from the Campbell County Board of Commissioners to close and relocate those portions of the Antelope and Matheson roads that cross and border the North Porcupine LBA Tract. If the Mackey Road is not closed or relocated, including the coal underlying the road in the lease would allow maximum recovery of all the mineable coal adjacent to the 100-foot buffer zone on either side of the road ROW. PRC is evaluating the feasibility of relocating the Mackey Road.

Not all of the coal included in the South Porcupine LBA Tract as applied for is considered mineable at this time. The BNSF & UP railroad line lies just west of the tract, and some of the coal included in the tract is located within a 1,000-foot wide layback buffer zone on the east side of the railroad ROW centerline. PRC does not consider the coal underlying the railroad layback buffer zone to be recoverable at this time because the cost that would be associated with moving the railroad would make it economically unfeasible to recover that coal. In addition to the railroad buffer, a portion of the Antelope Road (Campbell

County Road 4) crosses some of the coal included in the South Porcupine LBA Tract. SMCRA prohibits mining within 100 feet on either side of the ROW 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)). The coal underlying the portion of Antelope Road, its ROW, and the 100-foot buffer zone within the South Porcupine LBA Tract is included for consideration for leasing because it could be mined if the Campbell County Board of Commissioners (authorized agency) determine that the road can be closed or relocated (43 CFR 3461.5(c)(2)(iii)). PRC has obtained approval from the Campbell County Board of Commissioners to close and relocate a portion (approximately 1.25 miles) of Antelope Road that crosses the tract. PRC plans to apply for approval to close and relocate the remainder (approximately 2.25 miles) of Antelope Road that crosses the South Porcupine tract. Including the coal underlying the 2.25-mile portion of Antelope Road in the lease would allow maximum recovery of all the mineable coal adjacent to the 100-foot buffer zone on either side of the road if the remainder of the road is not moved. PRC is evaluating the feasibility of relocating the remainder of this county road.

A decision to lease the federal coal lands in these applications would be in conformance with the *Approved Resource Management Plan for Public Lands Administered by the Bureau of Land Management Buffalo Field Office* (BLM 2001a) and with the *Land and Resource Management Plan for the Thunder Basin National Grassland, Medicine Bow-Routt National Forest* (USFS 2001).

Proposed Actions and Alternatives

The Proposed Actions and alternatives to those actions are analyzed in detail in this Final EIS.

- **Proposed Action** - The Proposed Action for each LBA tract is to hold a competitive coal lease sale and issue a maintenance lease to the successful bidder for the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts as applied for (Figures ES-2 through ES-7, respectively). The applicant mines' estimates of the coal reserve, lease area and surface disturbance area for each tract as applied for are included in Tables ES-1 through ES-12. The applicant mines' estimated future coal production, remaining mine life, and employment are also given in Tables ES-1 through ES-12.

- **Alternative 1** - Under Alternative 1, the No Action Alternative for each tract, the LBA tracts would not be leased, but the existing leases at the adjacent Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines would be developed according to the existing approved mining plans. The applicant mines' remaining coal reserves, lease areas, future coal production rates, and employments are included in Tables ES-1

Table ES-1. Summary Comparison of Coal Production, Surface Disturbance, Mine Life, and Revenues for North Hilight Field LBA Tract and Black Thunder Mine – Shroyer Road is Not Moved and the Underlying Coal is Not Recovered.

Item	Alternative 1 - No Action Alternative (Existing Black Thunder Mine)	Added by Proposed Action	Added by Alternative 2
In-Place Coal (as of 1/1/09)	1,271.1 mmt	319.7 mmt	756.9 mmt
Mineable Coal (as of 1/1/09)[1]	1,271.1 mmt	286.3 mmt	709.6 mmt
Recoverable Coal (as of 1/1/09)[2]	1,169.4 mmt	263.4 mmt	652.8 mmt
Coal Mined Through 2008	1,087.9 mmt	--	--
Lease Area[3]	19,581.3 ac	2,613.5 ac	7,139.4 ac
Total Area To Be Disturbed[3]	26,490.2 ac	5,053.0 ac	12,908.8 ac
Permit Area[3]	29,212.0 ac	5,053.0 ac	12,908.8 ac
Average Annual Coal Production (by 2015)[4]	135 mmt	0 mmt	0 mmt
Remaining Life of Mine (post-2008)	9.3 yrs	2.0 yrs	4.8 yrs
Projected Number of Employees (by 2013)[4]	1,324	0	0
Total Projected State Revenues (post-2008)[5]	$1,977.9 mm	$488.5 – $584.4 mm	$1,210.5 – $1,448.3 mm
Total Projected Federal Revenues (post-2008)[6]	$1,541.1 mm	$390.1 – $486.0 mm	$966.8 – $1,204.5 mm

1 Under the Proposed Action and Alternative 2, the mineable coal figure excludes all coal that would not be mined beneath the BNSF & UP railroad ROW and associated buffer zone and Shroyer Road ROW and associated buffer zone.

2 Assumes 92 percent recovery of mineable coal that occurs during normal mining operation.

3 The lease area figure includes federal coal leases only and does not include state and private coal within the permit boundary. The disturbed area exceeds the leased area (total federal and state) because of the need for highwall reduction, topsoil removal, and other mine support activities outside the lease boundaries. The permit area is larger than the leased or disturbed area to assure that all disturbed lands are within the permit boundary and to allow an easily defined legal land description.

4 The mine projects to increase production rate from 100 mmtpy after 2008 to 135 mmtpy by 2015. The mine projects to increase employment from 1,080 to 1,324 as projected production increases.

5 Revenues to the State of Wyoming include severance taxes, property and production taxes (ad valorem), sales and use taxes, and Wyoming's share of federal royalty payments, AML fees and bonus bid payments. State revenues are based on $0.4312 per ton estimate for severance taxes × amount of recoverable coal, plus $0.372 per ton estimate for ad valorem taxes × amount of recoverable coal, plus $0.0569 per ton estimate for sales and use taxes × amount of recoverable coal, plus a projected coal price of $11.06 per ton × amount of recoverable coal × federal royalty of 12.5 percent minus federal's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus federal's 50 percent share, plus bonus bid payment on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus bid payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus federal's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

6 Federal revenues include black lung taxes and the federal government's share of federal royalty payments, AML fees, and bonus bid payments. Federal revenues are based on a projected coal price of $11.06 per ton × amount of recoverable coal × black lung tax of 4.4 percent, plus $11.06 per ton price × amount of recoverable coal × federal royalty of 12.5 percent minus state's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus state's 50 percent share, plus bonus bid payments on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus state's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

Table ES-2. Summary Comparison of Coal Production, Surface Disturbance, Mine Life, and Revenues for North Hilight Field LBA Tract and Black Thunder Mine – Shroyer Road is Moved and the Underlying Coal is Recovered.

Item	Alternative 1 - No Action Alternative (Existing Black Thunder Mine)	Added by Proposed Action	Added by Alternative 2
In-Place Coal (as of 1/1/09)	1,271.1 mmt	319.7 mmt	756.9 mmt
Mineable Coal (as of 1/1/09)[1]	1,271.1 mmt	295.8 mmt	727.5 mmt
Recoverable Coal (as of 1/1/09)[2]	1,169.4 mmt	272.1 mmt	669.3 mmt
Coal Mined Through 2008	1,087.9 mmt	--	--
Lease Area[3]	19,581.3 ac	2,613.5 ac	7,139.4 ac
Total Area To Be Disturbed[3]	26,490.2 ac	5,053.0 ac	12,908.8 ac
Permit Area[3]	29,212.0 ac	5,053.0 ac	12,908.8 ac
Average Annual Coal Production (by 2015)[4]	135 mmt	0 mmt	0 mmt
Remaining Life of Mine (post-2008)	9.3 yrs	2.0 yrs	5.0 yrs
Projected Number of Employees (by 2013)[4]	1,324	0	0
Total Projected State Revenues (post-2008)[5]	$1,977.9 mm	$504.6 – $603.7 mm	$1,241.1 – $1,484.9 mm
Total Projected Federal Revenues (post-2008)[6]	$1,541.1 mm	$403.0 – $502.1 mm	$991.2 – $1,234.9 mm

1 Under the Proposed Action and Alternative 2, the mineable coal figure excludes all coal that would not be mined beneath BNSF & UP railroad ROW and associated buffer zone.

2 Assumes 92 percent recovery of mineable coal that occurs during normal mining operation.

3 The lease area figure includes federal coal leases only and does not include state and private coal within the permit boundary. The disturbed area exceeds the leased area (total federal and state) because of the need for highwall reduction, topsoil removal, and other mine support activities outside the lease boundaries. The permit area is larger than the leased or disturbed area to assure that all disturbed lands are within the permit boundary and to allow an easily defined legal land description.

4 The mine projects to increase production rate from 100 mmtpy after 2008 to 135 mmtpy by 2015. The mine projects to increase employment from 1,080 to 1,324 as projected production increases.

5 Revenues to the State of Wyoming include severance taxes, property and production taxes (ad valorem), sales and use taxes, and Wyoming's share of federal royalty payments, AML fees and bonus bid payments. State revenues are based on $0.4312 per ton estimate for severance taxes × amount of recoverable coal, plus $0.372 per ton estimate for ad valorem taxes × amount of recoverable coal, plus $0.0569 per ton estimate for sales and use taxes × amount of recoverable coal, plus a projected coal price of $11.06 per ton × amount of recoverable coal × federal royalty of 12.5 percent minus federal's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus federal's 50 percent share, plus bonus bid payment on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus bid payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus federal's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

6 Federal revenues include black lung taxes and the federal government's share of federal royalty payments, AML fees, and bonus bid payments. Federal revenues are based on a projected coal price of $11.06 per ton × amount of recoverable coal × black lung tax of 4.4 percent, plus $11.06 per ton price × amount of recoverable coal × federal royalty of 12.5 percent minus state's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus state's 50 percent share, plus bonus bid payments on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus state's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

Table ES-3. Summary Comparison of Coal Production, Surface Disturbance, Mine Life, and Revenues for South Hilight Field LBA Tract and Black Thunder Mine – Reno Road is Not Moved and the Underlying Coal is Not Recovered.

Item	Alternative 1 - No Action Alternative (Existing Black Thunder Mine)	Added by Proposed Action	Added by Alternative 2
In-Place Coal (as of 1/1/09)	1,271.1 mmt	273.3 mmt	406.5 mmt
Mineable Coal (as of 1/1/09)[1]	1,271.1 mmt	232.2 mmt	330.8 mmt
Recoverable Coal (as of 1/1/09)[2]	1,169.4 mmt	213.6 mmt	304.3 mmt
Coal Mined Through 2008	1,087.9 mmt	--	--
Lease Area[3]	19,581.3 ac	1,976.7 ac	2,922.4 ac
Total Area To Be Disturbed[3]	26,490.2 ac	1,126.0 ac	2,731.4 ac
Permit Area[3]	29,212.0 ac	1,126.0 ac	2,731.4 ac
Average Annual Coal Production (by 2015)[4]	135 mmt	0 mmt	0 mmt
Remaining Life of Mine (post-2008)	9.3 yrs	1.6 yrs	2.3 yrs
Projected Number of Employees (by 2013)[4]	1,324	0	0
Total Projected State Revenues (post-2008)[5]	$1,977.9 mm	$396.1 – $473.9 mm	$564.3 – $675.1 mm
Total Projected Federal Revenues (post-2008)[6]	$1,541.1 mm	$316.3 – $394.1 mm	$450.7 – $561.5 mm

1 Under the Proposed Action and Alternative 2, the mineable coal figure excludes all coal that would not be mined beneath BNSF & UP railroad ROW and associated buffer zone. Under Alternative 2, the mineable coal figure excludes all coal that would not be mined beneath Reno Road ROW and associated buffer zone.

2 Assumes 92 percent recovery of mineable coal that occurs during normal mining operation.

3 The lease area figure includes federal coal leases only and does not include state and private coal within the permit boundary. The disturbed area exceeds the leased area (total federal and state) because of the need for highwall reduction, topsoil removal, and other mine support activities outside the lease boundaries. The permit area is larger than the leased or disturbed area to assure that all disturbed lands are within the permit boundary and to allow an easily defined legal land description.

4 The mine projects to increase production rate from 100 mmtpy after 2008 to 135 mmtpy by 2015. The mine projects to increase employment from 1,080 to 1,324 as projected production increases.

5 Revenues to the State of Wyoming include severance taxes, property and production taxes (ad valorem), sales and use taxes, and Wyoming's share of federal royalty payments, AML fees and bonus bid payments. State revenues are based on $0.4312 per ton estimate for severance taxes × amount of recoverable coal, plus $0.372 per ton estimate for ad valorem taxes × amount of recoverable coal, plus $0.0569 per ton estimate for sales and use taxes × amount of recoverable coal, plus a projected coal price of $11.06 per ton × amount of recoverable coal × federal royalty of 12.5 percent minus federal's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus federal's 50 percent share, plus bonus bid payment on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus bid payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus federal's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

6 Federal revenues include black lung taxes and the federal government's share of federal royalty payments, AML fees, and bonus bid payments. Federal revenues are based on a projected coal price of $11.06 per ton × amount of recoverable coal × black lung tax of 4.4 percent, plus $11.06 per ton price × amount of recoverable coal × federal royalty of 12.5 percent minus state's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus state's 50 percent share, plus bonus bid payments on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus state's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

Table ES-4. Summary Comparison of Coal Production, Surface Disturbance, Mine Life, and Revenues for South Hilight Field LBA Tract and Black Thunder Mine – Reno Road is Moved and the Underlying Coal is Recovered.

Item	Alternative 1 - No Action Alternative (Existing Black Thunder Mine)	Added by Proposed Action	Added by Alternative 2
In-Place Coal (as of 1/1/09)	1,271.1 mmt	273.3 mmt	406.5 mmt
Mineable Coal (as of 1/1/09)[1]	1,271.1 mmt	232.2 mmt	347.8 mmt
Recoverable Coal (as of 1/1/09)[2]	1,169.4 mmt	213.6 mmt	320.0 mmt
Coal Mined Through 2008	1,087.9 mmt	--	--
Lease Area[3]	19,581.3 ac	1,976.7 ac	2,922.4 ac
Total Area To Be Disturbed[3]	26,490.2 ac	1,126.0 ac	2,731.4 ac
Permit Area[3]	29,212.0 ac	1,126.0 ac	2,731.4 ac
Average Annual Coal Production (by 2015)[4]	135 mmt	0 mmt	0 mmt
Remaining Life of Mine (post-2008)	9.3 yrs	1.6 yrs	2.4 yrs
Projected Number of Employees (by 2013)[4]	1,324	0	0
Total Projected State Revenues (post-2008)[5]	\$1,977.9 mm	\$396.1 – \$473.9 mm	\$593.4 – \$709.9 mm
Total Projected Federal Revenues (post-2008)[6]	\$1,541.1 mm	\$316.3 – \$394.1 mm	\$473.9 – \$590.4 mm

1 Under the Proposed Action and Alternative 2, the mineable coal figure excludes all coal that would not be mined beneath BNSF & UP railroad ROW and associated buffer zone.

2 Assumes 92 percent recovery of mineable coal that occurs during normal mining operation.

3 The lease area figure includes federal coal leases only and does not include state and private coal within the permit boundary. The disturbed area exceeds the leased area (total federal and state) because of the need for highwall reduction, topsoil removal, and other mine support activities outside the lease boundaries. The permit area is larger than the leased or disturbed area to assure that all disturbed lands are within the permit boundary and to allow an easily defined legal land description.

4 The mine projects to increase production rate from 100 mmtpy after 2008 to 135 mmtpy by 2015. The mine projects to increase employment from 1,080 to 1,324 as projected production increases.

5 Revenues to the State of Wyoming include severance taxes, property and production taxes (ad valorem), sales and use taxes, and Wyoming's share of federal royalty payments, AML fees and bonus bid payments. State revenues are based on \$0.4312 per ton estimate for severance taxes × amount of recoverable coal, plus \$0.372 per ton estimate for ad valorem taxes × amount of recoverable coal, plus \$0.0569 per ton estimate for sales and use taxes × amount of recoverable coal, plus a projected coal price of \$11.06 per ton × amount of recoverable coal × federal royalty of 12.5 percent minus federal's 50 percent share, plus \$0.28 per ton for AML fees × amount of recoverable coal minus federal's 50 percent share, plus bonus bid payment on LBA leased coal of \$0.30 to \$0.97 per ton (based on the range of bonus bid payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus federal's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

6 Federal revenues include black lung taxes and the federal government's share of federal royalty payments, AML fees, and bonus bid payments. Federal revenues are based on a projected coal price of \$11.06 per ton × amount of recoverable coal × black lung tax of 4.4 percent, plus \$11.06 per ton price × amount of recoverable coal × federal royalty of 12.5 percent minus state's 50 percent share, plus \$0.28 per ton for AML fees × amount of recoverable coal minus state's 50 percent share, plus bonus bid payments on LBA leased coal of \$0.30 to \$0.97 per ton (based on the range of bonus payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus state's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

Table ES-5. Summary Comparison of Coal Production, Surface Disturbance, Mine Life, and Revenues for West Hilight Field LBA Tract and Black Thunder Mine – State Highway 450 and Hilight Road are Not Moved and the Underlying Coal is Not Recovered.

Item	Alternative 1 – No Action Alternative (Existing Black Thunder Mine)	Added by Proposed Action	Added by Alternative 2	Added by Alternative 3
In-Place Coal (as of 1/1/09)	1,271.1 mmt	440.4 mmt	1,147.9 mmt	1,373.4 mmt
Mineable Coal (as of 1/1/09)[1]	1,271.1 mmt	410.8 mmt	1,049.1 mmt	1,049.1 mmt
Recoverable Coal (as of 1/1/09)[2]	1,169.4 mmt	377.9 mmt	965.2 mmt	965.2 mmt
Coal Mined Through 2008	1,087.9 mmt	--	--	--
Lease Area[3]	19,581.3 ac	2,370.5 ac	7,191.3 ac	8,570.1 ac
Total Area To Be Disturbed[3]	26,490.2 ac	6,351.4 ac	10,250.8 ac	10,250.8 ac
Permit Area[3]	29,212.0 ac	6,351.4 ac	10,250.8 ac	10,250.8 ac
Average Annual Coal Production (by 2015)[4]	135 mmt	0 mmt	0 mmt	0 mmt
Remaining Life of Mine (post-2008)	9.3 yrs	2.8 yrs	7.1 yrs	7.1 yrs
Projected Number of Employees (by 2013)[4]	1,324	0	0	0
Total Projected State Revenues (post-2008)[5]	$1,977.9 mm	$700.8 – $838.4 mm	$1,789.9 – $2,141.3 mm	$1,789.9 – $2,141.3 mm
Total Projected Federal Revenues (post-2008)[6]	$1,541.1 mm	$559.7 – $697.3 mm	$1,429.4 – $1,780.8 mm	$1,429.4 – $1,780.8 mm

1 Under the Proposed Action, the mineable coal figure excludes all coal that would not be mined beneath State Highway 450 ROW and associated buffer zone. Under Alternatives 2 and 3, the mineable coal figure excludes all coal that would not be mined beneath State Highway 450 and Hilight Road ROWs and associated buffer zones. Under Alternative 3, the mineable coal figure excludes all coal that would not be mined beneath the Northwest Rail Loop Amendment Area.

2 Assumes 92 percent recovery of mineable coal that occurs during normal mining operation.

3 The lease area figure includes federal coal leases only and does not include state and private coal within the permit boundary. The disturbed area exceeds the leased area (total federal and state) because of the need for highwall reduction, topsoil removal, and other mine support activities outside the lease boundaries. The permit area is larger than the leased or disturbed area to assure that all disturbed lands are within the permit boundary and to allow an easily defined legal land description.

4 The mine projects to increase production rate from 100 mmtpy after 2008 to 135 mmtpy by 2015. The mine projects to increase employment from 1,080 to 1,324 as projected production increases.

5 Revenues to the State of Wyoming include severance taxes, property and production taxes (ad valorem), sales and use taxes, and Wyoming's share of federal royalty payments, AML fees and bonus bid payments. State revenues are based on $0.4312 per ton estimate for severance taxes × amount of recoverable coal, plus $0.372 per ton estimate for ad valorem taxes × amount of recoverable coal, plus $0.0569 per ton estimate for sales and use taxes × amount of recoverable coal, plus a projected coal price of $11.06 per ton × amount of recoverable coal × federal royalty of 12.5 percent minus federal's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus federal's 50 percent share, plus bonus bid payment on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus bid payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus federal's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

6 Federal revenues include black lung taxes and the federal government's share of federal royalty payments, AML fees, and bonus bid payments. Federal revenues are based on a projected coal price of $11.06 per ton × amount of recoverable coal × black lung tax of 4.4 percent, plus $11.06 per ton price × amount of recoverable coal × federal royalty of 12.5 percent minus state's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus state's 50 percent share, plus bonus bid payments on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus state's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

Table ES-6. Summary Comparison of Coal Production, Surface Disturbance, Mine Life, and Revenues for West Hilight Field LBA Tract and Black Thunder Mine – State Highway 450 and Hilight Road are Moved and the Underlying Coal is Recovered.

Item	Alternative 1 – No Action Alternative (Existing Black Thunder Mine)	Added by Proposed Action	Added by Alternative 2	Added by Alternative 3
In-Place Coal (as of 1/1/09)	1,271.1 mmt	440.4 mmt	1,147.9 mmt	1,373.4 mmt
Mineable Coal (as of 1/1/09)[1]	1,271.1 mmt	440.4 mmt	1,147.9 mmt	1,147.9 mmt
Recoverable Coal (as of 1/1/09)[2]	1,169.4 mmt	405.2 mmt	1,056.1 mmt	1,056.1 mmt
Coal Mined Through 2008	1,087.9 mmt	--	--	--
Lease Area[3]	19,581.3 ac	2,370.5 ac	7,191.3 ac	8,570.1 ac
Total Area To Be Disturbed[3]	26,490.2 ac	6,351.4 ac	11,629.5 ac	11,629.5 ac
Permit Area[3]	29,212.0 ac	6,351.4 ac	11,629.5 ac	11,629.5 ac
Average Annual Coal Production (by 2015)[4]	135 mmt	0 mmt	0 mmt	0 mmt
Remaining Life of Mine (post-2008)	9.3 yrs	3.0 yrs	7.8 yrs	7.8 yrs
Projected Number of Employees (by 2013)[4]	1,324	0	0	0
Total Projected State Revenues (post-2008)[5]	$1,977.9 mm	$751.4 – $898.9 mm	$1,958.4 – $2,343.0 mm	$1,958.4 – $2,343.0 mm
Total Projected Federal Revenues (post-2008)[6]	$1,541.1 mm	$600.1 – $747.6 mm	$1,564.0 – $1,948.6 mm	$1,564.0 – $1,948.6 mm

1 Under the Proposed Action, the mineable coal figure excludes all coal that would not be mined beneath State Highway 450 ROW and associated buffer zone. Under Alternatives 2 and 3, the mineable coal figure excludes all coal that would not be mined beneath State Highway 450 and Hilight Road ROWs and associated buffer zones. Under Alternative 3, the mineable coal figure excludes all coal that would not be mined beneath the Northwest Rail Loop Amendment Area.

2 Assumes 92 percent recovery of mineable coal that occurs during normal mining operation.

3 The lease area figure includes federal coal leases only and does not include state and private coal within the permit boundary. The disturbed area exceeds the leased area (total federal and state) because of the need for highwall reduction, topsoil removal, and other mine support activities outside the lease boundaries. The permit area is larger than the leased or disturbed area to assure that all disturbed lands are within the permit boundary and to allow an easily defined legal land description.

4 The mine projects to increase production rate from 100 mmtpy after 2008 to 135 mmtpy by 2015. The mine projects to increase employment from 1,080 to 1,324 as projected production increases.

5 Revenues to the State of Wyoming include severance taxes, property and production taxes (ad valorem), sales and use taxes, and Wyoming's share of federal royalty payments, AML fees and bonus bid payments. State revenues are based on $0.4312 per ton estimate for severance taxes × amount of recoverable coal, plus $0.372 per ton estimate for ad valorem taxes × amount of recoverable coal, plus $0.0569 per ton estimate for sales and use taxes × amount of recoverable coal, plus a projected coal price of $11.06 per ton × amount of recoverable coal × federal royalty of 12.5 percent minus federal's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus federal's 50 percent share, plus bonus bid payment on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus bid payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus federal's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

6 Federal revenues include black lung taxes and the federal government's share of federal royalty payments, AML fees, and bonus bid payments. Federal revenues are based on a projected coal price of $11.06 per ton × amount of recoverable coal × black lung tax of 4.4 percent, plus $11.06 per ton price × amount of recoverable coal × federal royalty of 12.5 percent minus state's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus state's 50 percent share, plus bonus bid payments on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus state's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

Table ES-7. Summary Comparison of Coal Production, Surface Disturbance, Mine Life, and Revenues for West Jacobs Ranch LBA Tract and Jacobs Ranch Mine – State Highway 450 and Hilight Road are Not Moved and the Underlying Coal is Not Recovered.

Item	Alternative 1 - No Action Alternative (Existing Jacobs Ranch Mine)	Added by Proposed Action	Added by Alternative 2
In-Place Coal (as of 1/1/09)	403.6 mmt	957.0 mmt	1,269.0 mmt
Mineable Coal (as of 1/1/09)[1]	403.6 mmt	744.0 mmt	1,014.0 mmt
Recoverable Coal (as of 1/1/09)[2]	379.4 mmt	669.6 mmt	912.6 mmt
Coal Mined Through 2008	671.1 mmt	--	--
Lease Area[3]	7,381.0 ac	5,944.4 ac	8,076.2 ac
Total Area To Be Disturbed[3]	15,261.5 ac	7,023.0 ac	9,370.0 ac
Permit Area[3]	15,625.0 ac	8,066.0 ac	10,766.0 ac
Average Annual Coal Production (post-2008)	40 mmt	0 mmt	0 mmt
Remaining Life of Mine (post-2008)	9.6 yrs	16.7 yrs	22.8 yrs
Projected Number of Employees	630	155	155
Total Projected State Revenues (post-2008)[4]	$641.7 mm	$1,244.1 – $1,493.4 mm	$1,695.6 – $2,035.3 mm
Total Projected Federal Revenues (post-2008)[5]	$500.0 mm	$994.1 – $1,243.3 mm	$1,354.8 – $1,694.5 mm

1 Under the Proposed Action and Alternative 2, the mineable coal figure excludes all coal that would not be mined beneath State Highway 450 and Hilight Road ROWs and associated buffer zones.

2 Assumes 94 percent recovery of mineable coal that occurs during normal mining operation under Alternative 1, and 90 percent recovery of mineable coal that occurs during normal mining operation under the Proposed Action and Alternative 2.

3 The lease area figure includes federal coal leases only and does not include state and private coal within the permit boundary. The disturbed area exceeds the leased area (total federal and state) because of the need for highwall reduction, topsoil removal, and other mine support activities outside the lease boundaries. The permit area is larger than the leased or disturbed area to assure that all disturbed lands are within the permit boundary and to allow an easily defined legal land description.

4 Revenues to the State of Wyoming include severance taxes, property and production taxes (ad valorem), sales and use taxes, and Wyoming's share of federal royalty payments, AML fees and bonus bid payments. State revenues are based on $0.4312 per ton estimate for severance taxes × amount of recoverable coal, plus $0.372 per ton estimate for ad valorem taxes × amount of recoverable coal, plus $0.0569 per ton estimate for sales and use taxes × amount of recoverable coal, plus a projected coal price of $11.06 per ton × amount of recoverable coal × federal royalty of 12.5 percent minus federal's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus federal's 50 percent share, plus bonus bid payment on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus bid payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus federal's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

5 Federal revenues include black lung taxes and the federal government's share of federal royalty payments, AML fees, and bonus bid payments. Federal revenues are based on a projected coal price of $11.06 per ton × amount of recoverable coal × black lung tax of 4.0 percent, plus $11.06 per ton price × amount of recoverable coal × federal royalty of 12.5 percent minus state's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus state's 50 percent share, plus bonus bid payments on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus state's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

Table ES-8. Summary Comparison of Coal Production, Surface Disturbance, Mine Life, and Revenues for West Jacobs Ranch LBA Tract and Jacobs Ranch Mine – State Highway 450 and Hilight Road are Moved and the Underlying Coal is Recovered.

Item	Alternative 1 - No Action Alternative (Existing Jacobs Ranch Mine)	Added by Proposed Action	Added by Alternative 2
In-Place Coal (as of 1/1/09)	403.6 mmt	957.0 mmt	1,269.0 mmt
Mineable Coal (as of 1/1/09)[1]	403.6 mmt	957.0 mmt	1,269.0 mmt
Recoverable Coal (as of 1/1/09)[2]	379.4 mmt	861.3 mmt	1,142.1 mmt
Coal Mined Through 2008	671.1 mmt	--	--
Lease Area[3]	7,381.0 ac	5,944.4 ac	8,076.2 ac
Total Area To Be Disturbed[3]	15,261.5 ac	7,023.0 ac	9,370.0 ac
Permit Area[3]	15,625.0 ac	8,066.0 ac	10,766.0 ac
Average Annual Coal Production (post-2008)	40 mmt	0 mmt	0 mmt
Remaining Life of Mine (post-2008)	9.6 yrs	21.5 yrs	28.6 yrs
Projected Number of Employees	630	155	155
Total Projected State Revenues (post-2008)[4]	$641.7 mm	$1,600.3 – $1,920.9 mm	$2,122.0 – $2,547.2 mm
Total Projected Federal Revenues (post-2008)[5]	$500.0 mm	$1,278.6 – $1,599.2 mm	$1,695.5 – $2,120.6 mm

1 Under the Proposed Action and Alternative 2, the mineable coal figure includes all coal that would be mined beneath State Highway 450 and Hilight Road ROWs and associated buffer zones.

2 Assumes 94 percent recovery of mineable coal that occurs during normal mining operation under Alternative 1, and 90 percent recovery of mineable coal that occurs during normal mining operation under the Proposed Action and Alternative 2.

3 The lease area figure includes federal coal leases only and does not include state and private coal within the permit boundary. The disturbed area exceeds the leased area (total federal and state) because of the need for highwall reduction, topsoil removal, and other mine support activities outside the lease boundaries. The permit area is larger than the leased or disturbed area to assure that all disturbed lands are within the permit boundary and to allow an easily defined legal land description.

4 Revenues to the State of Wyoming include severance taxes, property and production taxes (ad valorem), sales and use taxes, and Wyoming's share of federal royalty payments, AML fees and bonus bid payments. State revenues are based on $0.4312 per ton estimate for severance taxes × amount of recoverable coal, plus $0.372 per ton estimate for ad valorem taxes × amount of recoverable coal, plus $0.0569 per ton estimate for sales and use taxes × amount of recoverable coal, plus a projected coal price of $11.06 per ton × amount of recoverable coal × federal royalty of 12.5 percent minus federal's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus federal's 50 percent share, plus bonus bid payment on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus bid payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus federal's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

5 Federal revenues include black lung taxes and the federal government's share of federal royalty payments, AML fees, and bonus bid payments. Federal revenues are based on a projected coal price of $11.06 per ton × amount of recoverable coal × black lung tax of 4.4 percent, plus $11.06 per ton price × amount of recoverable coal × federal royalty of 12.5 percent minus state's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus state's 50 percent share, plus bonus bid payments on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus state's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

Table ES-9. Summary Comparison of Coal Production, Surface Disturbance, Mine Life, and Revenues for North Porcupine LBA Tract and North Antelope Rochelle Mine – Mackey Road is Not Moved and the Underlying Coal is Not Recovered.

Item	Alternative 1 - No Action Alternative (Existing North Antelope Rochelle Mine)	Added by Proposed Action	Added by Alternative 2
In-Place Coal (as of 1/1/09)	1,049.9 mmt	756.9 mmt	955.8 mmt
Mineable Coal (as of 1/1/09)[1]	1,015.0 mmt	653.5 mmt	810.2 mmt
Recoverable Coal (as of 1/1/09)[2]	933.8 mmt	601.2 mmt	745.4 mmt
Coal Mined Through 2008	1,230.8 mmt	--	--
Lease Area[3]	16,666.1 ac	5,795.8 ac	7,366.8 ac
Total Area To Be Disturbed[3]	27,443.0 ac	9,864.0 ac	11,444.0 ac
Permit Area[3]	45,975.0 ac	1,760.0 ac	3,120.0 ac
Average Annual Coal Production (post-2008)	95 mmt	0 mmt	0 mmt
Remaining Life of Mine (post-2008)	9.9 yrs	6.3 yrs	7.8 yrs
Projected Number of Employees	1,150	0	0
Total Projected State Revenues (post-2008)[4]	$1,579.4 mm	$1,114.9 – $1,333.8 mm	$1,382.3 – $1,653.7 mm
Total Projected Federal Revenues (post-2008)[5]	$1,230.6 mm	$890.3 – $1,109.3 mm	$1,103.9 – $1,375.3 mm

1 Under the Proposed Action, the mineable coal figure excludes all coal that would not be mined beneath BNSF & UP railroad ROW and associated buffer zone, Teckla Substation buffer zone, and Mackey Road ROW and associated buffer zone. Under Alternative 2, the mineable coal figure excludes all coal that would not be mined beneath BNSF & UP railroad ROW and associated buffer zone, Teckla Substation buffer zone, a portion of Matheson Road ROW and associated buffer zone, and Mackey Road ROW and associated buffer zone.

2 Assumes 92 percent recovery of mineable coal that occurs during normal mining operation.

3 The lease area figure includes federal coal leases only and does not include state coal within the permit boundary. The disturbed area exceeds the leased area (total federal and state) because of the need for highwall reduction, topsoil removal, and other mine support activities outside the lease boundaries. The permit area is larger than the leased or disturbed area to assure that all disturbed lands are within the permit boundary and to allow an easily defined legal land description.

4 Revenues to the State of Wyoming include severance taxes, property and production taxes (ad valorem), sales and use taxes, and Wyoming's share of federal royalty payments, AML fees and bonus bid payments. State revenues are based on $0.4312 per ton estimate for severance taxes × amount of recoverable coal, plus $0.372 per ton estimate for ad valorem taxes × amount of recoverable coal, plus $0.0569 per ton estimate for sales and use taxes × amount of recoverable coal, plus a projected coal price of $11.06 per ton × amount of recoverable coal × federal royalty of 12.5 percent minus federal's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus federal's 50 percent share, plus bonus bid payment on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus bid payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus federal's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

5 Federal revenues include black lung taxes and the federal government's share of federal royalty payments, AML fees, and bonus bid payments. Federal revenues are based on a projected coal price of $11.06 per ton × amount of recoverable coal × black lung tax of 4.4 percent, plus $11.06 per ton price × amount of recoverable coal × federal royalty of 12.5 percent minus state's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus state's 50 percent share, plus bonus bid payments on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus state's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

Table ES-10. Summary Comparison of Coal Production, Surface Disturbance, Mine Life, and Revenues for North Porcupine LBA Tract and North Antelope Rochelle Mine – Mackey Road is Moved and the Underlying Coal is Recovered.

Item	**Alternative 1 - No Action Alternative (Existing North Antelope Rochelle Mine)**	**Added by Proposed Action**	**Added by Alternative 2**
In-Place Coal (as of 1/1/09)	1,049.9 mmt	756.9 mmt	955.8 mmt
Mineable Coal (as of 1/1/09)[1]	1,015.0 mmt	688.3 mmt	845.0 mmt
Recoverable Coal (as of 1/1/09)[2]	933.8 mmt	633.3 mmt	777.4 mmt
Coal Mined Through 2008	1,230.8 mmt	--	--
Lease Area[3]	16,666.1 ac	5,795.8 ac	7,366.8 ac
Total Area To Be Disturbed[3]	27,443.0 ac	10,167.0 ac	11,767.0 ac
Permit Area[3]	45,975.0 ac	1,760.0 ac	3,120.0 ac
Average Annual Coal Production (post-2008)	95 mmt	0 mmt	0 mmt
Remaining Life of Mine (post-2008)	9.9 yrs	6.7 yrs	8.2 yrs
Projected Number of Employees	1,150	0	0
Total Projected State Revenues (post-2008)[4]	$1,579.4 mm	$1,174.4 – $1,405.0 mm	$1,441.6 – $1,724.7 mm
Total Projected Federal Revenues (post-2008)[5]	$1,230.6 mm	$937.9 – $1,168.4 mm	$1,151.3 – $1,434.4 mm

1 Under the Proposed Action, the mineable coal figure excludes all coal that would not be mined beneath BNSF & UP railroad ROW and associated buffer zone and Teckla Substation buffer zone. Under Alternative 2, the mineable coal figure excludes all coal that would not be mined beneath BNSF & UP railroad ROW and associated buffer zone, Teckla Substation buffer zone, and a portion of Matheson Road ROW and associated buffer zone.

2 Assumes 92 percent recovery of mineable coal that occurs during normal mining operation.

3 The lease area figure includes federal coal leases only and does not include state coal within the permit boundary. The disturbed area exceeds the leased area (total federal and state) because of the need for highwall reduction, topsoil removal, and other mine support activities outside the lease boundaries. The permit area is larger than the leased or disturbed area to assure that all disturbed lands are within the permit boundary and to allow an easily defined legal land description.

4 Revenues to the State of Wyoming include severance taxes, property and production taxes (ad valorem), sales and use taxes, and Wyoming's share of federal royalty payments, AML fees and bonus bid payments. State revenues are based on $0.4312 per ton estimate for severance taxes × amount of recoverable coal, plus $0.372 per ton estimate for ad valorem taxes × amount of recoverable coal, plus $0.0569 per ton estimate for sales and use taxes × amount of recoverable coal, plus a projected coal price of $11.06 per ton × amount of recoverable coal × federal royalty of 12.5 percent minus federal's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus federal's 50 percent share, plus bonus bid payment on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus bid payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus federal's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

5 Federal revenues include black lung taxes and the federal government's share of federal royalty payments, AML fees, and bonus bid payments. Federal revenues are based on a projected coal price of $11.06 per ton × amount of recoverable coal × black lung tax of 4.4 percent, plus $11.06 per ton price × amount of recoverable coal × federal royalty of 12.5 percent minus state's 50 percent share, plus $0.35 per ton for AML fees × amount of recoverable coal minus state's 50 percent share, plus bonus bid payments on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus state's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

Table ES-11. Summary Comparison of Coal Production, Surface Disturbance, Mine Life, and Revenues for South Porcupine LBA Tract and North Antelope Rochelle Mine – 2.25-Mile Section of Antelope Road is Not Moved and the Underlying Coal is Not Recovered.

Item	**Alternative 1 - No Action Alternative (Existing North Antelope Rochelle Mine)**	**Added by Proposed Action**	**Added by Alternative 2**
In-Place Coal (as of 1/1/09)	1,049.9 mmt	422.2 mmt	470.9 mmt
Mineable Coal (as of 1/1/09)[1]	1,015.0 mmt	336.6 mmt	368.8 mmt
Recoverable Coal (as of 1/1/09)[2]	933.8 mmt	309.7 mmt	339.3 mmt
Coal Mined Through 2008	1,230.8 mmt	--	--
Lease Area[3]	16,666.1 ac	3,186.0 ac	3,568.0 ac
Total Area To Be Disturbed[3]	27,443.0 ac	3,366.0 ac	4,068.0 ac
Permit Area[3]	45,975.0 ac	200.0 ac	400.0 ac
Average Annual Coal Production (post-2008)	95 mmt	0 mmt	0 mmt
Remaining Life of Mine (post-2008)	9.9 yrs	3.3 yrs	3.6 yrs
Projected Number of Employees	1,150	0	0
Total Projected State Revenues (post-2008)[4]	$1,579.4 mm	$574.3 – $687.1 mm	$629.2 – $752.7 mm
Total Projected Federal Revenues (post-2008)[5]	$1,230.6 mm	$458.6 – $571.4 mm	$502.5 – $626.0 mm

1 Under the Proposed Action and Alternative 2, the mineable coal figure excludes all coal that would not be mined beneath BNSF & UP railroad ROW and associated buffer zone and 2.25-mile section of Antelope Road and associated buffer zone.

2 Assumes 92 percent recovery of mineable coal that occurs during normal mining operation.

3 The lease area figure includes federal coal leases only and does not include state coal within the permit boundary. The disturbed area exceeds the leased area (total federal and state) because of the need for highwall reduction, topsoil removal, and other mine support activities outside the lease boundaries. The permit area is larger than the leased or disturbed area to assure that all disturbed lands are within the permit boundary and to allow an easily defined legal land description.

4 Revenues to the State of Wyoming include severance taxes, property and production taxes (ad valorem), sales and use taxes, and Wyoming's share of federal royalty payments, AML fees and bonus bid payments. State revenues are based on $0.4312 per ton estimate for severance taxes × amount of recoverable coal, plus $0.372 per ton estimate for ad valorem taxes × amount of recoverable coal, plus $0.0569 per ton estimate for sales and use taxes × amount of recoverable coal, plus a projected coal price of $11.06 per ton × amount of recoverable coal × federal royalty of 12.5 percent minus federal's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus federal's 50 percent share, plus bonus bid payment on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus bid payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus federal's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

5 Federal revenues include black lung taxes and the federal government's share of federal royalty payments, AML fees, and bonus bid payments. Federal revenues are based on a projected coal price of $11.06 per ton × amount of recoverable coal × black lung tax of 4.4 percent, plus $11.06 per ton price × amount of recoverable coal × federal royalty of 12.5 percent minus state's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus state's 50 percent share, plus bonus bid payments on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus state's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

Table ES-12. Summary Comparison of Coal Production, Surface Disturbance, Mine Life, and Revenues for South Porcupine LBA Tract and North Antelope Rochelle Mine – 2.25-Mile Section of Antelope Road is Moved and the Underlying Coal is Recovered.

Item	**Alternative 1 - No Action Alternative (Existing North Antelope Rochelle Mine)**	**Added by Proposed Action**	**Added by Alternative 2**
In-Place Coal (as of 1/1/09)	1,049.9 mmt	422.2 mmt	470.9 mmt
Mineable Coal (as of 1/1/09)[1]	1,015.0 mmt	408.4 mmt	440.6 mmt
Recoverable Coal (as of 1/1/09)[2]	933.8 mmt	375.7 mmt	405.4 mmt
Coal Mined Through 2008	1,230.8 mmt	--	--
Lease Area[3]	16,666.1 ac	3,186.0 ac	3,568.0 ac
Total Area To Be Disturbed[3]	27,443.0 ac	3,908.0 ac	4,610.0 ac
Permit Area[3]	45,975.0 ac	200.0 ac	400.0 ac
Average Annual Coal Production (post-2008)	95 mmt	0 mmt	0 mmt
Remaining Life of Mine (post-2008)	9.9 yrs	4.0 yrs	4.3 yrs
Projected Number of Employees	1,150	0	0
Total Projected State Revenues (post-2008)[4]	$1,579.4 mm	$696.7 – $833.5 mm	$751.8 – $899.4 mm
Total Projected Federal Revenues (post-2008)[5]	$1,230.6 mm	$556.4 – $693.2 mm	$600.4 – $748.0 mm

[1] Under the Proposed Action and Alternative 2, the mineable coal figure excludes all coal that would not be mined beneath BNSF & UP railroad ROW and associated buffer zone.

[2] Assumes 92 percent recovery of mineable coal that occurs during normal mining operation.

[3] The lease area figure includes federal coal leases only and does not include state coal within the permit boundary. The disturbed area exceeds the leased area (total federal and state) because of the need for highwall reduction, topsoil removal, and other mine support activities outside the lease boundaries. The permit area is larger than the leased or disturbed area to assure that all disturbed lands are within the permit boundary and to allow an easily defined legal land description.

[4] Revenues to the State of Wyoming include severance taxes, property and production taxes (ad valorem), sales and use taxes, and Wyoming's share of federal royalty payments, AML fees and bonus bid payments. State revenues are based on $0.4312 per ton estimate for severance taxes × amount of recoverable coal, plus $0.372 per ton estimate for ad valorem taxes × amount of recoverable coal, plus $0.0569 per ton estimate for sales and use taxes × amount of recoverable coal, plus a projected coal price of $11.06 per ton × amount of recoverable coal × federal royalty of 12.5 percent minus federal's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus federal's 50 percent share, plus bonus bid payment on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus bid payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus federal's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

[5] Federal revenues include black lung taxes and the federal government's share of federal royalty payments, AML fees, and bonus bid payments. Federal revenues are based on a projected coal price of $11.06 per ton × amount of recoverable coal × black lung tax of 4.4 percent, plus $11.06 per ton price × amount of recoverable coal × federal royalty of 12.5 percent minus state's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus state's 50 percent share, plus bonus bid payments on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus state's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

through ES-12. Rejection of the lease applications would not preclude applications to lease the tracts in the future.

- **Alternatives 2 and 3** - Under Alternative 2 for each of the six LBA tracts and Alternative 3 for the West Hilight Field LBA Tract, BLM would reconfigure the tract, hold a competitive coal lease sale for the lands included in the reconfigured tract, and issue a maintenance lease to the successful bidder for a tract that is larger than the applied-for tract.

  BLM identified a study area for each LBA tract in order to evaluate the potential that an alternate configuration of the tract would provide more efficient recovery of the federal coal, increase competitive interest in the tract, and/or reduce the potential that some of the remaining unleased federal coal in this area would be bypassed in the future. The BLM study area includes the tract as applied for plus adjacent unleased federal coal, which is depicted as the additional area evaluated under Alternatives 2 and 3 in Figures ES-2 through ES-7. These different tract configurations are considered as Alternatives 2 and 3 in this EIS. Alternative 2, holding a competitive sale for a modified tract, is BLM's Preferred Alternative for each of these six LBA tracts. The applicant mines' estimates of the coal reserve, lease area and surface disturbance area for each tract under Alternative 2 and for the West Hilight Field tract under Alternative 3 are included in Tables ES-1 through ES-12.

  The applicant mines' projected rates of coal production and employment would be similar to the Proposed Actions, although the life of the existing mines would be extended for a period of time, depending on if the public highway and/or county roads are or are not moved.

The analysis in this EIS assumes that ALC would be the successful bidder on the North, South and West Hilight Field LBA Tracts; ALC would be the successful bidder on the West Jacobs Ranch LBA Tract; and BTU would be the successful bidder on the North and South Porcupine LBA Tracts. Under the Proposed Actions and Alternatives 2 and 3, the leases would be subject to the standard and special lease stipulations developed for the PRB and for these tracts, which are listed in Appendix D of this EIS.

One alternative that was considered but not analyzed in detail included holding competitive coal lease sales and issuing leases for one or more of the LBA tracts to the successful bidder (not the applicants) for the purpose of developing new stand-alone mines. Another alternative that was not analyzed in detail called for delaying the competitive sales of one or more of the LBA tracts as applied for to increase the benefit to the public afforded by higher coal prices and/or to allow more complete recovery of the potential coal bed natural gas (CBNG) resources in the tracts prior to mining.

Environmental Concerns

Critical elements of the human environment (BLM 2008a) that could be affected by the Proposed Actions or Alternatives 2 and 3 include air quality, cultural resources, Native American religious concerns, threatened and endangered (T&E) plant and animal species, migratory birds, hazardous or solid waste, water quality (both surface and ground), wetlands/riparian zones, environmental justice, and invasive non-native species. Five other critical elements (areas of critical environmental concern, prime and unique farmland, 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 the LBA tracts on topography and physiography, geology and mineral resources, soils, water quantity and quality, alluvial valley floors (AVFs), vegetation, wildlife, land use and recreation, paleontological resources, visual resources, noise, transportation resources, and socioeconomics.

The environmental impacts of mining each of the LBA tracts would be similar under the Proposed Action and Alternatives 2 and 3.

The general analysis area for each of these six LBA tracts represents the maximum surface area that could be disturbed by mining activities analyzed in this EIS. More specifically, each LBA tract's general analysis area is defined as the BLM study area plus surrounding lands within a ¼-mile perimeter that could be disturbed by mining the coal within the BLM study area where future mining disturbance could occur. Surface disturbance occurs outside of a coal lease area as a result of activities including, but not limited to, overstripping, highwall backsloping (including catch benches), highwall reduction after mining to match undisturbed topography, and construction of flood- and sediment-control structures. For the purpose of this analysis, the general Wright analysis area is defined as the area encompassing all six of these LBA tracts' general analysis areas.

► **Topography**

The general Wright analysis area is located in the PRB, a part of the Northern Great Plains that includes most of northeastern Wyoming. The North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts are located in the southeastern part of the PRB, in an area consisting primarily of a gently rolling upland terrain of low relief, broken by minor drainages and internally-drained playa areas. Drainage densities are quite low, and the playas are common topographic and hydrologic features. Land surface elevations range from about 4,690 to 5,170 feet above sea level. 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, at the breaks or the broken land dissected by small ravines and gullies, or at the transitions between uplands and bottom lands.

The existing topography on each LBA tract that is leased would be substantially changed during mining. A highwall with a vertical height equal to overburden plus coal thickness would exist in the active pits. Following reclamation, the average surface elevation would be lower due to removal of the coal. The reclaimed land surface would approximate premining contours, and the basic drainage network would be retained; however, the reclaimed surface would typically contain fewer and gentler topographic features. This could contribute to reduced habitat diversity and wildlife carrying capacity on the LBA tracts. These topographic changes would not conflict with regional land use, and the postmining topography would adequately support anticipated postmining land use for each tract.

► **Geology**

The mineable coal seams in the PRB are part 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. The combined average thicknesses of the mineable coal seams range between 61 feet within the North Hilight Field LBA Tract to 104 feet within the West Jacobs Ranch LBA Tract. Interburden thickness between the coal seams varies from 0 (West Jacobs Ranch) to around 94 feet (South Hilight Field), and average overburden thickness on each tract ranges from around 246 feet (North Hilight Field) to around 480 feet (West Jacobs Ranch).

The geology from the base of the coal to the land surface would be subject to considerable permanent change on each LBA tract under the Proposed Actions or Alternatives 2 and 3. After removal of the coal, the replaced overburden would be a relatively homogeneous mixture compared to the premining layered overburden.

► **Other Mineral Resources**

With the exception of developing continuous oil and gas resources via horizontal wells completed in source rocks many thousands of feet below the mineable Wyodak-Anderson coal beds, other minerals present on the LBA tracts could not be developed during mining. Some of these other minerals could, however, be developed after coal mining and reclamation are completed. Development of other minerals potentially present on the LBA tracts could not occur during mining but could occur after mining.

Conventional oil and gas resources in the general Wright analysis area have been extensively developed. According to the WOGCC database as of May 2008, a total of 74 conventional oil and natural gas wells have been drilled and 33 were capable of producing within the six LBA tracts as applied for and the lands added by the respective BLM study areas included in this analysis (WOGCC 2008a). No conventional oil or natural gas wells have been drilled within these six LBA tract study areas since 1990, so the area generally appears to be unfavorable for additional production from known conventional reservoirs. According to the January 2008 reserve estimate of conventional oil and gas resources that was prepared by Allen & Crouch (A&C) Petroleum Engineers, Inc. of Casper, Wyoming, of the 33 wells capable of producing oil or conventional gas that are located within the respective BLM study areas for these six LBA tracts, 16 wells are considered to have recoverable reserves using in-place recovery methods. The actively producing wells, as presently completed, appear to have exhausted most of their recoverable reserves. Estimated remaining recoverable reserves from these 16 wells are approximately 43,308 barrels of oil and 1.654 million cubic feet of natural gas (A&C 2008). Any conventional oil and gas wells on the tracts would have to be plugged and abandoned during mining but could be recompleted after mining if the remaining reserves justify the expense of the recompletion.

Extensive development of coal bed natural gas (CBNG) in the Wyodak-Anderson coal zone has occurred in the general Wright analysis area. According to the WOGCC database as of May 2008, a total of 287 wells have been drilled for CBNG production and 248 were capable of producing within the six LBA tracts as applied for and the lands added by the respective BLM study areas included in this analysis (WOGCC 2008a). 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).

The Wyoming BLM State Office-Reservoir Management Group (WSO-RMG) and the U.S. Geological Survey (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.

CBNG from the Wyodak-Anderson coal zone that is not recovered prior to mining, albeit slight, would be vented to the atmosphere and irretrievably lost when the coal is removed. CBNG production from 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. BLM's policy is to optimize recovery of both resources, ensure the public receives a reasonable return, and encourage agreements between lessees or use BLM authority to minimize loss of publicly owned resources.

The USGS reports significant undiscovered reserves of continuous oil and gas resources exist in the PRB of Wyoming and Montana. Drilling for these resources is currently occurring in the Keeline and Wild West Oil and Gas Units located just east of the Black Thunder and Jacobs Ranch mines. It is possible that horizontal wells could be drilled from surface locations outside of the LBA tracts and deviated to run horizontally beneath the tracts within source rocks that are many thousands of feet deeper than the mineable Wyodak-Anderson coal beds. Continuous oil and gas resources could be developed in this manner on the LBA tracts during mining.

► **Paleontology**

The two geologic formations that are exposed on the surface in the general Wright analysis area are the Eocene age Wasatch Formation and the Paleocene age Fort Union Formation. The Wasatch Formation has been known to produce abundant and significant paleontological resources in several basins throughout Wyoming (Delson 1971, Winterfeld 1978, EVG 2001). Occurrences of significant fossils in this formation within the PRB have been more sporadic and less common than in other basins. 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. The upper-most member of the Fort Union Formation, the Lebo Member, is less significant in regards to paleontological resources. Fossils occur sporadically and significant vertebrate specimens have rarely been reported from the PRB.

The entire general analysis areas for each of the six WAC LBA Tracts were examined for the presence of fossils. Paleontological surveys on federal lands administered by the USFS were conducted in 2009 by qualified paleontologists with USFS approval to conduct paleontological resource surveys on the Thunder Basin National Grasslands (TBNG).

No fossils, scientifically significant or otherwise, were identified or collected during the survey of the North Hilight Field LBA Tract. No further paleontological work or specific mitigation measures prior to mining-related disturbances are recommended or required.

No scientifically significant or unique paleontological resources were identified or collected during the survey of the South Hilight Field LBA Tract. No further paleontological work or specific mitigation measures, aside from the notification of potentially interested researchers that a relatively common fossil was found at a locality that places it near the Paleocene-Eocene Thermal Maximum (PETM) boundary, prior to mining-related disturbances are recommended or required.

No scientifically significant or unique paleontological resources were identified or collected during the survey of the West Hilight Field LBA Tract. No further paleontological work or specific mitigation measures prior to mining-related disturbances are recommended or required.

No scientifically significant or unique paleontological resource localities have been recorded in the West Jacobs Ranch tract's general analysis area. No further paleontological work of mitigation measures prior to mining-related disturbances would be necessary.

Scientifically significant vertebrate fossil materials were identified and recorded at two localities in the Wasatch Formation during the survey of the North Porcupine LBA Tract. Specimens discovered on the surface at one of the localities were collected and will be reposited with the Denver Museum of Nature and Science. Because no in-situ sources for the discovered vertebrate fossil fragments were identified, further efforts to recover additional fossil material are considered to be unlikely. No additional paleontological work or specific mitigation measures prior to mining-related disturbances are recommended.

Ten new paleontological localities were discovered during the survey of the South Porcupine LBA Tract. Six of the localities contained fossil vertebrate material; three localities contained fossil invertebrate material; and one locality contained fossil plant impressions. Three vertebrate localities were discovered in the Wasatch Formation, while the remaining seven localities were discovered in the Lebo Member of the Fort Union Formation. Vertebrate specimens exposed on the surface that did not require excavation were collected from five localities. All collected specimens will be reposited with the Denver Museum of Nature and Science. None of the invertebrate or plant localities discovered during the 2009 survey were considered rare of scientifically significant, and therefore no specimens were collected from them. No additional paleontological work or mitigation measures prior to mining-related disturbances are recommended for any of the invertebrate or plant fossil localities. Based on the field survey, it is highly likely that additional buried fossil material may be present at several vertebrate fossil localities. In order to avoid future impacts to potentially scientifically significant paleontological resources at these localities, it is recommended that mitigation efforts be conducted to determine if additional buried material is present, and to then collect any scientifically significant specimens. These mitigation efforts would ensure that mining operations would have no adverse effect on these localities.

Fossils with scientific significance could be present on the tracts but not exposed at the surface. Additional surveys for paleontological resources may be required if discoveries are made during mining. If the tracts are leased under the Proposed Actions or Alternatives 2 or 3, undiscovered paleontological resources that are not exposed on the surface or detected during mining would be permanently lost during mining.

► **Air Quality**

Particulate and gaseous emissions are the two primary types of air pollutants directly associated with surface coal mining in the PRB; both of which are associated with a variety of health and environmental impacts. 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 of particulate emissions. Gases that contain nitrogen and oxygen in varying amounts are referred to as nitrogen oxides, or NO_x. These are the primary fugitive gaseous emissions produced during surface coal mining operations. Nitrogen oxides are generated from the tailpipe exhaust emissions from mining equipment and other vehicular traffic within the mine permit area.

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. NO_2 is one of several products resulting from the incomplete combustion of explosives used in the blasting process.

Other non-mining 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;
- 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 train 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; and
- Air pollutants transported from emission sources located outside the PRB.

Since 1989, the regulated particulate pollutant in Wyoming has been PM_{10} (particulate matter with an aerodynamic diameter of 10 microns or less). Wyoming also adopted a fine particulate, $PM_{2.5}$ (particulate matter with a mean aerodynamic diameter of 2.5 microns or less), standard in March 2000, but that standard is not yet part of the state's air quality monitoring requirements. EPA has revoked the annual PM_{10} standard of 50 micrograms per cubic meter ($\mu g/m^3$) but retained the 24-hour PM_{10} standard of 150 $\mu g/m^3$. Until the state of Wyoming enters into rulemaking to revise the Wyoming Ambient Air Quality Standards (WAAQS), the annual PM_{10} standard of 50 $\mu g/m^3$ is still effective. The federal and Wyoming air quality standard for annual NO_2 is 100 $\mu g/m^3$. This criteria air pollutant is not currently regulated at surface coal mines, although the WDEQ/AQD does require an assessment of annual NO_2 impacts as part of an air quality permitting analysis for new surface coal mines and existing mine plan revisions.

Moderately adverse, short-term impacts on air quality are currently present at the Black Thunder Mine due to existing mine operations, and would be extended onto the North, South, and West Hilight Field LBA Tracts during the time the tracts are mined if leases are issued. Air quality modeling for the current Black Thunder Mine permit predicted no exceedances of the annual PM_{10} particulate WAAQS and National Ambient Air Quality Standard (NAAQS) at the permitted production level of 135 million tons per year (mmtpy). The mine's anticipated production rate by 2015 is 135 mmtpy. The dispersion model showed a maximum concentration on the Black Thunder Mine LNCM (lands necessary to conduct mining) boundary of 49.96 $\mu g/m^3$ in 2017 (Figure ES-8), one of two projected worst-case years used for the model.

Moderately adverse short-term impacts to air quality are currently present at the Jacobs Ranch Mine due to existing mine operations, and would be extended onto the West Jacobs Ranch LBA Tract during the time the tract is mined if a lease is issued. Air quality modeling for the current Jacobs Ranch Mine permit predicted no exceedances of the annual PM_{10} particulate WAAQS and NAAQS at the permitted production level of 55 mmtpy. The mine's current and anticipated future production rate is approximately 40 mmtpy. The dispersion model showed a maximum concentration on the Jacobs Ranch Mine

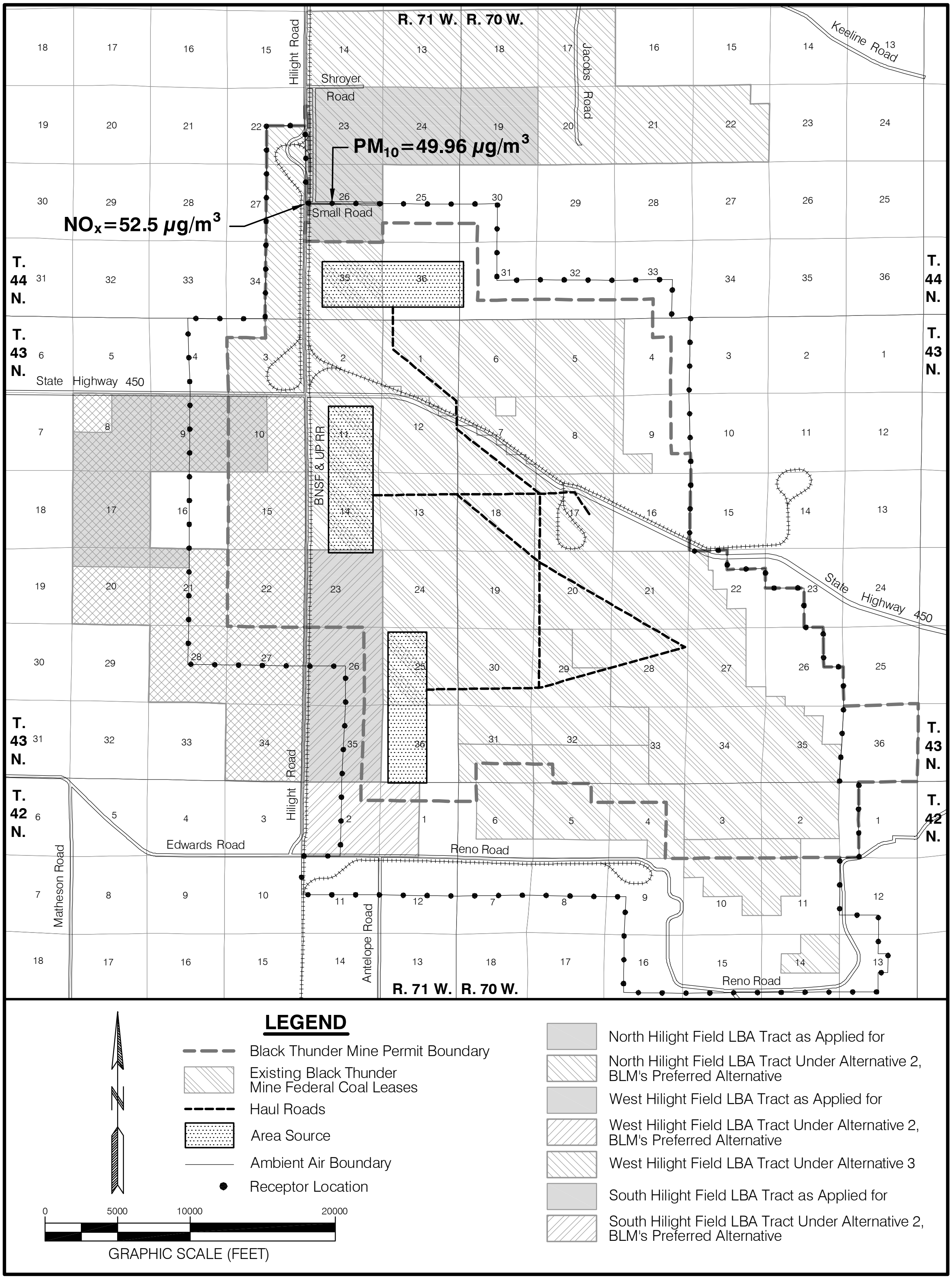

Figure ES-8. Maximum Modeled PM$_{10}$ and NO$_X$ Concentrations at the Black Thunder Mine Ambient Air Boundary for the Year 2017.

LNCM boundary of 49.61 μg/m^3 in 2015 (Figure ES-9), one of two projected worst-case years used for the model.

Moderately adverse short-term impacts to air quality are currently present at the North Antelope Rochelle Mine due to existing mine operations, and would be extended onto the North and South Porcupine LBA Tracts during the time the tracts are mined if leases are issued. Air quality modeling for the current North Antelope Rochelle Mine permit predicted no exceedances of the annual PM_{10} WAAQS and NAAQS at the permitted production level of 140 mmtpy. The mine's current and anticipated future production rate is approximately 95 mmtpy. The dispersion model showed a maximum concentration on the North Antelope Rochelle Mine LNCM boundary of 39.24 μg/m^3 in 2017 (Figure ES-10), one of two projected worst-case years used for the model.

There would be an increase in stripping ratio in each of the LBA tracts compared to the applicant mines' current leases, which could result in an increase in fugitive emissions per ton of coal mined from 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, thus decreasing the total annual disturbance acreage and causing haul distances to increase more slowly. Particulate emissions are nevertheless expected to remain within daily and annual limits.

There have been no exceedances of the annual PM_{10} standards documented by the Black Thunder Mine through 2009. There were a total of 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 miles per hour (mph). 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. There was one exceedance of the 24-hour PM_{10} particulate standards at the Black Thunder Mine reported in 2007, which was designated as an exceptional event under the NEAP due to high winds and no violation was issued to the mine. There was one exceedance of the 24-hour PM_{10} particulate standards at the Black Thunder Mine in 2008, and the EPA determined that it was not an exceptional event and a notice of violation was subsequently issued. There were no exceedances of the 24-hour PM_{10} particulate standards reported by the mine in 2009.

There has been one exceedance of the 24-hour PM_{10} NAAQS since PM_{10} monitoring began at the Jacobs Ranch Mine and no exceedances of the annual PM_{10} NAAQS.

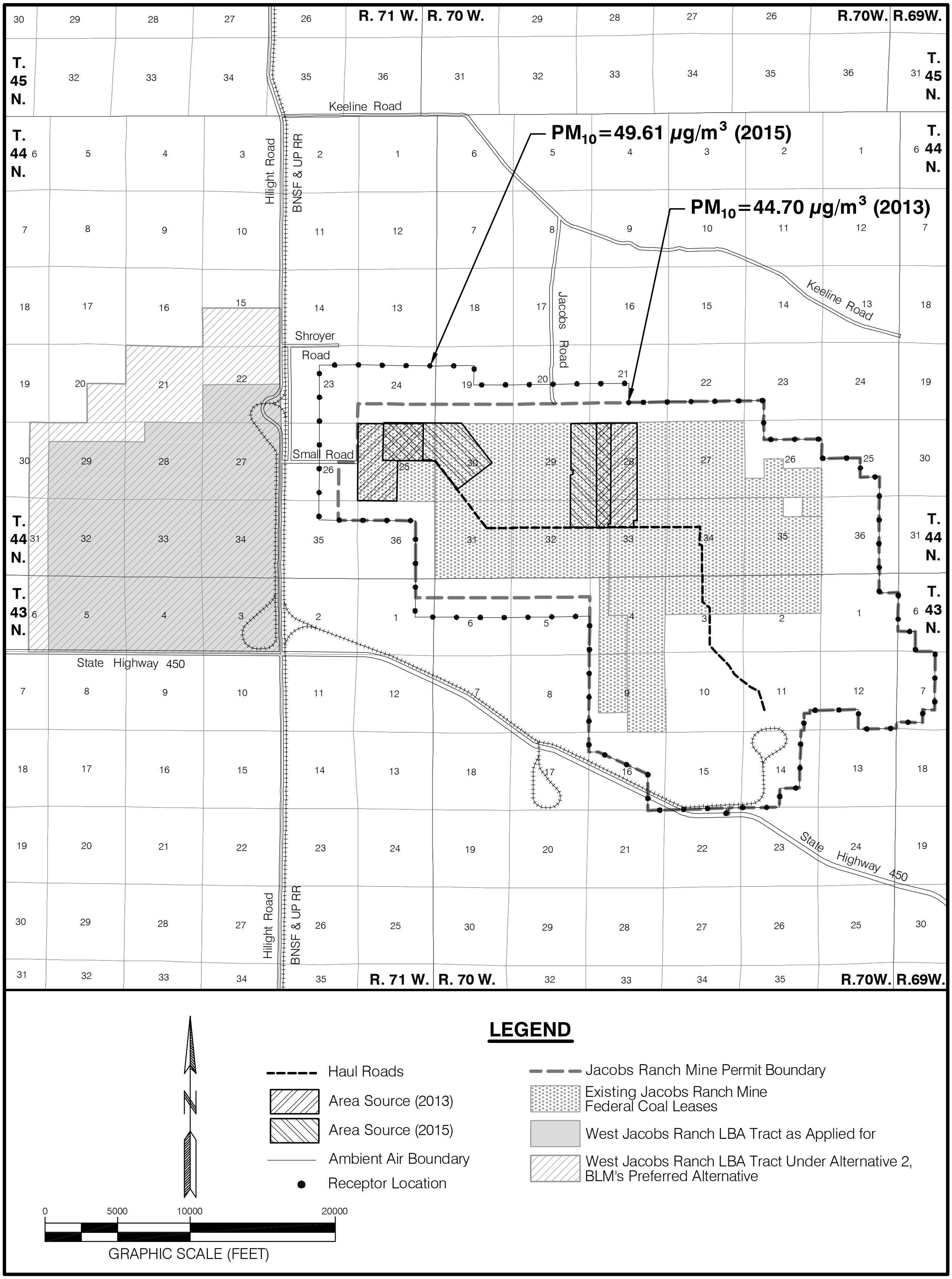

Figure ES-9. Maximum Modeled PM_{10} Concentrations at the Jacobs Ranch Mine Ambient Air Boundary for the Years 2013 and 2015.

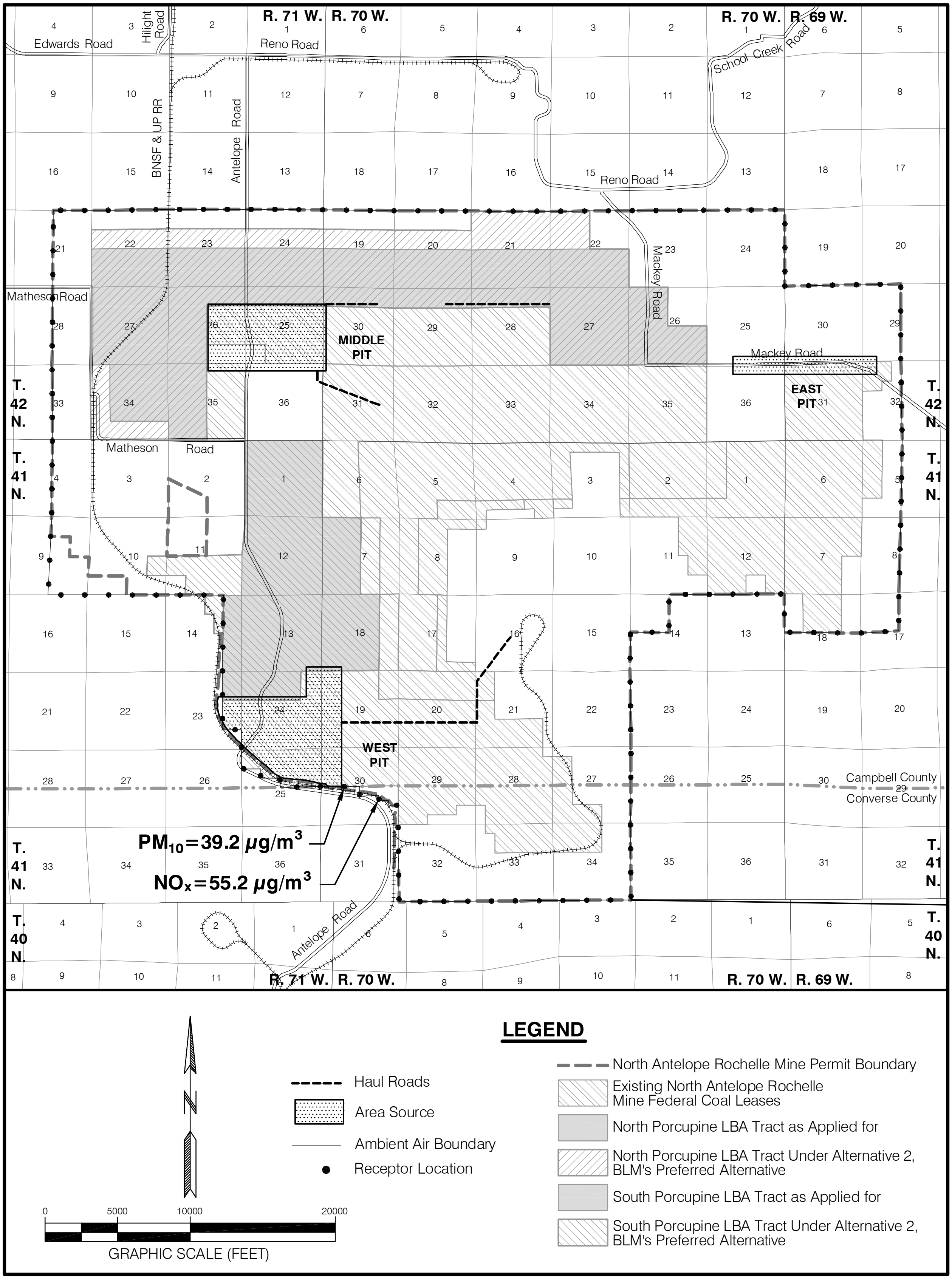

Figure ES-10. Maximum Modeled PM_{10} and NO_X Concentrations at the North Antelope Rochelle Mine Ambient Air Boundary for the Year 2017.

There have been no exceedances of the annual PM_{10} standards documented by the North Antelope Rochelle Mine through 2009. 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 of the 24-hour PM_{10} particulate standards reported in 2007 at the mine, 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 were no exceedances of the 24-hour PM_{10} particulate standards reported by the North Antelope Rochelle Mine in 2008 and 2009.

Low-lying, gaseous orange clouds containing NO_2 that can be transported by wind can sometimes form from overburden blasting prior to coal removal. EPA has expressed concerns that NO_x levels in some blasting clouds may be sufficiently high at times to cause human health effects. Because of these incidents, WDEQ/LQD has directed some mines to take steps designed to mitigate the effects of NO_2 emissions occurring from overburden blasting. 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. 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. 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. NO_x modeling was also conducted in support of the three applicant mines' most recent air quality permit applications, and impacts from the worst-case years fall well below the annual NO_2 NAAQS of 100 $\mu g/m^3$.

Motor vehicle exhaust and industrial emissions, gasoline vapors, and chemical solvents as well as natural sources emit NO_X and VOCs that help form ozone (O_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. No exceedances of the O_3 standard have occurred at either of the two monitoring sites when evaluated under the standard in place at the time the values were recorded.

Public exposure to emissions from surface mining operations is most likely to occur along publicly accessible roads and highways that pass through the areas of mining operations. Occupants of dwellings in the area could also be affected. Roads, highways, occupied dwellings, businesses, and school bus stops in the vicinity of the North Hilight Field, South Hilight Field, West Hilight

Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts are shown in Figure ES-11 through ES-16, respectively.

► **Groundwater**

Mining would disturb the coal aquifer and the aquifers in the overburden above the coal within the six WAC LBA tracts. The coal aquifer and any water-bearing strata in the overburden would be removed and replaced with relatively homogeneous, unconsolidated backfill.

A continuous cone of depression currently exists around the southern group of mines (Black Thunder, Jacobs Ranch, North Antelope Rochelle, and Antelope) due to their proximity to each other and the cumulative drawdown effects from pit dewatering and nearby CBNG development. Water level drawdowns have propagated much farther and in a more consistent manner in the Wyodak coal seam aquifer than in the overburden. Historical groundwater level monitoring data collected by the mines 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 mines 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. 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. The extent of drawdown in the coal aquifer west of each mine that is specifically attributable to mine dewatering can be estimated; however, the accuracy of those estimates cannot be tested or observed in the real world because drawdown related only to mining is a relatively small impact that is masked by the much larger drawdown that is due to CBNG development in the area.

The rate and extent of the actual drawdown in the coal is currently much greater than the life-of-mine drawdown predictions. This has occurred as drawdown caused by extensive CBNG development west of the existing mine permit areas has overlapped with drawdown caused by mining operations. Continued drawdown effects from CBNG withdrawals are probable; therefore, future drawdown to the Wyodak coal aquifer from mining the approved leases and the WAC 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. The area of drawdown in the discontinuous overburden aquifers would be smaller.

Figure ES-17 depicts the extrapolated extent of the 5-foot cumulative drawdown contour within the Wyodak coal aquifer resulting from the group of

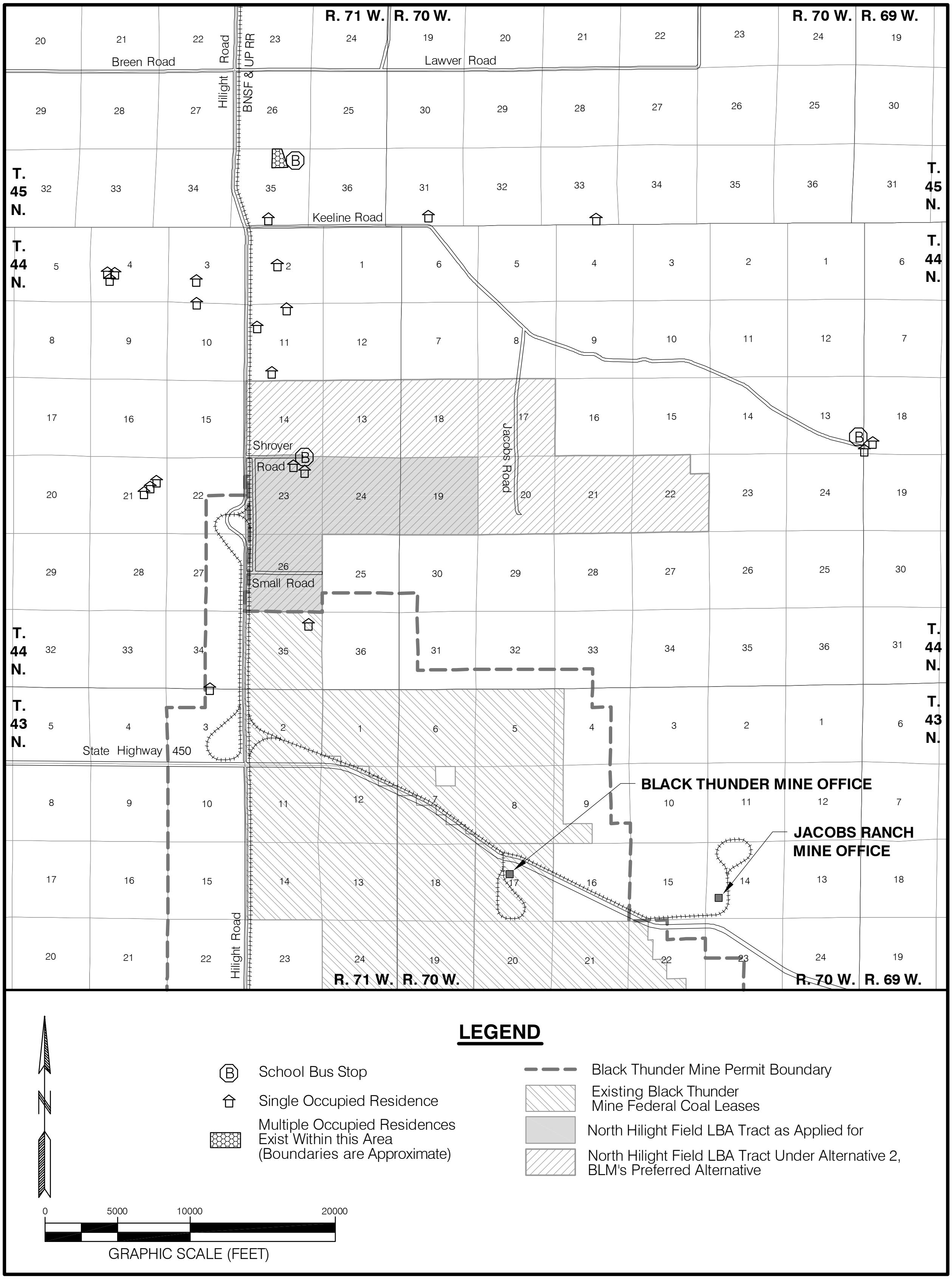

Figure ES-11. Residences, School Bus Stops, Public Roads, and Other Publicly Accessible Facilities in the Vicinity of the North Hilight Field LBA Tract Under Alternative 2.

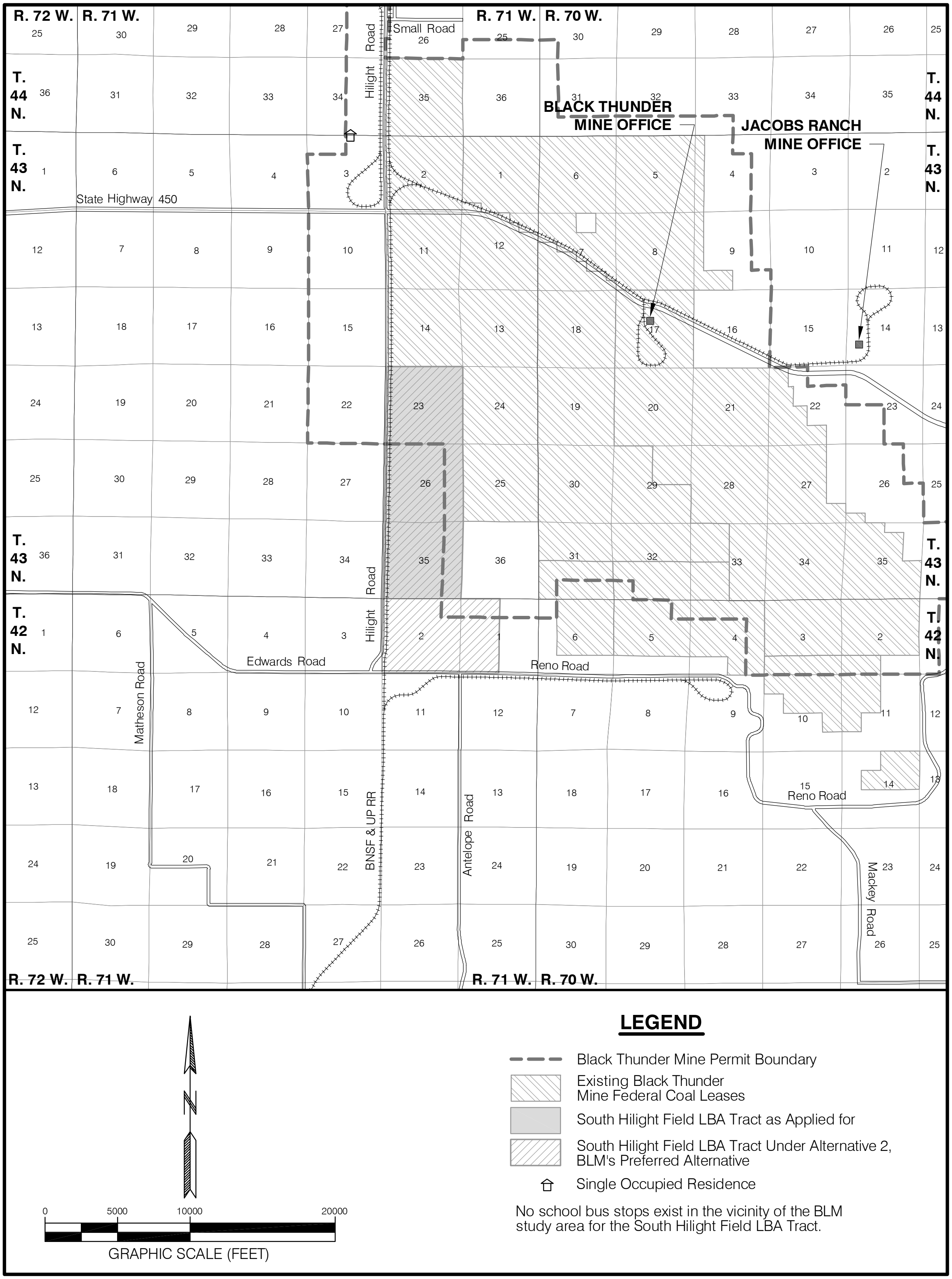

Figure ES-12. Residences, School Bus Stops, Public Roads, and Other Publicly Accessible Facilities in the Vicinity of the South Hilight Field LBA Tract Under Alternative 2.

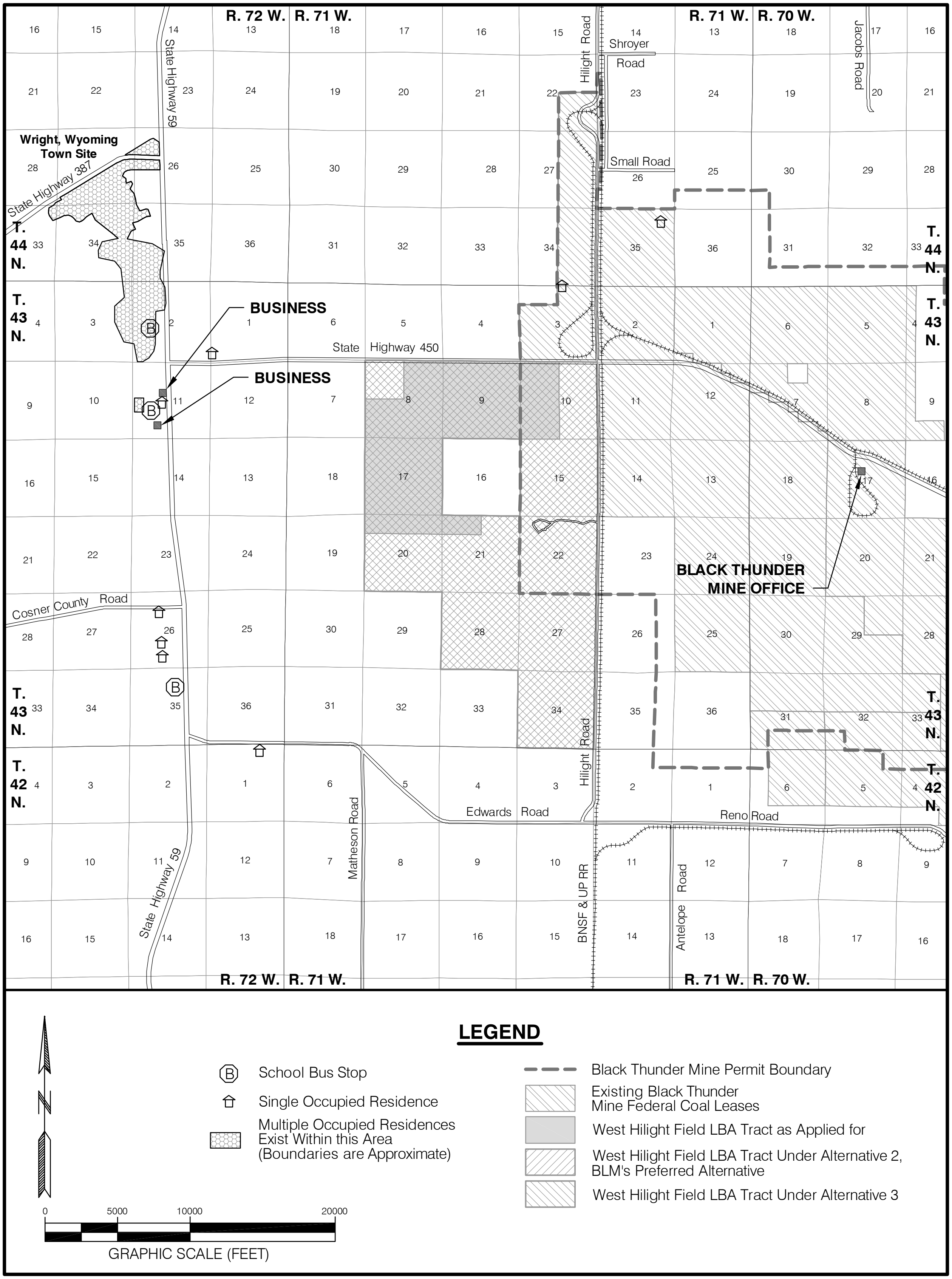

Figure ES-13. Residences, School Bus Stops, Public Roads, and Other Publicly Accessible Facilities in the Vicinity of the West Hilight Field LBA Tract Under Alternative 2.

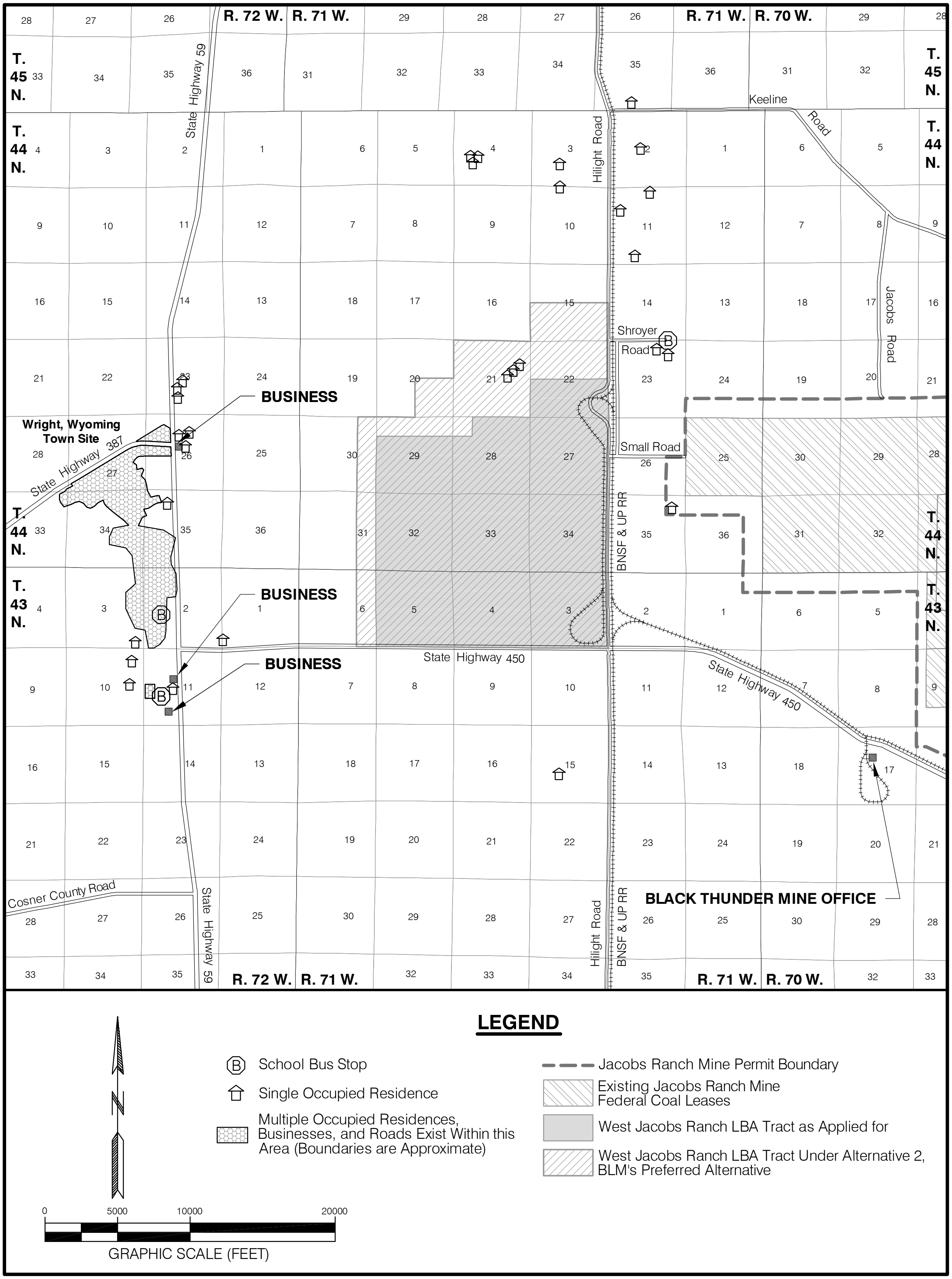

Figure ES-14. Residences, School Bus Stops, Public Roads, and Other Publicly Accessible Facilities in the Vicinity of the West Jacobs Ranch LBA Tract Under Alternative 2.

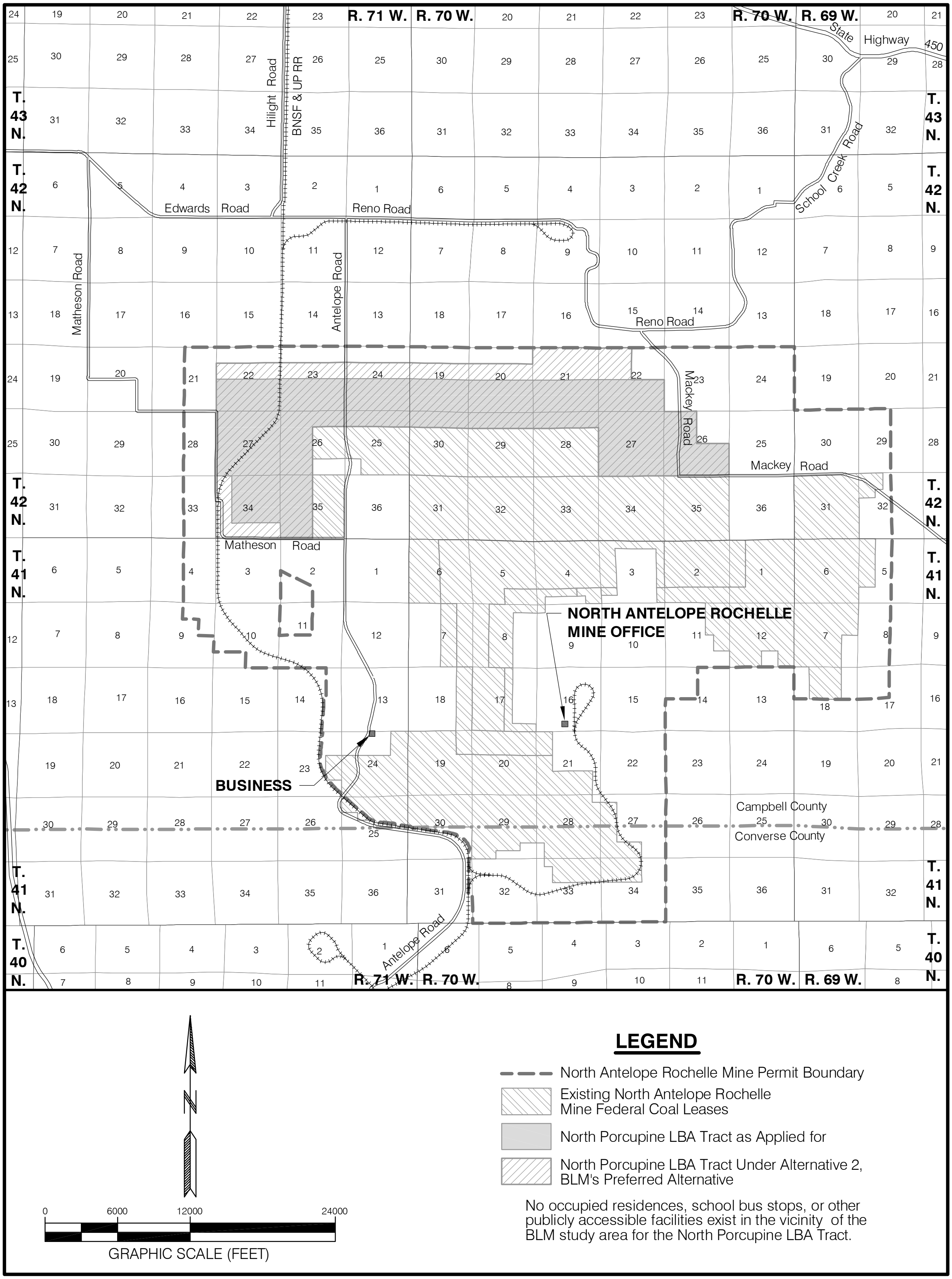

Figure ES-15. Residences, School Bus Stops, Public Roads, and Other Publicly Accessible Facilities in the Vicinity of the North Porcupine LBA Tract Under Alternative 2.

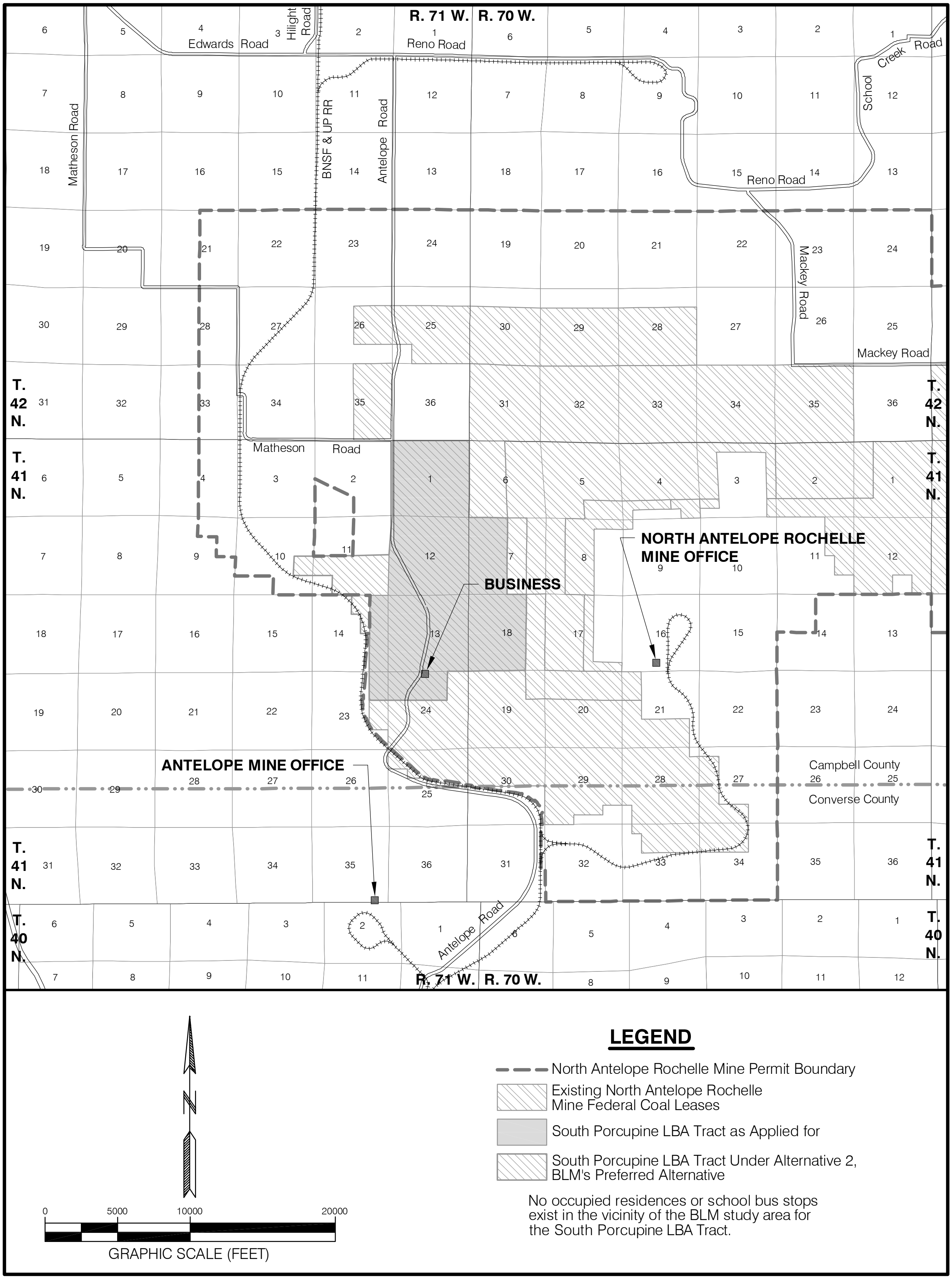

Figure ES-16. Residences, School Bus Stops, Public Roads, and Other Publicly Accessible Facilities in the Vicinity of the South Porcupine LBA Tract Under Alternative 2.

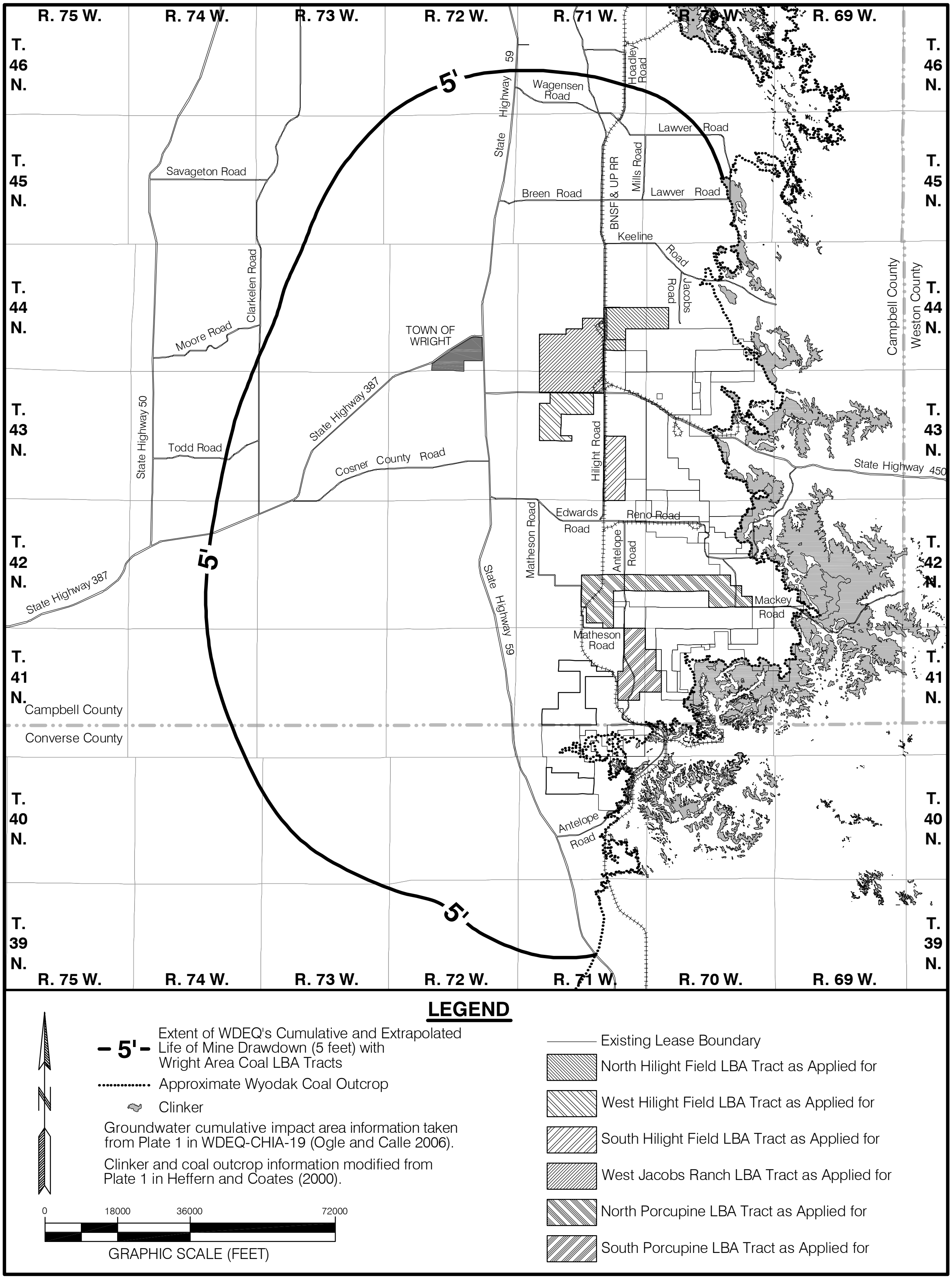

Figure ES-17. Extrapolated Extent of Life of Mine Cumulative Drawdown Within the Wyodak Coal Aquifer With the Addition of Wright Area Coal LBA Tracts.

four southern mines (Jacobs Ranch, Black Thunder, North Antelope Rochelle, and Antelope) in the Wright subregion with the addition of the six WAC LBA tracts. Analysis of the cumulative impacts as a result of mining was performed by qualitatively assessing the additive impacts of these mines. Each mine is required by WDEQ/LQD to evaluate the impacts to the hydrologic resources and will typically model groundwater level drawdown using the most conservative, worst-case scenario. The extent of the 5-feet drawdown contour is used by WDEQ/LQD to assess the extent of the impact to the groundwater system caused by mining operations. The predicted maximum 5-foot drawdown contour for the Wyodak coal aquifer from the four Wright area coal mines was superimposed by Ogle and Calle (2006) to generate the 5-foot cumulative estimate.

The data available indicate that, after reclamation, the hydraulic properties of the backfill would be comparable to the properties of the premining overburden and coal aquifers. Total dissolved solids (TDS) levels in groundwater from the backfill could initially be expected to be higher than in the premining overburden and coal aquifers, but would be expected to meet Wyoming Class III standards for use as livestock water.

Mining does not directly disturb aquifers 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 2001a). 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 WAC LBA tracts are leased by the applicant mines, water would be produced from these wells for a longer period of time and the mines would probably not require additional sub-coal wells to mine and reclaim the LBA tracts.

► Surface Water

Tributary streams of the Cheyenne River drain the general Wright analysis area. 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. 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. Typical of this semi-arid area, these streams, with the exception of Antelope Creek, are all ephemeral, receiving flow contributions primarily from convective thunderstorm runoff and, to a lesser extent, from snowmelt runoff in the spring. Surface water quality varies with flow and/or season. Playas that are formed by natural topographic depressions are common in the general Wright analysis area and portions of each tract's general analysis area are internally drained. Springs are uncommon in this area and none have been identified within the general analysis areas of these six LBA tracts.

Changes in runoff characteristics and sediment discharges would occur during mining of the WAC 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. In accordance with the SMCRA and Wyoming state statutes, once mining is complete the pits would be backfilled and drainage would be reestablished. Surface water drainages would be restored to approximate premine conditions and blend with the existing drainage system above and below the disturbance area. Surface water flow, quality, and sediment discharge would approximate premining conditions.

► Alluvial Valley Floors

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 Wright area LBA tracts. Based on existing and preliminary AVF evaluations within the general Wright analysis area, AVF characteristics on drainages are negligible. An AVF assessment would be part of the mine permitting process if a tract is leased and proposed for mining, 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. AVFs that are not significant to agriculture can be disturbed during mining but must be restored as part of the reclamation process. It is reasonable to assume that the WDEQ/LQD would determine that no AVFs are present within any of the Wright area 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.

► Wetlands

Formal wetland delineations have been confirmed by the U.S. Army Corps of Engineers (COE) for wetlands and Other Waters of the U.S. (OWUS) included in the general analysis areas for the Wright area LBA tracts that lie within the applicant mines' existing permit areas. Preliminary wetlands inventories of the LBA tracts' general analysis areas that have not been formally evaluated, based on U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) mapping, vegetation mapping, review of color infrared aerial photographs, and field survey reconnaissance were conducted in 2007 and 2008. Based on those previous wetland delineation surveys and the preliminary wetland inventories of the general analysis areas for the six Wright area LBA tracts, a maximum of approximately 602 acres of wetlands and OWUS would be disturbed if all the LBA tracts are leased and subsequently mined under Alternative 2, BLM's preferred alternative for each tract. These wetlands and OWUS were found within five general land categories: ephemeral streams, playas, ponds/reservoirs, isolated depressions, and excavated upland areas. 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.

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 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.

► **Soils**

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.

Consequences from the salvage and redistribution of soils during mining and reclamation of each LBA tract that is leased would include changes in physical, biological, and chemical properties of the soil resources. Following reclamation, the soils would be unlike premining soils in texture, structure, color, accumulation of clays, organic matter, microbial populations, and chemical composition. 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 reclaimed land. The baseline soils analyses 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 2-3 feet. The redistributed soil would be more uniform in type, thickness, and texture, and it would be adequate in quantity and quality to support planned postmining land uses (i.e., wildlife habitat and rangeland).

► **Vegetation**

The vegetation analysis area for each of the six LBA tracts is the respective tract's general analysis area. These vegetation analysis areas are either partially located within, contiguous to, or completely within applicant mines' existing 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.

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.

Mining would progressively remove this native vegetation. Reclamation, including revegetation of mined areas, would occur contemporaneously with mining on adjacent lands. Reestablished vegetation would be dominated by species mandated in the reclamation seed mixtures, which are approved by the WDEQ/LQD. The majority of these species would be native to the LBA tracts. Initially, the reclaimed land would be dominated by grassland vegetation, which would be less diverse than the premining vegetation. Estimates for the time it would take to restore sagebrush to premining density levels range from 20 to 100 years. A reduction in shrubs would result in a long-term reduction of habitat carrying capacity for some species and may delay use of the reclaimed area by shrub-dependent species. Following completion of reclamation (seeding with the approved seed mixture) and before release of the reclamation bond (a minimum of 10 years), a diverse, effective, and permanent vegetative cover would be established on the LBA tracts. The decrease in plant diversity would not seriously affect the potential productivity of the reclaimed areas, and the proposed postmining land uses (wildlife habitat and rangeland) should be achieved even with the changes in vegetation composition and diversity. The reclamation plans for the LBA tracts would also include steps to control invasion by weedy (invasive, nonnative) plant species.

► **Wildlife**

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.

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.

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). Direct impacts of surface coal mining on wildlife occur during mining and are therefore short term. They include road kills by mine-related traffic, direct losses of less mobile wildlife species, restrictions on wildlife movement created by fences, spoil piles and pits, displacement of wildlife from active mining areas (including abandonment of nests or nesting and breeding habitat for birds), increased competition between animals in areas adjacent to mining operations, and increased noise, dust, and human presence. Habitat for aquatic species would also be lost during mining operations. Displaced animals by find equally suitable habitat that is not occupied by other animals, or occupy poorer quality habitat than that from which they were displaced. Indirect impacts are longer term and include alterations in topography and vegetative cover, particularly the reduction in shrub density, and could cause a decrease in carrying capacity for some species and a decrease in vegetation diversity. Mining companies have initiated efforts in recent years to increase the diversity of post-mine topography and to increase the amount of sagebrush in the reclamation.

The six Wright area LBA tracts do not include any unique or crucial big game habitat or migration corridors. The two big game species that are common in suitable habitat throughout the general Wright analysis area are pronghorn and mule deer. A resident elk herd resides in the Rochelle Hills east of the general Wright analysis area, and elk do wander from the protection of the hills to forage in native and reclaimed grasslands in the vicinity of the general Wright analysis area. As more lands are reclaimed from mining, elk are shifting their winter use to these areas. Habitat disturbance and big game displacement would be incremental, occurring over several years and allowing for gradual changes in distribution patterns. Big game have continued to occupy areas adjacent to and within active mining operations, suggesting that some animals may become habituated to such disturbances.

Those raptor 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, though the nest sites themselves may not have been located. 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. Mining the LBA tracts would not impact overall regional raptor populations; however, individual birds or pairs may be impacted. 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. All three applicant mines operate under a current USFWS approved Monitoring and Mitigation Plan for raptors and other migratory bird species of management concern, and have successfully executed mitigation techniques to protect nest productivity. 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.

Four upland game bird species have historically been documented within the general Wright analysis area. These species are the mourning dove, gray partridge, wild turkey, and Greater sage-grouse. 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 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. Since 1999, the USFWS has received eight petitions requesting that the sage-grouse be listed under the Endangered Species Act (ESA) 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 USFWS for further reconsideration. On February 26, 2008, the USFWS announced the initiation of another status review for the Greater sage-grouse. The USFWS announced on March 5, 2010 its decision to classify the Greater sage-grouse as a candidate species under the ESA. The USFWS found that listing the Greater sage-grouse (rangewide) was warranted, but precluded by higher priority listing actions.

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 Freudenthal 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." 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.

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. As a result, most of the general analysis areas for the six Wright area LBA tracts have been included in previous regular survey efforts. A total of 10 sage-grouse leks have been documented on and within 2 miles of the six combined general analysis areas. 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. Two of the four occupied leks likely represent a shift in lekking activity rather than two distinct leks.

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. 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, but monitoring of sage-grouse activities has indicated that the birds may change lek sites. 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 LBA tracts 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. 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. 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.

Two of the four occupied leks are within 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. The 3-mile radii of concern for the other two occupied leks (which are likely only one strutting ground that has been relocated slightly), overlap the North Porcupine LBA Tract. If the North Porcupine LBA Tract 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 these leks would likely be affected by mining activity in those areas.

► Threatened and Endangered Species

T&E plant and animal species that could be present in the general Wright analysis area include the Ute ladies'-tresses orchid (threatened) and blowout penstemon (endangered). The habitat requirements for, occurrences of, and potential project effects on these species are included in Appendix G.

Dormant Ute ladies'-tresses plants typically persist underground for one to many years and can only be reliably documented after several years of repeated surveys. Recent USFWS survey requirements therefore recommend that all potentially suitable habitat be surveyed annually for three consecutive years during the time of year that the orchids are known to flower.

Areas of potentially suitable habitat for Ute ladies'-tresses within the general analysis areas for the North, South and West Hilight Field LBA Tracts were surveyed by qualified professionals in August 2008 and August 2009, and no orchids were found. In order to satisfy the USFWS survey requirements for the species, the third consecutive annual survey of each tract's general analysis area is scheduled in 2010.

Areas of potentially suitable habitat for Ute ladies'-tresses within the general analysis area for the West Jacobs Ranch LBA Tract were surveyed by qualified professionals in August 2007, August 2008 and August 2009, and no orchids were found.

Areas of potentially suitable habitat for Ute ladies'-tresses within the general analysis areas for the North and South Porcupine LBA Tracts were surveyed by qualified professionals in 2005, 2006, 2007 and 2009, and no orchids were found. Those surveys covered only USFS lands (TBNG) and therefore did not include all areas of suitable habitat (on both USFS and private lands) within the general analysis areas for the North and South Porcupine tracts. In order to satisfy the USFWS survey requirements for the species, surveys of the tracts' general analysis areas are scheduled in 2010 and 2011.

The blowout penstemon, one of Wyoming's rarest native plants, is a regional endemic species of the Sandhills of west-central Nebraska and the northeastern edge of the Great Divide Basin in Wyoming. In Wyoming, the species is currently known from just three populations, which all occur in the Ferris Dunes area located in the northwestern part of Carbon County. The general Wright analysis area is located approximately 150 miles northwest of the known occurrences in the Nebraska Sandhills and approximately 150 miles northeast of the three known populations in Carbon County, Wyoming. The species is most common in the open, sandy habitats or wind-excavated depressions (crater-like blowouts) in dune tops. In Wyoming, blowout penstemon is found in sparsely vegetated sandy blowouts in the early stages of plant community development.

No areas of potentially suitable habitat for the blowout penstemon have been identified within the general analysis area for each of the six WAC LBA tracts. No blowout penstemon or plants commonly associated with the species (blowout grass, lemon scurfpea and thickspike wheatgrass) were found during the baseline vegetation surveys of all six tracts, which were conducted in 2007 and/or 2008 by qualified professionals.

► **Land Use and Recreation**

Leasing and subsequently mining the Wright area LBA tracts would preclude other land uses. 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 would result. This would include the incremental removal of all existing oil and gas surface and downhole production and transportation equipment and facilities. The loss of accessibility to these lands would be long term (during mining and reclamation), but not permanent.

The six Wright area LBA tracts configured under Alternative 2, BLM's preferred alternative for each tract, 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. 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 that LBA tract were leased. Access to the 12,481 acres of federal grazing leases on TBNG surface, which are currently held by the Thunder Basin Grazing Association, would be suspended during mining and reclamation operations on the other five LBA tracts. According to the USFS Douglas Ranger District, each mine can close access in areas that are actively mined for human health and safety reasons. Hunting and other recreational activities on the LBA tracts, including the federal surface, would be eliminated during mining and reclamation. The federal lands actually represent a relatively small portion of the currently accessible public surface lands for recreational opportunity within TBNG. The cumulative impacts of energy development (coal mining, oil and gas) in the PRB will continue to contribute to a reduction in hunting opportunities for some animals (pronghorn, mule deer, and sage-grouse).

Within 10 years after initiation of each reclamation phase, rangeland and wildlife use (the historic land uses) would return to near premining levels. 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). Public access to federal lands would be restored after mining and reclamation are complete.

► **Cultural Resources**

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 have been mostly surveyed for cultural resources at a Class III level. A total of 333 cultural sites have been document within the six combined general analysis areas (a total of approximately 43,445 acres). Of those 333 sites, 195 are prehistoric cultural remains, 101 historic cultural remains, 27 multi-component (both historic and prehistoric) remains, and 10 are of indeterminate age and cultural affiliation.

Of those 333 sites, there are a total of 233 sites that have been evaluated as *not eligible* for nomination to the National Register of Historic Places (NRHP) by the State Historic Preservation Office (SHPO) and no further work is required at those sites. Nineteen sites have been determined to be *eligible* for the NRHP by SHPO and will have to be avoided or a mitigation plan approved and implemented prior to any disturbance. The remaining 81 sites are currently considered *unevaluated* by SHPO and will require additional evaluation and/or Native American consultation. The *unevaluated* sites are to be given the same protections as *eligible* sites and are to be avoided until a determination of eligibility have been made. Data recovery plans are required for all sites recommended *eligible* to the National Register following testing and consultation with SHPO. Until full consultation with SHPO has been completed and agreement regarding NRHP eligibility has been reached, all cultural sites within each WAC LBA tract's general analysis area would be protected from disturbance.

No sites of Native American religious or cultural importance have been identified on the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts. If such sites or localities are identified at a later date, appropriate action must be taken to address concerns related to those sites.

► Visual Resources

Currently, mine facilities and mining activities at the southern group of mines (Jacobs Ranch, Black Thunder, North Antelope Rochelle, and Antelope) 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.

Some mining activities on the North, South and West Hilight Field LBA Tracts would be visible from State Highway 450. 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. Portions of the West Hilight Field and West Jacobs Ranch tracts may also be visible from State Highway 59. 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 visual resources management (VRM) class is Class IV. This classification would not be altered by the leasing and subsequent mining of the six WAC LBA tracts under the Proposed Actions or Alternatives 2 and 3. 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. No unique visual resources have been identified on or near the WAC LBA tracts.

► Noise

Noise levels on the WAC 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. The five occupied dwellings that are located within the tracts (two within the North Hilight Field 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 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. After mining and reclamation are completed, noise would return to premining levels.

► **Transportation**

Essentially all of the coal mined on the Wright area 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 these 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.

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. As a result, the coal underlying the public road ROWs and adjacent buffer zones has been determined to be unsuitable for mining; however, it would be included in the LBA tract that is offered for lease in order to allow efficient recovery of economically mineable coal outside of the ROW and buffer zone. 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 applicant mines are currently evaluating options to close and/or relocate several county roads in order to recover the coal in the proposed leases.

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.

Active pipelines and utility/power transmission lines would have to be relocated in accordance with previous agreements, or agreements would have to be negotiated for their removal or relocation.

► **Socioeconomics**

Royalty and bonus payments for the coal in the LBA tracts would be collected by the federal government and split with the state. Assuming an average coal price of $11.06 per ton recovered and a potential range of bonus payments of 30 to 97 cents per ton, the potential additional federal revenues from the six Wright area LBA tracts would range from approximately $3.6 to $7.2 billion, depending on the alternative selected and the bonus price at the time the coal is leased. The potential additional revenue to the state of Wyoming from the six LBA tracts would range from approximately $4.5 to $8.7 billion, depending on the alternative selected, the bonus price at the time the coal is leased, and the selling price of the coal. Mine life and employment (at or slightly above current levels) would be extended for over nearly 23 additional years, depending on the LBA tracts involved and which alternatives are selected.

► **Environmental Justice**

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. Potentially adverse impacts do not disproportionately affect minorities, low-income groups or Native American tribes or groups. No tribal lands or Native American communities are included in the general Wright analysis area, and no Native American treaty rights or Native American trust resources are known to exist for this area.

► **Greenhouse Gas Emissions**

Greenhouse gases (GHGs) are an issue because of global warming and climate change. Global warming is a theory that certain gases in the atmosphere impede the radiation of heat from the earth back into space, trapping heat like the glass in a greenhouse. This raises the average temperature of the surface of the earth and the lower atmosphere, which contributes to climate change. Among these GHGs are carbon dioxide, methane, water vapor, ozone, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride. GHGs are not currently regulated, but there is a consensus in the international community that global climate change is occurring and that it should be addressed in governmental decision making.

Carbon dioxide equivalents (CO_2e) is a measurement for describing how much global warming a given type and amount of greenhouse gas may cause. The total annual 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. The increases 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. Annual coal production rates may also increase over time at the applicant mines.

The Center for Climate Strategies estimates that activities in Wyoming will account for approximately 60.3 million tonnes of gross CO_2e emissions in 2010 and 69.4 million tonnes in 2020. The total CO_2e emissions from the three applicant mines in 2007 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 CO_2e emissions at the three applicant mines would represent approximately 3.61 percent of the projected 2020 state-wide CO_2e emissions.

No Action Alternatives (Alternative 1)

Under the No Action alternatives for each tract, the coal lease applications would be rejected and the areas contained in the applications would not be offered for lease at this time. The tracts could be nominated for lease again in the future. Under the No Action alternatives, the impacts described in the preceding paragraphs to topography and physiology, geology and minerals, air quality, water resources, AVFs, wetlands, soils, vegetation, wildlife, T&E species, land use and recreation, cultural resources, Native American concerns, visual resources, noise, transportation, and socioeconomics would occur due to mining the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle mine coal leases, but these impacts would not be extended by mining onto the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts.

Mitigation

The Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines currently approved mining permits include extensive baseline information, ongoing monitoring information and commitments, and mitigation measures that are required by SMCRA and Wyoming state law. Compliance, mitigation, and monitoring measures that are required by regulation are considered to be part of the Proposed Actions and Alternatives considered in this EIS. These regulatory requirements, mitigation measures and monitoring commitments are in place for the No Action Alternative as part of the currently approved mining and reclamation plans for the three applicant mines and would be included in the permitting processes that would be required to mine the six WAC LBA tracts.

If impacts are identified during the leasing process that are not mitigated by existing required mitigation measures, BLM can include additional mitigation measures in the form of stipulations on a new lease, within the limits of its regulatory authority. Any special stipulations identified by BLM where additional or increased monitoring measures are recommended to be added to the BLM leases are included in Appendix D of this EIS.

Cumulative Impacts

Cumulative impacts result from the incremental impacts of an action added to other past, present, and reasonably foreseeable future actions, regardless of who is responsible for such actions. Cumulative impacts can result from individually minor, but collectively significant, actions occurring over time.

Since decertification of the Powder River Federal Coal Region in 1990, 20 coal leases containing approximately 5.8 billion tons of federal coal have been issued following competitive sealed-bid sales. Three exchanges of federal coal in the Wyoming portion of the Powder River Federal Coal Region have also been completed. Twelve additional coal lease applications, including the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine tract applications, are currently pending. The pending LBA applications contain over 3.8 billion tons of coal.

Recently, the BLM completed a regional technical study, called the PRB Coal Review, to help evaluate the cumulative impacts of coal and other mineral development in the PRB. The PRB Coal Review consists of three tasks:

- Task 1 identifies existing resource conditions in the PRB for the baseline year (2003) and, for applicable resources, updates the BLM's 1996 status check for coal development in the PRB.

- Task 2 defines the past and present development activities in the PRB and their associated development levels as of 2003 and develops a forecast of reasonably foreseeable development in the PRB through 2020. The reasonably foreseeable activities fall into three broad categories: coal development (coal mine and coal-related), oil and gas development (conventional oil and gas, coal bed natural gas, and major transportation pipelines), and other development, which includes development that is not energy-related as well as other energy-related development.

- Task 3 predicts the cumulative impacts that could be expected to occur to air, water, socioeconomic, and other resources if the development occurs as projected in the forecast developed under Task 2.

A series of reports have been prepared to present the results of the PRB Coal Review task studies. The Task 1, 2, and 3 reports represent components of a technical study of cumulative development in the PRB; they do not evaluate specific proposed projects, but they provide information that BLM is using to evaluate the cumulative impacts that would be expected to occur if specific projects or applications, such as the six WAC LBA tracts, are approved. The

PRB Coal Review is expressly not a NEPA analysis. It is a planning tool; a set of environmental impact analysis tools, and when maintained through time will provide a method to calibrate development projects and related estimation of effects. The results of the PRB Coal Review studies are summarized in Section 4.0 of this EIS. The Wyoming portion of the PRB is the primary focus of the PRB Coal Review, but the Montana portion of the PRB is included in some studies.

Due to variables associated with future coal production, two projected coal production scenarios (representing an upper and a lower production level) were developed for the PRB Coal Review. The projected development levels are based on projected demand, coal market forecasts, and availability of adequate coal transportation. The projected coal production levels at the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines during the baseline year and for 2010, 2015, and 2020 are included.

Cumulative impacts vary by resource, with potential impacts to air quality, groundwater quantity, wildlife habitat, and socioeconomics generally being the greatest concerns.

The PRB Coal Review air quality study documents the modeled air quality impact of existing operations during a baseline year, 2002, and of projected development activities in 2010. BLM updated the model and conducted the cumulative air quality impact analysis using a revised baseline year of 2004 with development levels projected for year 2015. BLM recently updated the model for the second time, and conducted the cumulative air quality impact analysis for the year 2020 using the same baseline year of 2004 with revised projected 2020 scenarios. The revised baseline year emissions inventory was developed using 2004 actual emissions data or emissions estimates and incorporated the recent analyses of emissions in Wyoming and Montana, which were not available when the 2010 modeling study was done. The model was used to evaluate impacts of existing and projected source emissions on several source groups, including near-field receptors in Wyoming and Montana, receptors in nearby federally designated "Class I" areas, and receptors at other sensitive "Class II" areas. The EPA guideline CALPUFF model system version 5.8 was used for the modeling analysis.

The existing regional air quality conditions generally are very good in the PRB, but the modeling showed substantial, localized impact of the 24-hour particulate concentrations, exceeding the national and state ambient air quality standards at some Wyoming near-field receptors for the baseline year (2004), as well as for both development scenarios for 2015 and 2020. Impacts at Montana near-field receptors would be in compliance with the national and state ambient air quality standards for all pollutants and averaging periods. Table ES-13 presents the maximum modeled impacts on ambient air quality at the near-field receptors in Wyoming and Montana for the baseline year (2004) and for both coal production scenarios for 2015 and 2020. The model results should not be construed as predicting an actual exceedance of any standard,

Table ES-13. Projected Maximum Potential Near-field Impacts (μg/m³).

Pollutant	Averaging Time	Base Year (2004) Impacts	2020 Lower Coal Development Scenario Impacts	2020 Upper Coal Development Scenario Impacts	NAAQS	Wyoming AAQS	Montana AAQS	PSD Class II Increments
				Wyoming Near-field				
NO_2	Annual	31.3	30.5	30.6	100	100	--[1]	25
SO_2	Annual	15.3	16.4	16.5	80	60	---	20
	24-hour	112.3	143.3	143.3	365	260	---	91
	3-hour	462.0	936.7	936.7	1,300	1,300	---	512
$PM_{2.5}$	Annual	13.4	**16.3**	**16.3**	15	15	---	---
	24-hour	**87.6**	**218.4**	**218.4**	35	35	---	---
PM_{10}	Annual	38.4	46.6	46.6	---	50	---	17
	24-hour	**250.4**	**624.1**	**624.3**	150	150	---	30
				Montana Near-field				
NO_2	Annual	3.3	2.5	2.6	100	---	100	25
	1-hour	409.0	440.1	442.7	---	---	564	---
SO_2	Annual	1.6	3.0	3.1	80	---	80	20
	24-hour	16.1	24.7	27.1	365	---	365	91
	3-hour	65.0	138.9	138.9	1,300	---	1,300	512
	1-hour	162.9	237.0	259.1	---	---	1,300	---
$PM_{2.5}$	Annual	1.0	0.9	0.9	15	---	15	---
	24-hour	10.2	10.2	10.2	35	---	35	---
PM_{10}	Annual	2.8	2.5	2.6	---	---	50	17
	24-hour	29.1	29.3	29.3	150	---	150	30

[1] No standard or increment
Value units are microgram per cubic meter (μg/m³)
Bold values indicate projected exceedance of AAQS
Source: PRB Coal Review Task 3A Update Report (BLM 2009c)

but are at best indicators of potential impacts. Table ES-14 lists the projected modeled visibility impacts for the baseline year (2004) and for the lower and upper coal production scenarios for all analyzed Class I and sensitive Class II areas. For the upper and lower coal production scenarios, it shows the number of additional days that the impacts were projected to be greater than 1.0 deciview (dv) (10 percent in extinction) for each site in 2015.

The PRB Coal Review provides an assessment of the cumulative impact to surface and ground water resources associated with future projected levels of coal mining, coal mine dewatering, CBNG groundwater withdrawal and surface disposal, and coal mine and conventional oil and gas surface disposal of groundwater. Several studies and modeling analyses have previously been conducted by various federal and state agencies, as well as the coal and oil and gas industries, to predict the cumulative impacts of surface coal mining and CBNG development on groundwater resources in the PRB. The most recent analysis, BLM's PRB Coal Review, summarizes the modeled changes in groundwater levels projected for 2010, 2015, and 2020. The base years used for comparison of groundwater impacts were 2002 (the year used for calibration of the groundwater model) and 1990 (a time period prior to CBNG pumpage and before major expansion by the eastern PRB coal mines). Information from earlier studies was incorporated into the modeling effort for the PRB Coal Review analysis. The cumulative effects groundwater model domain is within approximately 25 miles of the coal mines. As expected, modeling indicates groundwater impacts from CBNG development and surface coal mining are additive in nature and that the addition of CBNG development has greatly extended the area experiencing a loss in hydraulic head to the west of the mining area. Drawdown in the Upper Fort Union coal aquifers attributable to mining only from 1990 to 2020 ranges from 25 to 125 feet in the active mine areas with up to 125 feet of rebound in the reclaimed areas. At distances greater than 3 miles west of the southern group of mines, drawdowns attributed to mining only were projected to be less than 25 feet, from 1990 to 2010 as well as from 1990 to 2020. The effect of CBNG pumpage on the Upper Fort Union coal aquifers from 1990 to 2010 results in an extensive area of drawdown centered about 10 miles southwest of Wright, covering nearly 15 townships, and drawdowns range from 25 feet on the southern margin to 575 feet in the center of the depression. The modeled drawdown in the Upper Fort Union due to CBNG pumpage from 1990 to 2020 is also projected to primarily be located southwest of Wright, producing a groundwater depression of between 25 to 425 feet that covers roughly eight to nine townships.

In addition to conducting detailed analyses to assess the probable hydrologic consequences of mining as part of the mine permitting process, each mine must monitor groundwater levels in the coal and underlying and overlying aquifers. The monitoring programs track the extent of groundwater drawdown propagation to the west and the extent of recharge and quality of the water in the backfill areas of the mines. The monitoring data verify that recharge has occurred and is continuing in the backfill, and that the quality of water from the backfill will generally meet the state standard for livestock use. The PRB

Table ES-14. Modeled Change in Visibility Impacts at Class I and Sensitive Class II Areas.

Location	Base Year (2004) No. of Days >10%	2020 Lower Coal Development Scenario Change in No. of Days >10%	2020 Upper Coal Development Scenario Change in No. of Days >10%
Class I Areas			
Badlands National Park	218	44	44
Bob Marshall WA	8	0	0
Bridger WA	144	5	5
Fitzpatrick WA	91	6	6
Fort Peck Indian Reservation	105	20	21
Gates of the Mountain WA	55	4	4
Grand Teton National Park	70	6	6
North Absaroka WA	61	8	8
North Cheyenne Indian Reservation	243	59	60
Red Rock Lakes	42	3	3
Scapegoat WA	27	2	2
Teton WA	57	8	8
Theodore Roosevelt National Park	178	24	24
UL Bend WA	77	18	18
Washakie WA	83	8	8
Wind Cave National Park	262	28	31
Yellowstone National Park	84	5	5
Sensitive Class II Areas			
Absaroka Beartooth WA	101	10	10
Agate Fossil Beds National Monument	251	26	26
Big Horn Canyon National Rec. Area	331	1	1
Black Elk WA	236	47	47
Cloud Peak WA	126	29	30
Crow Indian Reservation	360	3	3
Devils Tower National Monument	274	31	32
Fort Belknap Indian Reservation	66	14	15
Fort Laramie National Historic Site	260	15	16
Jedediah Smith WA	79	3	5
Jewel Cave National Monument	261	36	37
Lee Metcalf WA	97	2	2
Mount Naomi WA	51	1	1
Mount Rushmore National Monument	222	49	52
Popo Agie WA	139	6	6
Soldier Creek WA	268	19	19
Wellsville Mountain WA	130	17	17
Wind River Indian Reservation	217	9	10

Source: PRB Coal Review Task 3A Update Report (BLM 2009c)

Coal Review predicts that resaturation of coal mine pit backfill to form backfill aquifers may take approximately 100 years after cessation of mining and is projected to result in the westward migration of groundwater with elevated TDS levels. Modeling of this westward migration indicates that TDS levels should be down to the average background (premine) value within 2,000 feet of the final westward extent of the coal mine boundaries. Thus, no impact to groundwater quality in either the Wasatch or Upper Fort Union aquifers is expected beyond approximately 2,000 feet west of the final coal mine boundaries.

The PRB Coal Review summarizes the cumulative impacts to surface water quality and stream channel stability as a result of surface discharge of groundwater by CBNG development and coal mine dewatering projected for 2010, 2015, and 2020 in the eastern PRB within approximately 25 miles of the coal mines. The base year used for comparison of surface water quality impacts was 2003. Projected cumulative surface water impacts primarily include the impacts of CBNG production water discharged to ephemeral drainages and the surface disturbance and subsequent reclamation of drainages that result from surface coal mining. For the coal mines, it was assumed that most, if not all, of the water produced was expected to be consumed during operation, and that any water discharged to nearby ephemeral drainages is in accordance with Wyoming Pollution Discharge Elimination System (WYPDES) permits. It was therefore projected that the primary source of water discharged directly to the receiving drainages in the PRB study area through 2020 would be limited to the production water from CBNG development.

The PRB Coal Review studies include an evaluation of the impacts to wildlife and aquatic species as of 2003 and an evaluation of the projected levels of disturbance in the PRB in 2010, 2015, and 2020, based on the projected development levels in those years. As discussed above, impacts to wildlife and fisheries can be classified as short-term and long-term. Short-term impacts are related to habitat disturbance during project development and operation. Long-term impacts result from changes in habitat after reclamation is completed. Habitat fragmentation can result from activities such as roads, well pads, mines, pipelines, and electrical power lines, as well as increased noise, elevated human presence, dispersal of noxious and invasive weed species, and dust from unpaved road traffic.

The cumulative impacts of energy development (coal, oil and gas) in the PRB are and will continue to contribute to a reduction in hunting opportunities for some animals (pronghorn, mule deer, and sage grouse).

The PRB Coal Review used the Regional Economic Models Inc. Policy Insight regional economic model to project cumulative employment and population levels and associated impacts in the PRB for the upper and lower coal production scenarios in 2010, 2015, and 2020. Table ES-15 presents the recent and projected population levels for the counties included in the PRB Coal Review socioeconomic analysis.

Table ES-15. Recent and Projected PRB Population.

Year	Campbell County	Converse County	Crook County	Johnson County	Sheridan County	Weston County	Six County PRB Total
				Census			
2000	33,698	12,104	5,895	7,108	26,606	6,642	92,053
2003	36,381	12,326	5,971	7,530	27,116	6,665	95,989
2006	38,934	12,866	6,255	8,014	27,673	6,762	100,504
				Lower Coal Production Scenario			
2010	45,925	13,103	6,542	8,389	28,459	7,108	109,526
2015	48,905	13,671	6,759	8,867	30,016	7,174	115,392
2020	50,995	14,193	6,989	9,326	31,467	7,208	120,178
				Upper Coal Production Scenario			
2010	47,662	13,160	6,570	8,424	28,579	7,137	111,532
2015	51,558	13,763	6,802	8,924	30,214	7,219	118,480
2020	54,943	14,313	7,045	9,403	31,733	7,266	124,703

Source: U.S. Census Bureau (2006a) and PRB Coal Review Task 3C Report

The cumulative impacts of mining the coal are considered in this EIS because it is a logical consequence of issuing a maintenance lease to an existing mine. The use of the coal after it is mined is not determined at the time of leasing or mining; the use is determined by the purchaser and end user. However, almost all of the coal mined in the PRB is utilized and burned by coal-fired power plants located throughout the U.S. to generate electricity. When coal is burned, it results in the release of CO_2, a GHG, as well as mercury and other compounds and elements. GHGs, climate change, the potential impacts of worldwide GHG emissions, and coal combustion by-products are discussed at length in Section 4.2.14. The U.S. Department of Energy's recent reports that project the nation's current and future energy needs and power generation sources are also cited in the discussion.

This EIS presents BLM's analysis of environmental impacts under authority of the NEPA and associated rules and guidelines. BLM will use this analysis to make a leasing decision. The decision to lease these lands is a necessary requisite for mining, but is not in itself the enabling action that will allow mining. The most detailed analysis prior to mine development would occur after the lease is issued, when the lessee files an application for a surface mining permit and mining plan approval, supported by extensive mining and reclamation plans, to the WDEQ/LQD.

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LIST OF APPENDICES

Abbreviations and Acronyms Used in this Report	
AAQS	Ambient Air Quality Standards
ac	acre(s)
ACC	Antelope Coal Company
ac-ft	acre-foot, acre-feet
ac-ft/yr	acre-foot per year, acre-feet per year
AIRS	Aerometric Information and Retrieval System
ALC	Ark Land Company
AML	Abandoned Mine Land
ANC	acidification neutralization capacity
ANFO	ammonium nitrate fuel oil
APD	Application for Permit to Drill
APLIC	Avian Power Line Interaction Committee
AQD	Air Quality Division
AQRV	air quality related values
ARCO	Atlantic Richfield Company
ARS	Air Resource Specialists, Inc.
ASCM	alternative sediment control measure
AUM	animal unit month
AVF	alluvial valley floor
A&C	Allen and Crouch Petroleum Engineers, Inc.
BACM	best available control method
BACT	best available control technology
bcf	billion cubic feet
bcy	bank cubic yards
BLM	Bureau of Land Management
BMP	best management practice
BNSF	Burlington Northern Santa Fe
BNSF-UP, BNSF&UP	Burlington Northern Santa Fe and Union Pacific
BN-UP, BN&UP	Burlington Northern-Union Pacific
boe	barrels of oil equivalent
B.P.	before present
BTU	BTU Western Resources, Inc.
Btu	British thermal units
Btu/lb	British thermal units per pound
CAA	Clean Air Act
CAAA	Clean Air Act Amendment
CAGR	compounded annual growth rate
CANAC	CANAC Railway Service, Inc.
CANDO	Converse Area New Development Organization
CBNG	coal bed natural gas
CCBC	Campbell County Board of Commissioners
CCC	Caballo Coal Company
CCEDC	Campbell County Economic Development Corporation
CCP	coal combustion product
CCS	carbon capture and storage
CCSD	Campbell County School District
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
cfs	cubic feet per second
CHIA	Cumulative Hydrologic Impact Assessment

Abbreviations and Acronyms Used in this Report

CH_4	methane
CMC	Cordero Mining Company
CMGC	Coal Mine Groundwater Model
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	CO_2 equivalents
COE	U.S. Army Corps of Engineers
CP	Canadian Pacific Railway Ltd.
CREG	Consensus Revenue Estimating Group
CRI	Caballo Rojo, Inc.
CSI	Community Strategies Institute
CWA	Clean Water Act
cy	cubic yards
dBA	A-weighted decibels
DEIS	Draft Environmental Impact Statement
DM&E	Dakota, Minnesota & Eastern Railroad Corporation
DOE	Department of Energy
DNRC	Department of Natural Resources and Conservation
DOI	Department of the Interior
dv	deciview, a measure of view impairment
EA	Environmental Assessment
EC	elemental carbon particles (re: air quality)
EIA	Energy Information Administration
EIS	Environmental Impact Statement
ENCOAL	Encoal Corporation
EO	Executive Order
EOR	enhanced oil recovery
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
EQC	Environmental Quality Council
ESA	Endangered Species Act
EUR	estimated ultimate recovery
EVG	Erathem-Vanir Geological, PLLC
F	Fahrenheit
FAA	Federal Aviation Administration
FCLAA	Federal Coal Leasing Act Amendments of 1976
FCW	Foundation Coal West, Inc.
FDM	Fugitive Dust Model
FEA	Final Environmental Assessment
FEIS	Final Environmental Impact Statement
FERC	Federal Energy Regulatory Commission
FGD	Flue Gas Desulfurization
FLM	Federal Land Management
FLPMA	Federal Land Policy Management Act of 1976
FOIA	Freedom of Information Act
FR	Federal Register
FRA	Federal Railroad Administration
ft	feet, foot
ft/day	feet per day
ft/mile	feet per mile
ft^3	cubic feet

Abbreviations and Acronyms Used in this Report	
FY	fiscal year
FYPC	Fossil Yield Potential Classification
g	gram
GAO	General Accounting Office
GAGMO	Gillette Area Ground Water Monitoring Organization
GDP	Gross Domestic Product
GHG	greenhouse gas
GIS	Geographic Information Systems
gpm	gallons per minute
GPS	Global Positioning System
GSP	Gross State Product
HAP	Hazardous Air Pollutant
HFC	hydrofluorocarbon
HIP	Health Impact Assessment
hp	horsepower
hr	hour
HUC	Hydrologic Unit Code
IBLA	Interior Board of Land Appeals
IGCC	Integrated Gasification Combined Cycle
IMPROVE	Interagency Monitoring of Protected Visual Environments
IR	Intermountain Resources
JRCC	Jacobs Ranch Coal Company
JRM	Jacobs Ranch Mine
J&S	Thunderbird - Jones & Stokes
km	kilometers
kV	kilovolts
LAC	limits of acceptable change (re: air quality)
LBA	lease by application
lbs/mmBtu	pounds per million British thermal units
LFC	liquids from coal
LNCM	Lands Necessary to Conduct Mining
LOP	life of project
LRMP	Land and Resource Management Plan
LW	Lower Wyodak coal seam
MACT	Maximum Achievable Control Technology
MBHFI	migratory birds of high federal interest
MBTA	Migratory Bird Treaty Act
μeq/L	microequivalents per liter
$\mu g/m^3$	micrograms per cubic meter
μmhos/cm	micromhos per centimeter
mcf	thousand cubic feet
MDEQ	Montana Department of Environmental Quality
MDEQ/AWM	Montana Department of Environmental Quality/Air and Waste Management Bureau
MEI	maximally exposed individual
mg/L	milligrams per liter
MLA	Mineral Leasing Act of 1920
MLE	most likely exposure
mm	million
mmbcy	million bank cubic yards
mmbo	million barrels of oil

Abbreviations and Acronyms Used in this Report

mmcf	million cubic feet
mmcfpd	million cubic feet of gas per day
mmgpy	million gallons per year
mmt	million tons
mmtpy	million tons per year
mph	miles per hour
MSA	Metropolitan Statistical Area
MSDS	material safety data sheet
MW	megawatts
NAAQS	National Ambient Air Quality Standards
NADP	National Atmospheric Deposition Program
NALMA	North American Land Mammal Age
NAPG	North American Power Group
NARM	North Antelope Rochelle Mine
NCTA	National Coal Transportation Association
NEAP	Natural Events Action Plan
NEPA	National Environmental Policy Act of 1969
NERC	North American Electric Reliability Council
NIOSH	National Institute of Occupational Safety and Health
NO	nitrogen oxide
NOA	notice of availability
NOAA	National Oceanic and Atmospheric Administration
NOI	notice of intent
N_2O	nitrous oxide
NO_2	nitrogen dioxide
NO_X	nitrogen oxides
NPDES	National Pollution Discharge Elimination System
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSPS	National Source Performance Standards
NSR	New Source Review
NWI	National Wetlands Inventory
NWLSWG	Northeast Wyoming Local Sage-Grouse Working Group
O_3	ozone (photochemical oxidants)
OC	organic carbon particles
OHWM	ordinary high water mark
OFE	Office of Fossil Energy
ORV	off road vehicle
OSHA	Occupational Safety and Health Administration
OSM	Office of Surface Mining Reclamation & Enforcement
OWUS	other waters of the U.S.
PEC	Peabody Energy Corporation
PECs	passive enclosure control systems
PETM	Paleocene-Eocene Thermal Maxim
PFYC	Probable Fossil Yield Classification
P.M.	Prime Meridian
P&M	Pittsburg and Midway Coal Mining Company
$PM_{2.5}$	particulates finer than 2.5 microns in effective diameter
PM_{10}	particulates finer than 10 microns in effective diameter
PMT	postmining topography

Abbreviations and Acronyms Used in this Report	
POD	Plan of Development
ppm	parts per million
PRB	Powder River Basin
PRBRC	Powder River Basin Resource Council
PRC	Powder River Coal, LLC
PRCC	Powder River Coal Company
PRPA	Paleontological Resource Preservation Act
PRRCT	Powder River Regional Coal Team
PSD	Prevention of Significant Deterioration
R2P2	Resource Recovery and Protection Plan
RAG	RAG Coal West, Inc.
RFD	reasonably foreseeable development
RH	relative humidity
RMEF	Rocky Mountain Elk Foundation
RMP	Resource Management Plan
ROD	Record of Decision
ROW	right-of-way
RTEA	Rio Tinto Energy America
RV	recreational vehicle
SAR	Sodium-adsorption ratio
SARA	Superfund Amendment & Reauthorization Act of 1986
scf/ton	standard cubic feet per ton
SCSD	Sheridan County School District
SEIS	Supplemental Environmental Impact Statement
SEO	State Engineer's Office
SGAC	South Gillette Area Coal
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SMCRA	Surface Mining Control and Reclamation Act of 1977
SO_2	sulfur dioxide
SPL	Sound Pressure Level
SPRB	South Powder River Basin
STB	Surface Transportation Board
T&E	Threatened and Endangered
TBCC	Thunder Basin Coal Company, LLC
TBGA	Thunder Basin Grazing Association
TBNG	Thunder Basin National Grassland
TBNG-DRD	Thunder Basin National Grassland – Douglas Ranger District
TCO	temporary cessation of operations
TDS	total dissolved solids
TJS	Thunderbird, Jones & Stokes
TPY	tons per year
TSP	total suspended particulates
TSS	total suspended solids
UPRR	Union Pacific Rail Road
U.S.	United States
USC, U.S.C.	United States Code
USDA	U.S. Department of Agriculture
USDA-FS	U.S. Department of Agriculture - Forest Service
USDI	U.S. Department of the Interior
USDOE	U.S. Department of Energy

Abbreviations and Acronyms Used in this Report	
USGS	U.S. Geological Survey
USFS	U.S. Department of Agriculture - Forest Service
USFWS	U.S. Fish and Wildlife Service
UW	University of Wyoming
VMT	vehicle miles traveled
VOCs	volatile organic compounds
VRM	visual resource management
WA	Wilderness Area
WAC	Wright Area Coal
WAAQS	Wyoming Ambient Air Quality Standards
WAQSR	Wyoming Air Quality Standards and Regulations
WARMS	Wyoming Air Resources Monitoring System
WCDA	Wyoming Community Development Authority
WCIC	Wyoming Coal Information Committee
WDEQ	Wyoming Department of Environmental Quality
WDEQ/AQD	Wyoming Department of Environmental Quality/Air Quality Division
WDEQ/ISD	Wyoming Department of Environmental Quality/Industrial Siting Division
WDEQ/LQD	Wyoming Department of Environmental Quality/Land Quality Division
WEQC	Wyoming Environmental Quality Council
WFA	Western Fuels Association
WGFD	Wyoming Game and Fish Department
WMA	Wyoming Mining Association
WOC	Wyoming Outdoor Council
WOGCC	Wyoming Oil and Gas Conservation Commission
WOUS	Waters of the U.S.
WRCC	Western Regional Climate Center
WRRI	Water Resources Research Institute
WSBLC	Wyoming State Board of Land Commissioners
WSFC	Wyoming School Facilities Commission
WSGS	Wyoming State Geological Survey
WSO-RMG	Wyoming State Office Reservoir Management Group (BLM)
WYDOT	Wyoming Department of Transportation
WYPDES	Wyoming Pollution Discharge Elimination System
WYNDD	Wyoming Natural Diversity Database
WWC	WWC Engineering

1.0 INTRODUCTION

This Environmental Impact Statement (EIS)[1] analyzes the environmental impacts of leasing six tracts of federal coal reserves adjacent to the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines. All are operating surface coal mines in the southern Powder River Basin (PRB) of Wyoming, near the town of Wright. The operators of the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines filed four applications to lease the six tracts of federal coal included in maintenance coal tracts under the regulations at 43 CFR 3425, Leasing On Application. The Division of Minerals and Lands at the Bureau of Land Management (BLM) Wyoming State Office reviewed all four applications and determined that the lease applications met the regulatory requirements for Lease by Applications (LBAs). These maintenance coal tracts, which would continue or extend the life of the applicant mines, are referred to as the North Hilight Field LBA Tract, the South Hilight Field LBA Tract, the West Hilight Field LBA Tract, the West Jacobs Ranch LBA Tract, the North Porcupine LBA Tract, and the South Porcupine LBA Tract. Figure 1-1 shows the six LBA tracts as applied for, other currently pending LBA tracts, and the existing federal leases including previously leased LBA tracts in the Wyoming PRB.

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 supplementary 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. These six tracts of federal coal reserves are located adjacent to operating mines in the southern Powder River Basin near Wright, Wyoming. Copies of the supplementary information document are available upon request and can be viewed at the BLM offices in Casper and Cheyenne.

1.1 Background

On October 7, 2005, Ark Land Company (ALC) filed an application with the BLM for federal coal reserves in two separate tracts located north and southwest of and immediately adjacent to the Black Thunder Mine in Campbell County, Wyoming. The tracts are referred to as the North Hilight Field and South Hilight Field LBA Tracts. The North Hilight Field tract is located approximately 5.5 miles east of Wright, Wyoming and the South Hilight Field tract is located approximately 7 miles southeast of Wright (Figure 1-1). The federal coal reserves were applied for as maintenance tracts for the Black Thunder Mine. BLM determined that the two tracts in the application would be processed separately and, if the decision is made to conduct a lease sale, would be offered for sale separately. ALC is a wholly owned subsidiary of Arch Coal,

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

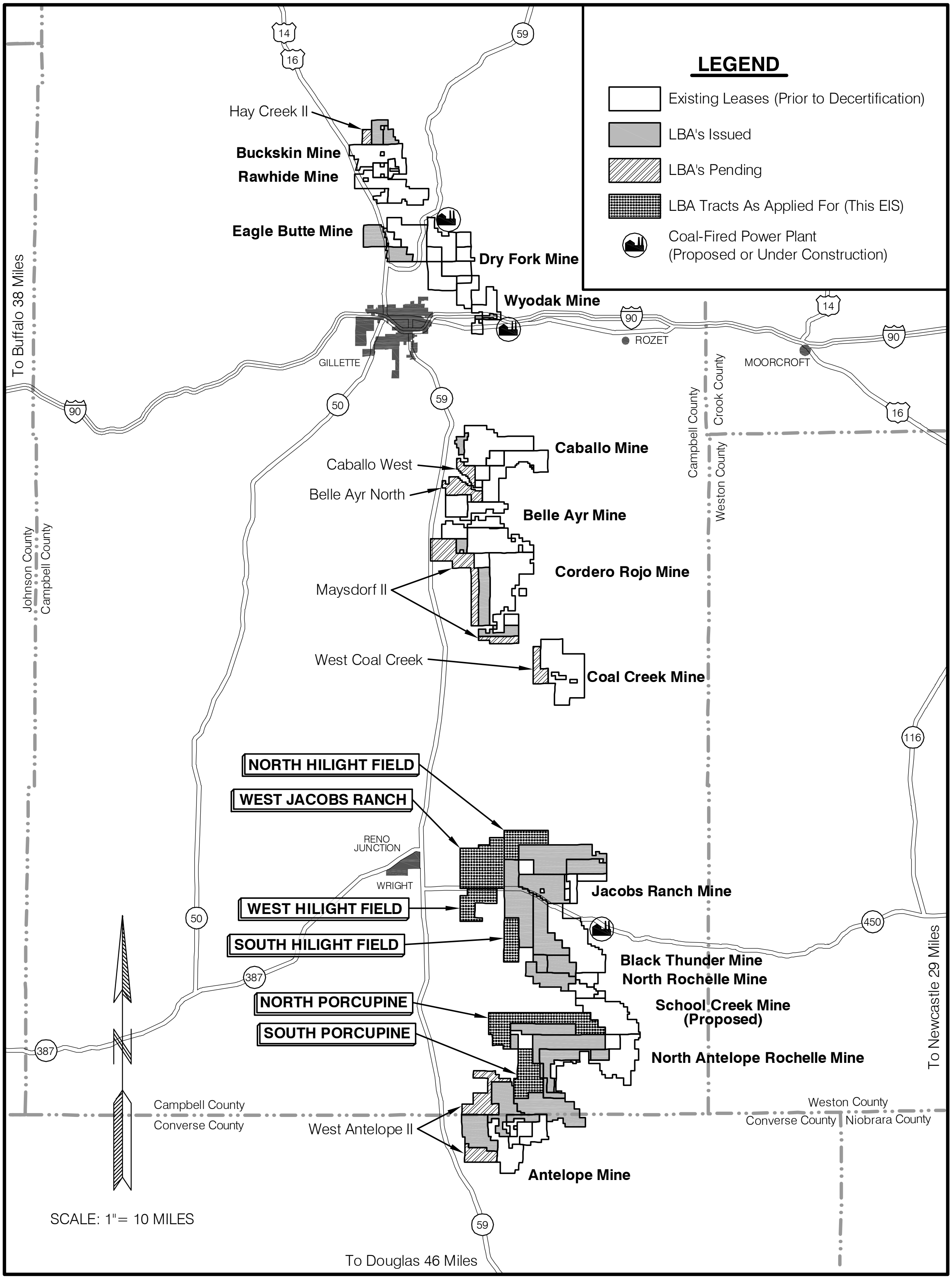


Figure 1-1. General Location Map with Federal Coal Leases and LBA Tracts.

Inc. The Black Thunder Mine is operated by Thunder Basin Coal Company (TBCC), a subsidiary of Arch Western Resources, LLC. In this EIS, ALC is referred to as the applicant and TBCC is referred to in discussions of mine operations. ALC's coal lease application was assigned case file numbers WYW164812 (North Hilight Field) and WYW174596 (South Hilight Field).

On January 17, 2006, ALC filed an application with the BLM for federal coal reserves in a tract located west of and immediately adjacent to the Black Thunder Mine in Campbell County, Wyoming, approximately 4 miles southeast of Wright, Wyoming (Figure 1-1). The tract, which is referred to as the West Hilight Field LBA Tract, was assigned case file number WYW172388. The federal coal reserves were applied for as a maintenance tract for the Black Thunder Mine.

On March 24, 2006, Jacobs Ranch Coal Company (JRCC) filed an application with the BLM for federal coal reserves in a tract located approximately 0.75 mile west of the Jacobs Ranch Mine in Campbell County, Wyoming. The tract, which is referred to as the West Jacobs Ranch LBA Tract, is located approximately 2.5 miles east of Wright, Wyoming (Figure 1-1). JRCC's coal lease application was assigned case file number WYW172685. The federal coal reserves were applied for as a maintenance tract for the Jacobs Ranch Mine. On October 1, 2009, the Jacobs Ranch Mine was acquired by Arch Coal, Inc. ALC intends to consolidate the permits for the Jacobs Ranch Mine and the Black Thunder Mine in order to integrate the two separate mining operations. In this EIS, the applicant for the West Jacobs Ranch LBA Tract will be referred to as ALC. It is assumed that ALC would be the successful bidder, and that the West Jacobs Ranch tract would be mined as a maintenance lease for the existing Jacobs Ranch Mine.

On September 29, 2006, BTU Western Resources, Inc. (BTU) filed an application with the BLM for federal coal reserves in three separate tracts located west, northwest, and north of and immediately adjacent to the North Antelope Rochelle Mine in Campbell County, Wyoming. The two tracts on the north side of the mine are referred to as the North Porcupine LBA Tract, and the tract on the west side of the mine is referred to as the South Porcupine LBA Tract.

On October 12, 2007, BTU filed a request with the BLM to modify the Porcupine LBA Tract configuration to increase the lease area and coal volume. The North Porcupine LBA Tract, which is located approximately 12 miles southeast of Wright, Wyoming, was combined into one tract and its size was increased with additional lands. The South Porcupine LBA Tract, which is located approximately 14 miles southeast of Wright, was also increased in size with additional lands (Figure 1-1). BLM reviewed the modified tract configuration and notified the company that their application had been modified. The federal coal reserves were applied for as maintenance tracts for the North Antelope Rochelle Mine. BLM determined that the two tracts in the application would be processed separately and, if the decision is made to conduct a lease sale, would be offered for sale separately. The North Antelope Rochelle Mine is operated by Powder River Coal, LLC (PRC), a subsidiary of Peabody Energy Corporation (PEC). BTU is also a subsidiary of PEC, and in this EIS, BTU is referred to as the applicant and PRC is referred to in discussions of mine operations. BTU's coal lease application was assigned case file numbers WYW173408 (North Porcupine) and WYW176095 (South Porcupine).

These federal coal lands are located within the Powder River Federal Coal Region, which was decertified in January, 1990. Although the Powder River Federal Coal Region is decertified, the Powder River Regional Coal Team (PRRCT), a federal/state advisory board established to develop recommendations concerning management of federal coal in the region, has continued to meet regularly and review all federal lease applications in the region. The PRRCT reviewed the ALC and JRCC maintenance coal lease applications (case file numbers WYW164812, WYW174596, WYW172388, and WYW172685) at a public meeting held on April 19, 2006 in Casper, Wyoming. The PRRCT reviewed the BTU maintenance coal lease application (case file numbers WYW173408 and WYW176095) at a public meeting held on January 18, 2007 in Casper, Wyoming. The PRRCT recommended that the BLM process the coal lease applications at those respective meetings.

In order to process an LBA, the BLM must evaluate the quantity, quality, maximum economic recovery, and fair market value of the federal coal and fulfill the requirements of the National Environmental Policy Act of 1969 (NEPA) by evaluating the environmental impacts of leasing the federal coal. BLM does not authorize mining by issuing a lease for federal coal, but the impacts of mining the coal are considered in this EIS because it is a logical consequence of issuing a maintenance lease to an existing mine.

The BLM determined that one EIS would be prepared to evaluate the environmental impacts that would be expected to occur if leases are issued for the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts. This EIS has been prepared to evaluate the site-specific and cumulative environmental impacts of leasing and developing the federal coal included in these application areas. For each of the six LBA tracts, BLM will use the analysis in this EIS to decide whether to hold a competitive, sealed-bid lease sale for the tract as applied for, hold a competitive, sealed-bid lease sale for the modified tract, or reject the lease application and not offer the tract for sale at this time. A separate Record of Decision (ROD) will be issued for each LBA tract. If the decision is made to offer the tract for lease, then a separate sale would be held for each tract. The bidding at the sale would be open to any qualified bidder; it would not be limited to the applicant.

If a lease sale is held, each lease would be issued to the highest bidder at the sale if a federal sale panel determines that the high bid meets or exceeds the fair market value of the coal as determined by BLM's economic evaluation.

Also, before the lease could be issued to the high bidder, the United States Department of Justice would need to determine that there would be no antitrust violations.

In return for receiving a lease, a lessee must pay the federal government a bonus equal to the amount it bids at the time the lease sale is held (the bonus can be paid in five yearly installments), make annual rental payments to the federal government, and make royalty payments to the federal government when the coal is mined. Prior to 2008, federal bonus, rental, and royalty payments were equally divided with the state in which the lease was located. However, in fiscal year 2008, Congress decreased the state's royalty share to 48 percent, and increased the federal government's share to 52 percent. The percentage of federal bonus, rental, and royalty payments distribution reverted back to 50 percent/50 percent at the end of the 2008 fiscal year.

Other agencies may use this analysis to make decisions related to leasing and mining the federal coal in these tracts. Cooperating agencies on this EIS include: Office of Surface Mining Reclamation and Enforcement (OSM), U.S. Department of Agriculture-Forest Service (USFS), Wyoming Department of Transportation (WYDOT), Wyoming Department of Environmental Quality (WDEQ) Air Quality Division (AQD) and WDEQ Land Quality Division (LQD), and the Converse County Board of Commissioners. OSM has primary responsibility to administer federal programs that regulate surface coal mining operations and will use this EIS to make decisions related to the approval of the Mineral Leasing Act of 1920 (MLA) mining plan if the tracts are leased. If USFS lands are included in a tract, USFS must consent to lease the federal coal that is located on USFS-administered lands before BLM can make a decision to hold a federal coal lease sale. WYDOT's responsibilities include planning and supervising road improvement work, maintaining roads, and supporting airports and aviation in the state. WDEQ has entered into a cooperative agreement with the Secretary of the Interior to regulate surface coal mining operations on federal and non-federal lands within the state of Wyoming.

Since decertification of the Powder River Federal Coal Region in 1990, 20 federal coal leases have been sold at competitive sealed-bid sales and three exchanges of federal coal in the Wyoming portion of the Powder River Federal Coal Region have been completed (BLM 2009a). Each mine with an application being considered in this EIS has previously been issued a maintenance coal lease since decertification (Table 1-1 and Figure 1-1).

Table 1-2 summarizes the 12 LBAs that are currently pending (BLM 2009a).

1.1.1 North and South Hilight Field LBA Tracts

As applied for, the Hilight Field LBA Tract, adjacent to the Black Thunder Mine, consisted of two separate blocks of federal coal and included a total of approximately 4,590.19 acres with an estimated 477.0 million tons of

Table 1-1. Leases Issued and Exchanges Completed Since Decertification, Powder River Basin, Wyoming.

Leases Issued			
LBA Name (Lease Number) **Applicant Mine** **Current Lessee** **Effective Date**	**Acres Leased[1]**	**Mineable Tons of Coal[1]**	**Successful Bid**
Jacobs Ranch (WYW117924) Jacobs Ranch Mine Thunder Basin Coal Co. 10/1/1992	1,708.620	147,423,560	$20,114,930.00
West Black Thunder (WYW118907) Black Thunder Mine Thunder Basin Coal Co. 10/1/1992	3,492.495	429,048,216	$71,909,282.69
North Antelope/Rochelle (WYW119554) North Antelope Rochelle Mine Powder River Coal Co., LLC 10/1/1992	3,064.040	403,500,000	$86,987,765.00
West Rocky Butte (WYW122586) No Existing Mine[2] Caballo Coal Co. 1/1/1993	463.205	56,700,000	$16,500,000.00
Eagle Butte (WYW124783) Eagle Butte Mine Alpha Coal West, Inc. 8/1/1995	1,059.180	166,400,000	$18,470,400.00
Antelope (WYW128322) Antelope Mine Antelope Coal Co. 2/1/1997	617.200	60,364,000	$9,054,600.00
North Rochelle (WYW127221) North Rochelle Mine Ark Land Co. 1/1/1998	1,481.930	157,610,000	$30,576,340.00
Powder River (WYW136142) North Antelope Rochelle Mine Powder River Coal Co., LLC 9/1/1998	4,224.225	532,000,000	$109,596,500.00
Thundercloud (WYW136458) Jacobs Ranch Mine Thunder Basin Coal Co. 1/1/1999	3,545.503	412,000,000	$158,000,008.50
Horse Creek (WYW141435) Antelope Mine Antelope Coal Co. 12/1/2000	2,818.695	275,577,000	$91,220,120.70
North Jacobs Ranch (WYW146744) Jacobs Ranch Mine Thunder Basin Coal Co. 5/1/2002	4,982.240	537,542,000	$379,504,652.00
NARO South (WYW154001) North Antelope Rochelle Mine BTU Western Resources, Inc. 9/1/2004	2,956.725	297,469,000	$274,117,684.00
West Hay Creek (WYW151634) Buckskin Mine Kiewit Mining Properties, Inc. 1/1/2005	921.158	142,698,000	$42,809,400.00

Table 1-1. Leases Issued and Exchanges Completed Since Decertification, Powder River Basin, Wyoming (Continued).

Leases Issued

LBA Name (Lease Number) **Applicant Mine** **Current Lessee** **Effective Date**	**Acres Leased**[1]	**Mineable Tons of Coal**[1]	**Successful Bid**
Little Thunder (WYW150318) Black Thunder Mine Ark Land Co. 3/1/2005	5,083.500	718,719,000	$610,999,949.80
West Antelope (WYW151643) Antelope Mine Antelope Coal Co. 3/1/2005	2,809.130	194,961,000	$146,311,000.00
NARO North (WYW150210) North Antelope Rochelle Mine BTU Western Resources, Inc. 3/1/2005	2,369.380	324,627,000	$299,143,785.00
West Roundup (WYW151134) North Rochelle Mine West Roundup Resources, Inc. 5/1/2005	2,812.510	327,186,000	$317,697,610.00
Eagle Butte West (WYW155132) Eagle Butte Mine Alpha Coal West, Inc. 5/1/2008	1,427.770	255,000,000	$180,540,000.00
South Maysdorf (WYW174407) Cordero Rojo Mine Cordero Mining Co. 8/1/2008	2,900.240	288,082,000	$250,800,000.00
North Maysdorf (WYW154432) Cordero Rojo Mine Cordero Mining Co. 1/29/2009	445.890	54,657,000	$48,098,424.00
TOTALS	**49,183.640**	**5,781,563,776**	**$3,162,452,451.69**

Exchanges Completed

Exchange Name **Case File Number** **Exchange Proponent** **Exchange Type** **Effective Date**	**Acres Exchanged**	**Mineable Tons of Coal**	**Federal Coal Exchanged for:**
EOG (Belco) I-90 Lease Exchange WYW150152 EOG Resources (formerly Belco)[3] I-90 Lease Exchanged for New Lease 4/1/2000	599.170	106,000,000	Lease Rights to Belco I-90 Lease (WYW0322794).
Pittsburg & Midway Coal Exchange WYW148816 Pittsburg and Midway Coal Mining Co. Private Land Exchanged for Federal Coal 1/27/2005	2,045.530	84,200,000	6,065.77 acres of land and some minerals in Lincoln, Carbon, and Sheridan Counties, Wyoming.
Gold Mine Draw Lease Exchange WYW0321779, WYW154001 Powder River Coal Co., LLC AVF Lease Exchanged for New Lease 6/25/2006	623.000	47,700,000	Lease rights to 921.60 acres of leased federal coal underlying an AVF.
TOTALS	**3,267.700**	**237,900,000**	

1 Information from Sale Notice.
2 The West Rocky Butte LBA was originally leased to Northwestern Resources Co.
3 The EOG Resources Belco Exchange lease is now owned by the Buckskin Mine.

Table 1-2. Pending LBAs, Powder River Basin, Wyoming.

LBA Name Lease Number Applicant Mine	Application Date	Acres as Applied for	Estimated as Applied for Coal (mmt)	Status
Belle Ayr North WYW161248 Belle Ayr Mine	7/6/2004	1,578.74	191.90 [3]	FEIS available 8/14/2009 ROD in preparation
West Antelope II WYW163340 Antelope Mine	4/6/2005	4,108.60	429.70 [1]	FEIS available 12/19/2008 ROD available 4/1/2010
North Hilight Field WYW164812 Black Thunder Mine	10/7/2005	2,613.50	263.40 [3]	FEIS in preparation
South Hilight Field WYW174596 Black Thunder Mine	10/7/2005	1,976.69	213.60 [3]	FEIS in preparation
West Hilight Field WYW172388 Black Thunder Mine	1/17/2006	2,370.52	377.90 [3]	FEIS in preparation
West Coal Creek WYW172585 Coal Creek Mine	2/10/2006	1,151.26	57.00 [3]	FEIS available 8/14/2009 ROD in preparation
Caballo West WYW172657 Caballo Mine	3/15/2006	777.49	81.80 [3]	FEIS available 8/14/2009 ROD in preparation
West Jacobs Ranch WYW172685 Jacobs Ranch Mine	3/24/2006	5,944.37	669.60 [3]	FEIS in preparation
Hay Creek II WYW172684 Buckskin Mine	3/24/2006 Modified 5/19/2008 Modified 1/23/2009	415.00	51.90 [2]	DEIS available 3/12/2010 Hearing 4/22/2010 FEIS in preparation
Maysdorf II WYW173360 Cordero Rojo Mine	9/1/2006	4,653.84	474.50 [3]	FEIS available 8/14/2009 ROD in preparation
North Porcupine WYW173408 North Antelope Rochelle Mine	9/29/2006 Modified 10/12/2007	5,795.78	601.20 [3]	FEIS in preparation
South Porcupine WYW176095 North Antelope Rochelle Mine	9/29/2006 Modified 10/12/2007	3,185.96	309.70 [3]	FEIS in preparation
TOTALS		**34,571.75**	**3,722.20**	

[1] Estimated tons of in-place coal as reported in the lease application.
[2] Estimated tons of mineable coal as reported in the lease application.
[3] Estimated tons of recoverable coal as reported by the applicant.

recoverable coal reserves. The BLM split this LBA into two separate tracts, the North and South Hilight Field Tracts, as shown in Figure 1-2, and the two tracts will be processed separately. The North Hilight Field LBA Tract as applied for includes approximately 2,613.50 acres and an estimated 263.4 million tons of recoverable coal reserves. The South Hilight Field LBA Tract as applied for includes approximately 1,976.69 acres and an estimated 213.6 million tons of recoverable coal reserves.

As of January 1, 2009, TBCC estimates the in-place reserves at the existing Black Thunder Mine to be 1,271.1 million tons, of which approximately 1,169.4 million tons of those remaining reserves would be recoverable. Black Thunder Mine's currently approved by WDEQ/AQD air quality permits (Permit Numbers MD-417A, MD-877, MD-1178, MD-1555, MD-6824, and MD-3851, which were approved on July 1, 1999, June 23, 2003, July 12, 2005, May 13, 2007, January 22, 2008, and August 18, 2008, respectively) allow up to 135 million tons of coal per year to be mined. The Black Thunder Mine produced approximately 67.4 million tons of coal in 2008, 65.3 million tons of coal in 2007, 67.3 million tons of coal in 2006, 62.7 million tons of coal in 2005, and 66.8 million tons of coal in 2004.

The North Hilight Field tract is contiguous with both the Black Thunder Mine and the Jacobs Ranch Mine federal coal leases. The South Hilight Field tract is contiguous with only the Black Thunder Mine federal coal leases. A portion of the North Hilight Field tract lies within Jacobs Ranch Mine's current permit area. A portion of the South Hilight Field tract lies within Black Thunder Mine's current permit area. None of the North Hilight Field tract lies within Black Thunder Mine's current permit area, although it does border the mine's permit boundary (Figure 1-2). The area applied for is similar to the adjacent mines for which detailed site-specific environmental data have been collected. Additionally, environmental analyses have previously been prepared for existing leases and mining permits. As previously stated, the Jacobs Ranch Mine was acquired by Arch Coal, Inc. on October 1, 2009, and ALC intends to consolidate the permits of the Jacobs Ranch Mine and the Black Thunder Mine in order to integrate the two separate mining operations. ALC proposes to mine the North and South Hilight Field LBA Tracts as applied for as maintenance tracts for the consolidated Black Thunder Mine.

The surface of the North Hilight Field LBA Tract as applied for is owned by TBCC, ALC, Mills Brothers Partnership, and Western Railroad Properties, Inc. & Burlington Northern Railroad. The surface of the South Hilight Field LBA Tract as applied for is owned by TBCC, Western Railroad Properties, Inc. & Burlington Northern Railroad, and the United States of America. The federally owned surface comprises roughly 82 percent (approximately 1,625.9 acres) of the South Hilight Field tract as applied for and is part of the Thunder Basin National Grassland (TBNG), administered by the USFS. Current land uses of the tracts include grazing by domestic livestock and wildlife, oil and gas production, recreation, and transportation (i.e., rail lines and public road).

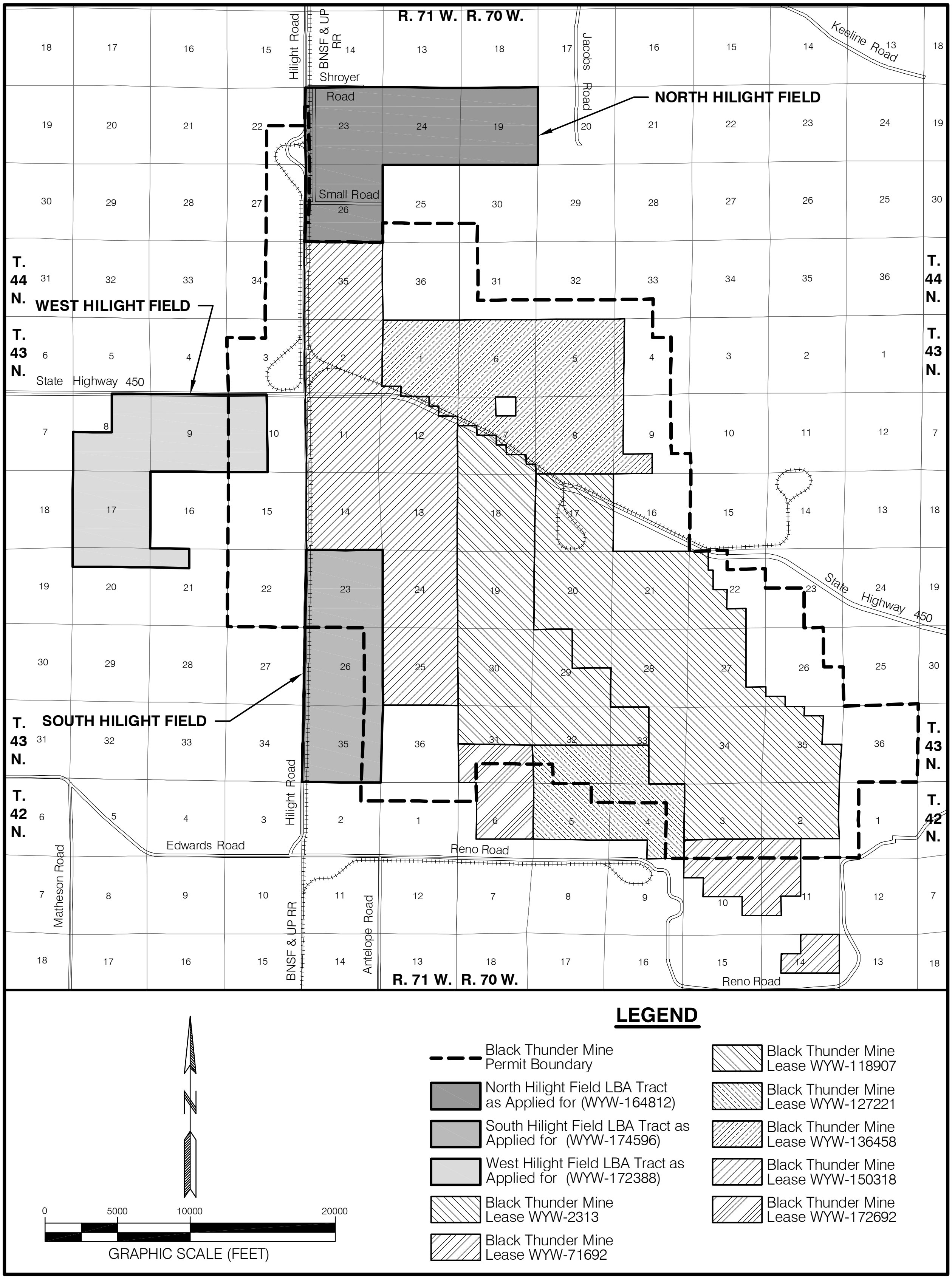


Figure 1-2. Black Thunder Mine's Federal Coal Leases and North Hilight Field, South Hilight Field, and West Hilight Field LBA Tracts as Applied for.

The mining methods would likely be a truck and shovel pre-benching operation in advance of a dragline, while cast blasting may be employed to supplement dragline productivity, which are the mining methods currently in use at the mine. The coal would be used primarily for electric power generation.

After mining, the land would be reclaimed for livestock grazing and wildlife use as is the current practice at the Black Thunder Mine. Industrial postmining land uses, which include but are not limited to oil and gas wells, pipelines, roads, rail lines, and utility easements, also would be reestablished as required.

1.1.2 West Hilight Field LBA Tract

The West Hilight Field LBA Tract as applied for and the existing federal coal leases in the adjacent Black Thunder Mine are shown in Figure 1-2. As applied for, the West Hilight Field LBA Tract consists of a single block of federal coal and includes approximately 2,370.52 acres and an estimated 377.9 million tons of recoverable coal reserves.

As of January 1, 2009, TBCC estimates the in-place reserves at the existing Black Thunder Mine to be 1,271.1 million tons, of which approximately 1,169.4 million tons of those remaining reserves would be recoverable. Black Thunder Mine's currently approved by WDEQ/AQD air quality permits (Permit Numbers MD-417A, MD-877, MD-1178, MD-1555, MD-6824, and MD-3851, which were approved on July 1, 1999, June 23, 2003, July 12, 2005, May 13, 2007, January 22, 2008, and August 18, 2008, respectively) allow up to 135 million tons of coal per year to be mined. The Black Thunder Mine produced approximately 67.4 million tons of coal in 2008, 65.3 million tons of coal in 2007, 67.3 million tons of coal in 2006, 62.7 million tons of coal in 2005, and 66.8 million tons of coal in 2004.

As discussed above, the West Hilight Field LBA Tract as applied for consists of a single block west of the Black Thunder Mine's existing federal coal leases, and a portion of the tract lies within Black Thunder Mine's current permit area (Figure 1-2). The area applied for is similar to the adjacent mines for which detailed site-specific environmental data have been collected. Additionally, environmental analyses have previously been prepared for existing leases and mining permits. As previously stated, the Jacobs Ranch Mine was acquired by Arch Coal, Inc. on October 1, 2009, and ALC intends to consolidate the permits of the Jacobs Ranch Mine and the Black Thunder Mine in order to integrate the two separate mining operations. ALC proposes to mine the West Hilight Field LBA Tracts as applied for as a maintenance tract for the consolidated Black Thunder Mine.

The surface of the West Hilight Field LBA Tract as applied for is owned by TBCC, James R. & Irene Stuart Trusts, and the United States of America. The federally owned surface comprises roughly 29 percent (approximately 695.9 acres) of the tract as applied for and is part of the TBNG, administered by the

USFS. Current land uses of the tract include grazing by domestic livestock and wildlife, oil and gas production, recreation, and transportation (i.e., public road).

The mining methods would likely be a truck and shovel pre-benching operation in advance of a dragline, while cast blasting may be employed to supplement dragline productivity, which are the mining methods currently in use at the mine. The coal would be used primarily for electric power generation.

After mining, the land would be reclaimed for livestock grazing and wildlife use as is the current practice at the Black Thunder Mine. Industrial postmining land uses, which include but are not limited to oil and gas wells, pipelines, roads, and utility easements, also would be reestablished as required.

1.1.3 West Jacobs Ranch LBA Tract

The West Jacobs Ranch LBA Tract as applied for and the existing federal coal leases in the adjacent Jacobs Ranch Mine are shown in Figure 1-3. The existing federal coal leases in the adjacent Black Thunder Mine are shown in Figure 1-2. As applied for, the West Jacobs Ranch LBA Tract consists of a single block of federal coal and includes approximately 5,944.37 acres and an estimated 669.6 million tons of recoverable coal reserves.

As of January 1, 2009, ALC estimates the in-place reserves at the existing Jacobs Ranch Mine to be 403.6 million tons, of which approximately 379.4 million tons of those remaining reserves would be recoverable. The Jacobs Ranch Mine's current WDEQ/AQD air quality permit (Permit Number MD-1005A2, approved on January 22, 2007) allows up to 55 million tons of coal per year to be mined. The Jacobs Ranch Mine produced approximately 42.1 million tons of coal in 2008, 38.1 million tons of coal in 2007, 40.0 million tons of coal in 2006, 37.3 million tons of coal in 2005, and 38.6 million tons of coal in 2004.

As discussed above, the West Jacobs Ranch LBA Tract as applied for consists of a single block located approximately 0.75 mile west of Jacobs Ranch Mine's current mining permit boundary and 1.0 mile west of the mine's current federal coal leases (Figure 1-3). The West Jacobs Ranch tract is contiguous with only the Black Thunder Mine, and a portion of the tract is within Black Thunder Mine's current permit area (Figure 1-2). The area applied for is similar to the adjacent mines for which detailed site-specific environmental data have been collected. Additionally, environmental analyses have previously been prepared for existing leases and mining permits. As previously stated, the Jacobs Ranch Mine was acquired by Arch Coal, Inc. on October 1, 2009, and ALC intends to consolidate the permits of the Jacobs Ranch Mine and the Black Thunder Mine in order to integrate the two separate mining operations. ALC proposes to mine the West Jacobs Ranch LBA Tract as applied for as maintenance tract for the consolidated Black Thunder Mine.

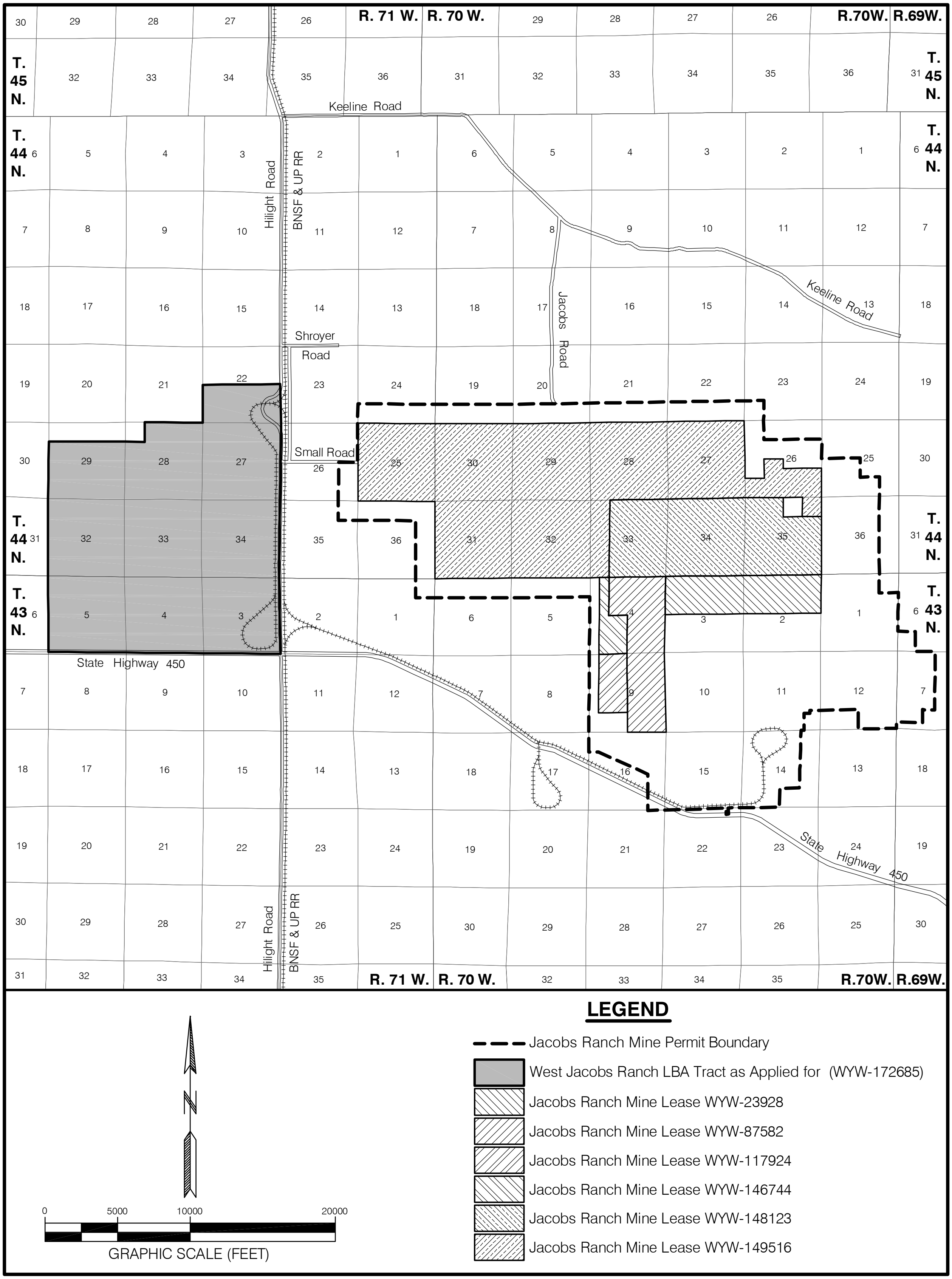


Figure 1-3. Jacobs Ranch Mine's Federal Coal Leases and West Jacobs Ranch LBA Tract as Applied for.

The surface of the West Jacobs Ranch LBA Tract as applied for is owned by ALC, Boller-Mills Ranch LP, and William M. & Lois R. Chittenden. Current land uses of the tract include grazing by domestic livestock and wildlife, oil and gas production, recreation, and transportation (i.e., public roads and railroad).

The mining methods would likely be a truck and shovel pre-benching operation in advance of a dragline, while cast blasting may be employed to supplement dragline productivity, which are the mining methods currently in use at the Black Thunder Mine. The coal would be used primarily for electric power generation.

After mining, the land would be reclaimed for livestock grazing and wildlife use as is the current practice at the Jacobs Ranch Mine. Industrial postmining land uses, which include but are not limited to oil and gas wells, pipelines, roads, and utility easements, also would be reestablished as required.

1.1.4 North and South Porcupine LBA Tracts

As applied for, the Porcupine LBA Tract, adjacent to the North Antelope Rochelle Mine, consisted of two separate blocks of federal coal and included a total of approximately 8,981.74 acres with an estimated 910.9 million tons of recoverable coal reserves. The BLM split this LBA into two separate tracts, the North and South Porcupine Tracts, as shown in Figure 1-4, and will process the two tracts separately. The North Porcupine LBA Tract as applied for includes approximately 5,795.78 acres and an estimated 601.2 million tons of recoverable coal reserves. The South Porcupine LBA Tract as applied for includes approximately 3,185.96 acres and an estimated 309.7 million tons of recoverable coal reserves.

As of January 1, 2009, PRC estimates the in-place reserves at the existing North Antelope Rochelle Mine to be 1,049.9 million tons, of which approximately 933.8 million tons of those remaining reserves would be recoverable. North Antelope Rochelle Mine's current WDEQ/AQD air quality permits (MD-1172, MD-1309, MD-1331, and MD-6375 approved in June 2005, January 2006, March 2006, and November 2008, respectively) allow up to 140 million tons of coal per year to be mined. The North Antelope Rochelle Mine produced approximately 97.6 million tons of coal in 2008, 91.5 million tons of coal in 2007, 88.5 million tons of coal in 2006, 82.7 million tons of coal in 2005, and 82.5 million tons of coal in 2004.

The North Porcupine tract is contiguous with the North Antelope Rochelle Mine's existing federal coal leases; the South Porcupine tract is contiguous with both the North Antelope Rochelle Mine's and the Antelope Mine's existing federal coal leases. Both tracts lie completely within the North Antelope Rochelle Mine's current permit area (Figure 1-4). The area applied for is similar to the adjacent mines for which detailed site-specific environmental

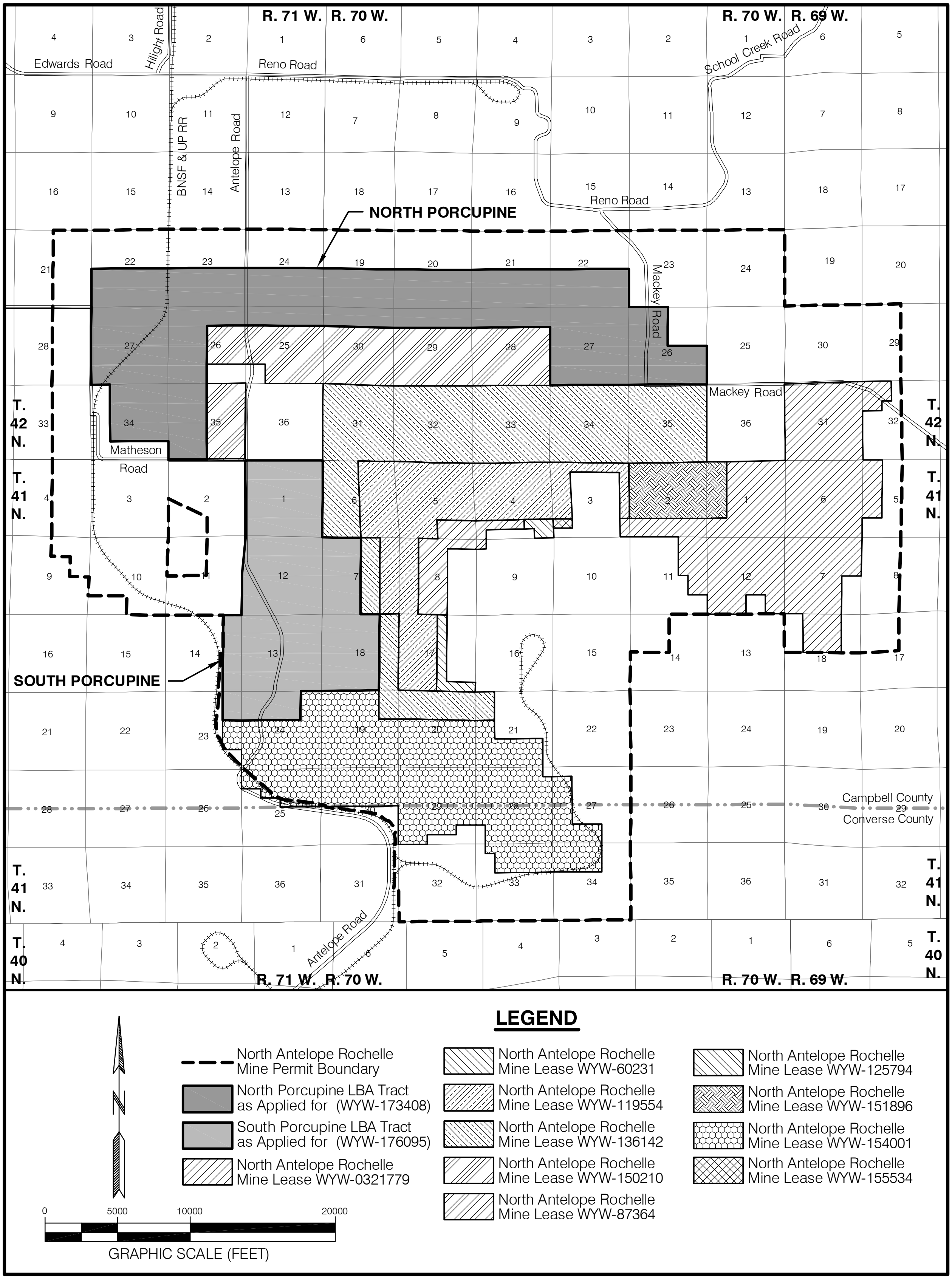


Figure 1-4. North Antelope Rochelle Mine's Federal Coal Leases and North Porcupine and South Porcupine LBA Tracts as Applied for.

data have been collected. Additionally, environmental analyses have previously been prepared for existing leases and mining permits.

The surface of the North Porcupine LBA Tract as applied for is owned by PRC, LLC., Jerry N. & Rhonda Wilkinson, the state of Wyoming, Western Railroad Properties, Inc., and the United States of America. The federally owned surface comprises roughly 72 percent (approximately 4,186.0 acres) of the tract as applied for and is part of the TBNG, administered by the USFS. The surface of the South Porcupine LBA Tract as applied for is owned by PRC, LLC., Jerry J. Dilts Living Trust, Jerry J. Dilts Family LP 1, Bridle Bit Ranch Company, Jerry J. Dilts Family LP II and Bridle Bit Ranch Company, and the United States of America. The federally owned surface comprises roughly 51 percent (approximately 1,637.2 acres) of the tract as applied for and is part of the TBNG, administered by the USFS. Current land uses of the tracts include grazing by domestic livestock and wildlife, oil and gas production, recreation, and transportation (i.e., rail lines and public roads).

The mining methods would be a truck and shovel pre-benching operation in advance of a dragline, while cast blasting may be employed to supplement dragline productivity, which are the methods currently in use at the North Antelope Rochelle Mine. The coal would be used primarily for electric power generation.

After mining, the land would be reclaimed for livestock grazing and wildlife use as is the current practice at the North Antelope Rochelle Mine. Industrial postmining land uses, which include but are not limited to oil and gas wells, pipelines, roads, rail lines, and utility easements, also would be reestablished as required.

1.2 Purpose and Need for Action

Approximately 92 percent of the total coal that is mined in the U.S. is used for generating reasonably priced electricity (USDOE 2009a). Coal is mined in 25 states (USDOE 2009a); the low cost and abundance of coal resources within the country is one of the primary reasons why consumers in the U.S. currently benefit from some of the lowest electricity rates of any free-market economy (USDOE 2009b).

Electricity is important to the country's security and economy and is structured on a market-based supply and demand system. Currently, coal-fired electric generating plants are the cornerstone of the nation's central power configuration (USDOE 2009b). Approximately half of the electricity currently generated in the United States comes from coal (USDOE 2009b). Wyoming coal is used to generate electricity in 36 other states (WMA 2009).

The Federal Land Policy and Management Act of 1976 (FLPMA) mandated BLM to manage public lands for multiple use so that the lands are utilized in the combination that will best meet the present and future needs of the American people. FLPMA authorized BLM to manage the use, occupancy, and development of public lands through leases and permits (BLM 2007).

The Energy Policy Act of 2005 directs federal agencies to undertake efforts to ensure energy efficiency and the production of secure, affordable, and reliable domestic energy. A primary goal of the National Energy Policy is to add energy supplies from diverse sources, including domestic oil, gas, and coal, as well as hydropower and nuclear power. BLM recognizes that the continued extraction of coal is essential in order to meet the nation's energy needs. As a result, private development of federal coal reserves is integral to the BLM coal leasing program under the authority of the Mineral Leasing Act of 1920 (MLA), as well as FLPMA and Federal Coal Leasing Act Amendments of 1976 (FCLAA).

The United States has the world's largest known coal reserves (BP 2009). The BLM's coal leasing program encourages the development of domestic coal reserves and the reduction of U.S. dependence on foreign sources of energy. As a result of the leasing, mining, and sale of federal coal resources in the PRB, the public has a reliable supply of low sulfur coal for generating affordable electric power. The public also receives extensive revenue from lease bonuses, rentals, and royalty payments.

As this EIS describes, the Black Thunder Mine, Jacobs Ranch Mine, and North Antelope Rochelle Mine have applied for a total of six maintenance tracts of federal coal reserves. The mines applied for these reserves in order to continue to supply and sell low sulfur compliance coal to power plants for the purpose of generating electric power for the public.

This EIS is being prepared in response to the four coal lease applications that BLM received from the three mines mentioned above. In response to each of the applications, BLM must decide whether to: 1) hold a competitive, sealed-bid lease sale for the tract as applied for, 2) hold a competitive, sealed-bid lease sale for a modified tract, or 3) reject the current lease application and not offer the tract for sale at this time.

If a decision is made to lease a tract of federal coal and if the tract is sold and a lease is issued, the federal coal lease would grant the lessee the exclusive right to apply for a WDEQ mining permit. The WDEQ approved mining permit is what allows coal mining to take place on a lease. It authorizes surface disturbance and mining operations subject to the terms of the lease, the mining permit, and applicable state and federal laws. Before mining operations can be conducted on a new lease, the lessee must obtain approval of a detailed mining permit. Additionally, for federal coal lessees, the lessee may not conduct surface coal mining operations on federal coal land prior to obtaining approval of the MLA mining plan, through OSM and by the Assistant Secretary of the Interior, Land and Minerals Management.

If an LBA tract is leased to the applicant as a maintenance tract, the permit to conduct mining operations for the adjacent mine would have to be amended to include the new lease area before it could be disturbed. This process takes several years to complete. ALC and BTU are applying for federal coal reserves now so that they can secure coal resources to market, enter into new contracts, and complete the permitting processes in time to mine the new federal reserves in a logical progression.

If a tract is leased, a WDEQ mining permit is obtained and Assistant Secretarial approval through OSM is obtained. The coal would then be mined and sold to power plants for the purpose of generating electricity for the United States. Continued leasing of low sulfur PRB coal would assist coal-fired power plants in meeting the Clean Air Act (CAA) requirements without constructing new plants or revamping existing ones. This helps to provide a stable supply of power to meet increasing electrical demands without a potentially significant increase in power costs for the public.

This EIS analyzes the environmental impacts of issuing federal coal leases and mining the federal coal in the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine maintenance coal lease applications as required by NEPA and associated rules and guidelines. A decision to hold a competitive sale and issue a lease for the lands in any of these applications is a prerequisite for mining but it is not the enabling action that would authorize mining.

The BLM does not authorize mining operations by issuing a lease. After a lease has been issued but prior to mine development, the lessee must file a permit application package with the Land Quality Division (LQD) of the WDEQ and OSM for a surface mining permit and approval of the MLA mining plan. An analysis of a detailed site-specific mining and reclamation plan occurs at that time. Authorities and responsibilities of the BLM and other concerned regulatory agencies are described in the following sections.

1.3 Regulatory Authority and Responsibility

The four Wright Area coal lease applications analyzed in this EIS were submitted to BLM and will be processed and evaluated under the following federal authorities:

- MLA, as amended;
- Multiple-Use Sustained Yield Act of 1960;
- NEPA;
- FCLAA;
- FLPMA; and
- SMCRA.

The development of federal coal reserves is integral to the BLM coal leasing program under the authority of the Mineral Leasing Act of 1920 (MLA), as well as the Federal Land Policy Management Act of 1976 (FLPMA) and the Federal Coal Leasing Act Amendments of 1976 (FCLAA). BLM is the lead agency responsible for leasing federal coal lands under the MLA as amended by FCLAA and is also responsible for preparation of this EIS to evaluate the potential environmental impacts of issuing a coal lease.

OSM is a cooperating agency on this EIS. After a federal coal lease is issued, the Surface Mining Control and Reclamation Act of 1977 (SMCRA) gives OSM primary responsibility to administer programs that regulate surface coal mining operations and the surface effects of underground coal mining operations. USFS is also a cooperating agency on this EIS. If any USFS-administered lands are included in a tract that is proposed for leasing, USFS must consent to leasing the federal coal before BLM can make a decision to hold a federal coal lease sale.

WDEQ is also a cooperating agency on this EIS. Pursuant to Section 503 of SMCRA, the WDEQ developed, and in November 1980 the Secretary of the Interior approved, a permanent program authorizing WDEQ to regulate surface coal mining operations and surface effects of underground mining on nonfederal lands within the state of Wyoming. In January 1987, pursuant to Section 523(c) of SMCRA, WDEQ entered into a cooperative agreement with the Secretary of the Interior authorizing WDEQ to regulate surface coal mining operations and surface effects of underground mining on federal lands within the state.

Pursuant to the cooperative agreement, a federal coal lease holder in Wyoming must submit a permit application package to OSM and WDEQ/LQD for any proposed coal mining and reclamation operations on federal lands in the state. WDEQ/LQD reviews the permit application package to insure the permit application complies with the permitting requirements and the coal mining operation will meet the performance standards of the approved Wyoming program. OSM, BLM, USFS and other federal agencies review the permit application package to insure it complies with the terms of the coal lease, the MLA, NEPA, and other federal laws and their attendant regulations. If the permit application package complies, WDEQ issues the applicant a permit to conduct coal mining operations. OSM recommends approval, approval with conditions, or disapproval of the MLA mining plan to the Assistant Secretary of the Interior, Land and Minerals Management. Before the MLA mining plan can be approved, the BLM must concur with this recommendation.

If a proposed LBA tract is leased to an existing mine, the lessee is required to revise its coal mining permit prior to mining the coal, following the processes outlined above. As a part of that process, a detailed new plan would be developed showing how the newly-leased lands would be mined and reclaimed. The area of mining disturbance would be larger than the newly-leased area to allow for activities such as overstripping, matching reclaimed topography to undisturbed topography, constructing flood control and sediment control facilities, and related activities. Specific impacts that would occur during the mining and reclamation of the LBA tract would be addressed in the mining and reclamation plan, and specific mitigation measures for anticipated impacts would be described in detail at that time.

WDEQ enforces the performance standards and permit requirements for reclamation during a mine's operation and has primary authority in environmental emergencies. OSM retains oversight responsibility for this enforcement. Where federal surface or coal resources are involved, BLM, and USFS for USFS-administered lands, have authority in emergency situations if WDEQ or OSM cannot act before environmental harm and damage occurs.

Appendix A presents other federal and state permitting requirements that must be satisfied to mine these LBA tracts.

1.4 Relationship to BLM Policies, Plans, and Programs

In addition to the federal acts listed under Section 1.3, guidance and regulations for managing and administering public lands, including the federal coal lands in the ALC and BTU applications, are set forth in 40 CFR 1500 (Protection of Environment), 43 CFR 1601 (Planning, Programming, Budgeting), and 43 CFR 3400 (Coal Management).

Specific guidance for processing applications is provided by BLM Manual 3420, Competitive Coal Leasing (BLM 1989) and the 1991 *Powder River Regional Coal Team Operational Guidelines For Coal Lease-By-Applications* (BLM 1991). The *National Environmental Policy Act Handbook* (BLM 2008a) has been followed in developing this EIS.

1.5 Conformance with Existing Land Use Plans

FCLAA requires that lands considered for leasing be included in a comprehensive land use plan and that leasing decisions be compatible with that plan. The BLM *Approved Resource Management Plan for Public Lands Administered by the Bureau of Land Management Buffalo Field Office* (BLM 2001a), an update of the *Buffalo Resource Area Resource Management Plan* (BLM 1985), governs and addresses the leasing of federal coal in Campbell County. The *Land and Resource Management Plan for the Thunder Basin National Grassland, Medicine Bow-Routt National Forest, Rocky Mountain Region* (USFS 2001) offers guidance for all resource management activities on the TBNG.

The major land use planning decision that BLM must make concerning the federal coal resources is a determination of which federal coal lands are acceptable for further consideration for leasing. There are four screening procedures that BLM uses to identify these coal lands. These screening procedures require BLM to:

- estimate development potential of the coal lands;
- apply the Unsuitability Criteria listed in the regulations at 43 CFR 3461;

- make multiple land use decisions that eliminate federal coal deposits from consideration for leasing to protect other resource values; and
- consult with surface owners who meet the criteria defined in the regulations at 43 CFR 3400.0-5(gg)(1) and (2).

Only those federal coal lands that pass these screens are given further consideration for leasing. BLM has applied these coal screens to federal coal lands in the Wyoming PRB several times, starting in the early 1980s. Most recently, in 1993, BLM began the process of reapplying these screens to federal coal lands in Campbell, Converse, and Sheridan counties. This analysis was adopted in the 2001 BLM Buffalo Field Office Resource Management Plan (RMP) update (BLM 2001a). The results of this analysis were included as Appendix D of the 2001 RMP update, which can be viewed in the 2001 NEPA documents section on the Wyoming BLM website at: http://www.blm.gov/wy/st/en/info/NEPA/documents.html. The coal screen was completed for use not only in updating the 1985 Buffalo RMP but also the TBNG planning documents. Appendix D of the 2001 RMP update was prepared in cooperation with the USFS, Douglas Ranger District for lands within the TBNG.

Under the first coal screening procedure, a coal tract must be located within an area that has been determined to have coal development potential in order to be acceptable for further consideration for leasing (43 CFR 3420.1-4(e)(1)). The lands in these four coal lease applications are within the area identified as having coal development potential by the BLM and the USFS in the coal screening analyses published in the 2001 BLM and USFS planning documents.

The second coal screening procedure requires the application of the coal mining unsuitability criteria listed in the federal coal management regulations at 43 CFR 3461. The coal mining unsuitability criteria were applied to high through moderate coal development potential lands in the Wyoming PRB, including the six LBA tracts and surrounding lands in these four coal lease applications, during the coal screening conducted for the 2001 BLM Buffalo Field Office RMP update. Appendix B of this EIS summarizes the Unsuitability Criteria, describes the general findings for the 2001 BLM Buffalo Field Office RMP update, and presents a validation of these findings for the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts.

Unsuitability Criterion Number 2 addresses lands within rights-of-way (ROWs) on federal lands. Under this criterion, portions of the Burlington Northern Santa Fe & Union Pacific (BNSF & UP) railroad ROW shall be considered unsuitable for surface coal mining. As shown in Figures 1-2 and 1-4, the BNSF & UP railroad borders the west sides of the North and South Hilight Field LBA Tracts as applied for, crosses the North Porcupine LBA Tract as applied for, and lies west of and adjacent to the South Porcupine LBA Tract as applied for.

Unsuitability Criterion Number 3 addresses lands used for public roads and other public purposes. Wyoming State Highway 450 east of the BNSF & UP railroad shall be considered unsuitable for surface coal mining. The 2001 BLM Buffalo RMP update deferred a decision on the unsuitability of the public road ROWs and associated buffer zones (with the exclusion of Wyoming State Highway 450 east of the BNSF & UP railroad and Interstate Highway I-90 ROWs) until a leasing action occurred.

There were no findings of unsuitability for the other criteria listed in the regulations; however, as indicated in Appendix B, several criteria will be further evaluated during the leasing process.

The third coal screening procedure, a multiple land use conflict analysis, must be completed to identify and "eliminate additional coal deposits from further consideration for leasing to protect resource values of a locally important or unique nature not included in the Unsuitability Criteria," in accordance with 43 CFR 3420.1-4(e)(3). The 2001 Buffalo RMP update addresses two types of multiple land use conflicts: municipal/residential conflicts and multiple mineral development (coal versus oil and gas) conflicts.

The North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts do not lie within or in proximity to an identified buffer zone surrounding an existing community. Therefore, no federal coal lands within these six LBA tracts have been eliminated from further consideration for leasing due to municipal/residential conflicts.

The 2001 Buffalo RMP includes two decisions related to multiple mineral development conflicts in Campbell, Converse and Sheridan counties. With respect to oil and gas leasing in coal mining areas, the RMP update determines that oil and gas tracts that would interfere with coal mining operations would not be offered for lease but that, where possible, oil and gas leases will be issued with specific conditions to prevent a development conflict with coal mining operations. With respect to coal leasing in oil and gas fields, the 2001 Buffalo RMP update states that coal leasing in producing oil and gas fields would be deferred unless or until coal development would not interfere with the economic recovery of the oil and gas resources, as determined on a case-by-case basis.

Both conventional oil and gas and coal bed natural gas (CBNG) wells have been drilled within or around the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts. BLM's evaluation of the potential for conflict with the development of oil and gas resources within the six LBA tracts is included in the Mineral Resources discussion in Section 3.3 and in the Land Use discussion in Section 3.11 of this EIS. BLM's policy and guidance on conflicts between surface coal mine and conventional oil and gas and CBNG development is to optimize the recovery of both resources and ensure that the public receives a reasonable return, as explained in BLM Instruction Memorandum No. 2006-153 (BLM 2006a).

The fourth coal screening procedure requires consultation with surface owners who meet the criteria defined in the regulations at 43 CFR 3400.0-5(gg)(1) and (2). Chapter 7 includes a definition of the term "qualified surface owner," based on these regulations. Surface owner consultation was conducted as part of the coal screening analysis published in the 2001 Buffalo RMP update. Private surface owners in the Gillette coal development potential area were provided the opportunity to express their preference for or against surface mining of federal coal under their private surface estate during that screening. At that time, no attempt was made to distinguish qualified surface owners, and Appendix D of the 2001 Buffalo RMP update states that "no area should be dropped from further consideration for leasing as a result of responses received from surface owners." Therefore, no federal coal lands within the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts have been eliminated from further consideration for leasing due to qualified surface owner conflicts at this time. The current surface ownership of the LBA tracts is discussed in Section 1.1 of this chapter and in Section 3.11. Private surface owners who are found to be qualified must consent to leasing before BLM can offer the underlying federal coal for lease. BLM will review the current surface ownership in the tracts that will be considered for leasing prior to holding a lease sale for each tract. Prior to holding a lease sale, surface owner consultation must be completed with any private surface owners who are determined to be qualified.

In summary, the lands in the ALC and BTU coal lease applications have been subjected to the four coal planning screens. The results are detailed in Appendix B and detailed in the description of the Proposed Action and alternatives for each LBA tract contained in Chapter 2 of this EIS. Thus, a decision to lease the federal coal lands in these applications, conditioned consistent with RMP decisions, would be in conformance with the current BLM Buffalo RMP and the TBNG RMP.

1.6 Consultation and Coordination

Initial Involvement

BLM received the Hilight Field coal lease application on October 7, 2005, the West Hilight Field coal lease application on January 17, 2006, the West Jacobs Ranch coal lease application on March 24, 2006, and the Porcupine coal lease application on September 29, 2006. The applications were initially reviewed by the BLM Wyoming State Office-Division of Minerals and Lands. BLM ruled that these four applications and the lands involved met the requirements of regulations governing coal leasing on application (43 CFR 3425).

The BLM Wyoming State Director notified the Governor of Wyoming on April 27, 2006, that ALC had filed a lease application with BLM for the North Hilight

Field and South Hilight Field LBA Tracts. The BLM Wyoming State Director notified the Governor of Wyoming on February 2, 2006, that ALC had filed a lease application with BLM for the West Hilight Field LBA Tract. The BLM Wyoming State Director notified the Governor of Wyoming on September 18, 2006, that JRCC had filed a lease application with BLM for the West Jacobs Ranch LBA Tract. The BLM Wyoming State Director notified the Governor of Wyoming on March 14, 2007, that BTU had filed a lease application with BLM for the North Porcupine and South Porcupine LBA Tracts.

The PRRCT reviewed the Hilight Field, West Hilight Field, and West Jacobs Ranch maintenance coal lease applications at a public meeting held on April 19, 2006 in Casper, Wyoming. The PRRCT reviewed the Porcupine maintenance coal lease application at a public meeting held on January 18, 2007 in Casper, Wyoming. Each of the applicants presented information about their existing mine and pending lease application to the PRRCT at those meetings. The PRRCT recommended that the BLM continue to process all four lease applications at those respective meetings. The major steps in processing an LBA are shown in Appendix C.

BLM published a Notice of Intent (NOI) to prepare an EIS and Notice of Public Meeting in the *Federal Register* on July 3, 2007, in the Gillette News-Record on July 6, 2007, and in the Douglas Budget on July 11, 2007. The publications served as public notice that the Hilight Field, West Hilight Field, West Jacobs Ranch, and Porcupine coal lease applications had been received, announced the time and location of a public scoping meeting, and requested public comment on the four applications. Letters requesting public comment and announcing the time and location of the public scoping meeting were mailed to all parties on the distribution list on July 11, 2007.

A public scoping meeting was held July 24, 2007 in Gillette, Wyoming. At the public meeting, the applicants orally presented information about their mines and their need for the coal. The presentations were followed with a question and answer period, during which three oral comments were made. The scoping period extended from July 3 through September 3, 2007, during which time BLM received nine comment letters.

Chapter 5 provides a list of other federal, state, and local governmental agencies that were consulted in preparation of this EIS and the distribution list for this EIS.

<u>Issues and Concerns</u>

Issues that have been identified through scoping and other recently expressed concerns related to the potential impacts of leasing the Wright Area maintenance tracts and other federal coal in the Wyoming PRB include:

- potential conflicts between coal mining and existing and proposed conventional oil and gas and CBNG development;

- potential cumulative impacts of coal leasing decisions combined with other existing and proposed development in the Wyoming PRB;
- potential impacts to Highway 450 and other transportation routes;
- potential impacts to people living in the area;
- socioeconomic concerns;
- potential impacts to ranching operations associated with the loss of grazing leases and permits;
- noxious weed concerns;
- potential impacts to visual resources;
- potential impacts to cultural and paleontological resources;
- potential impacts to Greater sage-grouse and other wildlife;
- potential impacts to threatened and endangered species and other species of concern;
- potential impacts to wetland resources;
- potential impacts related to coal loss during rail transport;
- potential air quality impacts and cumulative impacts to visibility;
- potential surface and groundwater quality and quantity impacts;
- potential impacts associated with nitrogen oxide emissions resulting from the blasting of coal and overburden;
- human health impacts;
- the need to address reasonably foreseeable actions, including the construction and operation of the DM&E railroad and power plants, in the cumulative analysis;
- the need to address mercury, coal combustion residues, and other by-products from coal-fired power plants;
- the need to address increasing PRB coal production in the cumulative analysis;
- the need to address site-specific greenhouse gas emissions;
- ozone; and
- climate change.

<u>Draft EIS</u>

Parties on the distribution list were sent copies of the Draft EIS, and copies were made available for review at the BLM offices in Casper and Cheyenne, Wyoming. The document was also available for review on the BLM Wyoming website at: <u>http://www.blm.gov/wy/st/en/info/NEPA/HighPlains/Wright-Coal.html</u>.

The U.S. Environmental Protection Agency (EPA) published a notice announcing the availability of the Draft EIS in the *Federal Register* on June 26, 2009. A 60-day comment period on the Draft EIS commenced with publication of the EPA's Notice of Availability (NOA) and ended on August 25, 2009. BLM published a NOA/Notice of Public Hearing for the Draft EIS in the *Federal Register* on July 8, 2009. The BLM's *Federal Register* notice announced the date and time of a public hearing, which was held during the 60-day comment period on July 29, 2009 at 7:00 p.m. at the Clarion Inn in Gillette, Wyoming. The purpose of the public hearing was to solicit public comments on the Draft

EIS and on the fair market value, the maximum economic recovery, and the proposed competitive sale of federal coal from the LBA tracts. BLM also published a notice of public hearing in both the Douglas Budget and Gillette News-Record newspapers on July 8, 2009. Two individuals representing organizations presented statements on the Draft EIS during the hearing. A summary of the statements that were presented at the public hearing are included in Appendix I of this Final EIS. An official transcript of the public hearing is available for review at the BLM High Plains District Office in Casper.

Final EIS and Future Involvement

BLM received written comments from 17 individuals, agencies, businesses, and organizations, as well as over 500 e-mails from interested individuals and entities regarding the Draft EIS. These comments are included, with agency responses, in Appendix I of this Final EIS. Availability of the Final EIS will be published in the *Federal Register* by BLM and EPA. After a 30-day availability period commencing from the date of the EPA's notice, BLM will make separate decisions to hold or not to hold a competitive lease sale for the federal coal in the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts.

The USFS must consent to leasing the federal coal underlying lands that they administer before BLM can include those lands in a decision to hold a federal coal lease sale. If any lands administered by the USFS are included in the tract that BLM considers for leasing, the USFS will issue a separate record of decision (ROD) consenting to leasing those lands. The decision to consent to leasing the USFS land can be appealed within 45 days from the date that the Notice of Publication of the USFS ROD is published in the Laramie Boomerang newspaper.

A public ROD for each of the tracts will be mailed to parties on the mailing list and others who commented on this EIS during the NEPA process. The public and/or the applicant can appeal the BLM decision to hold or not to hold a competitive sale and issue a lease for any of the six tracts. The BLM decision must be appealed within 30 days from the date the NOA for the ROD is published in the *Federal Register.* The decision can be implemented at that time if no appeal is received. If competitive lease sales are held, the lease sales will follow the procedures set forth in 43 CFR 3422, 43 CFR 3425, and BLM Handbook H-3420-1 (Competitive Coal Leasing).

Department of Justice Consultation

After each competitive coal lease sale, but prior to issuance of the lease, BLM must solicit the opinion of the Department of Justice on whether the planned lease issuance creates a situation inconsistent with federal antitrust laws. The Department of Justice is allowed 30 days to make this determination. If the Department of Justice has not responded in writing within the 30 days, the BLM can proceed with issuance of the lease.

2.0 PROPOSED ACTION AND ALTERNATIVES

This chapter describes the Proposed Action and alternatives to this action for each of the six Lease by Application (LBA[1]) tracts being evaluated in this EIS. The six LBA tracts are the North Hilight Field, South Hilight Field, West Hilight Field, and West Jacobs Ranch LBA Tracts as applied for by Ark Land Company (ALC), and the North Porcupine and South Porcupine LBA Tracts as applied for by BTU Western Resources, Inc. (BTU).

For each tract, the Proposed Action is to hold a separate competitive lease sale and issue a separate lease for the federal coal lands included in the tract as applied for by the applicant. Under each Proposed Action, the tract as applied for would be offered for lease at one competitive sealed bid lease sale, subject to standard and special lease stipulations developed for the Powder River Basin (PRB) and that tract. The boundaries of each tract would be consistent with the tract configuration proposed by each applicant. Figures 2-1 through 2-6 show the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts, respectively, under each Proposed Action. In each case, the Proposed Action assumes that the applicant would be the successful bidder on each tract, and that the tract would be mined as a maintenance lease for an existing mine.

The National Environmental Policy Act of 1969 (NEPA) requires the consideration and evaluation of other reasonable ways to meet proposal objectives while minimizing or avoiding environmental impacts. Thus, NEPA requires the evaluation of a No Action Alternative and a practical range of other "reasonable" alternatives that may avoid or minimize project impacts. Reasonable alternatives are defined by NEPA as those that are technically, economically, and environmentally practical and feasible. Reasonable alternatives are formulated to address issues and concerns raised by the public and agencies during scoping. These alternatives should represent another means of satisfying the stated purpose and need for the federal action.

The No Action Alternative (Alternative 1) for each tract considered in this Environmental Impact Statement (EIS) is to reject the lease application. Under the No Action Alternative, a tract would not be offered for competitive sale, and the coal contained within the tract would not be mined as proposed. Rejection of an application would not affect currently permitted mining activities on existing leases at any of the applicant mines, and selection of the No Action Alternative would not preclude an application to lease any rejected tract in the future. Portions of the surface of each LBA tract would probably be disturbed due to overstripping to allow coal to be removed from the adjacent existing leases.

The Bureau of Land Management (BLM) Competitive Coal Leasing Manual (BLM Manual 3420-1) requires BLM to evaluate modifying the configuration of

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

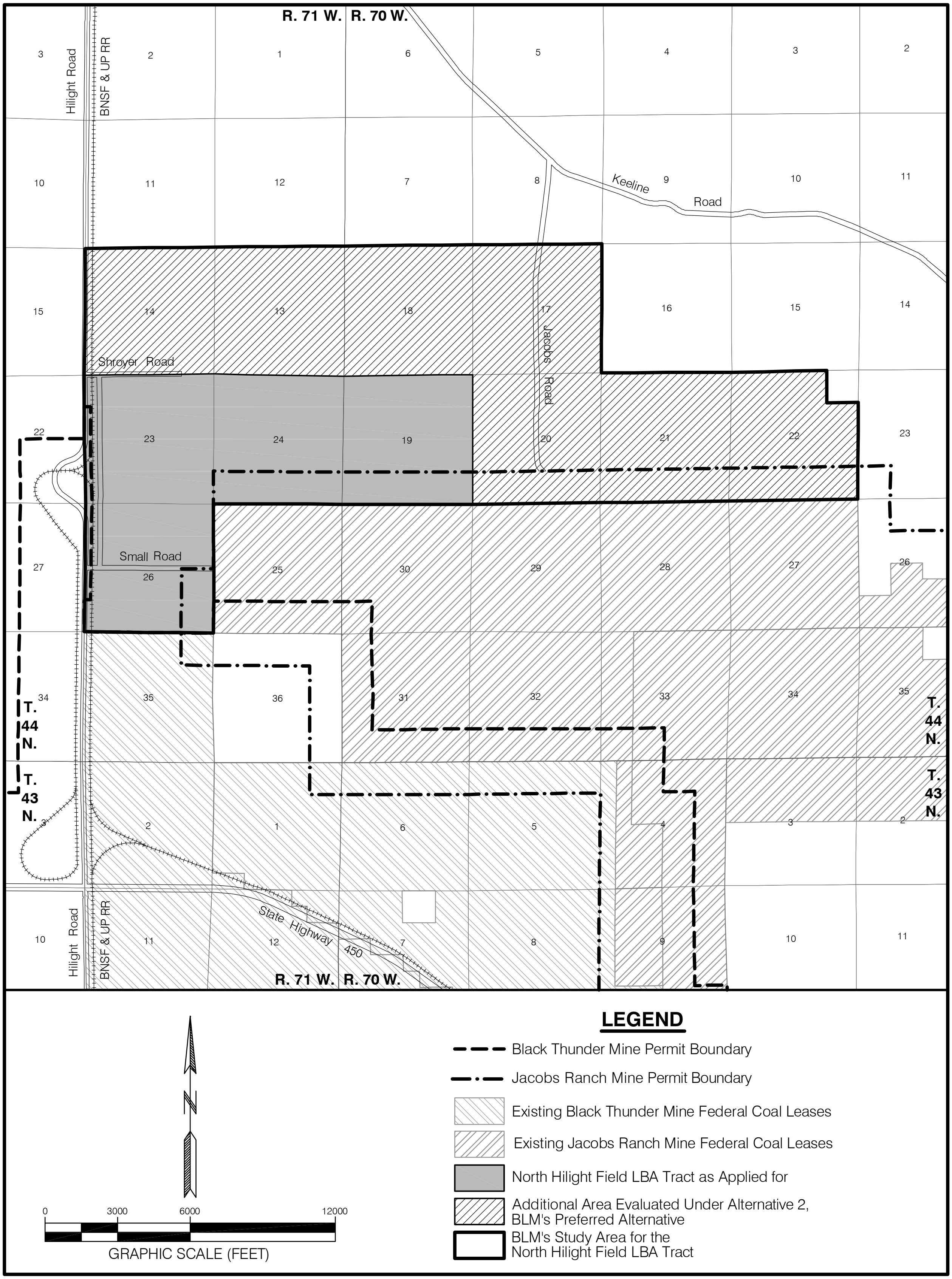


Figure 2-1. North Hilight Field LBA Tract Alternatives.

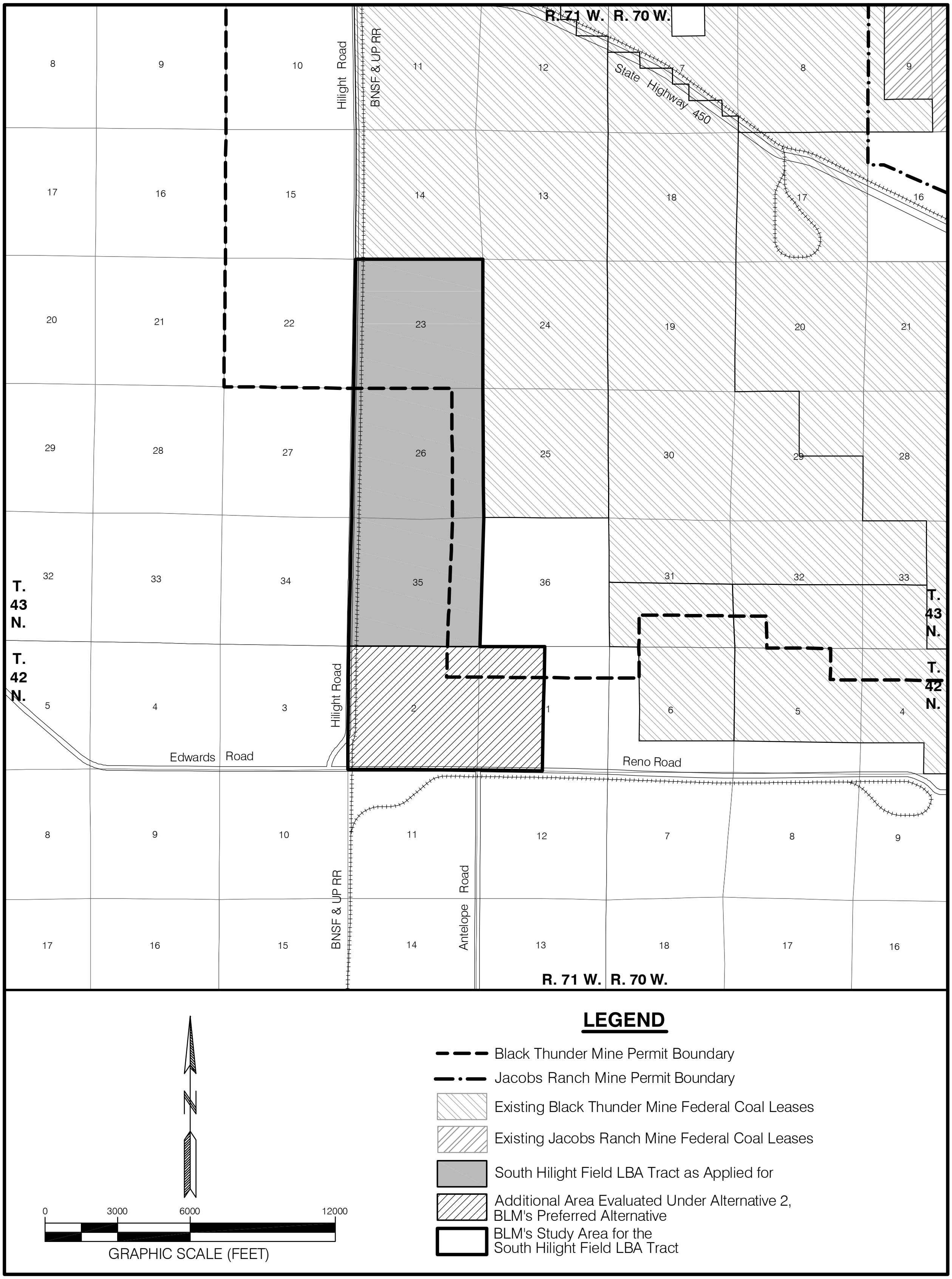


Figure 2-2. South Hilight Field LBA Tract Alternatives.

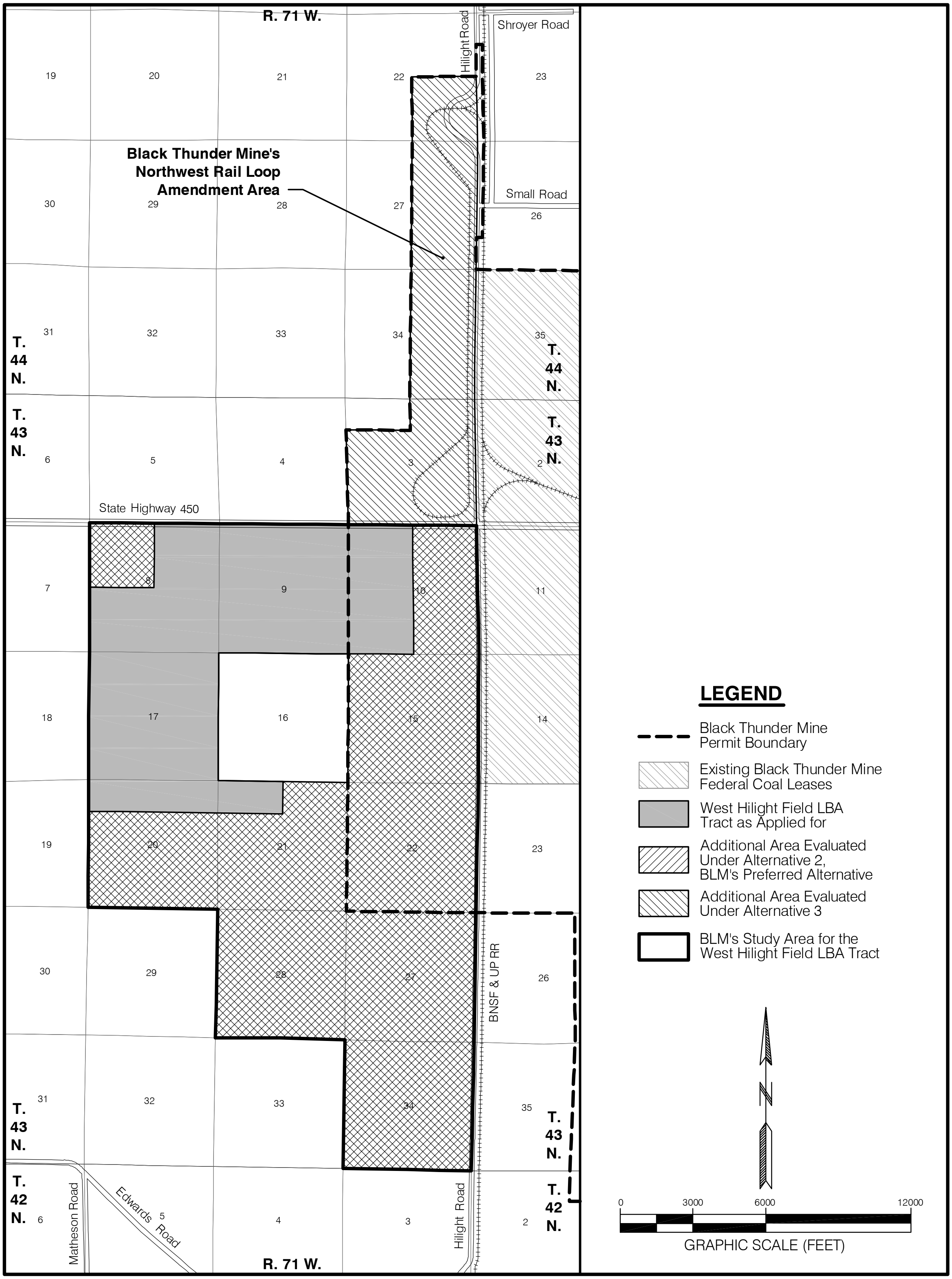


Figure 2-3. West Hilight Field LBA Tract Alternatives.

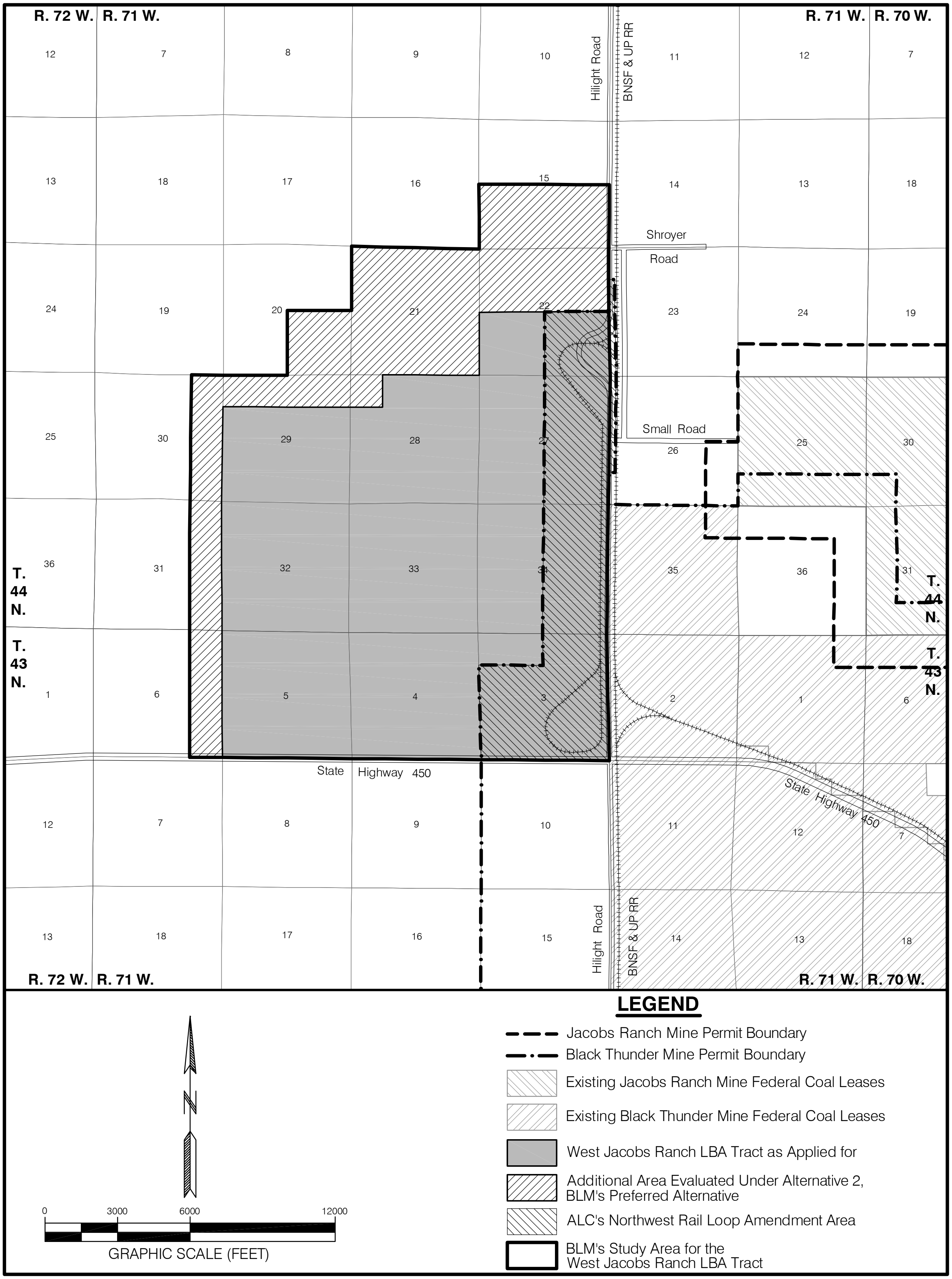


Figure 2-4. West Jacobs Ranch LBA Tract Alternatives.

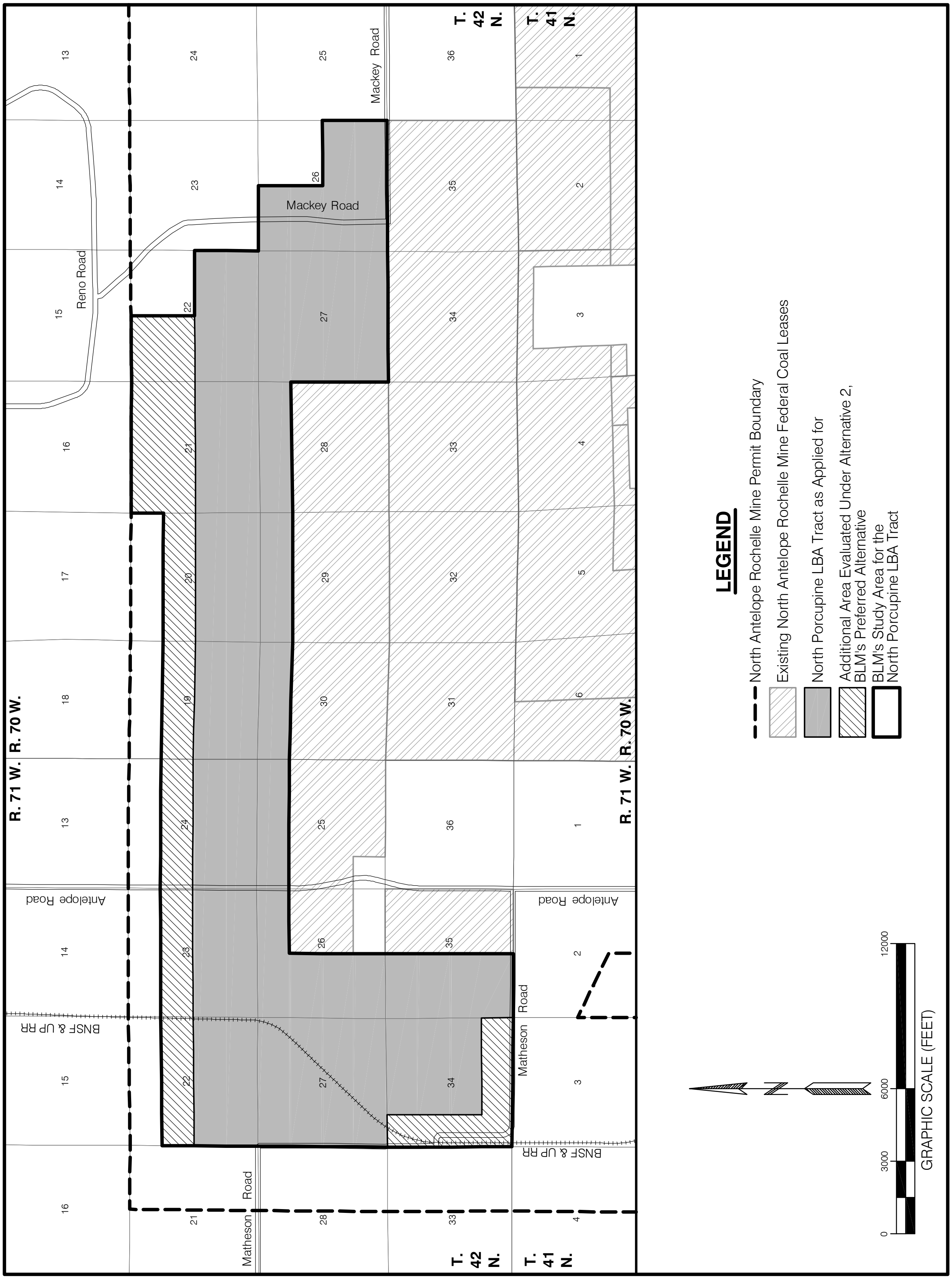


Figure 2-5. North Porcupine LBA Tract Alternatives.

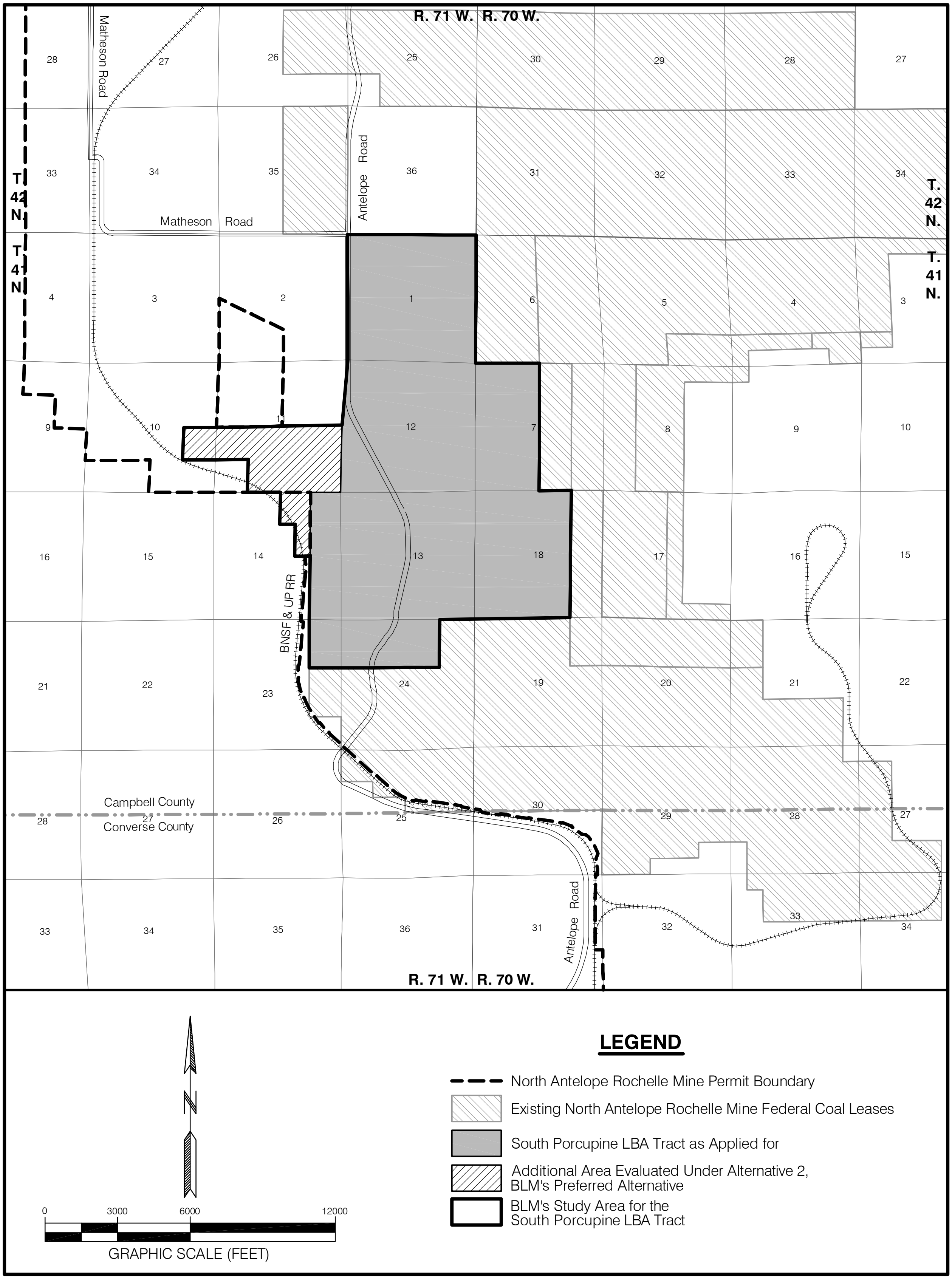


Figure 2-6. South Porcupine LBA Tract Alternatives.

federal coal tracts based on providing for maximum economic recovery of the coal resource, maintaining or increasing the potential for competition, and avoiding future bypass or captive tract situations. For NEPA purposes, BLM identifies alternate tract configurations and evaluates them as alternatives to the Proposed Action. BLM has identified a study area for each LBA tract that includes each tract as applied for and adjacent unleased federal coal. Figures 2-1 through 2-6 show these study areas for the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts, respectively. 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.

The Leasing on Application regulations at 43 CFR 3425.1-9 state that: "The authorized officer may add or delete lands from an area covered by an application for any reason he/she determines to be in the public interest." Accordingly, in evaluating alternate tract configurations, BLM could either increase or decrease the size of each tract as applied for.

The potential tract configurations, and therefore the potential number of alternatives evaluated for NEPA purposes, can vary for each tract. In this EIS, one alternative, Alternative 2, is evaluated in addition to the Proposed Action and Alternative 1 (the No Action Alternative) for all of the tracts considered in this EIS. Under Alternative 2 for each tract, BLM is evaluating adding all or part of the BLM study area to the tract as applied for and/or reducing the size of the tract as applied for. For only the West Hilight Field LBA Tract, another alternative, Alternative 3, is evaluated in detail in this EIS in addition to the Proposed Action, Alternative 1, and Alternative 2. Under Alternative 3 for the West Hilight Field tract, BLM is evaluating adding all or part of the BLM study area and all or part of Thunder Basin Coal Company's (TBCC's) permitted Northwest Rail Loop Amendment Area (Figure 2-3). One competitive sealed bid sale would be held for each tract as configured by BLM.

Two alternatives were considered but not analyzed in detail. They are:

- holding a competitive lease sale and issuing a lease for federal coal lands included in one or more of the LBA tracts (as applied for or as modified by BLM), with the assumption that one or more of the tracts would be developed as a new mine (see Section 2.7.1), and

- delaying the sale of one or more of the LBA tracts as applied for in order to take advantage of higher coal prices and/or to allow recovery of the potential coal bed natural gas (CBNG) resources in the tract prior to mining. Under this alternative, it is assumed that one or more of the tracts could be developed later as a maintenance tract or a new mine start, depending on how long the sale was delayed (see Section 2.7.2).

LBA tracts are nominated for leasing by companies with an interest in acquiring them but, as discussed in Chapter 1, the LBA process is, by law and regulation, an open, public, competitive sealed-bid process. If a tract is offered for lease, the applicant for that tract may or may not be the high bidder when the lease sale is held. For each tract, the Proposed Action and Alternative 2 or Alternative 3 considered in this EIS assume that the applicant that applied for the tract would be the successful bidder if the federal coal included in the tract is offered for lease, and that each tract would be mined as a maintenance tract for an existing permitted mine.

If a decision is made to hold a competitive lease sale for a tract of federal coal and a lease is issued, the lessee must obtain a permit to conduct coal mining operations before mining can begin on the tract. As discussed in Chapter 1, Section 1.3, this permit application would undergo detailed review by state and federal agencies as part of the approval process. The detailed permit application for each tract could potentially differ from the more general mining plan used in this EIS to analyze the impacts of the Proposed Action and Alternative 2 or Alternative 3 for each tract, but the differences would not be expected to substantially change the impacts described here. These differences would typically be related to the details of mining and reclaiming each tract but major factors, like the approximate number of tons of coal to be mined and yards of overburden to be removed, the acres disturbed, etc., would not be substantially different from the plans used in this analysis.

If any of the tracts are leased under the Proposed Action or Alternative 2 or 3 for each tract, 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, matching undisturbed topography, and construction of flood control and sediment control structures. This is referred to as the "general analysis area" for that tract. The Proposed Action and Alternative 2 or Alternative 3 for each LBA tract will be referred to collectively as the Action Alternatives.

For the Action Alternatives, future coal production rates are difficult to predict since mines must vary rates in response to the demand and competition for coal sales. BLM estimated future production rates for the purpose of estimating cumulative impacts. This was done as part of the Powder River Basin Coal Review - Task 2 Report - Past and Present and Reasonably Foreseeable Development Activities (BLM 2005a). The production estimates were based on forecasted coal demand for Wyoming PRB coal through the year 2020, and production rates were allocated to the three mine groups in the basin (Wright Area, South Gillette Area, and North Gillette Area) as constrained by production capacity. The Wright Area mines include the Antelope Mine as well as the three mines with the six LBA tracts addressed in this EIS (Figure 1-1). For this mine group, production was forecasted to reach somewhere between 291 million tons (lower range) to 307 million tons (upper range) per year by 2020. Mining company estimates from this EIS, as well as the West Antelope II EIS (BLM 2008d), total 306 million tons per year (mmtpy) by 2020.

The sum of the company projections is near the upper range of the forecasted Wright Area production rate. In addition, a fifth mine has been proposed in the Wright Area mine group. The proposed School Creek Mine has not been permitted at this time; however, if School Creek Mine opens, it will compete for a portion of the coal expected to be produced from this mine group, in response to demand and competition with other mines.

2.1 North Hilight Field LBA Tract

2.1.1 North Hilight Field LBA Tract Proposed Action

Ark Land Company (ALC) has filed an application for two separate LBA tracts (North Hilight Field and South Hilight Field). Each tract will be evaluated separately and if a decision is made to lease both of these tracts, a separate competitive lease sale will be held for each tract.

Under the Proposed Action for the North Hilight Field LBA Tract, the tract as applied for by ALC would be offered for lease at a sealed-bid, competitive lease sale, subject to standard and special lease stipulations developed for the PRB (Appendix D). The boundaries of the tract would be consistent with the tract configuration proposed in the North Hilight Field lease application (Figure 2-1). The Proposed Action assumes that ALC would be the successful bidder on the North Hilight Field LBA Tract, if it is offered for sale.

The legal description of the proposed North Hilight Field LBA Tract coal lease lands as applied for by ALC under the Proposed Action is as follows:

T.44N., R.70W., 6th PM, Campbell County, Wyoming		
Section 19:	Lots 5 through 20;	656.88 acres
T.44N., R.71W., 6th PM, Campbell County, Wyoming		
Section 23:	Lots 1 through 16;	653.11 acres
Section 24:	Lots 1 through 16;	653.44 acres
Section 26:	Lots 1 through 16;	650.07 acres
Total:		2,613.50 acres

Land descriptions and acreage are based on the BLM Status of Public Domain Land and Mineral Titles approved Master Title Plats as of August 30, 2005 and September 7, 2007 and Coal Plats as of September 7, 2007. The coal estate included in the tract described above is federally owned. The ownership of the surface and oil and gas estates is discussed in Section 3.11.

Some of the coal in the above-described lands in the North Hilight Field LBA Tract is not currently considered by TBCC, operator of the Black Thunder Mine, to be mineable due to the presence of the Burlington Northern Santa Fe & Union Pacific (BNSF & UP) rail line, which borders the western side of the tract (Figure 2-1). The coal underlying the BNSF & UP railroad right-of-way

(ROW) and an associated 100-foot buffer zone is not considered by TBCC to be mineable at this time because the cost that would be associated with moving the railroad tracks would make it economically unfeasible to recover the underlying coal. Although the federal coal underlying the railroad ROW and associated buffer zone would not be mined, it is included in the tract because it would allow maximum recovery of the mineable coal adjacent to but outside of the railroad ROW and its associated buffer zone and comply with the coal leasing regulations that do not allow leasing of less than 10-acre aliquot parts.

Also, some of the coal in the above-described lands in the North Hilight Field LBA Tract is overlain by the Shroyer Road (County Road 116), which borders the North Hilight Field LBA Tract (Figure 2-1). The Surface Mining Control and Reclamation Act of 1977 (SMCRA) prohibits surface mining operations on lands within 100 feet of the outside line of the ROW for a public road (SMCRA Section 522(e)(4) and 30 CFR 761.11(d)). Some of the coal in the above-described lands in the North Hilight Field LBA Tract is also within 100 feet of the Hilight Road (Campbell County Road 52) ROW. However, because the Hilight Road lies parallel and adjacent to the BNSF & UP rail line (Figure 2-1), the 100-foot buffer zone associated with the railroad ROW actually extends farther east and overlies more coal within the North Hilight Field LBA Tract than the 100-foot buffer zone associated with the Hilight Road ROW. The coal that is underlying the Shroyer Road, its ROW, and associated 100-foot buffer zone, and the coal that is within 100 feet of the Hilight Road ROW has been determined to be unsuitable for mining in accordance with SMCRA and as specified under Unsuitability Criterion 3 (43 CFR 3461).

There is an exception to this prohibition in the regulations at SMCRA Section 522(e)(4) and 30 CFR 761.11(d)(2), which can be applied if the appropriate road authority (Campbell County Board of Commissioners) allows the public roads 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. The Small Road (Campbell County Road 89) also overlies the North Hilight Field LBA Tract (Figure 2-1); however, it has been vacated by the Campbell County Commissioners. If TBCC obtains approval from the Campbell County Board of Commissioners to move the Shroyer Road, the exception to the prohibition on mining within the public road ROW and buffer zone could be applied and the unsuitability determination could be reconsidered. In that case, TBCC would be able to recover the coal underlying the county road ROW and its associated buffer zone. TBCC would not need to consider moving the Hilight Road for the reason explained above. If TBCC does not obtain approval to move or close the Shroyer Road, the coal underlying its ROW and associated buffer zone would remain unsuitable for mining and would not be recovered.

The federal coal underlying the Shroyer Road, its ROW and associated 100-foot buffer zone is included in the tract because it would allow maximum recovery of all the mineable coal adjacent to but outside of the road ROW and associated buffer zone if the road is not moved; it would also allow recovery of the coal under the road if it is moved or closed. If a lease is issued for this tract, a stipulation will be attached to the lease stating that no mining activity may be conducted in the portions of the lease within the ROW and buffer zone for the Shroyer Road and Hilight Road unless approval is obtained from the appropriate authority to move or close the road.

TBCC estimates that the North Hilight Field LBA Tract as applied for includes approximately 319.7 million tons of in-place coal. If the Shroyer Road is not moved or closed, and considering the coal underlying the BNSF & UP railroad ROW and buffer zone, TBCC estimates that the North Hilight Field LBA Tract as applied for contains approximately 286.3 million tons of mineable coal reserves. Based on historical recovery practices, TBCC assumes that about 92 percent of that coal, or approximately 263.4 million tons of coal, would be recovered from the North Hilight Field LBA Tract as applied for. If they acquire the tract and if the county road is not moved or closed, a total of 1,499.8 million tons of coal would be mined after January 1, 2008, with an estimated 263.4 million tons coming from the LBA tract. Based upon this estimate of recoverable reserves, about 17.6 percent of the in-place coal reserves included within the LBA tract would not be recovered under normal mining practices and due to the presence of the unmineable reserves within the railroad and public road ROWs and associated buffer zones. If the Shroyer Road is moved or closed, TBCC estimates that an additional 9.5 million tons of coal would be mineable in the North Hilight Field LBA Tract as applied for.

The North Hilight Field LBA Tract would be mined as an integral part of the Black Thunder Mine under the Proposed Action. Since the North Hilight Field LBA Tract would be an extension of the existing Black Thunder Mine, the facilities and infrastructure would be the same as those identified in the Wyoming Department of Environmental Quality/Land Quality Division (WDEQ/LQD) Mine Permit 233 Term T7, approved November 1, 2005 and the BLM Resource Recovery and Protection Plan (R2P2), which was approved December 12, 2006.

Black Thunder Mine's currently approved air quality permits (Permit Numbers MD-417A, MD-877, MD-1178, MD-1555, MD-6824, and MD-3851) from the Wyoming Department of Environmental Quality/Air Quality Division (WDEQ/AQD) allow up to 135 million tons of coal per year to be mined. The Black Thunder Mine produced:

- 62.6 million tons of coal in 2003,
- 66.8 million tons of coal in 2004,
- 62.7 million tons of coal in 2005,
- 67.3 million tons of coal in 2006,
- 65.3 million tons of coal in 2007, and
- 67.4 million tons of coal in 2008

(Wyoming Department of Employment 2003, Shamley 2008a and 2010).

As of December 31, 2008, a total of approximately 1,087.9 million tons of coal had been mined from within the current permitted area of the mine.

TBCC estimates an average annual coal production rate of 100 mmtpy after 2008 for the Black Thunder Mine, increasing to an average of 135 mmtpy by 2015. If ALC acquires the North Hilight Field LBA Tract as applied for, a total of approximately 1,432.8 million tons of coal would be recovered from the existing leases and the North Hilight Field LBA Tract after January 1, 2009, with an estimated 263.4 million tons coming from the LBA tract, as discussed above. With the North Hilight Field LBA Tract, coal production at the Black Thunder Mine would continue for approximately 11.3 years beyond 2008. The LBA tract accounts for approximately 2 years of the mine life extension.

BLM independently evaluates the volume and average quality of the coal resources included in proposed LBA tracts as part of the fair market value determination process. BLM's estimate of the mineable federal coal reserves and average quality of the coal included in the tract may not be in agreement with the mineable coal reserve and coal quality estimates provided by the applicant. BLM's estimate of the mineable federal coal reserves and average quality of the coal included in the tract will be published in the sale notice if the tract is offered for sale.

Prior to disturbance and in advance of mining, mine support structures such as roads, power lines, substations, and flood and sediment control measures would be built as needed, and any public utility lines and oil and gas pipelines would be relocated as necessary.

The first step of the mining process is soil salvage with suitable heavy equipment, such as rubber-tired scrapers. During initial pit development, soil is placed in temporary stockpiles for later use in final pit closure and reclamation. Whenever possible, direct haulage of soil from salvage areas to a reclamation area would be done, but due to scheduling, some topsoil would be temporarily stockpiled. As required by the reclamation plan, heavy equipment again would be used to haul and redistribute the stockpiled topsoil on regraded areas.

The Black Thunder Mine is one of several mines currently operating in the PRB where the coal seams are notably thick and the overburden is relatively thin. Mining would be conducted in three separate pits identified as the North Pit, West Pit, and South Pit. After soil salvage operations are complete, blast holes are drilled down through the overburden to the top of the upper-most mineable coal seam. The drill holes are then loaded with explosives (a mixture of ammonium nitrate and fuel oil, or ANFO) and detonated to fragment the overburden to facilitate efficient excavation. Overburden removal has been and would continue to be conducted primarily with draglines, trucks and shovels, and/or direct cast blasting. Other equipment used during overburden removal and backfilling includes dozers, scrapers, excavators, front-end loaders, graders, and water trucks. Exposed coal seams have been and would continue to be cleaned with a dozer, drilled and blasted to facilitate efficient excavation, and then loaded into haul trucks for transport to the coal crushing and storage facilities.

The design of the Black Thunder Mine seeks to confine disturbance to the active mine blocks. As overburden is removed, most would be directly placed into the previous empty pit where coal has been removed.

Chapter 4, Section 2(b)(i) of the WDEQ/LQD Coal Rules requires that rough backfilling and grading follow coal removal as closely as possible based on the mining conditions (WDEQ/LQD 2009). Replaced (backfilled) overburden is graded to approximate the original land surface contour, as required by WDEQ and the Office of Surface Mining Reclamation and Enforcement (OSM) rules. Elevations consistent with the approved post-mining topography (PMT) plan are established as quickly as possible to reconstruct a stable landscape and restore drainage. Under certain conditions, the PMT may not be immediately achievable. This occurs when there is an excess of material that may require temporary stockpiling, when there is insufficient material available from current overburden removal operations, or when future mining could redisturb an area already mined. Backfilled and recontoured overburden is sampled and analyzed to verify suitability as subsoil. Should unsuitable backfill materials be encountered (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), mitigation by additional soil depth, excavation and burial, or other special handling to remove them from the root zone would occur. Prior to soil distribution, regraded backfill is scarified to relieve compaction. Soil is redistributed on recontoured backfill using rubber-tired scrapers or haul trucks, dozers and blades. Once a seedbed has been formed, the reclaimed areas are revegetated using native grasses, forbs, and shrubs that are consistent with the postmining land use. According to the most recent OSM evaluation of the Wyoming coal mining industry, the reclamation to disturbance ratio in 2008 was approximately 86 percent (4,703 acres reclaimed vs. 5,497 acres disturbed) (OSM 2009).

Coal would be produced from two mineable seams within the North Hilight Field LBA Tract. TBCC refers to these seams as the Upper Wyodak (upper/rider seam) and the Middle Wyodak (main seam), which are separated by a shale parting that has an average thickness of approximately 1 foot. The Upper Wyodak seam averages 13 feet thick and the Middle Wyodak seam averages 48 feet thick. A third seam, the Lower Wyodak (basal seam), is not present over the entire tract. Coal would be mined at several working pit faces to enable blending of the coal to meet customer quality requirements, to comply with BLM lease requirements for maximum economic recovery of the coal resource, and to optimize coal removal efficiency with available equipment. Mining efficiency and air quality protection are and would continue to be facilitated by extensive use of near-pit crushers and overland conveyors.

Coal would be loaded with electric-powered shovels or hydraulic excavators into off-highway haul trucks for transport to crushing facilities. Coal haul roads would be temporary structures built within the mine areas. All coal transfer location points and crushing operations are controlled by baghouse-type dust collectors, dry foggers, or passive enclosure control systems (PECs). The truck dumping operations use stilling sheds to control fugitive dust and the overland conveyor is covered by a dust hood.

There are currently four existing crushing facilities, four existing silos, and a slot storage facility within the permit area that provide capacity to produce at the permitted level. New coal processing facilities and a new train loadout have been constructed within TBCC's Northwest Rail Loop Amendment Area (refer to Section 2.3.4 for a description of this area), will improve operating efficiency and air quality protection. The new Thundercloud near-pit crusher/conveyor systems would be used if ALC acquires the North Hilight Field LBA Tract.

Full-time employment at the Black Thunder Mine is currently 1,080. If the mine increases production as estimated, employment would grow to 1,324 by 2013. If ALC acquires the North Hilight Field LBA Tract under the Proposed Action, they anticipate that Black Thunder Mine's employment would remain at 1,324 for the additional 2 years that it would take to mine the coal included in the tract.

As discussed in Chapter 1, the North Hilight Field LBA Tract is adjacent to existing leases at both the Black Thunder and Jacobs Ranch mines, but is not adjacent to any of the other mines in this area, (Figure 1-1). If a company other than ALC was to acquire the tract, the rate of coal production, mining sequence, equipment, and facilities could be different than if ALC acquired the tract as a maintenance lease, as described above. However, the area of disturbance and the impacts of removing the coal would not be substantially different from the area of disturbance and the impacts of ALC mining the tract.

2.1.2 North Hilight Field LBA Tract Alternative 1

Under the North Hilight Field LBA Tract Alternative 1, the No Action Alternative, ALC's application to lease the coal included in the North Hilight Field LBA Tract would be rejected. The tract would not be offered for competitive sale at this time, and the coal included in the tract would not be mined.

Rejection of the application would not affect permitted mining activities nor employment on the existing leases at the Black Thunder Mine. The Black Thunder Mine currently leases approximately 19,581.3 acres of federal coal, 41.9 acres of private coal, and 2,792.9 acres of state coal, all of which are within the existing Black Thunder Mine permit boundary. A total of approximately 26,490.2 acres will eventually be affected in mining the current leases. If the North Hilight Field LBA Tract is not leased, TBCC estimates that the average annual coal production at the Black Thunder Mine after 2008 would be 100 mmtpy, increasing to an average of 135 mmtpy by 2015, and the average full-time employment level by 2013 is expected to be 1,324 persons. Mining would continue at Black Thunder for approximately 9.3 years. Portions of the surface of the LBA tract would probably be disturbed by both the Black

Thunder and Jacobs Ranch mines due to overstripping to allow coal to be removed from existing contiguous leases.

In order to compare the economic and environmental consequences of mining these lands versus not mining them, this EIS was prepared under the assumption that the North Hilight Field LBA Tract would not be mined in the foreseeable future if the No Action Alternative is selected. However, selection of the No Action Alternative would not preclude leasing and mining of this tract in the future. If the decision is made to reject the North Hilight Field lease application at this time, the tract could be leased as a maintenance lease in the future while the adjacent mine is in operation. If it is not leased while the existing adjacent mine is in operation, it may or may not be leased in the future. This tract does not include enough coal reserves to economically justify mining by a new operation; however, the coal reserves included in the tract could potentially be combined with unleased federal coal to the north, east and/or west to create a larger tract, which could be mined by a new operation in the future.

2.1.3 North Hilight Field LBA Tract Alternative 2--Preferred Alternative

Under Alternative 2 for the North Hilight Field LBA Tract, BLM would reconfigure the tract, hold one competitive coal sale for the lands included in the reconfigured tract, and issue a lease to the successful bidder. The modified tract would be subject to standard and special lease stipulations developed for the PRB and for this tract, if it is offered for sale (Appendix D). Alternative 2, holding a competitive coal sale for a modified tract, is BLM's Preferred Alternative.

Alternative 2 for the North Hilight Field LBA Tract assumes that ALC would be the successful bidder on the tract if a lease sale is held and that the federal coal would be mined as a maintenance lease for the existing Black Thunder Mine. Assumptions concerning mining methods, facilities, hazardous materials, mitigation and monitoring requirements, etc. are the same as described for the Proposed Action.

As applied for, the North Hilight Field LBA Tract consists of a single block of federal coal. In order to evaluate the potential that an alternate configuration of the tract would provide for more efficient recovery of the federal coal, increase competitive interest in the North Hilight Field LBA Tract, and/or reduce the potential that some of the remaining unleased federal coal in this area would be bypassed in the future, BLM identified a study area. The BLM study area includes the tract as applied for and unleased federal coal adjacent to the northern and eastern edges of the tract as applied for (Figure 2-1). The BLM study area includes lands (approximately 80.9 acres, or 1.1 percent of the study area) on the Thunder Basin National Grassland (TBNG), which is administered by the U.S. Department of Agriculture – Forest Service (USFS). Under Alternative 2, BLM could add all or part of the adjacent lands to the tract, or BLM could reduce the size of the tract, as discussed in Section 2.0.

Under Alternative 2, the area BLM is evaluating adding to the tract as applied for includes the following lands:

<u>T.44N., R.70W., 6th PM, Campbell County, Wyoming</u>

Section 17:	Lots 1 through 16;	654.17 acres
Section 18:	Lots 5 through 20;	655.14 acres
Section 20:	Lots 1 through 16;	651.07 acres
Section 21:	Lots 1 through 16;	658.37 acres
Section 22:	Lots 1 through 15;	606.85 acres

<u>T.44N., R.71W., 6th PM, Campbell County, Wyoming</u>

Section 13:	Lots 1 through 16;	655.53 acres
Section 14:	Lots 1 through 16;	644.74 acres
Total:		<u>4,525.87 acres</u>

The legal description of the Alternative 2 BLM reconfiguration (Figure 2-1) for the North Hilight Field LBA Tract is as follows:

<u>T.44N., R.70W., 6th PM, Campbell County, Wyoming</u>

Section 17:	Lots 1 through 16;	654.17 acres
Section 18:	Lots 5 through 20;	655.14 acres
Section 19:	Lots 5 through 20;	656.88 acres
Section 20:	Lots 1 through 16;	651.07 acres
Section 21:	Lots 1 through 16;	658.37 acres
Section 22:	Lots 1 through 15;	606.85 acres

<u>T.44N., R.71W., 6th PM, Campbell County, Wyoming</u>

Section 13:	Lots 1 through 16;	655.53 acres
Section 14:	Lots 1 through 16;	644.74 acres
Section 23:	Lots 1 through 16;	653.11 acres
Section 24:	Lots 1 through 16;	653.44 acres
Section 26:	Lots 1 through 16;	650.07 acres
Total:		<u>7,139.37 acres</u>

Land descriptions and acreage are based on the BLM Status of Public Domain Land and Mineral Titles approved Master Title Plats as of August 30, 2005 and September 7, 2007 and Coal Plats as of September 7, 2007. The coal estate included in the tract described above is federally owned. The ownership of the surface and oil and gas estates is discussed in Section 3.11.

TBCC estimates that the LBA tract reconfigured under Alternative 2 (the BLM study area) includes approximately 756.9 million tons of in-place coal reserves. As discussed in Section 2.1.1, some of the coal included in the above-described alternative tract configuration is not currently considered by TBCC to be mineable due to the presence of the BNSF & UP rail line ROW and associated 100-foot buffer zone, which borders the entire western side of the BLM study area (Figure 2-1). TBCC estimates that approximately 29.4 million tons of coal would not be mineable because of the railroad ROW and associated buffer zone.

As discussed in Sections 1.5 and 2.1.1 and shown in Figure 2-1, some of the coal in the above-described alternative tract configuration is overlain by the Shroyer Road. Some of the coal in the above-described alternative tract configuration is also within 100 feet of the Hilight Road ROW. The coal that is underlying the public road ROWs and associated 100-foot buffer zones extending on either side of the ROWs has been determined to be unsuitable for mining in accordance with SMCRA and as specified in coal leasing Unsuitability Criterion Number 3 (43 CFR 3461) and would not be recoverable. The Hilight Road runs parallel and adjacent to the west side of the BNSF & UP railroad ROW (Figure 2-1); therefore, the 100-foot buffer zone associated with the railroad ROW actually extends farther east and overlies more coal within the BLM study area than the 100-foot buffer zone associated with the Hilight Road ROW.

As discussed in Section 2.1.1, there is an exception to this prohibition to mine the coal underlying the public road ROWs and associated buffer zones that can be applied if the appropriate public road authority allows the road to be relocated or closed (SMCRA Section 522(e)(4) and 30 CFR 761.11(d)(2)). The Jacobs Road (Campbell County Road 59) and Small Road are two other county roads that overlie the Alternative 2 reconfiguration of the North Hilight Field LBA Tract (Figure 2-1), although they have been vacated by the Campbell County Commissioners. If TBCC obtains approval from the Campbell County Board of Commissioners to move or close the Shroyer Road, the exception to the prohibition on mining within the public road ROW and its associated 100-foot buffer zone could be applied and the unsuitability determination could be reconsidered. In that case, TBCC would be able to recover the coal underlying the road ROW and associated buffer zone. TBCC would not need to consider moving the Hilight Road for the reason explained above. If TBCC does not obtain approval to move or close Shroyer Road, the coal underlying its ROWs and associated buffer zone would remain unsuitable for mining and would not be recovered.

If the Shroyer Road is not moved or closed, TBCC estimates that the BLM study area under Alternative 2 (Figure 2-1) includes approximately 709.6 million tons of mineable coal reserves. Using TBCC's projected recovery factor of 92 percent of the mineable coal reserves, about 652.8 million tons of the mineable coal would be recoverable. TBCC estimates that approximately 47.3 million tons of coal would not be mineable because of the railroad and public road ROWs and associated buffer zones. Although these lands would not be mined, they are included in the BLM study area tract configuration to allow maximum recovery of all the mineable coal that is adjacent to but outside of the ROWs and associated buffer zones and to comply with the coal leasing regulations that do not allow leasing of less than 10-acre aliquot parts. If a lease is issued for this tract, a stipulation will be attached to the lease stating that no mining activity may be conducted in the portions of the leased tract within the Hilight and Shroyer county road ROWs and associated buffer zones unless approval is obtained from the appropriate public road authority to relocate or close the roads. If the Shroyer Road is moved or closed, TBCC estimates that an added 17.9 million tons of coal would be mineable in the BLM study area tract.

TBCC estimates an average annual coal production rate of 100 mmtpy after 2008 for the Black Thunder Mine, increasing to 135 mmtpy by 2015. With the BLM study area tract, coal production at the Black Thunder Mine would continue for approximately 14.1 years beyond 2008. The study area tract accounts for approximately 4.8 years of the mine life extension.

BLM independently evaluates the volume and average quality of the coal resources included in proposed LBA tracts as part of the fair market value determination process. BLM's estimate may not be in agreement with the estimate provided by the applicant. Under the Preferred Alternative (Alternative 2), BLM's estimate will be published in the sale notice for the tract, if it is offered for sale.

2.2 South Hilight Field LBA Tract

2.2.1 South Hilight Field LBA Tract Proposed Action

ALC has filed an application for two separate LBA tracts (North Hilight Field and South Hilight Field). Each tract will be evaluated separately and if a decision is made to lease both of these tracts, a separate competitive lease sale will be held for each tract.

Under the Proposed Action for the South Hilight Field LBA Tract, the tract as applied for by ALC would be offered for lease at a sealed-bid, competitive lease sale, subject to standard and special lease stipulations developed for the PRB (Appendix D). The boundaries of the tract would be consistent with the tract configuration proposed in the South Hilight Field lease application (Figure 2-2). The Proposed Action assumes that ALC would be the successful bidder on the South Hilight Field LBA Tract, if it is offered for sale.

The legal description of the proposed South Hilight Filed LBA Tract coal lease lands as applied for by ALC under the Proposed Action is as follows:

T.43N., R.71W., 6th PM, Campbell County, Wyoming

Section 23:	Lots 1 through 16;	649.36 acres
Section 26:	Lots 1 through 16;	667.69 acres
Section 35:	Lots 1 through 16;	659.64 acres
Total:		1,976.69 acres

Land descriptions and acreage are based on the BLM Status of Public Domain Land and Mineral Titles approved Master Title Plat as of September 7, 2007 and Coal Plat as of September 7, 2007. The coal estate included in the tract described above is federally owned. Much of the surface (approximately 82 percent, or 1,625.9 acres) of the tract as applied for includes lands on the TBNG, which is administered by the USFS. The ownership of the surface and oil and gas estates is discussed in Section 3.11.

As discussed in Section 1.5, some of the coal in the above-described lands in the South Hilight Field LBA Tract has been determined to be unsuitable for mining in accordance with SMCRA and as specified under Unsuitability Criterion 2 (43 CFR 3461) due to the presence of the BNSF & UP railroad line, which borders the western side of the LBA tract (Figure 2-2). The coal underlying the railroad ROW and an associated 100-foot buffer zone is also not considered by TBCC to be mineable at this time because the cost that would be associated with moving the railroad tracks would make it economically unsuitable to recover the underlying coal. Although the federal coal underlying the railroad ROW and its associated buffer zone would not be mined, the coal is included in the tract because it would allow maximum recovery of the mineable coal adjacent to but outside of the railroad ROW and its associated buffer zone and comply with the coal leasing regulations that do not allow leasing of less than 10-acre aliquot parts.

As indicated in Section 1.5, some of the coal in the above-described lands in the South Hilight Field LBA Tract is within 100 feet of the Hilight Road (Campbell County Road 52) ROW (Figure 2-2). SMCRA prohibits surface mining operations on lands within 100 feet of the outside line of the ROW for a public road (SMCRA Section 522(e)(4) and 30 CFR 761.11(d)). The coal that is within 100 feet of the Hilight Road ROW has been determined to be unsuitable for mining in accordance with SMCRA and as specified under Unsuitability Criterion 3 (43 CFR 3461). There is an exception to this prohibition in the regulations at SMCRA Section 522(e)(4) and 30 CFR 761.11(d)(2), which can be applied if the appropriate road authority (Campbell County Board of Commissioners) allows the public road to be relocated or closed. However, because the Hilight Road lies parallel and adjacent to the BNSF & UP rail line (Figure 2-2), the 100-foot buffer zone associated with the railroad ROW actually extends farther east and overlies more coal within the South Hilight Field LBA Tract than the 100-foot buffer zone associated with the Hilight Road ROW. TBCC would therefore not need to obtain approval from the Campbell County Board of Commissioners to close or move the Hilight Road in order to recover the coal underlying the 100-foot buffer zone along the east side of the Hilight Road ROW.

If a lease is issued for this alternative tract configuration, a stipulation will be attached to the lease stating that no mining activity may be conducted in the portions of the lease within 100 feet of either the BNSF & UP rail line or Hilight Road ROWs. The stipulation would allow recovery of the coal under Hilight Road if approval is obtained from the appropriate authority to move or close the road.

TBCC estimates that the South Hilight Field LBA Tract as applied for includes approximately 273.3 million tons of in-place coal, that approximately 232.2 million tons of those in-place coal reserves are mineable, and that about 213.6 million tons of coal would be recoverable. TBCC's estimate that approximately 78 percent of the estimated in-place reserves would be recoverable from the tract is based on assumptions about the currently unrecoverable reserves that lie within the railroad ROW and its associated buffer zone.

The South Hilight Field LBA Tract would be mined as an integral part of the Black Thunder Mine under the Proposed Action. Since the South Hilight Field LBA Tract would be an extension of the existing Black Thunder Mine, the facilities and infrastructure would be the same as those identified in the WDEQ/LQD Mine Permit 233 Term T7, approved November 1, 2005 and the BLM R2P2, which was approved December 12. 2006.

Black Thunder Mine's currently approved air quality permits from the WDEQ/AQD allow up to 135 million tons of coal per year to be mined. The Black Thunder Mine produced:

- 62.6 million tons of coal in 2003,
- 66.8 million tons of coal in 2004,
- 62.7 million tons of coal in 2005,
- 67.3 million tons of coal in 2006,
- 65.3 million tons of coal in 2007, and
- 67.4 million tons of coal in 2008

(Wyoming Department of Employment 2003, Shamley 2008a and 2010).

As of December 31, 2008, a total of approximately 1,087.9 million tons of coal had been mined from within the current permitted area of the mine.

TBCC estimates an average annual coal production rate of 100 mmtpy after 2008 for the Black Thunder Mine, increasing to an average of 135 mmtpy by 2015. If ALC acquires the South Hilight Field LBA Tract as applied for, a total of approximately 1,383.0 million tons of coal would be recovered from the existing leases and the South Hilight Field LBA Tract after January 1, 2009, with an estimated 213.6 million tons coming from the LBA tract, as discussed above. With the South Hilight Field LBA Tract, coal production at the Black Thunder Mine would continue for approximately 10.9 years beyond 2008. The LBA tract accounts for approximately 1.6 years of the mine life extension.

BLM independently evaluates the volume and average quality of the coal resources included in proposed LBA tracts as part of the fair market value determination process. BLM's estimate of the mineable federal coal reserves and average quality of the coal included in the tract may not be in agreement with the mineable coal reserve and coal quality estimates provided by the applicant. BLM's estimate of the mineable federal coal reserves and average quality of the coal included in the tract will be published in the sale notice if the tract is offered for sale.

Prior to disturbance and in advance of mining, mine support structures such as roads, power lines, substations, and flood and sediment control measures would be built as needed, and any public utility lines and oil and gas pipelines would be relocated as necessary.

A brief description of TBCC's mining operation at the Black Thunder Mine, emphasizing the methods and equipment that are used to remove, handle, and reclaim overburden and soil, is included in Section 2.1.1. The methods and equipment used to mine the coal, and the facilities used to process and store coal are also described in Section 2.1.1. Coal would be produced from two mineable seams within the South Hilight Field LBA Tract. TBCC refers to these seams as the Upper Wyodak (upper/rider seam) and the Middle Wyodak (lower/main seam), which are separated by a shale parting that has an average thickness of approximately 94 feet. The Upper Wyodak seam averages 5 feet thick and the Middle Wyodak seam averages 76 feet thick. The mining and reclamation methods, coal processing and storage facilities, and associated air quality protection measures would allow the Black Thunder Mine to produce at the currently permitted level. While sufficient capacity exists, future changes in facilities may be constructed to improve operating efficiency and air quality protection.

Full-time employment at the Black Thunder Mine is currently 1,080. If the mine increases production as estimated, employment would grow to 1,324 by 2013. If ALC acquires the South Hilight Field LBA Tract under the Proposed Action, they anticipate that the full-time employment level at the mine would remain at 1,324 for the additional 1.6 years that it would take to mine the coal included in the tract.

As discussed in Chapter 1, the South Hilight Field LBA Tract is adjacent to existing leases at the Black Thunder Mine, but is not adjacent to any of the other existing mines in this area (Figure 1-1). If a company other than ALC was to acquire the tract, the rate of coal production, mining sequence, equipment, and facilities would be different than if ALC acquired the tract as a maintenance lease, as described above. However, the area of disturbance and the impacts of removing the coal would not be substantially different from the area of disturbance and the impacts of ALC mining the tract.

2.2.2 South Hilight Field LBA Tract Alternative 1

Under the South Hilight Field LBA Tract Alternative 1, the No Action Alternative, ALC's application to lease the coal included in the South Hilight Field LBA Tract would be rejected. The tract would not be offered for competitive sale at this time, and the coal included in the tract would not be mined.

Rejection of the application would not affect permitted mining activities nor employment on the existing leases at the Black Thunder Mine. The Black Thunder Mine currently leases approximately 19,581.3 acres of federal coal, 41.9 acres of private coal, and 2,792.9 acres of state coal, all of which are within the existing Black Thunder Mine permit boundary. A total of approximately 26,490.2 acres will eventually be affected in mining the current leases. If the South Hilight Field LBA Tract is not leased, TBCC estimates that the average annual production at the Black Thunder Mine would be 100 mmtpy after 2008, increasing to an average of 135 mmtpy by 2015, and the average full-time employment level is expected to increase to 1,324 persons by 2013. Mining would continue at the Black Thunder Mine for approximately 9.3 years. Portions of the surface of the LBA tract would probably be disturbed by the Black Thunder Mine due to overstripping to allow coal to be removed from existing contiguous leases.

In order to compare the economic and environmental consequences of mining these lands versus not mining them, this EIS was prepared under the assumption that the South Hilight Field LBA Tract would not be mined in the foreseeable future if the No Action Alternative is selected. However, selection of the No Action Alternative would not preclude leasing and mining of this tract in the future. If the decision is made to reject the South Hilight Field lease application at this time, the tract could be leased as a maintenance lease in the future while the adjacent mine is in operation. If it is not leased while the existing adjacent mine is in operation, it may or may not be leased in the future. This tract does not include enough coal reserves to economically justify mining by a new operation; however, the coal reserves included in the tract could potentially be combined with unleased federal coal to the south and/or west to create a larger tract, which could be mined by a new operation in the future.

2.2.3 South Hilight Field LBA Tract Alternative 2--Preferred Alternative

Under Alternative 2 for the South Hilight Field LBA Tract, BLM would reconfigure the tract, hold one competitive coal sale for the lands included in the reconfigured tract, and issue a lease to the successful bidder. The modified tract would be subject to standard and special lease stipulations developed for the PRB and for this tract, if it is offered for sale (Appendix D). Alternative 2, holding a competitive coal sale for a modified tract, is BLM's preferred alternative.

Alternative 2 for the South Hilight Field LBA Tract assumes that ALC would be the successful bidder on the tract if a lease sale is held and that the federal coal would be mined as a maintenance lease for the existing Black Thunder Mine. Assumptions concerning mining methods, facilities, hazardous materials, mitigation and monitoring requirements, etc. are the same as described for the Proposed Action.

As applied for, the South Hilight Field LBA Tract consists of a single block of federal coal. In order to evaluate the potential that an alternate configuration of the tract would provide for more efficient recovery of the federal coal, increase competitive interest in the South Hilight Field LBA Tract, and/or reduce the potential that some of the remaining unleased federal coal in this area would be bypassed in the future, BLM identified a study area. The BLM study area includes the tract as applied for and unleased federal coal adjacent to the southern edge of the tract as applied for (Figure 2-2). Under Alternative 2, BLM could add all or part of the adjacent lands to the tract, or BLM could reduce the size of the tract, as discussed in Section 2.0.

Under Alternative 2, the area BLM is evaluating adding to the tract as applied for includes the following lands:

T.42N., R.71W., 6th PM, Campbell County, Wyoming		
Section 1:	Lots 7 through 10 and 15 through 18;	316.43 acres
Section 2:	Lots 5 through 20;	629.26 acres
Total:		945.69 acres

The legal description of the Alternative 2 BLM reconfiguration (Figure 2-2) for the South Hilight Field LBA Tract is as follows:

T.42N., R.71W., 6th PM, Campbell County, Wyoming		
Section 1:	Lots 7 through 10 and 15 through 18;	316.43 acres
Section 2:	Lots 5 through 20;	629.26 acres
T.43N., R.71W., 6th PM, Campbell County, Wyoming		
Section 23:	Lots 1 through 16;	649.36 acres
Section 26:	Lots 1 through 16;	667.69 acres
Section 35:	Lots 1 through 16;	659.64 acres
Total:		2,922.38 acres

Land descriptions and acreage are based on the BLM Status of Public Domain Land and Mineral Titles approved Master Title Plats as of September 7, 2007 and Coal Plats as of September 7, 2007. The coal estate included in the tract described above is federally owned. Much of the surface (approximately 88 percent, or 2,572.6 acres) of the BLM study area includes lands on the TBNG, which is administered by the USFS. The ownership of the surface and oil and gas estates is discussed in Section 3.11.

TBCC estimates that the LBA tract reconfigured under Alternative 2 (the BLM study area) includes approximately 406.5 million tons of in-place coal reserves. As discussed in Sections 1.5 and 2.2.1, some of the coal included in the above-described alternative tract configuration has been determined unsuitable for mining due to the presence of the BNSF & UP rail line, which borders the entire western side of the BLM study area (Figure 2-2). TBCC estimates that approximately 58.7 million tons of coal would not be mineable because of the railroad ROW and associated 100-foot buffer zone.

As shown in Figure 2-2, Reno Road (Campbell County Road 83) borders the southern edge of the BLM study area for the South Hilight Field LBA Tract. The coal that is underlying this public road ROW and associated 100-foot buffer zone has been determined to be unsuitable for mining in accordance with SMCRA and as specified under Unsuitability Criterion 3 (43 CFR 3461). Some of the coal in the above-described alternative tract configuration is also within 100 feet of the Hilight Road ROW; however, the 100-foot buffer zone associate with the railroad ROW extends farther east and overlies more coal within the BLM study area than the 100-foot buffer zone associated with the Hilight Road ROW.

As discussed in Section 2.2.1, there is an exception to this prohibition in the regulations at SMCRA Section 522(e)(4) and 30 CFR 761.11(d)(2), which can be applied if the appropriate road authority (Campbell County Board of Commissioners) allows the road to be relocated or closed. If TBCC obtains approval from the Campbell County Board of Commissioners to move or close Reno Road, the exception to the prohibition on mining within the public road ROW and its associated buffer zone could be applied and the unsuitability determination could be reconsidered. In that case, TBCC would be able to recover the coal underlying the county road ROW and buffer zone. TBCC would not need to consider closing or moving the Hilight Road for the reason explained above. If TBCC does not obtain approval to move or close Reno Road, the coal underlying its ROW and associated buffer zone would remain unsuitable for mining and would not be recovered.

If a lease is issued for this alternative tract configuration, a stipulation will be attached to the lease stating that no mining activity may be conducted in the portions of the lease within 100 feet of either the BNSF & UP railroad ROW, Hilight Road ROW, or Reno Road ROW. The stipulation would allow recovery of the coal under Reno or Hilight Road if approval is obtained from the appropriate authority to move or close the respective road.

If the Reno Road is not moved or closed, TBCC estimates that the BLM study area under Alternative 2 (Figure 2-2) includes approximately 330.8 million tons of mineable coal reserves. Using TBCC's projected recovery factor of 92 percent of the mineable coal reserves, about 304.3 million tons of the mineable coal would be recoverable. TBCC estimates that approximately 75.7 million tons of coal would not be mineable because of the railroad and public road ROWs and associated buffer zones. Although these lands would not be mined, they are included in the alternative tract configuration to allow maximum recovery of all the mineable coal that is adjacent to but outside of the ROWs and associated buffer zones and to comply with the coal leasing regulations that do not allow leasing of less than 10-acre aliquot parts. If a lease is issued for this tract, a stipulation will be attached to the lease stating that no mining activity may be conducted in the portions of the leased tract within the Reno Road ROW and associated buffer zone unless approval is obtained from the appropriate public road authority to relocate or close the road. If the Reno Road is moved or closed, TBCC estimates that an added 17.0 million tons of coal would be mineable in the BLM study area tract.

TBCC estimates an average annual coal production rate of 100 mmtpy after 2008 for the Black Thunder Mine, increasing to an average of 135 mmtpy by 2015. With the BLM study area tract, coal production at the Black Thunder Mine would continue for approximately 11.6 years beyond 2008. The study area tract accounts for approximately 2.3 years of the mine life extension.

BLM independently evaluates the volume and average quality of the coal resources included in proposed LBA tracts as part of the fair market value determination process. BLM's estimate may not be in agreement with the mineable coal reserve and coal quality estimates provided by the applicant. Under the Preferred Alternative (Alternative 2), BLM's estimate will be published in the sale notice for the tract, if it is offered for sale.

2.3 West Hilight Field LBA Tract

2.3.1 West Hilight Field LBA Tract Proposed Action

Under the Proposed Action for the West Hilight Field LBA Tract, the tract as applied for by ALC would be offered for lease at a sealed-bid, competitive lease sale, subject to standard and special lease stipulations developed for the PRB (Appendix D). The boundaries of the tract would be consistent with the tract configuration proposed in the West Hilight Field lease application (Figure 2-3). The Proposed Action assumes that ALC would be the successful bidder on the West Hilight Field LBA Tract, if it is offered for sale.

The legal description of the proposed West Hilight Field LBA Tract coal lease lands as applied for by ALC under the Proposed Action is as follows:

T.43N., R.71W., 6th PM, Campbell County, Wyoming

Section 8:	Lots 1, 2, and 7 through 16;	493.00 acres
Section 9:	Lots 1 through 16;	655.31 acres
Section 10:	Lots 3 through 6, and 11 through 14;	327.85 acres
Section 17:	Lots 1 through 16;	650.17 acres
Section 20:	Lots 1 through 4;	162.54 acres
Section 21:	Lots 3 and 4	81.65 acres
Total:		2,370.52 acres

Land descriptions and acreage are based on the BLM Status of Public Domain Land and Mineral Titles approved Master Title Plat as of September 7, 2007 and Coal Plat as of September 7, 2007. The coal estate included in the tract described above is federally owned. A portion of the surface of the tract as applied for (approximately 29 percent, or 695.9 acres) includes lands on the TBNG, which is administered by the USFS. The ownership of the surface and oil and gas estates is discussed in Section 3.11.

As discussed in Section1.5, Wyoming State Highway 450 borders the northern edge of the West Hilight LBA Tract (Figure 2-3). The Surface Mining Control and Reclamation Act of 1977 (SMCRA) prohibits mining within 100 feet on either side of the ROW 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)). For State Highway 450 west of the BNSF & UP railroad ROW, an unsuitability decision (43 CFR 3461) is deferred subject to a finding by the Wyoming Department of Transportation (WYDOT) under this process (BLM 2001a). As a result, some of the coal in the above described lands is not currently considered to be recoverable. Although the federal coal underlying these lands may not be mined, it is included in the tract to allow maximum recovery of the mineable coal adjacent to but outside of the highway ROW and its associated buffer zone and to comply with the coal leasing regulations that do not allow leasing of less than 10-acre aliquot parts.

If a lease is issued for this tract configuration, a stipulation will be attached to the lease stating that no mining activity may be conducted in the portions of the lease within 100 feet of the State Highway 450 ROW. The stipulation would allow recovery of the coal under State Highway 450 if approval is obtained from the appropriate authority to move the road.

As applied for, the West Hilight Field LBA Tract includes an estimated 440.4 million tons of in-place coal reserves. TBCC estimates that 29.6 million tons of the in-place coal would not be mineable because of the Highway 450 ROW and associated buffer zone. Of the 410.8 million tons of mineable reserves, using TBCC's projected recovery factor of 92 percent of the mineable coal reserves, approximately 377.9 million tons would be recoverable from the West Hilight LBA Tract as applied for.

The West Hilight Field LBA Tract would be mined as an integral part of the Black Thunder Mine under the Proposed Action. Since the West Hilight Field LBA Tract would be an extension of the existing Black Thunder Mine, the facilities and infrastructure would be the same as those identified in the WDEQ/LQD Mine Permit 233 Term T7, approved November 1, 2005 and the BLM R2P2, which was approved December 12, 2006.

Black Thunder Mine's currently approved air quality permits from the WDEQ/AQD allow up to 135 million tons of coal per year to be mined. The Black Thunder Mine produced:

- 62.6 million tons of coal in 2003,
- 66.8 million tons of coal in 2004,
- 62.7 million tons of coal in 2005,
- 67.3 million tons of coal in 2006,
- 65.3 million tons of coal in 2007, and
- 67.4 million tons of coal in 2008

(Wyoming Department of Employment 2003, Shamley 2008a and 2010).

As of December 31, 2008, a total of approximately 1,087.9 million tons of coal had been mined from within the current permitted area of the mine.

TBCC estimates an average annual coal production rate of 100 mmtpy after 2008 for the Black Thunder Mine, increasing to an average of 135 mmtpy by 2015. If ALC acquires the West Hilight Field LBA Tract as applied for, a total of approximately 1,547.3 million tons of coal would be recovered from the existing leases and the West Hilight Field LBA Tract after January 1, 2009, with an estimated 377.9 million tons coming from the LBA tract, as discussed above. About 14 percent of the in-place coal within the West Hilight Field LBA Tract would be lost under normal mining practices and would not be recovered due to the presence of the Highway 450 ROW and associated buffer zone. With the West Hilight Field LBA Tract, coal production at the Black Thunder Mine would continue for approximately 12.1 years beyond 2008. The LBA tract accounts for approximately 2.8 years of the mine life extension. If State Highway 450 is moved, TBCC estimates that an added 29.6 million tons of coal would be mineable in the West Hilight Field LBA Tract as applied for.

BLM independently evaluates the volume and average quality of the coal resources included in proposed LBA tracts as part of the fair market value determination process. BLM's estimate of the mineable federal coal reserves and average quality of the coal included in the tract may not be in agreement with the mineable coal reserves and coal quality estimates provided by the applicant. BLM's estimate of the mineable federal coal reserves and average quality of the coal included in the tract will be published in the sale notice if the tract is offered for sale.

Prior to disturbance and in advance of mining, mine support structures such as roads, power lines, substations, and flood and sediment control measures would be built as needed, and any public utility lines and oil and gas pipelines would be relocated as necessary.

A brief description of TBCC's mining operation at the Black Thunder Mine, emphasizing the methods and equipment that are used to remove, handle, and reclaim overburden and soil, is included in Section 2.1.1. The methods and equipment used to mine the coal, and the facilities used to process and store coal are also described in Section 2.1.1. Coal would be produced from two mineable seams within the West Hilight Field LBA Tract. TBCC refers to these seams as the Upper Wyodak (upper/rider seam) and the Middle Wyodak (lower/main seam), which are separated by a shale parting that has an average thickness of approximately 32 feet. The Upper Wyodak seam averages 6 feet thick and the Middle Wyodak seam averages 87 feet thick. The mining and reclamation methods, coal processing and storage facilities, and associated air quality protection measures would allow the Black Thunder Mine to produce at the currently permitted level. While sufficient capacity exists, future changes in facilities may be constructed to improve operating efficiency and air quality protection.

Full-time employment at the Black Thunder Mine is currently 1,080. If the mine increases production as estimated, employment would grow to 1,324 by 2013. If ALC acquires the West Hilight Field LBA Tract under the Proposed Action, they anticipate that the mine's full-time employment level would remain at 1,324 for the additional 2.8 years that it would take to mine the coal included in the tract.

As discussed in Chapter 1, the West Hilight Field LBA Tract is not adjacent to any existing leases at the Black Thunder Mine, although a portion of the tract lies within the mine's current mining permit boundary (Figure 2-3). The West Hilight Field LBA Tract is not adjacent to any of the other existing leases or mines in this area (Figure 1-1). If a company other than ALC was to acquire the tract, the rate of coal production, mining sequence, equipment, and facilities would be different than if ALC acquired the tract as a maintenance lease, as described above. However, the area of disturbance and the impacts of removing the coal would not be substantially different from the area of disturbance and the impacts of ALC mining the tract.

2.3.2 West Hilight Field LBA Tract Alternative 1

Under the West Hilight Field LBA Tract Alternative 1, the No Action Alternative, ALC's application to lease the coal included in the West Hilight Field LBA Tract would be rejected. The tract would not be offered for competitive sale at this time, and the coal included in the tract would not be mined.

Rejection of the application would not affect permitted mining activities nor employment on the existing leases at the Black Thunder Mine. The Black Thunder Mine currently leases approximately 19,581.3 acres of federal coal, 41.9 acres of private coal, and 2,792.9 acres of state coal, all of which are within the existing Black Thunder Mine permit boundary. A total of approximately 26,490.2 acres will eventually be affected in mining the current leases. If the West Hilight Field LBA Tract is not leased, TBCC estimates that the average annual coal production at the Black Thunder Mine would be 100 mmtpy after 2008, increasing to an average of 135 mmtpy by 2015, and the average full-time employment level is expected to increase to 1,324 persons by 2013. Mining would continue at the Black Thunder Mine for approximately 9.3 years. The surface of the LBA tract as applied for does not lie within any mine's current permit area and would therefore not likely be disturbed by mining activities.

In order to compare the economic and environmental consequences of mining these lands versus not mining them, this EIS was prepared under the assumption that the West Hilight Field LBA Tract would not be mined in the foreseeable future if the No Action Alternative is selected. However, selection of the No Action Alternative would not preclude leasing and mining of this tract in the future. If the decision is made to reject the West Hilight Field lease application at this time, the tract could be leased as a maintenance lease in the future while the adjacent mine is in operation. If it is not leased while the existing adjacent mine is in operation, it may or may not be leased in the future. This tract does not include enough coal reserves to economically justify mining by a new operation; however, the coal reserves included in the tract could potentially be combined with unleased federal coal that surrounds it to create a larger tract, which could be mined by a new operation in the future.

2.3.3 West Hilight Field LBA Tract Alternative 2--Preferred Alternative

Under Alternative 2 for the West Hilight Field LBA Tract, BLM would reconfigure the tract, hold one competitive coal sale for the lands included in the reconfigured tract, and issue a lease to the successful bidder. The modified tract would be subject to standard and special lease stipulations developed for the PRB and for this tract, if it is offered for sale (Appendix D). Alternative 2, holding a competitive coal sale for a modified tract, is BLM's preferred alternative.

Alternative 2 for the West Hilight Field LBA Tract assumes that ALC would be the successful bidder on the tract if a lease sale is held and that the federal coal would be mined as a maintenance lease for the existing Black Thunder Mine. Assumptions concerning mining methods, facilities, hazardous materials, mitigation and monitoring requirements, etc. are the same as described for the Proposed Action.

As applied for, the West Hilight Field LBA Tract consists of a single block of federal coal. In order to evaluate the potential that an alternate configuration of the tract would provide for more efficient recovery of the federal coal, increase competitive interest in the West Hilight Field LBA Tract, and/or reduce the potential that some of the remaining unleased federal coal in this area would be bypassed in the future, BLM identified a study area. The BLM study area includes the tract as applied for and unleased federal coal adjacent to the eastern, southern, northeastern, and northwestern edges of the tract as applied for (Figure 2-3). Under Alternative 2, BLM could add all or part of the adjacent lands to the tract, or BLM could reduce the size of the tract, as discussed in Section 2.0.

Under Alternative 2, the area BLM is evaluating adding to the tract as applied for includes the following lands:

T.43N., R.71W., 6th PM, Campbell County, Wyoming

Section 8:	Lots 3 through 6;	164.33 acres
Section 10:	Lots 1, 2, 7 through 10, 15, and 16;	326.18 acres
Section 15:	Lots 1 through 16;	659.26 acres
Section 20:	Lots 5 through 16;	488.50 acres
Section 21:	Lots 1, 2, and 5 through 16;	569.73 acres
Section 22:	Lots 1 through 16;	657.89 acres

Section 27:	Lots 1 through 16;	656.87 acres
Section 28:	Lots 1 through 16;	648.02 acres
Section 34:	Lots 1 through 16;	649.98 acres
Total:		4,820.76 acres

The legal description of the Alternative 2 BLM reconfiguration (Figure 2-3) for the West Hilight Field LBA Tract is as follows:

T.43N., R.71W., 6th PM, Campbell County, Wyoming

Section 8:	Lots 1 through 16;	654.33 acres
Section 9:	Lots 1 through 16;	655.31 acres
Section 10:	Lots 1 through 16;	654.03 acres
Section 15:	Lots 1 through 16;	659.26 acres
Section 17:	Lots 1 through 16;	650.17 acres
Section 20:	Lots 1 through 16;	651.04 acres
Section 21:	Lots 1 through 16;	651.38 acres
Section 22:	Lots 1 through 16;	657.89 acres
Section 27:	Lots 1 through 16;	656.87 acres
Section 28:	Lots 1 through 16;	648.02 acres
Section 34:	Lots 1 through 16;	649.98 acres
Total:		7,191.28 acres

Land descriptions and acreage are based on the BLM Status of Public Domain Land and Mineral Titles approved Master Title Plat as of September 7, 2007 and Coal Plat as of September 7, 2007. The coal estate included in the tract described above is federally owned. Approximately 40 percent (or about 2,900 acres) of the West Hilight Field LBA Tract under Alternative 2 includes lands on the TBNG, which is administered by the USFS. The ownership of the surface and oil and gas estates is discussed in Section 3.11.

TBCC estimates that the West Hilight Field LBA Tract reconfigured under Alternative 2 (the BLM study area) includes approximately 1,147.9 million tons of in-place coal reserves. As discussed in Section 2.3.1 and shown in Figure 2-3, a portion of Wyoming State Highway 450 borders the entire northern edge of the above-described alternate tract configuration. Therefore, some of the coal included in the West Hilight Field LBA Tract under this alternative is overlain by Highway 450 and SMCRA prohibits surface mining operations on lands within 100 feet of the outside line of the ROW for a public road (SMCRA Section 522(e)(4) and 30 CFR 761.11(d)). If TBCC obtains approval from the WYDOT to move State Highway 450, the exception to the prohibition on mining within the road ROW and buffer zone could be applied and the unsuitability determination could be reconsidered. In that case, TBCC would be able to recover the coal underlying Wyoming State Highway 450, its ROW, and associated buffer zone.

As discussed in Section 1.5, some of the coal included in the above-described alternative tract configuration has been determined unsuitable for mining due to the presence of the BNSF & UP rail line, which borders the entire eastern side of the BLM study area (Figure 2-3).

As shown in Figure 2-3, a portion of Hilight Road (Campbell County Road 52) lies west of and adjacent to the BNSF & UP rail line ROW, and also borders the entire eastern edge of the above described BLM study area. Therefore, some of the coal included in the West Hilight Field LBA Tract under this alternative is overlain by the Hilight Road and SMCRA prohibits surface mining operations on lands within 100 feet of the outside line of the ROW for a public road. The coal underlying this county road, its ROW, and associated 100-foot buffer zone has been determined to be unsuitable for mining in accordance with SMCRA and as specified under Unsuitability Criterion 3. There is an exception to this prohibition in the regulations at 30 CFR 761.11(d)(2), which can be applied if the appropriate road authority (Campbell County Board of Commissioners) allows the road to be relocated or closed. If TBCC obtains approval from the Campbell County Board of Commissioners to move this county road, the exception to the prohibition on mining within the road ROW and buffer zone could be applied and the unsuitability determination could be reconsidered. In that case, TBCC would be able to recover the coal underlying Hilight Road, its ROW, and associated buffer zone. If TBCC does not obtain approval to move or close the county road, the coal underlying the road, its ROW, and associated buffer zone would remain unsuitable for mining and would not be recovered.

If Wyoming State Highway 450 and the Hilight Road are not moved or closed, TBCC estimates that the West Hilight Field LBA Tract under Alternative 2 (Figure 2-3) includes approximately 1,049.1 million tons of mineable coal reserves. Using TBCC's projected recovery factor of 92 percent of the mineable coal reserves, about 965.2 million tons of the mineable coal would be recoverable. TBCC estimates that approximately 98.8 million tons of coal would not be mineable because of the public road ROWs and associated buffer zones. Although these lands would not be mined, they are included in the alternative tract configuration to allow maximum recovery of all the mineable coal that is adjacent to but outside of the ROWs and associated buffer zones and to comply with the coal leasing regulations that do not allow leasing of less than 10-acre aliquot parts. If a lease is issued for this tract, a stipulation will be attached to the lease stating that no mining activity may be conducted in the portions of the leased tract within the Wyoming State Highway 450 and Hilight Road ROWs and associated buffer zones unless approval is obtained from the appropriate public road authority to relocate or close the roads.

TBCC estimates an average annual coal production rate of 100 mmtpy after 2008 for the Black Thunder Mine, increasing to an average of 135 mmtpy by 2015. With the BLM study area tract, coal production at the Black Thunder Mine would continue for approximately 16.4 years beyond 2008. The study area tract accounts for approximately 7.1 years of the mine life extension.

If Hilight Road is moved or closed, TBCC estimates that an added 52.6 million tons of coal would be mineable in the BLM study area tract. If relocation of Wyoming State Highway 450 were approved, TBCC estimates that an additional 46.2 million tons of coal would be mineable in the BLM study area tract.

Full-time employment at the Black Thunder Mine is currently 1,080. If the mine increases production as estimated, employment would grow to 1,324 by 2013. If ALC acquires the BLM study area tract, they anticipate that the mine's full-time employment level would remain at 1,324 for the additional 7.1 years that it would take to mine the coal included in the tract.

BLM independently evaluates the volume and average quality of the coal resources included in proposed LBA tracts as part of the fair market value determination process. BLM's estimate may not be in agreement with the mineable coal reserve and coal quality estimates provided by the applicant. Under the Preferred Alternative (Alternative 2), BLM's estimate will be published in the sale notice for the tract, if it is offered for sale.

2.3.4 West Hilight Field LBA Tract Alternative 3

Under Alternative 3 for the West Hilight Field LBA Tract, BLM is considering adding some or all of the BLM study area, as discussed under Alternative 2 (Section 2.3.3), and some or all of TBCC's Northwest Rail Loop Amendment Area (Figure 2-3). Under Alternative 3, BLM would reconfigure the tract, hold one competitive coal sale for the lands included in the reconfigured tract, and issue a lease to the successful bidder. The modified tract would be subject to standard and special lease stipulations developed for the PRB and for this tract, if it is offered for sale (Appendix D).

Alternative 3 for the West Hilight Field LBA Tract assumes that ALC would be the successful bidder on the tract if a lease sale is held and that the federal coal would be mined as a maintenance lease for the existing Black Thunder Mine. Assumptions concerning mining methods, facilities, hazardous materials, mitigation and monitoring requirements, etc. are the same as described for the Proposed Action.

As applied for, the West Hilight Field LBA Tract consists of a single block of federal coal. As discussed under Alternative 2, BLM identified a study area in order to evaluate the potential that an alternate configuration of the tract would provide for more efficient recovery of the federal coal, increase competitive interest in the West Hilight Field LBA Tract, and/or reduce the potential that some of the remaining unleased federal coal in this area would be bypassed in the future. The BLM study area, shown in Figure 2-3, includes the tract as applied for and unleased federal coal adjacent to the eastern, southern, and northwestern edges of the tract as applied for, and additionally under Alternative 3, BLM is considering adding some or all of Black Thunder Mine's Northwest Rail Loop Amendment Area.

TBCC's Northwest Rail Loop Amendment Area, which lies north of Wyoming State Highway 450 and west of the Hilight Road, is entirely within Black Thunder Mine's current permit area (Figure 2-3). In 2008, Black Thunder Mine completed the construction of a new train loadout facility, including a railroad spur and two storage silos within their Northwest Rail Loop Amendment Area. This area is also entirely within the West Jacobs Ranch LBA Tract; therefore, BLM has not included it within the study area for the West Hilight Field LBA Tract. However, this alternative tract configuration will preserve the option of delineating some or all of TBCC's Northwest Rail Loop Amendment Area into the West Hilight Field, the West Jacobs Ranch, or both LBA tracts.

It may not be economically feasible to move the railroad spur, train loadout and silos to recover all the coal at this time. However, BLM is considering including this area in the tract because it may be possible to recover portions of the coal reserves in this area when the rest of the tract is mined, if it is leased at this time. It may also be economically feasible at some point in the future to move the train loadout facilities and recover the coal if it is leased.

Under Alternative 3, the lands within TBCC's Northwest Rail Loop Amendment Area that BLM is evaluating adding to the Alternative 2 reconfiguration of the West Hilight Field LBA Tract are as follows:

T.43N., R.71W., 6th PM, Campbell County, Wyoming		
Section 3:	Lots 2, 5, and 8 through 19;	557.99 acres

T.44N., R.71W., 6th PM, Campbell County, Wyoming		
Section 22:	Lots 9, 10, 15, and 16;	164.25 acres
Section 27:	Lots 1, 2, 7 through 10, 15, and 16;	327.88 acres
Section 34:	Lots 1, 2, 7 through 10, 15, and 16;	328.73 acres
Total:		1,378.85 acres

The legal description of the Alternative 3 reconfiguration of the West Hilight Field LBA Tract is as follows:

T.43N., R.71W., 6th PM, Campbell County, Wyoming		
Section 3:	Lots 2, 5, and 8 through 19;	557.99 acres
Section 8:	Lots 1 through 16;	654.33 acres
Section 9:	Lots 1 through 16;	655.31 acres
Section 10:	Lots 1 through 16;	654.03 acres
Section 15:	Lots 1 through 16;	659.26 acres
Section 17:	Lots 1 through 16;	650.17 acres
Section 20:	Lots 1 through 16;	651.04 acres
Section 21:	Lots 1 through 16;	651.38 acres
Section 22:	Lots 1 through 16;	657.89 acres
Section 27:	Lots 1 through 16;	656.87 acres
Section 28:	Lots 1 through 16;	648.02 acres
Section 34:	Lots 1 through 16;	649.98 acres

T.44N., R.71W., 6th PM, Campbell County, Wyoming

Section 22:	Lots 9, 10, 15, and 16;	164.25 acres
Section 27:	Lots 1, 2, 7 through 10, 15, and 16;	327.88 acres
Section 34:	Lots 1, 2, 7 through 10, 15, and 16;	328.73 acres
Total:		8,570.13 acres

Land descriptions and acreage are based on the BLM Status of Public Domain Land and Mineral Titles approved Master Title Plats as of August 30, 2005 and September 7, 2007 and Coal Plats as of September 7, 2007. The coal estate included in the tract described above is federally owned. Approximately 35 percent (roughly 2,900 acres) of the West Hilight Field LBA Tract under Alternative 3 includes lands on the TBNG, which is administered by the USFS. The ownership of the surface and oil and gas estates is discussed in Section 3.11.

TBCC estimates that the West Hilight Field LBA Tract under this alternative includes approximately 1,373.4 million tons of in-place coal reserves. As discussed in Sections 2.3.1 and 2.3.2, and shown in Figure 2-3, a portion of Wyoming State Highway 450 borders the northern edge and lies across a portion of the above-described alternate tract configuration. Therefore, some of the coal included in the West Hilight Field LBA Tract under this alternative is overlain by State Highway 450 and SMCRA prohibits surface mining operations on lands within 100 feet of the outside line of the ROW for a public road (SMCRA Section 522(e)(4) and 30 CFR 761.11(d)). If TBCC obtains approval from the WYDOT to relocate State Highway 450, the exception to the prohibition on mining within the road ROW and buffer zone could be applied and the unsuitability determination could be reconsidered. In that case, TBCC would be able to recover the coal underlying Wyoming State Highway 450, its ROW, and associated buffer zone.

As discussed in Section 1.5, some of the coal included in the above-described alternative tract configuration has been determined unsuitable for mining due to the presence of the BNSF & UP rail line, which borders the entire eastern side of the Alternative 3 reconfiguration of the West Hilight Field LBA Tract (Figure 2-3).

As shown in Figure 2-3, a portion of Hilight Road (Campbell County Road 52) lies west of and adjacent to the BNSF & UP rail line ROW, and also borders the entire eastern edge of the above described Alternative 3 tract reconfiguration. Therefore, some of the coal included in the West Hilight Field LBA Tract under this alternative is overlain by the Hilight Road and SMCRA prohibits surface mining operations on lands within 100 feet of the outside line of the ROW for a public road. The coal underlying this county road, its ROW, and associated 100-foot buffer zone has been determined to be unsuitable for mining in accordance with SMCRA and as specified under Unsuitability Criterion 3. There is an exception to this prohibition in the regulations at 30 CFR 761.11(d)(2), which can be applied if the appropriate road authority (Campbell

County Board of Commissioners) allows the road to be relocated or closed. If TBCC obtains approval from the Campbell County Board of Commissioners to move this county road, the exception to the prohibition on mining within the road ROW and buffer zone could be applied and the unsuitability determination could be reconsidered. In that case, TBCC would be able to recover the coal underlying Hilight Road, its ROW, and associated buffer zone. If TBCC does not obtain approval to move or close the county road, the coal underlying the road, its ROW, and associated buffer zone would remain unsuitable for mining and would not be recovered.

If a lease is issued for this tract, a stipulation will be attached to the lease stating that no mining activity may be conducted in the portions of the leased tract within the Wyoming State Highway 450 and Hilight Road ROWs and associated buffer zones unless approval is obtained from the appropriate public road authority to relocate or close the roads.

If Wyoming State Highway 450 and the Hilight Road are not moved or closed, TBCC estimates that the West Hilight Field LBA Tract under Alternative 3 (Figure 2-3) includes approximately 1,049.1 million tons of mineable coal reserves. Using TBCC's projected recovery factor of 92 percent of the mineable coal reserves, about 965.2 million tons of the mineable coal would be recoverable. TBCC estimates that approximately 324.3 million tons of coal would not be mineable because of the presence of the mine's new railroad spur, train loadout and two storage silos, plus the public road ROWs and associated buffer zones. Although these lands would not be mined, they are included in the alternative tract configuration to allow maximum recovery of all the mineable coal that is adjacent to but outside of the Northwest Rail Loop facilities, road ROWs and associated buffer zones, and to comply with the coal leasing regulations that do not allow leasing of less than 10-acre aliquot parts. If a lease is issued for this tract, a stipulation will be attached to the lease stating that no mining activity may be conducted in the portions of the leased tract within the Wyoming State Highway 450 and Hilight Road ROWs and associated buffer zones unless approval is obtained from the appropriate public road authority to relocate or close the roads.

TBCC estimates an average annual coal production rate of 100 mmtpy after 2008 for the Black Thunder Mine, increasing to an average of 135 mmtpy by 2015. With the West Hilight Field LBA Tract under Alternative 3, coal production at the Black Thunder Mine would continue for approximately 16.4 years beyond 2008. The Alternative 3 Tract configuration accounts for approximately 7.1 years of the mine life extension.

If Hilight Road is moved or closed, and if relocation of Wyoming State Highway 450 were approved, TBCC estimates that an added 98.8 million tons of coal would be mineable in the Alternative 3 tract. TBCC estimates that about 207.5 million tons could be recovered assuming coal under the Northwest Rail Loop Amendment Area were mineable at some time in the future.

Full-time employment at the Black Thunder Mine is currently 1,080. If the mine increases production as estimated, employment would grow to 1,324 by 2013. If ALC acquires the West Hilight Field LBA as configured under Alternative 3, they anticipate that the mine's full-time employment level would remain at 1,324 for the additional 7.1 years that it would take to mine the coal included in the tract.

BLM independently evaluates the volume and average quality of the coal resources included in proposed LBA tracts as part of the fair market value determination process. BLM's estimate may not be in agreement with the mineable coal reserve and coal quality estimates provided by the applicant. Under Alternative 3, BLM's estimate will be published in the sale notice for the tract, if it is offered for sale.

2.4 West Jacobs Ranch LBA Tract

2.4.1 West Jacobs Ranch LBA Tract Proposed Action

Under the Proposed Action for the West Jacobs Ranch LBA Tract, the tract as applied for by ALC would be offered for lease at a sealed-bid, competitive lease sale, subject to standard and special lease stipulations developed for the PRB (Appendix D). The boundaries of the tract would be consistent with the tract configuration proposed in the West Jacobs Ranch lease application (Figure 2-4). The Proposed Action assumes that ALC would be the successful bidder on the West Jacobs Ranch LBA Tract, if it is offered for sale.

The legal description of the proposed West Jacobs Ranch LBA Tract coal lease lands as applied for by ALC under the Proposed Action is as follows:

T.43N., R.71W., 6th PM, Campbell County, Wyoming		
Section 3:	Lots 2 and 5 through 19;	638.38 acres
Section 4:	Lots 5 through 20;	639.50 acres
Section 5:	Lots 5 through 20;	636.67 acres
T.44N., R.71W., 6th PM, Campbell County, Wyoming		
Section 22:	Lots 9 through 16;	326.99 acres
Section 27:	Lots 1 through 16;	658.21 acres
Section 28:	Lots 1 through 3 and 5 through 16;	608.43 acres
Section 29:	Lots 5 through 15 and SE¼SE¼;	478.10 acres
Section 32:	Lots 1 through 15 and SW¼SE¼;	643.83 acres
Section 33:	Lots 1 through 15 and NE¼SE¼ ;	653.02 acres
Section 34:	Lots 1 through 16;	661.24 acres
Total:		5,944.37 acres

Land descriptions and acreage are based on the BLM Status of Public Domain Land and Mineral Titles approved Master Title Plats as of August 30, 2005 and September 7, 2007 and Coal Plats as of September 7, 2007. The coal estate included in the tract described above is federally owned. The ownership of the surface and oil and gas estates is discussed in Section 3.11.

As discussed in Section 1.5, Wyoming State Highway 450 borders the entire southern edge of the West Jacobs Ranch LBA Tract (Figure 2-4). SMCRA prohibits mining within 100 feet on either side of the ROW 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)). For State Highway 450 west of the BNSF & UP railroad ROW, an unsuitability decision (43 CFR 3461) is deferred subject to a finding by WYDOT under this process (BLM 2001a). As a result, some of the coal in the above described lands is not currently considered to be recoverable.

TBCC's Northwest Rail Loop Amendment Area, which lies north of Wyoming State Highway 450 and west of the Hilight Road, is entirely within Black Thunder Mine's current permit area (Figure 2-3). Black Thunder Mine completed the construction of a new train loadout facility, including a railroad spur and two storage silos, within their Northwest Rail Loop Amendment Area in 2008. TBCC's new railroad spur, train loadout facility, and two storage silos are located entirely within the West Jacobs Ranch LBA Tract. It may not be economically feasible to move the railroad spur and the coal processing and storage facilities to recover all the coal at this time, but may be economically feasible at some point in the future, if the coal is leased.

As discussed in Section 1.5, some of the coal included in the above-described alternative tract configuration has been determined unsuitable for mining due to the presence of the BNSF & UP rail line ROW, which borders the entire eastern side of the LBA tract. As shown in Figure 2-4, a portion of Hilight Road (Campbell County Road 52) lies west of and adjacent to the BNSF & UP rail line ROW, and also borders the entire eastern edge of the above described lands. Therefore, some of the coal included in the West Jacobs Ranch LBA Tract as applied for is overlain by the Hilight Road and SMCRA prohibits surface mining operations on lands within 100 feet of the outside line of the ROW for a public road. The coal that is underlying this county road, its ROW, and associated 100-foot buffer zone has been determined to be unsuitable for mining in accordance with SMCRA and as specified under Unsuitability Criterion 3. There is an exception to this prohibition in the regulations at SMCRA Section 522(e)(4) and 30 CFR 761.11(d)(2), which can be applied if the appropriate road authority (Campbell County Board of Commissioners) allows the road to be relocated or closed. If ALC obtains approval from the Campbell County Board of Commissioners to move this county road, the exception to the prohibition on mining within the road ROW and buffer zone could be applied and the unsuitability determination could be reconsidered. In that case, ALC would be able to recover the coal underlying Hilight Road, its ROW, and associated buffer zone.

ALC estimates that the West Jacobs Ranch LBA Tract as applied for includes approximately 957.0 million tons of in-place coal reserves. If Wyoming State Highway 450 and the Hilight Road are not closed or relocated, ALC estimates that the West Jacobs Ranch LBA Tract as applied for (Figure 2-4) includes approximately 744.0 million tons of mineable coal reserves. Using ALC's projected recovery factor of 90 percent of the mineable coal reserves, about 669.6 million tons of the mineable coal would be recoverable. ALC estimates that approximately 213.0 million tons of coal would not be mineable because of the public road ROWs and associated buffer zones. Although these lands would not be mined, they are included in the as applied for tract configuration to allow maximum recovery of all the mineable coal that is adjacent to but outside of the public road ROWs and associated buffer zones, and to comply with the coal leasing regulations that do not allow leasing of less than 10-acre aliquot parts. If a lease is issued for this tract, a stipulation will be attached to the lease stating that no mining activity may be conducted in the portions of the leased tract within the State Highway 450 and Hilight Road ROWs and associated buffer zones unless approval is obtained from the appropriate public road authority to relocate or close the roads.

The West Jacobs Ranch LBA Tract would be mined as an integral part of the Jacobs Ranch Mine under the Proposed Action. Since the West Jacobs Ranch LBA Tract would be an extension of the existing Jacobs Ranch Mine, the facilities and infrastructure would be the same as those identified in the WDEQ/LQD Mine Permit 271 Term T5, approved November 23, 2004 and the BLM R2P2, which was approved October 19, 2005.

Jacobs Ranch Mine's currently approved air quality permit (Permit Number MD-1005A2) from the WDEQ/AQD allows up to 55 million tons of coal per year to be mined. The Jacobs Ranch Mine produced:

- 36.0 million tons of coal in 2003,
- 38.6 million tons of coal in 2004,
- 37.3 million tons of coal in 2005,
- 40.0 million tons of coal in 2006,
- 38.1 million tons of coal in 2007, and
- 42.1 million tons of coal in 2008

(Wyoming Department of Employment 2003, Shamley 2008a and 2010).

As of December 31, 2008, a total of approximately 671.1 million tons of coal had been mined from within the current permitted area of the mine.

ALC estimates an average annual coal production rate of 40 mmtpy for the Jacobs Ranch Mine for the years beyond 2008. If ALC acquires the West Jacobs Ranch LBA Tract as applied for, a total of approximately 1,049.0 million tons of coal would be recovered from the existing leases and the West Jacobs Ranch LBA Tract after January 1, 2009, with an estimated 669.6 million tons coming from the LBA tract, as discussed above. About 30 percent of the in-place coal within the West Jacobs Ranch LBA Tract would be lost under normal mining practices and would not be recovered due to the presence of the Highway 450 and Hilight Road ROWs and associated buffer zones. With the West Jacobs Ranch LBA Tract as applied for, coal production at the Jacobs Ranch Mine would continue for approximately 26.3 years beyond 2008. The LBA tract accounts for approximately 16.7 years of the mine life extension.

If the Hilight Road is moved or closed, and if relocation of Wyoming State Highway 450 were approved, ALC estimates that an added 213.0 million tons of coal would be mineable in the West Jacobs Ranch LBA Tract as applied for.

BLM independently evaluates the volume and average quality of the coal resources included in proposed LBA tracts as part of the fair market value determination process. BLM's estimate of the mineable federal coal reserves and average quality of the coal included in the tract may not be in agreement with the mineable coal reserve and coal quality estimates provided by the applicant. BLM's estimate of the mineable federal coal reserves and average quality of the coal included in the tract will be published in the sale notice if the tract is offered for sale.

Prior to disturbance and in advance of mining, mine support structures such as roads, power lines, substations, and flood and sediment control measures would be built as needed, and any public utility lines and oil and gas pipelines would be relocated as necessary.

The first step of the mining process is soil salvage with suitable heavy equipment, such as rubber-tired scrapers. During initial pit development, soil is placed in temporary stockpiles for later use in final pit closure and reclamation. Whenever possible, direct haulage of soil from salvage areas to a reclamation area would be done, but due to scheduling, some topsoil would be temporarily stockpiled. As required by the reclamation plan, heavy equipment again would be used to haul and redistribute the stockpiled topsoil on regraded areas.

The Jacobs Ranch Mine is one of several mines currently operating in the PRB where the coal seams are notably thick and the overburden is relatively thin. Mining has historically been conducted in two pits in order to facilitate blending of the coal to meet customers' coal quality requirements. Mining may be conducted in three separate pits; two located within the current permit area and one located within the proposed lease area. The locations of the specific pits may change as a result of further geologic and mining evaluations. After soil salvage operations are complete, blast holes are drilled down through the overburden to the top of the upper-most mineable coal seam. The drill holes are then loaded with explosives (ANFO) and detonated to fragment the overburden to facilitate efficient excavation. Overburden removal has been and would continue to be conducted primarily with a dragline and/or trucks and shovels. Cast blasting is employed to supplement dragline productivity. Other equipment used during overburden removal and backfilling includes dozers, scrapers, excavators, front-end loaders, graders, and water trucks. Exposed coal seams have been and would continue to be cleaned with a dozer, drilled and blasted to facilitate efficient excavation, and then loaded into haul trucks for transport to the coal crushing and storage facilities. Coal is also transported by overland conveyor to the final preparation plant and storage facilities.

The design of the Jacobs Ranch Mine seeks to confine disturbance to the active mine blocks. As overburden is removed, most would be directly placed into the previous empty pit where coal has been removed.

Chapter 4, Section 2(b)(i) of the WDEQ/LQD Coal Rules requires that rough backfilling and grading follow coal removal as closely as possible based on the mining conditions (WDEQ/LQD 2009). Replaced (backfilled) overburden is graded to approximate the original land surface contour, as required by WDEQ and OSM rules. Elevations consistent with the approved PMT plan are established as quickly as possible to reconstruct a stable landscape and restore drainage. Under certain conditions, the PMT may not be immediately achievable. This occurs when there is an excess of material that may require temporary stockpiling, when there is insufficient material available from current overburden removal operations, or when future mining could redisturb an area already mined. Backfilled and recontoured overburden is sampled and analyzed to verify suitability as subsoil. Should unsuitable backfill materials be encountered (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), mitigation by additional soil depth, excavation and burial, or other special handling to remove them from the root zone would occur. Prior to soil distribution, regraded backfill is scarified to relieve compaction. Soil is redistributed on recontoured backfill using rubber-tired scrapers. Once a seedbed has been formed the reclaimed areas are revegetation using native grasses, forbs, and shrubs that are consistent with the postmining land use. According to the most recent OSM evaluation of the Wyoming coal mining industry, the reclamation to disturbance ratio in 2008 was approximately 86 percent (4,703 acres reclaimed vs. 5,497 acres disturbed) (OSM 2009).

The Jacobs Ranch Mine mines up to three coal seams that the operator (TBCC) refers to as the Upper, Middle, and Lower Wyodak seams. Coal would be produced from one mineable seam within the West Jacobs Ranch LBA Tract. TBCC refers to this single coal seam as the Wyodak and it has an average thickness of about 102 feet in the LBA tract area. Coal would be mined at several working pit faces to enable blending of the coal to meet customer quality requirements, to comply with BLM lease requirements for maximum economic recovery of the coal resource, and to optimize coal removal efficiency with available equipment. Mining efficiency and air quality protection are and would continue to be facilitated by the use of a near-pit crusher and overland conveyor. Coal would be loaded with electric-powered shovels or hydraulic excavators into off-highway haul trucks for transport to the near-pit crusher or the coal preparation plant. Coal haul roads would be temporary structures built within the mine areas. All coal transfer location points and crushing operations are controlled by baghouse-type dust collectors, dry fog systems, or PECs. The truck dumping operations use stilling sheds to control fugitive dust and the overland conveyor system is entirely enclosed. There are two existing crushing facilities, the near-pit primary crusher and the coal preparation plant, and seven coal storage silos within the permit area that provide capacity to produce at the permitted level. While sufficient capacity exists, future changes in facilities may be constructed to improve operating efficiency and air quality protection. Future possibilities for processing and loadout of coal include overland conveying to existing facilities. Alternately, if ALC acquires the West Jacobs Ranch LBA Tract, TBCC's new coal processing and train loadout facilities that are located within Black Thunder Mine's Northwest Rail Loop Amendment Area (Figures 2-3 and 2-4) may be utilized once the Jacobs Ranch and Black Thunder Mine permits are consolidated.

Full-time employment at the Jacobs Ranch Mine is currently 630. If ALC acquires the West Jacobs Ranch LBA Tract under the Proposed Action, they anticipate that, at the expected average annual post-2008 coal production of 40 million tons, the average employment level would increase to from 630 to 785 for the additional 16.7 years that it would take to mine the coal included in the tract.

As discussed in Chapter 1, the West Jacobs Ranch LBA Tract is adjacent to existing leases at the Black Thunder Mine and a portion of the tract is within the mine's current permit area. The West Jacobs Ranch LBA Tract is not adjacent to any of the other existing leases or mines in this area (Figure 1-1). If a company other than ALC was to acquire the tract, the rate of coal production, mining sequence, equipment, and facilities would be different than if ALC acquired the tract as a maintenance lease, as described above. However, the area of disturbance and the impacts of removing the coal would not be substantially different from the area of disturbance and the impacts of TBCC mining the tract.

2.4.2 West Jacobs Ranch LBA Tract Alternative 1

Under the West Jacobs Ranch LBA Tract Alternative 1, the No Action Alternative, ALC's application to lease the coal included in the West Jacobs Ranch LBA Tract would be rejected. The tract would not be offered for competitive sale at this time, and the coal included in the tract would not be mined.

Rejection of the application would not affect permitted mining activities nor employment on the existing leases at the Jacobs Ranch Mine. The Jacobs Ranch Mine currently leases approximately 7,381.0 acres of federal coal, 720 acres of private coal, and 503.8 acres of state coal, all of which are within the existing Jacobs Ranch Mine permit boundary. A total of approximately 15,261.5 acres will eventually be affected in mining the current leases. If the West Jacobs Ranch LBA Tract is not leased, TBCC estimates that the annual production at the Jacobs Ranch Mine after 2008 would average 40 million tons, and the average full-time employment level is expected to be 630 persons. Mining would continue at the Jacobs Ranch Mine for approximately 9.6 years. No portion of the West Jacobs Ranch LBA Tract will be disturbed under the Jacobs Ranch and Black Thunder mines' existing mining plans in order to recover the coal in the existing contiguous coal leases. However, the construction of a new train loadout facility for the Black Thunder Mine within TBCC's permitted Northwest Rail Loop Amendment Area, which is located within the eastern portion of the LBA tract (Figures 2-3 and 2-4), was completed in 2008.

In order to compare the economic and environmental consequences of mining these lands versus not mining them, this EIS was prepared under the assumption that the West Jacobs Ranch LBA Tract would not be mined in the foreseeable future if the No Action Alternative is selected. However, selection of the No Action Alternative would not preclude leasing and mining of this tract in the future. If the decision is made to reject the West Jacobs Ranch lease application at this time, the tract could be leased as a maintenance lease in the future while the adjacent mine is in operation. If it is not leased while the existing adjacent mine is in operation, it may or may not be leased in the future. This tract includes enough coal reserves to economically justify mining by a new operation, and the coal reserves included in the tract could potentially be combined with unleased federal coal to the north, east and/or west to create a larger tract that could be mined by a new operation in the future.

2.4.3 West Jacobs Ranch LBA Tract Alternative 2--Preferred Alternative

Under Alternative 2 for the West Jacobs Ranch LBA Tract, BLM would reconfigure the tract, hold one competitive coal sale for the lands included in the reconfigured tract, and issue a lease to the successful bidder. The modified tract would be subject to standard and special lease stipulations developed for the PRB and for this tract, if it is offered for sale (Appendix D). Alternative 2, holding a competitive coal sale for a modified tract, is BLM's preferred alternative.

Alternative 2 for the West Jacobs Ranch LBA Tract assumes that ALC would be the successful bidder on the tract if a lease sale is held and that the federal coal would be mined as a maintenance lease for the existing Jacobs Ranch Mine. Assumptions concerning mining methods, facilities, hazardous materials, mitigation and monitoring requirements, etc. are the same as described for the Proposed Action.

As applied for, the West Jacobs Ranch LBA Tract consists of a single block of federal coal. In order to evaluate the potential that an alternate configuration of the tract would provide for more efficient recovery of the federal coal, increase competitive interest in the West Jacobs Ranch LBA Tract, and/or reduce the potential that some of the remaining unleased federal coal in this area would be bypassed in the future, BLM identified a study area. The BLM study area includes the tract as applied for and unleased federal coal adjacent to the northern and western edges of the tract as applied for (Figure 2-4). Under Alternative 2, BLM could add all or part of the adjacent lands to the tract, or BLM could reduce the size of the tract, as discussed in Section 2.0.

Under Alternative 2, the area BLM is evaluating adding to the tract as applied for includes the following lands:

<u>T.43N., R.71W., 6th PM, Campbell County, Wyoming</u>

Section 6:	Lots 8, 15, 16, and 23;	163.05 acres

<u>T.44N., R.71W., 6th PM, Campbell County, Wyoming</u>

Section 15:	Lots 9 through 16;	326.83 acres
Section 20:	Lots 9, 10, 14, and 15;	161.38 acres
Section 21:	Lots 1 through 16;	639.69 acres
Section 22:	Lots 1 through 8;	320.85 acres
Section 28:	Lot 4;	41.00 acres
Section 29:	Lots 1 through 4;	159.36 acres
Section 30:	Lots 5, 12, 13, and 20;	157.29 acres
Section 31:	Lots 5, 12, 13, and 20;	162.40 acres
Total:		<u>2,131.85 acres</u>

The legal description of the Alternative 2 BLM reconfiguration (Figure 2-4) for the West Jacobs Ranch LBA Tract is as follows:

<u>T.43N., R.71W., 6th PM, Campbell County, Wyoming</u>

Section 3:	Lots 2 and 5 through 19;	638.38 acres
Section 4:	Lots 5 through 20;	639.50 acres
Section 5:	Lots 5 through 20;	636.67 acres
Section 6:	Lots 8, 15, 16, and 23;	163.05 acres

<u>T.44N., R.71W., 6th PM, Campbell County, Wyoming</u>

Section 15:	Lots 9 through 16;	326.83 acres
Section 20:	Lots 9, 10, 14, and 15;	161.38 acres
Section 21:	Lots 1 through 16;	639.69 acres
Section 22:	Lots 1 through 16;	647.84 acres
Section 27:	Lots 1 through 16;	658.21 acres
Section 28:	Lots 1 through 16;	649.43 acres
Section 29:	Lots 1 through 15 and SE¼SE¼;	637.46 acres
Section 30:	Lots 5, 12, 13, and 20;	157.29 acres
Section 31:	Lots 5, 12, 13, and 20;	162.40 acres
Section 32:	Lots 1 through 15 and SW¼SE¼;	643.83 acres
Section 33:	Lots 1 through 15 and NE¼SE¼ ;	653.02 acres
Section 34:	Lots 1 through 16;	661.24 acres
Total:		<u>8,076.22 acres</u>

Land descriptions and acreage are based on the BLM Status of Public Domain Land and Mineral Titles approved Master Title Plats as of August 30, 2005 and September 7, 2007 and Coal Plats as of September 7, 2007. The coal estate included in the tract described above is federally owned. The ownership of the surface and oil and gas estates is discussed in Section 3.11.

ALC estimates that the LBA tract reconfigured under Alternative 2 (the BLM study area) includes approximately 1,269.0 million tons of in-place coal reserves. As discussed in Sections 1.1, 1.5, and 2.4.1 and shown in Figure 2-4, a portion of Wyoming State Highway 450 borders the entire southern edge of the above-described alternate tract configuration. Therefore, some of the coal included in the West Jacobs Ranch LBA Tract under this alternative is overlain by Highway 450 and SMCRA prohibits surface mining operations on lands within 100 feet of the outside line of the ROW for a public road (SMCRA Section 522(e)(4) and 30 CFR 761.11(d)). If ALC obtains approval from the WYDOT to move this state highway, the exception to the prohibition on mining within the road ROW and buffer zone could be applied and the unsuitability determination could be reconsidered. In that case, ALC would be able to recover the coal underlying Wyoming State Highway 450, its ROW and associated buffer zone. If ALC does not obtain approval to relocate the highway, the coal underlying the road, its ROW, and associated buffer zone would remain unsuitable for mining and would not be recovered.

TBCC's Northwest Rail Loop Amendment Area, which lies north of Wyoming State Highway 450 and west of the Hilight Road, is entirely within Black Thunder Mine's current permit area (Figures 2-3 and 2-4). Black Thunder Mine completed the construction of a new train loadout facility, including a railroad spur and two storage silos, within their Northwest Rail Loop Amendment Area in 2008. TBCC's new railroad spur, train loadout facility, and two storage silos are located entirely within the West Jacobs Ranch LBA Tract. It may not be economically feasible to move the railroad spur and the coal processing and storage facilities to recover all the coal at this time, but may be economically feasible at some point in the future, if the coal is leased.

As discussed in Section 1.5, some of the coal included in the above-described alternative tract configuration has been determined unsuitable for mining due to the presence of the BNSF & UP rail line, which borders the entire eastern side of the LBA study area (Figure 2-4).

As shown in Figure 2-4, a portion of Hilight Road (Campbell County Road 52) lies west of and adjacent to the BNSF & UP rail line ROW, and also borders the entire eastern edge of the above described lands. Therefore, some of the coal included in the West Jacobs Ranch LBA Tract under this alternative is overlain by the Hilight Road and SMCRA prohibits surface mining operations on lands within 100 feet of the outside line of the ROW for a public road. The coal underlying this county road, its ROW, and associated 100-foot buffer zone has been determined to be unsuitable for mining in accordance with SMCRA and as specified under Unsuitability Criterion 3. There is an exception to this prohibition in the regulations at 30 CFR 761.11(d)(2), which can be applied if the appropriate road authority (Campbell County Board of Commissioners) allows the road to be relocated or closed. If ALC obtains approval from the Campbell County Board of Commissioners to close or move this county road, the exception to the prohibition on mining within the road ROW and buffer zone could be applied and the unsuitability determination could be reconsidered. In that case, ALC would be able to recover the coal underlying Hilight Road, its ROW, and associated buffer zone. If ALC does not obtain approval to move or close the county road, the coal underlying the road, its ROW, and associated buffer zone would remain unsuitable for mining and would not be recovered.

If State Highway 450 and Hilight Road are not moved or closed, ALC estimates that the BLM study area tract (Figure 2-4) includes approximately 1,014.0 million tons of mineable coal reserves. Using ALC's projected recovery factor of 90 percent of the mineable coal reserves, about 912.6 million tons of the mineable coal would be recoverable. Although these lands would not be mined, they are included in the alternative tract configuration to allow maximum recovery of all the mineable coal that is adjacent to but outside of the public road ROWs and associated buffer zones and to comply with the coal leasing regulations that do not allow leasing of less than 10-acre aliquot parts. If a lease is issued for this tract, a stipulation will be attached to the lease stating that no mining activity may be conducted in the portions of the leased tract within the Wyoming State Highway 450 and Hilight Road ROWs and associated buffer zones unless approval is obtained from the appropriate public road authority to relocate or close the roads.

ALC estimates an average annual coal production rate of 40 mmtpy for the Jacobs Ranch Mine after 2008. With the West Jacobs Ranch LBA Tract reconfigured under Alternative 2, coal production at the Jacobs Ranch Mine would continue for approximately 32.4 years beyond 2008. The study area tract accounts for approximately 22.8 years of the mine life extension.

If the Hilight Road is moved or closed, and if relocation of Wyoming State Highway 450 were approved, ALC estimates that an added 255.0 million tons of coal would be mineable in the BLM study area tract.

BLM independently evaluates the volume and average quality of the coal resources included in proposed LBA tracts as part of the fair market value determination process. BLM's estimate may not be in agreement with the mineable coal reserve and coal quality estimates provided by the applicant. Under the Preferred Alternative (Alternative 2), BLM's estimate will be published in the sale notice for the tract, if it is offered for sale.

2.5 North Porcupine LBA Tract

2.5.1 North Porcupine LBA Tract Proposed Action

Under the Proposed Action for the North Porcupine LBA Tract, the tract as applied for by BTU Western Resources, Inc. (BTU) would be offered for lease at a sealed-bid, competitive lease sale, subject to standard and special lease stipulations developed for the PRB (Appendix D). The boundaries of the tract would be consistent with the tract configuration proposed in the North Porcupine lease application (Figure 2-5). The Proposed Action assumes that BTU would be the successful bidder on the North Porcupine LBA Tract, if it is offered for sale.

The legal description of the proposed North Porcupine LBA Tract coal lease lands as applied for by BTU under the Proposed Action is as follows:

T.42N., R.70W., 6th PM, Campbell County, Wyoming

Section 19:	Lots 13 through 20;	296.94 acres
Section 20:	Lots 9 through 16;	328.00 acres
Section 21:	Lots 9 through 16;	329.54 acres
Section 22:	Lots 9 through 16;	327.74 acres
Section 26:	Lots 3 through 6 and 9 through 16;	496.64 acres
Section 27:	Lots 1 through 16;	664.48 acres
Section 28:	Lots 1 through 4;	165.98 acres
Section 29	Lots 1 through 4;	164.30 acres
Section 30:	Lots 5 through 8;	147.79 acres

T.42N., R.71W., 6th PM, Campbell County, Wyoming

Section 22:	Lots 10 through 15 and 21 through 24;	323.49 acres
Section 23:	Lots 9 through 16;	324.94 acres
Section 24:	Lots 9 through 16;	325.82 acres
Section 25:	Lots 1 through 4;	162.96 acres
Section 26:	Lots 1 through 6 and 11 through 14;	404.09 acres
Section 27:	Lots 2 through 6, 9, 12, and 15 through 30;	649.42 acres
Section 34:	Lots 1 through 3 and 6 through 11;	360.46 acres
Section 35:	Lots 3 through 6 and 11 through 14;	323.19 acres
Total:		5,795.78 acres

Land descriptions and acreage are based on the BLM Status of Public Domain Land and Mineral Titles approved Master Title Plats as of September 7, 2007 and September 20, 2007 and Coal Plats as of September 7, 2007 and September 20, 2007. The coal estate included in the tract described above is federally owned. Much of the surface (approximately 72 percent, or 4,186 acres) of the tract as applied for includes lands on the TBNG, which is administered by the USFS. The ownership of the surface and oil and gas estates is discussed in Section 3.11.

As discussed in Section 1.5, and as shown in Figure 2-5, some of the coal included in the above-described lands in the North Porcupine LBA Tract has been determined to be unsuitable for mining in accordance with SMCRA and as specified under Unsuitability Criterion 2 (43 CFR 3461) due to the presence of the BNSF & UP railroad line, which crosses the western side of the LBA tract. The coal underlying the railroad ROW and an associated 100-foot buffer zone is also not considered by Powder River Coal (PRC), operator of the North Antelope Rochelle Mine, to be mineable at this time because the cost that would be associated with moving the railroad tracks would make it economically unfeasible to recover the underlying coal. Although the federal coal underlying the railroad ROW and associated buffer zone would not be mined, it is included in the tract to allow maximum recovery of all of the mineable coal that is adjacent to but outside of the railroad ROW and its associated buffer zone and to comply with the coal leasing regulations that do not allow leasing of less than 10-acre aliquot parts. PRC estimates that approximately 65.8 million tons of mineable coal included in the North Porcupine LBA Tract as applied for is located within a layback buffer zone that PRC has determined extends 1,000 feet on either side of the railroad centerline.

Some of the coal included in the above-described lands is not currently considered by PRC to be mineable due to the presence of the Teckla Electric Power Substation, which is located adjacent to the North Porcupine tract in the NE¼NE¼ of Section 3, T.41N., R.71W. Due to the requirement that no blasting operations be conducted within 500 feet of the substation, the coal underlying the southwestern diagonal half of Lot 13, Section 35, T.42N., R.71W., is not considered mineable at this time by PRC because the cost that would be associated with moving the substation would make it economically unfeasible to recover. PRC estimates that approximately 2.7 million tons of mineable coal included in the North Porcupine LBA Tract is located within the Teckla Substation layback buffer zone. Although the federal coal underlying the substation buffer zone would not be mined, it is included in the tract to allow maximum recovery of all of the mineable coal that is adjacent to but outside of the substation buffer zone and to comply with the coal leasing regulations that do not allow leasing of less than 10-acre aliquot parts.

As indicated in Section 1.5 and as shown in Figure 2-5, some of the coal included in the above-described lands in the North Porcupine LBA Tract is overlain by the Antelope Road (Campbell County Road 4), which crosses a portion of the LBA tract, the Matheson Road (Campbell County Road 70), which borders a portion of the LBA tract, and the Mackey Road (Campbell County Road 69), which borders and crosses a portion of the LBA tract. SMCRA prohibits surface mining operations on lands within 100 feet of the outside line of the ROW for a public road (SMCRA Section 522(e)(4) and 30 CFR 761.11(d)). The coal that is underlying these public road ROWs and associated 100-foot buffer zones has been determined to be unsuitable for mining in accordance with SMCRA and as specified under Unsuitability Criterion 3 (43 CFR 3461). There is an exception to this prohibition in the regulations at SMCRA Section 522(e)(4) and 30 CFR 761.11(d)(2), which can be applied if the appropriate road authority (Campbell County Board of Commissioners) allows the roads to be relocated or closed.

As discussed in Section 1.1, PRC has obtained approval from the Campbell County Board of Commissioners to close and relocate the portions of Antelope and Matheson roads that cross and border the North Porcupine LBA Tract as applied for. The exception to Unsuitability Criterion 3 is therefore applicable and the coal underlying those two county road ROWs and associated buffer zones would be recoverable if a lease is issued for the North Porcupine LBA Tract. If PRC obtains approval from the Campbell County Board of Commissioners to close and relocate the Mackey Road, which crosses and borders the North Porcupine tract, the exception to the prohibition on mining within that road's ROW and buffer zone could be applied and the unsuitability determination could be reconsidered. In that case, PRC would be able to recover the coal underlying the Mackey Road ROW and associated buffer zone. If PRC does not obtain approval to close and relocate the Mackey Road, the coal underlying its ROW and buffer zone would remain unsuitable for mining and would not be recovered. If the Mackey Road is moved or closed, PRC estimates that an added 34.9 million tons of coal would be mineable in the North Porcupine LBA Tract.

The federal coal underlying the Mackey Road, its ROW, and adjacent 100-foot buffer zone is included in the as applied for tract configuration because it would allow maximum recovery of all the mineable coal adjacent to but outside of the road ROW and associated buffer zone, and to comply with the coal leasing regulations that do not allow leasing of less than 10-acre aliquot parts if the road is not moved; it would also allow recovery of the coal under the road if it is closed or relocated. If a lease is issued for this tract, a stipulation will be attached to the lease stating that no mining activity may be conducted in the portions of the lease within 100 feet of either the BNSF & UP rail line ROW or Mackey Road ROW. The stipulation would allow recovery of the coal under Mackey Road if approval is obtained from the appropriate authority to move or close the road.

PRC estimates that the North Porcupine LBA Tract as applied for includes approximately 756.9 million tons of in-place coal reserves. If the Mackey Road is not closed or relocated, PRC estimates that the North Porcupine LBA Tract as applied for contains approximately 653.5 million tons of mineable coal reserves. Based on historical recovery practices, PRC assumes that about 92 percent of that coal, or approximately 601.2 million tons of coal, would be recovered from the North Porcupine LBA Tract as applied for. PRC estimates that approximately 103.4 million tons of coal (which is about 14 percent of the in-place coal within the North Porcupine LBA Tract as applied for) would not be mineable because of the public road ROW and the layback buffers for the substation and rail line.

The North Porcupine LBA Tract would be mined as an integral part of the North Antelope Rochelle Mine under the Proposed Action. Since the North Porcupine

LBA Tract would be an extension of the existing North Antelope Rochelle Mine, the facilities and infrastructure would be the same as those identified in the WDEQ/LQD Mine Permit 569 Term T7, approved July 28, 2009 and the BLM R2P2, which was approved February 28, 2007.

North Antelope Rochelle Mine's currently approved air quality permits (Permit Numbers MD-1172, MD-1309, MD-1331, and MD-6375) from the WDEQ/AQD allow up to 140 million tons of coal per year to be mined. The North Antelope Rochelle Mine produced:

- 80.1 million tons of coal in 2003,
- 82.5 million tons of coal in 2004,
- 82.7 million tons of coal in 2005,
- 88.5 million tons of coal in 2006,
- 91.5 million tons of coal in 2007, and
- 97.6 million tons of coal in 2008

(Wyoming Department of Employment 2003, Shamley 2008a and 2010).

As of December 31, 2008, a total of approximately 1,230.8 million tons of coal had been mined from within the current permitted area of the mine.

PRC estimates an average annual coal production rate of 95 mmtpy for the North Antelope Rochelle Mine for the years beyond 2008. If BTU acquires the North Porcupine LBA Tract as applied for, a total of approximately 1,535.0 million tons of coal would be recovered from the existing leases and the North Porcupine LBA Tract after January 1, 2009, with an estimated 601.2 million tons coming from the LBA tract, as discussed above. With the North Porcupine LBA Tract as applied for, coal production at the North Antelope Rochelle Mine would continue for approximately 16.2 years beyond 2008, and PRC anticipates that the current work force of 1,150 persons would remain the same. The LBA tract accounts for approximately 6.3 years of the mine life extension.

BLM independently evaluates the volume and average quality of the coal resources included in proposed LBA tracts as part of the fair market value determination process. BLM's estimate of the mineable federal coal reserves and average quality of the coal included in the tract may not be in agreement with the mineable coal reserve and coal quality estimates provided by the applicant. BLM's estimate of the mineable federal coal reserves and average quality of the coal included in the tract will be published in the sale notice if the tract is offered for sale.

Prior to disturbance and in advance of mining, mine support structures such as roads, power lines, substations, and flood and sediment control measures would be built as needed, and any public utility lines and oil and gas pipelines would be relocated as necessary.

The first step of the mining process is soil salvage with suitable heavy equipment, such as rubber-tired scrapers. During initial pit development, soil is placed in temporary stockpiles for later use in final pit closure and reclamation. Whenever possible, direct haulage of soil from salvage areas to a reclamation area would be done, but due to scheduling, some topsoil would be temporarily stockpiled. As required by the reclamation plan, heavy equipment would again be used to haul and redistribute the stockpiled topsoil on regraded areas.

The North Antelope Rochelle Mine is one of several mines currently operating in the PRB where the coal seams are notably thick and the overburden is relatively thin. Mining has been and would continue to be conducted in three semi-independent pits (West, North, and East Pits). The design of the North Antelope Rochelle Mine seeks to confine disturbance to the active mine blocks. After soil salvage operations are complete, blast holes are drilled down through the overburden to the top of the upper-most mineable coal seam. The drill holes are then loaded with explosives (ANFO) and detonated to fragment the overburden to facilitate efficient excavation. As overburden is removed, most would be directly placed into the previous empty pit where coal has been removed. The mine's current method of overburden removal employs a truck and shovel pre-benching operation in advance of a dragline. Cast blasting is also employed to supplement dragline productivity. Other equipment used during overburden removal and backfilling includes dozers, scrapers, excavators, front-end loaders, graders, and water trucks. While increasing overburden depths in the North Porcupine tract would require an increasing percentage of overburden material to be moved by the truck and shovel pre-benching operation, overburden removal methods would remain essentially the same as the current operation. However, once operations have moved west of the BNSF & UP rail line, the mine may utilize an alternative method of overburden removal and handling for the box cut and pre-benching operations. In combination with the conventional truck/shovel and dragline system, in-pit overburden crushing and overland conveying methods may be employed to move and emplace overburden materials to open pits areas east of the rail line and/or stockpile locations off of the coal lease area.

Exposed coal seams have been and would continue to be cleaned with a dozer, drilled and blasted to facilitate efficient excavation. Coal removal is currently accomplished with the conventional truck and shovel method and then transported to one of four truck dump/crusher locations. Two of these truck dumps are remotely located from the final coal preparation plant and unit train loadout facilities. Coal haul roads would be temporary structures built within the mine areas. Coal is also transported from the near-pit crushers by overland conveyor to the final preparation plant and storage facilities. Some changes to the coal handling system infrastructure may be implemented in the future. For example, an additional remote coal truck dump/near-pit crusher and overland conveyor may be constructed west of the BNSF & UP railroad line.

Chapter 4, Section 2(b)(i) of the WDEQ/LQD Coal Rules requires that rough backfilling and grading follow coal removal as closely as possible based on the mining conditions (WDEQ/LQD 2009). Replaced (backfilled) overburden is graded to approximate the original land surface contour, as required by WDEQ and OSM rules. Elevations consistent with the approved PMT plan are established as quickly as possible to reconstruct a stable landscape and restore drainage. Under certain conditions, the PMT may not be immediately achievable. This occurs when there is an excess of material that may require temporary stockpiling, when there is insufficient material available from current overburden removal operations, or when future mining could redisturb an area already mined. Backfilled and recontoured overburden is sampled and analyzed to verify suitability as subsoil. Should unsuitable backfill materials be encountered (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), mitigation by additional soil depth, excavation and burial, or other special handling to remove them from the root zone would occur. Prior to soil distribution, regraded backfill is scarified to relieve compaction. Soil is redistributed on recontoured backfill using rubber-tired scrapers. Once a seedbed has been formed the reclaimed areas are revegetated using native grasses, forbs, and shrubs that are consistent with the postmining land use. According to the most recent OSM evaluation of the Wyoming coal mining industry, the reclamation to disturbance ratio in 2008 was approximately 86 percent (4,703 acres reclaimed vs. 5,497 acres disturbed) (OSM 2009).

Coal would be produced from two mineable seams within the North Porcupine LBA Tract. PRC refers to these seams as the Wyodak-Anderson 1 and the Wyodak-Anderson 2. These two coal seams are separated by a shale parting that averages approximately 17 feet thick within North Antelope Rochelle Mine's existing lease areas. However, there is no shale parting in the LBA tract as applied for, and the combined Wyodak-Anderson 1 and 2 seam averages approximately 75 thick. Coal would be mined at several working pit faces to enable blending of the coal to meet customer quality requirements, to comply with BLM lease requirements for maximum economic recovery of the coal resource, and to optimize coal removal efficiency with available equipment. Mining efficiency and air quality protection are and would continue to be facilitated by extensive use of near-pit crushers and overland conveyors. There are four existing crushing facilities within the existing permit area. The overland conveyors are covered by dust hoods and all coal transfer points on conveyor belts and the truck dump hoppers are controlled by PECs, fogger/spray systems, or stilling sheds. There are five existing storage silos and one covered storage slot. While sufficient capacity exists to produce at the permitted level, future changes in coal handling and processing facilities may be constructed to improve operating efficiency and air quality protection.

The North Antelope Rochelle Mine has a current full-time work force of 1,150 persons. If BTU acquires the North Porcupine LBA Tract under the Proposed

Action, they anticipate that employment levels would remain the same for the additional 6.3 years that it would take to mine the coal included in the tract.

As discussed in Chapter 1, the North Porcupine LBA Tract is adjacent to existing leases at the North Antelope Rochelle Mine, but is not adjacent to any of the other existing mines in this area (Figure 1-1). If a company other than BTU was to acquire the tract, the rate of coal production, mining sequence, equipment, and facilities would be different than if BTU acquired the tract as a maintenance lease, as described above. However, the area of disturbance and the impacts of removing the coal would not be substantially different from the area of disturbance and the impacts of PRC mining the tract.

2.5.2 North Porcupine LBA Tract Alternative 1

Under the North Porcupine LBA Tract Alternative 1, the No Action Alternative, BTU's application to lease the coal included in the North Porcupine LBA Tract would be rejected. The tract would not be offered for competitive sale at this time, and the coal included in the tract would not be mined.

Rejection of the application would not affect permitted mining activities nor employment on the existing leases at the North Antelope Rochelle Mine. The North Antelope Rochelle Mine currently leases approximately 16,666 acres of federal coal and 1,400 acres of state coal, all of which are within the existing North Antelope Rochelle Mine permit boundary. A total of approximately 27,443 acres will eventually be affected in mining the current leases. If the North Porcupine LBA Tract is not leased, PRC estimates that the annual production at the North Antelope Rochelle Mine after 2008 would average 95 million tons, and the average full-time employment level is expected to remain at 1,150 persons. Mining would continue at the North Antelope Rochelle Mine for approximately 9.9 years. Portions of the surface of the LBA tract will be disturbed by the North Antelope Rochelle Mine due to overstripping to allow coal to be removed from existing contiguous leases.

In order to compare the economic and environmental consequences of mining these lands versus not mining them, this EIS was prepared under the assumption that the North Porcupine LBA Tract would not be mined in the foreseeable future if the No Action Alternative is selected. However, selection of the No Action Alternative would not preclude leasing and mining of this tract in the future. If the decision is made to reject the North Porcupine lease application at this time, the tract could be leased as a maintenance lease in the future while the adjacent mine is in operation. If it is not leased while the existing adjacent mine is in operation, it may or may not be leased in the future. This tract includes enough coal reserves to economically justify mining by a new operation, and the coal reserves included in the tract could potentially be combined with unleased federal coal to the north, south and/or west to create a larger tract that could be mined by a new operation in the future.

2.5.3 North Porcupine LBA Tract Alternative 2--Preferred Alternative

Under Alternative 2 for the North Porcupine LBA Tract, BLM would reconfigure the tract, hold one competitive coal sale for the lands included in the reconfigured tract, and issue a lease to the successful bidder. The modified tract would be subject to standard and special lease stipulations developed for the PRB and for this tract, if it is offered for sale (Appendix D). Alternative 2, holding a competitive coal sale for a modified tract, is BLM's preferred alternative.

Alternative 2 for the North Porcupine LBA Tract assumes that BTU would be the successful bidder on the tract if a lease sale is held and that the federal coal would be mined as a maintenance lease for the existing North Antelope Rochelle Mine. Assumptions concerning mining methods, facilities, hazardous materials, mitigation and monitoring requirements, etc. are the same as described for the Proposed Action.

As applied for, the North Porcupine LBA Tract consists of a single block of federal coal. In order to evaluate the potential that an alternate configuration of the tract would provide for more efficient recovery of the federal coal, increase competitive interest in the North Porcupine LBA Tract, and/or reduce the potential that some of the remaining unleased federal coal in this area would be bypassed in the future, BLM identified a study area. The BLM study area includes the tract as applied for and unleased federal coal adjacent to the northern and southwestern edges of the tract as applied for (Figure 2-5). Under Alternative 2, BLM could add all or part of the adjacent lands to the tract, or BLM could reduce the size of the tract, as discussed in Section 2.0.

Under Alternative 2, the area BLM is evaluating adding to the tract as applied for includes the following lands:

T.42N., R.70W., 6th PM, Campbell County, Wyoming

Section 19:	Lots 9 through 12;	149.02 acres
Section 20:	Lots 5 through 8;	162.93 acres
Section 21:	Lots l through 8;	330.71 acres
Section 22:	Lots 3 through 6;	163.80 acres

T.42N., R.71W., 6th PM, Campbell County, Wyoming

Section 22:	Lots 5 through 7, 19, and 20;	162.70 acres
Section 23:	Lots 5 through 8;	162.51 acres
Section 24:	Lots 5 through 8;	163.30 acres
Section 34:	Lots 4, 5, and 12 through 16;	276.04 acres
Total:		1,572.01 acres

The legal description of the Alternative 2 BLM reconfiguration (Figure 2-5) for the North Porcupine LBA Tract is as follows:

T.42N., R.70W., 6th PM, Campbell County, Wyoming

Section 19:	Lots 9 through 20;	445.96 acres
Section 20:	Lots 5 through 16;	490.93 acres
Section 21:	Lots 1 through 16;	660.25 acres
Section 22:	Lots 3 through 6 and 9 through 16;	491.54 acres
Section 26:	Lots 3 through 6 and 9 through 16;	496.64 acres
Section 27:	Lots 1 through 16;	664.48 acres
Section 28:	Lots 1 through 4;	165.98 acres
Section 29	Lots 1 through 4;	164.30 acres
Section 30:	Lots 5 through 8;	147.79 acres

T.42N., R.71W., 6th PM, Campbell County, Wyoming

Section 22:	Lots 5 through 7, 10 through 15, and 19 through 24;	486.19 acres
Section 23:	Lots 5 through 16;	487.45 acres
Section 24:	Lots 5 through 16;	489.12 acres
Section 25:	Lots 1 through 4;	162.96 acres
Section 26:	Lots 1 through 6 and 11 through 14;	404.09 acres
Section 27:	Lots 2 through 6, 9, 12, and 15 through 30;	649.42 acres
Section 34:	Lots 1 through 16;	636.50 acres
Section 35:	Lots 3 through 6 and 11 through 14;	323.19 acres

Total: 7,366.79 acres

Land descriptions and acreage are based on the BLM Status of Public Domain Land and Mineral Titles approved Master Title Plats as of September 7, 2007 and September 20, 2007 and Coal Plats as of September 7, 2007 and September 20, 2007. The coal estate included in the tract described above is federally owned. Much of the surface (approximately 72 percent, or 5,289.6 acres) of the BLM study area includes lands on the TBNG, which is administered by the USFS. The ownership of the surface and oil and gas estates is discussed in Section 3.11.

PRC estimates that the LBA tract reconfigured under Alternative 2 (the BLM study area) includes approximately 955.8 million tons of in-place coal reserves. As discussed in Sections 1.5, and 2.5.1, some of the coal included in the above-described alternative tract configuration is not currently considered by PRC to be mineable due to the presence of the BNSF & UP rail line ROW and associated 100-foot buffer zone, which crosses the BLM study area (Figure 2-5). The coal that is located within the BNSF & UP railroad ROW and associated buffer zone has been determined to be unsuitable for mining under Coal Unsuitability Criterion Number 2 and would not be recoverable. Within the BLM study area, PRC estimates that approximately 95.2 million tons of mineable coal is located within a layback buffer zone that extends 1,000 feet on either side of the railroad centerline.

As discussed in Section 2.5.1, some of the coal included in the above-described lands is not currently considered by PRC to be mineable due to the requirement that no blasting operations be conducted within 500 feet of the Teckla Electric Power Substation, which is located in the NE¼NE¼ of Section 3, T.41N., R.71W. Therefore, the coal underlying the substation buffer zone is not considered mineable at this time by PRC because the cost that would be associated with moving the substation would make it economically unfeasible to recover.

As discussed in Sections 1.5 and 2.5.1 and shown in Figure 2-5, some of the coal in the above-described alternative tract configuration is overlain by the Antelope, Matheson, and Mackey roads (Campbell County roads 4, 70, and 69, respectively). The coal that is underlying these public road ROWs and associated 100-foot buffer zones extending on either side of the ROWs has been determined to be unsuitable for mining in accordance with SMCRA and as specified in coal leasing Unsuitability Criterion Number 3 (43 CFR 3461) and would not be recoverable. There is an exception to this prohibition to mine the coal underlying the public road ROWs and associated buffer zones that can be applied if the appropriate public road authority allows the road to be relocated or closed (SMCRA Section 522(e)(4) and 30 CFR 761.11(d)(2)). PRC has currently obtained approval from the Campbell County Board of Commissioners to close and relocate the portion of Antelope Road that crosses the BLM study area and Matheson Road that crosses and borders the North Porcupine LBA Tract as applied for. However, PRC has not obtained approval from the County Commissioners to close and relocate the portion of Matheson Road that borders lands added by the BLM study area and would not seek approval because this portion of the road lies within the BNSF & UP railroad buffer zone, and because it provides access to the Teckla Electric Power Substation. PRC has not yet obtained approval from the County Commissioners to close and relocate the portion of Mackey Road that crosses the BLM study area. If PRC obtains approval from the Campbell County Board of Commissioners to close and relocate Mackey Road, which crosses and borders the BLM study area, the exception to the prohibition on mining within the road's ROW and buffer zone could be applied and the unsuitability determination could be reconsidered. In that case, PRC would be able to recover the coal underlying the Mackey Road ROW and associated buffer zone. If PRC does not obtain approval to close and relocate the Mackey Road, the coal underlying its ROW and buffer zone would remain unsuitable for mining and would not be recovered.

If the above-described portions of the Matheson and Mackey roads are not closed or relocated, PRC estimates that the BLM study area tract (Figure 2-5) includes approximately 810.2 million tons of mineable coal reserves. Using PRC's projected recovery factor of 92 percent of the mineable coal reserves, about 745.4 million tons of the mineable coal would be recoverable. At the average annual production rate of 95 mmtpy, mining this coal would extend the life of the mine by about 7.8 additional years. PRC estimates that approximately 145.6 million tons of coal would not be mineable within the BLM study area due to the presence of the railroad and public road ROWs and associated buffer zones and the Teckla Substation buffer zone. Although these lands would not be mined, they are included in BLM's study area (the preferred alternative tract configuration) to allow maximum recovery of all the mineable coal that is adjacent to but outside of the railroad and public road ROWs and associated buffer zones and the electric substation buffer zone and to comply with the coal leasing regulations that do not allow leasing of less than 10-acre aliquot parts. If a lease is issued for this tract, stipulations will be attached to the lease stating that no mining activity may be conducted in the portions of the leased tract within the BNSF & UP railroad and pubic road ROWs and associated buffer zones. The stipulations would also state that mining within the public road ROWs and buffer zones may be conducted if approval is obtained from the appropriate public road authority to relocate or close the roads.

If the Mackey Road is moved or closed, PRC estimates that an added 47.7 million tons of coal would be mineable in the BLM study area tract under Alternative 2.

BLM independently evaluates the volume and average quality of the coal resources included in proposed LBA tracts as part of the fair market value determination process. BLM's estimate may not be in agreement with the mineable coal reserve and coal quality estimates provided by the applicant. Under the Preferred Alternative (Alternative 2), BLM's estimate will be published in the sale notice for the tract, if it is offered for sale.

2.6 South Porcupine LBA Tract

2.6.1 South Porcupine LBA Tract Proposed Action

Under the Proposed Action for the South Porcupine LBA Tract, the tract as applied for by BTU would be offered for lease at a sealed-bid, competitive lease sale, subject to standard and special lease stipulations developed for the PRB (Appendix D). The boundaries of the tract would be consistent with the tract configuration proposed in the South Porcupine lease application (Figure 2-6). The Proposed Action assumes that BTU would be the successful bidder on the South Porcupine LBA Tract, if it is offered for sale.

The legal description of the proposed South Porcupine LBA Tract coal lease lands as applied for by BTU under the Proposed Action is as follows:

T.41N., R.70W., 6th PM, Campbell County, Wyoming

Section 7:	Lots 7 through 10 and 15 through 18;	320.94 acres
Section 18:	Lots 6 through 11 and 14 through 19;	479.71 acres

T.41N., R.71W., 6th PM, Campbell County, Wyoming

Section 1:	Lots 5 through 20;	638.15 acres
Section 12:	Lots 1 through 16;	678.52 acres
Section 13:	Lots 1 through 16;	668.93 acres
Section 14:	Lots 1, 8, 9, and 16;	154.62 acres

Section 23:	Lot 1 and N½ of Lot 8;	59.81 acres
Section 24:	Lots 2 through 4 and N½ of Lots 5, 6 and 7;	185.28 acres
Total:		3,185.96 acres

Land descriptions and acreage are based on the BLM Status of Public Domain Land and Mineral Titles approved Master Title Plats as of September 6, 2007 and Coal Plats as of September 6, 2007. The coal estate included in the tract described above is federally owned. Roughly half of the surface (approximately 51 percent or 1,637.2 acres) of the tract as applied for includes lands on the TBNG, which is administered by the USFS. The ownership of the surface and oil and gas estates is discussed in Section 3.11.

As discussed in Section 1.5 and as shown in Figure 2-6, some of the coal in the above-described lands in the South Porcupine LBA Tract is not mineable due to the presence of the BNSF & UP railroad ROW and associated 100-foot no-disturbance buffer zone. The rail line lies west of and adjacent to the South Porcupine tract, and like the North Porcupine tract, the coal underlying portions of the railroad ROW and associated 100-foot buffer zone in this area has been determined by the BLM to be unsuitable for mining according to the coal leasing Unsuitability Criterion 2 (43 CFR 3461). Although the federal coal underlying the railroad ROW and associated buffer zone has been determined to be unsuitable for mining and would therefore not be recovered, it is included in the LBA tract to allow maximum recovery of all of the mineable coal that is adjacent to but outside of the railroad ROW and its associated buffer zone and to comply with the coal leasing regulations that do not allow leasing of less than 10-acre aliquot parts. PRC estimates that approximately 13.8 million tons of mineable coal included in the South Porcupine LBA Tract as applied for is located within a layback buffer zone that extends 1,000 feet east of the railroad centerline. If a lease is issued for this tract, a stipulation will be attached to the lease stating that no mining activity may be conducted within the BNSF & UP railroad ROW.

As indicated in Section 1.5 and as shown in Figure 2-6, some of the coal included in the above-described lands in the South Porcupine LBA Tract is overlain by the Antelope Road (Campbell County Road 4), which crosses the LBA tract. SMCRA prohibits surface mining operations on lands within 100 feet of the outside line of the ROW for a public road (SMCRA Section 522(e)(4) and 30 CFR 761.11(d)). The coal that is underlying this public road ROW and associated 100-foot buffer zone on both sides of the ROW has been determined to be unsuitable for mining in accordance with SMCRA and as specified under Unsuitability Criterion 3 (43 CFR 3461). There is an exception to this prohibition in the regulations at SMCRA Section 522(e)(4) and 30 CFR 761.11(d)(2), which can be applied if the appropriate road authority (Campbell County Board of Commissioners) allows the road to be relocated or closed. As discussed in Section 1.1, PRC has obtained approval from the Campbell County Board of Commissioners to close and relocate a portion (approximately 1.25 miles) of the Antelope Road that crosses the South Porcupine LBA Tract.

PRC plans to apply for the approval of the County Commissioners to close or relocate the remaining length (approximately 2.25 miles) of Antelope Road that crosses the South Porcupine tract. If PRC obtains approval from the County Commissioners to close or relocate this section of the county road, the exception to the prohibition on mining within the road ROW and associated buffer zone could be applied and the unsuitability determination could be reconsidered. In that case, PRC would be able to recover the coal underlying the county road ROW and buffer zone. If PRC does not obtain approval to move or close the 2.25-mile section of Antelope Road, the coal underlying its ROW and buffer zone would remain unsuitable for mining and would not be recovered.

The federal coal underlying the above-described 2.25-mile section of Antelope Road, its ROW, and adjacent buffer zone is included in the tract because it would allow maximum recovery of all the mineable coal adjacent to but outside of the road ROW and associated buffer zone if this length of road is not moved; it would also allow recovery of the coal under the road if it is moved or closed. If a lease is issued for this tract, a stipulation will be attached to the lease stating that no mining activity may be conducted within the Antelope Road ROW and 100-foot buffer zone for this 2.25-mile section unless approval is obtained from the appropriate authority to close or relocate the road.

PRC estimates that the South Porcupine LBA Tract as applied for includes approximately 422.2 million tons of in-place coal. If the remaining 2.25-mile section of Antelope Road is not closed or relocated, PRC estimates that the South Porcupine LBA Tract as applied for contains approximately 336.6 million tons of mineable coal reserves. Based on historical recovery practices, PRC assumes that about 92 percent of that coal, or approximately 309.7 million tons of coal, would be recovered from the South Porcupine LBA Tract as applied for.

The South Porcupine LBA Tract would be mined as an integral part of the North Antelope Rochelle Mine under the Proposed Action. Since the South Porcupine LBA Tract would be an extension of the existing North Antelope Rochelle Mine, the facilities and infrastructure would be the same as those identified in the WDEQ/LQD Mine Permit 569 Term T7, approved July 28, 2009 and the BLM R2P2, which was approved February 28, 2007.

North Antelope Rochelle Mine's currently approved air quality permits from the WDEQ/AQD allow up to 140 million tons of coal per year to be mined. The North Antelope Rochelle Mine produced:

- 80.1 million tons of coal in 2003,
- 82.5 million tons of coal in 2004,
- 82.7 million tons of coal in 2005,
- 88.5 million tons of coal in 2006,
- 91.5 million tons of coal in 2007, and

- 97.6 million tons of coal in 2008

(Wyoming Department of Employment 2003, Shamley 2008a).

As of December 31, 2008, a total of approximately 1,230.8 million tons of coal had been mined from within the current permitted area of the mine.

PRC estimates an average annual coal production rate of 95 mmtpy for the North Antelope Rochelle Mine for the years beyond 2008. If BTU acquires the South Porcupine LBA Tract as applied for, a total of approximately 1,243.5 million tons of coal would be recovered from the existing leases and the South Porcupine LBA Tract after January 1, 2009, with an estimated 309.7 million tons coming from the LBA tract, as discussed above. Based upon this estimate of recoverable reserves, about 27 percent of the in-place coal reserves included within the LBA tract would not be recovered under normal mining practices and due to the presence of the unmineable reserves within the railroad ROW and associated buffer zone and the 2.25-mile section of the Antelope Road ROW and associated buffer zone. With the South Porcupine LBA Tract, coal production at the North Antelope Rochelle Mine would continue for approximately 13.2 years beyond 2008. The LBA tract accounts for approximately 3.3 years of the mine life extension.

If the remaining 2.25-mile section of Antelope Road is closed or relocated, PRC estimates that that an added 71.8 million tons of coal would be mineable in the South Porcupine LBA Tract. Based upon this estimate of recoverable reserves, about 11 percent of the in-place coal reserves included within the LBA tract would not be recovered under normal mining practices and due to the presence of the unmineable reserves within the railroad ROW and associated buffer zone.

BLM independently evaluates the volume and average quality of the coal resources included in proposed LBA tracts as part of the fair market value determination process. BLM's estimate of the mineable federal coal reserves and average quality of the coal included in the tract may not be in agreement with the mineable coal reserve and coal quality estimates provided by the applicant. BLM's estimate of the mineable federal coal reserves and average quality of the coal included in the tract will be published in the sale notice if the tract is offered for sale.

Prior to disturbance and in advance of mining, mine support structures such as roads, power lines, substations, and flood and sediment control measures would be built as needed, and any public utility lines and oil and gas pipelines would be relocated as necessary.

A brief description of PRC's mining operation at the North Antelope Rochelle Mine, emphasizing the methods and equipment that are used to remove, handle, and reclaim overburden and soil, is included in Section 2.5.1. The methods and equipment used to mine the coal, and the facilities used to process and store coal are also described in Section 2.5.1. Coal would be produced from two mineable seams within the South Porcupine LBA Tract. PRC refers to these seams as the Wyodak-Anderson 1 and the Wyodak-Anderson 2, which have a combined average thickness of approximately 76 feet in the LBA tract. These two coal seams are separated by a shale parting that averages approximately 17 feet thick within the mine's existing leases and approximately 10 feet thick within the South Porcupine LBA Tract. The mining and reclamation methods, coal handling, processing and storage facilities, and associated air quality protection measures would allow the North Antelope Rochelle Mine to produce at the currently permitted level. While sufficient capacity exists, future changes in facilities may be constructed to improve operating efficiency and air quality protection.

The North Antelope Rochelle Mine has a current full-time work force of 1,150 persons. If BTU acquires the South Porcupine LBA Tract under the Proposed Action, they anticipate that employment levels would remain the same for the additional 3.3 years that it would take to mine the coal included in the tract.

As discussed in Chapter 1, BTU applied for the South Porcupine LBA Tract, but the tract is also adjacent to the Antelope Mine, operated by Antelope Coal Company (Figure 1-1). As a result, Antelope Coal Company is potentially in a position to mine the South Porcupine LBA Tract. If a company other than BTU was to acquire the tract, the rate of coal production, mining sequence, equipment, and facilities would be different than if BTU acquired the tract as a maintenance lease, as described above. However, the area of disturbance and the impacts of removing the coal would not be substantially different from the area of disturbance and the impacts of PRC mining the tract.

2.6.2 South Porcupine LBA Tract Alternative 1

Under the South Porcupine LBA Tract Alternative 1, the No Action Alternative, BTU's application to lease the coal included in the South Porcupine LBA Tract would be rejected. The tract would not be offered for competitive sale at this time, and the coal included in the tract would not be mined.

Rejection of the application would not affect permitted mining activities nor employment on the existing leases at the North Antelope Rochelle Mine. The North Antelope Rochelle Mine currently leases approximately 16,666 acres of federal coal and 1,400 acres of state coal, all of which are within the existing North Antelope Rochelle Mine permit boundary. A total of approximately 27,443 acres will eventually be affected in mining the current leases. If the South Porcupine LBA Tract is not leased, PRC estimates that the annual production at the North Antelope Rochelle Mine after 2008 would average 95 million tons, and the average full-time employment level is expected to remain at 1,150 persons. Mining would continue at the North Antelope Rochelle Mine for approximately 9.9 years. Portions of the surface of the LBA tract would probably be disturbed by the North Antelope Rochelle Mine due to overstripping to allow coal to be removed from existing contiguous leases.

In order to compare the economic and environmental consequences of mining these lands versus not mining them, this EIS was prepared under the assumption that the South Porcupine LBA Tract would not be mined in the foreseeable future if the No Action Alternative is selected. However, selection of the No Action Alternative would not preclude leasing and mining of this tract in the future. If the decision is made to reject the South Porcupine lease application at this time, the tract could be leased as a maintenance lease in the future while the adjacent mine is in operation. If it is not leased while the existing adjacent mine is in operation, it may or may not be leased in the future. This tract does not include enough coal reserves to economically justify mining by a new operation; however, the coal reserves included in the tract could potentially be combined with unleased federal coal to the west to create a larger tract that could be mined by a new operation in the future.

2.6.3 South Porcupine LBA Tract Alternative 2--Preferred Alternative

Under Alternative 2 for the South Porcupine LBA Tract, BLM would reconfigure the tract, hold one competitive coal sale for the lands included in the reconfigured tract, and issue a lease to the successful bidder. The modified tract would be subject to standard and special lease stipulations developed for the PRB and for this tract, if it is offered for sale (Appendix D). Alternative 2, holding a competitive coal sale for a modified tract, is BLM's preferred alternative.

Alternative 2 for the South Porcupine LBA Tract assumes that BTU would be the successful bidder on the tract if a lease sale is held and that the federal coal would be mined as a maintenance lease for the existing North Antelope Rochelle Mine. Assumptions concerning mining methods, facilities, hazardous materials, mitigation and monitoring requirements, etc. are the same as described for the Proposed Action.

As applied for, the South Porcupine LBA Tract consists of a single block of federal coal. In order to evaluate the potential that an alternate configuration of the tract would provide for more efficient recovery of the federal coal, increase competitive interest in the South Porcupine LBA Tract, and/or reduce the potential that some of the remaining unleased federal coal in this area would be bypassed in the future, BLM identified a study area. The BLM study area includes the tract as applied for and unleased federal coal adjacent to the western edge of the tract as applied for (Figure 2-6). Under Alternative 2, BLM could add all or part of the adjacent lands to the tract, or BLM could reduce the size of the tract, as discussed in Section 2.0.

Under Alternative 2, the area BLM is evaluating adding to the tract as applied for includes the following lands:

T.41N., R.71W., 6th PM, Campbell County, Wyoming

Section 10:	Lot 9;	41.20 acres
Section 11:	Lots 9 through 12 and 14 through 16;	283.80 acres

Section 14:	Lot 2 and E½ of Lot 7;	57.07 acres
Total:		382.07 acres

The legal description of the Alternative 2 BLM reconfiguration (Figure 2-6) for the South Porcupine LBA Tract is as follows:

T.41N., R.70W., 6th PM, Campbell County, Wyoming

Section 7:	Lots 7 through 10 and 15 through 18;	320.94 acres
Section 18:	Lots 6 through 11 and 14 through 19;	479.71 acres

T.41N., R.71W., 6th PM, Campbell County, Wyoming

Section 1:	Lots 5 through 20;	638.15 acres
Section 10:	Lot 9;	41.20 acres
Section 11:	Lots 9 through 12 and 14 through 16;	283.80 acres
Section 12:	Lots 1 through 16;	678.52 acres
Section 13:	Lots 1 through 16;	668.93 acres
Section 14:	Lots 1, 2, E½ of 7, 8, 9, and 16;	211.69 acres
Section 23:	Lot 1 and N½ of Lot 8;	59.81 acres
Section 24:	Lots 2 through 4 and N½ of Lots 5, 6 and 7;	185.28 acres
Total:		3,568.03 acres

Land descriptions and acreage are based on the BLM Status of Public Domain Land and Mineral Titles approved Master Title Plats as of September 6, 2007 and Coal Plats as of September 6, 2007. The coal estate included in the tract described above is federally owned. A portion of the surface (approximately 46 percent, or 1,637.6 acres) of the BLM study area includes lands on the TBNG, which is administered by the USFS. The ownership of the surface and oil and gas estates is discussed in Section 3.11.

PRC estimates that the LBA tract reconfigured under Alternative 2 (the BLM study area) includes approximately 470.9 million tons of in-place coal reserves. As discussed in Sections 1.5, and 2.6.1, some of the coal included in the above-described alternative tract configuration is not currently considered by PRC to be mineable due to the presence of the BNSF & UP rail line ROW and associated 100-foot buffer zone, which crosses the BLM study area (Figure 2-6). The coal that is located within the BNSF & UP railroad ROW and associated buffer zone has been determined to be unsuitable for mining under Coal Unsuitability Criterion Number 2 and would not be recoverable. Within the BLM study area, PRC estimates that approximately 30.3 million tons of mineable coal included in the South Porcupine LBA Tract configured under Alternative 2 is located within a layback buffer zone that extends 1,000 feet on either side of the railroad centerline.

As discussed in Sections 1.5 and 2.6.1 and shown in Figure 2-6, some of the coal included in the above-described alternative tract configuration is overlain by the Antelope Road. The coal that is underlying this public road ROW and associated 100-foot buffer zone extending on either side of the ROW has been determined to be unsuitable for mining in accordance with SMCRA and as specified in coal leasing Unsuitability Criterion Number 3 (43 CFR 3461) and would therefore not be recoverable.

As discussed in Section 2.6.1, there is an exception to this prohibition to mine the coal underlying the public road ROW and associated buffer zone that can be applied if the appropriate public road authority allows the road to be relocated or closed (SMCRA Section 522(e)(4) and 30 CFR 761.11(d)(2)). As discussed in Section 1.1, PRC has obtained approval from the Campbell County Board of Commissioners to close and relocate a portion (approximately 1.25 miles) of the Antelope Road that crosses the South Porcupine LBA Tract under the alternative tract configuration. PRC plans to apply for the approval of the County Commissioners to close or relocate the remaining length (approximately 2.25 miles) of the Antelope Road that crosses the BLM study area for the South Porcupine tract. If PRC obtains approval from the County Commissioners to close or relocate this section of the county road, the exception to the prohibition on mining within the road ROW and associated buffer zone could be applied and the unsuitability determination could be reconsidered. In that case, PRC would be able to recover the coal underlying the county road ROW and buffer zone. If PRC does not obtain approval to move or close the 2.25-mile section of Antelope Road, the coal underlying its ROW and buffer zone would remain unsuitable for mining and would not be recovered.

Although these lands would not be mined, they are included in the alternative tract configuration to allow maximum recovery of all the mineable coal that is adjacent to but outside of the railroad and public road ROWs and associated buffer zones and to comply with the coal leasing regulations that do not allow leasing of less than 10-acre aliquot parts. If a lease is issued for this tract, stipulations will be attached to the lease stating that no mining activity may be conducted in the portions of the leased tract within the BNSF & UP railroad and public road ROWs and associated buffer zones. The stipulations would also state that mining within the public road ROW and buffer zone may be conducted if approval is obtained from the appropriate public road authority to relocate or close the remaining 2.25-mile portion of the Antelope Road.

If the remaining 2.25-mile section of Antelope Road is not closed or relocated, PRC estimates that the South Porcupine LBA Tract configured under Alternative 2 (BLM's study area) includes approximately 368.8 million tons of mineable coal reserves. Using PRC's projected recovery factor of 92 percent of the mineable coal reserves, about 339.3 million tons of the mineable coal would be recoverable. At the average annual production rate of 95 mmtpy, mining this coal would extend the life of the mine by about 3.6 additional years. PRC estimates that approximately 102.1 million tons of coal would not be mineable because of the railroad and public road ROWs and associated buffer zones.

If the remaining 2.25-mile section of Antelope Road is closed or relocated, PRC estimates that an added 71.8 million tons of coal would be mineable in the BLM study area tract (BLM's preferred tract configuration).

BLM independently evaluates the volume and average quality of the coal resources included in proposed LBA tracts as part of the fair market value determination process. BLM's estimate may not be in agreement with the mineable coal reserve and coal quality estimates provided by the applicant. Under the Preferred Alternative (Alternative 2), BLM's estimate will be published in the sale notice for the tract, if it is offered for sale.

2.7 Alternatives Considered but not Analyzed in Detail

2.7.1 Alternative 4: New Mine Start

Under this alternative, as under the Proposed Actions and Alternatives 2 and 3, BLM would hold a separate, competitive, sealed-bid sale for the lands included in each LBA tract. Under this alternative, it is assumed, however, that the successful qualified bidder for a tract would be someone other than the applicant and that this bidder would plan to open a new mine to develop the coal resources in one or more of the LBA tracts (North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine).

BLM currently estimates that a tract would potentially need to include as much as 500 to 600 million tons of in-place coal in order to attract a buyer interested in opening a new mine in the Wyoming PRB. This is based on several assumptions. First, it is assumed that an operator would need to construct facilities capable of producing 30 mmtpy in order to take advantage of the economies of scale offered by the coal deposits in the PRB. Secondly, it is assumed that 20 to 30 years of coal reserves would be needed to justify the expense of building the facilities described above. Given these assumptions, the West Jacobs Ranch and North Porcupine LBA Tracts as applied for include sufficient coal reserves to consider opening a new mine, while the three Hilight Field LBA Tracts as applied for and the South Porcupine LBA Tract as applied for do not. The North Hilight Field, West Hilight Field, West Jacobs Ranch, and North Porcupine LBA Tracts reconfigured under Alternative 2 (and Alternative 3 for the West Hilight Field tract), each include sufficient coal reserves to support a new mine, while the South Hilight Field and South Porcupine tracts do not. Therefore, it is unlikely that a company or companies would lease the South Hilight Field or South Porcupine tracts in order to open a new mine. However, the other four LBA Tracts that are included in this EIS analysis do include sufficient coal reserves to support a new mine.

A company or companies acquiring this coal for one or more new stand-alone mines would require considerable initial capital expenses, including the construction of new surface facilities (i.e., offices, shops, warehouses, coal processing facilities, coal loadout facilities, and rail spurs), mining equipment, extensive baseline data collection, and development of new mining and reclamation plans. A new start mine would also require a large number of new employees, which may not be available from the mining sector workforce (which includes the oil and gas industry), considering the current strong demand for labor and low unemployment in Campbell County and surrounding counties in the PRB.

In addition, a company or companies acquiring this coal for one or more new start mines would have to compete for customers with established mines in a competitive market. Based on demand forecasting for the Wyoming PRB mines, there is sufficient existing mine capacity to provide for expected coal demand through the year 2020 (BLM 2005a). While this does not mean that no new operations would open, it becomes difficult for a new operation with the capital costs of new facilities and mine start up costs to produce coal at a price competitive with the existing operations. The potential difficulty in obtaining an air quality permit is another issue that could discourage new mine starts in the PRB. A new mine would create a new source of air quality impacts. As discussed in Chapter 3, the WDEQ/AQD administers a permitting program to assist the agency in managing the state's air resources. Under this program, anyone planning to construct, modify, or use a facility capable of emitting designated pollutants into the atmosphere must obtain an air quality permit to construct. Coal mines fall into this category.

In order to obtain a construction permit, an operator may be required to demonstrate that the proposed activities will not increase air pollutant levels above annual standards established by the Wyoming Air Quality Standards and Regulations, which can be found on the WDEQ/AQD website at http://deq.state.wy.us/aqd/standards.asp. There were no exceedances of the 24-hour PM_{10} standard anywhere in the PRB through year 2000. From 2001 through 2006, there were 29 monitored exceedances of the 24-hour PM_{10} standard at seven operating mines in the Wyoming PRB. Nineteen of these exceedances occurred in 2001 and 2002, while two, three, five, and zero exceedances occurred in 2003, 2004, 2005, and 2006 respectively. In 2007, there were a total of 11 exceedances of the 24-hour PM_{10} standard reported at six PRB surface coal mines. Seven of those 11 exceedances in 2007 occurred at the mines that are located in the general Wright analysis area (one at the Black Thunder Mine, two at the North Antelope Rochelle Mine, and four at the North Rochelle Mine, which was acquired by Arch Coal, Inc. in 2004 and is located between and adjacent to the Black Thunder and North Antelope Rochelle mines). A total of two exceedances of the 24-hour PM_{10} standard were reported at the PRB mines in 2008, one each at the Black Thunder and North Rochelle mines. WDEQ/AQD subsequently issued notices of violation for the two exceedances that occurred in 2008 (Shamley 2010). Although many of these exceedances have been attributed to high winds, concerns about future potential exceedances of the federal and state ambient air quality standards may make it more difficult for an operator planning on opening a new mine to demonstrate that new operations would not result in air pollution levels that are above the standards.

In view of the issues discussed above, development of a new mine on one or more of the six LBA tracts that are included in this EIS is considered unlikely and this alternative is not analyzed in detail in this EIS.

The environmental impacts of developing one or more new mines to recover the coal resources in one or more of these six LBA tracts would be greater than under the Proposed Action, the No Action Alternative, or Alternatives 2 or 3 because of the need for new facilities, new rail lines, new employment, and the creation of additional sources of particulates (dust). In the event that one or more lease sales are held and the applicants are not the successful bidder(s), the successful bidder(s) would be required to submit detailed mining and reclamation plans for approval before any of the tract(s) could be mined, and this NEPA analysis would be reviewed and supplemented as necessary prior to approval of those mining and reclamation plans.

2.7.2 Alternative 5: Delaying the Sale

Under this alternative, BLM would delay the sale of one or more of the LBA tracts as applied for. This alternative assumes that a tract could be developed later as either a maintenance tract or a new start mine, depending on how long the sale was delayed.

Coal bed natural gas (CBNG) resources are currently being recovered from oil and gas leases on all six LBA tracts. Delaying the sale of one or more of the tracts would allow CBNG resources to be more completely recovered prior to mining. There are several mechanisms in place that would allow continuing recovery of the CBNG resources prior to mining if the federal coal reserves in the tracts are leased now. These include:

- BLM can attach a Multiple Mineral Development stipulation to each 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.

- BLM has a policy in place on CBNG-coal conflicts (BLM Instruction Memorandum No. 2006-153) that directs BLM decision makers to optimize the recovery of both resources and ensure that the public receives a reasonable return (BLM 2006a).

- Mining of each LBA tract cannot occur until the coal lessee has a permit to mine the tract approved by the WDEQ/LQD and a Mineral Leasing Act (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 development on the tract and the mining sequence proposed by the coal lessee.

- The mine permit approval process generally takes the coal lessee several years to complete. This would allow time for the CBNG resources to be recovered from each tract.

However, delaying the sale of one or more of the tracts would not necessarily result in the recovery of more CBNG because the recovery is likely to continue post-sale, and most (or all) of the CBNG has either been, or will be by the time coal mining operations commence, produced from the oil and gas leases on the tract.

There are two major sources of revenue to state and federal governments from the leasing and mining of federal coal: 1) the competitive bonus bid paid at the time the coal is leased, and 2) federal and state royalties and taxes collected when the coal is sold. Delaying the sale of one or more of the tracts may result in a higher coal price and/or higher bonus bid. If coal prices do increase, the fair market value of the coal resources in the LBA tracts could potentially increase, which could result in an increased bonus bid if the coal is leased at a later date. However, postponing a lease sale would not necessarily lead to higher royalty or tax income to the state and federal governments. Royalty and tax payments are the larger of the two revenue sources and they increase automatically when coal prices increase because they are collected at the time the coal is sold. They cannot be collected until the coal is leased and permitted, which takes several years. If leasing is delayed, then by the time the coal is mined, the higher coal prices may or may not persist. If the higher coal prices do persist, they may enable the coal lessee to negotiate longer term contracts at higher prices, which would result in longer term, higher royalty, and tax revenues. On the other hand, if a existing mine runs out of coal reserves before prices rise, it would potentially have to shut down before additional coal could be leased and permitted for mining. Under this scenario, the fair market value of the coal could actually decrease because the added expense of reopening a mine or starting a new mine would have to be factored into the fair market value.

The average price received for PRB coal in 2000 was just under $5.00 per ton. Prices increased to between $6.00 and $7.00 per ton from 2001 to 2004, and in 2005 the average price peaked at more than $20.00 per ton. During much of 2005, coal shipments from the PRB were limited due to damage to railroad lines in Wyoming and other states. These shipping constraints combined with increasing world energy demands and natural disasters in other parts of the country led to anomalously large increases in coal prices in 2005. Rail capacity increased in 2006, which effectively helped to moderate coal prices throughout 2006. Average prices received for PRB coal remained fairly stable at around $10.00 per ton in 2007, increased to around $14.50 in 2008, and then decreased to under $10.00 per ton throughout most of 2009.

The recent history of price volatility and the lengthy lease and permitting process underscores the difficulty in predicting the price of coal, and therefore, the bonus and royalty payments to the government. However, the global demand for coal has increased largely due to the rise of developing foreign markets like China and India. Fueled by recent overseas demand, Appalachian coal prices have increased dramatically. PRB coal may help to fill the gap left by the Appalachian coal exports, which could lead to greater demand and prices for PRB coal. If so, the bonus and royalty payments to the government might be higher if one or more of the tracts is offered for sale at a later date. There is no assurance however at this time that delaying the sale of one or more of the LBA tracts would result in a higher coal price or a higher bonus bid.

Other considerations include the value of leaving the mineable coal for future development versus the value of making low-sulfur coal available now, in anticipation of cleaner fuel sources being developed in the future. Continued leasing of PRB coal enables coal-fired power plants to continue meeting the nation's energy needs while also meeting the existing Clean Air Act requirements without constructing new plants, revamping existing plants, or switching to existing alternative fuels, which may significantly increase power costs for individuals and businesses. If cleaner fuel sources are developed in the future, they could be phased in with less economic impact to the public.

A range of the potential future economic benefits of delaying leasing until coal prices rise could be quantified in an economic analysis, but the benefits would have to be discounted to the present, which would make them similar to the Proposed Action and Alternatives 2 and 3.

This alternative was not analyzed in detail because it would not produce substantially different impacts from other alternatives analyzed in detail. Rental and royalty provisions in each proposed lease provide for the U.S. to benefit if coal prices increase by the time of mining. Moreover, recovery of a large portion of the economically-recoverable CBNG resources on the tracts would be anticipated after lease issuance because of the mechanisms discussed above. The environmental impacts of mining the coal later as part of an existing mine would be expected to be similar and about equal to the Proposed Action and Alternatives 2 and 3 for each LBA tract. If a new mine is required to mine the coal, the environmental impacts would be expected to be greater than if each tract were mined as an extension of an existing mine.

2.8 Regulatory Compliance, Mitigation and Monitoring

SMCRA and Wyoming state law require surface coal mines to collect extensive baseline information and implement extensive monitoring programs and mitigation measures. The currently approved permits to conduct mining operations for the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines include these requirements. Monitoring programs and mitigation measures that are required by regulation are considered to be part of the Proposed Action and the Action Alternatives considered in this EIS for the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts. These data collection requirements, mitigation plans, and monitoring plans are in place for the No Action Alternative as part of the current approved permit to conduct mining operations for the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines. These data collection requirements, mitigation plans, and monitoring commitments would be extended to include mining operations on the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts if they are leased and permitted for mining. A mining and reclamation plan would have to be approved for each tract before any mining operations could be conducted, regardless of who acquires the tract. The major mitigation and monitoring measures that are required by state or federal regulation are summarized in Table 2-1. More specific information about some of these mitigation and monitoring measures and their results at the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines are described in Chapter 3.

If impacts are identified during the leasing process that are not mitigated by existing required mitigation measures, BLM can require additional mitigation measures in the form of stipulations on the new lease, within the limits of its regulatory authority. In general, the levels of mitigation and monitoring required for surface coal mining by SMCRA and Wyoming state law are more extensive than those required for other surface disturbing activities; however, concerns are periodically identified that are not monitored or mitigated under existing procedures.

2.9 Hazardous and Solid Waste

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 the approved mine permits (TBCC 2005, JRCC 2009, and PRC 2009, respectively). Under the Proposed Action and Action Alternatives for each of the six LBA tracts, the procedures and requirements for handling of hazardous and solid wastes would be the same as the procedures and requirements for the existing mining operations and in accordance with the mines' approved waste disposal plans.

Solid waste that is produced at the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines consists of floor sweepings, shop rags, empty lubricant containers, welding rod ends, metal shavings, worn tires, packing material, used filters, and office and food wastes. A portion of the solid wastes produced at the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines is disposed of within the mines' permit boundaries in accordance with WDEQ-approved solid waste disposal plans. Non-hazardous solid waste from the mines is also disposed of at the regulated Campbell County landfill near Gillette. Sewage is handled by WDEQ-permitted sewage systems present on the existing mine facilities. Maintenance and lubrication of most of the equipment takes place at existing shop facilities at each of the three mines. Major lubrication, oil changes, etc. of most equipment are performed inside the service building lubrication bays at the Black Thunder, Jacobs Ranch, and

Table 2-1. Regulatory Compliance, Mitigation and Monitoring Measures for Surface Coal Mining Operations Required by SMCRA and State Law for all Alternatives.

Resource	Regulatory Compliance or Mitigation Required by Stipulations, State or Federal Law[1]	Monitoring[1]
Topography & Physiography	▪ Restoring to approximate original contour or other approved topographic configuration.	▪ WDEQ/LQD checks as-built vs. approved topography with each annual report.
Geology & Minerals	▪ Identifying & selectively placing or mixing chemically or physically unsuitable overburden materials to minimize adverse effects to vegetation or groundwater.	▪ WDEQ/LQD requires monitoring in advance of mining to detect unsuitable overburden.
Soil	▪ Salvaging soil suitable to support plant growth for use in reclamation; ▪ Protecting soil stockpiles from disturbance and erosional influences; ▪ Selectively placing at least 4 feet of suitable overburden on the graded backfill surface below replaced topsoil to meet guidelines for vegetation root zones.	▪ Monitoring vegetation growth on reclaimed areas to determine need for soil amendments; ▪ Sampling regraded overburden for compliance with root zone criteria.
Air Quality	▪ Dispersion modeling of mining plans for annual average particulate pollution impacts on ambient air; ▪ Using particulate pollution control technologies; ▪ Using work practices designed to minimize fugitive particulate emissions; ▪ Using EPA- or state-mandated BACT, including: -Fabric filtration or wet scrubbing of coal storage silo and conveyor vents, -Watering or using chemical dust suppression on haul roads and exposed soils, -Containment of truck dumps and primary crushers, -Covering of conveyors, -Prompt revegetation of exposed soils, -High efficiency baghouse dust collection systems or PECs, or atomizers/foggers on the crusher, conveyor transfer, storage bin and train loadout, meeting a standard of 0.01 grains per dry standard cubic foot (dscf) of exit volume, -Watering of active work areas, -Reclamation plan to minimize surface disturbances subject to wind erosion, -Paving of access roads, -Haul truck speed limits, -Limited material drop heights for shovels and draglines.	▪ On-site air quality monitoring for PM_{10} and/or TSP; ▪ Off-site ambient monitoring for PM_{10} and/or TSP; ▪ On-site compliance inspections.

[1] These requirements, mitigation plans, and monitoring plans are required by SMCRA and Wyoming state law, and are already in place for the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines in their current approved WDEQ/LQD mining and reclamation plans (the No Action Alternatives). If the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts were leased, these requirements, mitigation plans, and monitoring plans would be part of the mining plan revisions covering each of the LBA tracts that must be approved before mining can occur on the tracts under the Proposed Actions or Action Alternatives.

Table 2-1. Regulatory Compliance, Mitigation and Monitoring Measures for Surface Coal Mining Operations Required by SMCRA and State Law for all Alternatives (Continued).

Resource	Regulatory Compliance or Mitigation Required by Stipulations, State or Federal Law[1]	Monitoring[1]
Air Quality (continued)	▪ Following voluntary and required measures to avoid exposing the public to NO_2 from blasting clouds, including: -Phone notification of neighbors and workers prior to blasting, -Monitoring weather and atmospheric conditions prior to decisions to blast, -Timing blasts to avoid temperature inversions and to minimize inconvenience to neighbors, -Closing public roads when appropriate to protect the public, -Minimizing blast sizes, -Posting signs on major public roads.	
Surface Water	▪ Building and maintaining sediment control ponds or other devices during mining; ▪ Restoring approximate original drainage patterns during reclamation; ▪ Restoring stock ponds and playas during reclamation.	▪ Monitoring storage capacity in sediment ponds; ▪ Monitoring quality of discharges; ▪ Monitoring streamflow and water quality.
Groundwater Quantity	▪ Evaluating cumulative impacts to water quantity associated with proposed mining; ▪ Replacing existing water rights that are interrupted, discontinued, or diminished by mining with water of equivalent quantity.	▪ Monitoring wells track water levels in overburden, coal, interburden, underburden, and backfill.
Groundwater Quality	▪ Evaluating cumulative impacts to water quality associated with proposed mining; ▪ Replacing existing water rights that are interrupted, discontinued, or diminished by mining with water of equivalent quality.	▪ Monitoring wells track water quality in overburden, coal, interburden, underburden, and backfill.
Alluvial Valley Floors	▪ Identifying all AVFs that would be affected by mining; ▪ WDEQ/LQD determination of significance to agriculture of all identified AVFs affected by mining; ▪ Protecting downstream AVFs during mining; ▪ Restoring essential hydrologic function of all AVFs affected by mining.	▪ Monitoring to determine restoration of essential hydrologic functions of any declared AVF.
Wetlands	▪ Identifying all wetlands that would be affected by mining; ▪ COE identification of jurisdictional wetlands; ▪ Replacing all jurisdictional wetlands that would be disturbed by mining; ▪ Replacing functional wetlands as required by surface managing agency, surface landowner, or WDEQ/LQD.	▪ Monitoring of reclaimed wetlands using same procedures used to identify pre-mining jurisdictional wetlands.

[1] These requirements, mitigation plans, and monitoring plans are required by SMCRA and Wyoming state law, and are already in place for the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines in their current approved WDEQ/LQD mining and reclamation plans (the No Action Alternatives). If the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts were leased, these requirements, mitigation plans, and monitoring plans would be part of the mining plan revisions covering each of the LBA tracts that must be approved before mining can occur on the tracts under the Proposed Actions or Action Alternatives.

Table 2-1. Regulatory Compliance, Mitigation and Monitoring Measures for Surface Coal Mining Operations Required by SMCRA and State Law for all Alternatives (Continued).

Resource	Regulatory Compliance or Mitigation Required by Stipulations, State or Federal Law[1]	Monitoring[1]
Vegetation	▪ Permanently revegetating reclaimed areas according to a comprehensive revegetation plan using approved permanent reclamation seed mixtures consisting predominantly of species native to the area; ▪ Reclaiming 20 percent of reclaimed area with native shrubs at a density of one per square meter; ▪ Controlling erosion on reclaimed lands prior to seeding with final seed mixture using mulching, cover crops, or other approved measures; ▪ Chemically and mechanically controlling weed infestation; ▪ Direct hauling of topsoil; ▪ Selectively planting shrubs in riparian areas; ▪ Planting sagebrush; ▪ Creating depressions and rock piles; ▪ Using special planting procedures around rock piles; ▪ Posting reclamation bond covering the cost of reclamation.	▪ Monitoring of revegetation growth & diversity until release of final reclamation bond (minimum 10 years); ▪ Monitoring of erosion to determine need for corrective action during establishment of vegetation; ▪ Use of controlled grazing during revegetation evaluation to determine suitability for post-mining land uses.
Wildlife and Sensitive Species	▪ Restoring pre-mining topography to the maximum extent possible; ▪ Planting a diverse mixture of grasses, forbs, and shrubs in configurations beneficial to wildlife; ▪ Designing fences to permit wildlife passage; ▪ Raptor-proofing power transmission poles; ▪ Using raptor safe power lines; ▪ Creating artificial raptor nest sites; ▪ Increasing habitat diversity by creating rock clusters and shallow depressions on reclaimed land; ▪ Cottonwood plantings along reclaimed drainages; ▪ Replacing drainages, wetlands, and AVFs disturbed by mining; ▪ Reducing vehicle speed limits to minimize mortality; ▪ Instructing employees not to harass or disturb wildlife; ▪ Following USFWS-approved raptor mitigation plans; ▪ Avoiding bald eagle disturbance; ▪ Restoring bald eagle perching and foraging areas disturbed by mining; ▪ Creating raptor nesting habitat through enhancement efforts; ▪ Development of a Migratory Bird Species of Management Concern (including the Greater sage-grouse) Monitoring and Mitigation Plan; ▪ Restoring sage-grouse and mountain plover habitat disturbed by mining; ▪ Surveying for sage-grouse, mountain plover and black-tailed prairie dogs.	▪ Baseline and annual wildlife monitoring surveys; ▪ Monitoring for raptors and other migratory bird species of management concern.

[1] These requirements, mitigation plans, and monitoring plans are required by SMCRA and Wyoming state law, and are already in place for the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines in their current approved WDEQ/LQD mining and reclamation plans (the No Action Alternatives). If the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts were leased, these requirements, mitigation plans, and monitoring plans would be part of the mining plan revisions covering each of the LBA tracts that must be approved before mining can occur on the tracts under the Proposed Actions or Action Alternatives.

Table 2-1. Regulatory Compliance, Mitigation and Monitoring Measures for Surface Coal Mining Operations Required by SMCRA and State Law for all Alternatives (Continued).

Resource	Regulatory Compliance or Mitigation Required by Stipulations, State or Federal Law[1]	Monitoring[1]
Threatened, Endangered, Proposed, and Candidate Species (Vegetation and Animals)	▪ Surveying for Ute ladies'-tresses and blowout penstemon; ▪ USFWS block clearance from black-footed ferret surveys in project area; ▪ Same as Wildlife and Sensitive Species above.	▪ Baseline and annual wildlife monitoring surveys.
Land Use	▪ Suitably restoring reclaimed area for historic uses (grazing and wildlife);	▪ Monitoring of controlled grazing prior to bond release evaluation.
Cultural Resources	▪ Conducting Class I & III surveys to identify cultural properties on all state and federal lands and on private lands affected by federal undertakings; ▪ Consulting with SHPO to evaluate eligibility of cultural properties for the NRHP; ▪ Avoiding or recovering data from significant cultural properties identified by surveys, according to an approved plan; ▪ Notifying appropriate federal personnel if historic or prehistoric materials are uncovered during mining operations; ▪ Instructing employees of the importance of and regulatory obligations to protect cultural resources.	▪ Monitoring of mining activities during topsoil stripping; ▪ Cessation of activities and notification of authorities if unidentified sites are encountered during topsoil removal.
Native American Concerns	▪ Notifying Native American tribes with known interest in this area of leasing action and request for help in identifying potentially significant religious or cultural sites.	▪ No specific monitoring program.
Paleontological Resources	▪ Notifying appropriate federal personnel if potentially significant paleontological sites are discovered during mining.	▪ No specific monitoring program.
Visual Resources	▪ Restoring landscape character during reclamation through return to approximate original contour and revegetation with native species.	▪ No specific monitoring program.
Noise	▪ Protecting employees from hearing loss.	▪ MSHA inspections.
Transportation Facilities	▪ Relocating existing pipelines, if necessary, in accordance with specific agreement between pipeline owner and coal lessee.	▪ No specific monitoring program.
Socioeconomics	▪ Paying royalty and taxes as required by federal, state, and local regulations. ▪ No mitigation measures are proposed.	▪ Surveying and reporting to document volume of coal removed.

[1] These requirements, mitigation plans, and monitoring plans are required by SMCRA and Wyoming state law, and are already in place for the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines in their current approved WDEQ/LQD mining and reclamation plans (the No Action Alternatives). If the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts were leased, these requirements, mitigation plans, and monitoring plans would be part of the mining plan revisions covering each of the LBA tracts that must be approved before mining can occur on the tracts under the Proposed Actions or Action Alternatives.

Table 2-1. Regulatory Compliance, Mitigation and Monitoring Measures for Surface Coal Mining Operations Required by SMCRA and State Law for all Alternatives (Continued).

Resource	Regulatory Compliance or Mitigation Required by Stipulations, State or Federal Law[1]	Monitoring[1]
Hazardous & Solid Waste	▪ Disposing of solid waste and sewage within permit boundaries according to approved plans; ▪ Storing and recycling waste oil; ▪ Maintaining of files containing Material Safety Data Sheets for all chemicals, compounds, and/or substances used during course of mining; ▪ Ensuring that all production, use, storage, transport, and disposal of hazardous materials is in accordance with applicable existing or hereafter promulgated federal, state, and government requirements; ▪ Complying with emergency reporting requirements for releases of hazardous materials as established in CERCLA, as amended; ▪ Preparing and implementing spill prevention control and countermeasure plans, spill response plans, inventories of hazardous chemical categories pursuant to Section 312 of SARA, as amended; ▪ Preparing emergency response plans.	▪ No specific monitoring other than required by these other regulations and response plans.

[1] These requirements, mitigation plans, and monitoring plans are required by SMCRA and Wyoming state law, and are already in place for the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines in their current approved WDEQ/LQD mining and reclamation plans (the No Action Alternatives). If the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts were leased, these requirements, mitigation plans, and monitoring plans would be part of the mining plan revisions covering each of the LBA tracts that must be approved before mining can occur on the tracts under the Proposed Actions or Action Alternatives.

North Antelope Rochelle mines, where used oil and grease are currently contained and deposited in storage tanks. All of the collected used oils and grease are then beneficially recycled off site or used for energy recovery, including, at some of the PRB mines, blending with diesel fuel oil for use as equipment fuel. These practices would not change if the applicants acquire these LBA tracts.

TBCC and PRC have reviewed EPA's *Consolidated List of Chemicals Subject to Reporting Under Title III of the Superfund Amendments and Re-authorization Act* (SARA) *of 1986* (as amended) and EPA's *List of Extremely Hazardous Substances* as defined in 40 CFR 355 (as amended) for hazardous substances.

TBCC and PRC maintain files containing Material Safety Data Sheets (MSDS) for all chemicals, compounds, and/or substances that are or would be used during the course of mining.

TBCC and PRC are responsible for ensuring that all production, use, storage, transport, and disposal of hazardous and extremely hazardous materials as a result of mining are in accordance with all applicable existing or hereafter promulgated federal, state, and local government rules, regulations, and guidelines. All mining activities involving the production, use, and/or disposal of hazardous or extremely hazardous materials are and would continue to be conducted so as to minimize potential environmental impacts.

TBCC and PRC must comply with emergency reporting requirements for release of hazardous materials. Any release of hazardous or extremely hazardous substances in excess of the reportable quantity, as established in 40 CFR 117, is reported as required by Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended. The materials for which such notification must be given are the extremely hazardous substances listed in Section 302 of the *Emergency Planning and Community Right to Know Act* and the hazardous substances designated under Section 102 of CERCLA, as amended. If a reportable quantity of a hazardous or extremely hazardous substance is released, immediate notice must be given to the WDEQ Solid and Hazardous Waste Division, WDEQ Water Quality Division, and all other appropriate federal and state agencies.

Each mining company is expected to prepare and implement several plans and/or policies to ensure environmental protection from hazardous and extremely hazardous materials. These plans/policies include:

- Spill Prevention Control and Countermeasure Plans;
- Spill Response Plans;
- Stormwater Pollution Prevention Plans;
- Inventories of Hazardous Chemical Categories Pursuant to Section 313 of SARA, as amended; and
- Emergency Response Plans.

All mining operations are also required to be in compliance with regulations promulgated under the Resource Conservation and Recovery Act, Federal Water Pollution Control Act (Clean Water Act), Safe Drinking Water Act, Toxic Substances Control Act, Mine Safety and Health Act, Department of Transportation, and the Federal Clean Air Act. In addition, mining operations must comply with all attendant state rules and regulations relating to hazardous material reporting, transportation, management, and disposal.

Compliance with these rules is the current practice at the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines. Acquisition of the LBA tracts by the applicants would not change these current practices nor the type of any wastes generated and disposed of by the mines; however, the quantities of some wastes (e.g., lubricants and solid wastes produced in the shops and offices) would likely increase in proportion to increases in coal production.

2.10 Summary of Alternatives and Environmental Consequences

2.10.1 Background

The decision-making process for public lands in Wyoming is conducted in compliance with NEPA, which requires all federal agencies to involve interested publics in their decision-making, consider reasonable alternatives to the proposed actions, develop measures to mitigate environmental impacts, and prepare environmental documents that disclose the impacts of proposed actions and alternatives.

This final EIS analyzes in detail different alternatives for the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts described in the discussion above.

2.10.2 Summary of Alternatives

The North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts under the Action Alternatives are shown on Figures 2-1 through 2-6, respectively. A summary comparison of projected coal production, surface disturbance, mine life, and federal and state revenues for the Proposed Action and Alternatives 1, 2, and 3 (if applicable) for the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts LBA Tracts are presented in Tables 2-2 through 2-13, respectively.

Table 2-2 presents the comparisons assuming that Shroyer Road is not moved and the underlying coal is not recovered from the North Hilight Field tract. Table 2-3 presents the comparisons assuming that Shroyer Road is moved and the underlying coal is recovered from the North Hilight Field tract.

Table 2-4 presents the comparisons assuming that Reno Road is not moved and the underlying coal is not recovered from the South Hilight Field tract.

Table 2-2. Summary Comparison of Coal Production, Surface Disturbance, Mine Life, and Revenues for North Hilight Field LBA Tract and Black Thunder Mine – Shroyer Road is Not Moved and the Underlying Coal is Not Recovered.

Item	Alternative 1 - No Action Alternative (Existing Black Thunder Mine)	Added by Proposed Action	Added by Alternative 2
In-Place Coal (as of 1/1/09)	1,271.1 mmt	319.7 mmt	756.9 mmt
Mineable Coal (as of 1/1/09)[1]	1,271.1 mmt	286.3 mmt	709.6 mmt
Recoverable Coal (as of 1/1/09)[2]	1,169.4 mmt	263.4 mmt	652.8 mmt
Coal Mined Through 2008	1,087.9 mmt	--	--
Lease Area[3]	19,581.3 ac	2,613.5 ac	7,139.4 ac
Total Area To Be Disturbed[3]	26,490.2 ac	5,053.0 ac	12,908.8 ac
Permit Area[3]	29,212.0 ac	5,053.0 ac	12,908.8 ac
Average Annual Coal Production (by 2015)[4]	135 mmt	0 mmt	0 mmt
Remaining Life of Mine (post-2008)	9.3 yrs	2.0 yrs	4.8 yrs
Projected Number of Employees (by 2013)[4]	1,324	0	0
Total Projected State Revenues (post-2008)[5]	$1,977.9 mm	$488.5 – $584.4 mm	$1,210.5 – $1,448.3 mm
Total Projected Federal Revenues (post-2008)[6]	$1,541.1 mm	$390.1 – $486.0 mm	$966.8 – $1,204.5 mm

1 Under the Proposed Action and Alternative 2, the mineable coal figure excludes all coal that would not be mined beneath the BNSF & UP railroad ROW and associated buffer zone and Shroyer Road ROW and associated buffer zone.

2 Assumes 92 percent recovery of mineable coal that occurs during normal mining operation.

3 The lease area figure includes federal coal leases only and does not include state and private coal within the permit boundary. The disturbed area typically exceeds the leased area (total federal and state) because of the need for highwall reduction, topsoil removal, and other mine support activities outside the lease boundaries. The permit area is larger than the leased or disturbed area to assure that all disturbed lands are within the permit boundary and to allow an easily defined legal land description.

4 The mine projects to increase production rate from 100 mmtpy after 2008 to 135 mmtpy by 2015. The mine projects to increase employment from 1,080 to 1,324 as projected production increases.

5 Revenues to the State of Wyoming include severance taxes, property and production taxes (ad valorem), sales and use taxes, and Wyoming's share of federal royalty payments, AML fees and bonus bid payments. State revenues are based on $0.4312 per ton estimate for severance taxes × amount of recoverable coal, plus $0.372 per ton estimate for ad valorem taxes × amount of recoverable coal, plus $0.0569 per ton estimate for sales and use taxes × amount of recoverable coal, plus a projected coal price of $11.06 per ton × amount of recoverable coal × federal royalty of 12.5 percent minus federal's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus federal's 50 percent share, plus bonus bid payment on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus bid payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus federal's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

6 Federal revenues include black lung taxes and the federal government's share of federal royalty payments, AML fees, and bonus bid payments. Federal revenues are based on a projected coal price of $11.06 per ton × amount of recoverable coal × black lung tax of 4.4 percent, plus $11.06 per ton price × amount of recoverable coal × federal royalty of 12.5 percent minus state's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus state's 50 percent share, plus bonus bid payments on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus state's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

Table 2-3. Summary Comparison of Coal Production, Surface Disturbance, Mine Life, and Revenues for North Hilight Field LBA Tract and Black Thunder Mine – Shroyer Road is Moved and the Underlying Coal is Recovered.

Item	Alternative 1 - No Action Alternative (Existing Black Thunder Mine)	Added by Proposed Action	Added by Alternative 2
In-Place Coal (as of 1/1/09)	1,271.1 mmt	319.7 mmt	756.9 mmt
Mineable Coal (as of 1/1/09)[1]	1,271.1 mmt	295.8 mmt	727.5 mmt
Recoverable Coal (as of 1/1/09)[2]	1,169.4 mmt	272.1 mmt	669.3 mmt
Coal Mined Through 2008	1,087.9 mmt	--	--
Lease Area[3]	19,581.3 ac	2,613.5 ac	7,139.4 ac
Total Area To Be Disturbed[3]	26,490.2 ac	5,053.0 ac	12,908.8 ac
Permit Area[3]	29,212.0 ac	5,053.0 ac	12,908.8 ac
Average Annual Coal Production (by 2015)[4]	135 mmt	0 mmt	0 mmt
Remaining Life of Mine (post-2008)	9.3 yrs	2.0 yrs	5.0 yrs
Projected Number of Employees (by 2013)[4]	1,324	0	0
Total Projected State Revenues (post-2008)[5]	$1,977.9 mm	$504.6 – $603.7 mm	$1,241.1 – $1,484.9 mm
Total Projected Federal Revenues (post-2008)[6]	$1,541.1 mm	$403.0 – $502.1 mm	$991.2 – $1,234.9 mm

1 Under the Proposed Action and Alternative 2, the mineable coal figure excludes all coal that would not be mined beneath BNSF & UP railroad ROW and associated buffer zone.

2 Assumes 92 percent recovery of mineable coal that occurs during normal mining operation.

3 The lease area figure includes federal coal leases only and does not include state and private coal within the permit boundary. The disturbed area typically exceeds the leased area (total federal and state) because of the need for highwall reduction, topsoil removal, and other mine support activities outside the lease boundaries. The permit area is larger than the leased or disturbed area to assure that all disturbed lands are within the permit boundary and to allow an easily defined legal land description.

4 The mine projects to increase production rate from 100 mmtpy after 2008 to 135 mmtpy by 2015. The mine projects to increase employment from 1,080 to 1,324 as projected production increases.

5 Revenues to the State of Wyoming include severance taxes, property and production taxes (ad valorem), sales and use taxes, and Wyoming's share of federal royalty payments, AML fees and bonus bid payments. State revenues are based on $0.4312 per ton estimate for severance taxes × amount of recoverable coal, plus $0.372 per ton estimate for ad valorem taxes × amount of recoverable coal, plus $0.0569 per ton estimate for sales and use taxes × amount of recoverable coal, plus a projected coal price of $11.06 per ton × amount of recoverable coal × federal royalty of 12.5 percent minus federal's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus federal's 50 percent share, plus bonus bid payment on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus bid payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus federal's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

6 Federal revenues include black lung taxes and the federal government's share of federal royalty payments, AML fees, and bonus bid payments. Federal revenues are based on a projected coal price of $11.06 per ton × amount of recoverable coal × black lung tax of 4.4 percent, plus $11.06 per ton price × amount of recoverable coal × federal royalty of 12.5 percent minus state's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus state's 50 percent share, plus bonus bid payments on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus state's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

Table 2-4. Summary Comparison of Coal Production, Surface Disturbance, Mine Life, and Revenues for South Hilight Field LBA Tract and Black Thunder Mine – Reno Road is Not Moved and the Underlying Coal is Not Recovered.

Item	Alternative 1 - No Action Alternative (Existing Black Thunder Mine)	Added by Proposed Action	Added by Alternative 2
In-Place Coal (as of 1/1/09)	1,271.1 mmt	273.3 mmt	406.5 mmt
Mineable Coal (as of 1/1/09)[1]	1,271.1 mmt	232.2 mmt	330.8 mmt
Recoverable Coal (as of 1/1/09)[2]	1,169.4 mmt	213.6 mmt	304.3 mmt
Coal Mined Through 2008	1,087.9 mmt	--	--
Lease Area[3]	19,581.3 ac	1,976.7 ac	2,922.4 ac
Total Area To Be Disturbed[3]	26,490.2 ac	1,126.0 ac	2,731.4 ac
Permit Area[3]	29,212.0 ac	1,126.0 ac	2,731.4 ac
Average Annual Coal Production (by 2015)[4]	135 mmt	0 mmt	0 mmt
Remaining Life of Mine (post-2008)	9.3 yrs	1.6 yrs	2.3 yrs
Projected Number of Employees (by 2013)[4]	1,324	0	0
Total Projected State Revenues (post-2008)[5]	$1,977.9 mm	$396.1 – $473.9 mm	$564.3 – $675.1 mm
Total Projected Federal Revenues (post-2008)[6]	$1,541.1 mm	$316.3 – $394.1 mm	$450.7 – $561.5 mm

1 Under the Proposed Action and Alternative 2, the mineable coal figure excludes all coal that would not be mined beneath BNSF & UP railroad ROW and associated buffer zone. Under Alternative 2, the mineable coal figure excludes all coal that would not be mined beneath Reno Road ROW and associated buffer zone.

2 Assumes 92 percent recovery of mineable coal that occurs during normal mining operation.

3 The lease area figure includes federal coal leases only and does not include state and private coal within the permit boundary. The disturbed area typically exceeds the leased area (total federal and state) because of the need for highwall reduction, topsoil removal, and other mine support activities outside the lease boundaries. The permit area is larger than the leased or disturbed area to assure that all disturbed lands are within the permit boundary and to allow an easily defined legal land description.

4 The mine projects to increase production rate from 100 mmtpy after 2008 to 135 mmtpy by 2015. The mine projects to increase employment from 1,080 to 1,324 as projected production increases.

5 Revenues to the State of Wyoming include severance taxes, property and production taxes (ad valorem), sales and use taxes, and Wyoming's share of federal royalty payments, AML fees and bonus bid payments. State revenues are based on $0.4312 per ton estimate for severance taxes × amount of recoverable coal, plus $0.372 per ton estimate for ad valorem taxes × amount of recoverable coal, plus $0.0569 per ton estimate for sales and use taxes × amount of recoverable coal, plus a projected coal price of $11.06 per ton × amount of recoverable coal × federal royalty of 12.5 percent minus federal's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus federal's 50 percent share, plus bonus bid payment on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus bid payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus federal's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

6 Federal revenues include black lung taxes and the federal government's share of federal royalty payments, AML fees, and bonus bid payments. Federal revenues are based on a projected coal price of $11.06 per ton × amount of recoverable coal × black lung tax of 4.4 percent, plus $11.06 per ton price × amount of recoverable coal × federal royalty of 12.5 percent minus state's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus state's 50 percent share, plus bonus bid payments on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus state's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

Table 2-5. Summary Comparison of Coal Production, Surface Disturbance, Mine Life, and Revenues for South Hilight Field LBA Tract and Black Thunder Mine – Reno Road is Moved and the Underlying Coal is Recovered.

Item	Alternative 1 - No Action Alternative (Existing Black Thunder Mine)	Added by Proposed Action	Added by Alternative 2
In-Place Coal (as of 1/1/09)	1,271.1 mmt	273.3 mmt	406.5 mmt
Mineable Coal (as of 1/1/09)[1]	1,271.1 mmt	232.2 mmt	347.8 mmt
Recoverable Coal (as of 1/1/09)[2]	1,169.4 mmt	213.6 mmt	320.0 mmt
Coal Mined Through 2008	1,087.9 mmt	--	--
Lease Area[3]	19,581.3 ac	1,976.7 ac	2,922.4 ac
Total Area To Be Disturbed[3]	26,490.2 ac	1,126.0 ac	2,731.4 ac
Permit Area[3]	29,212.0 ac	1,126.0 ac	2,731.4 ac
Average Annual Coal Production (by 2015)[4]	135 mmt	0 mmt	0 mmt
Remaining Life of Mine (post-2008)	9.3 yrs	1.6 yrs	2.4 yrs
Projected Number of Employees (by 2013)[4]	1,324	0	0
Total Projected State Revenues (post-2008)[5]	\$1,977.9 mm	\$396.1 – \$473.9 mm	\$593.4 – \$709.9 mm
Total Projected Federal Revenues (post-2008)[6]	\$1,541.1 mm	\$316.3 – \$394.1 mm	\$473.9 – \$590.4 mm

1 Under the Proposed Action and Alternative 2, the mineable coal figure excludes all coal that would not be mined beneath BNSF & UP railroad ROW and associated buffer zone.

2 Assumes 92 percent recovery of mineable coal that occurs during normal mining operation.

3 The lease area figure includes federal coal leases only and does not include state and private coal within the permit boundary. The disturbed area typically exceeds the leased area (total federal and state) because of the need for highwall reduction, topsoil removal, and other mine support activities outside the lease boundaries. The permit area is larger than the leased or disturbed area to assure that all disturbed lands are within the permit boundary and to allow an easily defined legal land description.

4 The mine projects to increase production rate from 100 mmtpy after 2008 to 135 mmtpy by 2015. The mine projects to increase employment from 1,080 to 1,324 as projected production increases.

5 Revenues to the State of Wyoming include severance taxes, property and production taxes (ad valorem), sales and use taxes, and Wyoming's share of federal royalty payments, AML fees and bonus bid payments. State revenues are based on \$0.4312 per ton estimate for severance taxes × amount of recoverable coal, plus \$0.372 per ton estimate for ad valorem taxes × amount of recoverable coal, plus \$0.0569 per ton estimate for sales and use taxes × amount of recoverable coal, plus a projected coal price of \$11.06 per ton × amount of recoverable coal × federal royalty of 12.5 percent minus federal's 50 percent share, plus \$0.28 per ton for AML fees × amount of recoverable coal minus federal's 50 percent share, plus bonus bid payment on LBA leased coal of \$0.30 to \$0.97 per ton (based on the range of bonus bid payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus federal's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

6 Federal revenues include black lung taxes and the federal government's share of federal royalty payments, AML fees, and bonus bid payments. Federal revenues are based on a projected coal price of \$11.06 per ton × amount of recoverable coal × black lung tax of 4.4 percent, plus \$11.06 per ton price × amount of recoverable coal × federal royalty of 12.5 percent minus state's 50 percent share, plus \$0.28 per ton for AML fees × amount of recoverable coal minus state's 50 percent share, plus bonus bid payments on LBA leased coal of \$0.30 to \$0.97 per ton (based on the range of bonus payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus state's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

Table 2-6. Summary Comparison of Coal Production, Surface Disturbance, Mine Life, and Revenues for West Hilight Field LBA Tract and Black Thunder Mine – State Highway 450 and Hilight Road are Not Moved and the Underlying Coal is Not Recovered.

Item	Alternative 1 – No Action Alternative (Existing Black Thunder Mine)	Added by Proposed Action	Added by Alternative 2	Added by Alternative 3
In-Place Coal (as of 1/1/09)	1,271.1 mmt	440.4 mmt	1,147.9 mmt	1,373.4 mmt
Mineable Coal (as of 1/1/09)[1]	1,271.1 mmt	410.8 mmt	1,049.1 mmt	1,049.1 mmt
Recoverable Coal (as of 1/1/09)[2]	1,169.4 mmt	377.9 mmt	965.2 mmt	965.2 mmt
Coal Mined Through 2008	1,087.9 mmt	--	--	--
Lease Area[3]	19,581.3 ac	2,370.5 ac	7,191.3 ac	8,570.1 ac
Total Area To Be Disturbed[3]	26,490.2 ac	6,351.4 ac	10,250.8 ac	10,250.8 ac
Permit Area[3]	29,212.0 ac	6,351.4 ac	10,250.8 ac	10,250.8 ac
Average Annual Coal Production (by 2015)[4]	135 mmt	0 mmt	0 mmt	0 mmt
Remaining Life of Mine (post-2008)	9.3 yrs	2.8 yrs	7.1 yrs	7.1 yrs
Projected Number of Employees (by 2013)[4]	1,324	0	0	0
Total Projected State Revenues (post-2008)[5]	$1,977.9 mm	$700.8 – $838.4 mm	$1,789.9 – $2,141.3 mm	$1,789.9 – $2,141.3 mm
Total Projected Federal Revenues (post-2008)[6]	$1,541.1 mm	$559.7 – $697.3 mm	$1,429.4 – $1,780.8 mm	$1,429.4 – $1,780.8 mm

1 Under the Proposed Action, the mineable coal figure excludes all coal that would not be mined beneath State Highway 450 ROW and associated buffer zone. Under Alternatives 2 and 3, the mineable coal figure excludes all coal that would not be mined beneath State Highway 450 and Hilight Road ROWs and associated buffer zones. Under Alternative 3, the mineable coal figure excludes all coal that would not be mined beneath the Northwest Rail Loop Amendment Area.

2 Assumes 92 percent recovery of mineable coal that occurs during normal mining operation.

3 The lease area figure includes federal coal leases only and does not include state and private coal within the permit boundary. The disturbed area typically exceeds the leased area (total federal and state) because of the need for highwall reduction, topsoil removal, and other mine support activities outside the lease boundaries. The permit area is larger than the leased or disturbed area to assure that all disturbed lands are within the permit boundary and to allow an easily defined legal land description.

4 The mine projects to increase production rate from 100 mmtpy after 2008 to 135 mmtpy by 2015. The mine projects to increase employment from 1,080 to 1,324 as projected production increases.

5 Revenues to the State of Wyoming include severance taxes, property and production taxes (ad valorem), sales and use taxes, and Wyoming's share of federal royalty payments, AML fees and bonus bid payments. State revenues are based on $0.4312 per ton estimate for severance taxes × amount of recoverable coal, plus $0.372 per ton estimate for ad valorem taxes × amount of recoverable coal, plus $0.0569 per ton estimate for sales and use taxes × amount of recoverable coal, plus a projected coal price of $11.06 per ton × amount of recoverable coal × federal royalty of 12.5 percent minus federal's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus federal's 50 percent share, plus bonus bid payment on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus bid payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus federal's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

6 Federal revenues include black lung taxes and the federal government's share of federal royalty payments, AML fees, and bonus bid payments. Federal revenues are based on a projected coal price of $11.06 per ton × amount of recoverable coal × black lung tax of 4.4 percent, plus $11.06 per ton price × amount of recoverable coal × federal royalty of 12.5 percent minus state's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus state's 50 percent share, plus bonus bid payments on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus state's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

Table 2-7. Summary Comparison of Coal Production, Surface Disturbance, Mine Life, and Revenues for West Hilight Field LBA Tract and Black Thunder Mine – State Highway 450 and Hilight Road are Moved and the Underlying Coal is Recovered.

Item	Alternative 1 – No Action Alternative (Existing Black Thunder Mine)	Added by Proposed Action	Added by Alternative 2	Added by Alternative 3
In-Place Coal (as of 1/1/09)	1,271.1 mmt	440.4 mmt	1,147.9 mmt	1,373.4 mmt
Mineable Coal (as of 1/1/09)[1]	1,271.1 mmt	440.4 mmt	1,147.9 mmt	1,147.9 mmt
Recoverable Coal (as of 1/1/09)[2]	1,169.4 mmt	405.2 mmt	1,056.1 mmt	1,056.1 mmt
Coal Mined Through 2008	1,087.9 mmt	--	--	--
Lease Area[3]	19,581.3 ac	2,370.5 ac	7,191.3 ac	8,570.1 ac
Total Area To Be Disturbed[3]	26,490.2 ac	6,351.4 ac	11,629.5 ac	11,629.5 ac
Permit Area[3]	29,212.0 ac	6,351.4 ac	11,629.5 ac	11,629.5 ac
Average Annual Coal Production (by 2015)[4]	135 mmt	0 mmt	0 mmt	0 mmt
Remaining Life of Mine (post-2008)	9.3 yrs	3.0 yrs	7.8 yrs	7.8 yrs
Projected Number of Employees (by 2013)[4]	1,324	0	0	0
Total Projected State Revenues (post-2008)[5]	$1,977.9 mm	$751.4 – $898.9 mm	$1,958.4 – $2,343.0 mm	$1,958.4 – $2,343.0 mm
Total Projected Federal Revenues (post-2008)[6]	$1,541.1 mm	$600.1 – $747.6 mm	$1,564.0 – $1,948.6 mm	$1,564.0 – $1,948.6 mm

1 Under the Proposed Action, the mineable coal figure excludes all coal that would not be mined beneath State Highway 450 ROW and associated buffer zone. Under Alternatives 2 and 3, the mineable coal figure excludes all coal that would not be mined beneath State Highway 450 and Hilight Road ROWs and associated buffer zones. Under Alternative 3, the mineable coal figure excludes all coal that would not be mined beneath the Northwest Rail Loop Amendment Area.

2 Assumes 92 percent recovery of mineable coal that occurs during normal mining operation.

3 The lease area figure includes federal coal leases only and does not include state and private coal within the permit boundary. The disturbed area typically exceeds the leased area (total federal and state) because of the need for highwall reduction, topsoil removal, and other mine support activities outside the lease boundaries. The permit area is larger than the leased or disturbed area to assure that all disturbed lands are within the permit boundary and to allow an easily defined legal land description.

4 The mine projects to increase production rate from 100 mmtpy after 2008 to 135 mmtpy by 2015. The mine projects to increase employment from 1,080 to 1,324 as projected production increases.

5 Revenues to the State of Wyoming include severance taxes, property and production taxes (ad valorem), sales and use taxes, and Wyoming's share of federal royalty payments, AML fees and bonus bid payments. State revenues are based on $0.4312 per ton estimate for severance taxes × amount of recoverable coal, plus $0.372 per ton estimate for ad valorem taxes × amount of recoverable coal, plus $0.0569 per ton estimate for sales and use taxes × amount of recoverable coal, plus a projected coal price of $11.06 per ton × amount of recoverable coal × federal royalty of 12.5 percent minus federal's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus federal's 50 percent share, plus bonus bid payment on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus bid payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus federal's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

6 Federal revenues include black lung taxes and the federal government's share of federal royalty payments, AML fees, and bonus bid payments. Federal revenues are based on a projected coal price of $11.06 per ton × amount of recoverable coal × black lung tax of 4.4 percent, plus $11.06 per ton price × amount of recoverable coal × federal royalty of 12.5 percent minus state's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus state's 50 percent share, plus bonus bid payments on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus state's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

Table 2-8. Summary Comparison of Coal Production, Surface Disturbance, Mine Life, and Revenues for West Jacobs Ranch LBA Tract and Jacobs Ranch Mine – State Highway 450 and Hilight Road are Not Moved and the Underlying Coal is Not Recovered.

Item	Alternative 1 - No Action Alternative (Existing Jacobs Ranch Mine)	Added by Proposed Action	Added by Alternative 2
In-Place Coal (as of 1/1/09)	403.6 mmt	957.0 mmt	1,269.0 mmt
Mineable Coal (as of 1/1/09)[1]	403.6 mmt	744.0 mmt	1,014.0 mmt
Recoverable Coal (as of 1/1/09)[2]	379.4 mmt	669.6 mmt	912.6 mmt
Coal Mined Through 2008	671.1 mmt	--	--
Lease Area[3]	7,381.0 ac	5,944.4 ac	8,076.2 ac
Total Area To Be Disturbed[3]	15,261.5 ac	7,023.0 ac	9,370.0 ac
Permit Area[3]	15,625.0 ac	8,066.0 ac	10,766.0 ac
Average Annual Coal Production (post-2008)	40 mmt	0 mmt	0 mmt
Remaining Life of Mine (post-2008)	9.6 yrs	16.7 yrs	22.8 yrs
Projected Number of Employees	630	155	155
Total Projected State Revenues (post-2008)[4]	$641.7 mm	$1,244.1 – $1,493.4 mm	$1,695.6 – $2,035.3 mm
Total Projected Federal Revenues (post-2008)[5]	$500.0 mm	$994.1 – $1,243.3 mm	$1,354.8 – $1,694.5 mm

1 Under the Proposed Action and Alternative 2, the mineable coal figure excludes all coal that would not be mined beneath State Highway 450 and Hilight Road ROWs and associated buffer zones.

2 Assumes 94 percent recovery of mineable coal that occurs during normal mining operation under Alternative 1, and 90 percent recovery of mineable coal that occurs during normal mining operation under the Proposed Action and Alternative 2.

3 The lease area figure includes federal coal leases only and does not include state and private coal within the permit boundary. The disturbed area typically exceeds the leased area (total federal and state) because of the need for highwall reduction, topsoil removal, and other mine support activities outside the lease boundaries. The permit area is larger than the leased or disturbed area to assure that all disturbed lands are within the permit boundary and to allow an easily defined legal land description.

4 Revenues to the State of Wyoming include severance taxes, property and production taxes (ad valorem), sales and use taxes, and Wyoming's share of federal royalty payments, AML fees and bonus bid payments. State revenues are based on $0.4312 per ton estimate for severance taxes × amount of recoverable coal, plus $0.372 per ton estimate for ad valorem taxes × amount of recoverable coal, plus $0.0569 per ton estimate for sales and use taxes × amount of recoverable coal, plus a projected coal price of $11.06 per ton × amount of recoverable coal × federal royalty of 12.5 percent minus federal's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus federal's 50 percent share, plus bonus bid payment on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus bid payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus federal's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

5 Federal revenues include black lung taxes and the federal government's share of federal royalty payments, AML fees, and bonus bid payments. Federal revenues are based on a projected coal price of $11.06 per ton × amount of recoverable coal × black lung tax of 4.0 percent, plus $11.06 per ton price × amount of recoverable coal × federal royalty of 12.5 percent minus state's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus state's 50 percent share, plus bonus bid payments on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus state's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

Table 2-9. Summary Comparison of Coal Production, Surface Disturbance, Mine Life, and Revenues for West Jacobs Ranch LBA Tract and Jacobs Ranch Mine – State Highway 450 and Hilight Road are Moved and the Underlying Coal is Recovered.

Item	Alternative 1 - No Action Alternative (Existing Jacobs Ranch Mine)	Added by Proposed Action	Added by Alternative 2
In-Place Coal (as of 1/1/09)	403.6 mmt	957.0 mmt	1,269.0 mmt
Mineable Coal (as of 1/1/09)[1]	403.6 mmt	957.0 mmt	1,269.0 mmt
Recoverable Coal (as of 1/1/09)[2]	379.4 mmt	861.3 mmt	1,142.1 mmt
Coal Mined Through 2008	671.1 mmt	--	--
Lease Area[3]	7,381.0 ac	5,944.4 ac	8,076.2 ac
Total Area To Be Disturbed[3]	15,261.5 ac	7,023.0 ac	9,370.0 ac
Permit Area[3]	15,625.0 ac	8,066.0 ac	10,766.0 ac
Average Annual Coal Production (post-2008)	40 mmt	0 mmt	0 mmt
Remaining Life of Mine (post-2008)	9.6 yrs	21.5 yrs	28.6 yrs
Projected Number of Employees	630	155	155
Total Projected State Revenues (post-2008)[4]	$641.7 mm	$1,600.3 – $1,920.9 mm	$2,122.0 – $2,547.2 mm
Total Projected Federal Revenues (post-2008)[5]	$500.0 mm	$1,278.6 – $1,599.2 mm	$1,695.5 – $2,120.6 mm

[1] Under the Proposed Action and Alternative 2, the mineable coal figure includes all coal that would be mined beneath State Highway 450 and Hilight Road ROWs and associated buffer zones.

[2] Assumes 94 percent recovery of mineable coal that occurs during normal mining operation under Alternative 1, and 90 percent recovery of mineable coal that occurs during normal mining operation under the Proposed Action and Alternative 2.

[3] The lease area figure includes federal coal leases only and does not include state and private coal within the permit boundary. The disturbed area typically exceeds the leased area (total federal and state) because of the need for highwall reduction, topsoil removal, and other mine support activities outside the lease boundaries. The permit area is larger than the leased or disturbed area to assure that all disturbed lands are within the permit boundary and to allow an easily defined legal land description.

[4] Revenues to the State of Wyoming include severance taxes, property and production taxes (ad valorem), sales and use taxes, and Wyoming's share of federal royalty payments, AML fees and bonus bid payments. State revenues are based on $0.4312 per ton estimate for severance taxes × amount of recoverable coal, plus $0.372 per ton estimate for ad valorem taxes × amount of recoverable coal, plus $0.0569 per ton estimate for sales and use taxes × amount of recoverable coal, plus a projected coal price of $11.06 per ton × amount of recoverable coal × federal royalty of 12.5 percent minus federal's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus federal's 50 percent share, plus bonus bid payment on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus bid payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus federal's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

[5] Federal revenues include black lung taxes and the federal government's share of federal royalty payments, AML fees, and bonus bid payments. Federal revenues are based on a projected coal price of $11.06 per ton × amount of recoverable coal × black lung tax of 4.4 percent, plus $11.06 per ton price × amount of recoverable coal × federal royalty of 12.5 percent minus state's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus state's 50 percent share, plus bonus bid payments on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus state's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

Table 2-10. Summary Comparison of Coal Production, Surface Disturbance, Mine Life, and Revenues for North Porcupine LBA Tract and North Antelope Rochelle Mine – Mackey Road is Not Moved and the Underlying Coal is Not Recovered.

Item	Alternative 1 - No Action Alternative (Existing North Antelope Rochelle Mine)	Added by Proposed Action	Added by Alternative 2
In-Place Coal (as of 1/1/09)	1,049.9 mmt	756.9 mmt	955.8 mmt
Mineable Coal (as of 1/1/09)[1]	1,015.0 mmt	653.5 mmt	810.2 mmt
Recoverable Coal (as of 1/1/09)[2]	933.8 mmt	601.2 mmt	745.4 mmt
Coal Mined Through 2008	1,230.8 mmt	--	--
Lease Area[3]	16,666.1 ac	5,795.8 ac	7,366.8 ac
Total Area To Be Disturbed[3]	27,443.0 ac	9,864.0 ac	11,444.0 ac
Permit Area[3]	45,975.0 ac	1,760.0 ac	3,120.0 ac
Average Annual Coal Production (post-2008)	95 mmt	0 mmt	0 mmt
Remaining Life of Mine (post-2008)	9.9 yrs	6.3 yrs	7.8 yrs
Projected Number of Employees	1,150	0	0
Total Projected State Revenues (post-2008)[4]	$1,579.4 mm	$1,114.9 – $1,333.8 mm	$1,382.3 – $1,653.7 mm
Total Projected Federal Revenues (post-2008)[5]	$1,230.6 mm	$890.3 – $1,109.3 mm	$1,103.9 – $1,375.3 mm

1 Under the Proposed Action, the mineable coal figure excludes all coal that would not be mined beneath BNSF & UP railroad ROW and associated buffer zone, Teckla Substation buffer zone, and Mackey Road ROW and associated buffer zone. Under Alternative 2, the mineable coal figure excludes all coal that would not be mined beneath BNSF & UP railroad ROW and associated buffer zone, Teckla Substation buffer zone, a portion of Matheson Road ROW and associated buffer zone, and Mackey Road ROW and associated buffer zone.

2 Assumes 92 percent recovery of mineable coal that occurs during normal mining operation.

3 The lease area figure includes federal coal leases only and does not include state coal within the permit boundary. The disturbed area typically exceeds the leased area (total federal and state) because of the need for highwall reduction, topsoil removal, and other mine support activities outside the lease boundaries. The permit area is larger than the leased or disturbed area to assure that all disturbed lands are within the permit boundary and to allow an easily defined legal land description.

4 Revenues to the State of Wyoming include severance taxes, property and production taxes (ad valorem), sales and use taxes, and Wyoming's share of federal royalty payments, AML fees and bonus bid payments. State revenues are based on $0.4312 per ton estimate for severance taxes × amount of recoverable coal, plus $0.372 per ton estimate for ad valorem taxes × amount of recoverable coal, plus $0.0569 per ton estimate for sales and use taxes × amount of recoverable coal, plus a projected coal price of $11.06 per ton × amount of recoverable coal × federal royalty of 12.5 percent minus federal's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus federal's 50 percent share, plus bonus bid payment on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus bid payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus federal's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

5 Federal revenues include black lung taxes and the federal government's share of federal royalty payments, AML fees, and bonus bid payments. Federal revenues are based on a projected coal price of $11.06 per ton × amount of recoverable coal × black lung tax of 4.4 percent, plus $11.06 per ton price × amount of recoverable coal × federal royalty of 12.5 percent minus state's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus state's 50 percent share, plus bonus bid payments on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus state's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

Table 2-11. Summary Comparison of Coal Production, Surface Disturbance, Mine Life, and Revenues for North Porcupine LBA Tract and North Antelope Rochelle Mine – Mackey Road is Moved and the Underlying Coal is Recovered.

Item	Alternative 1 - No Action Alternative (Existing North Antelope Rochelle Mine)	Added by Proposed Action	Added by Alternative 2
In-Place Coal (as of 1/1/09)	1,049.9 mmt	756.9 mmt	955.8 mmt
Mineable Coal (as of 1/1/09)[1]	1,015.0 mmt	688.3 mmt	845.0 mmt
Recoverable Coal (as of 1/1/09)[2]	933.8 mmt	633.3 mmt	777.4 mmt
Coal Mined Through 2008	1,230.8 mmt	--	--
Lease Area[3]	16,666.1 ac	5,795.8 ac	7,366.8 ac
Total Area To Be Disturbed[3]	27,443.0 ac	10,167.0 ac	11,767.0 ac
Permit Area[3]	45,975.0 ac	1,760.0 ac	3,120.0 ac
Average Annual Coal Production (post-2008)	95 mmt	0 mmt	0 mmt
Remaining Life of Mine (post-2008)	9.9 yrs	6.7 yrs	8.2 yrs
Projected Number of Employees	1,150	0	0
Total Projected State Revenues (post-2008)[4]	$1,579.4 mm	$1,174.4 – $1,405.0 mm	$1,441.6 – $1,724.7 mm
Total Projected Federal Revenues (post-2008)[5]	$1,230.6 mm	$937.9 – $1,168.4 mm	$1,151.3 – $1,434.4 mm

[1] Under the Proposed Action, the mineable coal figure excludes all coal that would not be mined beneath BNSF & UP railroad ROW and associated buffer zone and Teckla Substation buffer zone. Under Alternative 2, the mineable coal figure excludes all coal that would not be mined beneath BNSF & UP railroad ROW and associated buffer zone, Teckla Substation buffer zone, and a portion of Matheson Road ROW and associated buffer zone.

[2] Assumes 92 percent recovery of mineable coal that occurs during normal mining operation.

[3] The lease area figure includes federal coal leases only and does not include state coal within the permit boundary. The disturbed area typically exceeds the leased area (total federal and state) because of the need for highwall reduction, topsoil removal, and other mine support activities outside the lease boundaries. The permit area is larger than the leased or disturbed area to assure that all disturbed lands are within the permit boundary and to allow an easily defined legal land description.

[4] Revenues to the State of Wyoming include severance taxes, property and production taxes (ad valorem), sales and use taxes, and Wyoming's share of federal royalty payments, AML fees and bonus bid payments. State revenues are based on $0.4312 per ton estimate for severance taxes × amount of recoverable coal, plus $0.372 per ton estimate for ad valorem taxes × amount of recoverable coal, plus $0.0569 per ton estimate for sales and use taxes × amount of recoverable coal, plus a projected coal price of $11.06 per ton × amount of recoverable coal × federal royalty of 12.5 percent minus federal's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus federal's 50 percent share, plus bonus bid payment on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus bid payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus federal's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

[5] Federal revenues include black lung taxes and the federal government's share of federal royalty payments, AML fees, and bonus bid payments. Federal revenues are based on a projected coal price of $11.06 per ton × amount of recoverable coal × black lung tax of 4.4 percent, plus $11.06 per ton price × amount of recoverable coal × federal royalty of 12.5 percent minus state's 50 percent share, plus $0.35 per ton for AML fees × amount of recoverable coal minus state's 50 percent share, plus bonus bid payments on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus state's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

Table 2-12. Summary Comparison of Coal Production, Surface Disturbance, Mine Life, and Revenues for South Porcupine LBA Tract and North Antelope Rochelle Mine – 2.25-Mile Section of Antelope Road is Not Moved and the Underlying Coal is Not Recovered.

Item	**Alternative 1 - No Action Alternative (Existing North Antelope Rochelle Mine)**	**Added by Proposed Action**	**Added by Alternative 2**
In-Place Coal (as of 1/1/09)	1,049.9 mmt	422.2 mmt	470.9 mmt
Mineable Coal (as of 1/1/09)[1]	1,015.0 mmt	336.6 mmt	368.8 mmt
Recoverable Coal (as of 1/1/09)[2]	933.8 mmt	309.7 mmt	339.3 mmt
Coal Mined Through 2008	1,230.8 mmt	--	--
Lease Area[3]	16,666.1 ac	3,186.0 ac	3,568.0 ac
Total Area To Be Disturbed[3]	27,443.0 ac	3,366.0 ac	4,068.0 ac
Permit Area[3]	45,975.0 ac	200.0 ac	400.0 ac
Average Annual Coal Production (post-2008)	95 mmt	0 mmt	0 mmt
Remaining Life of Mine (post-2008)	9.9 yrs	3.3 yrs	3.6 yrs
Projected Number of Employees	1,150	0	0
Total Projected State Revenues (post-2008)[4]	$1,579.4 mm	$574.3 – $687.1 mm	$629.2 – $752.7 mm
Total Projected Federal Revenues (post-2008)[5]	$1,230.6 mm	$458.6 – $571.4 mm	$502.5 – $626.0 mm

1 Under the Proposed Action and Alternative 2, the mineable coal figure excludes all coal that would not be mined beneath BNSF & UP railroad ROW and associated buffer zone and 2.25-mile section of Antelope Road and associated buffer zone.

2 Assumes 92 percent recovery of mineable coal that occurs during normal mining operation.

3 The lease area figure includes federal coal leases only and does not include state coal within the permit boundary. The disturbed area typically exceeds the leased area (total federal and state) because of the need for highwall reduction, topsoil removal, and other mine support activities outside the lease boundaries. The permit area is larger than the leased or disturbed area to assure that all disturbed lands are within the permit boundary and to allow an easily defined legal land description.

4 Revenues to the State of Wyoming include severance taxes, property and production taxes (ad valorem), sales and use taxes, and Wyoming's share of federal royalty payments, AML fees and bonus bid payments. State revenues are based on $0.4312 per ton estimate for severance taxes × amount of recoverable coal, plus $0.372 per ton estimate for ad valorem taxes × amount of recoverable coal, plus $0.0569 per ton estimate for sales and use taxes × amount of recoverable coal, plus a projected coal price of $11.06 per ton × amount of recoverable coal × federal royalty of 12.5 percent minus federal's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus federal's 50 percent share, plus bonus bid payment on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus bid payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus federal's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

5 Federal revenues include black lung taxes and the federal government's share of federal royalty payments, AML fees, and bonus bid payments. Federal revenues are based on a projected coal price of $11.06 per ton × amount of recoverable coal × black lung tax of 4.4 percent, plus $11.06 per ton price × amount of recoverable coal × federal royalty of 12.5 percent minus state's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus state's 50 percent share, plus bonus bid payments on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus state's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

Table 2-13. Summary Comparison of Coal Production, Surface Disturbance, Mine Life, and Revenues for South Porcupine LBA Tract and North Antelope Rochelle Mine – 2.25-Mile Section of Antelope Road is Moved and the Underlying Coal is Recovered.

Item	Alternative 1 - No Action Alternative (Existing North Antelope Rochelle Mine)	Added by Proposed Action	Added by Alternative 2
In-Place Coal (as of 1/1/09)	1,049.9 mmt	422.2 mmt	470.9 mmt
Mineable Coal (as of 1/1/09)[1]	1,015.0 mmt	408.4 mmt	440.6 mmt
Recoverable Coal (as of 1/1/09)[2]	933.8 mmt	375.7 mmt	405.4 mmt
Coal Mined Through 2008	1,230.8 mmt	--	--
Lease Area[3]	16,666.1 ac	3,186.0 ac	3,568.0 ac
Total Area To Be Disturbed[3]	27,443.0 ac	3,908.0 ac	4,610.0 ac
Permit Area[3]	45,975.0 ac	200.0 ac	400.0 ac
Average Annual Coal Production (post-2008)	95 mmt	0 mmt	0 mmt
Remaining Life of Mine (post-2008)	9.9 yrs	4.0 yrs	4.3 yrs
Projected Number of Employees	1,150	0	0
Total Projected State Revenues (post-2008)[4]	$1,579.4 mm	$696.7 – $833.5 mm	$751.8 – $899.4 mm
Total Projected Federal Revenues (post-2008)[5]	$1,230.6 mm	$556.4 – $693.2 mm	$600.4 – $748.0 mm

1 Under the Proposed Action and Alternative 2, the mineable coal figure excludes all coal that would not be mined beneath BNSF & UP railroad ROW and associated buffer zone.

2 Assumes 92 percent recovery of mineable coal that occurs during normal mining operation.

3 The lease area figure includes federal coal leases only and does not include state coal within the permit boundary. The disturbed area typically exceeds the leased area (total federal and state) because of the need for highwall reduction, topsoil removal, and other mine support activities outside the lease boundaries. The permit area is larger than the leased or disturbed area to assure that all disturbed lands are within the permit boundary and to allow an easily defined legal land description.

4 Revenues to the State of Wyoming include severance taxes, property and production taxes (ad valorem), sales and use taxes, and Wyoming's share of federal royalty payments, AML fees and bonus bid payments. State revenues are based on $0.4312 per ton estimate for severance taxes × amount of recoverable coal, plus $0.372 per ton estimate for ad valorem taxes × amount of recoverable coal, plus $0.0569 per ton estimate for sales and use taxes × amount of recoverable coal, plus a projected coal price of $11.06 per ton × amount of recoverable coal × federal royalty of 12.5 percent minus federal's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus federal's 50 percent share, plus bonus bid payment on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus bid payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus federal's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

5 Federal revenues include black lung taxes and the federal government's share of federal royalty payments, AML fees, and bonus bid payments. Federal revenues are based on a projected coal price of $11.06 per ton × amount of recoverable coal × black lung tax of 4.4 percent, plus $11.06 per ton price × amount of recoverable coal × federal royalty of 12.5 percent minus state's 50 percent share, plus $0.28 per ton for AML fees × amount of recoverable coal minus state's 50 percent share, plus bonus bid payments on LBA leased coal of $0.30 to $0.97 per ton (based on the range of bonus payments for the last 9 LBAs sold from 2004 through early 2009) × amount of mineable coal minus state's 50 percent share. These figures could change based on the outcome of recent legislation that changed the percent of distribution to states.

Table 2-5 presents the comparisons assuming that Reno Road is moved and the underlying coal is recovered from the South Hilight Field tract.

Table 2-6 presents the comparisons assuming that State Highway 450 and Hilight Road are not moved and the underlying coal is not recovered from the West Hilight Field tract. Table 2-7 presents the comparisons assuming that State Highway 450 and Hilight Road are moved and the underlying coal is recovered from the West Hilight Field tract.

Table 2-8 presents the comparisons assuming that State Highway 450 and Hilight Road are not moved and the underlying coal is not recovered from the West Jacobs Ranch tract. Table 2-9 presents the comparisons assuming that State Highway 450 and Hilight Road are moved and the underlying coal is recovered from the West Jacobs Ranch tract.

Table 2-10 presents the comparisons assuming that Mackey Road is not moved and the underlying coal is not recovered from the North Porcupine tract. Table 2-11 presents the comparisons assuming that Mackey Road is moved and the underlying coal is recovered from the North Porcupine tract.

Table 2-12 presents the comparisons assuming that the remaining 2.25-mile section of Antelope Road is not moved and the underlying coal is not recovered from the South Porcupine tract. Table 2-13 presents the comparisons assuming that the remaining 2.25-mile section of Antelope Road is moved and the underlying coal is recovered from the South Porcupine tract.

Table 2-14 presents a comparative summary for all six LBA tracts of the direct and indirect environmental impacts of implementing each alternative as compared to the No Action Alternative. Each No Action Alternative assumes completion of currently permitted mining at the applicant mine for comparison to anticipated mining if the associated LBA tract is leased. Table 2-15 presents a comparative summary for the six LBA tracts regarding the cumulative environmental impacts of implementing each alternative for each tract. The environmental consequences of the Proposed Action and alternatives for each of the six LBA tracts are analyzed in Chapters 3 and 4. These summary impact tables are derived from the following explanation of impacts and magnitude. NEPA requires all agencies of the federal government to include, in every recommendation or report on proposals for legislation and other major federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on:

(i) the environmental impact of the Proposed Action,
(ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,
(iii) alternatives to the Proposed Action,
(iv) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and

Table 2-14. Summary Comparison of Magnitude[1] and Duration of Direct and Indirect Impacts for Alternative 1 (No Action), the Proposed Action, Alternative 2, and Alternative 3 for the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts[2].

DESCRIPTION OF POTENTIAL IMPACT BY RESOURCE	***MAGNITUDE AND DURATION OF IMPACT***	
RESOURCE NAME	**ALTERNATIVE 1**	**PROPOSED ACTION, ALTERNATIVE 2 and ALTERNATIVE 3**
TOPOGRAPHY & PHYSIOGRAPHY (Applicable to all six tracts)		
Lower surface elevation	Moderate, permanent on existing mine areas	Same as Alternative 1 on expanded mine areas
Permanent topographic moderation, which could result in:		
Microhabitat reduction	Moderate, long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Habitat diversity reduction	Moderate, long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Big game carrying capacity reduction	Moderate, long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Reduction in water runoff and peak flows	Moderate, beneficial, long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Increased precipitation infiltration	Moderate, beneficial, long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Reduction in erosion	Moderate, beneficial, long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Potential enhanced vegetative productivity	Moderate, beneficial, long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Potential acceleration of groundwater recharge	Moderate, beneficial, long term on existing mine areas	Same as Alternative 1 on expanded mine areas
GEOLOGY AND MINERALS (Applicable to all six tracts)		
Removal of coal	Moderate, permanent on existing mine areas	Same as Alternative 1 on expanded mine areas
Removal and replacement of topsoil and overburden	Moderate, permanent on existing mine areas	Same as Alternative 1 on expanded mine areas
Physical characteristic alterations in replaced overburden	Moderate, permanent on existing mine areas	Same as Alternative 1 on expanded mine areas
Loss of unrecovered CBNG through venting and/or depletion of hydrostatic pressure	Moderate to substantial, permanent on existing mine areas	Same as Alternative 1 on expanded mine areas
Loss of access for development of sub-coal oil and gas resources and other minerals	Moderate, short term on existing mine areas	Same as Alternative 1 on expanded mine areas
Destruction of paleontological resources that are not exposed on the surface	Moderate, permanent on the existing mine areas	Same as Alternative 1 on expanded mine areas
AIR QUALITY (Applicable to all six tracts)		
Particulate Emissions:		
Elevated concentrations associated with projected average production of 270 mmtpy in compliance with ambient standards	Moderate, short term on existing mines and surrounding areas	Same as Alternative 1 on expanded mines and surrounding areas for 1.6 to 22.8 additional years
Potential for public exposure to particulate emissions along State Highway 450, various county roads, and occupied dwellings in area	Minor to moderate, short term on existing mines and surrounding areas	Same as Alternative 1 on expanded mines and surrounding areas for 1.6 to 22.8 additional years
Potential for human health impacts as a result of exposure to particulate emissions	Minor to moderate, short term on existing mines and surrounding areas	Same as Alternative 1 on expanded mines and surrounding areas for 1.6 to 22.8 additional years

[1] Refer to Chapter 3 for a discussion on magnitude of impacts.
[2] All impacts are assumed to be adverse unless noted otherwise.

Table 2-14. Summary Comparison of Magnitude[1] and Duration of Direct and Indirect Impacts for Alternative 1 (No Action), the Proposed Action, Alternative 2, and Alternative 3 for the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts[2] (Continued).

DESCRIPTION OF POTENTIAL IMPACT BY RESOURCE	***MAGNITUDE AND DURATION OF IMPACT***	
RESOURCE NAME	**ALTERNATIVE 1**	**PROPOSED ACTION, ALTERNATIVE 2 and ALTERNATIVE 3**
AIR QUALITY (Continued) **(Applicable to all six tracts)**		
NO_x Emissions from Machinery:		
Elevated concentrations associated with average production of 270 mmtpy in compliance with ambient standards	Moderate, short term on existing mines and surrounding areas	Same as Alternative 1 on expanded mines and surrounding areas for 1.6 to 22.8 additional years
Potential for public exposure to NO_x emissions from machinery along State Highway 450, various county roads, and occupied dwellings in area	Moderate, short term on existing mines and surrounding areas	Same as Alternative 1 on expanded mines and surrounding areas for 1.6 to 22.8 additional years
Potential for human health impacts as a result of exposure to NO_x emissions	Moderate, short term on existing mines and surrounding areas	Same as Alternative 1 on expanded mines and surrounding areas for 1.6 to 22.8 additional years
NO_x Emissions from Blasting (in compliance with Black Thunder, Jacobs Ranch, and North Antelope Rochelle Mine Permit Blasting Conditions):		
Potential for public exposure	No projected events	No events projected
Potential for human health impacts as a result of exposure to NO_x emissions	No projected events	No events projected
Visibility:		
Elevated concentrations of fine particulate matter associated with average production of 270 mmtpy	Moderate, short term on existing mines and surrounding areas	Same as Alternative 1 on expanded mines and surrounding areas for 1.6 to 22.8 additional years
Acidification of Lakes:		
SO_2 emissions derived from burning Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines' coal to produce power	Moderate, short term in vicinity of power plants	Same as Alternative 1
WATER RESOURCES **(Applicable to all six tracts)**		
GROUNDWATER		
Removal of coal and overburden aquifers	Moderate, short term on existing mine areas	Same as Alternative 1 on expanded mine areas
Replacement of existing coal and overburden with unconsolidated backfill material	Moderate, permanent on existing mine areas	Same as Alternative 1 on expanded mine areas
Depressed water levels in overburden and coal aquifers adjacent to mines	Moderate, short to long term on existing mines and surrounding areas	Same as Alternative 1 on expanded mines and surrounding areas
Change in hydraulic properties in backfilled areas	Negligible, long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Increase in TDS concentrations in backfilled areas	Moderate, long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Use of subcoal aquifers for water supply	Negligible, short term on existing mines and surrounding areas	Same as Alternative 1 on expanded mines and surrounding areas

[1] Refer to Chapter 3 for a discussion on magnitude of impacts.
[2] All impacts are assumed to be adverse unless noted otherwise.

Table 2-14. Summary Comparison of Magnitude[1] and Duration of Direct and Indirect Impacts for Alternative 1 (No Action), the Proposed Action, Alternative 2, and Alternative 3 for the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts[2] (Continued).

DESCRIPTION OF POTENTIAL IMPACT BY RESOURCE	***MAGNITUDE AND DURATION OF IMPACT***	
RESOURCE NAME	**ALTERNATIVE 1**	**PROPOSED ACTION, ALTERNATIVE 2 and ALTERNATIVE 3**
WATER RESOURCES (Continued)		
(Applicable to all six tracts)		
GROUNDWATER (Continued)		
Decrease in water supply for groundwater-right holders having wells completed in the coal or overburden aquifers within the 5-foot drawdown areas for each mine	Moderate, long term on existing mines and surrounding areas	Same as Alternative 1 on expanded mines and surrounding areas
SURFACE WATER		
Diversion and disruption of surface drainage systems	Moderate, short term on existing mine areas	Same as Alternative 1 on expanded mine areas
Reconstruction of surface drainage systems	Permanent on existing mine areas	Same as Alternative 1 on expanded mine areas
Increased runoff and erosion rates on disturbed lands due to vegetation removal	Moderate, short term on existing mine areas	Same as Alternative 1 on expanded mine areas
Increased infiltration on reclaimed lands due to topographic moderation	Moderate, beneficial, long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Increased runoff on reclaimed lands due to loss of soil structure	Moderate, long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Potential for adverse downstream effects as a result of sediment produced by large storms	Moderate, long term for existing mining operations	Same as Alternative 1 on expanded mining operations
ALLUVIAL VALLEY FLOORS		
(Applicable to all six tracts)		
While final determinations have not been made by WDEQ/LQD, it is believed that there are no AVFs significant to agriculture on the proposed lease tracts		
Removal and restoration of AVFs determined not to be significant to agriculture	Moderate, short term for existing mining operations	Same as Alternative 1 on expanded mine areas
Disruptions to streamflows supplying downstream AVFs	Negligible, short term on existing leases	Same as Alternative 1 on expanded mine areas
WETLANDS		
(Applicable to all six tracts)		
Removal of jurisdictional wetlands and loss of wetland function until reclamation occurs	Moderate, short term on existing mining operations; jurisdictional wetlands would be replaced as required under Section 404 of the Clean Water Act	Same as Alternative 1 on expanded mine areas
Removal of non-jurisdictional wetlands and loss of wetland function until reclamation occurs	Moderate, short term to long term on existing mining operations; non-jurisdictional wetlands would be replaced as required by the surface land owner or WDEQ/LQD	Same as Alternative 1 on expanded mine areas

[1] Refer to Chapter 3 for a discussion on magnitude of impacts.
[2] All impacts are assumed to be adverse unless noted otherwise.

Table 2-14. Summary Comparison of Magnitude[1] and Duration of Direct and Indirect Impacts for Alternative 1 (No Action), the Proposed Action, Alternative 2, and Alternative 3 for the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts[2] (Continued).

DESCRIPTION OF POTENTIAL IMPACT BY RESOURCE	***MAGNITUDE AND DURATION OF IMPACT***	
RESOURCE NAME	**ALTERNATIVE 1**	**PROPOSED ACTION, ALTERNATIVE 2 and ALTERNATIVE 3**
SOILS		
(Applicable to all six tracts)		
Changes in physical properties after reclamation would include:		
Increased near-surface bulk density and decreased soil infiltration rate resulting in increased potential for soil erosion	Moderate, long term on existing mine areas	Same as Alternative 1 on expanded mine areas
More uniformity in soil type, thickness, and texture	Moderate, beneficial, long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Decreased runoff due to topographic modification	Moderate, beneficial, long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Changes in biological properties in soils that are stockpiled before reclamation would include:		
Reduction in organic matter	Moderate, short to long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Reduction in microorganism population	Moderate, short to long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Reduction in seeds, bulbs, rhizomes, and live plant parts	Moderate, short to long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Changes in chemical properties would include: More uniform soil nutrient distribution	Moderate, beneficial, long term on existing mine areas	Same as Alternative 1 on expanded mine areas
VEGETATION		
(Applicable to all six tracts)		
During mining:		
Progressive removal of existing vegetation	Moderate, short term on existing mine areas	Same as Alternative 1 on expanded mine areas
Increased erosion	Moderate, short term on existing mine areas	Same as Alternative 1 on expanded mine areas
Wildlife habitat and livestock grazing loss	Moderate, short term on existing mine areas	Same as Alternative 1 on expanded mine areas
After revegetation:		
Changes in vegetation patterns	Negligible, long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Reduction in vegetation diversity	Negligible, long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Reduction in shrub density	Moderate, long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Decreased big game habitat carrying capacity	Moderate, long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Decreased habitat for shrub dependent species	Moderate, long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Potential invasion of non-native plant species	Moderate, short term on existing mine areas	Same as Alternative 1 on expanded mine areas

[1] Refer to Chapter 3 for a discussion on magnitude of impacts.
[2] All impacts are assumed to be adverse unless noted otherwise.

Table 2-14. Summary Comparison of Magnitude[1] and Duration of Direct and Indirect Impacts for Alternative 1 (No Action), the Proposed Action, Alternative 2, and Alternative 3 for the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts[2] (Continued).

DESCRIPTION OF POTENTIAL IMPACT BY RESOURCE	***MAGNITUDE AND DURATION OF IMPACT***	
RESOURCE NAME	**ALTERNATIVE 1**	**PROPOSED ACTION, ALTERNATIVE 2 and ALTERNATIVE 3**
WILDLIFE		
(Applicable to all six tracts)		
Big game displacement from active mining areas	Moderate, short term on existing mine areas	Same as Alternative 1 on expanded mine areas
Increased competition on adjacent undisturbed or reclaimed lands, especially big game	Moderate, short term on adjacent areas	Same as Alternative 1 on adjacent areas
Restriction of wildlife movement, especially big game	Moderate, short term on existing mine areas	Same as Alternative 1 on expanded mine areas
Increased mortality of small mammals	Moderate, short term on existing mine areas	Same as Alternative 1 on expanded mine areas
Displacement of small and medium-sized mammals	Moderate, short term on existing mine areas	Same as Alternative 1 on expanded mine areas
Surface and noise disturbance of active sage grouse leks	Moderate, short to long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Disturbance of sage grouse nesting habitat during mining	Moderate, short term on existing mine areas	Same as Alternative 1 on expanded mine areas
Loss of sage grouse nesting habitat after reclamation	Moderate, long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Alteration of plant and animal communities after reclamation	Negligible, short term on existing mine areas	Same as Alternative 1 on expanded mine areas
Abandonment of raptor nests	Negligible, short term on existing mine areas	Same as Alternative 1 on expanded mine areas
Loss of foraging habitat for raptors	Negligible, short to long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Loss of nesting and foraging habitat for Migratory Birds of Management Concern (including sage-grouse)	Negligible, short to long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Reduction in waterfowl resting and feeding habitat	Negligible, short term on existing mine areas	Same as Alternative 1 on expanded mine areas
Loss of habitat for aquatic species, amphibians and reptiles	Negligible, short term on existing mine areas	Same as Alternative 1 on expanded mine areas
Road kills by mine-related traffic	Moderate, long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Reduction in habitat carrying capacity and habitat diversity on reclaimed lands	Moderate, long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Potential reduction in microhabitats on reclaimed lands	Moderate, long term on existing mine areas	Same as Alternative 1 on expanded mine areas
THREATENED, ENDANGERED, PROPOSED, AND CANDIDATE SPECIES (Refer to Appendix G in this EIS)		
(Applicable to all six tracts)		
Ute ladies'-tresses (Threatened)	As determined by previous consultation with USFWS	No effect
Blowout penstemon (Endangered)	for all listed species at the time	No effect
Greater sage-grouse (Candidate)		
LAND USE AND RECREATION		
(Applicable to all six tracts)		
Reduction of livestock grazing	Moderate, long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Loss of wildlife habitat	Moderate, long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Loss of access for sub-coal oil and gas development	Moderate, short term on existing mine areas	Same as Alternative 1 on expanded mine areas
Removal of oil and gas production facilities	Moderate, short term on existing mine areas	Same as Alternative 1 on expanded mine area
Loss of access to public land available for recreation and grazing	Moderate, short term on existing mine areas	Same as Alternative 1 on expanded mine areas

[1] Refer to Chapter 3 for a discussion on magnitude of impacts.
[2] All impacts are assumed to be adverse unless noted otherwise.

Table 2-14. Summary Comparison of Magnitude[1] and Duration of Direct and Indirect Impacts for Alternative 1 (No Action), the Proposed Action, Alternative 2 and Alternative 3 for the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts[2] (Continued).

DESCRIPTION OF POTENTIAL IMPACT BY RESOURCE	***MAGNITUDE AND DURATION OF IMPACT***	
RESOURCE NAME	**ALTERNATIVE 1**	**PROPOSED ACTION, ALTERNATIVE 2 and ALTERNATIVE 3**
CULTURAL RESOURCES		
(Applicable to all six tracts)		
Sites that are not eligible for NRHP	Ineligible sites may be destroyed without further work on existing mine areas	Same as Alternative 1 on expanded mine areas
Sites that are eligible for NRHP	Impacts to sites that are eligible for the NHRP are not permitted; eligible sites would be avoided or mitigated through data recovery prior to mining on existing mine areas	Same as Alternative 1 on expanded mine areas
Sites that are unevaluated for eligibility	Impacts to unevaluated sites are not permitted; unevaluated sites would be evaluated prior to mining on existing mine areas	Same as Alternative 1 on expanded mine areas
NATIVE AMERICAN CONCERNS		
(Applicable to all six tracts)	No impact identified on existing mine areas	Same as Alternative 1 on expanded mine areas
VISUAL RESOURCES		
(Applicable to all six tracts)		
During mining:		
Alteration of landscape by mining facilities and operations	Moderate, short term on existing mine areas	Same as Alternative 1 on expanded mine areas
Visibility of mining operations from highway	Moderate, short term on existing mine areas	Same as Alternative 1 on expanded mine areas
Following reclamation:		
Smoother sloped terrain	Negligible, long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Reduction in sagebrush density	Moderate, short to long term on existing mine areas	Same as Alternative 1 on expanded mine areas
NOISE		
(Applicable to all six tracts)		
Increased noise levels	Moderate to substantial, short term on existing mines, surrounding areas (including occupied dwellings and businesses) within 2,500 feet of mining activities	Same as Alternative 1 on expanded mine areas and surrounding areas
TRANSPORTATION FACILITIES		
(Applicable to all six tracts)		
Use of railroads and existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle mine infrastructure to ship coal	Moderate, for duration of existing approved mining operations	Same as Alternative 1 for additional 1.6 to 22.8 years
Employee and service contractor use of highways to and from mine sites	Moderate, for duration of existing approved mining operations	Same as Alternative 1 for additional 1.6 to 22.8 years

[1] Refer to Chapter 3 for a discussion on magnitude of impacts.
[2] All impacts are assumed to be adverse unless noted otherwise.

Table 2-14. Summary Comparison of Magnitude[1] and Duration of Direct and Indirect Impacts for Alternative 1 (No Action), the Proposed Action, Alternative 2, and Alternative 3 for the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts[2] (Continued).

DESCRIPTION OF POTENTIAL IMPACT BY RESOURCE	***MAGNITUDE AND DURATION OF IMPACT***	
RESOURCE NAME	**ALTERNATIVE 1**	**PROPOSED ACTION, ALTERNATIVE 2 and ALTERNATIVE 3**
TRANSPORTATION FACILITIES (Continued) (Applicable to all six tracts)		
Relocation of pipelines	Negligible, short to long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Relocation of utility lines	Negligible, short to long term on existing mine areas	Same as Alternative 1 on expanded mine areas
Relocation of county roads, if approved by Campbell County Commissioners, to allow recovery of coal under lease	No impact on existing mine areas	Moderate, long term to permanent on expanded mine areas
Mining operations near State Highway 450	Moderate, for duration of existing approved mining operations (Black Thunder Mine only)	Same as Alternative 1 for additional 1.6 to 22.8 years (Black Thunder and Jacobs Ranch Mines only)
HAZARDOUS AND SOLID WASTE (Applicable to all six tracts)		
Waste generated by mining operations	Negligible, for duration of existing approved mining operations	Same as Alternative 1 for additional 1.6 to 22.8 years
SOCIOECONOMICS (Applicable to all six tracts)		
Employment	Substantial benefit, short term for existing approved mining operations	Same as Alternative 1 for additional 1.6 to 22.8 years
Revenues from royalties and taxes to the state and local government	Substantial benefit, short term for existing approved mining operations	Same as Alternative 1 for additional 1.6 to 22.8 years
Revenues from royalties and taxes to the federal government	Substantial benefit, short term for existing approved mining operations	Same as Alternative 1 for additional 1.6 to 22.8 years
Economic development	Moderate, beneficial short term for existing approved mining operations	Same as Alternative 1 for additional 1.6 to 22.8 years
Additional housing and infrastructure needs	No new impact related to existing approved mining operations	Same as Alternative 1 for additional 1.6 to 22.8 years

[1] Refer to Chapter 3 for a discussion on magnitude of impacts.
[2] All impacts are assumed to be adverse unless noted otherwise.

Table 2-15. Summary Comparison of Magnitude and Duration of Cumulative Impacts[1, 2].

DESCRIPTION OF POTENTIAL IMPACT BY RESOURCE	MAGNITUDE, TYPE, AND DURATION OF IMPACT	
RESOURCE NAME	**ALTERNATIVE 1**	**PROPOSED ACTION, ALTERNATIVE 2 and ALTERNATIVE 3**
TOPOGRAPHY & PHYSIOGRAPHY		
▪ Alteration of topography following reclamation of coal disturbance areas	▪ Permanent topographic moderation following reclamation	▪ Same as Alternative 1
▪ Alteration of topography to accommodate coal-related, oil and gas, and oil- and gas-related facilities	▪ Long term to permanent limited changes in discrete, scattered areas	▪ Same as Alternative 1
GEOLOGY AND MINERALS		
▪ Recovery of coal resulting in reduction in coal resources and disturbance and replacement of overburden and topsoil	▪ Moderate, long term to permanent	▪ Same as Alternative 1
▪ Surficial disturbance and reclamation on oil and gas well sites and associated facilities	▪ Moderate, long term to permanent	▪ Same as Alternative 1
PALEONTOLOGY		
▪ Coal, coal-related, oil and gas, and oil- and gas-related development disturbance of PFYC Class 5 Wasatch and Class 3 Fort Union formations	▪ Permanent potential adverse effects to scientifically significant fossils that are present but not visible prior to disturbance	▪ Same as Alternative 1
AIR QUALITY		
Impacts to Wyoming near-field receptors:		
▪ 24-hour PM_{10} and $PM_{2.5}$	▪ Maximum modeled impacts occurring at isolated receptors show localized exceedances of the WAAQS and NAAQS for the base year (2004) as well as for both coal production scenarios for 2015 and 2020	▪ Same as Alternative 1
▪ Annual PM_{10}	▪ Maximum modeled impacts at peak receptors show 20% increase from base year (2004) but in compliance with WAAQS for both coal production scenarios for 2020, but exceed the WAAQS for both coal production scenarios for 2015	▪ Same as Alternative 1
▪ Annual $PM_{2.5}$	▪ Maximum modeled impacts at peak receptors show 20% increase from base year (2004) and localized exceedances of the WAAQS and NAAQS for both coal production scenarios for 2015 and 2020	▪ Same as Alternative 1
▪ All other parameters	▪ Modeled impacts in compliance with WAAQS and NAAQS for both coal production scenarios for 2015 and 2020	▪ Same as Alternative 1
Impacts to Montana near-field receptors:		
▪ All parameters	▪ Impacts at all Montana receptors would be in compliance with NAAQS and Montana AAQS for all pollutants and averaging periods. Impacts are predicted to decrease for annual NO_2, PM_{10} and $PM_{2.5}$ relative to the base year (2004)	▪ Same as Alternative 1

[1] Cumulative impact discussion in this table and in Chapter 4 is based on the PRB Coal Review analyses (BLM 2005a-f, 2006b-d, 2008h-i, 2009b-f).
[2] All impacts are assumed to be adverse unless noted otherwise.

Table 2-15. Summary Comparison of Magnitude and Duration of Cumulative Impacts[1, 2] (Continued).

DESCRIPTION OF POTENTIAL IMPACT BY RESOURCE RESOURCE NAME	***MAGNITUDE, TYPE, AND DURATION OF IMPACT*** ALTERNATIVE 1	PROPOSED ACTION, ALTERNATIVE 2 and ALTERNATIVE 3
AIR QUALITY (Continued)		
Non-regulatory PSD Impacts at Class I and Sensitive Class II Areas:		
▪ Class I Northern Cheyenne Indian Reservation	▪ Modeled impacts above Class I increment levels for 24-hour PM_{10} for base year (2004) and both coal production scenarios for 2020; for 24-hour SO_2 for both coal production scenarios for 2020; for 3-hour SO_2 for upper coal production scenario for 2020	▪ Same as Alternative 1
▪ Class I Badlands National Park	▪ Modeled impacts above Class I increment levels for 24-hour PM_{10} for both coal production scenarios for 2020	▪ Same as Alternative 1
▪ Class I Wind Cave National Park	▪ Modeled impacts above Class I increment levels for 24-hour PM_{10} for base year (2004) and both coal production scenarios for 2020	▪ Same as Alternative 1
▪ All Sensitive Class II Areas (including Cloud Peak Wilderness Area and Crow Indian Reservation)	▪ Modeled impacts below Class II increments for all Sensitive Class II areas for base year (2004) and both coal production scenarios for 2020	▪ Same as Alternative 1
Visibility Impacts:		
▪ Class I Areas	▪ Modeled impacts show 200 or more days a year during the base year (2004) with a change of 1.0 dv or greater at the Northern Cheyenne Indian Reservation, Badlands National Park, and Wild Cave National Park.; the same three Class I areas have the highest predicted visibility change in 2020	▪ Same as Alternative 1
▪ Sensitive Class II Areas	▪ All but four areas have more than 100 days a year during the base year (2004) with a change of 1.0 dv or greater	▪ Same as Alternative 1
Acid Deposition Impacts:	▪ All modeled impacts below the deposition threshold values for nitrogen and sulfur compounds	▪ Same as Alternative 1
▪ Florence Lake	▪ Modeled impact above 10 percent ANC threshold for both coal production scenarios for 2015 and 2020	▪ Same as Alternative 1
▪ Upper Frozen Lake	▪ Modeled impact above 1 μeq/L ANC for both coal production scenarios for 2015 and 2020	▪ Same as Alternative 1
▪ All other modeled sensitive lakes	▪ Modeled impact below 10 percent ANC threshold values for both coal production scenarios for 2015 and 2020	▪ Same as Alternative 1
GROUNDWATER RESOURCES		
▪ Removal of coal aquifer and replacement with backfill material	▪ Moderate, permanent for mining areas	▪ Same as Alternative 1
▪ Lowering of water levels in aquifers around the mines	▪ Moderate, long term in area immediately west of mines	▪ Same as Alternative 1
▪ Water level decline in sub-coal aquifers as a result of all development	▪ No cumulative impacts anticipated	▪ Same as Alternative 1
▪ Change in groundwater quality as a result of all development	▪ No cumulative impacts anticipated	▪ Same as Alternative 1
▪ Overlapping drawdown in the coal aquifer caused by surface mining and CBNG development	▪ Additive, long term in area immediately west of surface coal mines	▪ Same as Alternative 1

[1] Cumulative impact discussion in this table and in Chapter 4 is based on the PRB Coal Review analyses (BLM 2005a-f, 2006b-d, 2008h-i, 2009b-f).
[2] All impacts are assumed to be adverse unless noted otherwise.

Table 2-15. Summary Comparison of Magnitude and Duration of Cumulative Impacts[1, 2] (Continued).

DESCRIPTION OF POTENTIAL IMPACT BY RESOURCE	***MAGNITUDE, TYPE, AND DURATION OF IMPACT***	
RESOURCE NAME	**ALTERNATIVE 1**	**PROPOSED ACTION, ALTERNATIVE 2 and ALTERNATIVE 3**
SURFACE WATER RESOURCES		
▪ Surface disturbance of intermittent and ephemeral streams and scattered ponds and reservoirs as a result of coal mining, coal-related, oil and gas, and oil- and gas-related development	▪ Moderate, short term	▪ Same as Alternative 1
▪ Discharge of coal mining and CBNG produced waters into intermittent and ephemeral streams	▪ Moderate, short term	▪ Same as Alternative 1
▪ Sediment input into intermittent and ephemeral streams and scattered ponds and reservoirs as a result of coal mining, coal-related, oil and gas, and oil- and gas-related development	▪ Moderate, short term	▪ Same as Alternative 1
ALLUVIAL VALLEY FLOORS		
▪ Coal mining disturbance of AVFs determined to be significant to agriculture	▪ Not permitted by regulation	▪ Same as Alternative 1
▪ Coal mining disturbance of AVFs determined not to be significant to mining	▪ AVFs disturbed by mining must be restored to essential hydrologic function; no cumulative impacts anticipated	▪ Same as Alternative 1
SOILS		
▪ Coal mining, coal-related, oil and gas, and oil- and gas-related disturbance and replacement of soil resources	▪ Moderate, short term and long term impacts through accelerated wind or water erosion, declining soil quality factors through compaction, reduced microbial populations and organic matter, and potential mixing of soil zones	▪ Same as Alternative 1
▪ CBNG water disposal impacts to soil resources	▪ Potential increase in soil alkalinity depending on SAR levels in water and method of water disposal	▪ Same as Alternative 1
VEGETATION		
▪ Coal mining, coal-related, oil and gas, and oil- and gas-related removal and replacement of native vegetation	▪ Moderate, short to long term impacts due to potential differences in species composition and presence and size of woody species on reclaimed lands	▪ Same as Alternative 1
▪ Coal mining, coal-related, oil and gas, and oil- and gas-related impacts to Special Status Plant Species	▪ Potential incremental loss of alteration of potential or known habitat	▪ Same as Alternative 1
▪ Coal mining, coal related, oil and gas, and oil- and gas-related dispersal of noxious and invasive species	▪ Potential displacement of native species and changes in species composition	▪ Same as Alternative 1
WETLAND AND RIPARIAN VEGETATION		
▪ CBNG-related discharge of produced water	▪ Moderate, short to long term creation of wetlands in areas that previously supported upland vegetation	▪ Same as Alternative 1
WILDLIFE		
▪ Direct and indirect coal mining, coal-related, oil and gas, and oil- and gas-related development impacts to game and non-game species, including direct mortality, habitat fragmentation, animal displacement, noise and increased human presence	▪ Moderate, short term	▪ Same as Alternative 1
▪ Coal mining, coal-related, oil and gas, and oil- and gas-related disturbance of game and nongame species habitat during project development and operation	▪ Moderate, short term loss of all types of habitat present in disturbed areas	▪ Same as Alternative 1
▪ Coal mining, coal related, oil and gas, and oil- and gas-related habitat changes after reclamation	▪ Moderate, long term change in habitat with potential changes in associated wildlife populations	▪ Same as Alternative 1

[1] Cumulative impact discussion in this table and in Chapter 4 is based on the PRB Coal Review analyses (BLM 2005a-f, 2006b-d, 2008h-i, 2009b-f).
[2] All impacts are assumed to be adverse unless noted otherwise.

Table 2-15. Summary Comparison of Magnitude and Duration of Cumulative Impacts[1, 2] (Continued).

DESCRIPTION OF POTENTIAL IMPACT BY RESOURCE	***MAGNITUDE, TYPE, AND DURATION OF IMPACT***	
RESOURCE NAME	**ALTERNATIVE 1**	**PROPOSED ACTION, ALTERNATIVE 2 and ALTERNATIVE 3**
FISHERIES		
▪ Alteration or loss of habitat due to coal mining, coal-related, oil and gas, and oil- and gas-related development	▪ Moderate, short to long term	▪ Same as Alternative 1
▪ Changes in water quality as a result of surface disturbance or introduction of contaminants into drainages caused by coal mining, coal-related, oil and gas, and oil- and gas-related development	▪ Moderate, short to long term	▪ Same as Alternative 1
▪ Changes in available habitat as a result of water withdrawals or discharges related to coal mining, coal-related, oil and gas, and oil- and gas-related development	▪ Moderate, short term	▪ Same as Alternative 1
SPECIAL STATUS SPECIES		
▪ Direct and indirect coal mining, coal-related, oil and gas, and oil- and gas-related development impacts, including direct mortality, breeding area, nest or burrow abandonment, sage-grouse lek abandonment, noise and increased human presence	▪ Moderate, short term	▪ Same as Alternative 1
▪ Coal mining, coal-related, oil and gas, and oil- and gas-related disturbance of habitat (breading and nesting) during project development and operation	▪ Moderate, short term loss of all types of special status species habitat present in disturbed areas	▪ Same as Alternative 1
▪ Coal mining, coal related, oil and gas, and oil- and gas-related habitat changes after reclamation	▪ Moderate, long term change in habitat with potential changes in associated populations of special status species	▪ Same as Alternative 1
LAND USE AND RECREATION		
▪ Loss of forage and range improvements and restriction of livestock movement due to coal mining, coal-related, oil and gas, and oil- and gas-related development	▪ Moderate, short term	▪ Same as Alternative 1
▪ Disturbance of developed recreation sites by coal mining, coal-related, oil and gas, and oil- and gas-related development	▪ Negligible, short term	▪ Same as Alternative 1
▪ Reduction or degradation of opportunities for dispersed recreation activities related to coal mining, coal-related, oil and gas, and oil- and gas-related development	▪ Moderate, short term on existing mine areas	▪ Same as Alternative 1
CULTURAL RESOURCES		
▪ Disturbance of cultural resource sites	▪ Moderate, permanent	▪ Same as Alternative 1
TRANSPORTATION AND UTILITIES		
▪ Movement of segments of existing public roads, pipelines, transmission lines, or railroads to accommodate coal mining development	▪ Moderate, long term to permanent, disruptive effects would be minimized	▪ Same as Alternative 1
▪ Increased vehicular traffic on roads and highways due to coal mining, coal-related, oil and gas, and oil- and gas-related development, and associated impacts including traffic accidents, road wear, air emissions, dust, noise, and vehicle collisions with wildlife and livestock	▪ Moderate, short term	▪ Same as Alternative 1
▪ Construction and operation of additional railroad and pipeline facilities and transmission lines to transport coal, oil and gas, and electricity	▪ Moderate, short to long term	▪ Same as Alternative 1

[1] Cumulative impact discussion in this table and in Chapter 4 is based on the PRB Coal Review analyses (BLM 2005a-f, 2006b-d, 2008h-i, 2009b-f).
[2] All impacts are assumed to be adverse unless noted otherwise.

Table 2-15. Summary Comparison of Magnitude and Duration of Cumulative Impacts[1, 2] (Continued).

DESCRIPTION OF POTENTIAL IMPACT BY RESOURCE	***MAGNITUDE, TYPE, AND DURATION OF IMPACT***	
RESOURCE NAME	**ALTERNATIVE 1**	**PROPOSED ACTION, ALTERNATIVE 2 and ALTERNATIVE 3**
SOCIOECONOMICS		
▪ Increases in employment related to coal mining, coal-related, oil and gas, and oil- and gas-related development	▪ Significant, short to long term	▪ Same as Alternative 1
▪ Increases in personal income due to employment increases related to coal mining, coal-related, oil and gas, and oil- and gas-related development	▪ Significant, beneficial, short to long term	▪ Same as Alternative 1
▪ Increase in population due to employment increases related to coal mining, coal-related, oil and gas, and oil- and gas-related development	▪ Significant, short to long term	▪ Same as Alternative 1
▪ Expansion of housing supply due to employment increases related to coal mining, coal-related, oil and gas, and oil- and gas-related development	▪ Significant, short to long term	▪ Same as Alternative 1
▪ Increases in school enrollment due to employment increases related to coal mining, coal-related, oil and gas, and oil- and gas-related development	▪ Moderate, short term	▪ Same as Alternative 1
▪ Need for additional local government facilities and services due to employment increases related to coal mining, coal-related, oil and gas, and oil- and gas-related development	▪ Moderate, short to long term	▪ Same as Alternative 1
▪ Increased federal, state, and local revenues related to coal mining, coal-related, oil and gas, and oil-and gas-related development	▪ Significant, beneficial, short to long term	▪ Same as Alternative 1

[1] Cumulative impact discussion in this table and in Chapter 4 is based on the PRB Coal Review analyses (BLM 2005a-f, 2006b-d, 2008h-i, 2009b-f).
[2] All impacts are assumed to be adverse unless noted otherwise.

(v) any irreversible and irretrievable commitments of resources which would be involved in the Proposed Action should it be implemented (42 USC § 4332(C)).

Impacts can be beneficial or 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 through 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 insignificant following completion of reclamation.

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 xxvii 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 22,416 acres. Under the mine's currently approved mining and reclamation plan, a total of approximately 26,490 acres

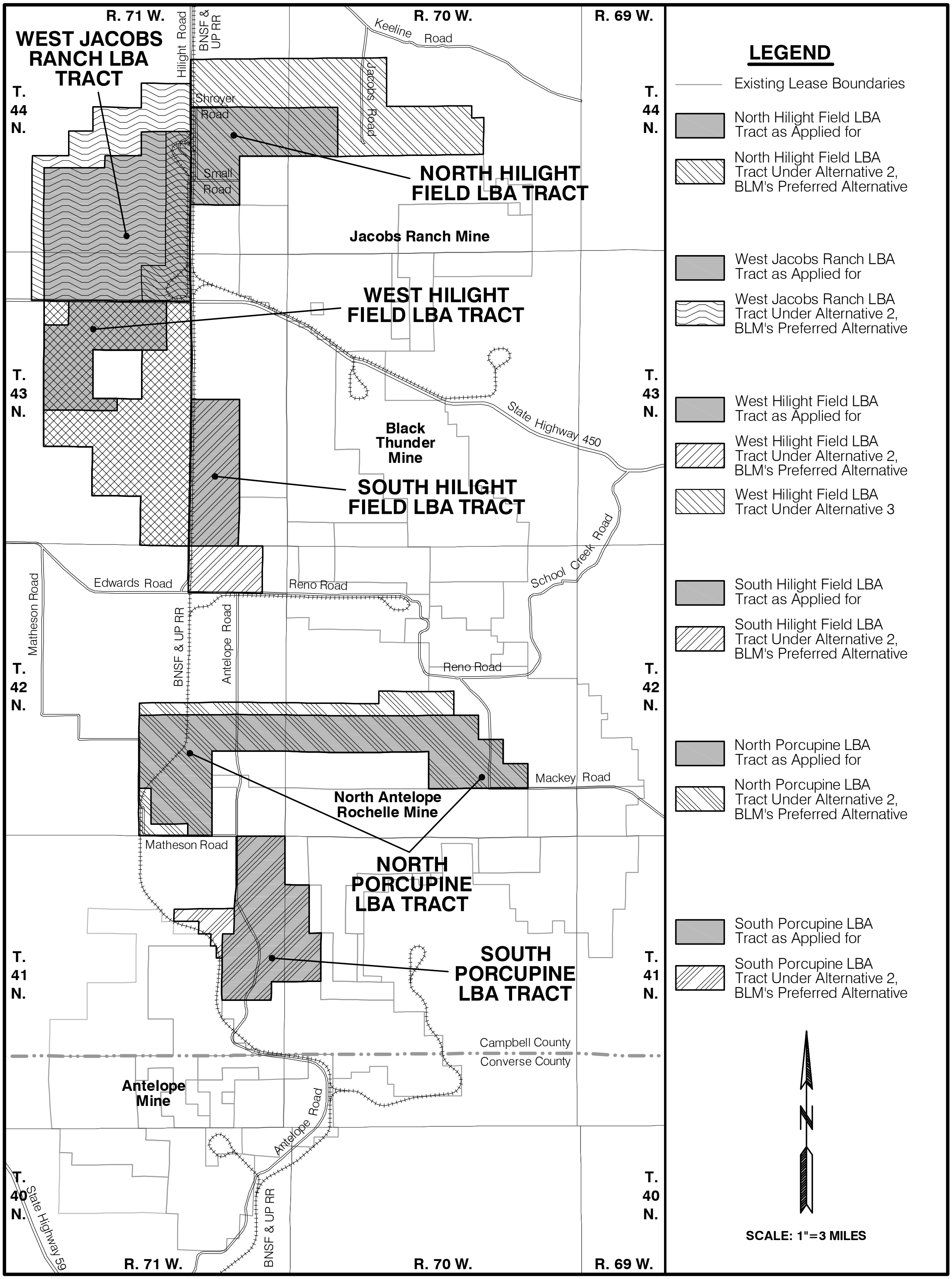


Figure 3-1. General Wright Analysis Area.

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]	22,416.2	25,029.7	29,555.6
Increase in Lease Area (Percent)	---	11.7	31.8
Estimated Additional Mine Disturbance Area (Acres)[2]	---	5,053.0	12,908.8
Estimated Total Mine Disturbance Area (Acres)	26,490.2	31,543.2	39,399.0
Increase in Estimated Disturbance Area (Percent)	---	19.1	48.7
Estimated Additional Recoverable Coal (Million Tons)[3]	---	263.4	652.8
Estimated Recoverable Coal for Mine as of 1/09 (Million Tons)	1,169.4	1,432.8	1,822.2
Increase in Estimated Recoverable Coal as of 1/09 (Percent)	---	22.5	55.8

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]	22,416.2	24,392.9	25,338.6
Increase in Lease Area (Percent)	---	8.8	13.0
Estimated Additional Mine Disturbance Area (Acres)[2]	---	1,126.0	2,731.4
Estimated Total Mine Disturbance Area (Acres)	26,490.2	27,616.2	29,221.6
Increase in Estimated Disturbance Area (Percent)	---	4.3	10.3
Estimated Additional Recoverable Coal (Million Tons)[3]	---	213.6	304.3
Estimated Recoverable Coal for Mine as of 1/09 (Million Tons)	1,169.4	1,383.0	1,473.7
Increase in Estimated Recoverable Coal as of 1/09 (Percent)	---	18.2	26.0

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]	22,416.2	24,786.7	29,607.5	30,986.3
Increase in Lease Area (Percent)	---	10.6	32.1	38.2
Estimated Additional Mine Disturbance Area (Acres)[2]	---	6,351.4	10,250.8	10,250.8
Estimated Total Mine Disturbance Area (Acres)	26,490.2	32,841.6	36,741.0	36741.0
Increase in Estimated Disturbance Area (Percent)	---	24.0	38.7	38.7
Estimated Additional Recoverable Coal (Million Tons)[3]	---	377.9	965.2	965.2
Estimated Recoverable Coal for Mine as of 1/09 (Million Tons)	1,169.4	1,547.3	2,125.6	2,125.6
Increase in Estimated Recoverable Coal as of 1/09 (Percent)	---	32.3	82.5	82.5

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]	8,604.7	14,549.1	16,680.9
Increase in Lease Area (Percent)	---	69.1	93.9
Estimated Additional Mine Disturbance Area (Acres)[2]	---	7,023.0	9,370.0
Estimated Total Mine Disturbance Area (Acres)	15,261.5	22,284.5	24,631.5
Increase in Estimated Disturbance Area (Percent)	---	46.0	61.4
Estimated Additional Recoverable Coal (Million Tons)[3]	---	669.6	912.6
Estimated Recoverable Coal for Mine as of 1/09 (Million Tons)	379.4	1,049.0	1,292.0
Increase in Estimated Recoverable Coal as of 1/09 (Percent)	---	176.5	240.5

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 1/09 (Million Tons)	933.8	1,535.0	1,679.2
Increase in Estimated Recoverable Coal as of 1/09 (Percent)	---	64.4	79.8

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 1/09 (Million Tons)	933.8	1,243.5	1,273.1
Increase in Estimated Recoverable Coal as of 1/09 (Percent)	---	33.2	36.3

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).

will be disturbed in order to recover that coal. According to Black Thunder Mine's 2008 Annual Report submitted to the Wyoming Department of Environmental Quality/Land Quality Division (WDEQ/LQD), the mine had disturbed a total of approximately 13,874.0 acres as of October 1, 2008. Of that total area of disturbance, approximately 4,769.9 acres (34.4 percent) were occupied by permanent or temporary facilities (stockpiles, hydrologic control structures, mine buildings and coal loading facilities, railroad loop, environmental monitoring areas, etc.), 2,628.2 acres (18.9 percent) were occupied by areas being actively mined, and 6,476.0 acres (46.7 percent) were occupied by areas that had been mined and reclaimed or were in the process of being reclaimed (TBCC 2008).

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 8,604.7 acres. Under the mine's currently approved mining and reclamation plan, a total of approximately 15,262 acres will be disturbed in order to recover that coal. According to Jacobs Ranch Mine's 2008 Annual Report submitted to WDEQ/LQD, the mine had disturbed a total of approximately 9,681 acres as of December 31, 2008. Of that total area of disturbance, approximately 1,191 acres (12.3 percent) were occupied by permanent or temporary facilities (stockpiles, hydrologic control structures, mine buildings and coal loading facilities, railroad loop, environmental monitoring areas, etc.), 2,508 acres (25.9 percent) were occupied by areas being actively mined, and 5,982 acres (61.8 percent) were occupied by areas that had been mined and reclaimed or were in the process of being reclaimed (JRCC 2008).

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.

On October 1, 2009, the Jacobs Ranch Mine was acquired by Arch Coal, Inc. ALC intends to consolidate the permits for the Jacobs Ranch Mine and the Black Thunder Mine in order to integrate the two separate mining operations. In this EIS, the applicant for the West Jacobs Ranch LBA Tract will be referred to as ALC, and the operator of the Jacobs Ranch Mine will be referred to as Thunder Basin Coal Company (TBCC). It is assumed that ALC would be the successful bidder, and that the West Jacobs Ranch tract would be mined as a maintenance lease for the existing Jacobs Ranch Mine.

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 2008 Annual Report submitted to the WDEQ/LQD, the mine had disturbed a total of approximately 15,311 acres as of September 30, 2008. Of that total area of disturbance, approximately 3,415 acres (22 percent) were occupied by permanent or temporary facilities (stockpiles, hydrologic control structures, mine buildings and coal loading facilities, railroad loop, environmental monitoring areas, etc.), 6,488 acres (43 percent) were occupied by areas being actively mined, and 5,409 acres (35 percent) were occupied by areas that had been mined and reclaimed or were in the process of being reclaimed (PRC 2008b).

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

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

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 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

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 (domestic use) 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 Wyoming 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, although ranges between 400 to 1,000 ft in the Gillette area and 400 to 800 ft in the general Wright analysis area. 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, and the town of Wright is currently utilizing four wells completed in the Tullock for its municipal water supply.
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 818 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 part of its 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.

Sources: Stratigraphy from Stratigraphic Nomenclature Committee, Wyoming Geological Association, 1969. Hydrogeology from Lewis and Hotchkiss, 1981.

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

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 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. Clinker is often exposed on the surface as predominantly red-colored, resistant rock outcrops. The occurrence of clinker 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 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. 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. Any acid that is formed by the coal would be diluted or neutralized by contact with groundwater that becomes alkaline as the minerals from the backfilled overburden materials are dissolved. 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, and coal, all of which are currently being produced. In addition, uranium, bentonite, and clinker (scoria) are mined in the PRB (WSGS 2003).

3.3.2.1.1 Conventional Oil and Gas

Conventional hydrocarbon resource accumulations are described in terms of discrete fields or pools localized in structural or stratigraphic traps by the buoyancy of oil or gas in water. In contrast, unconventional (or “continuous”) accumulations (oil or gas) have large special dimensions regional in extent, have diffuse, indistinctly defined boundaries, do not have obvious seals and traps, and exist more or less independently of the water column (Schmoker 1995). Unconventional oil and gas resources are discussed in the following subsection (3.3.2.1.2).

The following is based on information from BLM's Task 2 Report of the PRB Coal Review (BLM 2005a and 2009b), the Wyoming State Geological Survey's oil and gas map of the PRB (WSGS 2007), 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 Casper, Wyoming, of conventional oil and gas resources in the general Wright analysis area.

The U.S. Geological Survey (USGS) estimated means of undiscovered conventional oil and natural gas resources in the PRB of Wyoming and Montana, as of December 2006, are 215 million barrels of oil, 1.16 trillion cubic feet of natural gas, and 105 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 in the eastern PRB occur in reservoirs ranging from Pennsylvanian to Late (Upper) 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 natural 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 conventional oil or natural 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 A&C, 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 as well as secondary recovery in the PRB. Since 1990, most reserve additions in the U.S.-89 percent of oil reserve additions and 92 percent of gas reserve additions-have come from finding new reserves in old fields (OFE 1999). Most recent reserve additions in the PRB have come from old fields (BLM 2005g). Secondary recovery uses methods like gas reinjection and water flooding to boost primary production and displace hydrocarbons not produced in the primary recovery phase. Enhanced oil recovery involves the injection of liquids or gases (such as carbon dioxide) to stimulate hydrocarbon flow bypassed in earlier recovery phases (BLM 2005g). Sources of fresh or treatable water is needed for water flooding and accessibility to cheap natural gas is needed for gas injection projects; however, sources of abundant fresh water and cheap natural gas are not currently available in the general Wright analysis area. Enhanced oil recovery using carbon dioxide (CO_2) flooding also 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 Unconventional Oil and Gas

Continuous hydrocarbon accumulations form a geologically diverse group that includes CBNG, tight-sand gas, shale gas, basin-center gas, gas hydrates, and shallow biogenic gas. These various petroleum deposits are linked together as continuous accumulations by two key geologic characteristics: 1) they consist of large volumes of rock pervasively charged with oil or gas, and 2) they do not depend upon the buoyancy of oil or gas in water for their existence (Schmoker 2005).

The USGS estimated means of undiscovered continuous oil and natural gas resources in the PRB of Wyoming and Montana, as of December 2006, are 424 million barrels of oil, 15.5 trillion cubic feet of natural gas, and 26 million barrels of natural gas liquids (USGS 2006). Continuous oil and gas resources in the PRB occur in reservoirs ranging from Pennsylvanian to Late (Upper) Cretaceous age rocks,

Natural gas from hydrocarbon rich shale formations, known as shale gas is one of the most rapidly expanding trends in onshore domestic oil and gas exploration and production today (OFE 2009). Analysts have estimated that by 2011 most new reserves growth in the U.S. will come from continuous natural gas accumulations in highly organic shales and tight sands (OFE 2009). In their 2009 analysis of modern shale gas development in the United States, the U.S. Department of Energy, Office of Fossil Energy (OFE 2009) identified the locations of the nation's current producing gas shales and prospective shales, of which the PRB was not included.

The USGS (2006) reported that the potential for undiscovered continuous oil and gas resources in the PRB of Wyoming and Montana are most likely to occur in the Early (Lower) Cretaceous Mowry Continuous Oil Assessment Unit, the Upper Cretaceous Niobrara Continuous Oil Assessment Unit, the Lower Fort Union Lance Formation CBNG Assessment Unit, the Upper Fort Union Formation CBNG Assessment Unit, the Wasatch Formation CBNG Assessment Unit, and an unnamed "Shallow Continuous Biogenic" Gas Assessment Unit.

Shale gas investigations by the Wyoming State Geological Survey are currently focused on the Lower Cretaceous Mowry Shale, which is one of the major source rocks in the northern Rocky Mountain region. The Mowry Shale is extensively distributed throughout Wyoming's Laramide basins and has considerable potential for shale gas production (WSGS 2010). Depths to the Mowry Shale in the general Wright analysis area are generally 8,000 to 10,000 feet. Drilling for these resources is currently occurring in the Keeline and Wild West Oil and Gas Units (Elser 2010), which are located just east of the Black Thunder and Jacobs Ranch mines in T.43N., R.69W. and T.44N., R.69W., respectively.

Continued advances in technology will be key to providing the most effective means of reducing costs and minimizing adverse environmental impacts when trying to recover unconventional hydrocarbon resources (OFE 2003).

3.3.2.1.2.1 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 upper Fort Union Formation 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 producing uranium mining operation in Wyoming, the Smith Ranch-Highland in-situ recovery operation, which is located in west-central Converse County (WSGS 2009). 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. Clinker consists of sediments that were baked, fused, or melted in place when an underlying coal seam burned. Clinker is present within the existing Black Thunder, Jacobs Ranch, and North Antelope Rochelle mine permit areas, predominantly east of the mineable coal limit. Clinker 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

With the exception of developing continuous oil and gas resources from source rocks below the mineable Wyodak-Anderson coal beds, other minerals present on the LBA tracts could not be developed during mining. 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, as presently completed, located within the BLM study areas for the six WAC LBA tracts 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 conventional oil and gas wells have been drilled in the general Wright analysis area over the last 18 years, so the area generally appears to be unfavorable for additional production from known conventional reservoirs.

Currently, the drilling and completion of shale gas wells includes both vertical and horizontal wells. Horizontal wells provide more exposure to a formation than a vertical well does; six to eight horizontal wells drilled from one well pad can access the same volume of source rock as sixteen vertical wells (OFE 2009). As stated in Section 3.3.2.1.2, there is active interest in Mowry continuous shale gas near the general Wright analysis area, and it is anticipated that horizontal wells would be used almost exclusively to develop this continuous gas play (Elser 2010). It is possible that horizontal wells could be drilled from surface locations outside of the LBA tracts and deviated to run horizontally beneath the tracts within source rocks that are many thousands of feet deeper than the mineable Wyodak-Anderson coal beds. Continuous oil and gas resources could be developed in this manner on the LBA tracts during mining.

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 early 1980s. 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 and dewatered 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 current 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 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 improbable 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 region of the PRB, where the general Wright analysis area is located, is exclusively comprised of sedimentary rocks from the Lower Tertiary Period, including exposures of the Eocene age Wasatch Formation at the surface with a few minor exposures of the underlying Paleocene age Fort Union Formation (Green and Drouillard 1994, Love and Christiansen 1985). The Wasatch Formation, the geologic 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, has been interpreted to represent a fluvial system dominated by meandering channel belts (Pocknall 1987). This formation consists of buff tan to gray, non-marine, arkosic sandstone, drab siltstone, varicolored mudstone, lenticular pebble conglomerate, and carbonaceous shale. The formation also contains numerous relatively thin, discontinuous coal seams near the base. Most lithologies are poorly cemented with the exception of some calcite-cemented sandstone beds. Clinker deposits are also present in the area with this formation. Formation thickness can be up to 2,000 feet (Love and Christiansen 1985).

The Paleontological Resource Preservation Act (PRPA) was passed as part of the Omnibus Public Land Management Act of 2009 and is referenced as Public Law 111-011 Subtitle D. Land managing agencies are currently in the process of developing guidelines and procedures to implement PRPA. Several key features of PRPA include the definition of paleontological resources, a mandate to manage paleontological resources on federal lands using scientific principles and expertise, criteria for issuing permits to collect paleontological resources, definitions of specifically prohibited acts, specific penalties for violations, and an exemption of specific paleontological locality data from Freedom of

Information Act (FOIA) requests. Overall, PRPA gives land managing agencies the authority to specifically protect and manage paleontological resources on federal lands.

BLM ranks geologic formations 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 currently uses an additional planning tool, called the Potential Fossil Yield Classification (PFYC) system (Instructional Memorandum No. 2008-009), which was developed by the U.S. Department of Agriculture-Forest Service (USFS). This system uses a Class 1-5 ranking scale where Class 1 represents the lowest potential and Class 5 the highest potential for paleontological resources. The PFYC 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.

The PFYC 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 Class 5 under the PFYC system, which is described as follows:

> Class 5: Highly fossiliferous geologic units that consistently and predictably produce vertebrate fossils or scientifically significant invertebrate or plant fossils, and that are at risk of natural degradation and/or human-caused adverse impacts.

The BLM considers the Wasatch Formation to fulfill the PFYC Class 5 in other parts of Wyoming; however, the BLM considers the Wasatch Formation in the PRB to fulfill the PFYC Class 3a. Class 3a formations in the PFYC system are described as follows:

> Class 3a: Fossiliferous sedimentary geologic units known to contain vertebrate fossils or scientifically significant fossils, but occurrences are widely scattered. Common invertebrate or plant fossils may be found in the area, and opportunities may exist for hobby collecting. The potential for a project to be sited on or impact a significant fossil locality is low, but is somewhat higher for common fossils.

The Eocene Wasatch Formation has been known to produce abundant and significant paleontological resources in several basins throughout Wyoming (Delson 1971, Winterfeld 1978, EVG 2001). Occurrences of significant fossils in this formation within the PRB have been more sporadic and less common than in other basins. This formation is best known for its diverse mammalian fauna that define the Wasatchian North American Land Mammal Age (NALMA). Several groups of mammals have been discovered from this formation over the past 150 years. PRB mammalian taxa include multituberculates, marsupials, insectivores, deltatherians, primates, condylarths, carnivores, rodents, pantodonts, perissodactyls, and artiodactyls (Delson 1971). Non-mammalian taxa known to occur in this formation includes champsosaurs, squamates, fish, turtles, crocodilians and birds. Non-vertebrate fossils include a wide variety of mollusks and numerous paleofloral biotas (fossil plants). 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 in the Wasatch Formation in the PRB 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.

Distinguishing between the Eocene Wasatch and Paleocene Fort Union formations in the PRB is complicated. The distinction is paleontologically significant because the Paleocene-Eocene transition was marked by a major climatic shift that influenced floral and faunal communities. The base of the Wasatch Formation represents the Paleocene-Eocene Thermal Maximum (PETM), a brief period (10-20,000 years) of intense global warming that also marks the onset of the Eocene (Wing et al. 2003). The cause of warming has been attributed to a rapid, massive addition of greenhouse gases to the atmosphere (Dickens et al. 1995). Although the amount of warming has been well-documented (Kennet and Stott 1991, Zachos et al. 2005), changes of other climate factors such as precipitation are less resolved. Changes to faunal and floral community compositions during the PETM have been documented in Wyoming (Gingerich 2003, Smith et al. 2007). The PETM is represented in terrestrial and marine sediments by a negative carbon isotope excursion. Evidence for the carbon isotope excursion (CIE) in the PRB comes from paleosol carbonate nodules, mammal teeth, and bulk organic matter. These data place the onset of the PETM approximately 5 to 13 meters above the uppermost carbonaceous shale unit that exists within the base of the Wasatch Formation and indicate that approximately 50 meters of sediments are within the PETM interval (Wing et al. 2003). Similar studies place the Paleocene-Eocene boundary at the base of the Willwood Formation in the southern Bighorn Basin of Wyoming and indicate that the main PETM interval is approximately 37 meters thick (Wing et al. 2005, Smith et al. 2007).

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.

The upper-most member of the Fort Union Formation, the Lebo Member, is less significant in regards to paleontological resources. Fossils occur sporadically and significant vertebrate specimens have rarely been reported from the PRB. The most common fossils from this member include various paleofloral and invertebrate specimens.

Surficial materials in the general Wright analysis area are derived primarily from the underlying bedrock, which consists mainly of soft shale, sandstone and coal beds, and most of these rocks weather to fine-grained material. The physical properties of the weathered materials depend largely on the mode of transportation and deposition, whether by water, gravity, or wind that account for the position of the weathered materials. Actual outcrops of the Wasatch and underlying Fort Union formations that could be prospected for fossils occur infrequently and are found most commonly in areas having the steepest slopes (i.e., rough breaks between upland areas and drainage channels).

<u>3.3.3.1.1 Paleontological Resource Survey</u>

The entire 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, focusing attention on bedrock exposures and planar surfaces lacking vegetative cover. Anthills were also investigated. Three distinct types of paleontological localities could potentially exist in the general Wright analysis area. The first consists of in-situ (in its natural position) specimens weathering out from the point of original bedrock deposition. The second consists of identifiable specimens for which the exact source location (and contextual information) cannot be determined. The third consists of unidentifiable specimens (e.g., bone fragments) for which the source could not be determined and no contextual data could be recovered.

The USFS requires that the paleontological survey of the federally-owned surface lands within the LBA tracts' general analysis areas be undertaken to locate, identify, and document paleontological resources that might be affected, and to provide recommendations of management/mitigation for identified paleontological resources. Surveys on the federal lands (TBNG) in the general Wright analysis area were conducted in 2009 by qualified paleontologists with USFS approval to conduct paleontological resource surveys on the TBNG. Survey results are included in the following subsections.

Each newly discovered locality was recorded on a field data sheet and marked on a master project field map. Site recording involved a detailed contextual description of the geology, stratigraphy, and lithology of each locality. Specimens were identified in the field to the extent possible. Global positioning system (GPS) coordinates were recorded as point features from each locality, and a detailed photographic log of the fossils and outcrops was also completed for each locality. Potentially significant specimens exposed on the surface were collected to prevent any potential loss of data.

3.3.3.1.2 North Hilight Field LBA Tract

All lands managed by the TBNG–Douglas Ranger District (TBNG-DRD) within the general analysis area for the North Hilight Field LBA Tract were surveyed in July 2009 by ARCADIS U.S., Inc. under Paleontological Resource Special Use Permit DGL275. The entire project area was block surveyed. No new paleontological localities were discovered and no specimens were found to collect as a result of the survey. A report documenting the findings of the survey was prepared and submitted to the TBNG-DRD for review.

3.3.3.1.3 South Hilight Field LBA Tract

All lands managed by the TBNG-DRD within the general analysis area for the South Hilight Field LBA Tract were surveyed in July 2009 by ARCADIS U.S., Inc. under Paleontological Resource Special Use Permit DGL275. The entire project area was block surveyed. A report documenting the findings of the survey was prepared and submitted to the TBNG-DRD for review.

Two new paleontological localities were discovered in the South Hilight Field LBA Tract. The first locality contained abundant multi-specific leaf impressions in a buff to tan, very thinly-bedded sandy siltstone within the Wasatch Formation. The fossil-bearing unit was approximately 0.3 meters thick and overlaid a carbonaceous shale. Exposed bedrock from this locality weathered buff to light brown and tended to break along bedding planes. Leaf impressions were oriented parallel to bedding planes and the preservation of leaf morphology was excellent. Occasional woody debris up to 5 centimeters in diameter was also present. The leaf impressions were identified as *Glyptostrobus sp*. from the Cupressaceae family and an unknown genus of the family Betulaceae. The type of fossil material at this locality was considered relatively common, and although the locality may have scientific interest, it was considered to have low scientific significance. No specimens were collected or reposited for curation from this locality.

The second locality covered an area of approximately 50 square meters and consisted of a dark brown, carbonaceous shale with extremely abundant, multispecific paleofloral remains. The carbonaceous shale was overlain by a thin (1 meter) buff, fine-grained, poorly consolidated sandstone. The sandstone was overlain by another carbonaceous shale, which weathers to a comparatively reddish horizon. The carbonaceous shale overlying the sandstone horizon also contained leaves, but the fossils were less abundant and exhibited poorer preservation. The upper horizon was exposed throughout the outcrop, whereas the lower, more productive horizon was only exposed along the eastern half because the beds dip to the west at approximately 10 degrees. Within the lower carbonaceous shale, clastic material and preservation quality of individual leaves both increased upwards. The lower portions of the horizon were composed almost entirely of leaf remnants, many of which have preserved organic material. The abundance of leaves in the lower shale made identification of individual specimens (i.e., leaf margins) difficult. All of the leaf impressions were representative of angiosperm (broadleaf) species. Specimens representing Betulaceae, *Nyssa sp.* and *Archeampelos sp.* were tentatively identified. Occasional seed pods and possible fruit structures are occasionally present. No large pieces of petrified wood were identified at this locality. The type of fossil material at this locality is considered relatively common. Because the locality contains such abundant material, it may be representative of the local paleofloral community and useful in paleoecologic and paleoclimatic reconstructions. Furthermore, because its stratigraphic location near the base of the Wasatch Formation places it near the Paleocene-Eocene boundary, this location may represent a paleoflora from the PETM, a brief warm period marked by floral and faunal migrations which has been intensively studied over the past decade (Wing et al. 2005). Paleobotanists with potential interest in the locality (Scott Wing – Smithsonian Institution and Kirk Johnson – Denver Museum of Nature and Science) were informed of its location and potential significance. No specimens were collected or reposited for curation from this locality.

3.3.3.1.4 West Hilight Field LBA Tract

All lands managed by the TBNG-DRD within the general analysis area for the West Hilight Field LBA Tract were surveyed in July 2009 by ARCADIS U.S., Inc. under Paleontological Resource Special Use Permit DGL275. The entire project area was block surveyed. A report documenting the findings of the survey was prepared and submitted to the TBNG-DRD for review.

Only one new locality was discovered as a result of the field survey. This locality contained scattered bone and petrified wood fragments. Bone fragments have weathered to a dull yellow or brown color. All fragments except one were smaller than one square inch. The fossils were found weathering from Wasatch Formation regolith. Due to the flat topography, no contextual geologic data could be collected. The fragments were not identifiable in terms of animal type or anatomy. Examination of anthills in the vicinity of the locality produced no teeth or other bone fragments. Although the fragments were broken and weathered beyond the point of usefulness, they were well preserved and hard, indicating that identifiable fragments may exist. However, discovery of identifiable fossils was considered unlikely due to the low density of bones at the ground surface and overall limited ground visibility. Thus, the locality was considered to have low scientific significance, and no specimens were collected or reposited for curation from this locality.

3.3.3.1.5 West Jacobs Ranch LBA Tract

No lands are managed by the TBNG-DRD within the general analysis area for the West Jacobs Ranch LBA Tract. Therefore, paleontological surveys in the project area were not conducted by a paleontologist with USFS approval. However, professional archeologists, in effort to locate unique localities of fossilized bone, closely examined Wasatch outcrops in conjunction with their intensive pedestrian surveys for cultural resources. Such concentrations of fossilized bone were not found. The only observed fossils were of small petrified wood fragments. No significant or unique paleontological resource localities have been recorded in the West Jacobs Ranch tract's general analysis area.

3.3.3.1.6 North Porcupine LBA Tract

All lands managed by the TBNG-DRD within the general analysis area for the North Porcupine LBA Tract were surveyed in November 2009 by ARCADIS U.S., Inc. under Paleontological Resource Special Use Permit DGL275. The entire project area was block surveyed. A report documenting the findings of the survey was prepared and submitted to the TBNG-DRD for review.

A background investigation was conducted to identify any publications, reports, collections records or previous field surveys that detailed any paleontological discoveries in or near the general analysis area for the North Porcupine LBA Tract. USFS and BLM were also consulted by ARCADIS to identify any known paleontological resources in the vicinity of the project area. The northern portion of the tract's general analysis area was previously block surveyed by Uinta Paleontological Associates (UPA 2008). No previously discovered localities were identified.

Overall, two new paleontological localities were discovered in the project area by the paleontologists. Localities consisted of moderately well-preserved specimens discovered as float (not in-situ). Both localities discovered in the LBA tract's general analysis area are from the Wasatch Formation.

The first locality contained associated scattered vertebrate bone and petrified wood fragments. Despite the heavy weathering due to exposure, the fragments exhibited relatively good preservation of bone structure. A long bone or rib fragments, a jaw fragment from a small crocodilian, and the distal end of a small tibia were recognizable, although none were complete enough to identify taxonomically. The locality was in an area of lightly rolling topography and no bedrock was visible at or in the vicinity of the locality. Because vertebrate fossils from this portion of the PRB are relatively rare, these fossils were collected for curation, and pending taxonomic identification may be considered scientifically significant.

The second locality contained isolated, scattered, unidentifiable vertebrate bone fragments as well as abundant petrified wood fragments. Based on the highly porous bone structure, the fragments are possibly crocodilian. This locality was discovered in an area that was previously inventoried by Uinta Paleontological Associates, Inc. as the result of spot checking areas of exposed bedrock. This locality is within a bedrock exposure of the Wasatch Formation, consisting of poorly cemented, fine-grained, gray sandstone. Silicified wood fragments were often found as float downslope from the bedrock outcrops, and one large (8-inch diameter) petrified log was identified in-situ; however, these resources are common and not considered to be scientifically significant. Because the vertebrate fossils were unidentifiable with no contextual data, they are not considered to be scientifically significant and were not collected.

In summary, two new paleontological localities were discovered during this 2009 survey. Both of the localities contained vertebrate fossil material and were discovered in the Wasatch Formation. Specimens discovered on the surface at one of the localities were collected and will be reposited with the Denver Museum of Nature and Science. Because no in-situ sources for the discovered fossil fragments were identified, further efforts to recover additional fossil material are considered unlikely to be successful. Fragments of fossilized wood were intermittently identified throughout the North Porcupine general analysis area, but were not considered scientifically significant.

3.3.3.1.7 South Porcupine LBA Tract

All lands managed by the TBNG-DRD within the general analysis area for the South Porcupine LBA Tract were surveyed in November 2009 by ARCADIS U.S., Inc. under Paleontological Resource Special Use Permit DGL275. The entire project area was block surveyed. A report documenting the findings of the survey was prepared and submitted to the TBNG-DRD for review.

A background investigation was conducted to identify any publications, reports, collections records or previous field surveys that detailed any paleontological discoveries in or near the general analysis area for the South Porcupine LBA Tract. USFS and BLM were also consulted by ARCADIS to identify any known paleontological resources in the vicinity of the project area. No previously discovered paleontological localities were identified within the project area.

As described in Section 3.2.1, the terrain in the northern portion of the South Porcupine tract is comprised of gently rolling hills with subdued draws, but the southern portion of the tract contains steep-sided gullies that have formed as a result of deep incision by the headwaters of tributaries to Horse, Antelope, and Porcupine creeks.

Overall, 10 new paleontological localities were discovered in the project area by the paleontologists. Localities discovered in the LBA tract's general analysis area are from both the Wasatch and Fort Union formations.

The first locality contains the terminal ends of two possible limb bones, abundant crocodilian scutes (skin armor), a crocodilian jaw fragment, a heavily abraded rib fragment and numerous unidentifiable bone fragments. The fossils at this locality were discovered at the surface of a fine- to medium-grained, poorly cemented, gray-tan sandstone near the base of the Wasatch Formation. It is highly likely that additional fossil material may be buried at this locality, and because of their potential scientific significance, all fossil material discovered on the surface was collected from this locality.

The second locality contains one unidentified in-situ vertebrate bone. The specimen is extremely fragile and preserved within a very poorly-cemented sandstone block in the lower Wasatch Formation. The significance of this fossil cannot be assessed without identification, which cannot be determined without careful excavation and preparation. The specimen was not collected due to its fragile condition.

The third locality contains abundant freshwater unionid mollusk shells. The shells are very fragile and often crumble or flake apart when handled. Due to the fragile nature of the specimens, it was very difficult to identify them to a taxon, although several specimens appear to be from the genus *Plesielliptio*. These fossils were discovered in-situ within a poorly cemented fine- to very fine-grained, very well sorted sandstone interbedded with mudstone. The outcrop is capped by a well-cemented, very fine-grained sandstone that contains occasional woody debris. This locality occurs in the Lebo Member of the Fort Union Formation. The type of invertebrate fossil materials at this locality is considered relatively common, and although the locality may have scientific interest in terms of taphonomy or paleogeography, it is considered to have low scientific significance. No specimens were collected from this locality.

The fourth locality contains abundant unionid mollusk shells similar to those found at the third locality, but the shells at this locality are somewhat better preserved, less fragile, and more complete. At least one genus, *Plesielliptio*, was recognized. These shells were discovered in-situ within a very fine-grained sandstone overlying a carbonaceous shale within the Lebo Member of the Fort Union Formation. These invertebrate fossils are considered relatively common, and although the locality may have scientific interest in terms of taphonomy or paleocommunity structure, it is considered to have low scientific significance. These specimens occur in both Paleocene and Eocene and therefore do not serve as good biostratigraphic markers in that respect. Due to the poor preservation of fossil material and common occurrence, no specimens were collected from this locality.

The fifth locality contains abundant associated vertebrate bones identified as *Champsosaurus sp*. Skeletal elements present include distal tibia, two dorsal vertebrae, and other bone fragments, including a partial illium. The bones are relatively well preserved and exhibit moderate weathering. Although found as surface float within the Lebo Member of the Fort Union Formation, the fossils were constrained to a small area, and the lack of dispersal suggests minimal transport resulting from modern erosion processes. It is highly likely that additional in-situ resources are present at this location. The paleontological resources at this locality are considered to be scientifically significant given the abundance of associated vertebrate fossil material that appears to represent a single individual and the high potential for additional buried material to be located in-situ. All fossil material on the surface was collected. Excavation of this locality may likely yield additional significant paleontological resources.

The sixth locality contains abundant vertebrate fossils, including five *Champsosaurus* dorsal vertebrae, crocodilian scutes, and other associated unidentifiable bone fragments. The *Champsosaurus* vertebrae are identified on the basis of amphicoelous centra and an hourglass-shaped neural spine when viewed dorsally. The vertebrae and larger bone fragments were all found on the surface in close association and are interpreted to have weathered from the same horizon. Abundant crocodilian scutes and unidentified bone fragments were scattered amongst colluvium throughout the locality. These fossils were located within colluvium and residuum formed in the uppermost Lebo Member of the Fort Union Formation. Fossil material from this locality appears to be in the same stratigraphic position as the fossils discovered at the fifth locality. The paleontological resources at this locality are considered to be scientifically significant given the abundance of associated vertebrate fossil material that appears to represent a single individual and the high potential for additional buried material to be located in-situ. All fossil material on the surface was collected. Excavation of this locality may likely yield additional significant paleontological resources. Additionally, samples of paleofloral fossils from underlying carbonaceous shale at this locality could provide additional contextual paleoecological data.

The seventh locality contains numerous heavily abraded crocodilian scutes, a possible crocodilian ungal phalanx (toe claw), and unidentifiable bone fragments. All fossils at this locality have good preservation despite heavy weathering. Fossils were discovered as surface float along a flat, heavily vegetated surface. The regolith at the surface has weathered from the underlying Lebo Member of the Fort Union Formation. The specimens were not discovered in-situ and therefore no contextual depositional data was available. The abundance of fossil material at this locality spread across the surface may indicate the presence of additional buried paleontological resources. All specimens discovered on the surface were collected. With no exact source identified, it is difficult to predict if excavation would yield additional paleontological resources.

The eighth locality contains abundant paleofloral impressions in a very well-cemented siltstone. Most specimens were observed to be broadleaf, but occasional *Glyptostrobus* (a narrow-leaf cypress) specimens were observed. The partially silicified siltstone containing these leaf fossils is in the Lebo Member of the Fort Union Formation. This locality is very similar lithologically and stratigraphically to the sixth locality and was probably preserved during the same depositional sequence. The type of fossil material at this locality is considered relatively common, and although the locality may have scientific interest, it is considered to have low scientific significance. No specimens were collected from this locality.

The ninth locality contains abundant gastropod fossils. The specific taxon represented by these gastropods has not been determined, but only one morphology was observed. The shells are well preserve with distinct morphology, including pronounced horizontal varices on each whorl with less pronounced vertical varices. The fossils were abundant and could be found along the entire exposure of the fossil-bearing horizon, which is a single mudstone in the Lebo Member of the Fort Union Formation. The type of invertebrate fossil material at this locality is considered relatively common, and although the locality may have scientific interest in terms of taphonomy or paleocommunity structure, it is considered to have low scientific significance. No specimens were collected from this locality.

The tenth locality contained an in-situ single small robust humerus, possibly from a medium-sized reptile. The lack of epiphyseal sutures excludes the possibility of the bone representing any mammal species, and the dense, robust, non-hollow character excludes birds. The bone is well preserved, even though both termini are highly abraded, indicating transport prior to fossilization. The fossil was discovered in-situ within a medium-grained, poorly cemented quartzitic sandstone in the lowermost Wasatch Formation. The outcrop containing this locality forms the headwall of a steep headcut in an ephemeral stream channel. No other bone material, including fragments, was discovered at this locality. This specimen is considered to be scientifically significant as it is well preserved, identifiable and was discovered in-situ, allowing for the collection of important contextual data. Even though no additional fossil bones were discovered on the surface, it is highly likely that additional buried fossil material may be present at this locality. Excavation efforts at this locality may potentially yield additional significant paleontological resources. The humerus discovered at this locality was removed from the bedrock and collected to prevent any future adverse impacts to the specimen.

In summary, 10 new paleontological localities were discovered during this survey. Six of the localities contained fossil vertebrate material, three localities contained fossil invertebrate material, and one locality contained fossil plant impressions. Three vertebrate localities were discovered in the Wasatch Formation, while the remaining seven localities were discovered in the Lebo Member of the Fort Union Formation. Vertebrate specimens exposed on the surface that did not require excavation were collected from five localities. All collected specimens will be reposited with the Denver Museum of Nature and Science. None of the invertebrate or plant localities discovered during this 2009 survey were considered rare of scientifically significant, and therefore no specimens were collected from them. Fragments of fossil wood were intermittently identified throughout the general analysis area for the South Porcupine LBA Tract, but were not considered scientifically significant.

3.3.3.2 Environmental Consequences

3.3.3.2.1 Proposed Action and Alternatives 2 and 3

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.

Paleontological resources adjacent to the mine areas may be impacted as a result of increased access to the areas. There may be increased unauthorized collecting of fossils associated with recreational activity and other pursuits outside 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 paleontological resources.

The sections that follow describe the potential impacts to paleontological resources on each LBA tract under the Action Alternatives.

3.3.3.2.1.1 North Hilight Field LBA Tract

No fossils, scientifically significant or otherwise, were identified or collected during the July 2009 survey. No additional paleontological mitigation measures prior to mining-related disturbances are recommended by the qualified paleontologist who conducted the survey.

3.3.3.2.1.2 South Hilight Field LBA Tract

All localities would likely be affected by mining activities if the LBA tract is leased under the Proposed Action or Alternative 2, BLM's preferred alternative. No scientifically significant fossils were identified or collected during the July 2009 survey. The type of fossil material at one locality was considered relatively common, and although the locality may have scientific interest, it was considered to have low scientific significance. Because the locality contains such abundant material, it may be representative of the local paleofloral community and useful in paleoecologic and paleoclimatic reconstructions. Furthermore, because its stratigraphic location near the base of the Wasatch Formation places it near the Paleocene-Eocene boundary, this location may represent a paleoflora from the PETM. No additional specific mitigation measures, aside from the notification of potentially interested researchers, are recommended for this locality by the qualified paleontologist who conducted the survey.

3.3.3.2.1.3 West Hilight Field LBA Tract

All localities would likely be affected by mining activities if the LBA tract is leased under the Proposed Action or Alternative 2, BLM's preferred alternative.

No scientifically significant fossils were identified or collected during the July 2009 survey. No additional paleontological mitigation measures prior to mining-related disturbances are recommended by the qualified paleontologist who conducted the survey.

3.3.3.2.1.4 West Jacobs Ranch LBA Tract

All localities would likely be affected by mining activities if the LBA tract is leased under the Proposed Action or Alternative 2, BLM's preferred alternative. No significant or unique paleontological resource localities have been recorded in the West Jacobs Ranch tract's general analysis area. No additional paleontological mitigation measures prior to mining-related disturbances would be necessary.

3.3.3.2.1.5 North Porcupine LBA Tract

All localities would likely be affected by mining activities if the LBA tract is leased under the Proposed Action or Alternative 2, BLM's preferred alternative. Scientifically significant vertebrate fossil materials were identified and specimens discovered on the surface at one of the localities were collected and will be reposited with the Denver Museum of Nature and Science. Because no in-situ sources for the discovered vertebrate fossil fragments were identified, further efforts to recover additional fossil material are considered to likely be unsuccessful. No additional paleontological mitigation measures prior to mining-related disturbances are recommended by the qualified paleontologist who conducted the survey.

3.3.3.2.1.6 South Porcupine LBA Tract

All localities would likely be affected by mining activities if the LBA tract is leased under the Proposed Action or Alternative 2, BLM's preferred alternative. No additional mitigation measures are recommended by the qualified paleontologist who conducted the survey for any of the invertebrate or plant fossil localities. Scientifically significant vertebrate specimens exposed on the surface that did not require excavation were collected from five localities. Based on the field survey, it is highly likely that additional buried fossil material may be present at several vertebrate fossil localities. In order to avoid future impacts to potentially scientifically significant paleontological resources at these localities, it is recommended by the qualified paleontologist who conducted the survey that mitigation efforts be conducted to determine if additional buried material is present, and to then collect any scientifically significant specimens. These mitigation efforts would ensure that mining operations would have no adverse effect on these localities.

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 Wright area coal (WAC) 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

Although potentially buried paleontological resources may exist within the general analysis areas for each of the WAC LBA tracts, long term monitoring is neither a safe nor practical mitigation measure due to the size and complexity of surface mining operations.

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 applicants' 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 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 for particulate matter associated with surface coal mining and preparation. The primary direct source of gaseous emissions from surface coal mining operations is tailpipe exhaust from large mining equipment and other vehicle traffic inside the mine permit area. Small amounts of gaseous pollutants are also emitted from small stationary boilers and off-road diesel engines. The federal and Wyoming state ambient air quality standards for the six criteria pollutants are shown in Table 3-8.

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. The federal and Wyoming state 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;
- 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.

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	1-hour[5]	---	188.1	---	---	---	---
	Annual	25[6]	100	100	100	2.5	25
Ozone	8-hour	133[6]	147	147	157	---	---
Sulfur dioxide	3-hour	157[7]	---	1,300	1,300	25	512
	24-hour	68[7]	365	---	260	5	91
	Annual	9[7]	80	---	60	2	20
PM_{10} [8]	24-hour	103[9]	150	150	150	8	30
	Annual	26[9]	---	---	50	4	17
$PM_{2.5}$ [8]	24-hour	18.9[10]	35	35	65	---	---
	Annual	6.4[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 EPA set a new 1-hour NO_2 standard at 0.100 ppm (188.1 μg/m³) effective January 22, 2010. To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 0.100 ppm.

6 Data collected at WDEQ/AQD site located 15 miles SSW of Gillette, Wyoming. (Annual = average of mean annual values in 2005-2008. 8-hr = average of four highest 8-hr values in 2005-2008).

7 Data collected at Wyodak Site 4, Campbell County, Wyoming. (Annual = average of mean annual values in 2005-2008. 24-hr and 3-hr = average of two highest 24-hr and 3-hr values in 2005-2008.)

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 Jacobs Ranch Mine, Site 5, Campbell County, Wyoming. (Annual = average of mean annual values in 2005-2008. 24-hr = average of four highest 24-hr values in 2005-2008.)

10 Data collected at the Black Thunder Mine, Site BTM-26-2, Campbell County, Wyoming. (Annual = average of mean annual values in 2005-2008. 24-hr = average of 98th percentile values in 2005-2008.)

Source: BLM 2005b, EPA 2009a, and WDEQ/AQD

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 48,950 PM_{10} samples had been collected through 2008. 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.

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 applicant mines (Black Thunder, Jacobs Ranch, and North Antelope Rochelle) 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

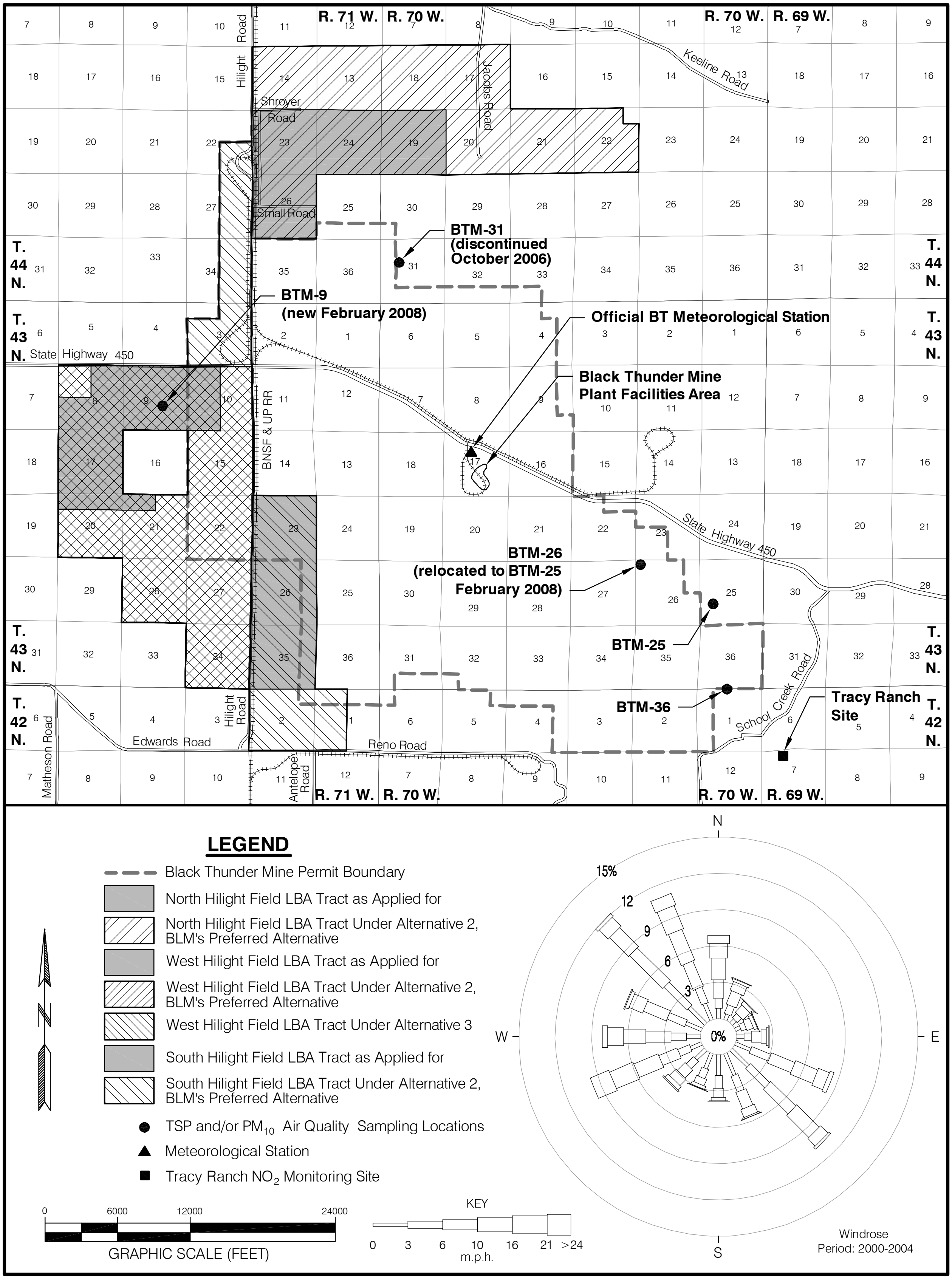


Figure 3-3. Wind Rose, Air Quality and Meteorological Stations at the Black Thunder Mine.

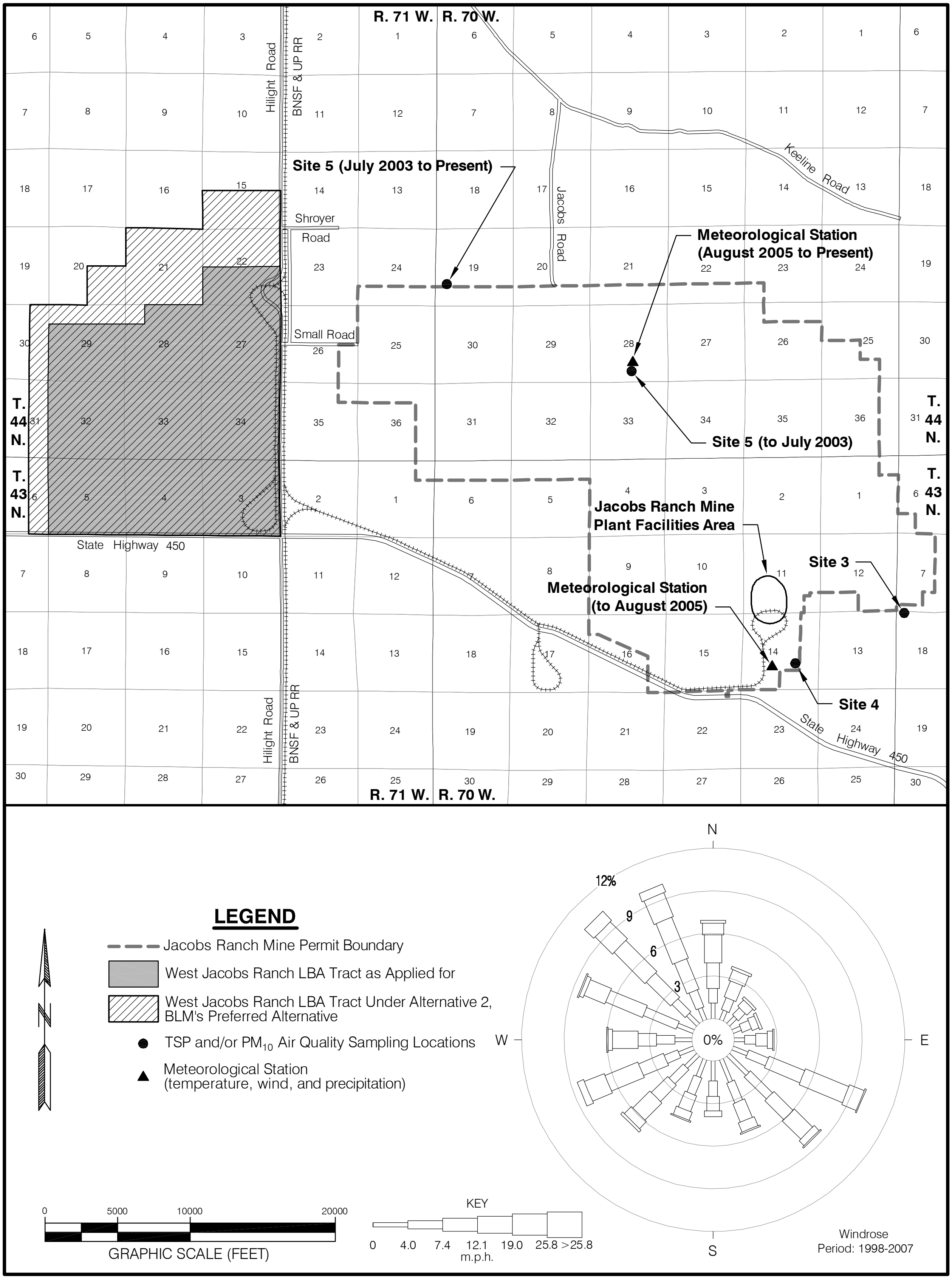


Figure 3-4. Wind Rose, Air Quality and Meteorological Stations at the Jacobs Ranch Mine.

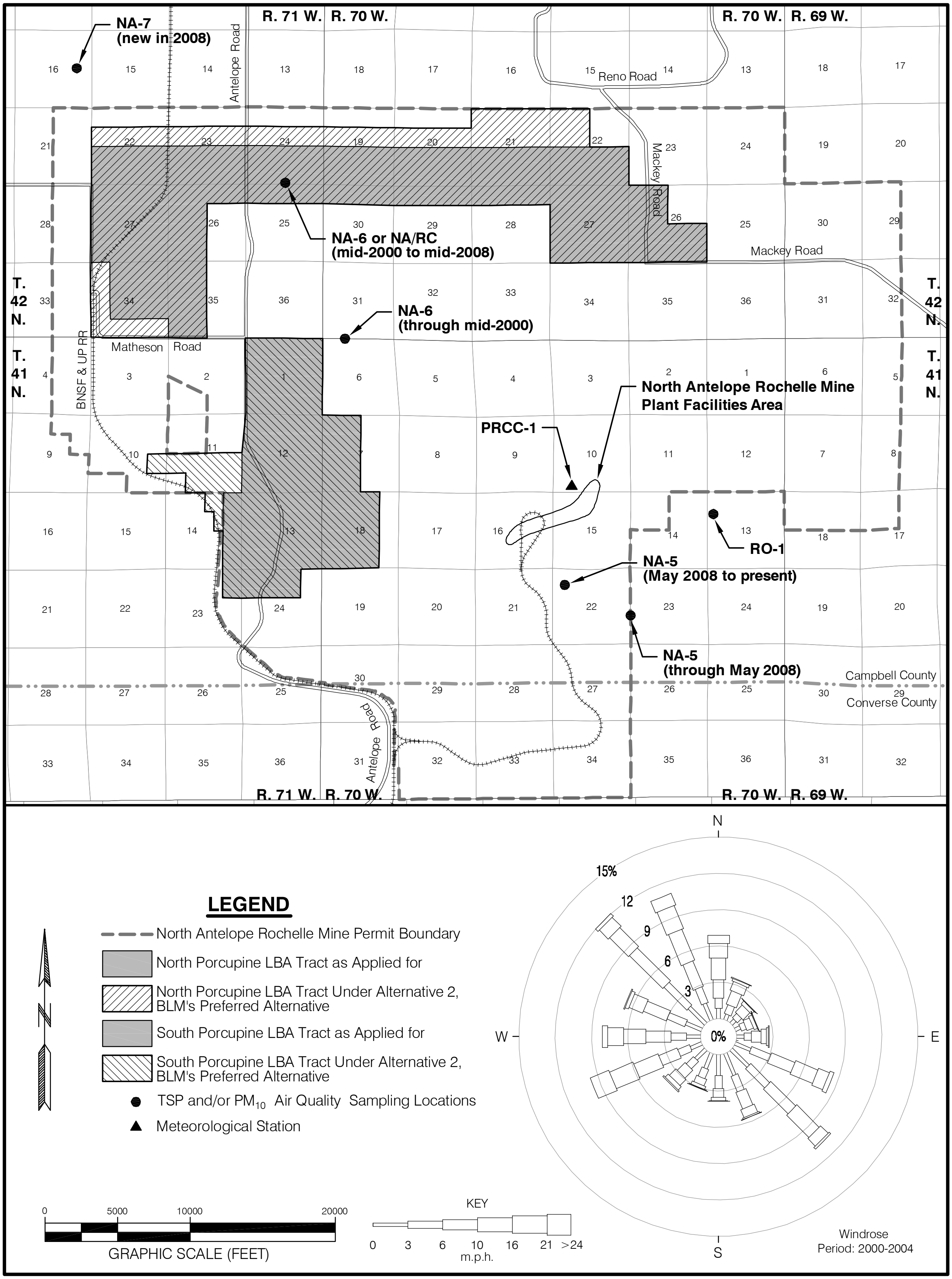


Figure 3-5. Wind Rose, Air Quality and Meteorological Stations at the North Antelope Rochelle Mine.

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 three applicant Wright area coal (WAC) mines' particulate monitoring samplers from 1998 through 2008. Annual coal and overburden production for the three WAC 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 three applicant mines through 2007. From 2001 through 2006 there were a total of nine exceedances of the 24-hour PM_{10} particulate standard associated with the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines. 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 more detail 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.

In 2007, a total of three 24-hour PM_{10} exceedances were reported at the three WAC mines (two at North Antelope Rochelle, one at Black Thunder, and none at Jacobs Ranch). These three exceedances reported in 2007 have been flagged by EPA as exceptional events under the NEAP and will not be considered when determining the region's air quality designation.

One 24-hour PM_{10} particulate standard exceedance was reported by the Black Thunder Mine and no 24-hour PM_{10} exceedances were reported by the Jacobs Ranch and North Antelope Rochelle mines in 2008 (Shamley 2010). The single exceedance reported in 2008 at the Black Thunder mine was determined to be a valid exceedance (not considered to be an exceptional event under the NEAP) and a notice of violation was subsequently issued to the mine (Shamley 2010).

No exceedances of the 24-hour PM_{10} particulate standard were reported by the three WAC mines, or any of the other surface coal mines in the PRB in 2009 (Shamley 2010).

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 micrometers in diameter and smaller), 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

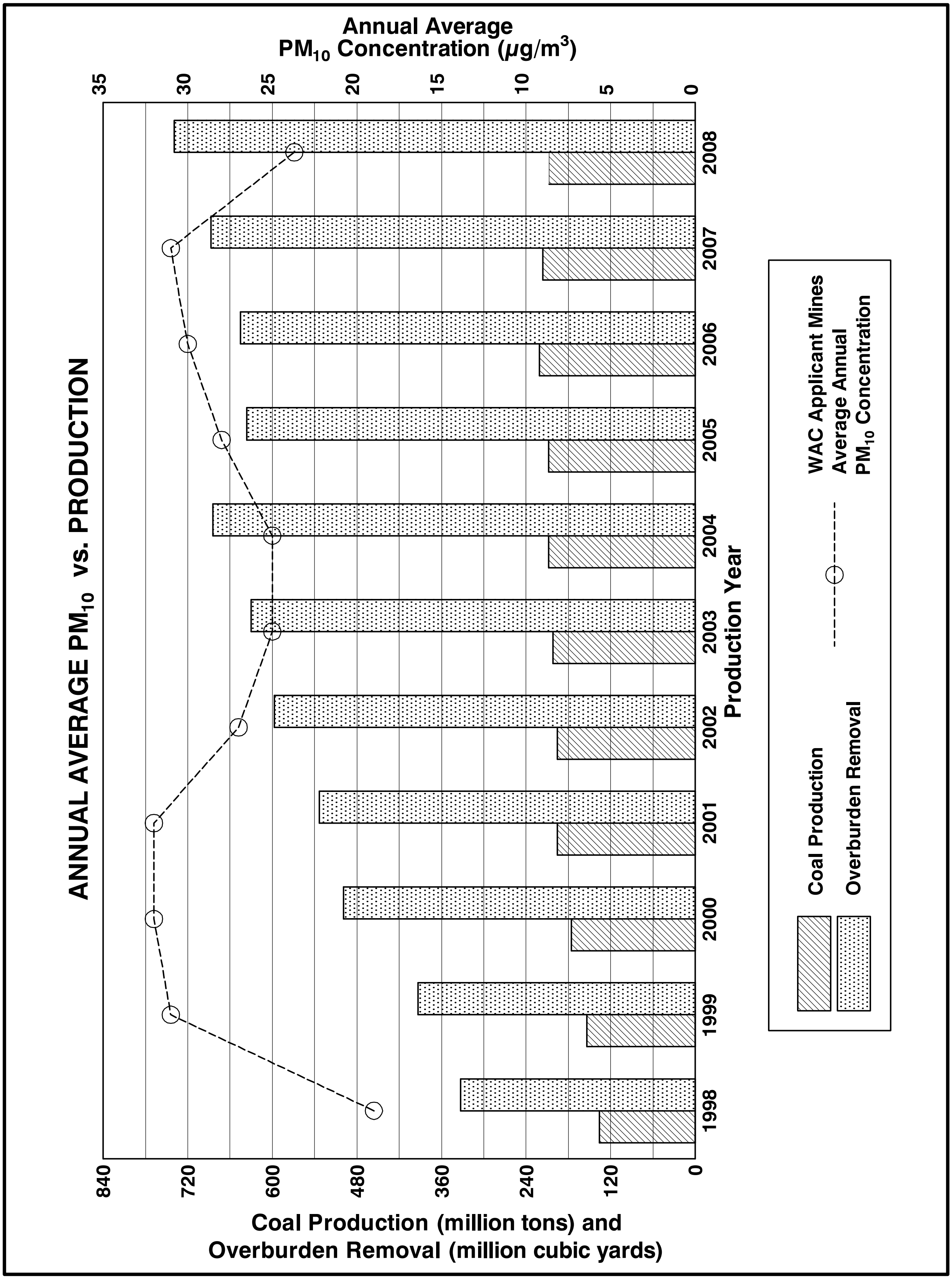


Figure 3-6. Annual Coal Production and Overburden Removal vs. Ambient Particulates for the General Wright Analysis Area (1998 through 2008).

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 $\mu g/m^3$ 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 13.50 $\mu g/m^3$ 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 $\mu g/m^3$ 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 a total of nine exceedances of the 24-hour PM_{10} particulate standards associated with the three applicant mines. These nine exceedances were all associated with elevated wind speeds exceeding 20 mph, which could have qualified as exceptional events under the NEAP. In 2007, a total of 11 exceedances of the 24-hour PM_{10} particulate standards were reported by six mines in the PRB; three of which were reported by the WAC mines (two at North Antelope Rochelle, one at Black Thunder, and none at Jacobs Ranch). These three exceedances reported in 2007 have been flagged by EPA as exceptional events under the NEAP. One exceedance of the 24-hour PM_{10} particulate standard was reported by the Black Thunder Mine and no 24-hour PM_{10} exceedances were reported by the Jacobs Ranch and North Antelope Rochelle mines in 2008 (Shamley 2010). The single exceedance reported in 2008 at the Black Thunder mine was determined to be a valid exceedance (not considered to be an exceptional event under the NEAP) and a notice of violation was subsequently issued to the mine (Shamley 2010). No exceedances of the 24-hour PM_{10} particulate standard were reported by the three WAC mines, or any of the other surface coal mines in the PRB in 2009 (Shamley 2010).

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 mine's annual coal production rate will be 135 million tons by 2015, with or without the North, South, or West Hilight Field LBA Tracts. Black Thunder Mine's currently approved air quality permit from the WDEQ/AQD limits 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 more years under the Proposed Action, or for about 14.2 additional 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 $\mu g/m^3$ (very close to the standard) in 2017. Coal production in both years was modeled at the maximum permitted annual 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 was designated by EPA as an exceptional event (due to a high wind event) under the NEAP. There was one exceedance of the 24-hour PM_{10} particulate standards at the Black Thunder Mine in 2008, and EPA determined that it was not an exceptional event under the NEAP and a notice of violation was subsequently issued to the mine (Shamley 2010). There were no exceedances of the 24-hour PM_{10} particulate standards reported by the mine in 2009. 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

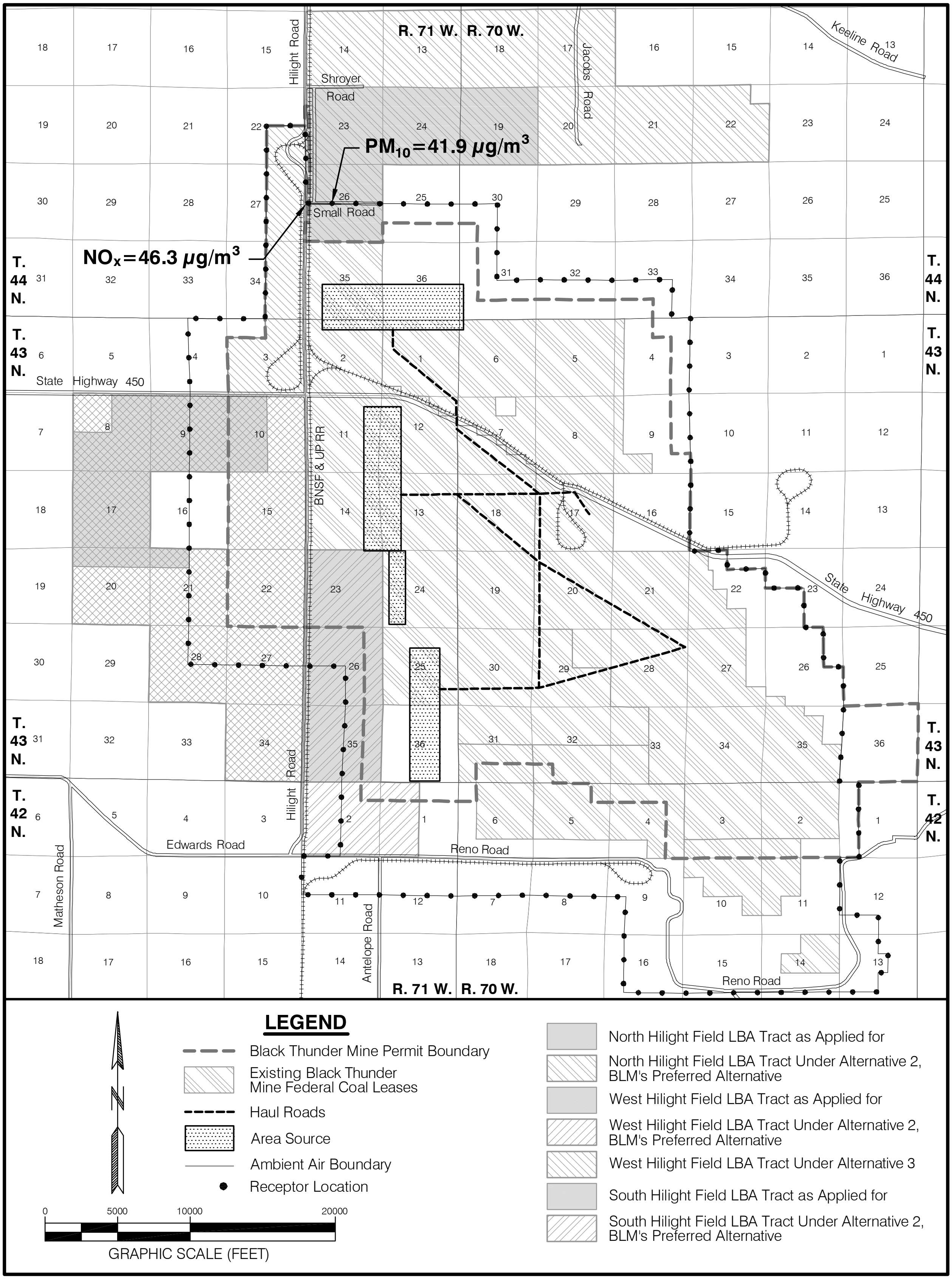


Figure 3-7. Maximum Modeled PM_{10} and NO_X Concentrations at the Black Thunder Mine Ambient Air Boundary for the Year 2015.

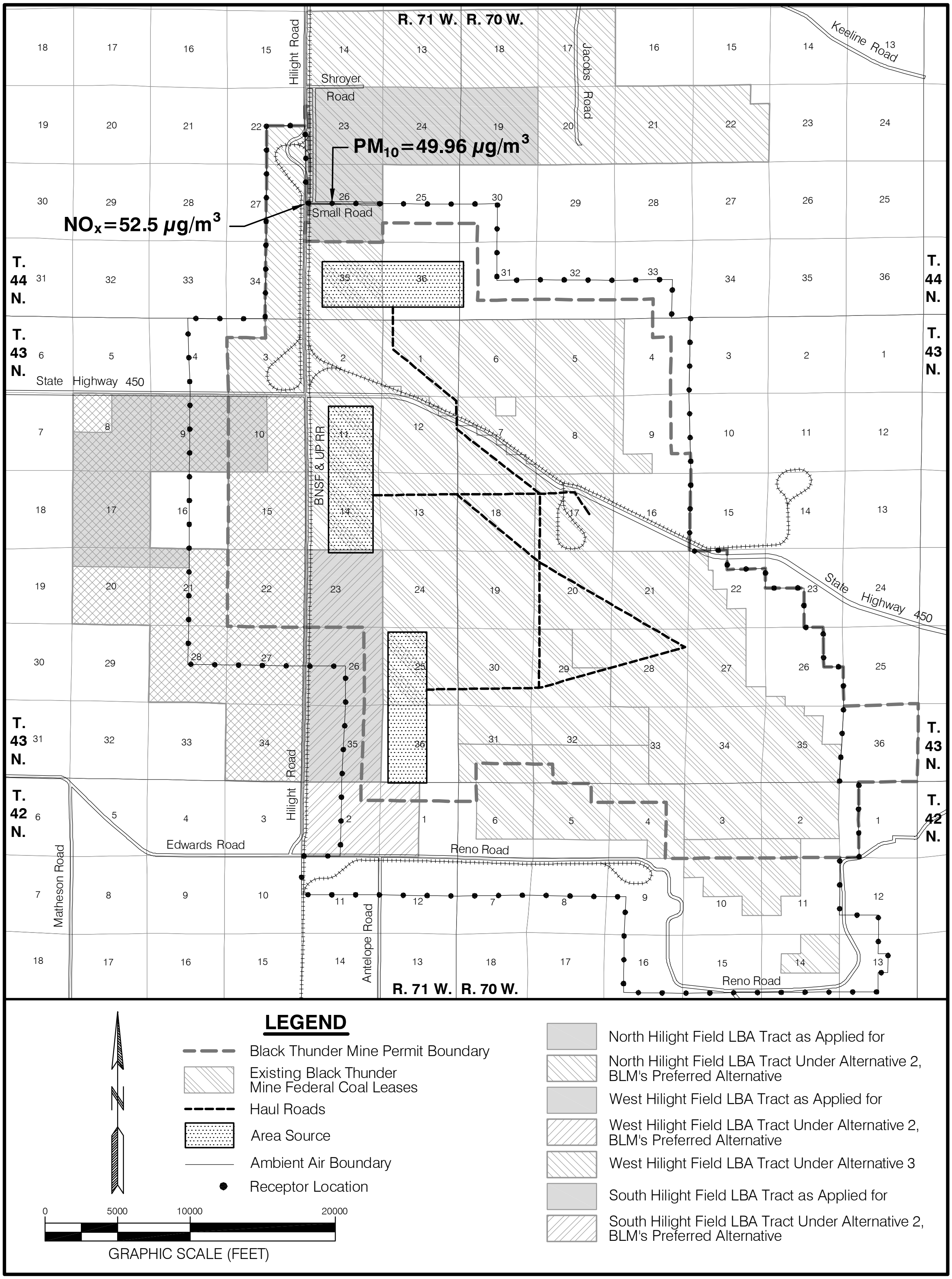


Figure 3-8. Maximum Modeled PM_{10} and NO_X Concentrations at the Black Thunder Mine Ambient Air Boundary for the Year 2017.

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.

3.4.2.2.1.2 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.

TBCC projects that the mine's 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 TBCC, 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 additional years under the Proposed Action, or for about 22.8 more 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

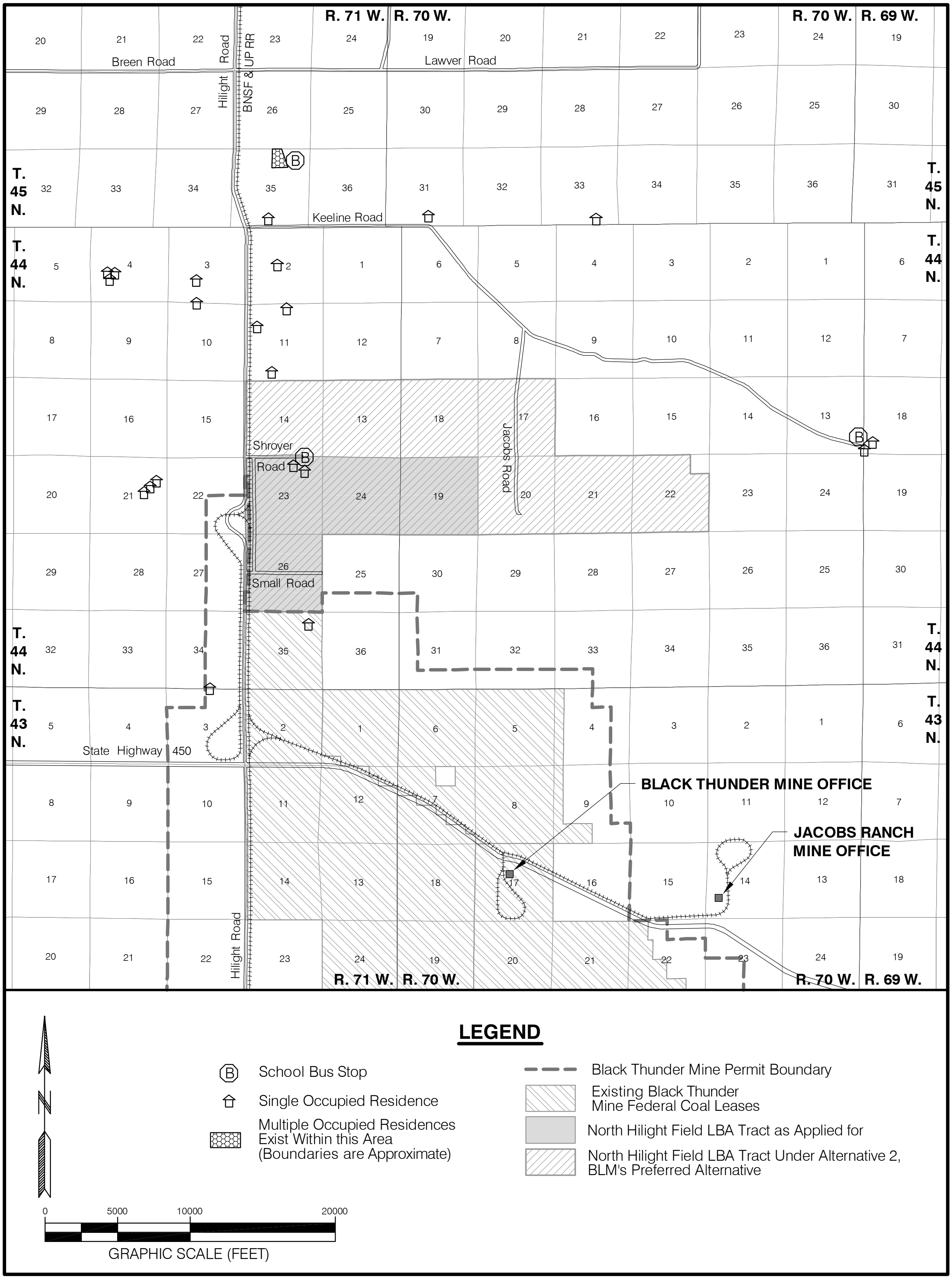


Figure 3-9. Residences, School Bus Stops, Public Roads, and Other Publicly Accessible Facilities in the Vicinity of the North Hilight Field LBA Tract Under Alternative 2.

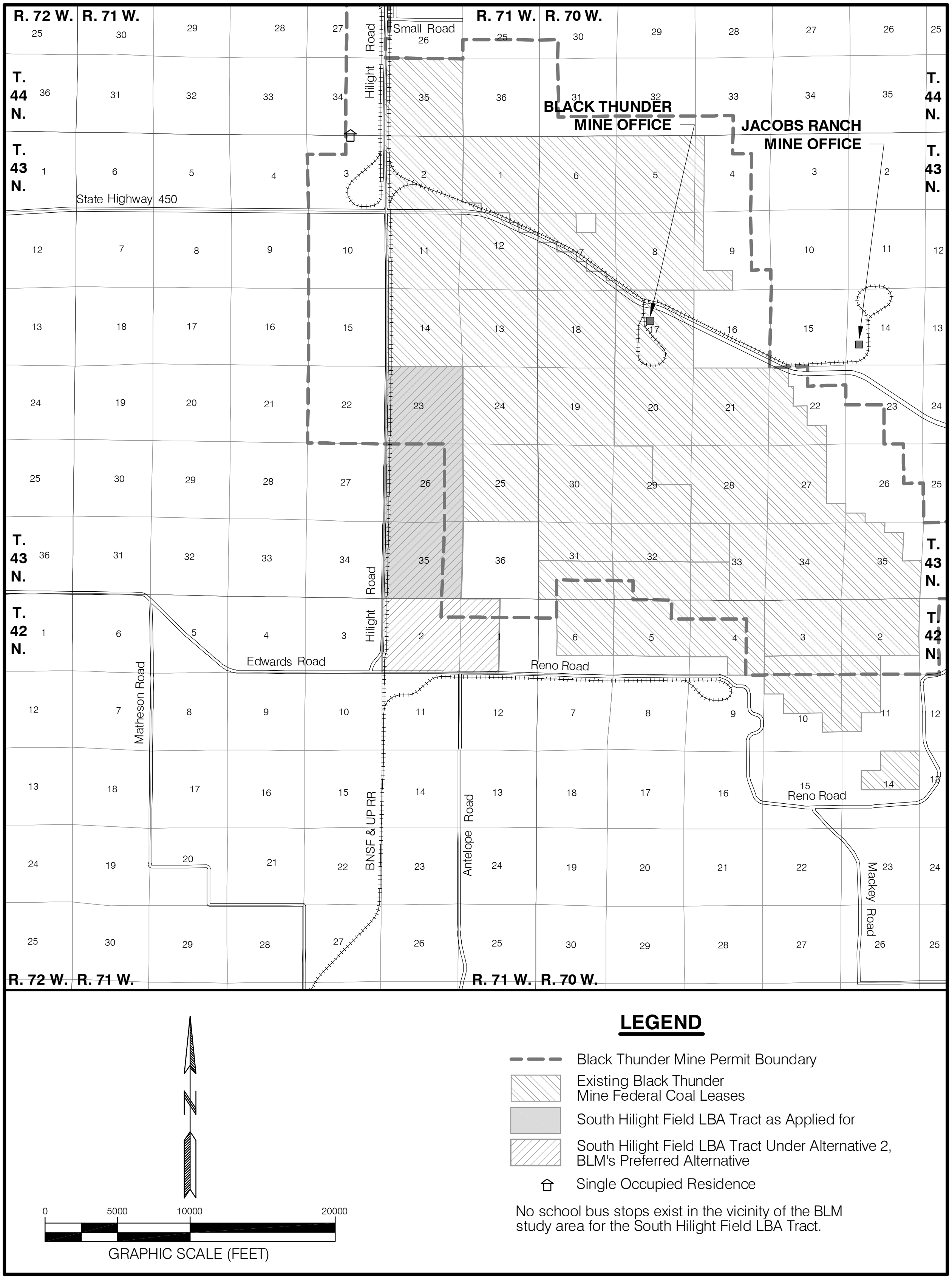


Figure 3-10. Residences, School Bus Stops, Public Roads, and Other Publicly Accessible Facilities in the Vicinity of the South Hilight Field LBA Tract Under Alternative 2.

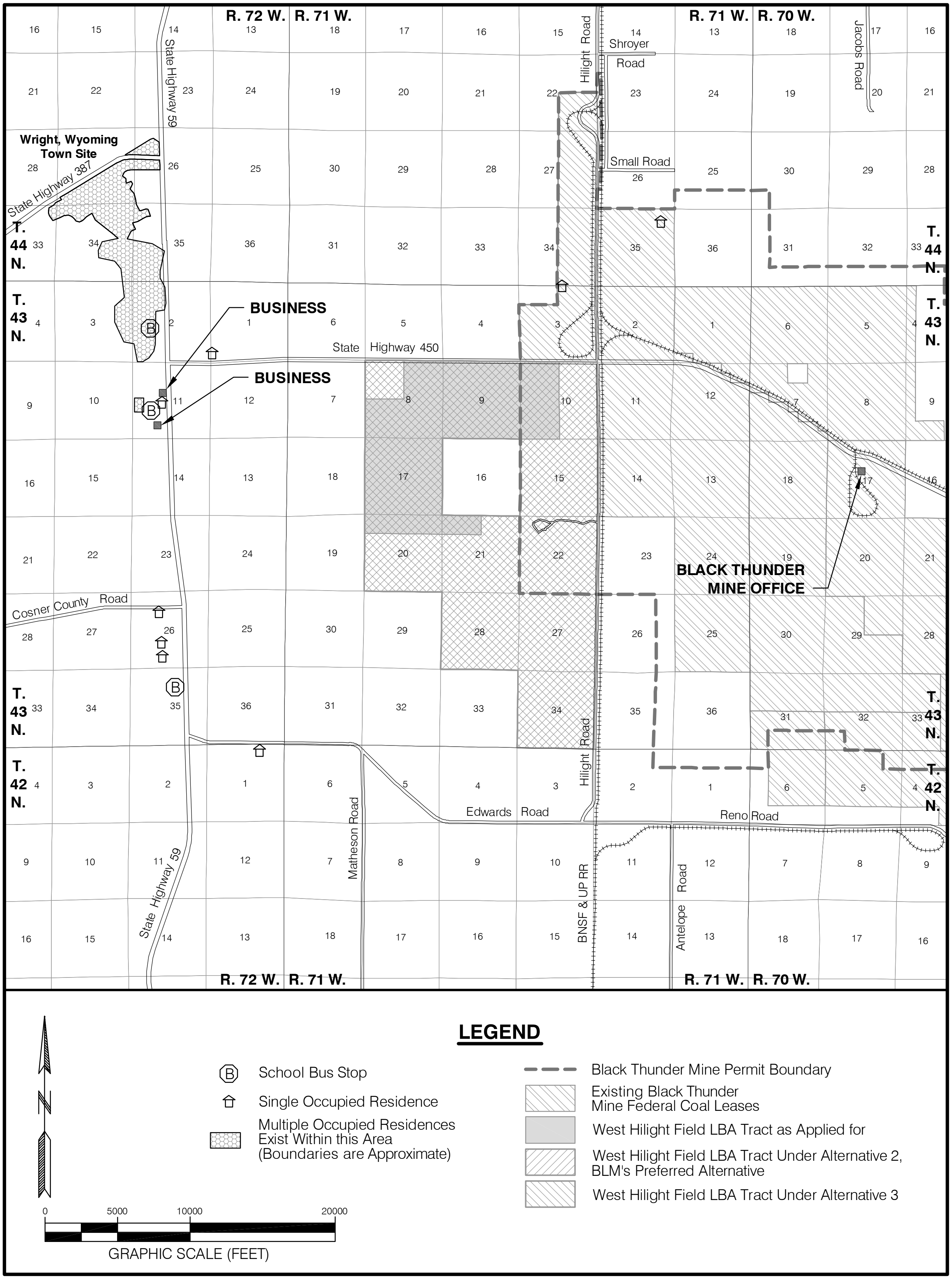


Figure 3-11. Residences, School Bus Stops, Public Roads, and Other Publicly Accessible Facilities in the Vicinity of the West Hilight Field LBA Tract Under Alternative 2.

Mine LNCM boundary of 44.70 μg/m³ in 2013 and 49.61 μg/m³ in 2015. Coal production in both years was modeled at the maximum permitted production 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. TBCC 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 140 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 more years under the Proposed Action, or for about 11.4 additional 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.

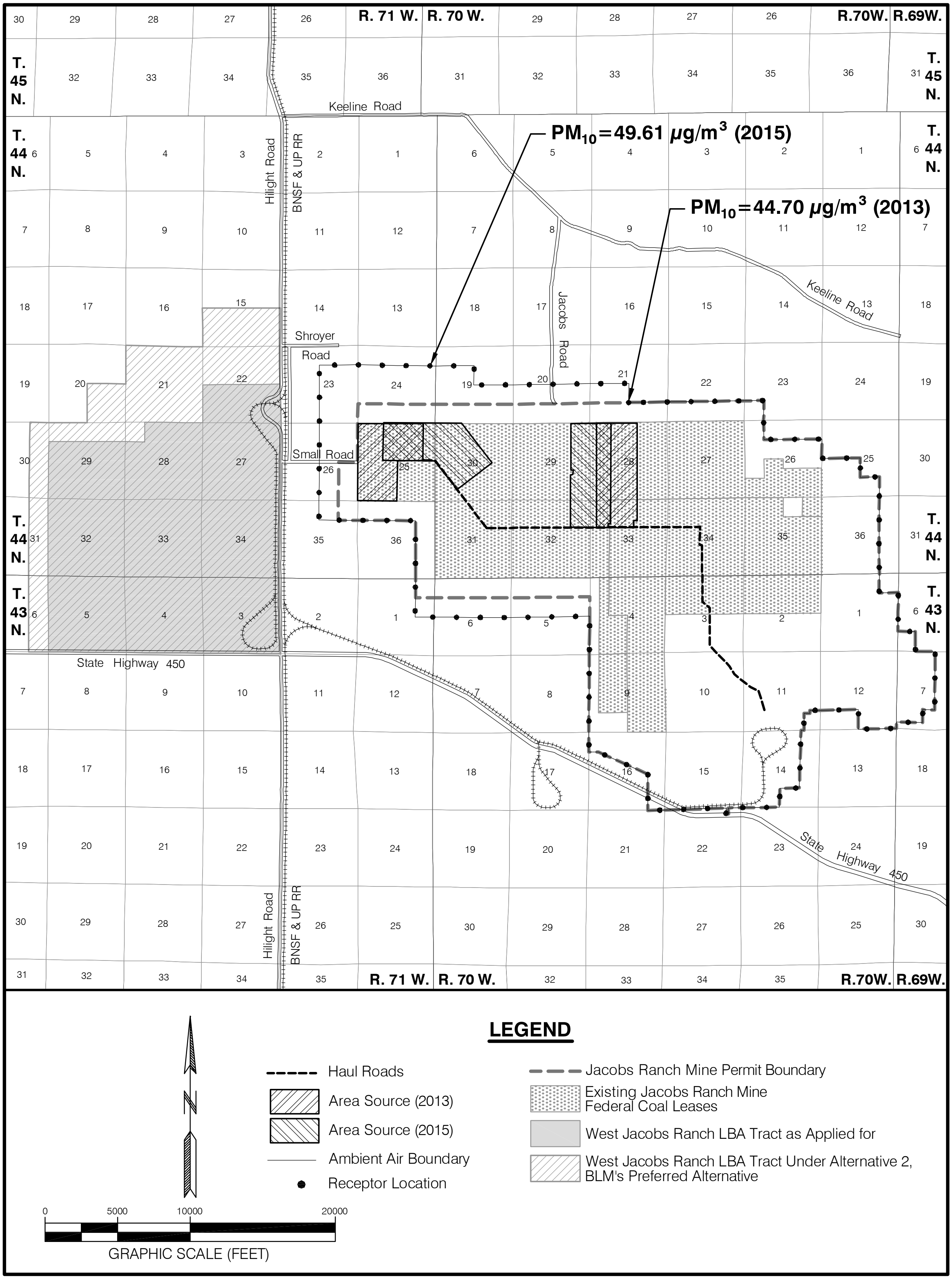


Figure 3-12. Maximum Modeled PM_{10} Concentrations at the Jacobs Ranch Mine Ambient Air Boundary for the Years 2013 and 2015.

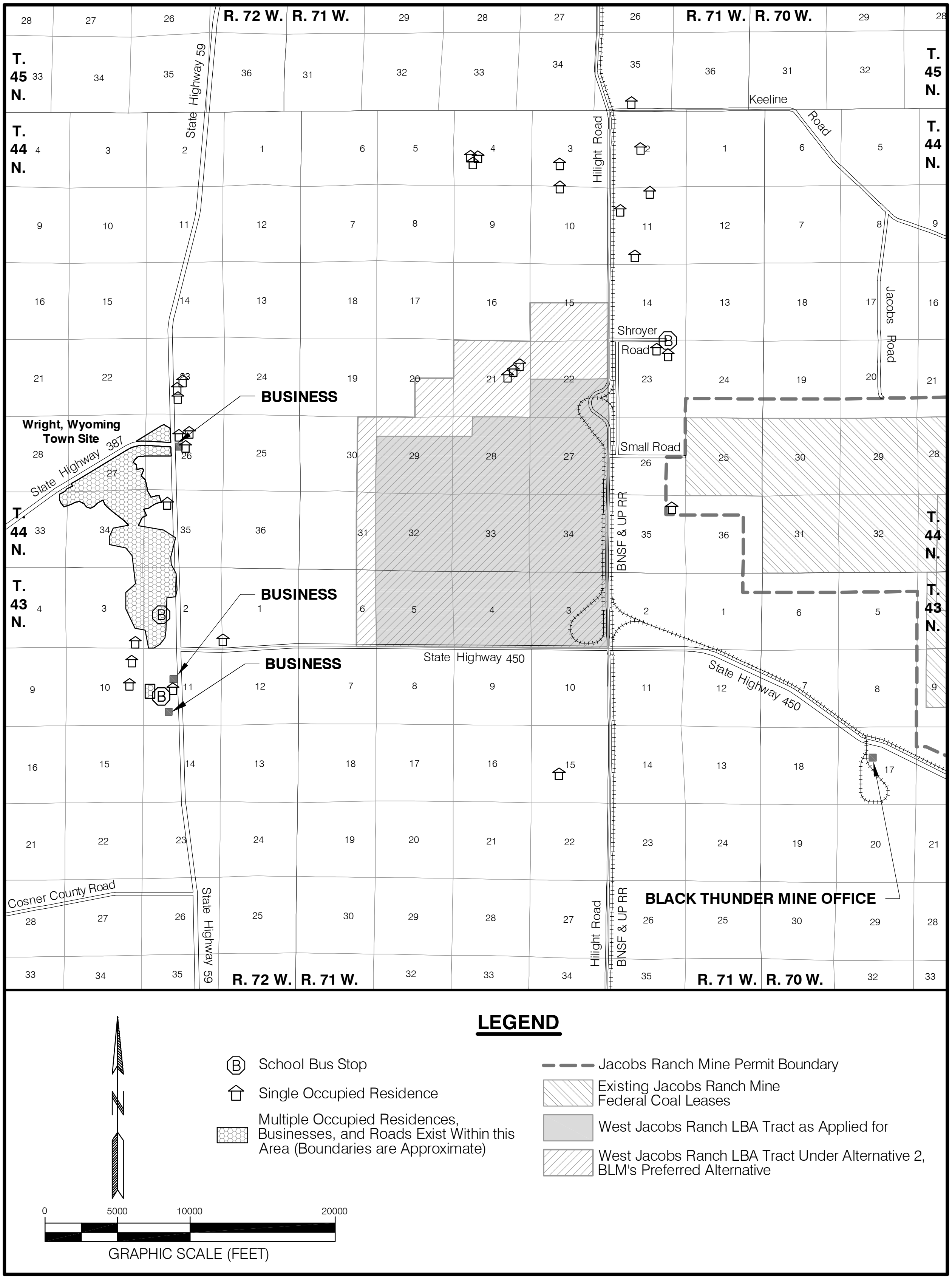


Figure 3-13. Residences, School Bus Stops, Public Roads, and Other Publicly Accessible Facilities in the Vicinity of the West Jacobs Ranch LBA Tract Under Alternative 2.

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 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. WDEQ/AQD issued air quality permit MD-6375 on November 10, 2008 to modify operations and increase the permitted coal production at the North Antelope Rochelle Mine from 99 mmtpy to 140 mmtpy (PRC 2008a).

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-6375 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 2017 were selected as the worst-case years. The dispersion model showed a maximum concentration on the North Antelope Rochelle LNCM boundary of 33.10 $\mu g/m^3$ in 2012 and 39.24 $\mu g/m^3$ in 2017. Coal production in both years was modeled at a maximum production level of 140 million tons (PRC 2008a). The locations of the maximum-modeled PM_{10} concentrations for 2012 and 2017 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 40.2 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 2008a).

Modeling conducted for the current air quality permit predicted no exceedances of the annual PM_{10} NAAQS at a 140-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 were no exceedances of the 24-hour PM_{10} particulate standards reported by the North Antelope Rochelle Mine in 2008 and 2009 (Shamley 2010). There have been no exceedances of the annual PM_{10} NAAQS.

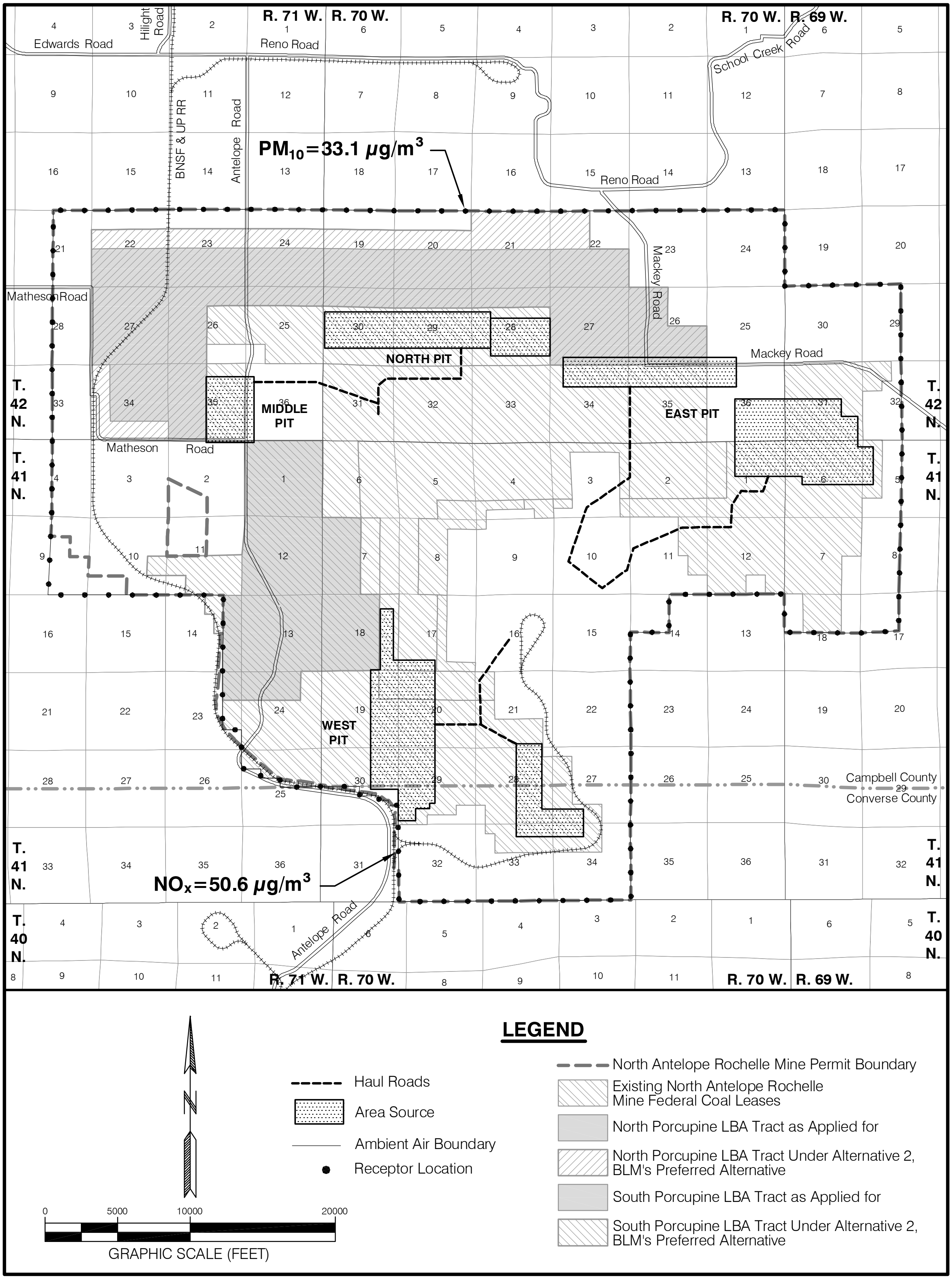


Figure 3-14. Maximum Modeled PM_{10} and NO_X Concentrations at the North Antelope Rochelle Mine Ambient Air Boundary for the Year 2012.

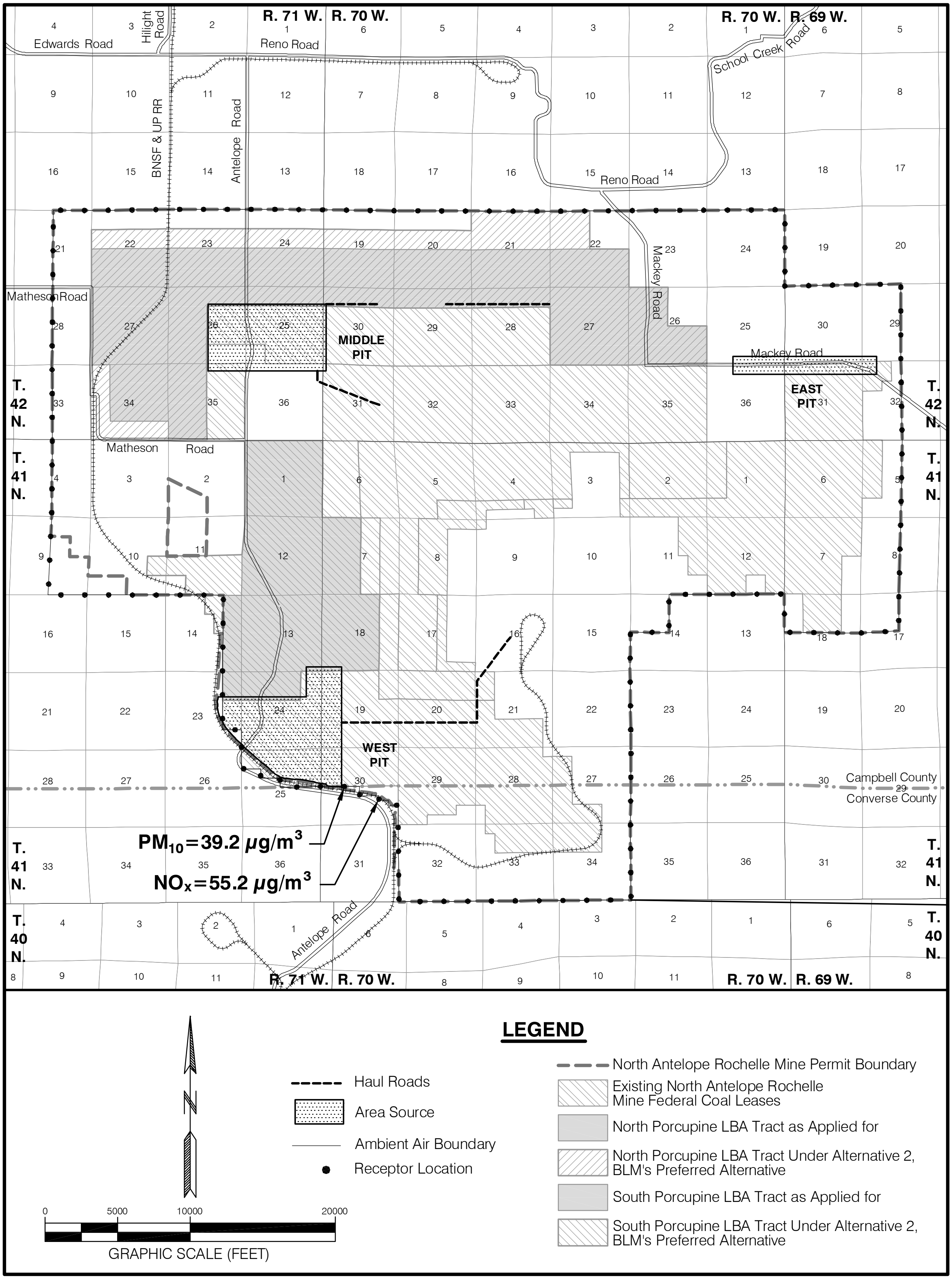


Figure 3-15. Maximum Modeled PM_{10} and NO_X Concentrations at the North Antelope Rochelle Mine Ambient Air Boundary for the Year 2017.

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 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 Best Available Control Methods (BACMs):

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.

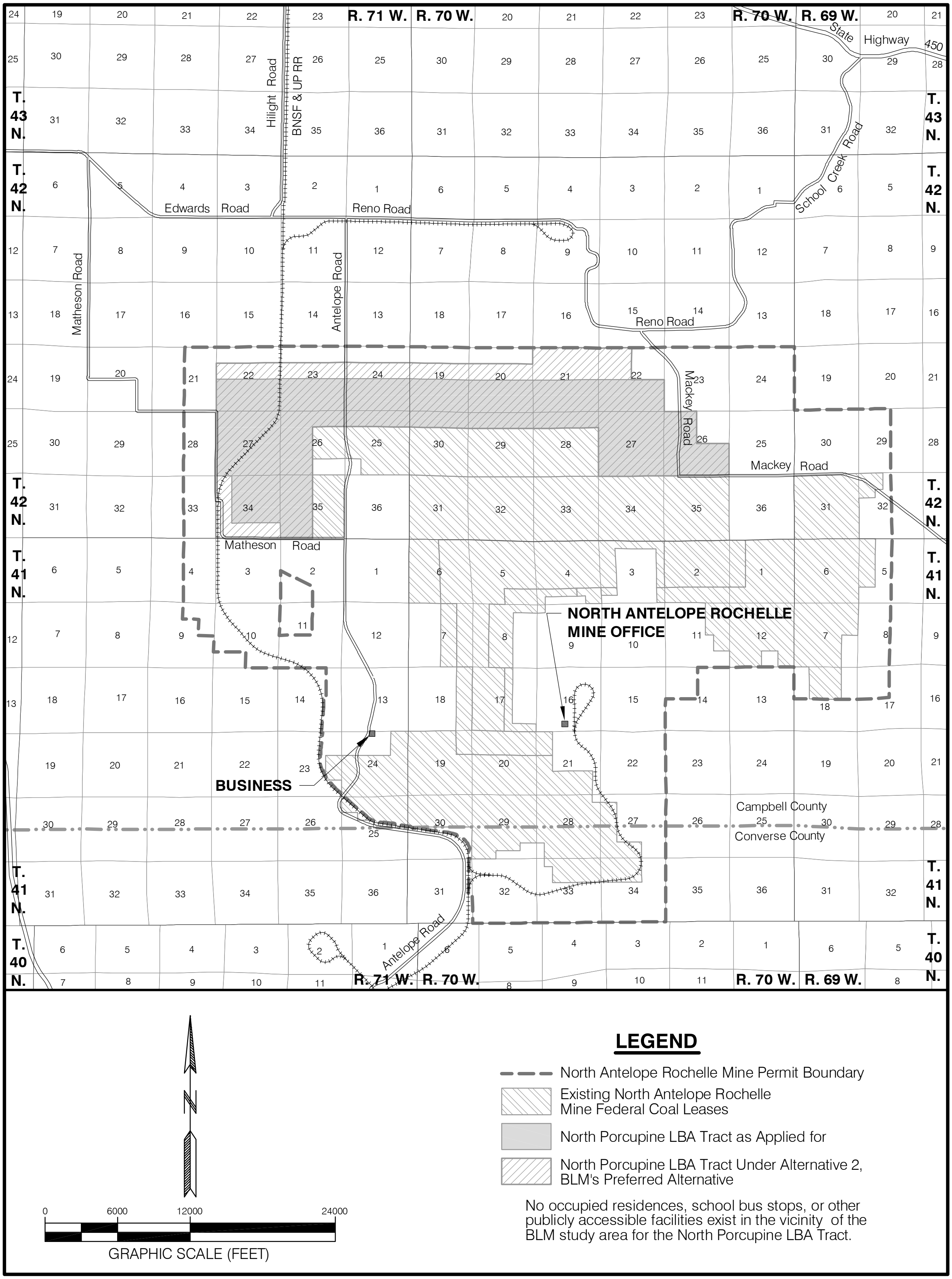


Figure 3-16. Residences, School Bus Stops, Public Roads, and Other Publicly Accessible Facilities in the Vicinity of the North Porcupine LBA Tract Under Alternative 2.

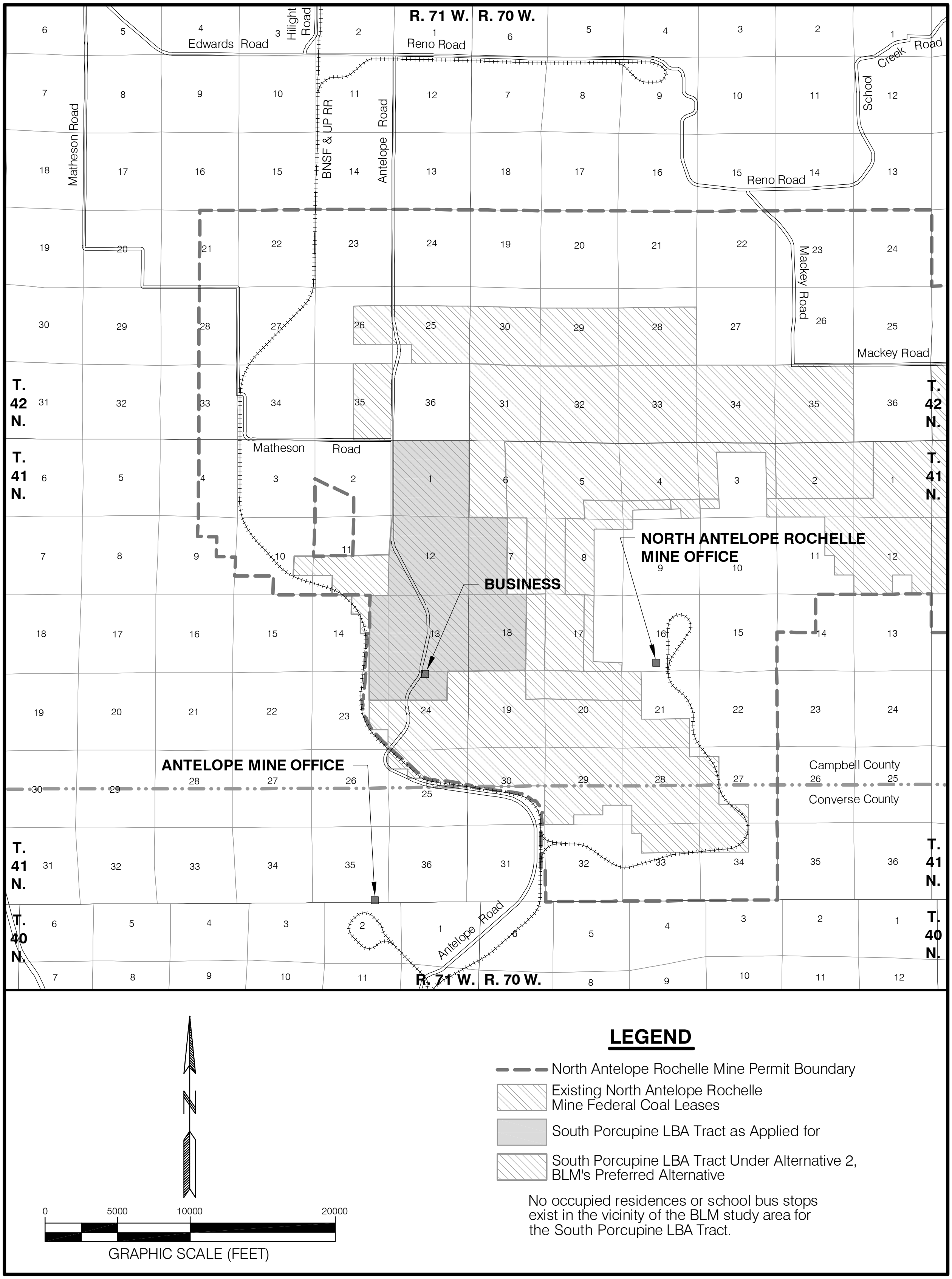


Figure 3-17. Residences, School Bus Stops, Public Roads, and Other Publicly Accessible Facilities in the Vicinity of the South Porcupine LBA Tract Under Alternative 2.

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.
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 and air quality 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 PRB in April 2006 (revised January 2007). The NEAP was developed under the framework afforded by EPA's Natural Events Policy of May 30, 1996. EPA Region VIII approved the WDEQ NEAP on March 13, 2007, and the PRB mining operators have implemented these measures and are presently complying with the NEAP. 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 required BACMs.

EPA's Exceptional Event Rule of March 22, 2007 no longer requires a NEAP. However, according to the preamble to the Exceptional Event Rule (signed March 22, 2007, effective May 21, 2007), "The EPA believes that it is advantageous for states to keep NEAPs in place that are currently being implemented in order to address the public health impacts associated with recurring natural events such as high wind events. "However, following the promulgation of this rule, states will no longer be required to keep NEAPs in place that were not approved as a part of a SIP for an area." WDEQ will retain the NEAP because it provides the flexibility to control other emission sources, like fugitive emission sources, that otherwise might not be controlled with BACT. The BACM specified in the NEAP contains an appropriate and reasonable minimum level of control as required under the Exceptional Event Rule for the PRB coal mines.

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 a means of better evaluating dust problems. For example, 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 2009b).

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 emissions from industrial sources contain NO_X and in the presence of VOCs react to form ground-level O_3. 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 $\mu g/m^3$). Effective May 27, 2008, the 8-hour standard was revised by EPA to 0.075 ppm (147 $\mu g/m^3$). 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.

3.4.3.1.1 Site Specific NO_X and O_3 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

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 (2009a)
Pre-May 27, 2008, 8-Hour O_3 NAAQS = 0.080 ppm
Post-May 27, 2008, 8-Hour O_3 NAAQS = 0.075 ppm

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 the Campbell County site). BLM expects a stricter O_3 standard of between 0.06 and 0.07 ppm to be announced in August 2010 (Zachariassen 2010).

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 reactants 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 2009b).

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).

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). WDEQ has yet not established a WAAQS for NO_2 for averaging times shorter than one year. EPA recently set a 1-hour NO_2 NAAQS at 100 parts per billion (ppb) effective January 22, 2010.

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 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 μg/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 μg/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.

<u>3.4.3.2.1 Proposed Action and Alternatives 2 and 3</u>

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 μg/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 μg/m^3 and for year 2013, the maximum annual NO_X concentration along the Jacobs Ranch Mine LNCM boundary was 55.0 μg/m^3 (JRM 2007). 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.

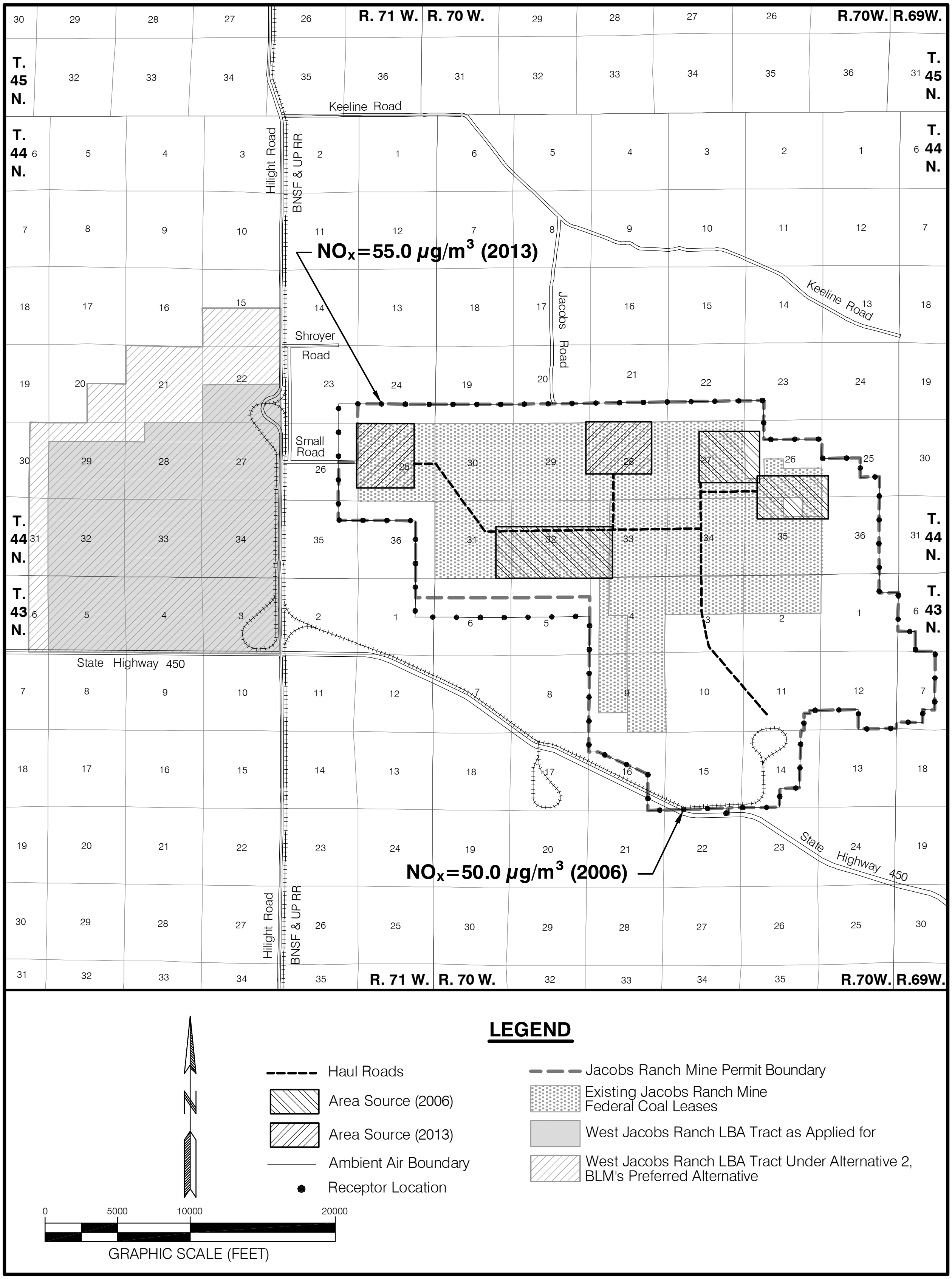


Figure 3-18. Maximum Modeled NO_X Concentrations at the Jacobs Ranch Mine Ambient Air Boundary for the Years 2006 and 2013.

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. TBCC 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-6375, for the North Antelope Rochelle Mine on February 10, 2008, which modified air quality permit MD-1331 that was issued on March 7, 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 from blasting is related to the amount of ANFO utilized. NO_X emission rates for 2012 and 2017 are expected to be 3,323 tpy and 3,856 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 50.6 $\mu g/m^3$ and for year 2017, the maximum annual NO_X concentration along the North Antelope Rochelle Mine LNCM boundary was 55.2 $\mu g/m^3$ (PRC 2008a). Coal production in both years was assumed to be the maximum permitted production level of 140 million tons. The locations of the maximum-modeled NO_X concentrations for 2012 and 2017 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 NO_X 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 Ranch Site is located roughly in the geographic 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 (2009a)
[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 program website at http://deq.state.wy.us/aqd/visibility.asp (WDEQ/AQD 2009).

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.

The Regional Haze Rule calls for improved visibility on the most-impaired days and no additional improvement 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 the four IMPROVE visibility monitoring sites located within approximately 200 miles of the general Wright analysis area (IMPROVE 2010). These historical visibility data, in deciview, for the Badlands and Wind Cave National Parks in South Dakota, and the Bridger/Fitzpatrick and Cloud Peak Wilderness Areas in Wyoming, are depicted on Figure 3-19. Visibility data for all IMPROVE visibility monitoring sites in the U.S. are available on the Visibility Information Exchange Web System (VIEWS) website at http://views.cira.colostate.edu/web/Trends/. Visibility data for Badlands National Park have statistically shown a trend toward improved visibility on the least-, average-, and most-impaired days. The visibility data for the Bridger/Fitzpatrick Wilderness Areas have statistically shown a trend toward improved visibility on the average- and least-impaired days and a trend toward greater perceived visibility impairment on the most-impaired days. The visibility data for Wind Cave National Park have statistically shown a trend toward improved visibility on the least- and most-impaired days and a trend toward greater perceived visibility impairment on the average-impaired days. The Cloud Peak Wilderness Area site was established in 2003; therefore, the data set is not yet large enough to statistically determine accurate trends in the best, average and worst visibility days. However, Figure 3-19 illustrates that there may be a slight trend toward increasing visibility impairment on the average- and least-impaired days at the Cloud Peak site.

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 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

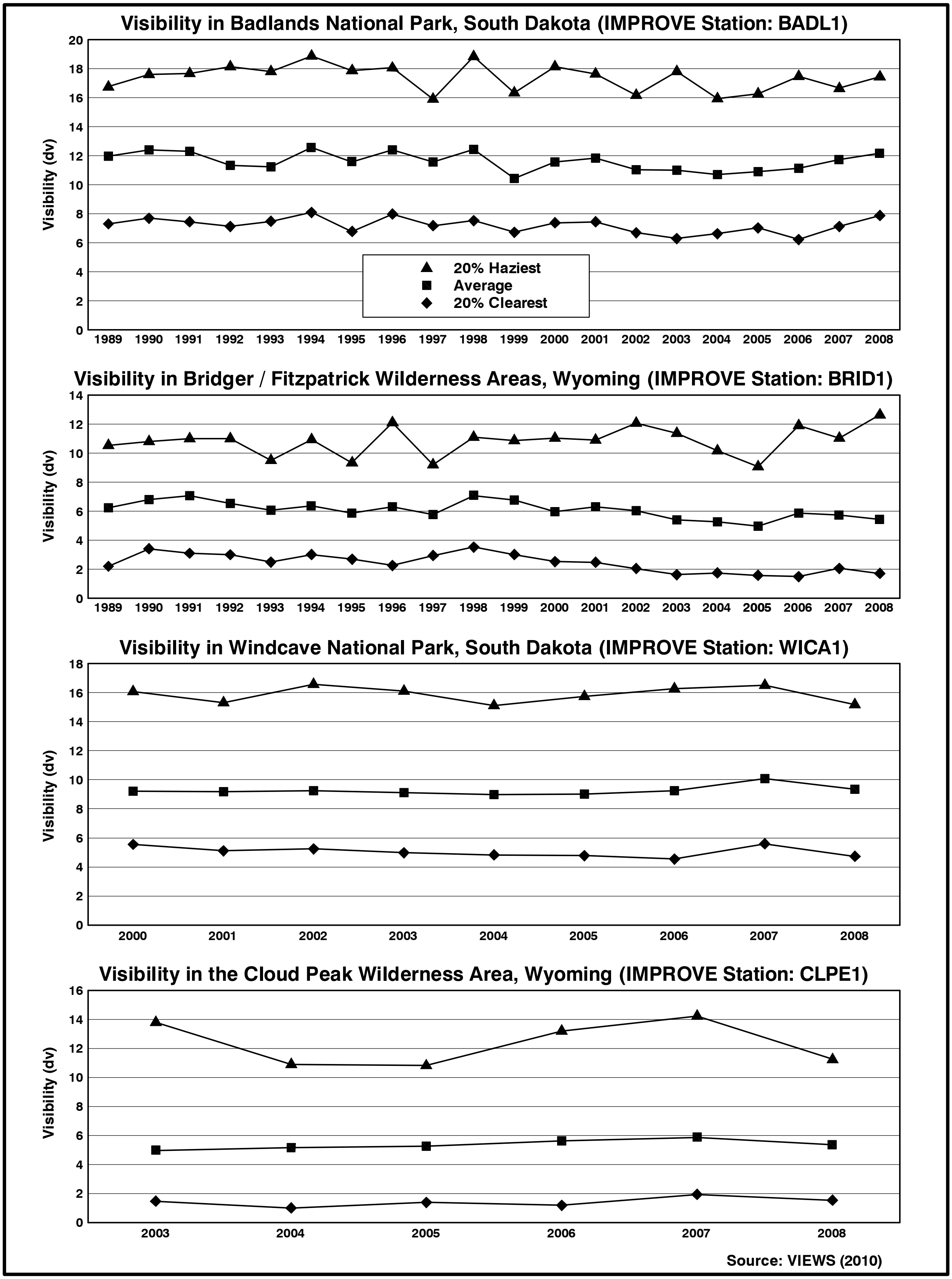


Figure 3-19. Visibility in the Badlands and Windcave National Parks and the Bridger / Fitzpatrick and Cloud Peak Wilderness Areas.

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).

<u>3.4.4.2.1 Affected Environment</u>

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.

<u>3.4.4.2.2 Environmental Consequences</u>

<u>3.4.4.2.2.1 Proposed Action and Alternatives 2 and 3</u>

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

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	Black Joe	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)

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, JRCC 2009, and PRC 2009). Figures 3-20, 3-21, and 3-22 depict the locations of the groundwater monitoring wells that are actively being monitored by TBCC and PRC at the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines. Figure 3-2 presents the stratigraphic

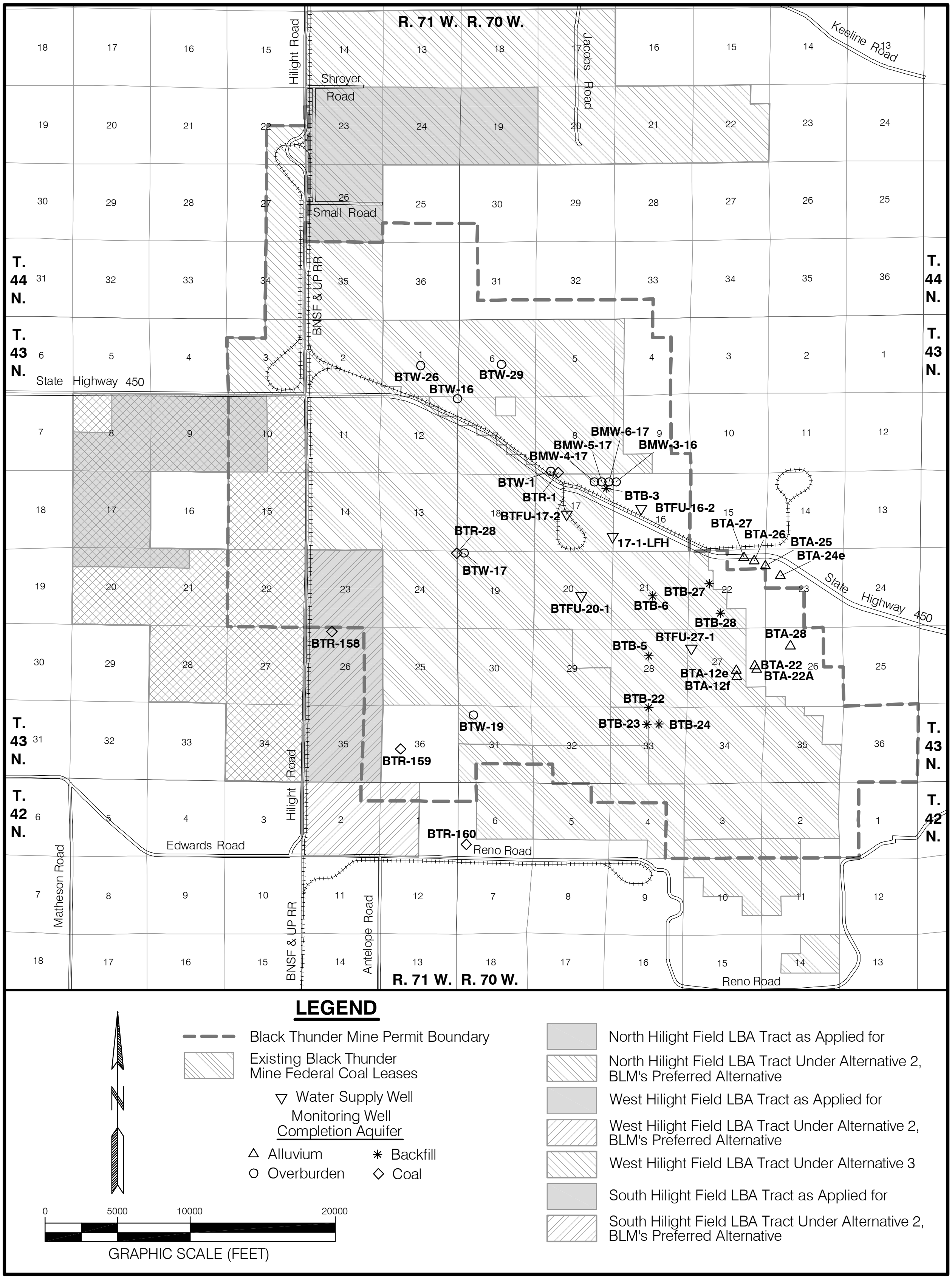


Figure 3-20. Locations of Currently Active Groundwater Monitoring and Water Supply Wells at the Black Thunder Mine.

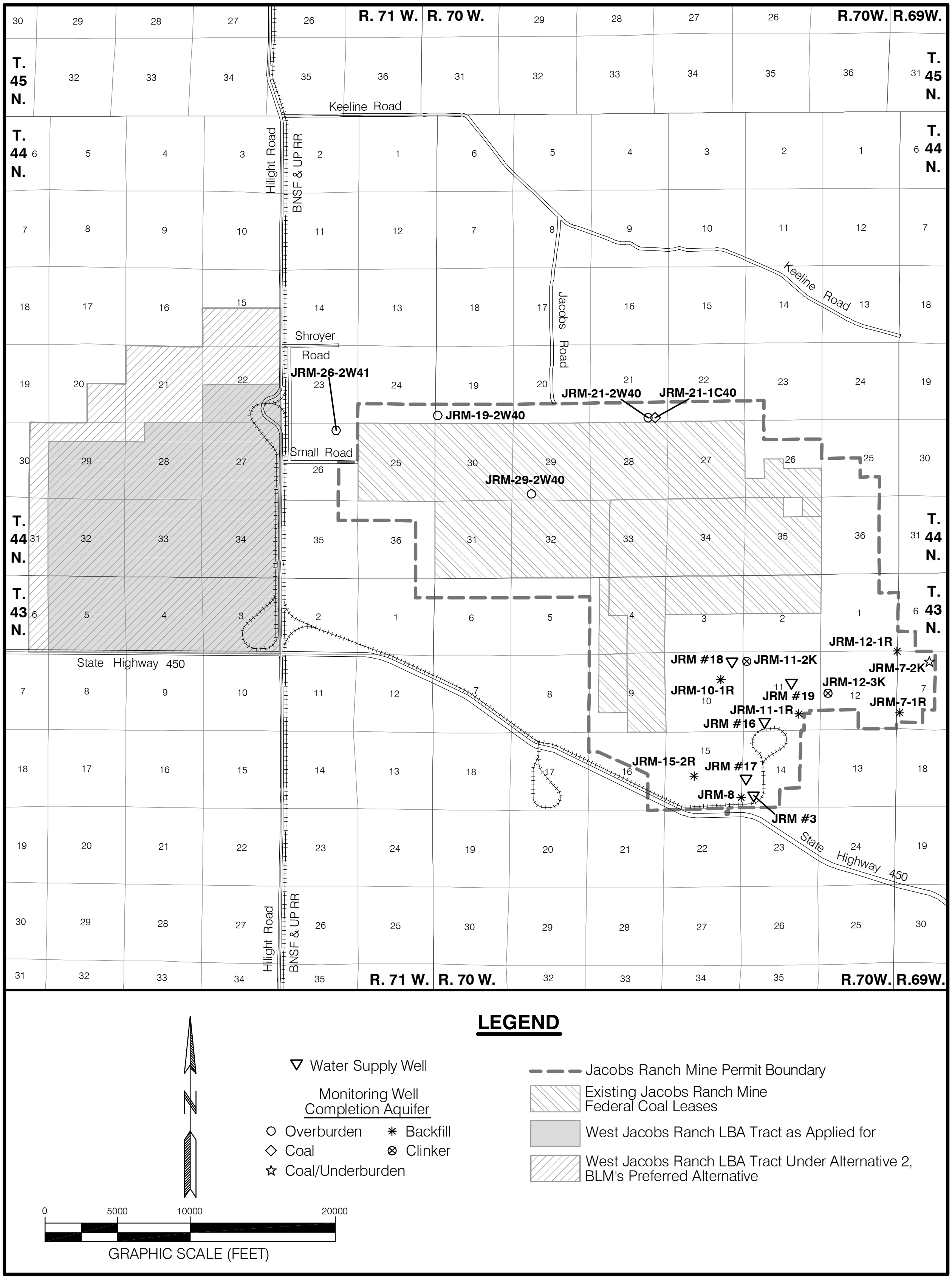


Figure 3-21. Locations of Currently Active Groundwater Monitoring and Water Supply Wells at the Jacobs Ranch Mine.

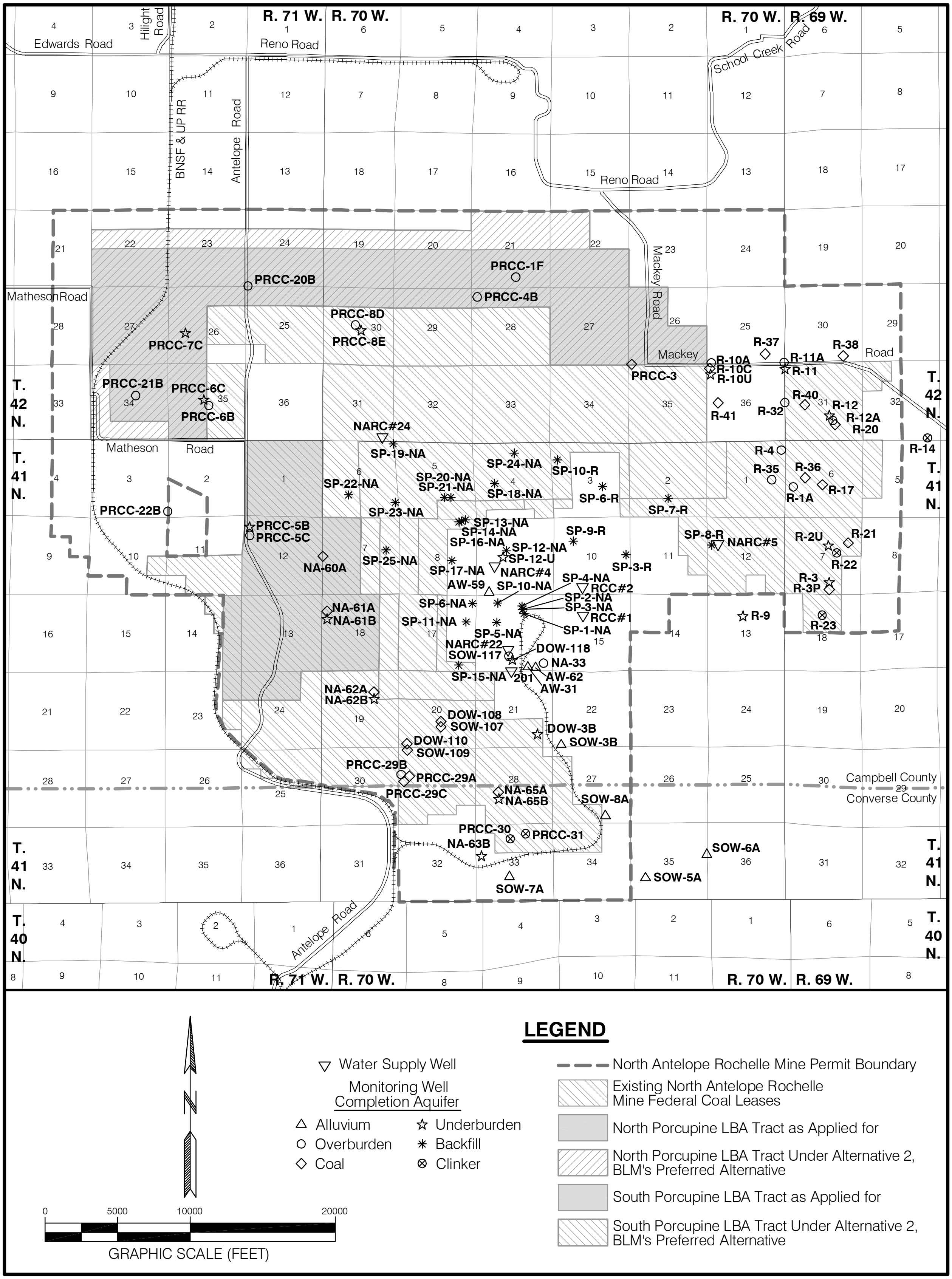


Figure 3-22. Locations of Currently Active Groundwater Monitoring and Water Supply Wells at the North Antelope Rochelle Mine.

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 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 2005).

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 2005).

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 2009). 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 2009) 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 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 clinker, also called scoria or burn. It consists of sediments that were baked, fused, and melted in place when the underlying coal burned (via range fire, lightening or spontaneous combustion). These baked sediments collapsed into the void left by the burned coal. Clinker deposits can be a very permeable aquifer and can extend laterally for miles in the eastern PRB. The occurrence of clinker is site specific, typically occurring in areas where coal seams crop out at the surface. The hydrologic function of clinker 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 clinker 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 significant 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 clinker 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 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.

The Wyodak coal seam is considered to be a regional aquifer because of its water bearing properties and it 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 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 southern group of PRB mines (Jacobs Ranch, Black Thunder, North Rochelle, North Antelope Rochelle, and Antelope) 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. 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 development. The extent of drawdown west of the mines that is specifically attributable to mine dewatering alone can no longer be directly 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.

In general, the water in the Wyodak coal aquifer is suitable only for livestock and wildlife use (WDEQ/WQD Class III). Certain constituent concentrations, such as TDS, sulfate, iron and manganese, commonly exceed the domestic use (Class I) standards, while the sodium-adsorption ratio (SAR) and TDS and sulfate concentrations commonly exceed the agricultural use (Class II) standards (WDEQ/WQD 2009). 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 aquifer is generally characterized as a calcium/magnesium-sulfate type near the clinker 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 (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. The extent that drawdown would propagate away from the mine pits is primarily a function of the affected aquifer's hydraulic properties (i.e., hydraulic conductivity, storativity, and current saturated thickness). While there are variations in the affected aquifers' hydraulic properties, duration of time that the pits would be open, distance from the open pits, and CBNG development (intensity and duration) in the vicinity of mining, the area subject to lower groundwater levels would be extended roughly in proportion to the increase in areas affected by mining. The amount and extent of additional drawdown may not be significant 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, relatively homogeneous 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 49,086.9 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 southern group of mines (Black Thunder, Jacobs Ranch, North Antelope Rochelle, and Antelope) due to their proximity to each other and due to the large drawdowns caused to the west by CBNG development. The cumulative coal mine dewatering drawdown caused by the southern group of mines overlaps west of the mines with drawdown caused by CBNG development. Hydro-Engineering (2007) states that the extent of drawdown west of the mines caused by mining alone can no longer be directly defined due to the much greater drawdown caused by CBNG development. 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. Overlapping impacts of the existing mining activities with other existing and 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 (generally less than ½ mile) 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 immediately 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 contiguous 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 levels are projected to recover to near pre-mining and pre-CBNG development levels once these industrial uses of groundwater have ceased. Backfill material would gradually resaturate and eventually discharge downgradient to hydrostratigraphic units contiguous to the backfilled pit; at which time, groundwater levels and flow patterns are expected to be similar to premining conditions. 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. Backfill in the PRB can take anywhere from 50 to 200 years to resaturate (Hydro-Engineering 2001). The rate at which the mine backfill resaturates and the postmining potentiometric surfaces reach equilibrium is dependent upon the hydraulic conductivity of the backfill, sources of recharge water, and groundwater flow rates in the adjacent aquifers.

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 2009, PRC 2009, 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 flow. 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 22,416 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 TBCC 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 development.

BLM's PRB Coal Review Task 3B Report, Cumulative Water Resources Effects (BLM 2009e), summarizes the modeled cumulative changes in groundwater levels projected for 2010, 2015, and 2020 in the eastern PRB within approximately 25 miles of the coal mines. The Task 3B report describes the modeled cumulative groundwater impacts associated with ongoing coal mine-related groundwater withdrawal in the eastern PRB for the time periods of 2010, 2015, and 2020, and the base years used for comparison of groundwater impacts were 2002 (the year used for calibration of the groundwater model) and 1990 (a time period prior to CBNG pumpage and when the coal mines were beginning to increase dewatering as mining of the coal seams progressed to deeper levels). The eastern PRB cumulative effects study area for water resources comprises the Coal Mine Groundwater Model (CMGM) domain as shown in Figure 4-4. The CMGM was developed specifically for the PRB Coal Review study. The GAGMO databases for 1990 to 2002 were used to calibrate the groundwater model to best reflect conditions in the basin. The Task 3B report evaluated the potential groundwater impacts due only to coal mine dewatering. The projected locations of coal mine pits from 2002 to 2020 were used for placement of drain cells in the CMGM that represent pumpage of groundwater by the mines. The amount of water removed by the drain cells reflects calibration to GAGMO monitoring wells surrounding each mine, rather than estimated or recorded discharge rates (BLM 2009e). The cumulative groundwater effects in the eastern PRB, including a discussion on the results of the PRB Task 3B report CMGM results, is included in Section 4.2.4.1 of this EIS.

It is therefore possible to estimate the extent of drawdown in the Wyodak coal aquifer west of each mine that is specifically attributable to mine dewatering. The accuracy of those estimates however cannot be tested or observed in the real world because drawdown related only to mining is a relatively small impact that is masked by the much larger drawdown that is due to CBNG development in the area. 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 Wyodak 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

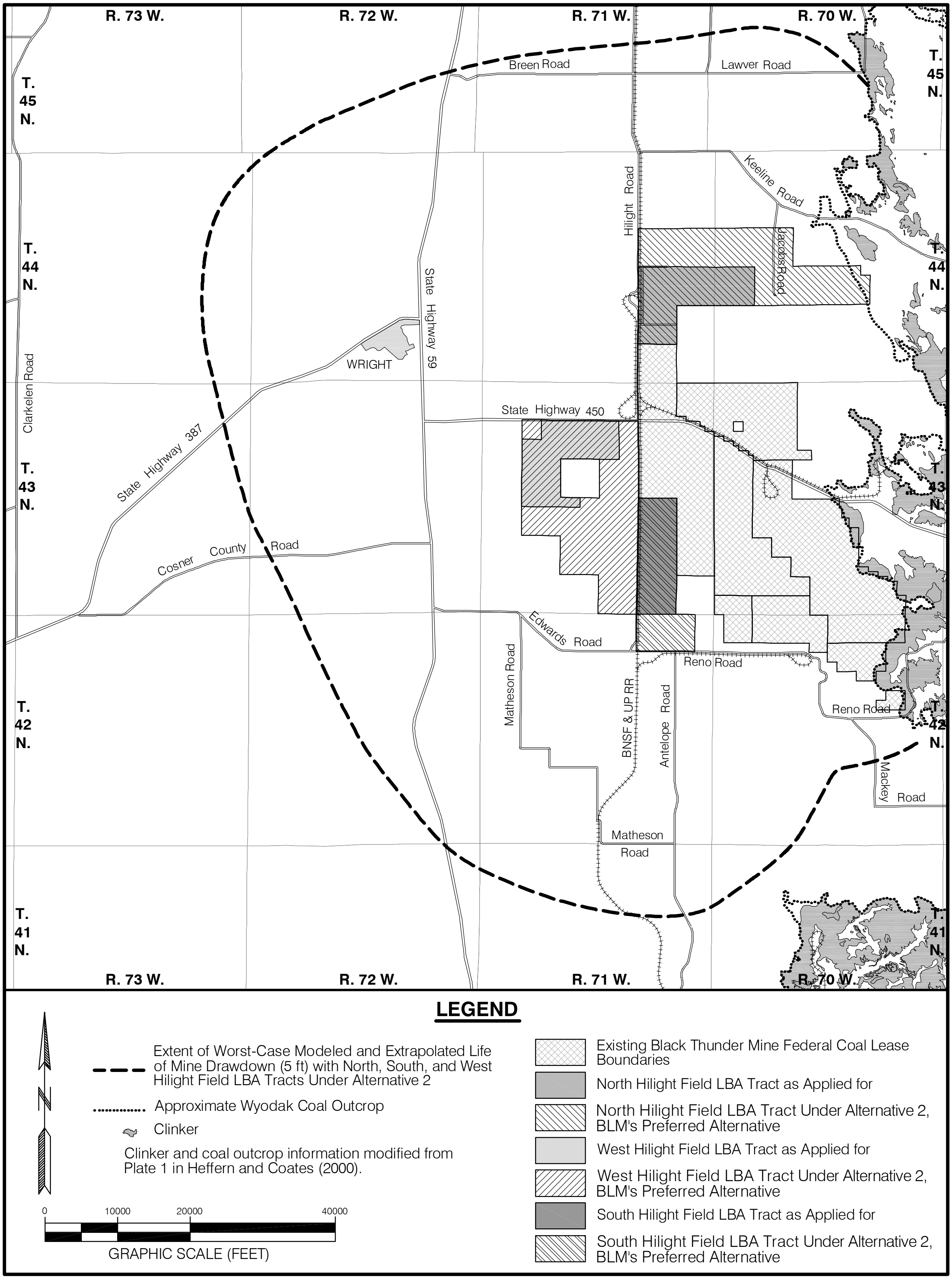


Figure 3-23. Black Thunder Mine Life of Mine Drawdown, Resulting from Currently Approved Mining with the Addition of the North, South, and West Hilight Field LBA Tracts.

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 are probable; 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 ALC 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 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 8,605 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 TBCC 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 proximity to each other and the cumulative drawdown effects from pit dewatering and nearby CBNG development.

BLM's PRB Coal Review Task 3B Report, Cumulative Water Resources Effects (BLM 2009e), summarizes the modeled cumulative changes in groundwater levels projected for 2010, 2015, and 2020 in the eastern PRB within approximately 25 miles of the coal mines. The Task 3B report describes the modeled cumulative groundwater impacts associated with ongoing coal mine-related groundwater withdrawal in the eastern PRB for the time periods of 2010, 2015, and 2020, and the base years used for comparison of groundwater impacts were 2002 (the year used for calibration of the groundwater model) and 1990 (a time period prior to CBNG pumpage and when the coal mines were beginning to increase dewatering as mining of the coal seams progressed to deeper levels). The eastern PRB cumulative effects study area for water resources comprises the Coal Mine Groundwater Model (CMGM) domain as shown in Figure 4-4. The CMGM was developed specifically for the PRB Coal Review study. The GAGMO databases for 1990 to 2002 were used to calibrate the groundwater model to best reflect conditions in the basin. The Task 3B report evaluated the potential groundwater impacts due only to coal mine dewatering. The projected locations of coal mine pits from 2002 to 2020 were used for placement of drain cells in the CMGM that represent pumpage of groundwater by the mines. The amount of water removed by the drain cells reflects calibration to GAGMO monitoring wells surrounding each mine, rather than estimated or recorded discharge rates (BLM 2009e). The cumulative groundwater effects in the eastern PRB, including a discussion on the results of the PRB Task 3B report CMGM results, is included in Section 4.2.4.1 of this EIS.

It is therefore possible to estimate the extent of drawdown in the Wyodak coal aquifer west of each mine that is specifically attributable to mine dewatering. The accuracy of those estimates however cannot be tested or observed in the real world because drawdown related only to mining is a relatively small impact that is masked by the much larger drawdown that is due to CBNG development in the area. 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-T6 (JRCC 2009). 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 TBCC'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.

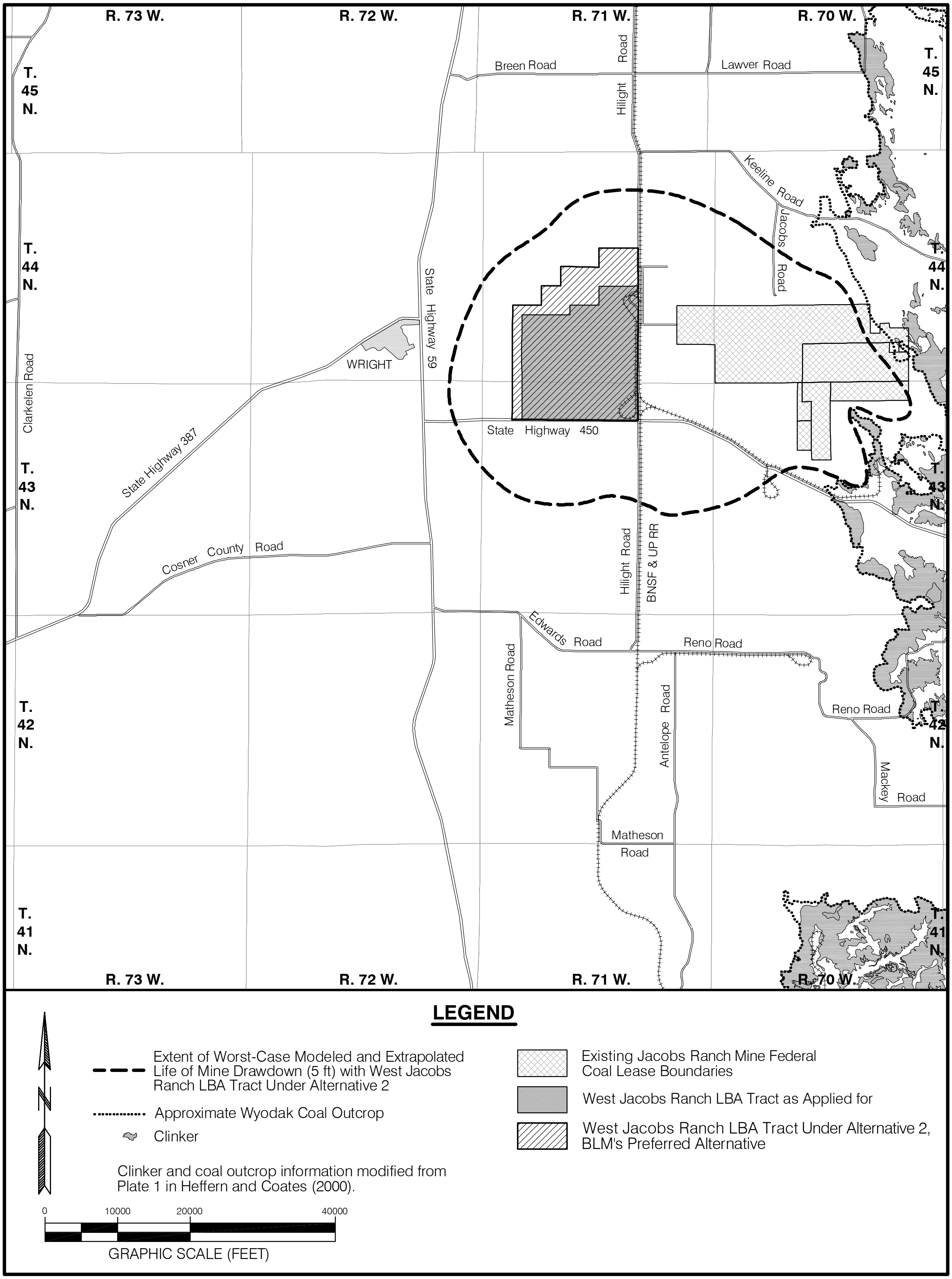


Figure 3-24. Jacobs Ranch Mine Life of Mine Drawdown, Resulting from Currently Approved Mining with the Addition of the West Jacobs Ranch LBA Tract.

The rate and extent of the actual drawdown in the Wyodak 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 Ranch Mine permit area has overlapped with drawdown caused by mining operations. Continued drawdown effects from CBNG withdrawals are probable; 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 TBCC 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 TBCC 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 clinker 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 proximity to each other and the cumulative drawdown effects from pit dewatering and nearby CBNG development.

BLM's PRB Coal Review Task 3B Report, Cumulative Water Resources Effects (BLM 2009e), summarizes the modeled cumulative changes in groundwater levels projected for 2010, 2015, and 2020 in the eastern PRB within approximately 25 miles of the coal mines. The Task 3B report describes the modeled cumulative groundwater impacts associated with ongoing coal mine-related groundwater withdrawal in the eastern PRB for the time periods of 2010, 2015, and 2020, and the base years used for comparison of groundwater impacts were 2002 (the year used for calibration of the groundwater model) and 1990 (a time period prior to CBNG pumpage and when the coal mines were beginning to increase dewatering as mining of the coal seams progressed to deeper levels). The eastern PRB cumulative effects study area for water resources comprises the Coal Mine Groundwater Model (CMGM) domain as shown in Figure 4-4. The CMGM was developed specifically for the PRB Coal Review study. The GAGMO databases for 1990 to 2002 were used to calibrate the groundwater model to best reflect conditions in the basin. The Task 3B report evaluated the potential groundwater impacts due only to coal mine dewatering. The projected locations of coal mine pits from 2002 to 2020 were used for placement of drain cells in the CMGM that represent pumpage of groundwater by the mines. The amount of water removed by the drain cells reflects calibration to GAGMO monitoring wells surrounding each mine, rather than estimated or recorded discharge rates (BLM 2009e). The cumulative groundwater effects in the eastern PRB, including a discussion on the results of the PRB Task 3B report CMGM results, is included in Section 4.2.4.1 of this EIS.

It is therefore possible to estimate the extent of drawdown in the Wyodak coal aquifer west of each mine that is specifically attributable to mine dewatering. The accuracy of those estimates however cannot be tested or observed in the real world because drawdown related only to mining is a relatively small impact that is masked by the much larger drawdown that is due to CBNG development in the area. 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-T7 (PRC 2009). 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 are probable; 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, 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

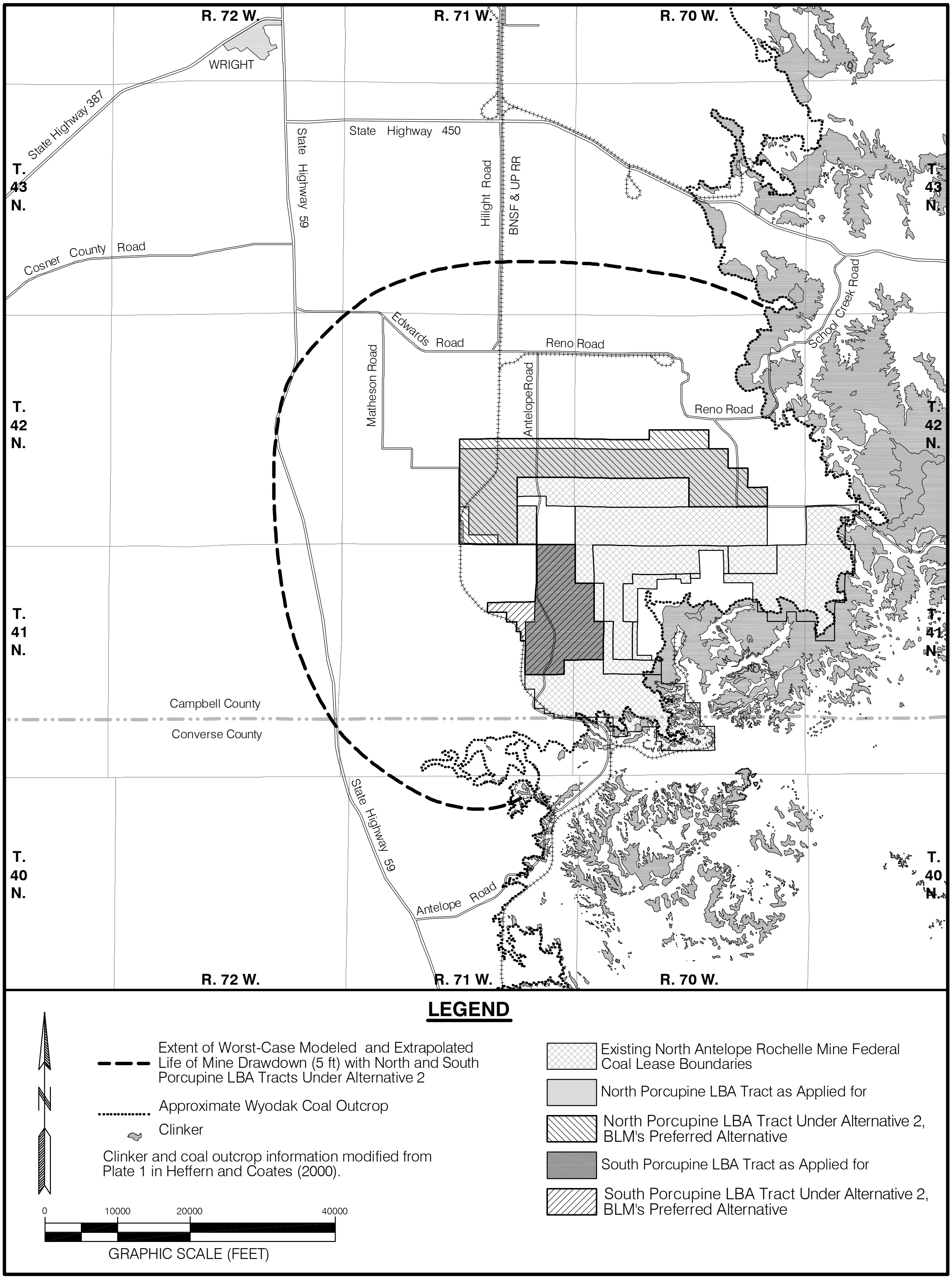


Figure 3-25. North Antelope Rochelle Mine Life of Mine Drawdown, Resulting from Currently Approved Mining with the Addition of the North and South Porcupine LBA Tracts.

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 2008b).

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 2009).

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, JRCC 2009, and PRC 2009). 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

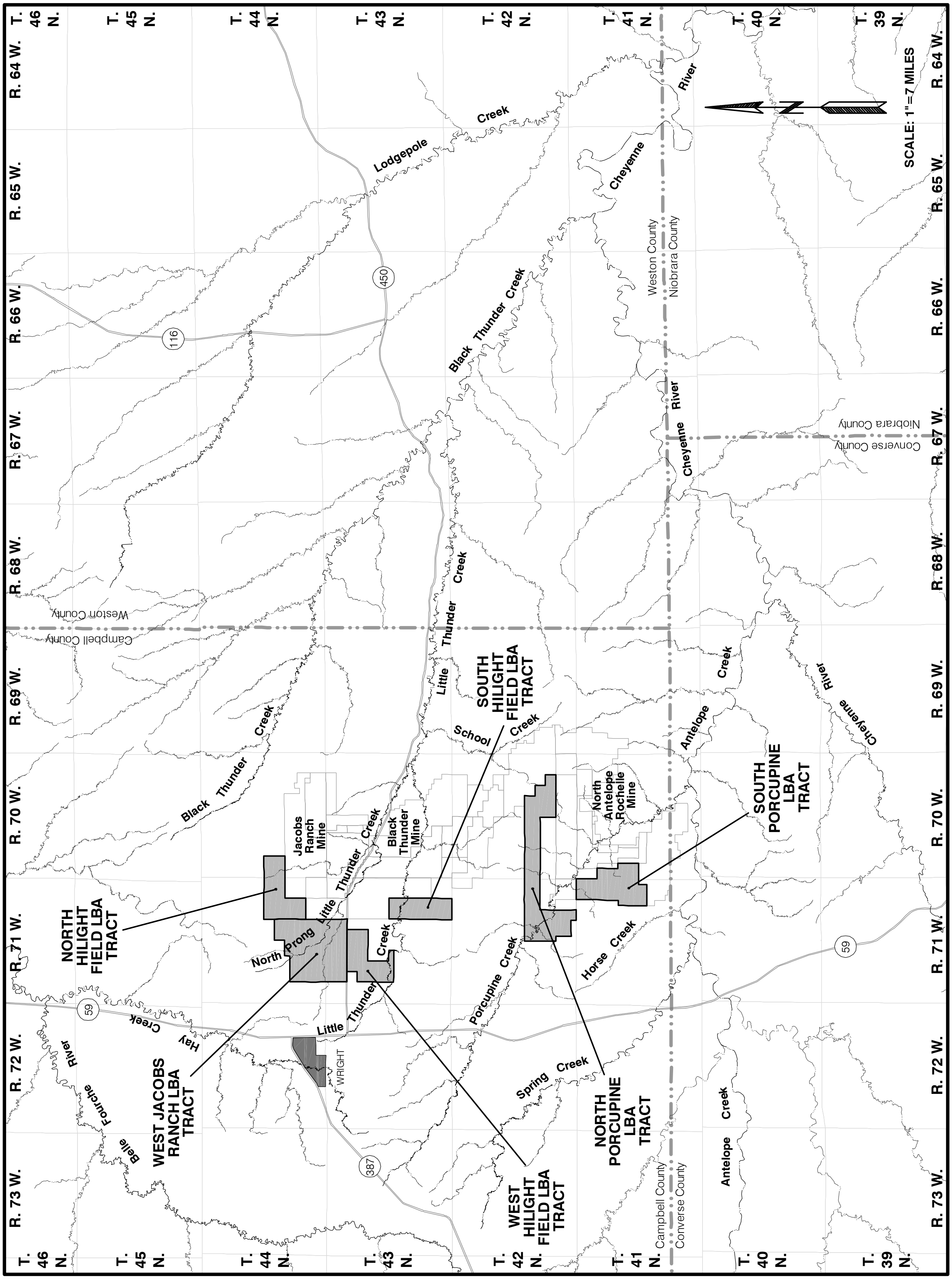


Figure 3-26. Surface Drainage in the General Wright Analysis Area.

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-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.

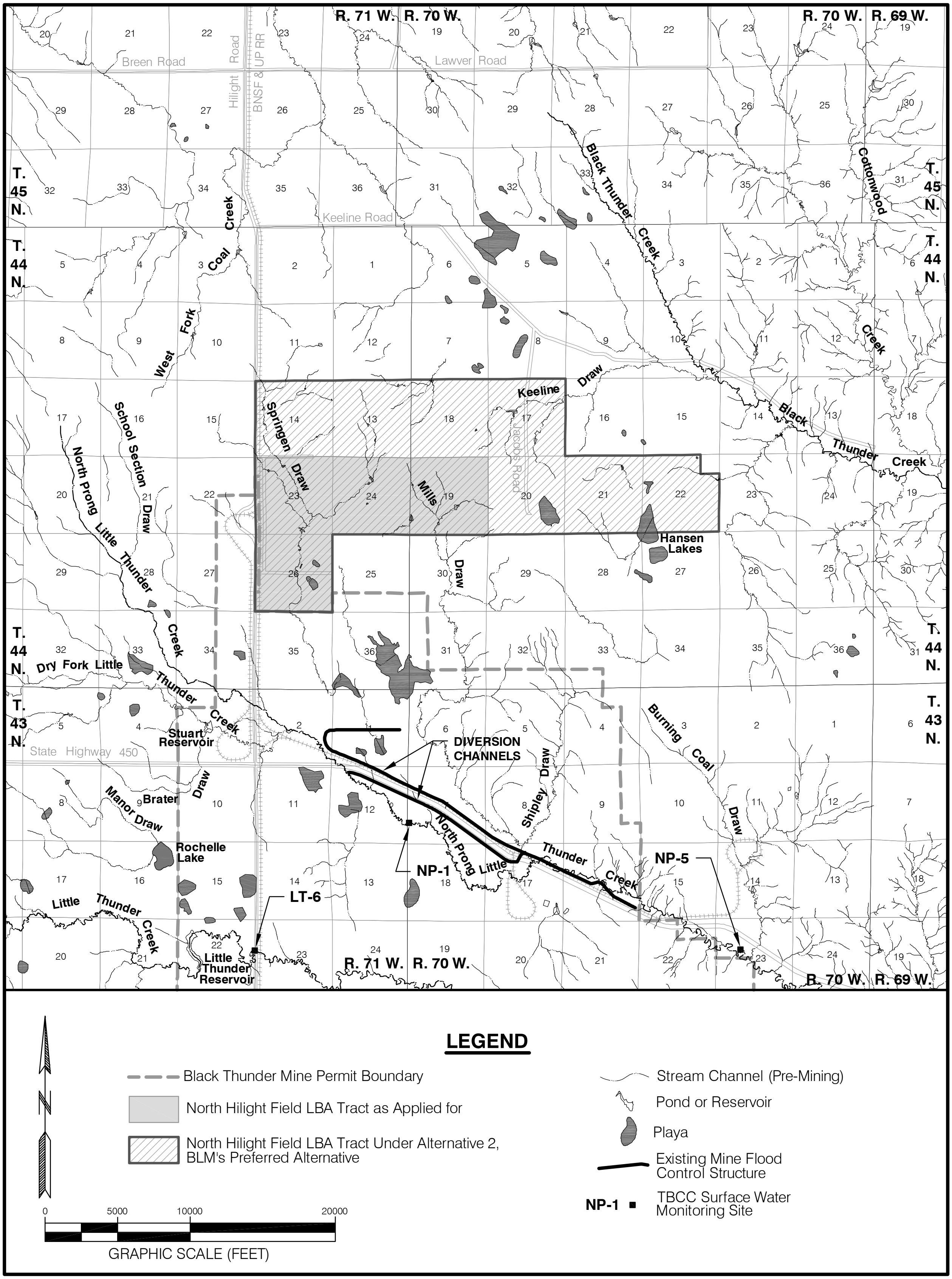


Figure 3-27. Surface Water Features Within and Adjacent to the North Hilight Field LBA Tract Alternatives.

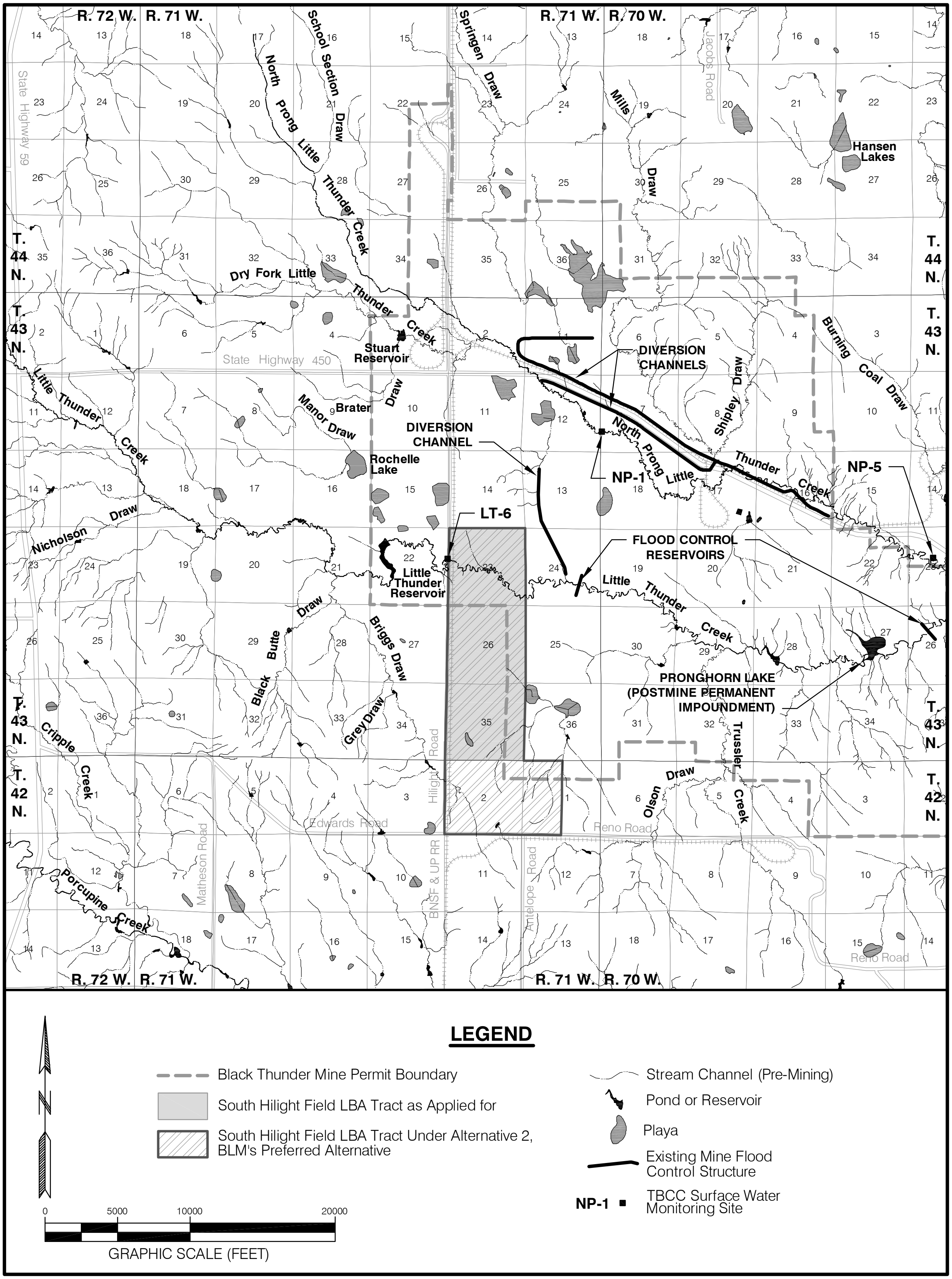


Figure 3-28. Surface Water Features Within and Adjacent to the South Hilight Field LBA Tract Alternatives.

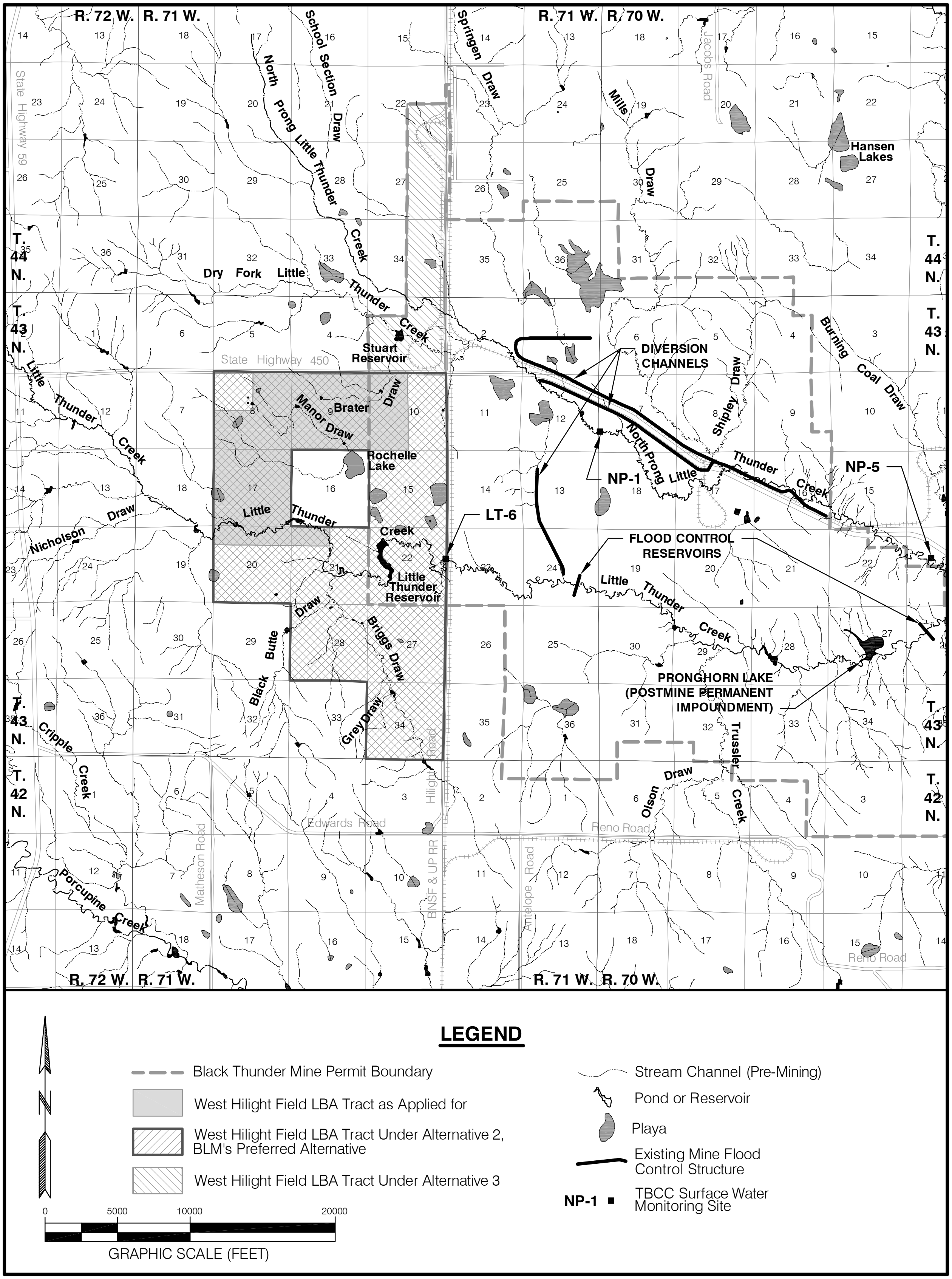


Figure 3-29. Surface Water Features Within and Adjacent to the West Hilight Field LBA Tract Alternatives.

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.

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

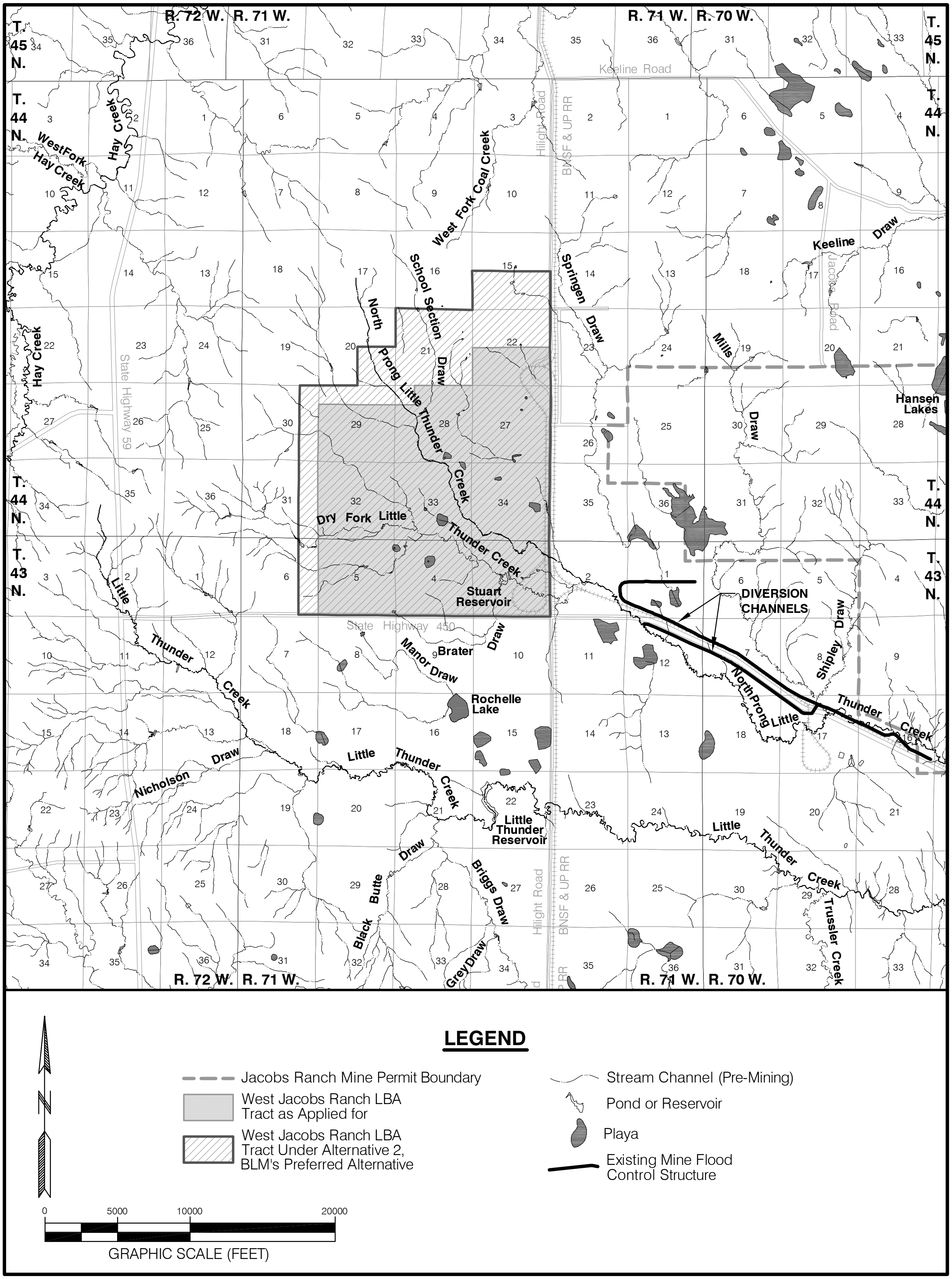


Figure 3-30. Surface Water Features Within and Adjacent to the West Jacobs Ranch LBA Tract Alternatives.

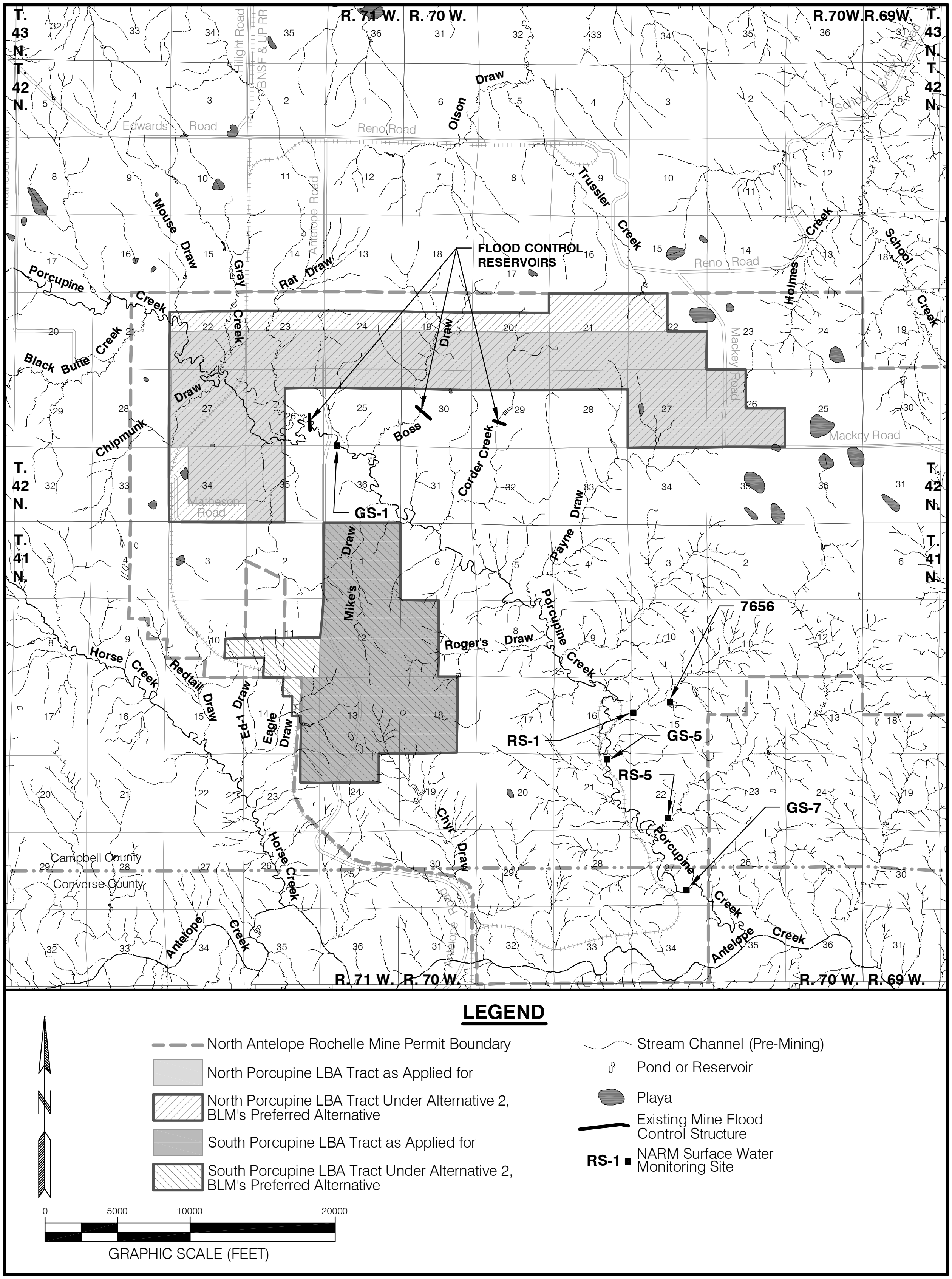


Figure 3-31. Surface Water Features Within and Adjacent to the North and South Porcupine LBA Tract Alternatives.

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 released 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.

3.5.2.2.1.1 North, South, and West Hilight Field LBA Tracts

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 335 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 are probable, 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 36 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 2009). 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 2009). 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 19.7 acres of jurisdictional wetlands and OWUS. Of those 19.7 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, TBCC 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.

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,

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**

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 3-14) 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 3-14). 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.

<u>3.9.2.2 No Action Alternative</u>

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.

OSM evaluates the success of contemporaneous reclamation by evaluating the timeliness of reclamation bond release. According the OSM's 2009 evaluation of the Wyoming regulatory program, with respect to achieving the purposes of SMCRA, a total of approximately 5,500 acres were disturbed within the state at all surface coal mines, 3,955 acres received Phase I bond release, 1,424 acres received Phase II bond release, and 341 acres received Phase III bond release (OSM 2009). Another measurement OSM uses for contemporaneous reclamation success at Wyoming surface coal mines is by comparison of the rate at which lands are being permanently reclaimed (seeded) to the rate of disturbance. OSM's 2009 evaluation indicates that approximately 4,700 acres were seeded, which is a reclamation to disturbance ratio of approximately 86 percent. OSM's most recent evaluation of contemporaneous reclamation at Wyoming's surface coal mines finds that reclamation is proceeding on schedule consistent with the requirements of the state's regulatory program (OSM 2009).

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 tract's 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 (J&S 2008); JRCC conducted baseline investigations in 2007 and 2008 expressly for the West Jacobs Ranch LBA Tract (IR 2008); and PRC conducted baseline investigations during 2007 and early 2008 specifically for the North and South Porcupine LBA Tracts (J&S 2009). 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). No crucial winter range for pronghorn is contained in the general Wright analysis area. 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) (the previous owner of 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. Removal of sagebrush and grassland habitat will reduce overall forage for all three of these big game species. 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

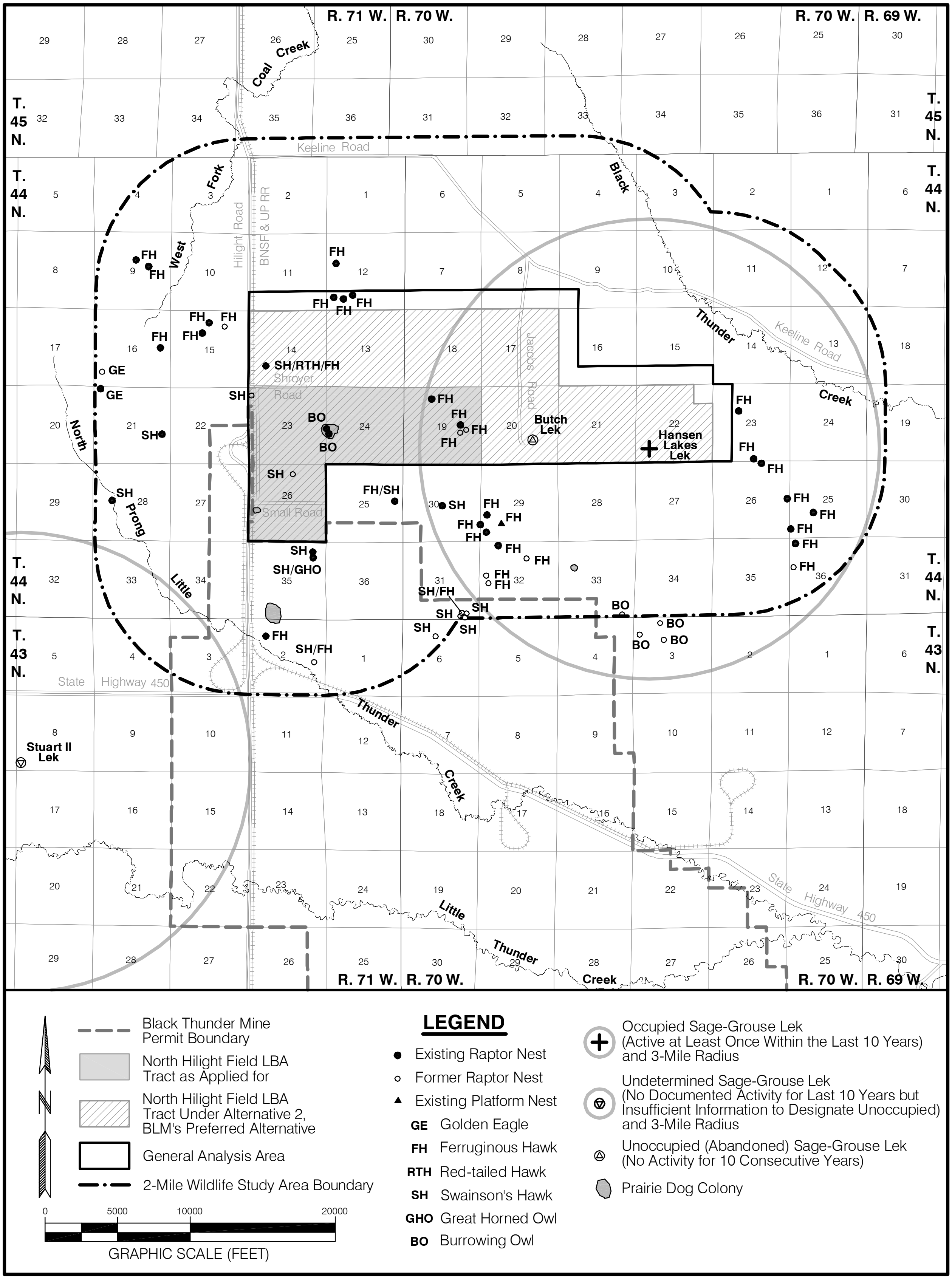


Figure 3-32. Raptor Nest Sites, Sage-Grouse Leks, and Prairie Dog Colonies Within and Adjacent to the North Hilight Field LBA Tract.

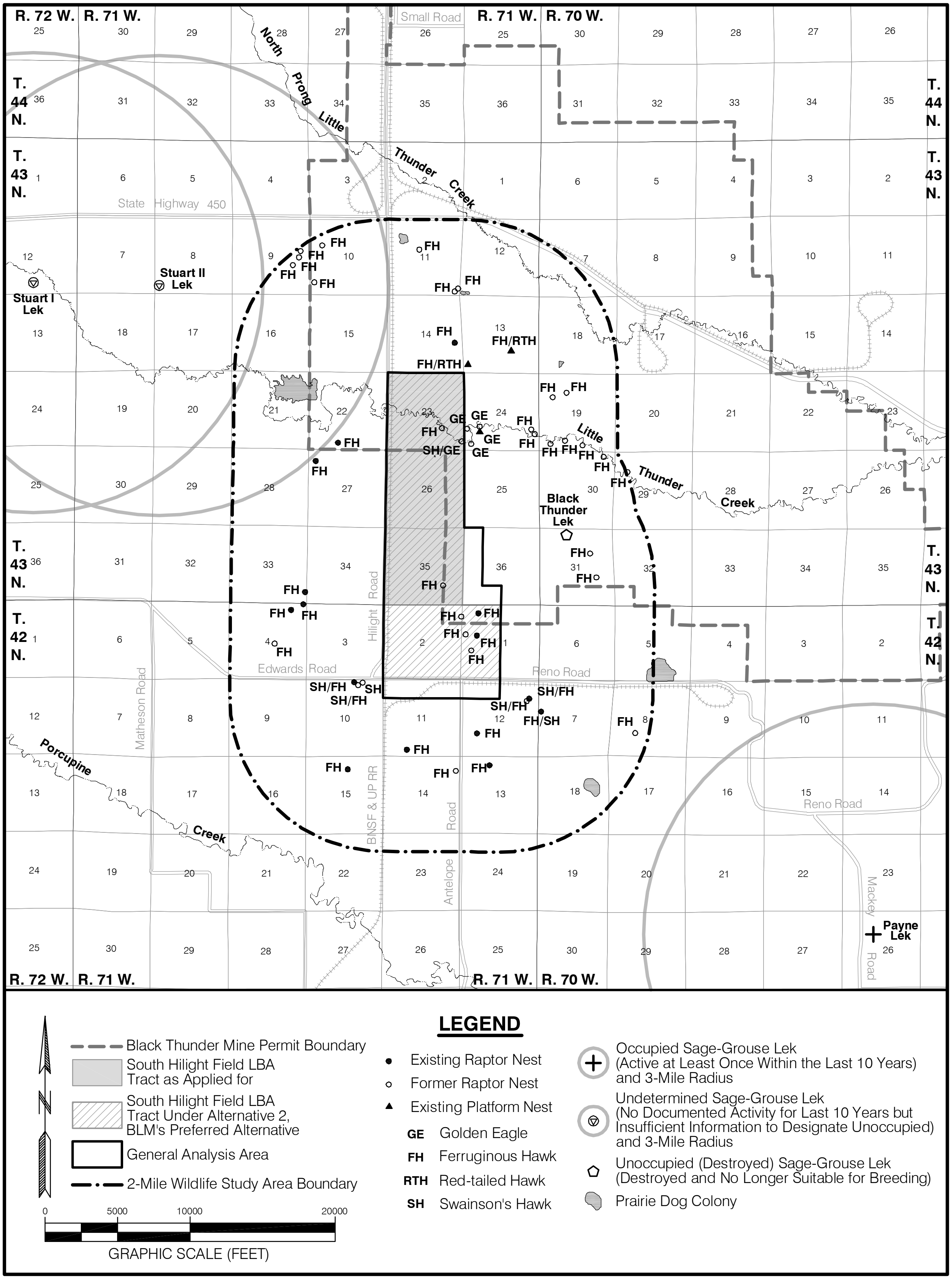


Figure 3-33. Raptor Nest Sites, Sage-Grouse Leks, and Prairie Dog Colonies Within and Adjacent to the South Hilight Field LBA Tract.

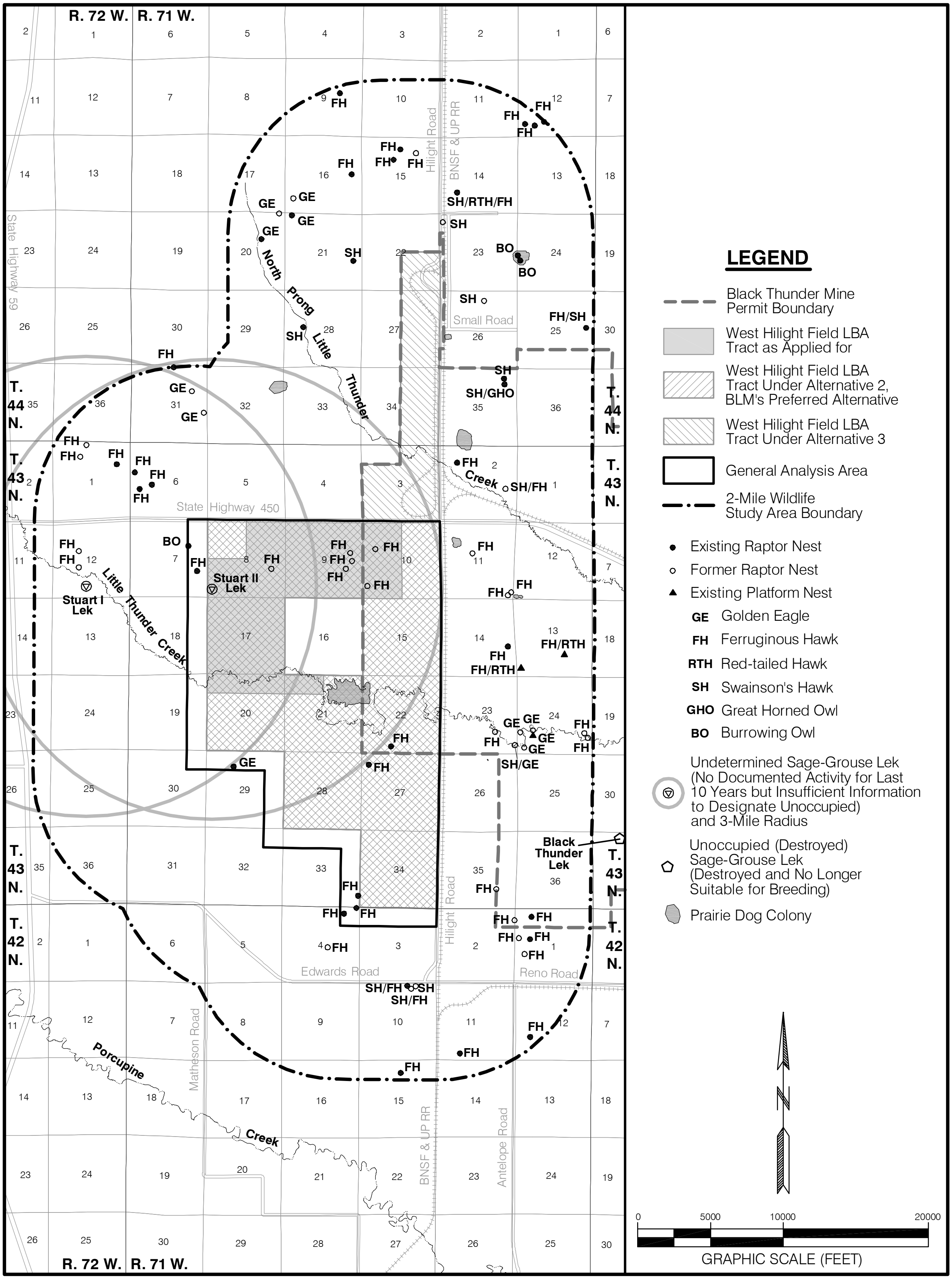


Figure 3-34. Raptor Nest Sites, Sage-Grouse Leks, and Prairie Dog Colonies Within and Adjacent to the West Hilight Field LBA Tract.

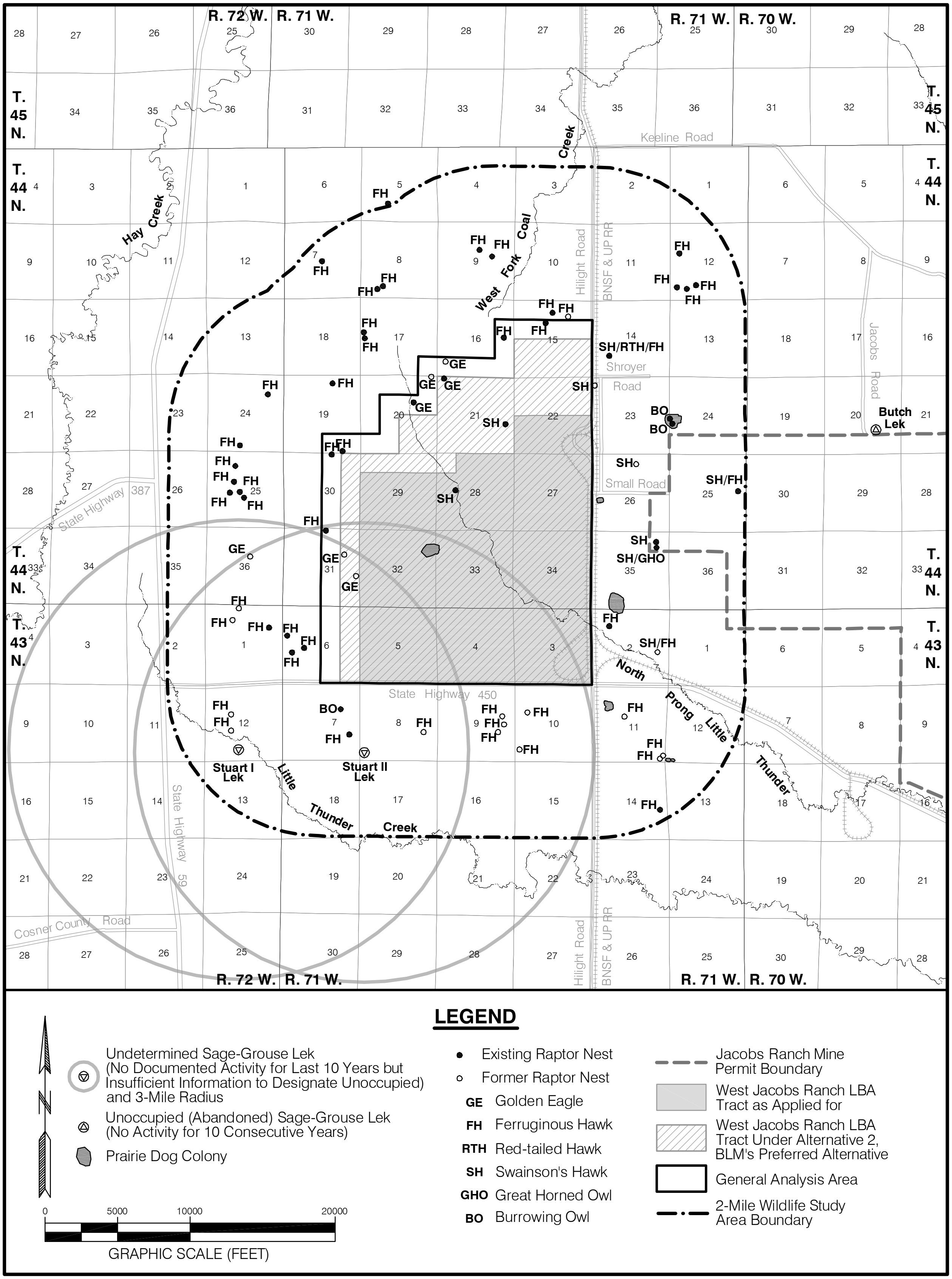


Figure 3-35. Raptor Nest Sites, Sage-Grouse Leks, and Prairie Dog Colonies Within and Adjacent to the West Jacobs Ranch LBA Tract.

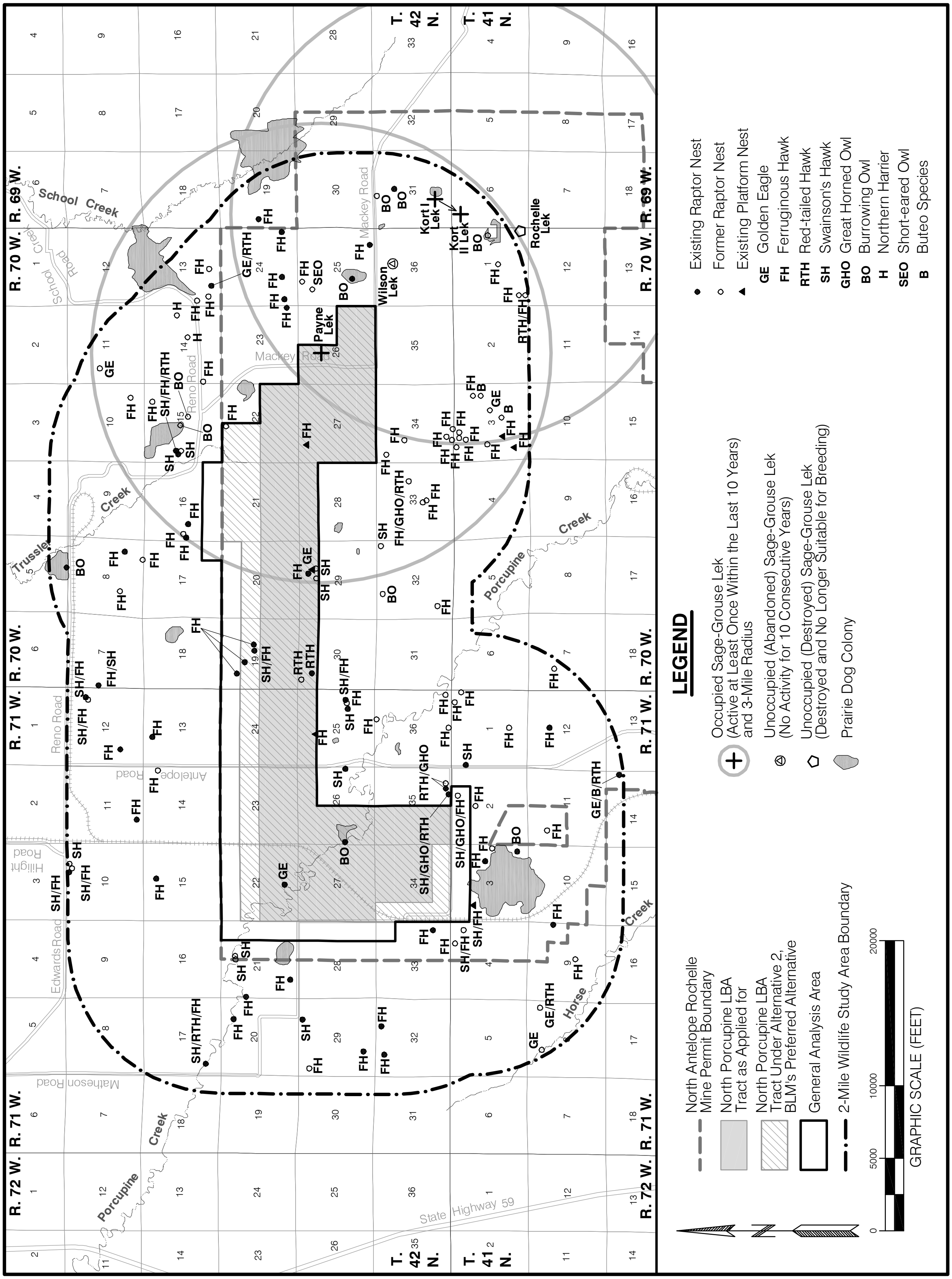


Figure 3-36. Raptor Nest Sites, Sage-Grouse Leks, and Prairie Dog Colonies Within and Adjacent to the North Porcupine LBA Tract.

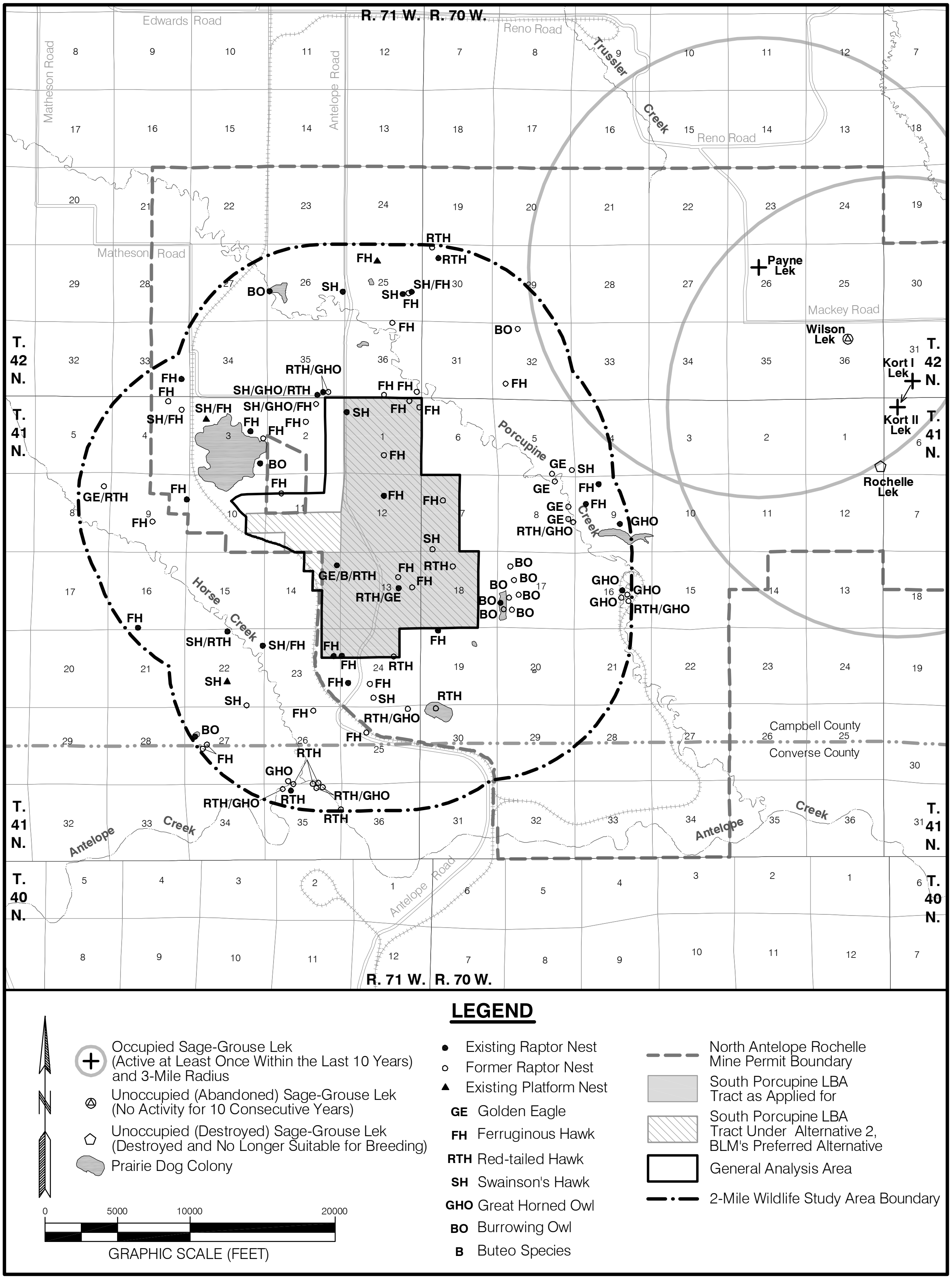


Figure 3-37. Raptor Nest Sites, Sage-Grouse Leks, and Prairie Dog Colonies Within and Adjacent to the South Porcupine LBA Tract.

these figures and in the individual tract discussions that follow below. A total 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 Wright area coal (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 2008), 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 2008), 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 Thunderbird-Jones & Stokes (J&S 2009), 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 (ESA) 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 sage-grouse. The USFWS announced on March 5, 2010 its decision to classify the sage-grouse as a candidate species under the ESA. The USFWS found that listing the sage-grouse (rangewide) was warranted, but precluded by higher priority listing actions.

Candidate species are plants and animals for which the Service has sufficient information on their biological status and threats to propose them for listing as endangered or threatened under the ESA, but for which development of a proposed listing regulation is precluded by higher priority listing actions to address species in greater need. Candidate species receive no statutory protection under the ESA, but the USFWS encourages voluntary cooperative conservation efforts for these species because they are, by definition, species that warrant future protection under the ESA (USFWS 2010).

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. On August 1, 2008, Governor Freudenthal 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 general Wright analysis area is not located within the mapped core breeding 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 10 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 in the adjacent mines' Wildlife Annual Monitoring reports to the WDEQ/LQD 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 10 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 analysis 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).

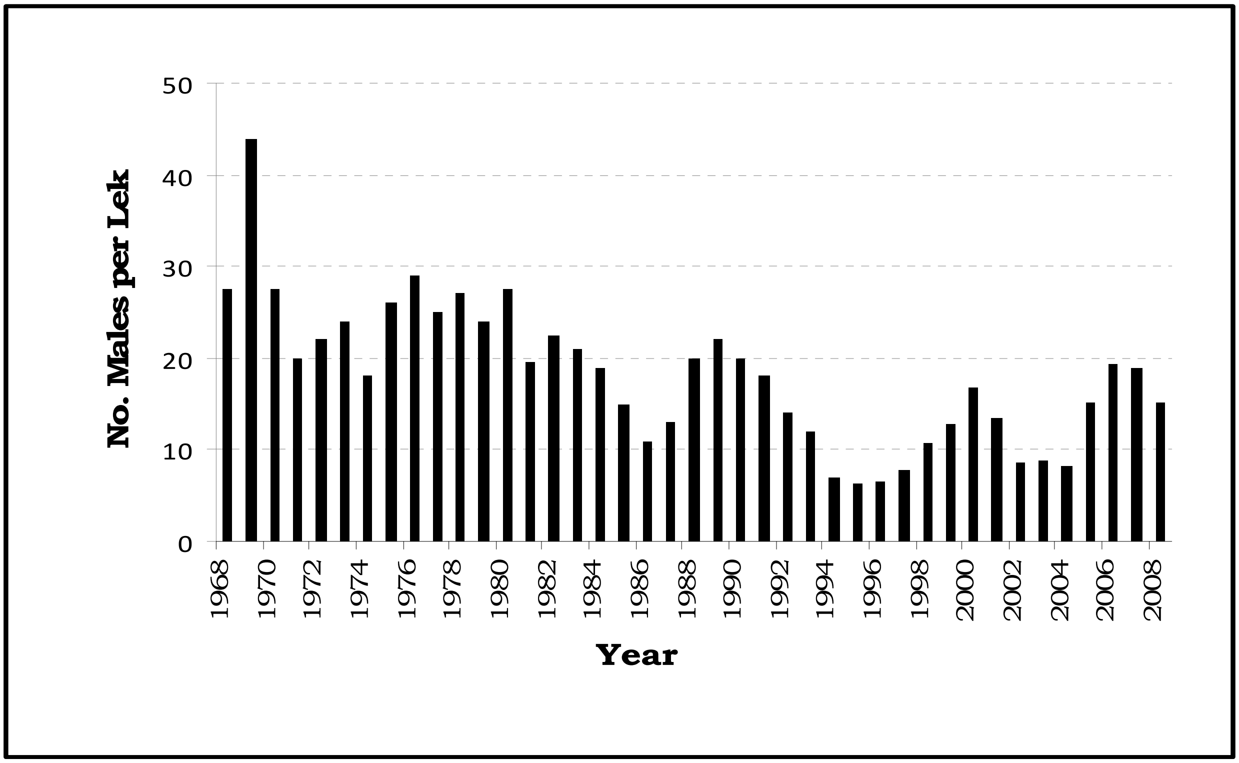


Figure 3-38. Average Male Sage-grouse Lek Attendance Within the Northeast Wyoming Local Working Group Area (1968-2008).
Source: USFS (2006), Thiele (2009)

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, 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).

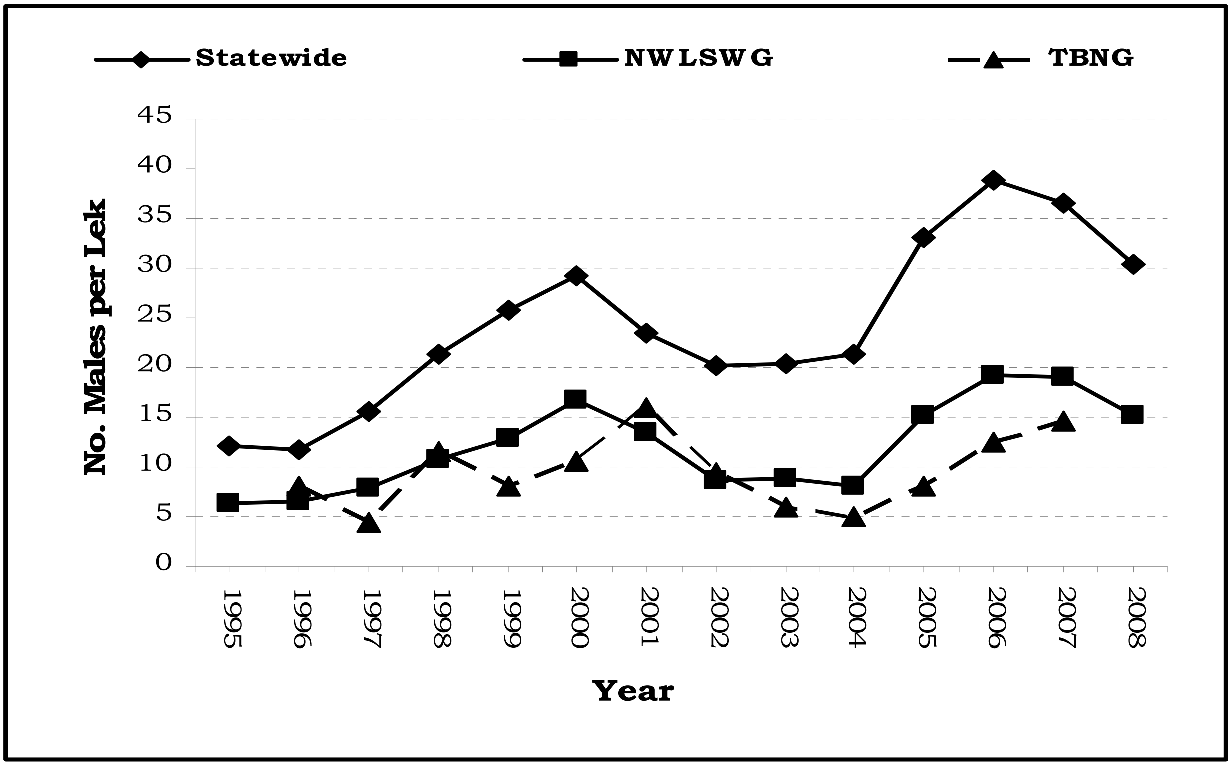


Figure 3-39. Average Male Sage-grouse Lek Attendance Statewide and Within the Northeast Wyoming Local Sage-grouse Working Group Area and the Thunder Basin National Grasslands (1995-2008).
Source: USFS (2006), Thiele (2009), Painter (2009)

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, 10 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 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*), 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). 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 groundwater discharges from CBNG development 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.

3.10.7.2.2 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 and native forbs 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 3-15, 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,

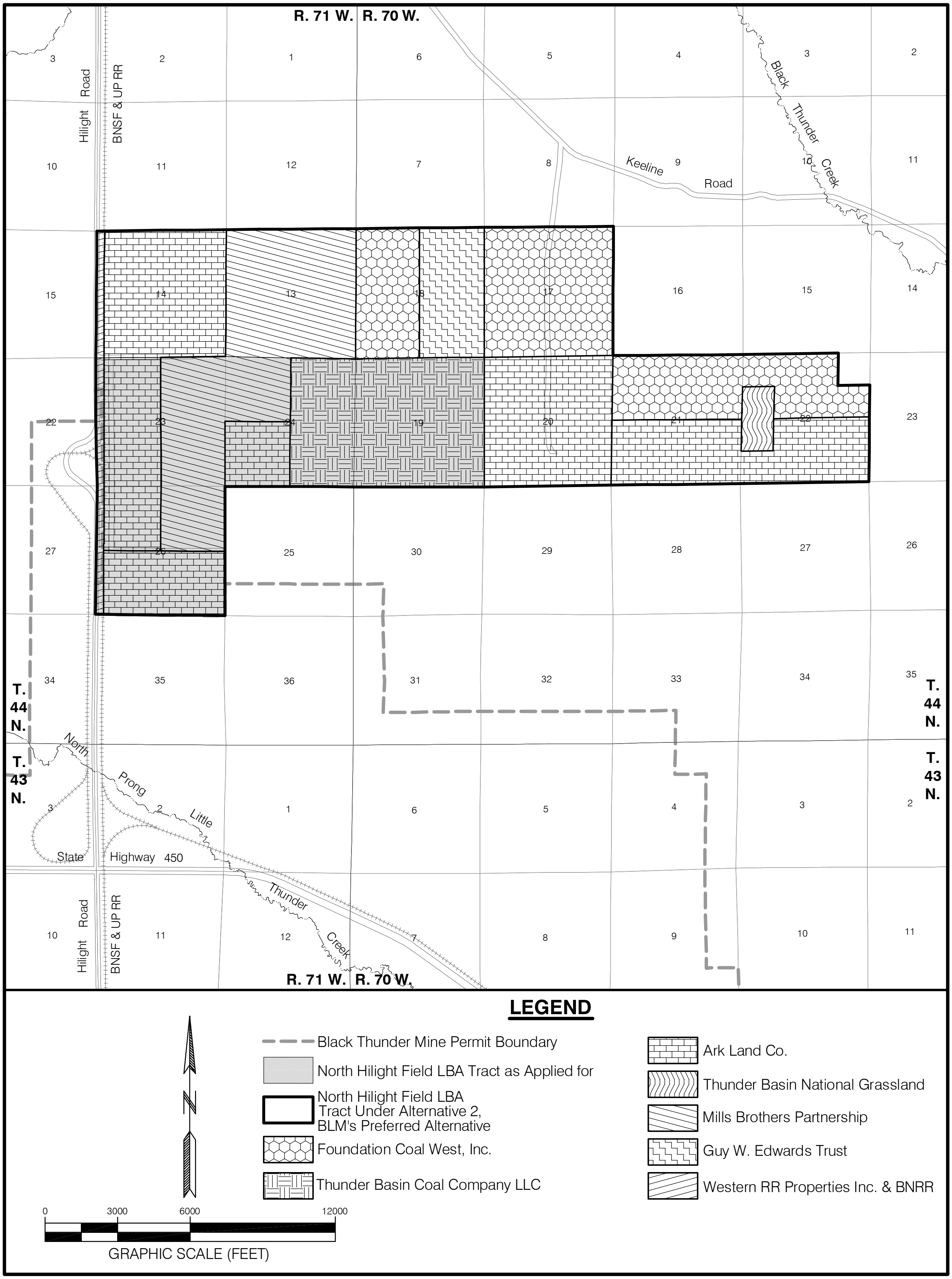


Figure 3-40. Surface Ownership Within the North Hilight Field LBA Tract Alternatives.

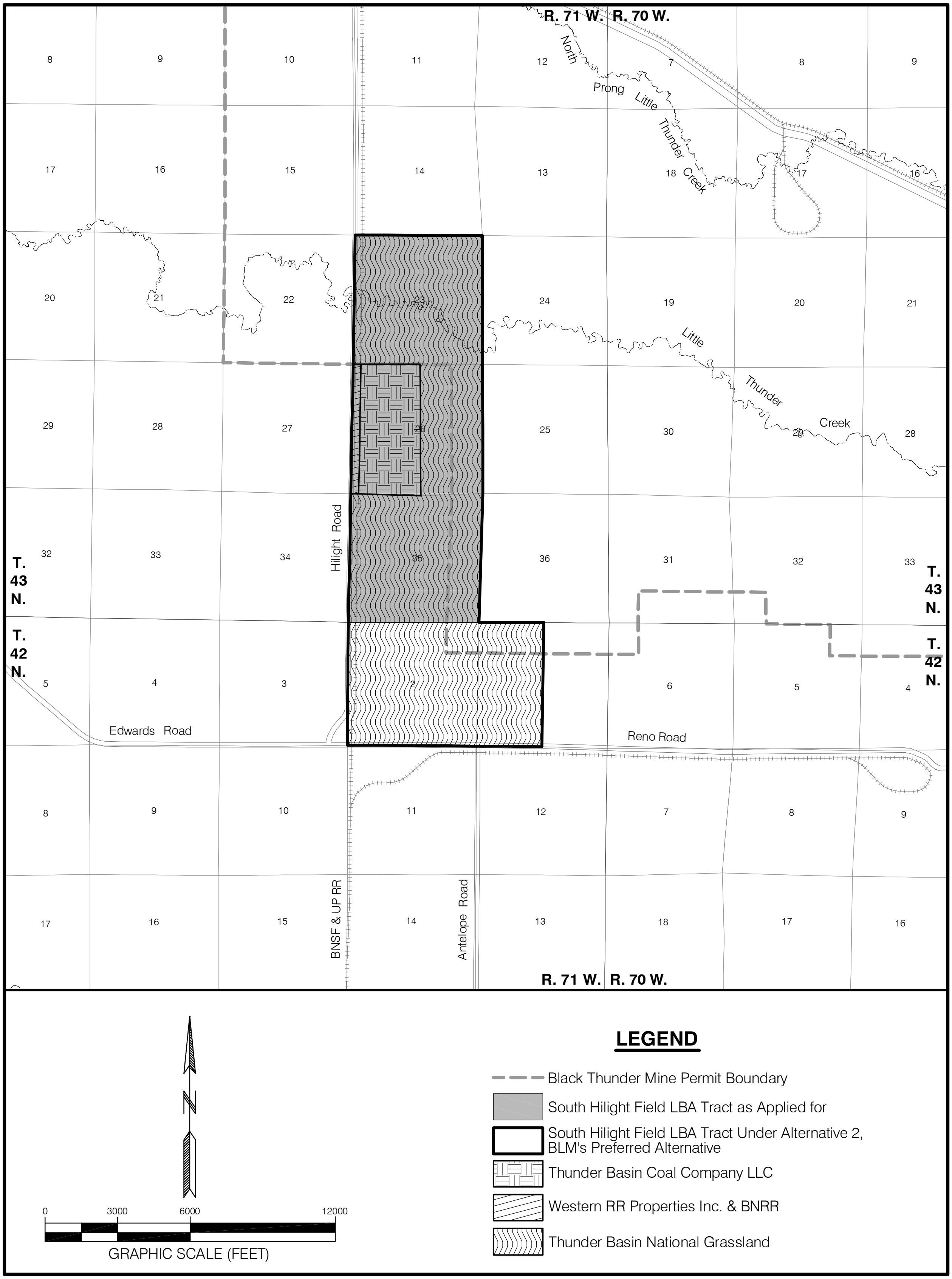


Figure 3-41. Surface Ownership Within the South Hilight Field LBA Tract Alternatives.

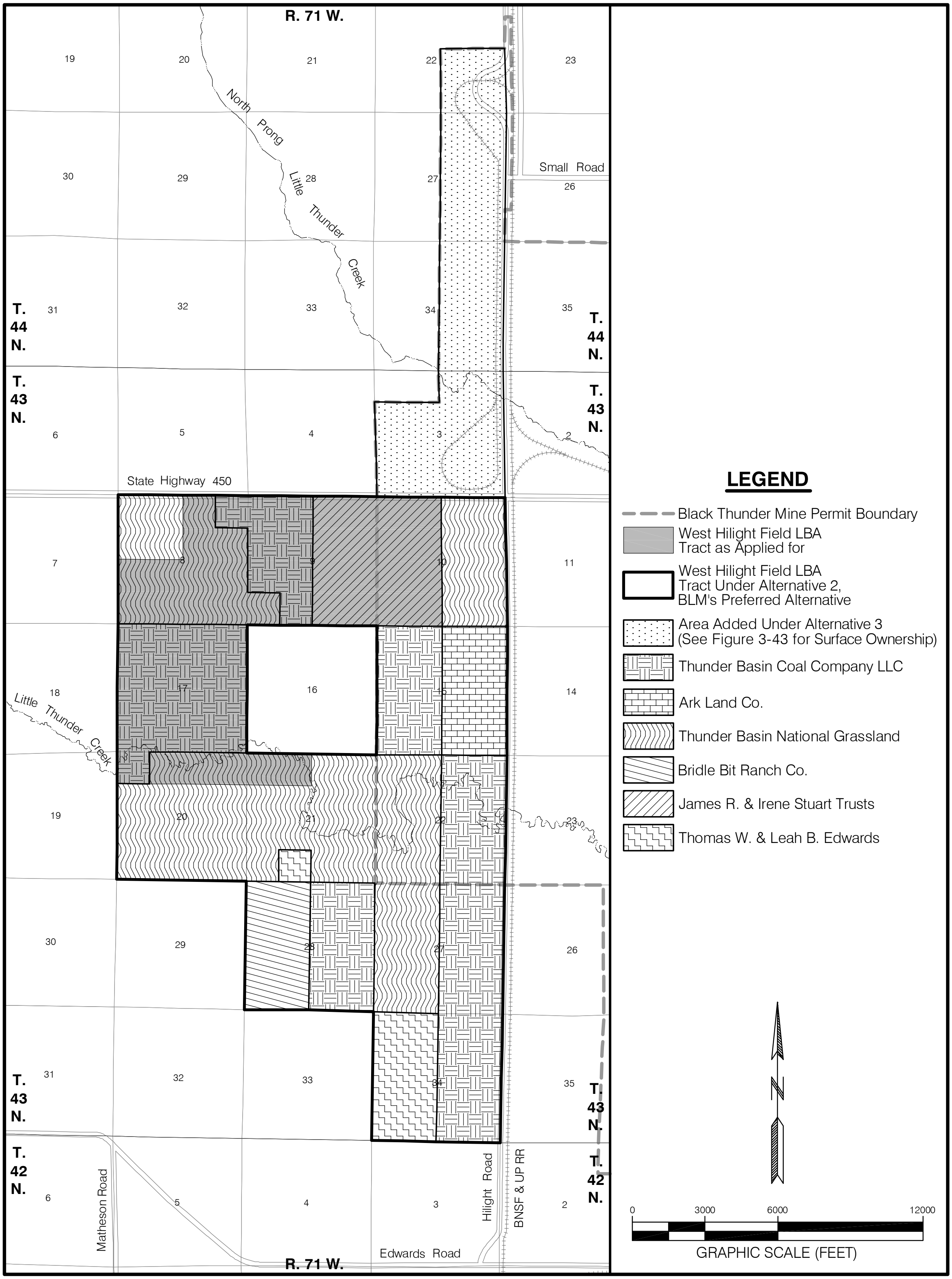


Figure 3-42. Surface Ownership Within the West Hilight Field LBA Tract Alternatives.

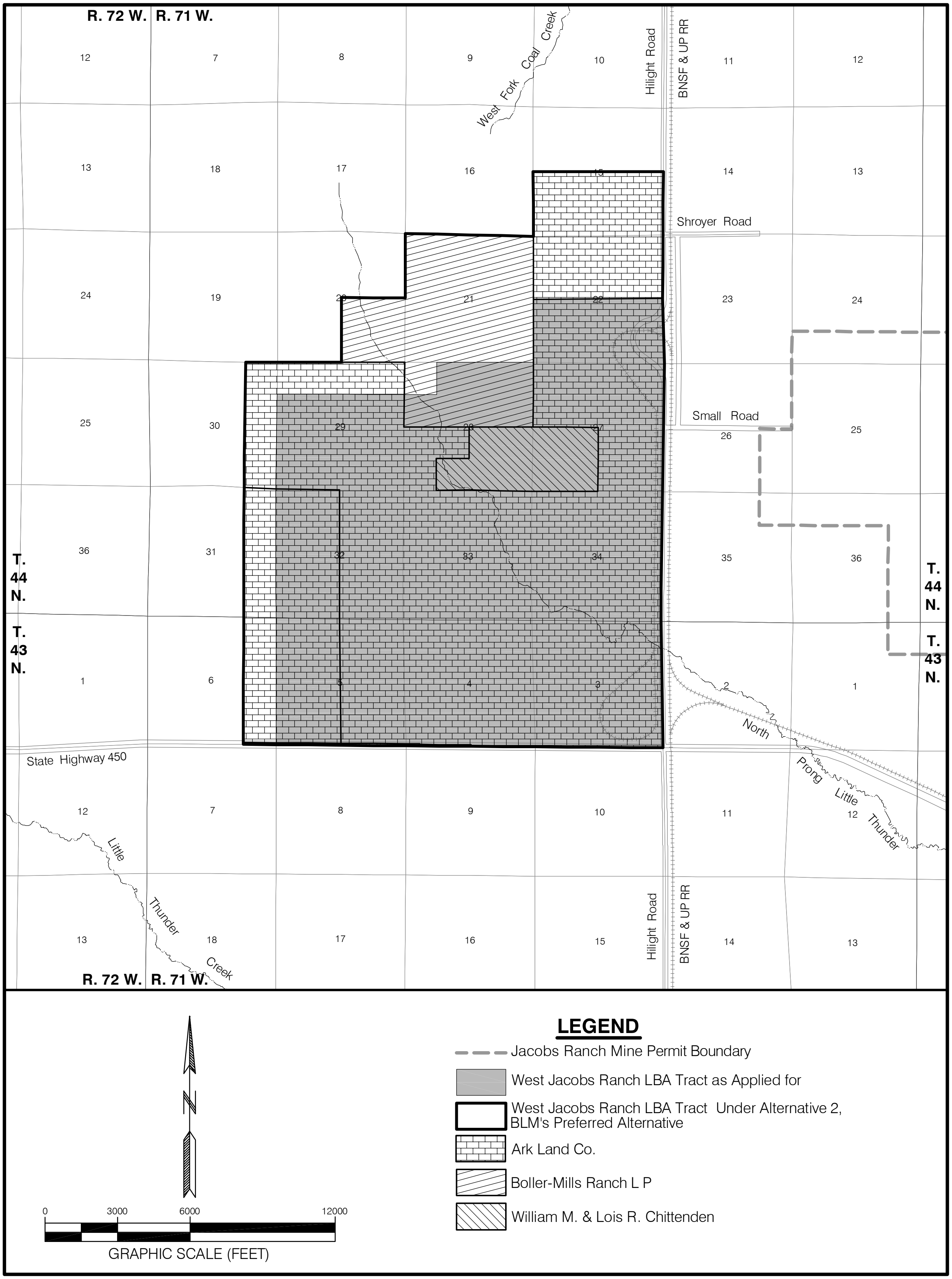


Figure 3-43. Surface Ownership Within the West Jacobs Ranch LBA Tract Alternatives.

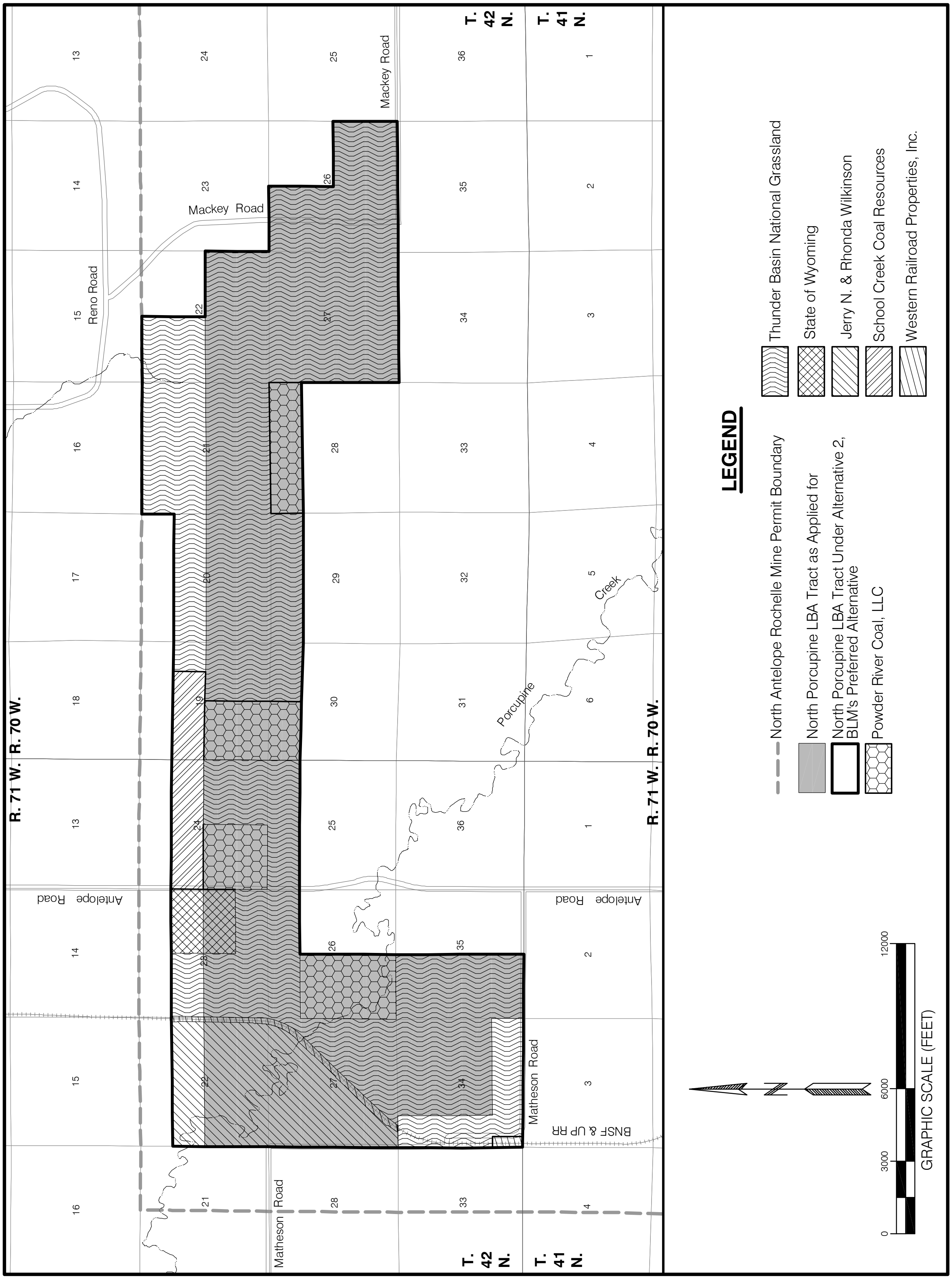


Figure 3-44. Surface Ownership Within the North Porcupine LBA Tract Alternatives.

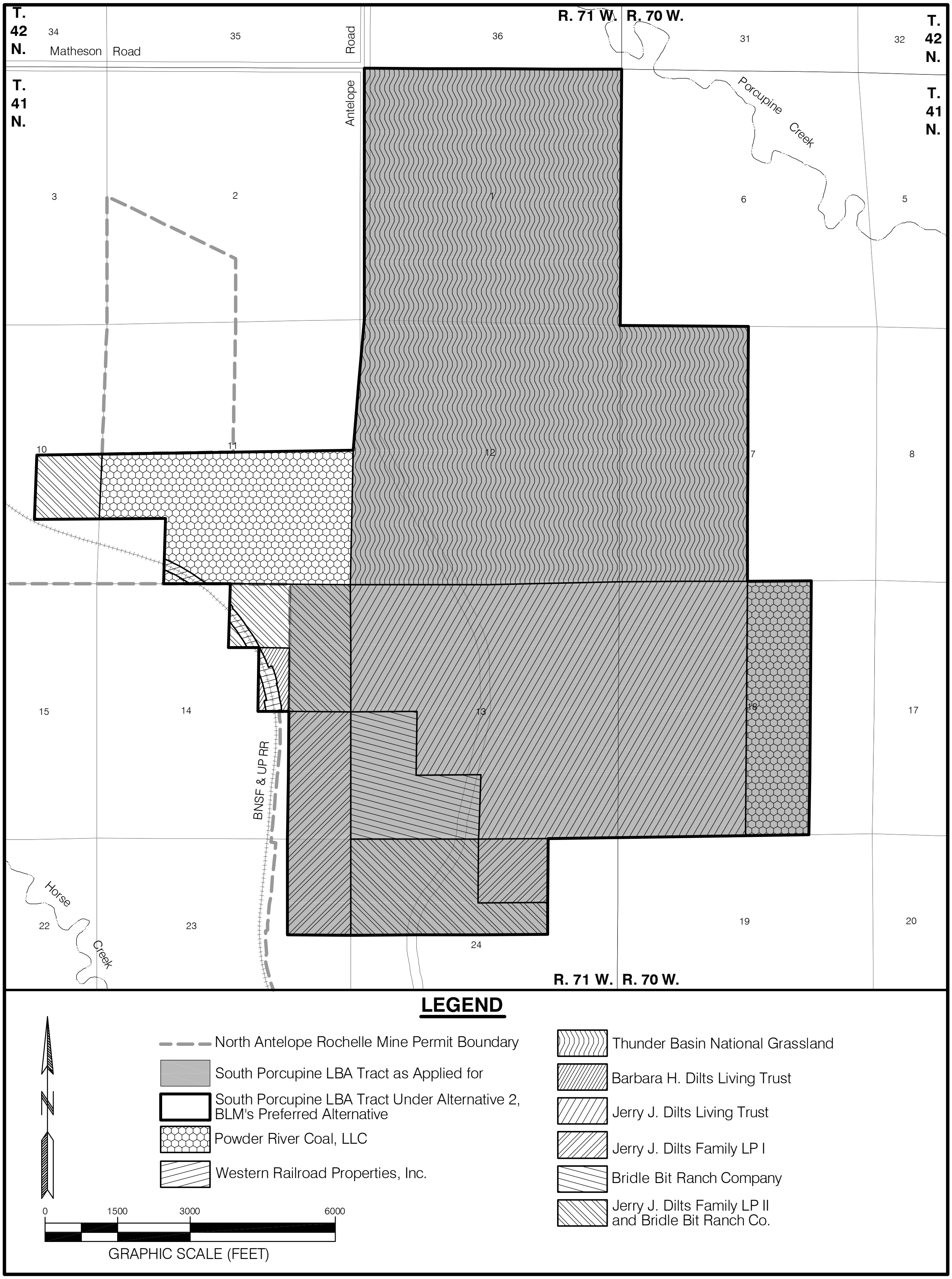


Figure 3-45. Surface Ownership Within the South Porcupine LBA Tract Alternatives.

and recreation are secondary land uses for both public and private lands. As indicated in Table 3-15, 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). This agreement annually permits the Thunder Basin Grazing Association (TBGA) for 71,500 animal unit months (AUMs) on approximately 351,192 TBNG acres for a period of 10 years. In turn, TBGA permits these allotments to its individual members. These allotments within the proposed lease tracts are currently permitted to six members for a total 2,976 AUMs.

Areas of disturbance within and near the six proposed lease areas include roads, oil and gas wells and associated production facilities, surface mine-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

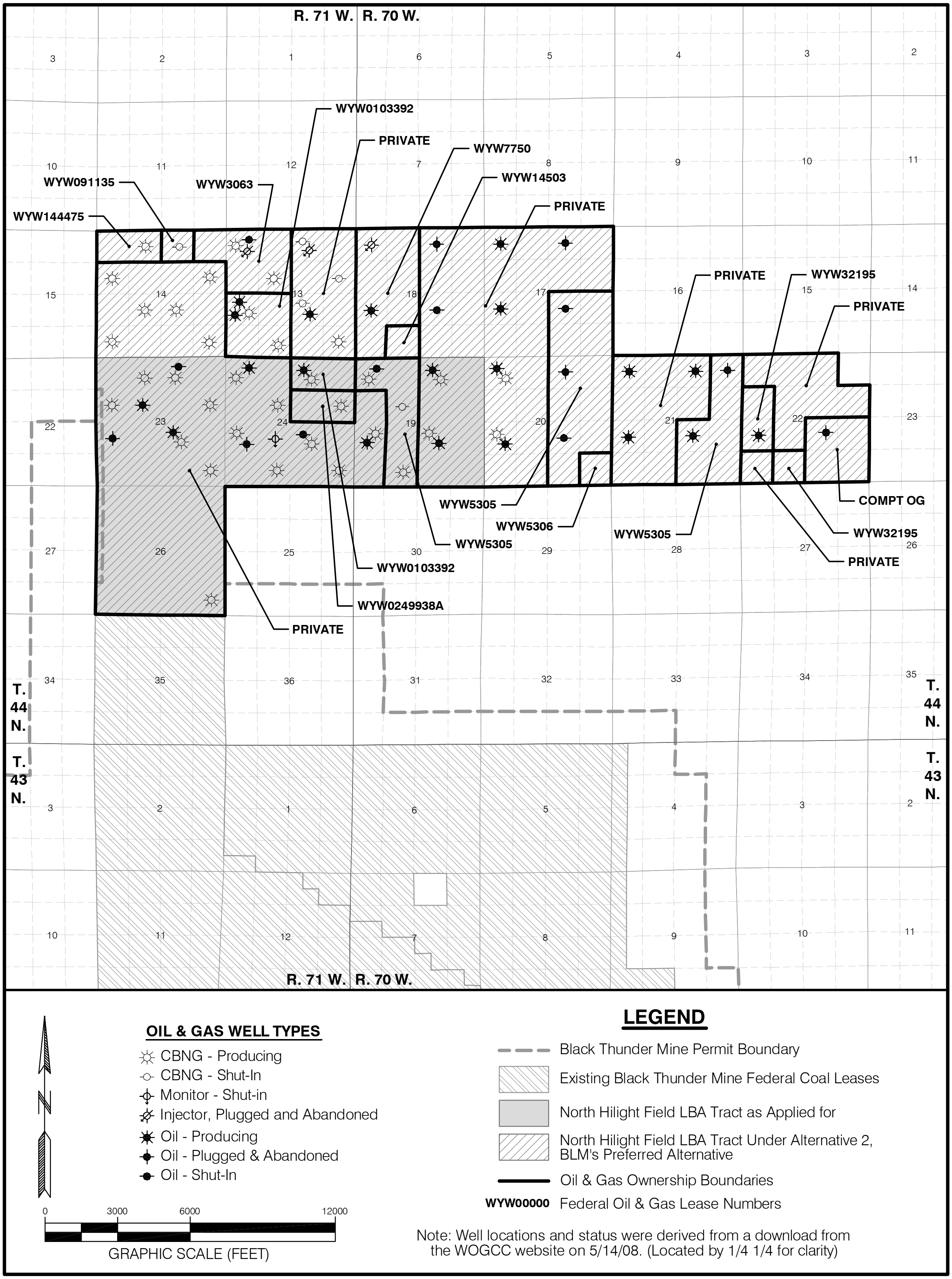


Figure 3-46. Oil and Gas Wells and Oil and Gas Ownership Within the North Hilight Field LBA Tract Alternatives.

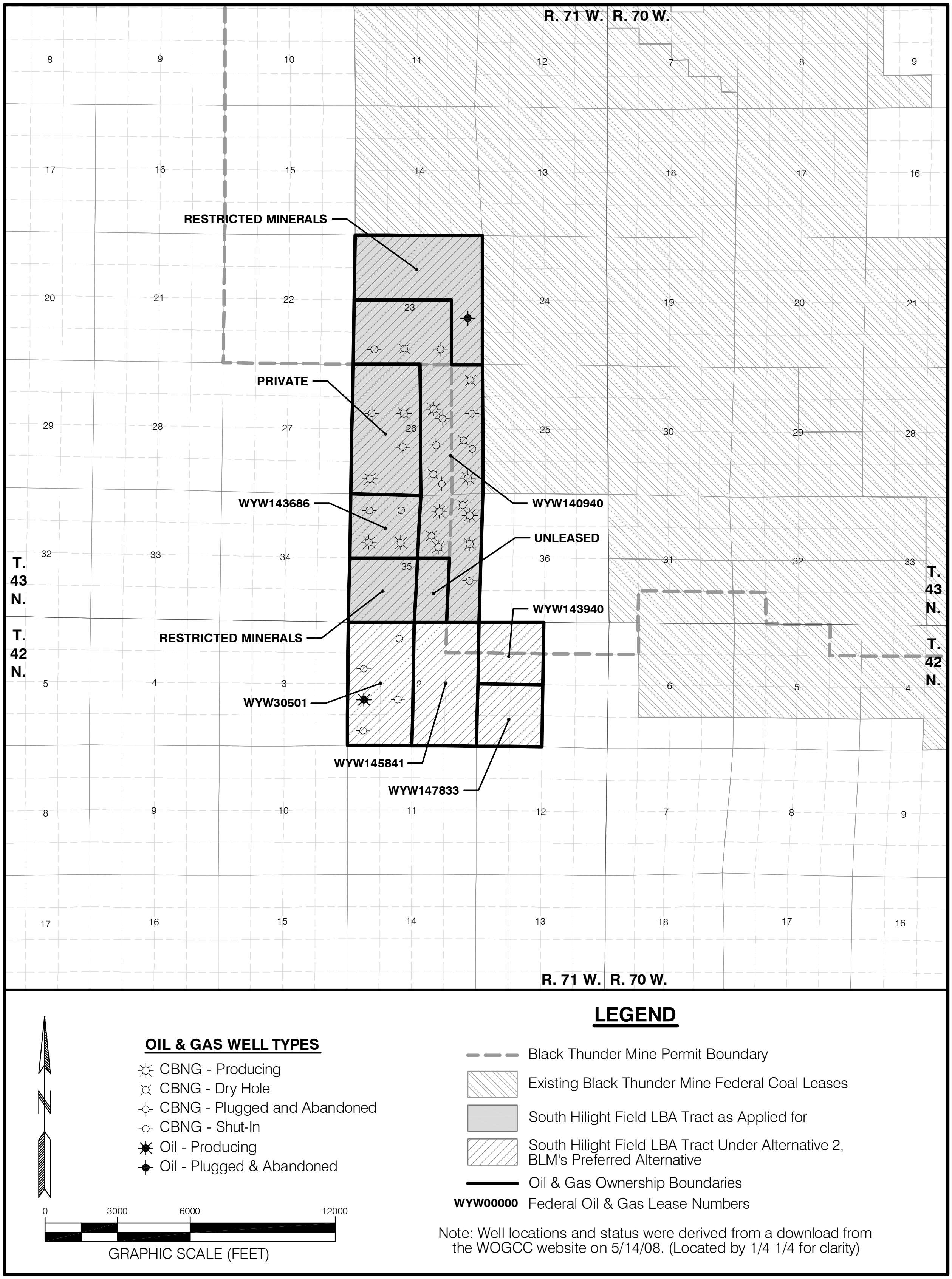


Figure 3-47. Oil and Gas Wells and Oil and Gas Ownership Within the South Hilight Field LBA Tract Alternatives.

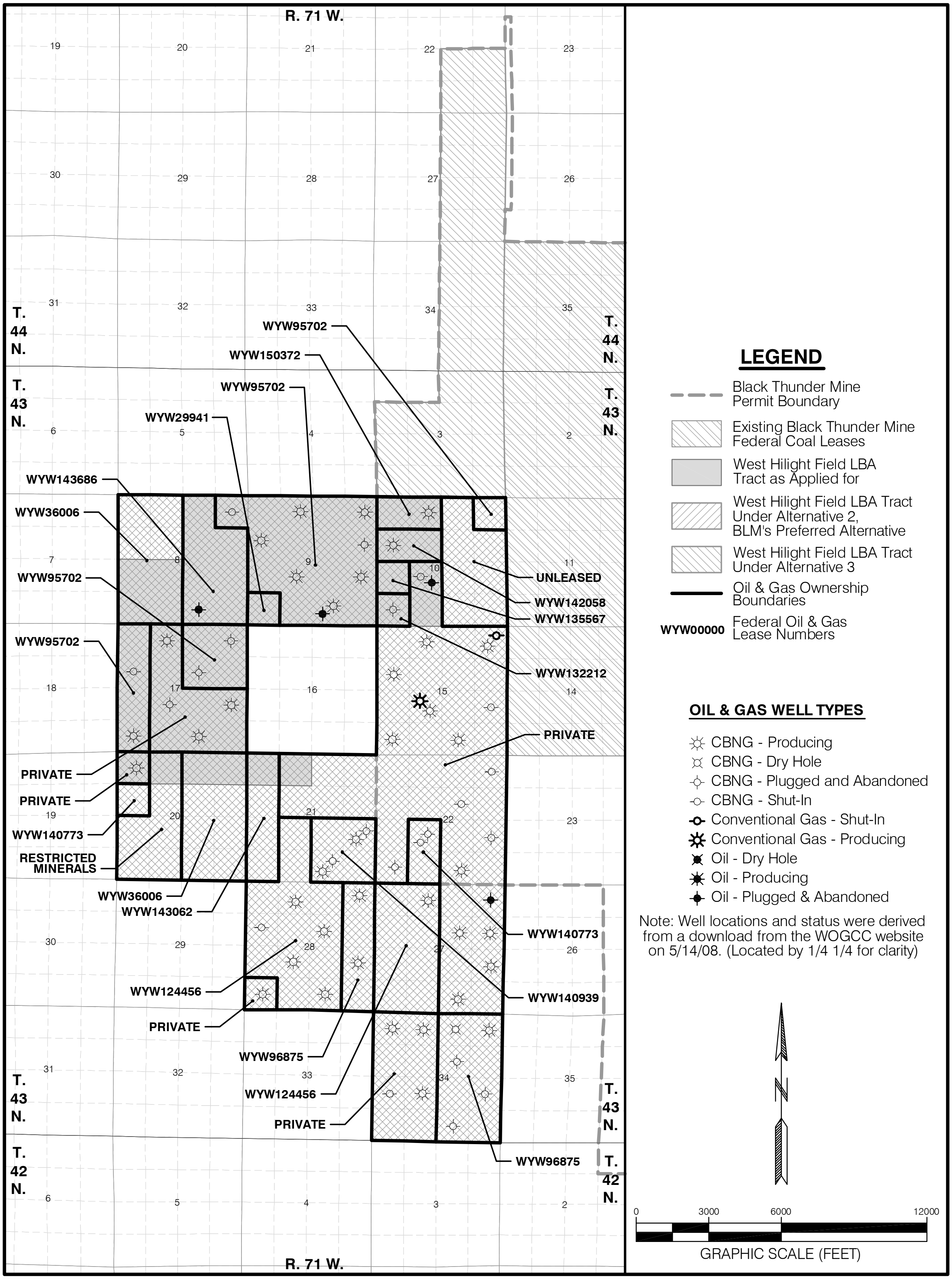


Figure 3-48. Oil and Gas Wells and Oil and Gas Ownership Within the West Hilight Field LBA Tract Alternatives.

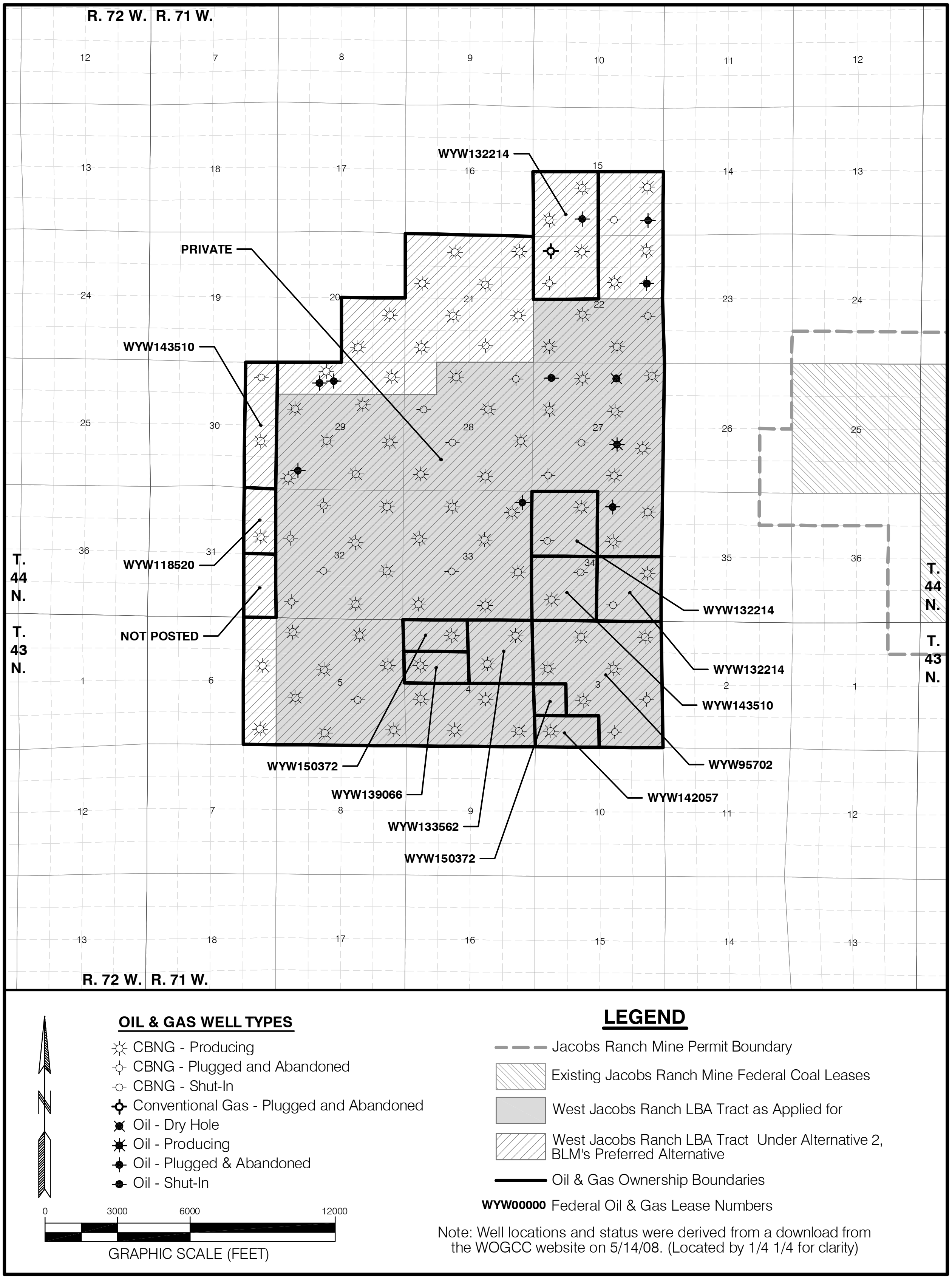


Figure 3-49. Oil and Gas Wells and Oil and Gas Ownership Within the West Jacobs Ranch LBA Tract Alternatives.

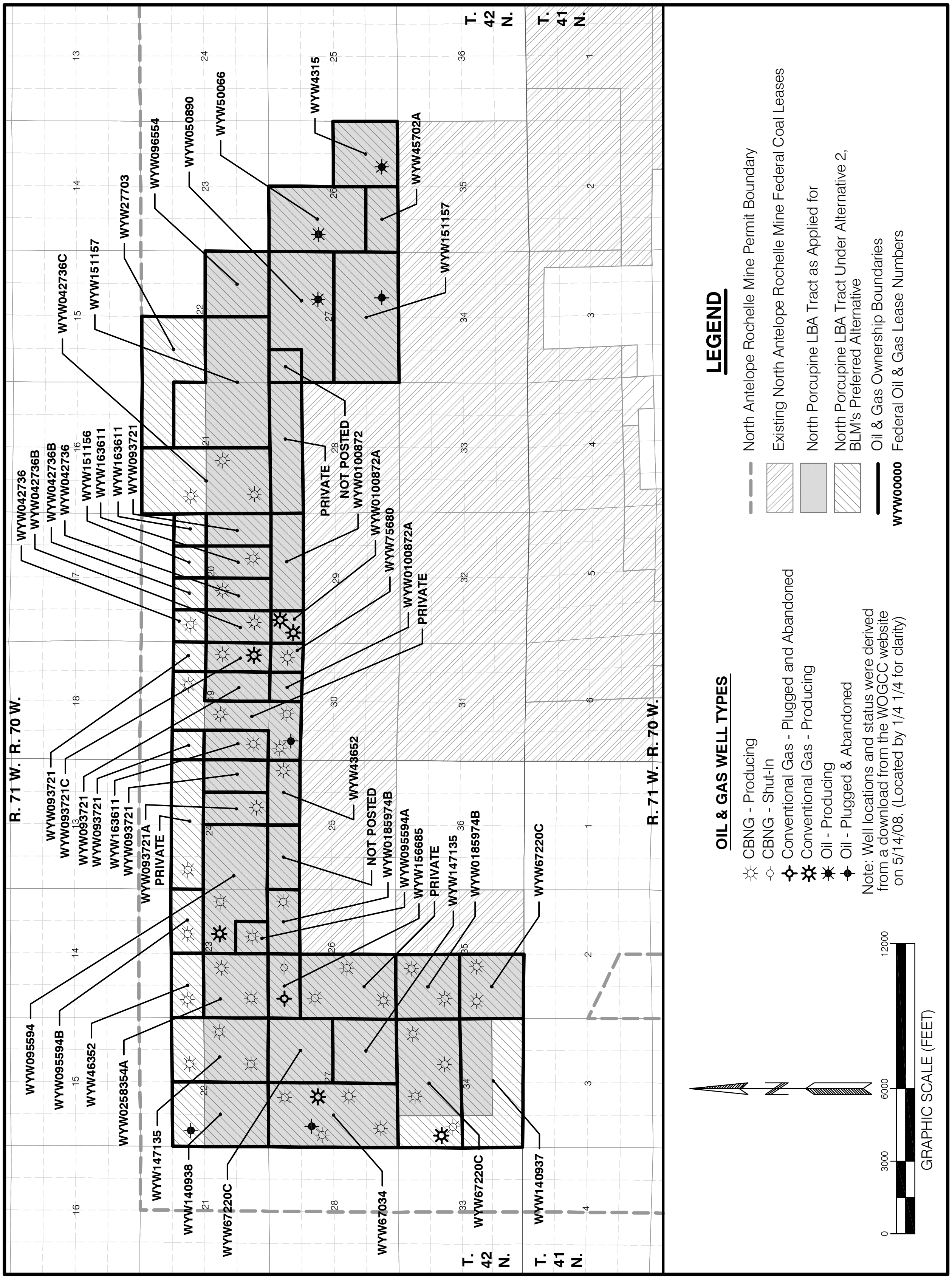


Figure 3-50. Oil and Gas Wells and Oil and Gas Ownership Within the North Porcupine LBA Tract Alternatives.

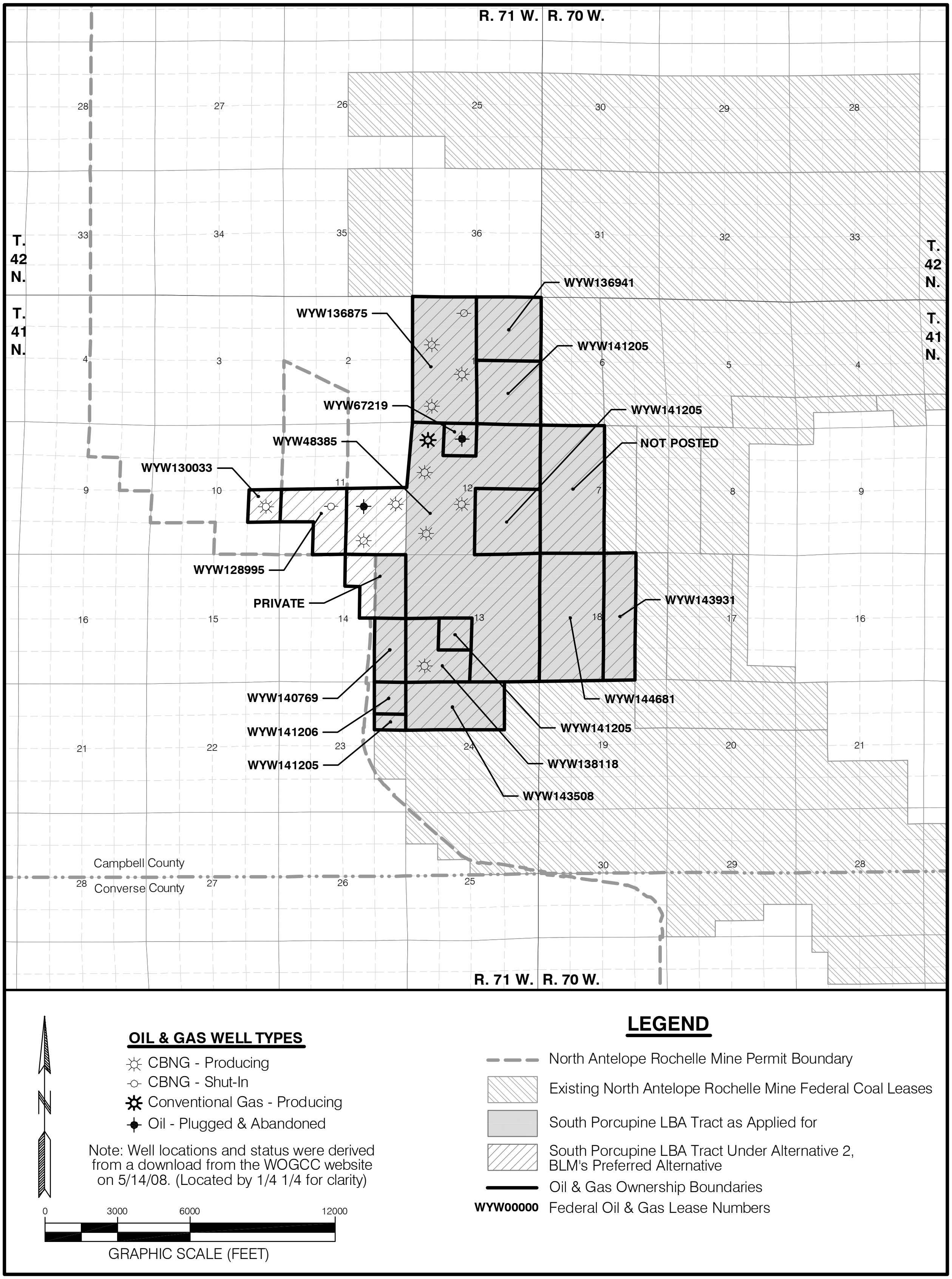


Figure 3-51. Oil and Gas Wells and Oil and Gas Ownership Within the South Porcupine LBA Tract Alternatives.

Table 3-16. North Hilight Field LBA Tract Federal Oil and Gas Lessees of Record.

Location	Lease Number	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	Lease Number	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.

Table 3-18. West Hilight Field LBA Tract Federal Oil and Gas Lessees of Record.

Location	Lease Number	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

Table 3-18. West Hilight Field LBA Tract Federal Oil and Gas Lessees of Record (Continued).

Location	Lease Number	Lessees of Record
T.43N., R.71W.		
Section 8; Lots 3-6, 11-14 Section 20; Lots 1, 2, 7-10, 15, 16 (Continued)	WYW036006 (Continued)	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	Lease Number	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.

Table 3-19. West Jacobs Ranch LBA Tract Federal Oil and Gas Lessees of Record (Continued).

Location	Lease Number	Lessees of Record
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.

Table 3-20. North Porcupine LBA Tract Federal Oil and Gas Lessees of Record.

Location	Lease Number	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

Table 3-20. North Porcupine LBA Tract Federal Oil and Gas Lessees of Record (Continued).

Location	Lease Number	Lessees of Record
T.42N., R.70W.		
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
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

Table 3-20. North Porcupine LBA Tract Federal Oil and Gas Lessees of Record (Continued).

Location	Lease Number	Lessees of Record
T.42N., R.71W.		
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	Lease Number	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.

Table 3-21. South Porcupine LBA Tract Federal Oil and Gas Lessees of Record (Continued).

Location	Lease Number	Lessees of Record
T.41N., R.71W.		
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.

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 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 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 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), the previous 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 the 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 groundwater discharges from CBNG development 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.

Approximately 12,481 acres of TBNG surface that are currently permitted for federal grazing by the TBGA would be suspended during mining and reclamation operations. This suspension would result in an additional seven allotments that would no longer be available for grazing, one allotment that would be reduced by approximately 50 percent, and three allotments that would have small reductions in grazing for a total of approximately 2,890 AUMs lost from TBGA, or 4 percent of the total grazing agreement. 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. These reductions in combination with past impacts from mining would result in an additional three grazing members that would no longer have allotments to graze, one member that would have grazing allotments reduced by 65 percent, one member that would have grazing allotments reduced by 50 percent, and one member that is minimally impacted. While the TBGA could potentially provide relief to some of its members impacted by mining through the possible allocation of other vacant allotments if they are available, TBGA cannot totally recover these losses, especially in combination with past losses. Often, lost AUMs ultimately result in a net loss to the member and the TBGA and negatively impact the ranchers that were allocated those AUMs for their livestock operations.

Since the onset of mining in this portion of the PRB, approximately 44,000 acres of federal surface administered by the USFS within 20 allotments have been impacted by mining through mining of leases, overstripping for mining, or ancillary facilities. This has resulted in a loss of approximately 10,200 AUMs from the TBGA. Combined with grazing losses from the current mining operations, the loss of grazing the lands successfully leased and proposed for mining would result in a total reduction of approximately 13,090 AUMs, or 18 percent of the TBGA grazing agreement. While these suspensions are considered temporary, they are nevertheless long term. Since the beginning of mining in this area in approximately 1980, none of the lands permitted for grazing to the TBGA have reached final bond release and been returned for use under the TBGA grazing agreement. Thirty years equates to three terms of the grazing agreement and at least one generation of ranchers that are unable to graze their livestock on these lands. As previously described, for five TBGA members, the loss of TBNG grazing use due to the leasing and subsequent mining of the WAC LBA tracts could cause serious impacts to their livestock operations and family ranches.

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. If the USFS-administered lands are leased for coal mining, loss of public access could potentially extend for 20 years or more depending on individual mine plans, mine variation in coal production rates, permitting requirements, and reclamation sequence and succession. 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.

For those ranching operations that would be seriously impacted by the loss of grazing allotments through the TBGA on federal surface administered by the USFS, a potential exists for the grazing association, affected TBGA members, USFS, and mine operators to partner and collaborate in addressing the issue.

As a consolidated stakeholder group, potential solutions to help mitigate the adverse affects could be developed.

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 literature and records reviews 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 mostly 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. Currently, Class III inventory is needed on 160 acres within the general analysis area for the South Hilight Field tract, 480 acres within the general analysis area for the West Jacobs Ranch tract, and 58 acres within the general analysis area for the South Porcupine tract. The inventories must be completed, along with agency review and SHPO consultation, prior to the signing of a record of decision to hold a competitive lease sale for the LBA tract in question.

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 literature and records reviews 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. At this time, the only portion that does not meet current Class III standards is 160 acres within Section 2, T.42N., R.71W. within the South Hilight Field tract. That area was surveyed in 1980; however, BLM does not recognize surveys prior to 1985 as adequate, nor was the report ever reviewed by a federal agency or by SHPO. No federal decisions can be made based on such an old survey or report.

A total of 59 cultural sites have been documented in the North Hilight Field general analysis area. Of these, 41 are prehistoric, 16 are historic, and two are multi-component sites consisting of both prehistoric and historic elements. Prehistoric sites consist primarily of lithic scatters, cairns, stone circles, and campsites. Historic sites consist primarily of homesteads and trash dumps. Twenty-three of the previously recorded sites have been determined *not eligible* for the NRHP by the agency with SHPO concurrence. Eight of the prehistoric sites have been determined to be *eligible* for the NRHP by the agency with SHPO concurrence. Twenty-eight of the previously recorded sites are considered *unevaluated* for eligibility by the agency, and all will require further work including historic documentation, updated site recording, and additional subsurface testing in order for the agency to make an eligibility determination and consult with SHPO.

A total of 36 cultural sites have been documented in the South Hilight Field general analysis area. Of these, 18 are prehistoric, 12 are historic, and six are multi-component sites. Prehistoric sites consist primarily of lithic scatters and campsites. Historic sites consist primarily homesteads and trash dumps. Twenty-three of the previously recorded sites have been determined *not eligible* for the NRHP by the agency with SHPO concurrence. Thirteen of the previously recorded sites are considered *unevaluated* by the agency and all will require further work including historic documentation, updated site recording, and additional subsurface testing in order for the agency to make an eligibility determination and consult with 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 79 cultural sites have been documented in the West Hilight Field general analysis area. Of these, 56 are prehistoric, 17 are historic, and six are multi-component. Prehistoric sites consist primarily of lithic scatters and campsites. Historic sites consist primarily of homesteads and trash dumps. Forty-nine of the previously recorded sites have been determined *not eligible* for the NRHP by the agency with SHPO concurrence. One of the prehistoric sites has been determined to be *eligible* for the NRHP by the agency with SHPO concurrence. Twenty-nine of the previously recorded sites are considered *unevaluated* for eligibility by the agency, and all will require further work including historic documentation, updated site recording, and additional subsurface testing in order for the agency to make an eligibility determination and consult with SHPO.

In summary, a total of 174 cultural sites have been documented in the general analysis areas for the North, South, and West Hilight Field LBA Tracts. Of these, 138 sites were previously recorded and identified during record searches. An additional 36 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 174 total cultural sites, nine sites have been determined to be *eligible* for the NRHP by the agency with SHPO concurrence. Those nine sites must be avoided or a mitigation plan approved and implemented prior to any disturbance. There are a total of 70 sites currently considered *unevaluated* for the NRHP, which will require additional documentation, formal testing, or evaluation in order for the agency to make an eligibility determination and consult with SHPO. *Unevaluated* sites are given the same protections as *eligible* sites and are to be avoided until a determination of eligibility has been made. There are 95 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 literature and records reviews and Class III surveys of the West Jacobs Ranch LBA Tract and surrounding areas in 2006 and 2007. At this time, the only portion of the tract that does not meet current Class III standards is 480 acres within Section 16, T.44N., R.71W. That area was surveyed in 1980; however, BLM does not recognize surveys prior to 1985 as adequate, nor was the report ever reviewed by a federal agency or by SHPO. No federal decisions can be made based on such an old survey or report.

The literature and records review of the general analysis area for the West Jacobs Ranch LBA Tract identified 24 previously recorded, documented cultural sites, while 23 new cultural properties were identified during the Class III surveys. Of these 47 total sites, 22 are historic, 14 are prehistoric, one contains both historic and prehistoric components, and 10 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. Newly recorded sites include 11 historic sites, three prehistoric sites, and nine rock cairns of indeterminate age and cultural affiliation.

Eight of these 24 previously recorded cultural properties have not been reviewed and evaluated by the lead agency or SHPO in terms of their NRHP eligibility. All 24 of these *unevaluated* properties require further documentation or subsurface testing. Of the 24 previously recorded sites, 15 have been reviewed and determined *not eligible* for the NRHP by the agency with SHPO concurrence. There is one site within the tract's ¼-mile disturbance buffer zone considered *eligible* for the NRHP. Significance determinations for the newly recorded sites, all of which have been recommended *not eligible* by the contractor, will have to be made by the lead agency and SHPO consulted. All *unevaluated* sites and sites that have not received lead agency and SHPO review will be treated as if they are *eligible* for the NRHP.

3.12.1.3 North and South Porcupine LBA Tracts

Cultural resource inventories in this area began in the early 1980s 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 area for the North Porcupine LBA Tract has been previously surveyed for cultural resources at a Class III level. Approximately 58 acres of Class III inventory is still needed in the South Porcupine LBA Tract in Section 7, T.41N., R.70W., and Section 14, T.41N., R.71W.

A total of 66 cultural sites have been documented in the North Porcupine tract general analysis area. Of these, 36 are prehistoric, 20 are historic, and 10 are multi-component sites. Prehistoric sites consist primarily of lithic scatters, cairns, stone circles, 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 and will need to be carried out at others. A total of four prehistoric sites (campsites) and two of the multi-component sites have been determined *eligible* for the NRHP by SHPO. Two sites remain *unevaluated* for the NRHP including one prehistoric site that needs to be recorded to current standards. The other 58 sites have been determined *not eligible* for the NRHP and no further work is required at these sites.

A total of 46 cultural sites have been documented in the South Porcupine general analysis area. Of these, 30 are prehistoric, 14 are historic, and two are multi-component. Prehistoric sites consist primarily of lithic scatters and campsites. Historic sites consist primarily of homesteads and associated remains. Three sites have been determined to be *eligible* for the NRHP by the agency with SHPO concurrence. Those three sites must be avoided or a mitigation plan approved and implemented prior to any disturbance. Only one site is currently considered *unevaluated* for the NRHP, which will require additional documentation, formal testing, or evaluation in order for the agency to make an eligibility determination and consult with SHPO. The other 42 sites have been determined *not eligible* for the NRHP and no further work is required at these sites.

In summary, a total of 112 cultural sites have been documented in the general analysis areas for the North and South Porcupine LBA Tracts. All 112 sites were previously recorded and were identified during record searches that were conducted by PRC in 2008. However, approximately 58 acres of the South Porcupine LBA Tract still requires Class III inventory. Of the 112 cultural sites documented in the entire general analysis areas for the North and South Porcupine LBA Tracts, 66 are prehistoric, 34 are historic, and 12 are multi-component sites. A total of 17 homestead sites, all dating back to the early 1900s, are located within the general analysis areas for the North and South Porcupine LBA Tracts. Of the homestead sites, 12 are located within the general analysis area for the North Porcupine tract, four are located within the general analysis area for the South Porcupine tract, and portions of one homestead are located on both general analysis areas. Either BLM or OSM have reviewed the cultural resource inventories covering most of the general analysis areas for the North and South Porcupine LBA Tracts and have submitted the results to SHPO. SHPO has concurred with the recommendations finding nine sites (six in the North Porcupine tract general analysis area and three in the South Porcupine tract general analysis area) *eligible* for the NRHP. Three of the previously recorded sites are considered *unevaluated* for eligibility by the agency and those sites will require further work including historic documentation, updated site recording, and additional subsurface testing in order for the agency to make an eligibility determination and consult with SHPO. There are 100 sites that have been determined *not eligible* for the NRHP and no further work is required at these sites.

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 shall be protected from disturbance.

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 shall not 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.

<u>3.12.2.2 No Action Alternative</u>

Under the No Action Alternative for each of the LBA tracts, the coal lease application would be rejected and coal removal and the associated disturbance and impacts would not occur on the portions of the LBA tract as applied for or the LBA tract 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.

<u>3.12.3 Native American Consultation</u>

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 tracts 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

Literature and records reviews and Class 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 data 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 are destroyed by surface coal mining operations but, as a result of the intensive pedestrian inventories, site evaluations, and excavation and analysis of cultural resources discussed above, there is a more informed understanding of what types of past human activity exist in the region and a better understanding of local prehistory.

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 do not receive any further work after recordation is completed.

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.

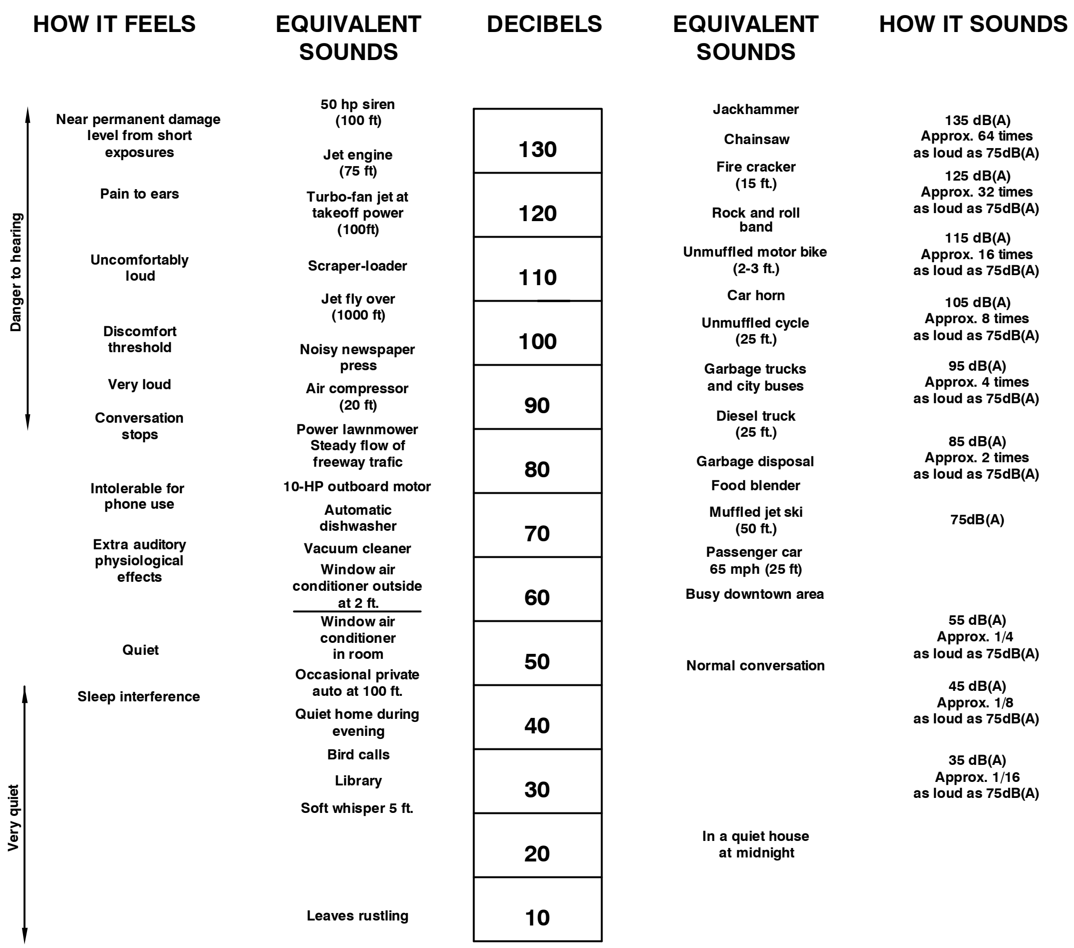
3.14 Noise

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



Adapted From ABC's of Our Noise Codes published by Citizens Against Noise, Honolulu, Hawaii

Figure 3-52. Relationship Between A-Scale Decibel Readings and Sounds of Daily Life.

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 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)

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)	Maximum Noise Level to Closest Dwelling (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]	3[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.

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:

- 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.

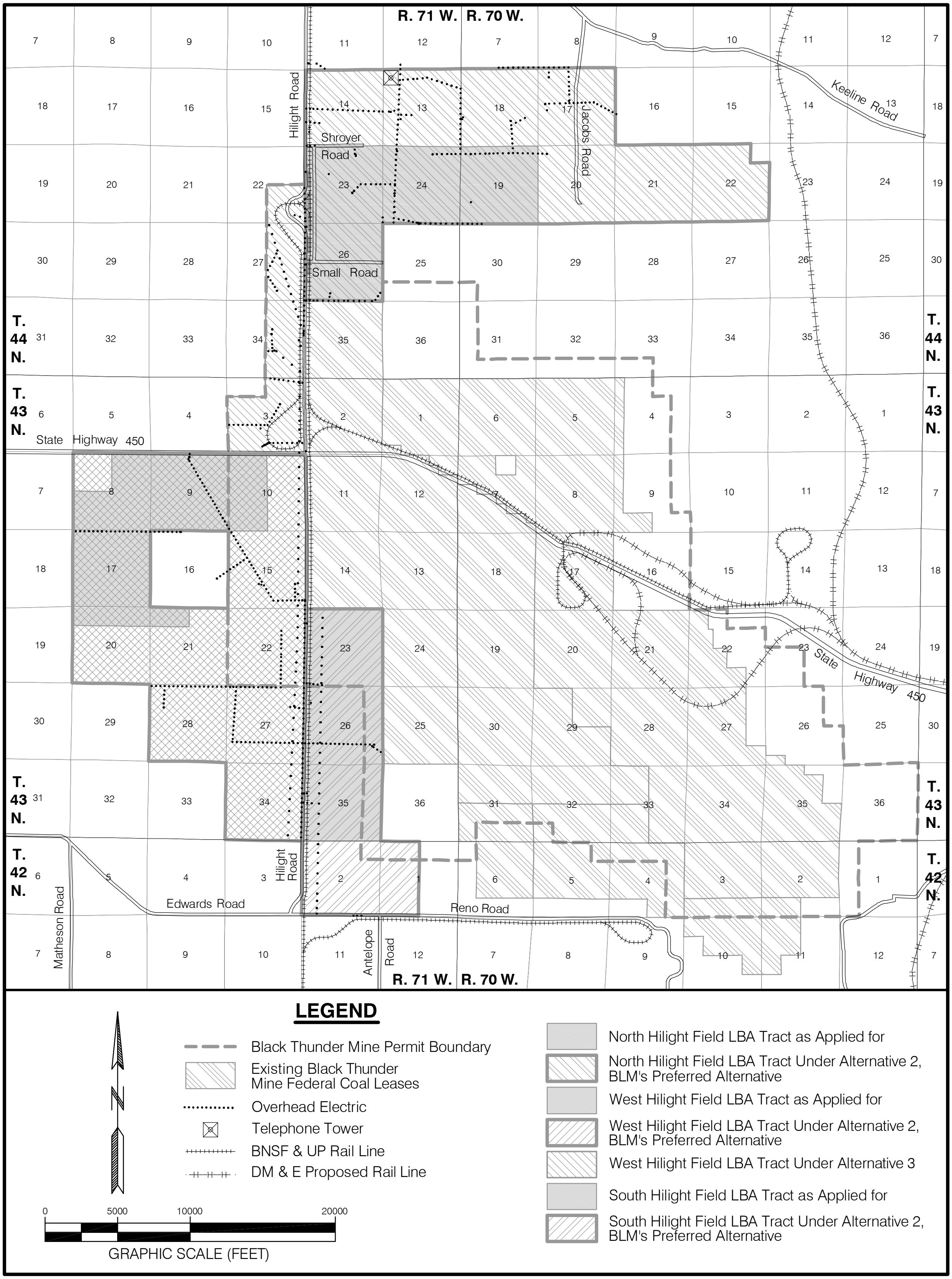


Figure 3-53. Transportation Facilities Within and Adjacent to the North, South, and West Hilight Field LBA Tracts.

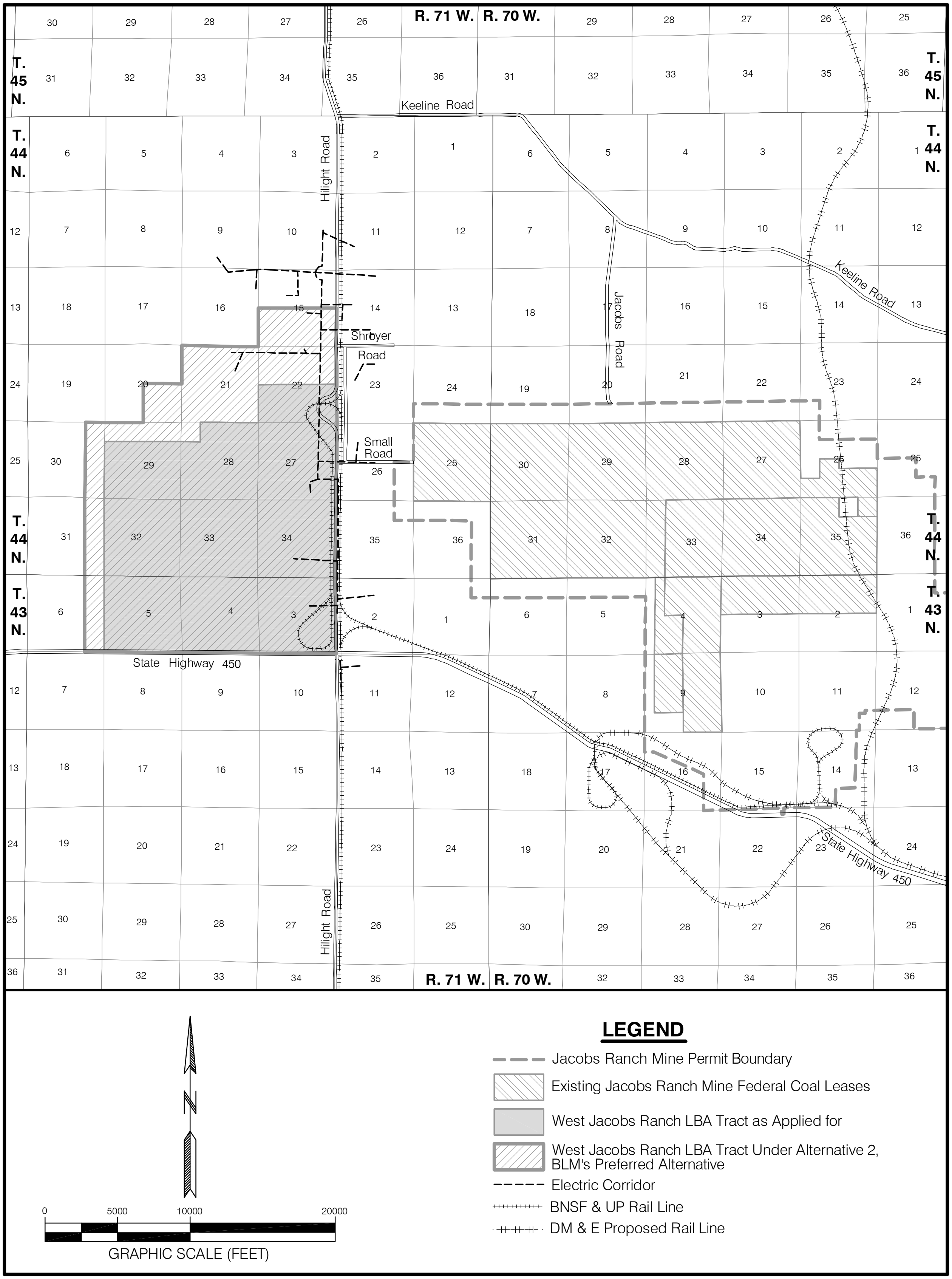


Figure 3-54. Transportation Facilities Within and Adjacent to the West Jacobs Ranch LBA Tract.

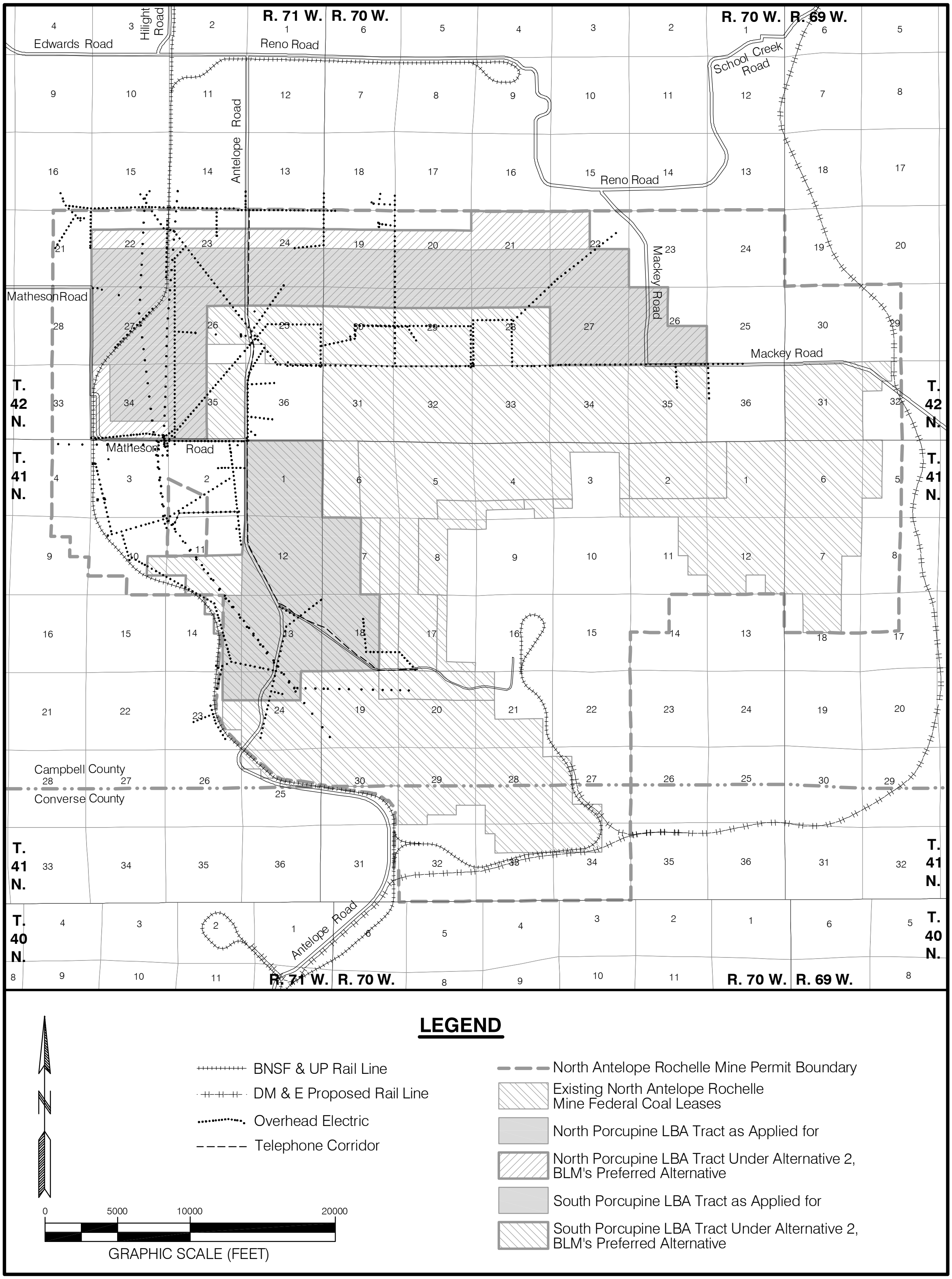


Figure 3-55. Transportation Facilities Within and Adjacent to the North and South Porcupine LBA Tracts.

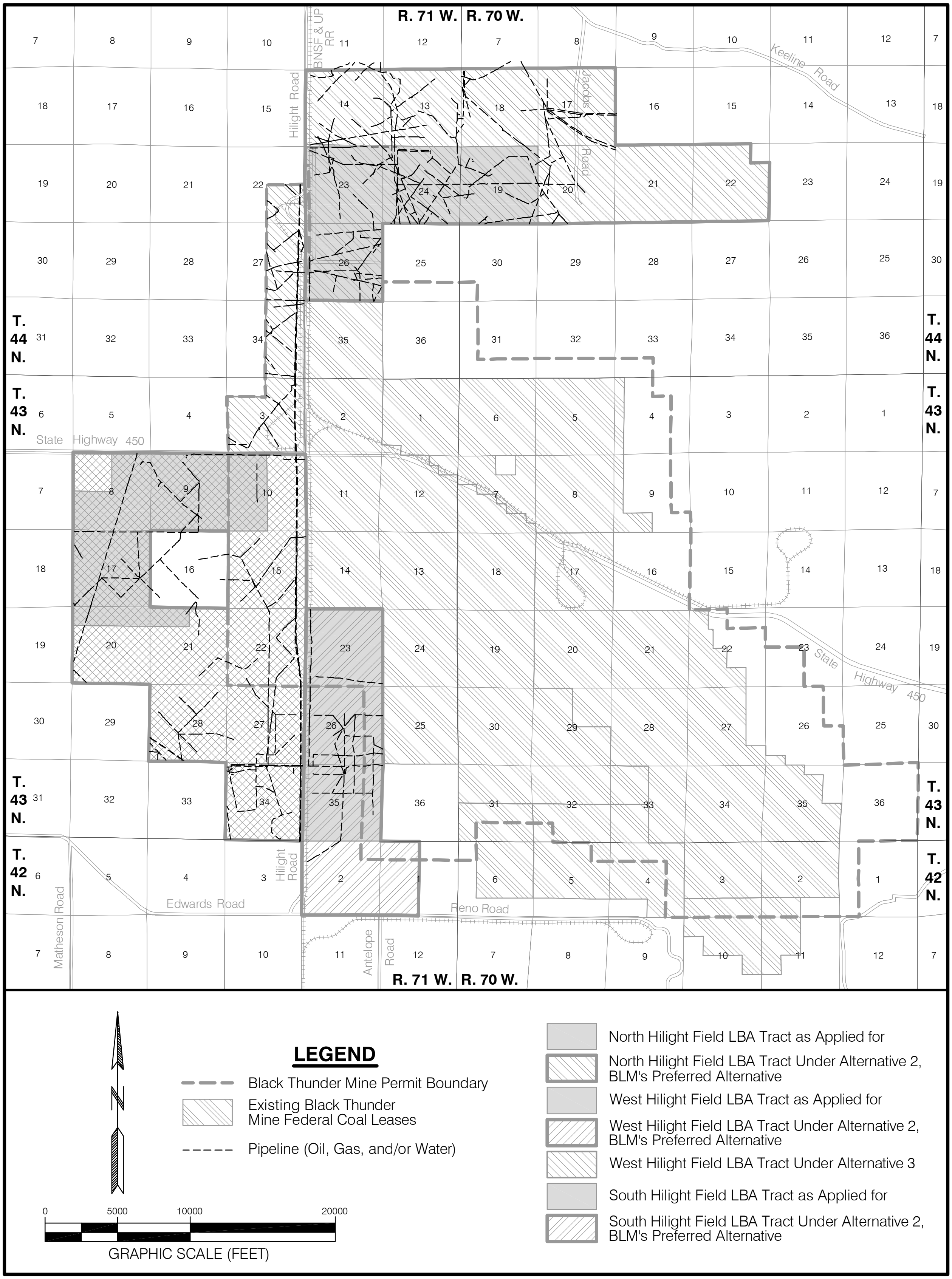


Figure 3-56. Pipelines Within and Adjacent to the North, South, and West Hilight Field LBA Tracts.

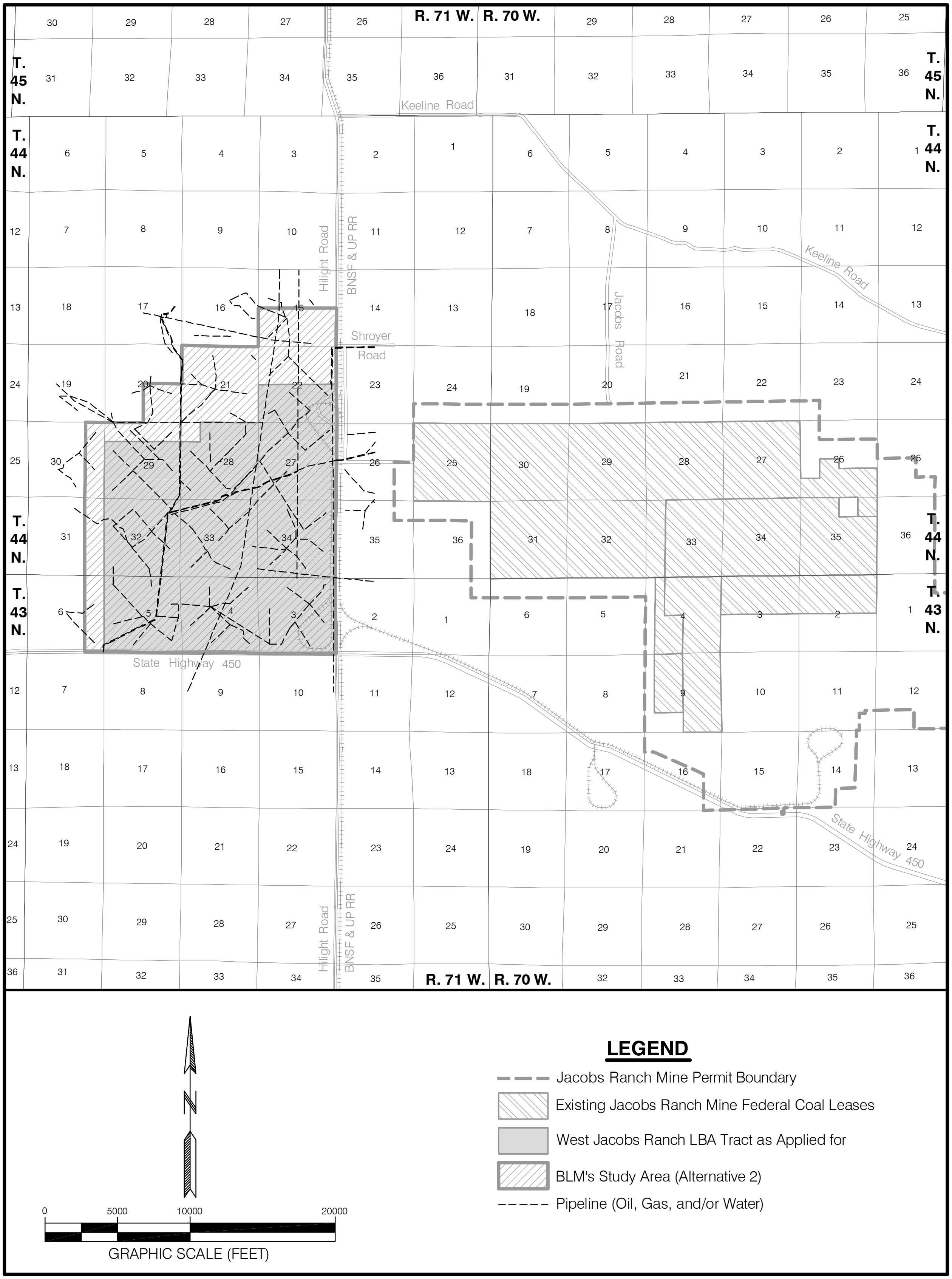


Figure 3-57. Pipelines Within and Adjacent to the West Jacobs Ranch LBA Tract.

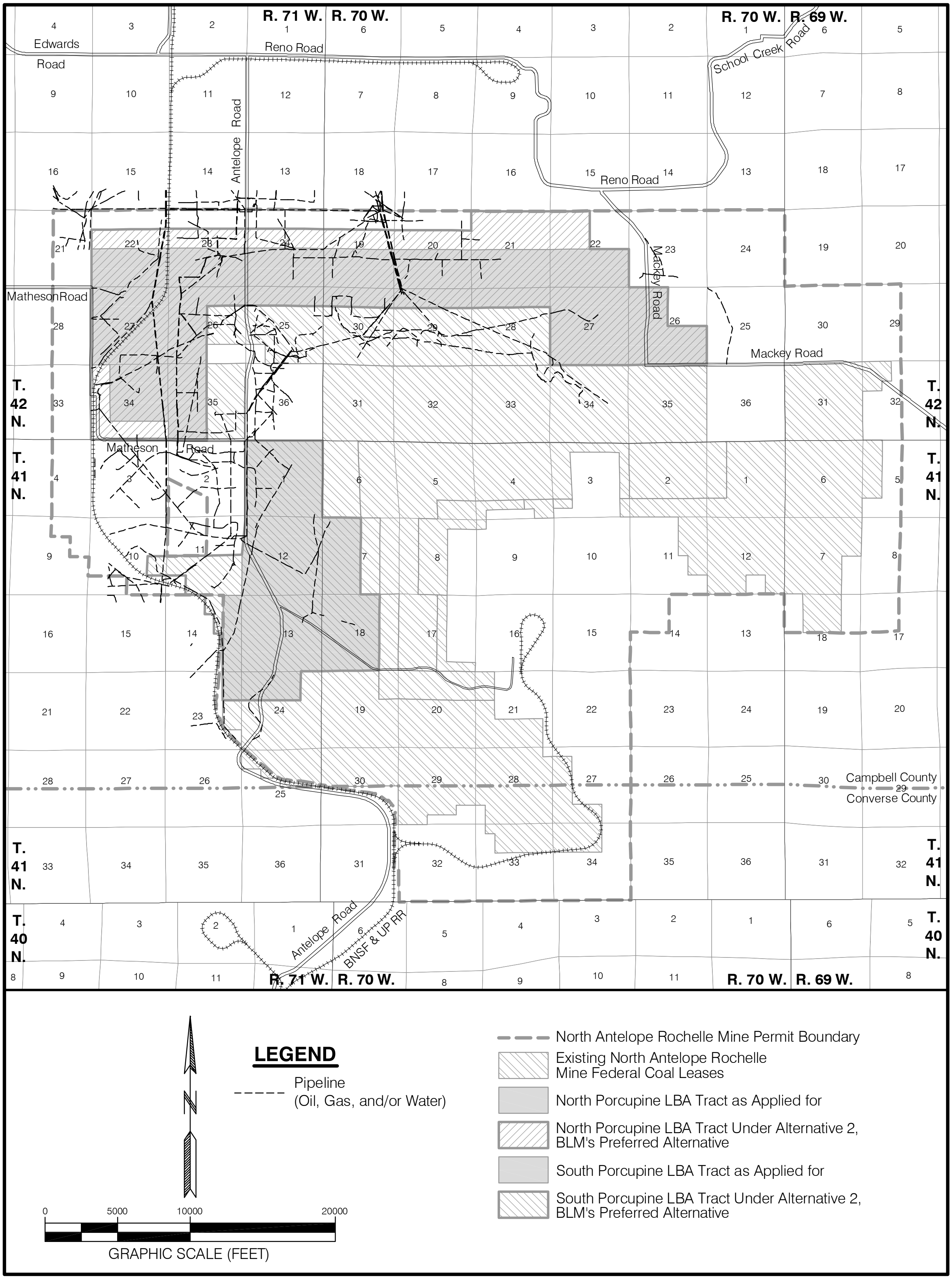


Figure 3-58. Pipelines Within and Adjacent to the North and South Porcupine LBA Tracts.

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 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 2007a). 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 2007a). 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 2007a).

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 2009a). 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, 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 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

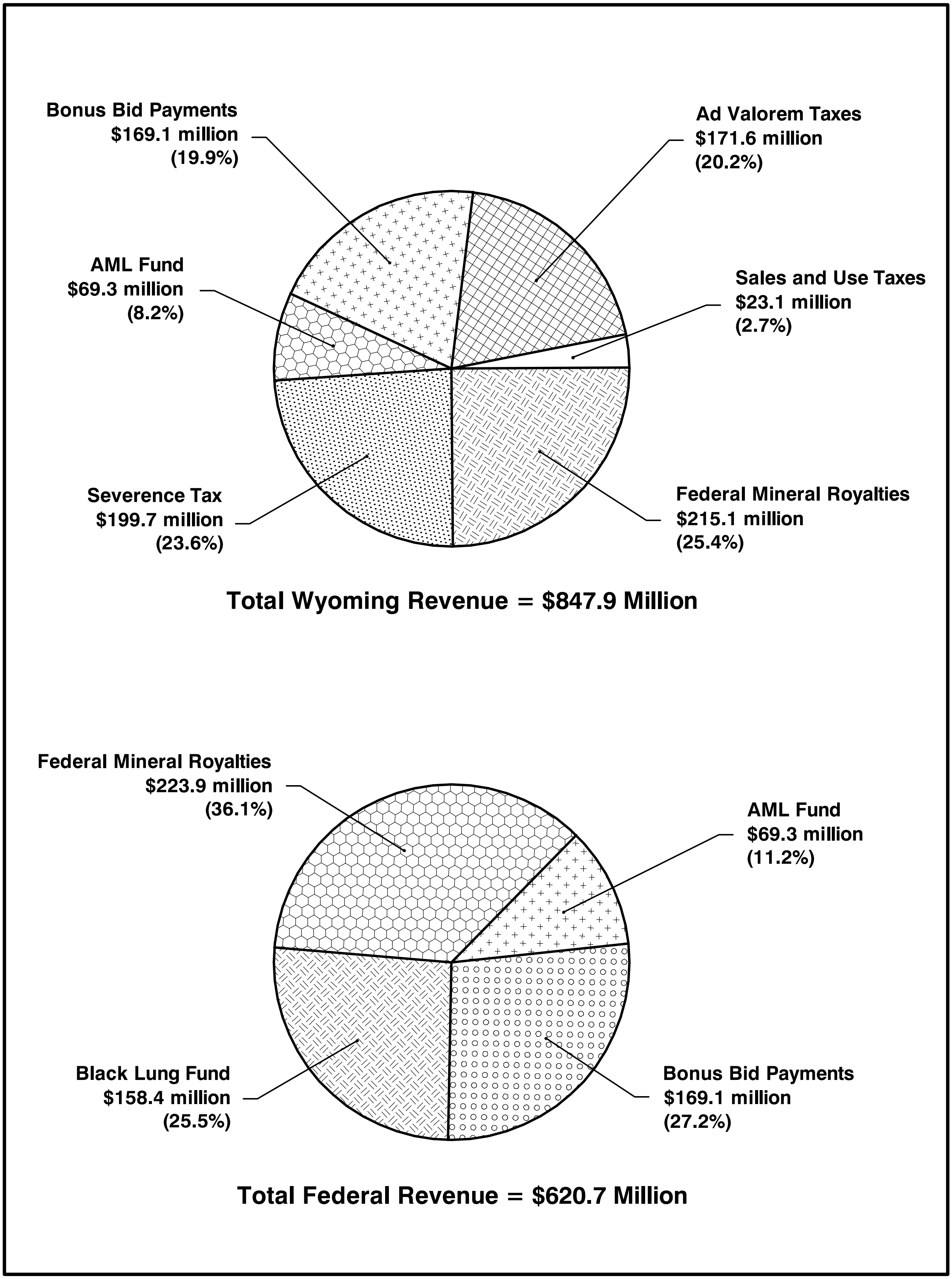


Figure 3-59. Estimated Wyoming and Federal Revenues from 2007 Coal Production in Campbell County.

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

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 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

Gillette city limits 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, TBCC 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, TBCC 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, TBCC 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 recently increasing global mean temperatures and whether a warming trend will continue. This section will address greenhouse gas (GHG) 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.

As discussed in Chapter 1, BLM does not authorize mining by issuing a lease for federal coal, but the impacts of mining the coal are considered in this EIS because it is a logical consequence of issuing a maintenance lease to an existing mine. WDEQ, with oversight from OSM, has regulatory authority in issuing permits to mine coal in Wyoming.

GHGs are an issue because of global warming and climate change. Global warming is a theory that certain gases in the atmosphere impede the radiation of heat from the earth back into space, trapping heat like the glass in a greenhouse. This raises the average temperature of the surface of the earth and the lower atmosphere, which contributes to climate change. Among these GHGs are carbon dioxide (CO_2), methane (CH_4), water vapor, ozone (O_3), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). GHGs are not currently regulated, but there is a consensus in the international community that the global climate change is occurring and that it should be addressed in governmental decision making. 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, so-called GHG emissions from the mining operations would be released into the atmosphere. A discussion of emissions and by-products that are generated by burning coal to produce electricity, and a more complete discussion of the global warming and climate change phenomena is included in Section 4.2.14 of this EIS.

The use of the coal after it is mined is not determined at the time of leasing; however, almost all of the coal that is currently being mined in the Wyoming PRB is being used by coal-fired power plants to generate electricity. 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 1,169.4 million tons of recoverable coal reserves in 9.3 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, TBCC anticipates that the mine would produce its remaining estimated 379.4 million tons of recoverable coal reserves in 9.6 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, TBCC 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, TBCC 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 933.8 million tons of recoverable coal reserves in 9.9 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 inventories included 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, which was not included in the emissions estimates for the three applicant mines due to a lack of information, is rail transport, both on-site and in moving coal to the buyers. Emissions are measured as metric tons (tonnes) of carbon dioxide equivalents (CO_2e). CO_2e is a unit of measure that takes into account the global warming potential of each emitted GHG in terms of equivalent CO_2 emissions. Using the functionally equivalent amount or concentration of CO_2 as the reference, a conversion is made to put any of the various gases emitted (i.e., CH_4 and N_2O) into the equivalent greenhouse effect.

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 increases 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 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 3-24) represents 2.22 percent of the 2010 state-wide CO_2e 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 CO_2e 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 WAC LBA tracts in Table 3-24 include projected methane emissions vented from exposed, unmined coal, given the applicant mines' anticipated annual production rates. Using the gas content data obtained by the USGS and WSO-RMG (2006) from coal cores that the agencies collected in the vicinity of the applicant mines, the amount of methane vented annually, expressed as CO_2e, was calculated to be approximately 761.57 tonnes per million tons of coal. Based on the 2007 combined coal production from the three applicant mines, the estimated annual methane emissions vented from exposed unmined coal at these mines was 164,347 tonnes (WWC 2009). The total methane emissions from all anthropogenic sources in the U.S. in 2007 was 722.7 million tonnes (USDOE 2009a); therefore, about 0.02 percent of that total was from exposed coal at these three mines. Based on the applicant mines' projected maximum future mining rates, the estimated contribution of CO_2e emissions from vented coal bed methane would be approximately 205,624 tonnes per year during the mining of the WAC LBA tracts, or about 8.2 percent of the estimated total annual CO_2e emissions that are expected to result from mining the LBA tracts.

Section 4.2.14 includes an assessment of cumulative impacts related to GHGs, and how the Action Alternatives considered in this EIS contribute.

3.18.2.1 Regulatory Compliance, Mitigation and Monitoring

In 2009, EPA issued the Mandatory Reporting of Greenhouse Gases Rule, which requires reporting of GHG emissions from large sources and suppliers in the U.S. The rule was signed by the Administrator on September 22, 2009, and it became effective December 29, 2009 (EPA 2010a). Under the rule, suppliers of fossil fuels or industrial greenhouse gases, manufacturers of vehicles and engines, and facilities that emit 25,000 tonnes or more per year of GHG emissions are required to submit annual reports to the EPA. EPA believes that the new reporting system will provide a better understanding of where GHGs are coming from and will guide development of the best possible policies and programs to reduce emissions.

The PRB mines are suppliers of fossil fuel and each emits more than 25,000 tonnes of GHGs per year. However, EPA did not finalize reporting requirements for coal suppliers with other source categories in the Final Rule, Subpart KK (EPA 2010b). The agency anticipates making these reporting requirements known by January 1, 2011 so that record keeping can begin and the first annual GHG emissions reports can be submitted in 2012. If a coal mine has general stationary fuel combustion units and the facility emits more than 25,000 tonnes CO_2e per year from stationary combustion, then the mine must report stationary combustion source emissions for calendar year 2010. The three applicant mines, with or without the WAC LBA tracts, do not approach this stationary source threshold. Therefore, it is anticipated that formal recording and reporting of GHG emissions for the PRB mines, including the three applicant mines, will commence in January 2011.

Control of GHG emissions is not required by permit at the PRB coal mines. However, the reduction of GHG emissions and management of carbon footprint at the mines is being implemented through the following measures:

- using new mining technologies and striving to continually improve the efficiency of each phase of the operation, from haul road design to seed planting at final reclamation;

- implementing new blasting technology to achieve the greatest efficiency in moving overburden and the highest degree of reducing emissions from the blasting agent;

- minimizing blast size to the extent possible and using the appropriate blend of blasting agents (i.e., ANFO slurries and gels) to match the overburden properties;

- reducing fuel consumption to the greatest extent possible by improving fuel efficiency, use of highly efficient engines, and restricting idling times; and

- suppressing in-pit coal fires promptly.

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.

4.0 CUMULATIVE ENVIRONMENTAL CONSEQUENCES

Cumulative impacts result from the incremental impacts of an action added to other past, present, and reasonably foreseeable future actions, regardless of who is responsible for such actions. Cumulative impacts can result from individually minor, but collectively significant, actions occurring over time.

This section summarizes the cumulative impacts that are occurring as a result of existing development in the Powder River Basin (PRB[1]) and considers how those impacts would change if other projected development in the area occurs and if the six lease by application (LBA) tracts in the general Wright analysis area are leased and mined.

BLM completed three regional Environmental Impact Statements (EISs) evaluating the potential cumulative impacts of surface coal development in the 1970s and early 1980s (BLM 1974, 1979, and 1981). A draft document for a fourth regional EIS was prepared and released in 1984 (BLM 1984). Since those regional EISs were prepared, BLM has prepared a number of NEPA (National Environmental Policy Act of 1969) analyses evaluating coal leasing actions and oil and gas development in the PRB. Each of these NEPA analyses includes an analysis of cumulative impacts in the Wyoming PRB.

Recently, the BLM completed a regional technical study, called the PRB Coal Review, to help evaluate the cumulative impacts of coal and other mineral development in the PRB. The PRB Coal Review consists of three tasks:

- Task 1 identifies existing resource conditions in the PRB for the baseline year (2003) and, for applicable resources, updates the BLM's 1996 status check for coal development in the PRB.

- Task 2 defines the past and present development activities in the PRB and their associated development levels as of 2003 and develops a forecast of reasonably foreseeable development in the PRB through 2020. The reasonably foreseeable activities fall into three broad categories: coal development (coal mine and coal-related), oil and gas development (conventional oil and gas, coal bed natural gas, and major transportation pipelines), and other development, which includes development that is not energy-related as well as other energy-related development.

- Task 3 predicts the cumulative impacts that could be expected to occur to air, water, socioeconomic, and other resources if the development occurs as projected in the forecast developed under Task 2.

A series of reports have been prepared to present the results of the PRB Coal Review task studies. The Task 1, 2, and 3 reports represent components of a technical study of cumulative development in the PRB; they do not evaluate

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

specific proposed projects, but they provide information that BLM is using to evaluate the cumulative impacts that would be expected to occur if specific projects or applications, such as the six LBA tracts in the general Wright analysis area, are approved. The Task 1 reports, which include air quality conditions, water resources conditions, social/economic conditions, and other environmental resource conditions, and the Task 2 Report have been completed. An update of the Task 2 Report is reflected in this document. The Task 3 reports for air quality conditions, social/economic conditions, and other resource conditions have been completed. The Task 3A Cumulative Air Quality Effects were included in the draft of this EIS to project air quality effects for 2015. After the draft of this EIS was issued, modeling of Cumulative Air Quality Effects for 2020 was completed (the Task 3A Supplemental Report) and the new data and analysis is reflected in this Final EIS. The groundwater impacts modeling portion of the Cumulative Water Effects (the Task 3B Report) was recently completed and is also reflected in this document along with the cumulative surface water effects. The information in these reports is summarized later in this chapter, and the completed reports are available for viewing at the BLM offices in Casper and Cheyenne and on the Wyoming BLM website at http://www.blm.gov/wy/st/en/programs/energy/Coal_Resources/PRB_Coal/prbdocs.html.

The PRB includes portions of northeastern Wyoming and southeastern Montana. The Wyoming portion of the PRB is the primary focus of the PRB Coal Review reports. The Montana portion of the PRB is included in the Task 2 Report and in the Task 1 and 3 air resources studies. For the majority of resources in the Task 1 reports and for the Task 2 Report, the Wyoming portion of the PRB Coal Review study area encompasses all of Campbell County, all of Sheridan and Johnson counties outside of the Bighorn National Forest, and the northern portion of Converse County (Figure 4-1). For some components of the Task 2 Report and for the Task 1 and 3 air resource studies, the Montana PRB Coal Review study area includes portions of Big Horn, Custer, Powder River, Rosebud, and Treasure counties. For several resources, the Task 1 and Task 3 study areas include only potentially affected portions of the Wyoming PRB Coal Review study area; for other resources, the study area extends outside of Wyoming and Montana because the impacts would extend beyond the PRB. For example, the groundwater drawdown is evaluated in the area surrounding and extending west of the mines, because that is the area where surface coal mining operations and coal bed natural gas (CBNG) production operations would impact groundwater resources; but air quality impacts are evaluated over a multi-state area because they would be expected to extend beyond the PRB.

Section 4.1 summarizes the information presented in the PRB Coal Review Task 1 and Task 2 reports. Section 4.2 summarizes the predicted cumulative impacts to air, water, socioeconomic, and other resources presented in the PRB Coal Review Task 3 reports.

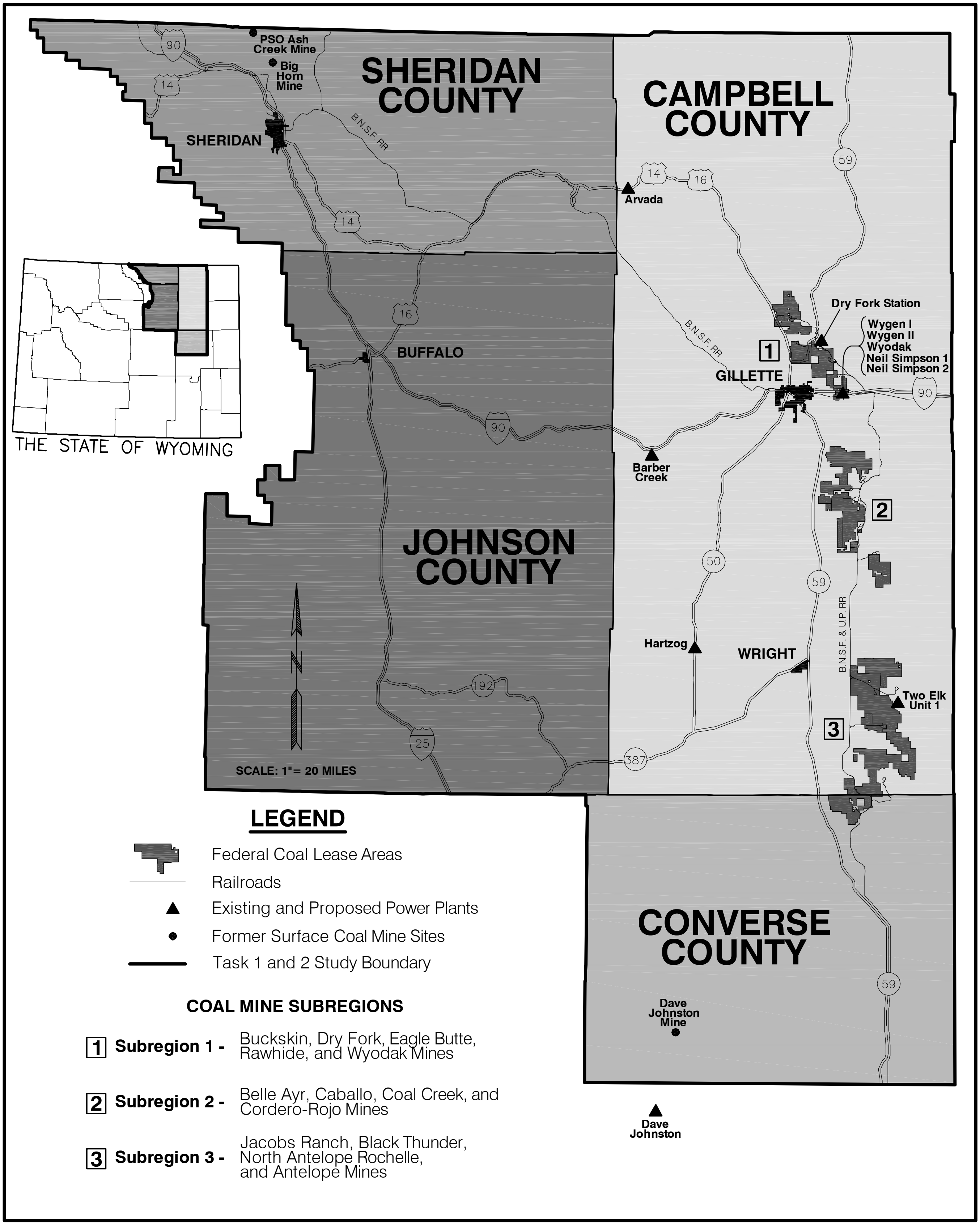


Figure 4-1. Wyoming Study Area for PRB Coal Review Evaluating Current and Projected Levels of Development.

4.1 Past, Present, and Reasonably Foreseeable Development

Past, present, and reasonably foreseeable development in the Wyoming PRB are considered in the Task 1 and Task 2 reports for the PRB Coal Review. The Task 1 reports describe the existing situation as of the end of 2003, which reflects the past and present levels of development. The Task 2 Report defines the past and present development activities in the PRB as of the end of 2003 and projects reasonably foreseeable development in the Wyoming PRB through 2020. Task 2 was updated based on actual levels of development through 2007, and current development estimates available through year 2009 (BLM 2009b).

4.1.1 Coal Development

4.1.1.1 Coal Mine Development

The Powder River Federal Coal Region was decertified as a federal coal production region by the Powder River Regional Coal Team (PRRCT) in 1990. Decertification of the region allows leasing to take place on an application basis, as discussed in the regulations at 43 CFR 3425.1-5. Between 1990 and January 2009, the BLM's Wyoming State Office held 25 competitive coal lease sales and issued 20 new federal coal leases containing almost 5.8 billion tons of coal using the LBA process. The lease sales are listed in Table 1-1, and the leased tracts are shown in Figure 1-1. This leasing process has undergone the scrutiny of two appeals to the Interior Board of Land Appeals (IBLA) and one audit by the General Accounting Office (GAO). As can be seen in Figure 4-2, leasing activity has generally paralleled production since decertification. This is consistent with the PRRCT's objective at the time of decertification, which was to use the LBA process to lease tracts of federal coal to maintain production at existing mines.

The pending applications in the Wyoming PRB are shown in Table 1-2.

BLM has also completed three exchanges involving federal coal resources in the Wyoming PRB since decertification:

- Belco Exchange – an exchange of lease rights for a portion of the former Hay Creek federal coal tract for lease rights to coal near Buffalo, Wyoming, which became unmineable when Interstate 90 was constructed. This exchange was authorized by Public Law 95-554 and completed in 2000.

- Pittsburg and Midway Coal Mining Company (P&M) Exchange – an exchange of federal coal in Sheridan County, Wyoming, for land and mineral rights in Lincoln, Carbon, and Sheridan counties, Wyoming, completed in 2004.

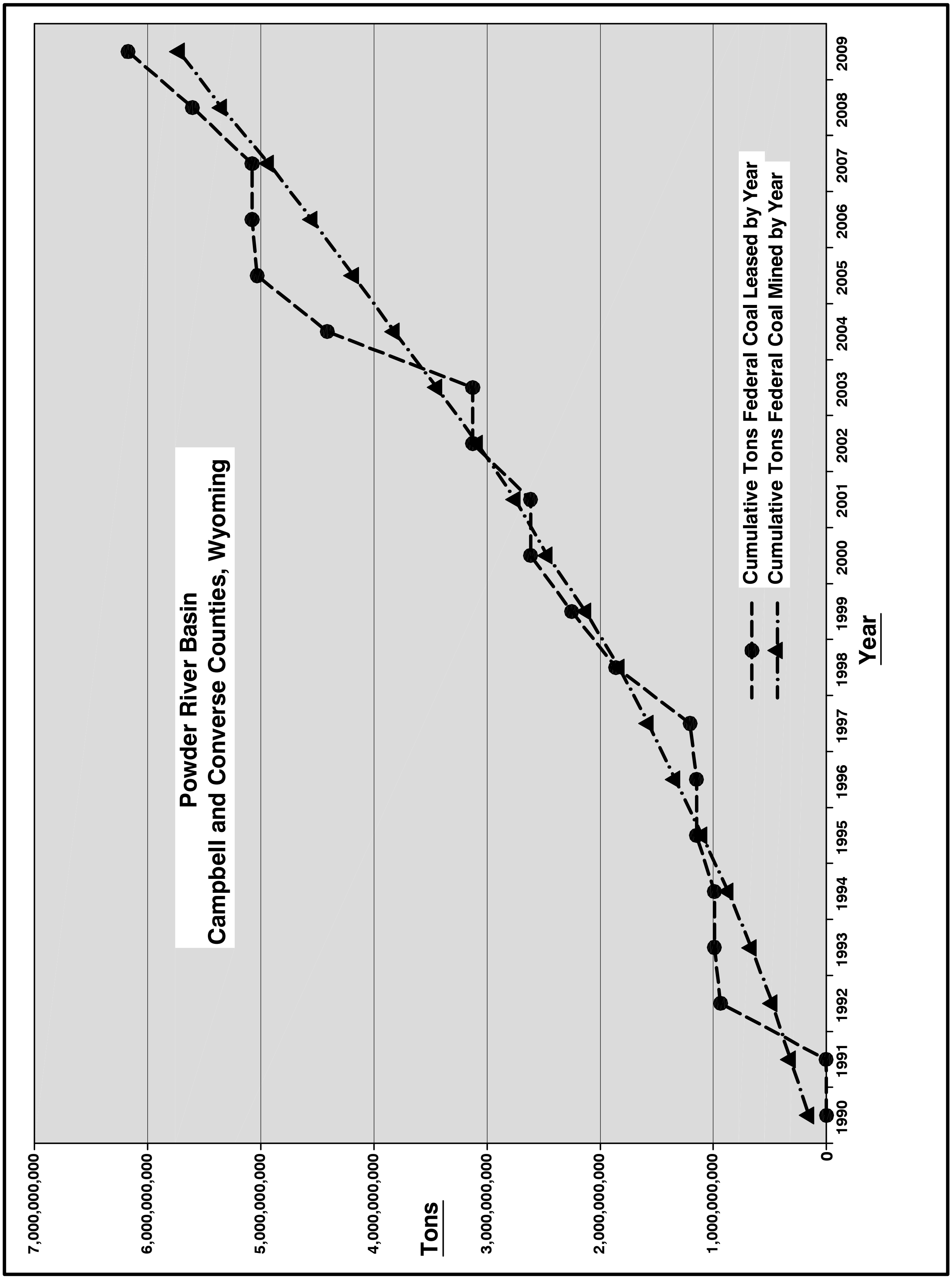


Figure 4-2. Tons of Federal Coal Leased Versus Tons of Federal Coal Mined Since 1990.

- Powder River Coal Company AVF Exchange – an exchange of lease rights underlying an AVF at the Caballo Mine, which cannot be mined, for lease rights of equal value adjacent to existing federal leases at Powder River Coal Company's North Antelope Rochelle Mine, completed in 2006.

Table 4-1 provides information about the status, ownership and production levels for the existing surface coal mines in the Wyoming PRB in 2003 and their status as of 2007. In 2003, which was the baseline year for the PRB Coal Review Task 1 and Task 2 studies, there were 12 active surface coal mines and one inactive mine. Since 2003, the inactive mine (Coal Creek) has resumed operations and the North Rochelle Mine has been incorporated into the Black Thunder Mine following its purchase by the operator of the Black Thunder Mine. The North Rochelle Mine leases were divided between Black Thunder and North Antelope Rochelle Mine in 2006. Peabody has deferred startup of their new mine, the School Creek Mine, which is located between the Black Thunder and North Antelope Rochelle mines, until at least late 2010, or later. These mines are all located in Campbell and Converse counties, just west of the outcrop of the Wyodak coal, where the coal is at the shallowest depth (Figure 1-1). As indicated in Table 4-1, there have been numerous changes in mine ownership since decertification, which have resulted in mine consolidations and mine closings within the PRB.

Two recently active surface coal mines (the Big Horn Coal Mine in northern Sheridan County and the Dave Johnston Mine in southern Converse County) in the PRB have ended mining operations, relinquished their federal coal leases, and reclaimed areas of disturbance. The lands within the Dave Johnston Mine permit boundary are owned by PacifiCorp. PacifiCorp requested a change in post mining land use from livestock/wildlife grazing to industrial for the areas that would be affected by a wind energy project right-of-way. Some of the area was on full reclamation bond release and some area included was on pre-law lands. Wyoming Department of Environmental Quality/Land Quality Division (WDEQ/LQD) approved this change of land use in three stages between September of 2007 and May of 2008. The Glenrock Wind Energy Project is sited at the reclaimed surface coal mine and it began operations in late 2008 and early 2009.

There are existing permits for other surface coal mining-related operations in the PRB. These include the Ash Creek and Welch Mine permits in Sheridan County and the Izita Mine permit in Campbell County. Operations at these sites are completed and the disturbed areas have been reclaimed, but monitoring of the reclaimed areas is no longer ongoing. The KFx Mine, located north of Gillette on privately owned coal, has stopped mining coal for processing at the KFx coal enhancement plant, which is discussed in Section 4.1.1.2.4. The Fort Union plant was idled down in March 2008, until further notice.

The active mines in the Wyoming PRB are geographically grouped into three subregions (Figure 4-1). For purposes of this cumulative impact discussion,

Table 4-1. Status and Ownership of Wyoming PRB Coal Mines for 2003, the PRB Coal Review Baseline Year, and for 2007.

2003 Mine	1994 Mine Owner	2007 Mine Owner	2007 Coal Production (mm Tons)[1]	Permitted Production Level (mm Tons)[2]	Status and Additional Comments
SUBREGION 1 (North Gillette)					
Buckskin	SMC (Zeigler)	Kiewit Mining Properties	25.3	42.0	Active
Dry Fork	Phillips/WFA & Fort Union Ltd	WFA	5.3	15.0	Active (includes former Fort Union Mine)
Eagle Butte	Cyprus-Amax	Foundation Coal West	25.0	35.0	Active
Rawhide	Carter (Exxon)	Peabody Holding Co.	17.1	24.0	Active
Wyodak	Wyodak Resources	Wyodak Resources	5.0	12.0	Active (includes former Clovis Point Mine)
Total			**77.7**	**128.0**	
SUBREGION 2 (South Gillette)					
Belle Ayr	Cyprus-Amax	Foundation Coal West	26.6	45.0	Active
Caballo	Carter (Exxon) & Western Energy	Peabody Holding Co.	31.2	50.0	Active (includes Rocky Butte and West Rocky Butte leases)
Cordero Rojo	Kennecott & Drummond	Rio Tinto Energy America[3]	40.5	65.0	Active (consolidation of former Cordero and Caballo Rojo Mines)
Coal Creek	ARCO	Arch Coal Inc.	10.2	25.0	Inactive in 2003, operations resumed in 2006
Total			**108.5**	**185.0**	
SUBREGION 3 (Wright)					
Antelope	Kennecott	Rio Tinto Energy America[3]	34.5	36.0	Active
Black Thunder	ARCO	Arch Coal Inc.	65.3	100.0	Active
Jacobs Ranch	Kerr-McGee	Rio Tinto Energy America[3]	38.1	55.0	Active
North Antelope Rochelle	Peabody	Peabody Holding Co.	91.5	99.0	Active (consolidation of former North Antelope and Rochelle Mines)
North Rochelle	SMC (Zeigler)	Arch Coal Inc.	20.9	35.0	Inactive since 2005, leases split between Black Thunder and North Antelope Rochelle Mines
Total			**250.3**	**325.0**	
TOTAL FOR 3 MINE GROUPS			**436.5**	**638.0**	

1 Wyoming State Inspector of Mines (2007a) and Shamley (2008)
2 WDEQ 2007 permitting levels (Shamley 2008)
3 Kennecott Energy Company changed its name to Rio Tinto Energy America in 2006.

these subregions are called the North Gillette, South Gillette, and Wright subregions. Table 4-1 lists the mines included in each subregion.

A fourth subregion includes former and proposed mines in Sheridan County and existing mines just north of Sheridan County, in Montana. There are currently no active mines in the Wyoming portion of the fourth subregion. However, the PRB Coal Review Task 2 Report projected that a new mine would be developed near Sheridan by 2010. In April, 2007, P&M and CONSOL Energy Inc. announced that they have formed a new company, Youngs Creek Mining Company, LLC, and entered into a joint agreement to develop a new mine in Wyoming north of Sheridan (Reuters 2007). According to the announcement, engineering, environmental and permitting work are in progress, but actual mine construction will not start until the joint venture has enough coal sales under contract to justify the investment. The coal reserves included in this project are all privately owned.

The surface coal mines listed in Table 4-1 currently produce over 96 percent of the coal produced in Wyoming each year. Since 1989, coal production in the PRB has increased by an average of 6 percent per year. The increasing production is primarily due to increasing sales of low-sulfur, low-cost PRB coal to electric utilities who must comply with the Phase I requirements of Title III of the 1990 Clean Air Act Amendments. Electric utilities account for 97 percent of Wyoming's coal sales. In 2009, production from the Wyoming PRB coal mines dropped by about 7 percent from the 2008 levels, the first drop since the early 1900s. This drop coincided with a national coal production decline due to reduced industrial electric demand in 2009.

In 2003 (the baseline year for the PRB Coal Review), more than 35 percent of the coal mined in the United States came from the Wyoming PRB. By 2007, about 38 percent of the coal mined in the United States came from the Wyoming PRB (USDOE 2009a), and according to the U.S. Department of Energy (USDOE), over 38 percent of the coal mined in the United States came from the Wyoming PRB by 2009.

BLM estimates that the surface coal mines listed in Table 4-1 currently have about 125,180 acres of federal coal leased in Campbell and Converse counties. This represents approximately 4.1 percent of Campbell County, where the majority of the leases are located.

Task 2 of the PRB Coal Review projected coal development into the future for the years 2010, 2015, and 2020. Due to the variables associated with future coal production, two projected coal production scenarios (representing an upper and a lower production level) were developed to bracket the most likely foreseeable regional coal production level. The basis for the projected production levels included:

1) an analysis of historic PRB production levels in comparison to the gross domestic product and national coal demand;

2) an analysis of PRB coal market forecasts that model the impact of gross domestic product growth, potential regulatory changes affecting coal-fired power plants, and mining and transportation costs on PRB coal demand;

3) the availability, projected production cost, and quality of future mine-specific coal reserves within the PRB region; and

4) the availability of adequate infrastructure for coal transportation.

The projected upper and lower production levels subsequently were allocated to the Wyoming PRB subregions, discussed above, and to individual mines based on past market shares. Individual mine production levels were reviewed relative to potential future production constraints (e.g., loadout capacities), permitted production levels, mining costs, and coal quality. Then the projected future production was aggregated on a subregion basis. The actual 2003 and 2005 production levels and the two projected coal production scenarios for those years are shown on Figure 4-3. The two projected production levels for 2010, 2015, and 2020 are shown on Figure 4-3 and in Tables 4-2 and 4-3. The actual 2007 and 2008 production levels are also shown on Figure 4-3 as a reference.

Tables 4-2 and 4-3 show the cumulative coal mining disturbance as of the baseline year and the cumulative coal mine disturbance projected for the future years for the upper and lower coal production scenarios. In these tables, the baseline year (2003), actual values as of 2007, and cumulative projected disturbance areas for 2010, 2015 and 2020 are broken down into three categories:

- areas which are or projected to be permanently reclaimed;

- areas which are or projected to be undergoing active mining or which have been mined but are not yet reclaimed; and,

- areas which are or projected to be occupied by mine facilities, haul roads, stockpiles, and other long-term structures, and which are therefore unavailable for reclamation until mining operations are completed.

Tables 4-2 and 4-3 also include estimates of baseline year and projected future coal mining employment, water consumption, and water production.

The six LBA tracts in the general Wright analysis area are associated with three of the four currently operating mines (Jacobs Ranch, Black Thunder, North Antelope Rochelle, and Antelope) in the southern-most group of mines in the eastern PRB (Figure 1-1). This group of mines is referred to as the Wright Subregion or Subregion 3 in the PRB Coal Review. Each of these four operating mines has a least one LBA pending (Table 1-2). The analysis

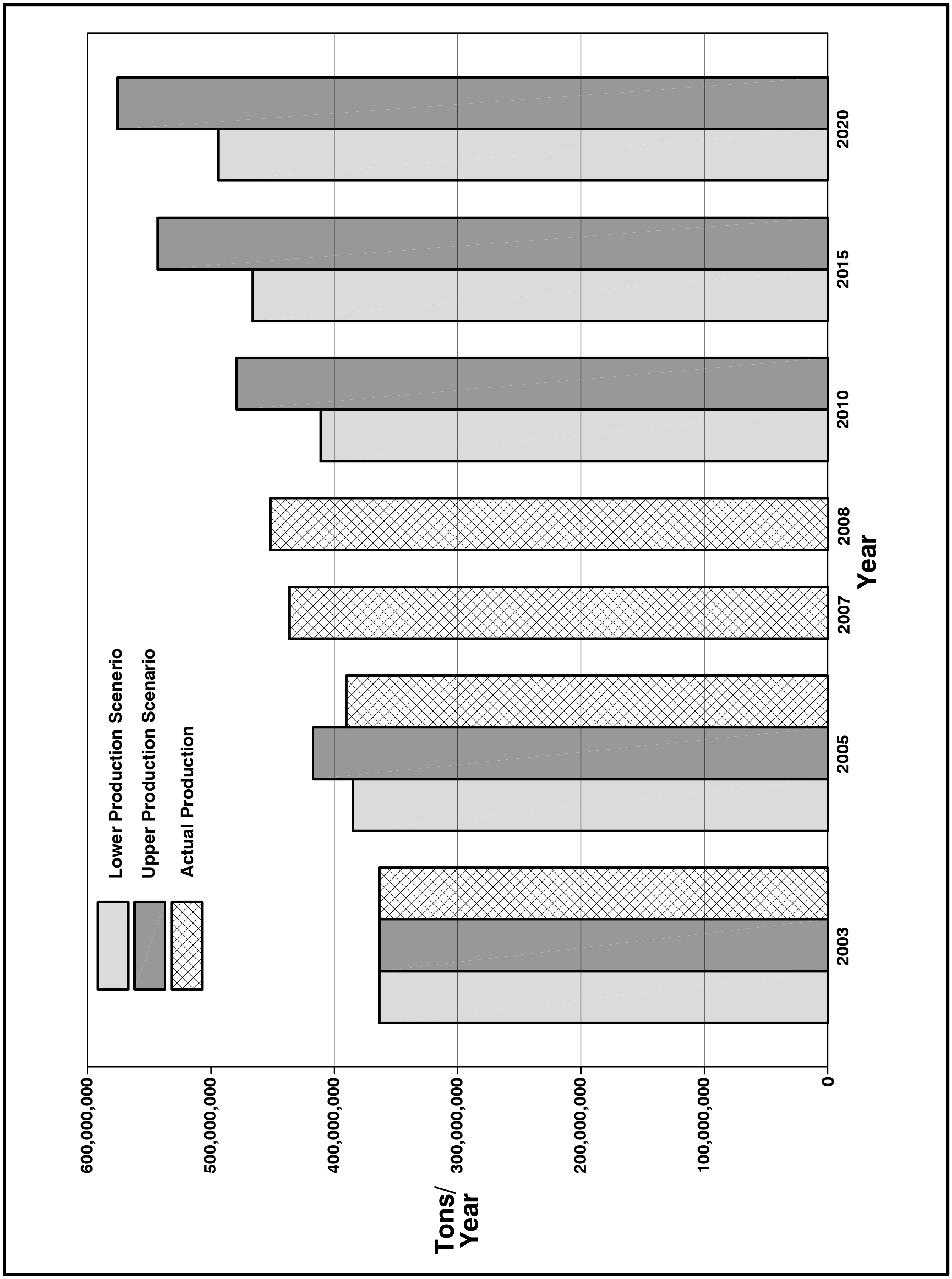


Figure 4-3. Projected and Actual Total Coal Production from Campbell and Converse Counties Under the Lower and Upper Production Scenarios.

Table 4-2. Actual and Projected Wyoming PRB Coal Mine Development, Lower Coal Production Scenario.

Subregion	Annual Production (million tons)	Cumulative Disturbed Area (acres)	Cumulative Permanently Reclaimed Area (acres)	Cumulative Active Mining Area and Unreclaimed Mined Area (acres)	Cumulative Area Disturbed and Unavailable for Reclamation[1] (acres)	Total Mine Employment	Annual Water Consumption (mmgpy)	Annual Water Production (acre-ft)
Original Baseline Year (2003)								
North Gillette Subregion	55	12,047	3,054	3,360	5,633	746	387	191
South Gillette Subregion	77	21,249	6,783	6,107	8,359	861	544	447
Wright Subregion	232	35,498	11,401	13,992	10,105	3,090	1,709	748
Total for 2003	**364**	**68,794**	**21,238**	**23,459**	**24,097**	**4,697**	**2,640**	**1,386**
Actual 2007								
North Gillette Subregion	78	14,421	3,658	8,342	5,781	1,032	351	191
South Gillette Subregion	100	23,630	6,441	12,353	9,273	1,424	544	447
Wright Subregion	250	45,542	15,785	31,577	11,941	3,077	1,709	748
Total for 2007	**428**	**83,593**	**25,884**	**52,272**	**24,338**	**5,533**	**2,604**	**1,386**
Reasonably Foreseeable Development for 2010								
North Gillette Subregion	62	15,231	5,004	3,968	6,260	787	628	165
South Gillette Subregion	95	28,021	12,183	6,830	9,008	1,323	50	675
Wright Subregion	254	55,410	27,751	16,588	11,070	3,153	1,115	1,419
Total for 2010	**411**	**98,662**	**44,938**	**27,386**	**26,338**	**5,263**	**1,793**	**2,258**
Reasonably Foreseeable Development for 2015								
North Gillette Subregion	74	17,457	6,654	4,202	6,601	830	724	165
South Gillette Subregion	112	32,356	15,683	7,314	9,359	1,369	458	675
Wright Subregion	281	67,423	38,851	16,983	11,589	3,186	1,277	1,419
Total for 2015	**467**	**117,236**	**61,188**	**28,499**	**27,549**	**5,405**	**2,059**	**2,258**
Reasonably Foreseeable Development for 2020								
North Gillette Subregion	78	19,729	8,429	4,350	6,950	840	456	165
South Gillette Subregion	126	36,994	19,683	7,589	9,723	1,476	72	675
Wright Subregion	291	80,720	51,351	17,243	12,124	3,215	1,334	1,419
Total for 2020	**495**	**137,443**	**79,463**	**29,182**	**28,797**	**5,531**	**2,162**	**2,258**

[1] Area unavailable for reclamation includes disturbed areas occupied by permanent or long-term facilities such as buildings, roads, topsoil stockpiles, etc.
Source: PRB Coal Review Task 2 Update Report (BLM 2009b)

Table 4-3. Actual and Projected Wyoming PRB Coal Mine Development, Upper Coal Production Scenario.

Subregion	Annual Production (million tons)	Cumulative Disturbed Area (acres)	Cumulative Permanently Reclaimed Area (acres)	Cumulative Active Mining Area and Unreclaimed Mined Area (acres)	Cumulative Area Disturbed and Unavailable for Reclamation[1] (acres)	Total Mine Employment	Annual Water Consumption (mmgpy)	Annual Water Production (acre-ft)
Original Baseline Year (2003)								
North Gillette Subregion	55	12,047	3,054	3,360	5,633	746	387	191
South Gillette Subregion	77	21,249	6,783	6,107	8,359	861	544	447
Wright Subregion	232	35,498	11,401	13,992	10,105	3,090	1,709	748
Total for 2003	**364**	**68,794**	**21,238**	**23,459**	**24,097**	**4,697**	**2,640**	**1,386**
Actual 2007								
North Gillette Subregion	78	14,421	3,658	8,342	5,781	1,032	351	191
South Gillette Subregion	100	23,630	6,441	12,353	9,273	1,424	544	447
Wright Subregion	250	45,542	15,785	31,577	11,941	3,077	1,709	748
Total for 2007	**428**	**83,593**	**25,884**	**52,272**	**24,338**	**5,533**	**2,604**	**1,386**
Reasonably Foreseeable Development for 2010								
North Gillette Subregion	78	15,911	5,404	4,217	6,290	811	788	165
South Gillette Subregion	117	29,279	13,416	7,536	8,328	1,375	58	675
Wright Subregion	284	57,258	27,951	18,236	11,070	3,153	1,184	1,419
Total for 2010	**479**	**102,448**	**46,771**	**29,989**	**25,688**	**5,339**	**2,030**	**2,258**
Reasonably Foreseeable Development for 2015								
North Gillette Subregion	104	18,490	7,329	4,500	6,660	905	492	165
South Gillette Subregion	138	35,624	18,616	8,248	8,760	1,431	75	675
Wright Subregion	301	70,431	39,451	19,391	11,589	3,186	1,333	1,419
Total for 2015	**543**	**124,545**	**65,396**	**32,139**	**27,009**	**5,522**	**1,897**	**2,258**
Reasonably Foreseeable Development for 2020								
North Gillette Subregion	121	21,311	9,529	4,766	7,013	1,019	880	165
South Gillette Subregion	148	42,981	25,016	8,758	9,206	1,444	86	675
Wright Subregion	307	84,797	51,651	21,021	12,124	3,215	1,437	1,419
Total for 2020	**576**	**149,089**	**86,196**	**34,545**	**28,345**	**5,678**	**2,403**	**2,258**

[1] Area unavailable for reclamation includes disturbed areas occupied by permanent or long-term facilities such as buildings, roads, topsoil stockpiles, etc.
Source: PRB Coal Review Task 2 Update Report (BLM 2009b)

assumes that if the LBAs are offered and if the applicant becomes the lessee, each mine will increase current production to a level where the four mines collectively will produce at an aggregate production level midway between the low and high projected coal production scenarios for 2015 and 2020 shown on Figure 4-3 and in Tables 4-2 and 4-3. The coal development levels and associated disturbance shown in Tables 4-2 and 4-3 include production at the four Wright area mines during the baseline year (2003) and projected production at the mines for 2010, 2015, and 2020.

As discussed above, the projected development levels shown in Tables 4-2 and 4-3 are based on projected demand and coal market forecasts, which are not affected by a decision to lease or not to lease the six LBA tracts in the general Wright analysis area. The reserves in these six LBA tracts, if offered, and if the applicants become the lessees, would add to the mine life of each of the three Wright Area Coal (WAC) mines.

As discussed in Sections 1.1 and 2.1, Ark Land Company (ALC) estimates that there were 1,169.4 million tons of recoverable coal reserves on the existing Black Thunder Mine at the end of 2008. In 2008, the mine produced approximately 67.4 million tons and the currently approved (by Wyoming Department of Environmental Quality/Air Quality Division) air quality permit allows mining of up to 135 million tons of coal per year (mmtpy). If the mine produces at the estimated average of 135 mmtpy, the remaining recoverable reserves would be depleted in about 9 years (by 2017). ALC estimates that the North Hilight Field LBA Tract includes approximately 263.4 million tons of recoverable coal as applied for. Based on that estimate, acquisition of the North Hilight Field LBA Tract would increase the recoverable reserves at the Black Thunder Mine by about 23 percent. At the estimated future production level (135 mmtpy), mine life would be extended by about 2 years. However, if the Wyoming Department of Environmental Quality/Air Quality Division (WDEQ/AQD) approves a higher annual rate of production, the coal would be recovered more quickly. ALC estimates that the South Hilight Field LBA Tract includes approximately 213.6 million tons of recoverable coal as applied for. Based on that estimate, acquisition of the South Hilight Field LBA Tract would increase the recoverable reserves at the Black Thunder Mine by about 18 percent. At the estimated future production level (135 mmtpy), mine life would be extended by about 1.6 years. However, if WDEQ/AQD approves a higher annual rate of production, the coal would be recovered more quickly. ALC estimates that the West Hilight Field LBA Tract includes approximately 377.9 million tons of recoverable coal as applied for. Based on that estimate, acquisition of the West Hilight Field LBA Tract would increase the recoverable reserves at the Black Thunder Mine by nearly 32 percent. At the estimated future production level (135 mmtpy), mine life would be extended by about 2.8 years. However, if WDEQ/AQD approves a higher annual rate of production, the coal would be recovered more quickly.

As discussed in Sections 1.1 and 2.1, Jacobs Ranch Coal Company (JRCC) estimates that there were 379.4 million tons of recoverable coal reserves on the existing Jacobs Ranch Mine at the end of 2008. In 2008, the mine produced approximately 42.1 million tons and the currently approved (by WDEQ/AQD) air quality permit allows mining of up to 55 mmtpy. If the mine produces at the estimated average of 40 mmtpy, the remaining recoverable reserves would be depleted in about 9.6 years (by 2018). JRCC estimates that the West Jacobs Ranch LBA Tract includes approximately 669.6 million tons of recoverable coal as applied for. Based on that estimate, acquisition of the West Jacobs Ranch LBA Tract would increase the recoverable reserves at the Jacobs Ranch Mine by about 177 percent. At the estimated future production level (40 mmtpy), mine life would be extended by about 16.7 years. However, if production levels increase to the currently permitted level (55 mmtpy) or if WDEQ/AQD approves a higher annual rate of production, the coal would be recovered more quickly.

As discussed in Sections 1.1 and 2.1, BTU Western Resources, Inc. (BTU) estimates that there were 933.8 million tons of recoverable coal reserves on the existing North Antelope Rochelle Mine at the end of 2008. In 2008, the mine produced approximately 97.6 of coal million tons and the currently approved (by WDEQ/AQD) air quality permit allows mining of up to 140 mmtpy. If the mine produces at the estimated average of 95 mmtpy, the remaining recoverable reserves would be depleted in about 9.9 years (by 2018). BTU estimates that the North Porcupine LBA Tract includes approximately 601.2 million tons of recoverable coal as applied for. Based on that estimate, acquisition of the North Porcupine LBA Tract would increase the recoverable reserves at the North Antelope Rochelle Mine by about 64 percent. At the estimated future production level (95 mmtpy), mine life would be extended by about 6.3 years. However, if production levels increase to the currently permitted level (140 mmtpy) or if WDEQ/AQD approves a higher annual rate of production, the coal would be recovered more quickly. BTU estimates that the South Porcupine LBA Tract includes approximately 309.7 million tons of recoverable coal as applied for. Based on that estimate, acquisition of the South Porcupine LBA Tract would increase the recoverable reserves at the North Antelope Rochelle Mine by about 33 percent. At the estimated future production level (95 mmtpy), mine life would be extended by about 3.3 years. However, if production levels increase to the currently permitted level (140 mmtpy) or if WDEQ/AQD approves a higher annual rate of production, the coal would be recovered more quickly.

4.1.1.2 Coal-Related Development

Coal-related development as defined for this analysis includes railroads, coal-fired power plants, major (230-kV) transmission lines, and coal technology projects. Table 4-4 summarizes the estimated disturbance associated with coal-related development activities for the baseline year and the projected disturbance through 2020. The subsequent paragraphs summarize the existing coal-related development in the Wyoming PRB and the reasonably foreseeable development considered in the PRB Coal Review.

Table 4-4. Actual and Projected Wyoming PRB Coal-Related Development Scenario.

	2003	2007	2010	2015	2020
Coal-Related Disturbance (Acres)	4,892	5,802	5,963	6,915	6,914

Source: PRB Coal Review Task 2 Update Report (BLM 2009b)

4.1.1.2.1 Coal Transportation

As discussed above, electric utilities account for about 97 percent of Wyoming's coal sales. Most of the coal sold to electric utilities is transported to power plants by rail. A small part, about 2 percent in 2007, of national coal production is exported abroad, but data are not published as to where this export coal is produced. The coal mines in the South Gillette and Wright subregions are served by a joint Burlington Northern Santa Fe and Union Pacific (BNSF & UP) rail line. For the baseline year of 2003, the existing capacity of the line was estimated at approximately 350 mmtpy. For that same year, the existing capacity of the BNSF line, which services the North Gillette subregion, was estimated at 250 mmtpy.

The PRB Coal Review projected that two coal transportation projects would be developed prior to 2020 in Wyoming: expansion of the BNSF & UP rail facilities south of Gillette, and the construction of the Dakota, Minnesota & Eastern Railroad Corporation (DM&E) rail line in Wyoming and South Dakota. A third project proposed by the Tongue River Rail Company would be built between Decker and Miles City, Montana.

BNSF & UP completed work to improve sections of the existing joint rail line and had increased capacity from 350 mmtpy to 450 mmtpy by 2008 with plans to improve additional sections of the existing joint rail line and to further increase capacity to 500 mmtpy by 2012 (BNSF 2008, CANAC 2007). This work includes construction of third and fourth main line track segments where needed. The increased capacity would accommodate the projected upper and lower production rates at the southern mines, which are projected to produce 439 mmtpy and 455 mmtpy by 2020. The remaining planned expansion projects are considered highly likely to occur.

The proposed DM&E rail line would include new rail construction in South Dakota and Wyoming (approximately 15 and 265 miles, respectively) and 600 miles of rail line rehabilitation in South Dakota and Minnesota. Approximately 78 miles of the new rail line construction would provide new rail services to the coal mines in the South Gillette and Wright subregions. The Surface Transportation Board (STB) released a Final Supplemental EIS for the DM&E project on December 30, 2005 and granted final approval to construct the rail line on February 15, 2006. The Supplemental EIS, which addressed issues that were successfully appealed after an EIS was completed in 2001, was also appealed. The Supplemental EIS was upheld by the U.S. Court of Appeals for the Eighth Circuit in December 2006. In 2007, Canadian Pacific Railway Ltd.

(CP) acquired DM&E and the STB approved CP's acquisition of DM&E on September 30, 2008 (All Business 2008). The railroad's expansion into the PRB would require a substantial financial commitment and CP is concentrating on the integration of DM&E's operation before making a decision on the expansion project. No decision has been made on whether or not CP will build the PRB extension. This decision is contingent on several conditions: (1) acquire the necessary right-of-way to build the line, (2) execute agreements with PRB mines on terms for operations by DM&E over their loading tracks and facilities, (3) secure sufficient contractual commitments from prospective coal shippers to route their traffic over the PRB line to justify the investment required to build the line, (4) arrange financing for the project, and (5) an economic and regulatory environment that would support a long-term investment of this magnitude must be present (DM&E 2009).

The STB announced approval of the final stretch of the rail line proposed by the Tongue River Railroad Company in October 2007. The company must acquire necessary federal and state permits and rights-of-way (ROWs) through private and public property before constructing the line. If it is constructed, it would provide a shorter route for some of the mines in the North Gillette subregion, which ship coal on the existing BNSF rail line (Billings Gazette 2007).

For the purposes of the PRB Coal Review, it was projected that the DM&E line would be constructed when the total rail haulage requirement from the eastern Wyoming PRB reaches 450 to 500 mmtpy and would potentially be operational by 2015. The construction of this rail line is considered moderately likely to occur. The PRB Coal Review assigned a low likelihood of development by 2010 under the upper coal production scenario, and projected the construction of the Tongue River Railroad Company line would not occur unless the Otter Creek Mine is developed. Development of the Otter Creek tracts–more than a billion tons of state and private coal–could initiate expansion of the region's coal industry and facilitate construction of the Tongue River Railroad. Appraisals of the Otter Creek lease tracts were completed in April 2009 (Billings Gazette 2009a) and the Montana Land Board voted to lease the 572 million tons of state-owned coal in December 2009 (Billings Gazette 2009b). The Montana Board of Land Commissioners voted to approve the lease of the Otter Creek tracts to Ark Land Company on March 18, 2010 (MDNRC 2010).

4.1.1.2.2 Electric Power Generation

Currently, there are five existing coal-fired power plants in the Wyoming study area for the PRB Coal Review Tasks 1 and 2 (Figure 4-1). Black Hills Power Corporation owns and operates the Neal Simpson Units 1 and 2 (21.7-megawatts [MW] and 80-MW, respectively), Wygen I and II (80-MW and 95-MW, respectively), and Wyodak (330-MW) power plants, all of which are located approximately five miles east of Gillette, Wyoming. Pacific Power and Light's Dave Johnston Power Plant is located near Glenrock, Wyoming, outside of but adjacent to the study area.

There are also three separate interconnected gas-fired power plants (Hartzog, Arvada, and Barber Creek) located near Gillette, Wyoming (Figure 4-1). Each contains three separate 5-MW-rated turbines that provide electric power to Basin Electric and its customers. In winter, the maximum capacity can reach 22.6-MW from each site. All units are in operating condition, although they do not operate at maximum capacity.

Several additional power plants are projected to be built prior to 2020. The PRB Coal Review assumed that proposed coal-fired power plants that plan to initiate operation by 2010 would have to have been undergoing air permit review by 2003 in order to obtain the required construction permits and complete construction by 2010. The study identified the following four projects as likely for 2015 development:

- Black Hills Power and Light has received an air permit for the start of construction of WYGEN III; issues related to that permit currently are being resolved. WYGEN III would be a 100-MW facility located adjacent to WYGEN II. The plant is in construction and nearing completion. Operation of this facility by 2015 is considered highly likely.

- Basin Electric Power Cooperative has obtained an air construction permit for a 385-MW coal-fired power plant (Dry Fork Station) near Gillette, Wyoming. The estimated startup date is 2011. It is estimated that 1.2 million tons of coal per year would be required to fuel the facility. The cooling technology includes a dry scrubber, since that type of operation commonly is installed for PRB coal-fired units. Operation of this facility by 2015 is considered highly likely.

- North American Power Group (NAPG) has permitted a 280-MW coal-fired power plant (Two Elk Unit #1) at a 40-acre site located approximately 15 miles southeast of Wright, Wyoming. As originally permitted, the project also would include installation of a 45-MW gas-fired turbine. The air permit originally was issued in August 2002; construction has been initiated, with actual startup expected in 2011. This unit would be dry-cooled, requiring very little water. Campbell County approved more than $123 million in industrial revenue bonds for application to the Two-Elk financing. Operation of this facility by 2015 is considered moderately likely.

- Wyoming Power Company (a subsidiary of NAPG) has submitted a permit application for Two-Elk Unit #2. This unit would be a 750-MW supercritical pulverized coal-fired electric generating unit that would burn coal from the nearby mines. The unit would be located on an approximately 60-acre site adjacent to Two-Elk Unit #1. The permit was expected to be issued in 2008, and operation of this unit is considered moderately likely in 2015.

The PRB Coal Review assumes that all existing power plants in the PRB region would remain operational through 2020.

4.1.1.2.3 Transmission Lines

Major transmission lines in the Wyoming PRB study area that support the regional distribution system are associated with the Dave Johnston power plant located near Glenrock, Wyoming, and the power plants operated by Black Hills Power Corporation, which are located east of Gillette. These 230-kV transmission lines have been in place for several years, and their associated permanent disturbance is minimal. Distribution power lines associated with conventional oil and gas and coal bed natural gas (CBNG) development also occur within the study area. For the PRB Coal Review, these lines were included by factoring them in proportionally on a per well basis.

The PRB Coal Review estimated that by 2020, four major transmission lines would be constructed. Markets would dictate the size and location of such facilities, and these are not known as of this time. Because transmission lines are a necessary supporting infrastructure for power generating facilities to provide connection to the grid, the PRB Coal Review assumes they would be required as part of the overall system development for the proposed power plants discussed in the previous section. Six specific proposals for these transmission lines have been identified by the PRB Coal Review analysis update. There is currently insufficient information to analyze or assign likelihood of development by 2020.

The governors of California, Nevada, Utah, and Wyoming entered into a Memorandum of Understanding to encourage development of a high voltage power transmission line, the Frontier Line, connecting those states in April, 2005. Since that time, no specific plans have been announced as to the location or timing of the Frontier Line. The 345-kV Wyoming-Colorado Intertie, as well as the Trans West and Gateway West and South projects, have been proposed in Wyoming in order to move power from Wyoming to growing Idaho and Nevada and other western U.S. load demand areas (Casper Star Tribune 2007b). The TransWestern Express proposes to move electric power from Wyoming to Arizona through Colorado or Utah. The High Plains Express is proposed to move power from Wyoming to New Mexico and Arizona.

4.1.1.2.4 Coal Conversion Technology

With rising energy prices, there has been considerable interest in either enhancing the quality of PRB coal and/or converting the coal to other fuels. Test facilities were previously constructed by AMAX (predecessor to Foundation Coal West, Inc. and Alpha Coal West, Inc.) at the Belle Ayr Mine, and by ENCOAL at the Buckskin Mine, but no commercial production occurred and these facilities have either been dismantled or are no longer in use. Evergreen Energy (formerly operating as KFx) previously built a prototype commercial-scale coal upgrading plant near the old Fort Union Mine (now part of the Dry

Fork Mine). The facility did achieve commercial production levels of K-Fuel® (the company's enhanced coal product) for a short period (2006 through early 2008); it was used for testing and demonstration purposes. Approximately 60 people were employed at the plant. Evergreen Energy decided to idle the plant in May 2008, laying off all but a caretaker staff.

The following coal conversion projects have been proposed, and are described in some detail in the PRB Coal Review. These projects were not included in the PRB Coal Review analysis because the likelihood of their occurrence was not known when the analysis was conducted:

- Evergreen Energy Coal Beneficiation Project. Long-term plans for Evergreen Energy's coal upgrading plant near the Dry Fork Mine have not been announced, although re-opening and dismantling the currently idle plant and redeploying some of the equipment to another location have surfaced as possibilities.

- Rentech Inc. Coal Liquefaction Project. In 2004, Rentech completed a feasibility study for a coal liquefaction facility, based on the historic Fischer-Tropsch process, to produce low-sulfur diesel fuel from sub-bituminous coal. Thereafter, Rentech continued to consider the potential of developing a commercial-scale facility in the PRB, while simultaneously investing in a product demonstration facility near Denver, Colorado.

- White Energy Company, NRG Energy, and Buckskin Mining Company. In March 2008, the three companies entered into a joint development agreement to complete a feasibility study of building and operating a plant having a capacity to produce at least 1 million tons of binderless coal briquettes annually at the Buckskin Mine.

- GreatPoint Energy and Peabody Coal. These two companies entered into an agreement in January 2008, under which Peabody Coal would become the preferred provider of coal to GreatPoint Energy for use in a commercial-scale coal-to-gas conversion plant in the PRB.

- Wyoming Infrastructure Authority. The Wyoming Infrastructure Authority (WIA) was created in 2004 by the Wyoming State Legislature. It was tasked with promoting the state's economic development by assisting in the development of interstate electric transmission infrastructure. In 2006, WIA's role was expanded to also promote advanced coal technologies related to electric generation (WIA 2008a). In 2007, WIA selected PacifiCorp from a list of 17 candidate firms and entered into a public-private partnership to assess the feasibility of developing an integrated gasification combined cycle power plant. The initial study focused on a site in southwestern Wyoming, but may open the way for similar projects elsewhere in the state (WIA 2008a), including the PRB.

- Additionally, there currently is a developing technology that would use existing oil and gas wells to generate biologically-formed methane by enhancing the methane production from naturally occurring microbes in the coal. This process is proposed for commercial testing. It is a hybrid between conventional in-situ coal gasification and conventional CBNG development. A policy to authorize and regulate this activity currently is being developed.

4.1.1.2.5 Carbon Sequestration

Carbon sequestration, the process of carbon capture, separation, and storage or reuse, is being researched as a means to stabilize and reduce concentrations of carbon dioxide (a greenhouse gas). Direct options for carbon sequestration would involve means to capture carbon dioxide (CO_2) at the source (e.g., power plant) before it enters the atmosphere coupled with "value-added" sequestration (e.g., use of captured CO_2 in enhanced oil recovery [EOR] operations). Indirect sequestration would involve means of integrating fossil fuel production and use with terrestrial sequestration and enhanced ocean storage of carbon.

No carbon sequestration projects currently exist in the Wyoming PRB study area. However, there is CO_2 being injected underground for the purpose of EOR near the study area in the Salt Creek area.

The 59th Session of the Wyoming State Legislature passed, and Governor Freudenthal signed into law, legislation that could affect long-term energy-related development in the PRB (House Bills 0089 and 0090) (Wyoming Legislative Services 2008). The former (now part of Wyoming Statute 34-1) specified the ownership of subsurface "pore" space, established the rights to use such space for the purpose of carbon sequestration, and maintained the primacy of the mineral estate and the owners of such estate to reasonable use of the surface for the purpose of mineral exploration and production.

Legal provisions enacted as a result of House Bill 0090 vested regulatory control over carbon sequestration with WDEQ and directed the department to promulgate rules, regulations (including permitting processes), and standards for such use. The legislation also specifies that applications for a carbon sequestration project must describe the geology of the area, aquifers above and below the intended injection zone, drill holes and operating wells in the area, potential impacts to other fluid resources, and identify a program for detecting migration or excursion of the CO_2. Finally, the enacted legislation (Wyoming Statute 35-11-103) specifically states that the act is not intended to impede or impair the rights of oil and gas operators to inject CO_2 through an approved EOR project and establish, verify, register, and sell emissions reduction credits.

Based on the coal- and oil and gas-related development in the PRB study area, the potential exists for future development of carbon sequestration in the area. However, no commercial projects specifically targeted at capturing and sequestering carbon have been identified at this time. Sequestration was not included in the PRB Coal Review analysis because the likelihood of projects occurring was not known when the analysis was conducted.

A summary of past, present, and reasonably foreseeable coal mines, coal-related facilities, coal production, coal mine employment, and coal and coal-related disturbance in the Wyoming PRB is presented in Table 4-5.

Table 4-5. Past, Present, and Projected Wyoming PRB Coal Mine and Coal-Related Development Scenario.

Year	Coal Production (mmtpy)	Number of Active Coal Mines[1]	Number of Active Power Plants	Number of Active Coal Conversion Facilities[2]	Direct Coal Mine Employment	Total Coal Disturbance (acres)[3]
Past and Present						
1990	163	18	3	1	2,862	na
1995	247	19	4	1	3,177	na
2000	323	12	4	2	3,335	na
2003	364	12	4	0	4,697	68,794
2007	428	13	5	0	5,533	83,593
Projected Development - Lower Coal Production Scenario						
2010	411	13[1]	7	1[2]	5,433	98,662
2015	467	13[1]	7	1[2]	5,705	117,236
2020	495	13[1]	7	1[2]	5,731	137,443
Projected Development - Upper Coal Production Scenario						
2010	479	13[1]	7	1[2]	5,509	102,448
2015	543	13[1]	7	1[2]	5,722	124,545
2020	576	13[1]	8	1[2]	5,998	149,089

[1] Mines have consolidated and may continue to do so in the future. Also, new mines may be permitted to better access the coal reserves projected for mining by 2020.

[2] Several coal conversion facilities currently are being evaluated; however, there is only one for which the likelihood of future development currently can be assessed.

[3] Disturbance area includes coal mine and coal-related disturbance areas.

Source: Annual Report of the Wyoming State Mine Inspector (Wyoming Department of Employment 1990, 1995, 2000, 2003, and 2007a) and PRB Coal Review Task 2 Update Report (BLM 2009b)

4.1.2 Oil and Gas Development

The following information on existing conventional and CBNG development is summarized from the PRB Coal Review Task 2 Report (BLM 2009b). The information reported is for 2003, which was the baseline year for the coal review.

4.1.2.1 Conventional Oil and Gas

Conventional oil and gas development includes all non-CBNG development activity. Approximately 1,500 conventional oil and gas wells, including producing, non-producing and injection wells, were drilled between 1990 and 2003 (IHS 2004) in the PRB Coal Review Task 2 Study Area. Of those, 60 percent were development wells, drilled in established producing areas. The remaining 40 percent were classified as wildcat wells, which are wells that are drilled in non-producing areas or drilled to evaluate untested prospective zones in producing areas. Approximately 75 percent of the wildcat wells were plugged and abandoned. By 2003, the successful new field wildcat wells had resulted in the discovery of 61 new fields that produced 719,000 barrels of oil and 1.45 billion cubic feet (bcf) of non-CBNG (WOGCC 2004).

As of the end of 2003, there were approximately 3,500 producing conventional oil and gas wells in the Wyoming PRB study area plus 1,386 seasonally active wells (IHS 2004). The Wyoming Oil and Gas Conservation Commission (WOGCC) reported that these wells produced approximately 13 million barrels of oil (mmbo) and 41 bcf of conventional gas in 2003 (WOGCC 2004). The U.S. Geological Survey (USGS) estimated that the mean undiscovered non-coal bed hydrocarbon resource in the PRB (including Montana) is 1.8 billion barrels of oil equivalent (boe) (USGS 2002a).

By the end of 2007, there were approximately 3,857 producing conventional oil and gas wells in the Wyoming PRB study area plus an estimated 1,500 seasonally active wells (IHS 2008). WOGCC reported that these wells produced approximately 11.4 mmbo and 22 bcf of conventional gas in 2007 (WOGCC 2008c).

Most of Wyoming's current oil production is from old oil fields with declining production and the level of exploration drilling to discover new fields has been low (WSGS 2002). This situation is reflected in the PRB where, over the 10-year period from 1992 through 2002, oil production from conventional oil and gas wells in Campbell and Converse counties decreased approximately 60.4 percent (from 32.8 million barrels in 1992 to 13.0 million barrels in 2002). Oil prices have been increasing, which is reversing projections of a continuing decline in oil and gas production; production is now expected to increase in the PRB, with a peak around 2010 of approximately 15.7 million barrels (WSO-RMG 2005). Oil production in the short term may also be bolstered by some planned CO_2 flood projects in the PRB (WSGS 2003). This projected temporary upward trend in conventional oil and gas development is reflected in the PRB Coal Review projections (Table 4-6).

The active wells identified in Table 4-6 include wells that produce year-round, seasonally producing wells, and service wells (mainly injection wells). It is estimated that there are approximately 2,000 idle conventional oil and gas wells in the PRB study area (WOGCC 2008a); however, the number of idle wells gradually would be reduced in the future through plugging programs, and the idle well locations (once the wells are abandoned) would be reclaimed and no longer represent a disturbance.

Table 4-6. Actual and Projected Wyoming PRB Conventional Oil and Gas Development Scenario.

	Actual		Projected		
Production and Wells	**2003**	**2007**	**2010**	**2015**	**2020**
Annual Gas Production (bcf)	39.9	22.0	42.7	39.0	35.1
Annual Oil Production (mmbo)	12.9	11.4	15.7	14.3	12.9
Active Wells	5,067[1]	3,857[2]	5,603	5,115	4,625
Inactive Wells	1,994	0[3]	954	563	332

[1] Total includes approximately 1,500 seasonally active wells.
[2] Total includes approximately 1,500 seasonally active wells and an unknown number of inactive wells.
[3] Unknown.
Source: PRB Coal Review Task 2 Update Report (BLM 2009b)

4.1.2.2 CBNG Development

Natural gas production has been increasing in Wyoming. In the PRB, this is due to the development of shallow CBNG resources. Commercial development of these resources began in limited areas west of and adjacent to the northernmost surface coal mines in the late 1980s. Since that time, CBNG development has spread south and west into other parts of the PRB Coal Review Task 1 and Task 2 study area (Figure 4-1).

On private and state oil and gas leases, the WOGCC and the Wyoming State Engineers Office (SEO) authorize CBNG drilling. On federal oil and gas leases, BLM must analyze the individual and cumulative environmental impacts of all drilling (federal, state, and private), as required by NEPA, before CBNG drilling can be authorized. BLM does not authorize drilling on state or private leases but must consider the impacts from those wells in their NEPA analyses. In many areas of the PRB, the coal estate is federally owned, but the oil and gas estate is privately owned. A June 7, 1999 Supreme Court decision (98-830) assigned the rights to develop CBNG on a piece of land to the owner of the oil and gas estate.

Annual CBNG production increased rapidly in the PRB between 1999 and 2003 but has leveled off somewhat since then. At the end of 2003, there were 14,758 producing CBNG wells in the study area (IHS 2004), and total production for that year was 346 bcf, or 88 percent of the total gas production from the basin (WOGCC 2004). Total CBNG production in the PRB was 377 bcf for 2006, 432 bcf for 2007, and 536 bcf for 2008 (WOGCC 2009). Average daily CBNG production was about 947 million cubic feet per day (mmcfpd) in 2003 (Holcomb 2003), 1,033 mmcfpd in 2006, 1,177 mmcfpd in 2007, and 1,469 mmcfpd in 2008. From 1987 to 2003, the total cumulative gas production from PRB coals was over 1.2 trillion cubic feet. The total water production for the same time period was approximately 2.3 billion barrels (96,600 million gallons). According to the WOGCC database (WOGCC 2009), water production in the PRB associated with CBNG production has ranged between 567 million barrels (23,814 million gallons), or about 1.6 million barrels per day in 2003 to 679 million barrels, or about 1.9 million barrels per day in 2008.

Since the early 1990s, the Wyoming BLM has completed numerous Environmental Assessments (EAs) and two EISs analyzing CBNG projects. The most recent of these is the Final EIS and Proposed Plan Amendment for the PRB Oil and Gas Project, which was completed in January 2003 (BLM 2003). The level of CBNG development since 2003 appears to be lower than was forecast in that document. New CBNG well numbers fell from a high of slightly more than 4,600 in 2001 to approximately 2,000 in 2004. The PRB Coal Review Task 2 Report discusses the uncertain trends for future CBNG activity in recent years. The methodology used to project future activity is detailed in Appendix E of that report. Table 4-7 shows the 2003 baseline, actual values for 2007, and projected 2010, 2015, and 2020 levels of CBNG development levels used to evaluate projected cumulative environmental impacts in the PRB Coal Review.

Table 4-7. Actual and Projected Wyoming PRB CBNG Development Scenario.

	Actual		**Projected**		
Production and Wells	**2003**	**2007**	**2010**	**2015**	**2020**
Annual Production (bcf)	338	432	708	1,005	1,026
Active Wells	14,758	20,408	31,943	42,980	42,108

Source: PRB Coal Review Task 2 Update Report (BLM 2009b)

The amount of CBNG activity appears to be at a lower rate than was forecast by earlier projections in the Final EIS and Proposed Plan Amendment for the PRB Oil and Gas Project (BLM 2003), as well as in the 2005 version of the Task 2 report (BLM 2005a). New CBNG well numbers fell from a high of slightly more than 4,600 in 2001 to approximately 2,000 in 2004. It is anticipated that the number of new wells would increase so that between 2010 and 2020 the number of new wells drilled per year, basin-wide, would range between 2,892 to 3,943. As shown in Table 4-7, there would be 31,943 CBNG wells basin-wide by 2010, considerably lower than the over 40,000 wells predicted for the same time period in the Final EIS and Proposed Plan Amendment for the PRB Oil and Gas Project (BLM 2003). It is anticipated that production in the cumulative effects study area would increase from the 432 bcf per year observed in 2007 to approximately 1,026 bcf per year in 2020. These estimates are relatively aggressive related to actual activity from 2003 to 2007 (BLM 2009b), and it is likely that the Buffalo RMP revision, currently underway, will further refine these estimates.

4.1.2.3 Oil and Gas Related Development

Oil and gas related development activities considered in the PRB Coal Review include major transportation pipelines and refineries. Table 4-8 summarizes the net disturbance, reclamation, and water production associated with oil and gas activity (conventional oil and gas, CBNG, and major transportation pipelines) for 2003 (baseline year) and projects disturbance, reclamation, and water production for future years.

Table 4-8. Wyoming PRB Conventional Oil and Gas, CBNG, and Related Development Disturbance and Water Production.

	Actual		Projected		
Category	**2003**	**2007**	**2010**	**2015**	**2020**
Cumulative Disturbed Area (acres)[1]	177,140	178,023	248,086	344,713	427,557
Cumulative Permanently Reclaimed Area (acres)	114,777	111,926	157,803	226,775	310,959
Cumulative Unreclaimed Area (acres)	62,363	66,097	90,283	117,959	116,598
Annual Water Production (mmgpy)	26,405	31,738	50,865	71,166	72,047

[1] Inclusive of conventional oil and gas and CBNG activities and major transportation pipelines. Disturbance associated with ancillary facilities (including gathering lines and distribution power lines) has been factored in a per well basis.

Source: PRB Coal Review Task 2 Update Report (BLM 2009b)

4.1.2.3.1 Pipelines

Major transportation pipelines for the transport of product to outside markets are a key factor in the development of CBNG and conventional oil and gas resources in the Wyoming PRB study area. Major transportation pipelines also provide for transport of CO_2 to crude oil well fields, which depend somewhat on the availability of CO_2 for EOR. Currently, there are over 13 major transportation pipeline systems in the PRB that transport gas resources to markets outside of the basin (Flores et al. 2001, Wyoming Pipeline Authority 2008). The current capacity of these pipeline systems is approximately 2.1 bcf per day. Currently, the combined natural gas production (CBNG and conventional gas) in the Wyoming PRB study area is approximately 1.22 bcf per day.

Gathering lines and power lines associated with conventional oil and gas and CBNG development also occur within the study area; disturbance from these ancillary facilities were factored into the PRB Coal Review analysis on a per well basis.

Currently, there are two proposed natural gas transportation pipeline projects that would cross the PRB study area:

- Bison Pipeline LLC (Bison), wholly owned by a subsidiary of TransCanada Corporation, is proposing to construct the Bison Pipeline Project, an interstate natural gas pipeline designed to transport gas from the PRB to the Midwest market. The Bison project will consist of approximately 302 miles of 30-inch diameter natural gas pipeline and related facilities that will extend from near Gillette through southeastern Montana and southwestern North Dakota where it will interconnect with the Northern Border Pipeline system in North Dakota. Approximately 53 miles of the proposed route is within the Wyoming PRB Coal Review study area. If constructed, the Bison project would have a 470 mmcfpd capacity with potential to expand to approximately 1,000 mmcfpd. Bison filed an application with the Federal Energy Regulatory Commission (FERC) for a certificate of public convenience and necessity to construct, own and operate the pipeline in April 2009 with an in-service estimate of 2010 (Bison Pipeline 2009).

- The proposed Pathfinder Pipeline Project, a 42-inch diameter, 500-mile long natural gas pipeline, would cross the Wyoming PRB study area; however, its main supply of gas would come from the Green River Basin, where it would originate. It is possible that an interconnect at Dead Horse Creek might provide an outlet for PRB-produced gas into Pathfinder. If constructed, the Pathfinder project would have a 1.2 to 2.0 bcf per day capacity. Submittal of an application with FERC is pending, with an in-service estimate of 2010.

Beyond the Wyoming PRB study area, these projects essentially would parallel one another to the interconnect with Northern Border's main pipeline in North Dakota. Since these projects would be interstate gas transportation pipelines, they would be regulated by the FERC. Although FERC lists these projects as "on the horizon" (FERC 2008), no formal applications have been filed with the regulatory agencies (FERC 2008, WDEQ/ISD 2008). Both of these projects are dependent upon acquisition of sufficient support in the open season process. Based on the lack of formal applications, their likelihood currently is considered low (BLM 2009b).

There currently are proposed and construction-in-progress natural gas transportation pipeline projects that would not cross the Wyoming PRB study area; however, they would influence the ability of PRB gas producers to access outside markets. These projects are the Alliance Pipeline (a 42-inch-diameter natural gas pipeline proposed from Wamsutter, Wyoming, to Emerson, Manitoba) and the Rockies Express (from Rio Blanco County, Colorado, to Monroe County, Ohio) (Rockies Express Pipeline LLC 2008, Wyoming Pipeline Authority 2008). The Alliance Pipeline is expected to commence construction in 2012, with a proposed in-service date sometime in 2013. Rockies Express Pipeline (western segment from western Colorado to Missouri) was in-service in

January 2008. The expected in-service date for the eastern segment (Missouri to Ohio) is October 2011. Although important to PRB gas producers, because these projects would not cross the Wyoming PRB study area, they are not considered further in this analysis.

The amount of available pipeline capacity could limit the amount of future CBNG development. In the original Task 2 Report (BLM 2003a), it was estimated that growth of Wyoming PRB CBNG production could rise from the 2003 level of 947 mmcf per day up to 3 to 4 bcf per day around 2007 and remain at or above those levels until 2015 (Holcomb 2003). However, production rates of 3 to 4 bcf per day were not realized by 2007, and the average daily production for all gas (conventional and CBNG) was approximately 1.22 bcf per day (WOGCC 2008). Average CBNG production in 2007 was approximately 1.24 bcf per day. The addition of the Bison Pipeline Project would increase the take-away capacity of the PRB by approximately 0.5 bcf per day, resulting in total take-away capacity for the PRB of approximately 2.55 bcf per day. The addition of the Pathfinder Pipeline Project would increase the take-away capacity by approximately an additional 1.6 bcf per day, for a total of approximately 4.15 bcf per day. Based on the assumptions in the Task 2 report, the projected total gas production (conventional and CBNG) would increase to 2.06 bcf per day in 2010, 2.86 bcf per day in 2015, and 2.91 bcf per day in 2020. Therefore, likelihood for additional new pipeline construction for 2010 is low, with a higher likelihood in subsequent years (BLM 2009b).

In the original Task 2 report (BLM 2005a), it was indicated that Anadarko Petroleum Corporation was planning to extend its CO_2 pipeline that runs between Bairoil, Wyoming, and Salt Creek, Wyoming, to the Sussex Field located in the southern Johnson County portion of the Wyoming PRB study area. However, more recent information indicates that this has not occurred (Anadarko Petroleum Corporation 2008). According to the Wyoming Enhanced Oil Recovery Institute, fields in the Wyoming PRB study area that would be good candidates for EOR using CO_2 include Hartzog Draw, Hilight, and House Creek (Boyles and vant Veld 2006). Since no CO_2 projects have been proposed for construction in the Wyoming PRB study area, they are not considered further in this analysis.

4.1.2.3.2 Refineries

Construction of a new refinery was completed in the Wyoming PRB study area in 2008. The NorthCut Refinery, owned and operated by Interline Resources, is located in Converse County, approximately 20 miles north of the town of Douglas. Construction of the refinery, which was a conversion of the previously existing Well Draw Gas Plant, included installation of a crude oil pipeline between the company's existing crude gathering system and the refinery.

The NorthCut Refinery is a crude oil topping plant, specifically engineered to process 4,000 barrels per day of sweet crude produced in the PRB. Output from the refinery will include naptha, off-road diesel, and reduced crude oil. The markets for the products include ethanol manufacturers, mines, and other refineries. The company-owned crude oil pipeline and third-party tanker trucks will be used for delivery of crude stocks. Tanker trucks also will be used to transport finished products from the facility (Interline Resources 2008).

The refinery is adjacent to and east of State Highway 59, with the joint BNSF&UP rail line located just to the west of the highway. The site previously had been the location of the Well Draw Gas Plant (approximately 20 acres), which shut down in 2002 following a fire. Interline has acquired an additional 12 acres bordering the original site for administrative, maintenance, and transportation-related uses (Interline Resources 2008).

The level and composition of outputs from the existing NorthCut Refinery would respond to various markets, potentially resulting in the construction of additional infrastructure and/or facilities in the future. Any future changes and associated disturbances would occur within the property currently owned by Interline Resources at the NorthCut site (Williams 2008). No specific plans for expansion currently have been identified. As a result, the likelihood for project expansion currently is considered speculative. Therefore, it has been eliminated from further analysis in this study.

No other reasonably foreseeable plans for construction and operation of new petroleum refineries in the Wyoming portion of the PRB have been identified.

4.1.3 Other Development Activity

4.1.3.1 Other Mining

Uranium, sand, gravel, bentonite, and clinker (or scoria) have been and are being mined in the Wyoming PRB study area.

Wyoming has been the nation's leading producer of uranium ore since 1995, and also hosts the nation's largest uranium reserves (WSGS 2009). There are three primary uranium mining districts in the PRB: Pumpkin Buttes, Southern Powder River, and Kaycee (BLM 2003). Numerous uranium mining sites, both potential and existing, are present in these districts. Wyoming's only currently producing uranium mine, the Smith Ranch-Highland operation, is located in Converse County in the Southern Powder River District. The Smith Ranch-Highland operation is owned by Power Resources, Inc. (dba Cameco) and uses the in-situ recovery (or in-situ leach) method of mining. Aside from the Smith Ranch-Highland operation, the only other uranium mining operation in the PRB that is currently licensed by the U.S. Nuclear Regulatory Commission (USNRC) is the Christensen Ranch/Irigaray operation (owned by COGEMA Mining, Inc.) located in Johnson and Campbell counties (USNRC 2009). In-situ operations are expected to restart at the Christensen Ranch mine in the near future.

In the PRB Coal Review Task 2 report (BLM 2005a), reasonably foreseeable uranium development was eliminated from further consideration because: 1) there were no specific projects with pending applications and 2) no development was anticipated, based on market conditions. Based on commodity forecasts and uranium activity as of June 2004, the likelihood and potential timing of new uranium mining operations in the PRB was not known, and additional development was not projected in the PRB Coal Review analysis.

Due to increased overall demand for energy in recent years, uranium prices have increased from a low of $7 a pound in 2001 to over $138 a pound in 2007 (Barry 2008). The price fell to $62 in 2008 and is currently in a range of $40-$50 per pound, which is expected to hold through 2010 because of stable demand and a growing supply. The recent upsurge in yellowcake spot prices has increased exploration and claim-staking activity in the PRB and is generating considerable interest in new development (WSGS 2009).

In response to the increased price of uranium, a number of uranium mine developments currently are proposed in the Wyoming PRB study area. The USNRC is currently reviewing applications for two new uranium recover facilities in the PRB: the Moore Ranch and the Nichols Ranch-Hank Unit (USNRC 2009). The Moore Ranch, owned by Energy Minerals Corporation (dba Uranium One), is located in Converse County, and the Nichols Ranch-Hank Unit, owned by Uranerz Energy Corporation, is located in Campbell and Johnson counties. Both of these projects submitted license applications in 2007, they are located in the Pumpkin Buttes District, and would use the in-situ recovery method of mining.

Over the next three years, the USNRC expects to receive additional applications for new uranium recovery facilities, as well as requests for restarts and expansions of existing facilities. Table 4-9 provides information on the three new projects and four expansion projects currently proposed in the PRB, all of which would use in-situ recovery. With the exception of the Ross Project, which is located in western Crook County, the proposed developments are all in the Pumpkin Buttes District in southwestern Campbell and northwestern Converse counties. The actual number of the proposed developments that would become operational would depend on several factors including uranium prices and approval of permits.

Bentonite is weathered volcanic ash that is used in a variety of products, including drilling mud and kitty litter, because of its absorbent properties. There are three major bentonite producing districts in and around the PRB: the Colony District in the Northern Black Hills, the Clay Spur District in the Southern Black Hills, and the Kaycee District west of Kaycee, Wyoming. Within the PRB Coal Review study area, bentonite is mined at Kaycee (WMA 2006). The PRB Coal Review assumed that bentonite mining would continue throughout the study period and that production would continue at existing active mines, with no new mines developed through 2020.

Table 4-9. In-Situ Recovery Uranium Projects Currently Proposed in the Wyoming PRB Study Area.

Project/ Company	County	Application Type	Watershed/ Mining District	Likelihood/ Rationale
Ludeman Satellite Project/ Energy Metals Corp (dba Uranium One)	Converse	Expansion/ Amendment to Moore Ranch	Antelope Creek/ Pumpkin Buttes District	Moderate for 2012/ Letter of intent to USNRC February 2009, application expected 2009.
Allemand-Ross Satellite Project/ Energy Metals Corp (dba Uranium One)	Converse	Expansion/ Amendment to Moore Ranch	Antelope Creek/ Pumpkin Buttes District	Moderate for 2012/ Letter of intent to USNRC February 2009, application expected 2009.
Ross Project/ Peninsula Minerals, Ltd.	Crook	New	Little Missouri River/ Not in one of the three districts	Moderate for 2012/ Letter of intent to USNRC October 2009, application expected 2010.
Collins Draw Project/ Uranerz Energy Corporation	Campbell	New	Powder River/ Pumpkin Buttes District	Moderate for 2012/ Letter of intent to USNRC March 2008, application expected 2009.
North Butte-Ruth Project/ Power Resources, Inc. (dba Cameco)	Campbell and Johnson	Expansion/ Satellite to Smith Ranch	Powder River/ Pumpkin Buttes District	High probability for 2012/ Application for commercial operation filed March 2006.
Reno Creek Project/ Bayswater Uranium Corporation	Campbell	New	Belle Fourche River and Antelope Creek/ Pumpkin Buttes District	Moderate for 2015/ Letter of intent to USNRC March 2009, application expected 2010.
Ruby Ranch Project/ Power Resources, Inc. (dba Cameco)	Campbell	Expansion/ Satellite to Smith Ranch	Powder River and Belle Fourche River/ Pumpkin Buttes District	Moderate for 2015/ Letter of intent to USNRC March 2008, application expected 2009.

Sources: USNRC (2009), World Information Service on Energy (2009)

Aggregate, which is sand, gravel, and stone, is used for construction purposes. In the PRB, the more important aggregate mining localities are in Johnson and Sheridan counties (WSGS 2004). The largest identified aggregate operation is located in northern Converse County. It has an associated total disturbance area of approximately 67 acres, of which 4 acres have been reclaimed.

Clinker (which is formed when coal beds burn and the adjacent rocks become baked) is used as aggregate where alluvial terrace gravel or in-place granite/igneous rock is not available. Clinker generally is mined in the Converse and Campbell counties portion of the Wyoming PRB study area.

Increased sand, gravel, and clinker production and associated surface disturbance are anticipated in the Wyoming PRB study area in the future because aggregate would be required for road maintenance and new construction activities as other primary resources, such as coal and oil and gas, continue to be developed. New operations and increased production from existing operations can be expected. These operations would vary in size based on the immediate need from the primary industries, but there is no specific information about these projected operations. As a result, new sand, gravel, or clinker operations were not analyzed in detail in the PRB Coal Review.

4.1.3.2 Industrial Manufacturing

There are a number of existing industrial manufacturing establishments located in the Wyoming PRB Coal Review study area. Most are relatively small with fewer than 25 employees; they predominately serve regional and local markets, and most are directly or indirectly related to energy resource development and production. Over the years, some of these firms have expanded such that they now support activities and serve markets outside of the region, but those operations remain dependent upon the local and regional markets to sustain their existing operations.

The PRB Coal Review anticipates that increased coal production would result in an increased demand for fuels and explosives. This increased demand could result in the need for the development of new off-site chemical feedstock plants in the study area. Project-specific information is not available, however, and the potential development of new chemical feedstock plants was not considered in the PRB Coal Review.

Local economic development organizations, including CCEDC and CANDO, are continually engaged in efforts to recruit or assist new business formation in the PRB study area. For example, CANDO has pursued development of long-term potential projects; however, the outcomes of those projects are uncertain and little information and detail are available. As a result, they were not considered in the PRB Coal Review.

4.1.3.3 Wind Power

Due to increasing concerns over global climate change, there is strong interest from consumers, investor-owned utilities, and environmental and economic sustainability interests in wind energy generating projects and other forms of renewable energy projects. The current development interest in wind energy generation is driven in part by mandates for many utilities to increase the use of renewables in their overall energy portfolio, decisions by environmentally conscious firms to use renewable energy sources, and also due to the development of wind energy manufacturing infrastructure in the region.

Wind power facilities have been proposed, are being constructed, and are providing energy at various sites in Wyoming, including the PRB region. There is good potential for wind power, and these facilities can contribute to meeting forecasted electric power demands; however, they are dependent on available transmission capacity to send power to users. Compared to the lower 48 states, Wyoming currently ranks in eleventh place in terms of existing wind power capacity from projects currently in operation with 986 MW and 299 MW under construction. Texas ranks in first place with 8,797 MW in operation and 660 MW under construction. In terms of annual wind energy potential, Wyoming ranks seventh with 747 billion kilowatt-hours per year. North Dakota ranks first with 1,210 billion kilowatt-hours per year (AWEA 2010). Although many Wyoming locations having the highest potential are in the southern portion of the state, areas in both Converse and Campbell counties offer sufficient potential to support commercial-scale wind generation projects.

- One such project, the Glenrock Wind Farm, is currently providing power in the Wyoming PRB study area. PacifiCorp completed construction of this three-phase project in Converse County in 2009. The Glenrock Wind Farm is located approximately 15 miles north of the existing Dave Johnston Power Plant, on and near the site of the former Dave Johnston Coal Mine. This is the first wind energy project in the nation to be located at a reclaimed coal mine. The first phase, known as the Glenrock Wind Energy Project, went online in 2008. The second and third phases, the Rolling Hills Wind Energy Project and the Glenrock III Wind Energy Project, respectively, went online in 2009. The Glenrock and Rolling Hills phases each consist of 66 wind turbine generators (each rated at 1.5-MW [99-MW total]). The Glenrock III phase consists of 26, 1.5-MW wind turbines (39-MW total) (PacifiCorp 2009).

- Duke Energy (dba Three Buttes Windpower, LLC) completed the Campbell Hill Windpower Project and began commercial operations in December 2009. The Campbell Hill Windpower Project is located approximately 15 miles northeast of Casper in Converse County and consists of 66 wind turbines generating 99-MW. PacifiCorp will buy all of the output generated by the project.

- Duke Energy plans to build the Top of the World Wind Energy Project, a 200-MW wind farm located northeast of Glenrock in Converse County. Construction is expected to begin in early 2010 upon receipt of all necessary permits from the state. PacifiCorp will buy the power generated by the project (Duke Energy 2009).

- Third Planet Windpower is in the initial development phase of a wind energy project (Reno Junction Windfarm) in the Pumpkin Buttes area of southwestern Campbell County. Third Planet Windpower has acquired approximately 13,000 acres of land leases for the project, installed meteorological monitoring sites, and is currently doing environmental and feasibility studies. The company plans to install up to 133, 1.5-MW towers, yielding a total capacity of 200-MW, if fully constructed. The site for the Reno Junction Wind Farm is close to the Black Hills Power Pumpkin Buttes substation and the companies are seeking an agreement for interconnection. Third Planet Windpower plans to start construction in mid-2010 with an online date expected for the end of 2010 (Gillette

News-Record 2008c). This project is considered moderately likely to occur (BLM 2009b).

Land use disturbance for wind energy projects is associated with development of access roads, a turbine assembly pad, and foundation pad for each wind turbine tower. Additional land disturbance results from installation of transformers and substations, underground electric and fiber optic communications cables, one or more operations and maintenance facilities, meteorological towers, and a transmission line connecting the project to the regional grid. Much of the disturbance area is reclaimed immediately following construction, with long-term disturbance associated with permanent facilities (i.e., access roads, support facilities, and tower foundations).

Wind generating projects have an expected life of approximately 25 years, which could be extended based on market conditions and the overall condition of the infrastructure. Some redisturbance would occur at the time of decommissioning, followed by final reclamation.

According to the American Wind Energy Association (2010), transmission will be a key issue for the wind industry's future development over the next two decades.

4.1.3.4 Solar Power

Although Wyoming has been given a rating of very good for Annual Solar Potential for Flat Plate Collectors, there currently are no utility-scale solar power collection facilities on federal, state, or private lands in Wyoming. Furthermore, no applications for the development of utility-scale solar energy projects have been filed as of January 1, 2010.

The BLM, the Office of Energy Efficiency and Renewable Energy (EERE), and the USDOE are jointly preparing a solar energy Programmatic Environmental Impact Statement (PEIS) which could facilitate future solar energy development application processes. Wyoming is not covered in the PEIS but still may be affected by it. Information on the PEIS can be found at: http://solareis.anl.gov. The BLM currently evaluates solar energy project proposals on a case by case basis.

Solar energy utilization in Wyoming is, as of January 1, 2010, limited to private residences and private commercial establishments. Current Wyoming solar energy incentives include a sales tax rebate on industrial or commercial solar energy generation equipment, a one-time grant of up to $3,000 offered through lottery from the Wyoming Business Council, and the utility buy back of unused electricity at the wholesale price. Solar energy production equipment and installation at residential, commercial, and utility sites is expensive. Currently, the electric utility costs in Wyoming are such that the cost of installation does not favor solar energy development over existing forms of energy development.

4.1.3.5 Reservoirs

Currently, there are five key water storage reservoirs in the Wyoming PRB Coal Review study area (Healy, Lake DeSmet, Muddy Guard No. 2, Gillette, and Betty No. 1) (HKM Engineering et al. 2002a and 2002b). The total disturbance associated with these five key water storage areas is 3,263 acres.

Based on the applicable water plans prepared for the Wyoming Water Development Commission for its Basin Planning Program (HKM Engineering et al. 2002a and 2002b), there are long range projections for development of additional reservoirs in the Wyoming PRB study area. However, none of these reservoirs have reached the planning stage; therefore, there was not enough information to analyze them in the PRB Coal Review.

4.1.3.6 Other Non-Energy Development

In addition to the specific projects and developments described above, a network of public and private physical infrastructure, private enterprises, and public activities has been developed in the PRB over time. Examples of infrastructure include the highway and road networks, airports, government offices, hospitals, public schools, municipal water systems, and extensive residential and commercial real estate development. Private enterprises include local retail and service establishments, newspaper publishing, and transportation and distribution firms.

There are a number of existing industrial manufacturing and service establishments located in the Wyoming PRB study area. Most are relatively small with fewer than 50 employees, and most serve local and regional markets, the majority of which are directly or indirectly related to energy resource development and production. Hettinger Welding and L&H Welding and Machine, both based in Gillette, are the largest industrial manufacturing firms in the region specializing in repairs, rebuilding, and manufacturing for the mining industry. Though classified as wholesalers and repair establishments, rather than as manufactures, firms such as Wyoming Machinery and P&H Mining Equipment also serve the mining and oil and gas industries. Other industrial manufacturing and service establishments in the region provide metal fabrication, metal plating, custom and precast concrete products, and specialized chemical products and services. Over the years, some of these firms have expanded such that they now support activities and serve markets outside the PRB region. However, they remain dependent upon the local and regional markets to sustain their existing operations (BLM 2009b).

Local economic development organizations, including Campbell County Economic Development Corporation (CCEDC) and Converse Area New Development Organization (CANDO) are continually engaged in efforts to recruit or assist new business formation in the PRB study area. For example, CANDO is pursuing development of an ammonium nitrate plant (using methane as a feedstock) in the Bill, Wyoming, area, as well as location of an aluminum mill in the same general location. These and similar prospects are long-term potential whose outcomes are uncertain and for which little information and detail are available. As a result, they were eliminated from analysis in the PRB Coal Review (BLM 2009b).

Local governments, school districts, and other special service districts and public entities continually engage in long-term planning. Examples of some of the recently completed projects and developments, as well as anticipated plans or proposals for development in public, private, and commercial infrastructure within the city of Gillette and Campbell County, are included in the current city of Gillette development summary (City of Gillette 2009) and summarized below:

- The city of Gillette's Wastewater Treatment Plant was upgraded in 2007.

- An expansion and renovation of the county courthouse were completed in 2006, and a new public health building was completed in 2007.

- The Wyoming Center, a conference and multi-event facility expansion of the Gillette CAM-PLEX, was completed in 2008. The expansion includes more exhibit space, conference and indoor athletic facilities with seating for up to 9,000, an indoor ice rink, and various concession and support spaces.

- A new $10 million headquarters for the Campbell County Fire Department providing administrative, training, storage space, and additional parking bays for firefighting equipment and vehicles was completed in 2008.

- A new Hospice Center, the Cummins Diesel Service Center, and the Hillcrest School were completed in 2008.

- Construction of the new Health Sciences Center at Gillette College was competed in 2008. The facility houses the school's nursing program, providing classrooms, labs, faculty offices, and other spaces. The nursing program functions in conjunction with the Campbell County Memorial Hospital

- Major infrastructure projects within and adjacent to the city limits in 2008 and 2009 included highway and roadway improvements, drainage system improvements, library renovations, subdivision developments, and expansion of the county landfill.

- Expansion of the Campbell County Detention Center and remodeling of the Sheriff's Office were completed in 2009.

- Construction of various commercial and residential housing developments is ongoing.

- The new $55 million Campbell County Recreation Center is currently under construction and scheduled for completion in 2010.

- The county, city, and Gillette College are partnering on a Campus Housing Complex and the Industrial Technical Education Center. Construction of these facilities is ongoing and part of a long-range master plan for the college that is designed to provide a broad college-level curriculum and provide more focused education and training to support local business and industry.

- Campbell County Memorial Hospital is undergoing a major expansion and renovation project that began in 2009.

- The city of Gillette is seeking state and local funding to construct an additional municipal water supply. Construction of a second Madison Formation well field in Crook County near the Keyhole Reservoir and a second water supply line from the well field to Gillette is expected to begin in 2011 or 2012.

- The Wyoming School Facilities Commission (WSFC) oversees all aspects of construction and maintenance of school facilities and physical plant. School districts submit 5-year plans for facilities spending, which are subject to approval and funding by the WSFC. Currently approved master plans for the seven school districts serving some portion of the Wyoming PRB study area include defined needs for more than $115 million in capital construction, some of which have already been funded (WSFC 2008). The total includes approximately $51 million for the Campbell County School District, the bulk of which would fund three new elementary schools and one new high school (WSFC 2008).

Additional private sector industrial and commercial development is expected to occur within the context of normal community and economic development. The strong economic base provided by the coal mines, oil and gas companies, and relatively high income of residents draws regional and national retailers (e.g., The Home Depot) to the area. Gillette's location on I-90 and the strong demand for lodging by energy workers, travelers, and visitors associated with events at the CAM-PLEX also have spurred construction of several new motels (CCEDC 2008, City of Gillette 2008a).

The 2010 Wyoming Department of Transportation (WYDOT) State Transportation Improvement Program (STIP) includes planned construction for the 2010 fiscal year and preliminary engineering estimates for projects with anticipated construction dates through 2015. In general, Wyoming transportation projects scheduled over the next 6 years include maintenance, reconstruction, and improvement projects. Airport improvement plans consist primarily of pavement rehabilitation and overlays, with some minor expansion of taxiways, aprons, and parking. Costs anticipated for 2010 through 2015 for highway and airport maintenance, reconstruction, and improvement projects in the PRB Coal Review study area (Sheridan, Johnson and Campbell counties) are approximately $190 million. No construction of new highways is scheduled and no new airports are proposed (WYDOT 2010).

In addition to highway projects included in WYDOT's 2008-2013 plan, the Eagle Butte Mine received approval from WYDOT to relocate a portion of U.S. Highway 14-16 in the vicinity of the Gillette-Campbell County Airport, north of the city of Gillette. The relocation will facilitate the recovery of approximately 40 million tons of additional coal recently acquired by the mine through the West Eagle Butte LBA Tract coal sale. Three alternative alignments, involving the construction of up to 6.8 centerline miles of new roadway, were identified and a preferred alternative was subsequently chosen and approved by WYDOT. Construction of the new highway segment is anticipated in 2011/2012 (WYDOT and Foundation Coal Company 2008).

There are numerous current and anticipated plans for future investment in public and private infrastructure in the PRB. Such investments would include state and local investment in transportation, administrative, and educational facilities. Given the timing, scale, year-to-year variability, relatively short construction timetables associated with such investments, the existence of a relatively large and diversified construction industry in the region and nearby areas, and the limited potential for these projects to alter long-term conditions in the PRB, they are not included in the PRB Coal Review analysis. However, one or more of these and similar projects could warrant consideration in a cumulative analysis for a site-specific project due to proximity or coincidental project schedules and timetables (BLM 2009b).

4.2 Cumulative Environmental Consequences

Section 4.1 of this chapter discusses existing and projected levels of development in the Wyoming PRB, and includes summaries of the results of PRB Coal Review Task 2 studies. Task 2 was updated based on actual levels of development through 2007, and current development estimates available through year 2009. This section summarizes the existing conditions resulting from baseline year (2003) development and the cumulative environmental consequences of the projected development for 2010, 2015, and 2020 based on the results of the analyses conducted for PRB Coal Review Task 1 and 3 reports, respectively.

As discussed in Section 4.1, the Wyoming portion of the PRB is the primary focus of the PRB Coal Review analyses. For the majority of resources in the Task 1 analysis, the Wyoming PRB Coal Review study area encompasses all of Campbell County, all of Sheridan and Johnson counties outside of the Bighorn National Forest, and the northern portion of Converse County (Figure 4-1). The study areas for the Task 3 analyses are different. For the majority of the resources considered in the PRB Coal Review, the Task 3 study area is based on watershed boundaries in the PRB and includes the portions of the Upper Powder River, Little Powder River, Upper Belle Fourche River, Upper Cheyenne

River, Antelope Creek, and Dry Fork Cheyenne River subwatersheds that lie within Sheridan, Johnson, Campbell and northern Converse counties (Figure 4-4). This study area includes over 4 million acres and is referred to below as the cumulative study area. Table 4-10 summarizes the total disturbance and reclamation acreages for the baseline year of 2003 and actual data for 2007, as well as the total projected disturbance and reclamation acreages for 2010, 2015, and 2020 within the cumulative study area described above.

A total of approximately 210,096 acres of this land area had been disturbed by development activities as of 2003. Based on the information in Appendices A and D of the Task 2 Update Report for the PRB Coal Review – Past, Present and Reasonably Foreseeable Development Activities (BLM 2009b), a total of approximately 222,568 acres (5 percent) of land area have been disturbed by development activities in the cumulative effects study area as of end of 2007. Of the 222,568 acres of total cumulative disturbance, approximately 83,593 acres of disturbance (37 percent) were associated with coal mine development.

Of the 222,568 acres of total cumulative disturbance, approximately 113,382 acres (51 percent) have been reclaimed. The remaining 132,645 acres of disturbance would be reclaimed incrementally or following a project's completion, depending on the type of development activity and permit requirements. Of the 83,593 total cumulative acres of disturbance directly associated with coal mine development, approximately 25,884 acres (31 percent) have been reclaimed (as of end of 2007). Of the remaining 57,709 acres of disturbance, approximately 24,338 acres currently are not available for reclamation, as they are occupied by long-term facilities that are needed to conduct mining operations. These areas would be reclaimed near the end of each mine's life. Reclamation of the remaining 33,371 acres, which represent areas of active mining and areas where coal has been recovered but reclamation has not been completed, would proceed concurrently with coal mining.

The total cumulative disturbance is projected to increase to as much as 434,374 acres in 2020 under the upper coal production scenario, which would represent approximately 9.7 percent of the cumulative study area. This projected disturbance includes coal mining, coal-related development, and oil and gas and related development disturbance in the study area. Of the 434,374 acres, it is projected that 149,089 acres (34 percent) would be associated with coal mining activities. Areas reclaimed during each future time period shown in Table 4-10 reflect how much of the disturbed acreage is projected to be permanently reclaimed by that point in time.

Under the upper coal production scenario for 2020, of the 434,374 acres of total cumulative disturbance, approximately 296,670 (68 percent) would be reclaimed by 2020. The remaining 137,702 acres of disturbance would be reclaimed incrementally or following a project's completion, depending on the type of development activity and permit requirements. Of the 149,089 acres of disturbance associated with coal mining, it is projected that approximately

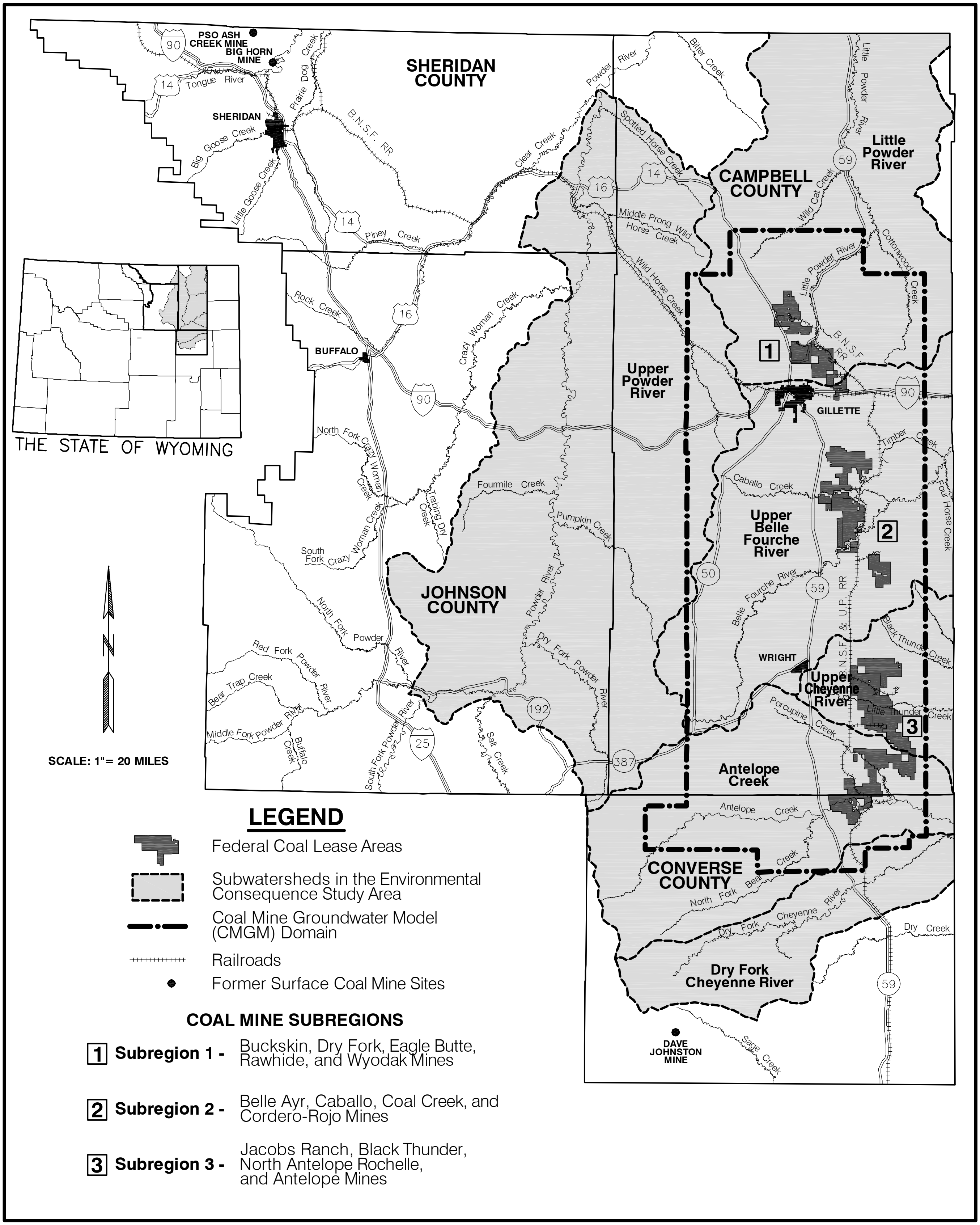


Figure 4-4. Wyoming Task 3 Study Area for PRB Coal Review Studies Evaluating Projected Environmental Consequences.

Table 4-10. Actual and Projected Wyoming PRB Total Development Scenario, Task 3 Study Area.

Year	Total Acres Disturbed	Acres Reclaimed	Acres Unreclaimed	Acres Unavailable for Reclamation[1]	Acres Affected by Coal Development[1]
			Actual		
2003	210,096	111,879	98,217	24,097	68,794
2007	222,568	113,382	132,645	24,338	83,593
	Projected Development - Lower Coal Production Scenario				
2010	278,209	159,291	118,919	26,338	98,662
2015	354,148	219,816	134,334	27,549	117,236
2020	422,727	289,937	132,789	28,797	137,443
	Projected Development - Upper Coal Production Scenario				
2010	281,996	161,124	120,872	25,688	102,448
2015	361,456	224,024	137,432	27,099	124,545
2020	434,374	296,670	137,702	28,345	149,089

[1] Includes coal mine and coal-related disturbance.
Source: PRB Coal Review Task 2 Update Report (BLM 2009b)

86,196 (58 percent) would be reclaimed by 2020. Of the remaining 62,893 acres of coal mining-related disturbance, it is estimated that approximately 28,345 acres would be unavailable for concurrent reclamation due to the presence of long-term facilities, which would be reclaimed near the end of each mine's life. Reclamation of the remaining 34,548 acres of disturbance would proceed concurrently with mining operations.

The acres of unreclaimed disturbance would be reclaimed incrementally or following a project's completion, depending on the type of development activity and permit requirements. The acres currently not available for reclamation are occupied by long-term facilities that are needed to conduct mining operations or coal-related activities. These areas would be reclaimed near the end of each mine or facility's life.

Adjustments were made to the study area described above and shown in Figure 4-4 for several resources as described below:

- The potential air quality impacts were evaluated over a multi-state area (including most of Wyoming, southeastern Montana, southwestern North Dakota, western South Dakota, and northwestern Nebraska) because they would be expected to extend beyond the Wyoming and Montana PRB study area that was used to identify emissions sources for the air quality analysis.

- The socioeconomic impact analysis focused on Campbell County, but also considered Converse, Crook, Johnson, Sheridan, and Weston counties as directly affected and Niobrara and Natrona counties as indirectly affected.

The groundwater drawdown was evaluated in the area surrounding and extending west of the surface coal mines, shown in Figure 4-4, because that is the area where groundwater drawdown related to surface coal mining operations and CBNG production operations would overlap.

4.2.1 Topography and Physiography

The PRB is located within the Upper Missouri Basin Broken Lands physiographic subprovince that includes northeastern Wyoming and eastern Montana to the Canadian border. The topography generally is of low to moderate relief with occasional buttes and mesas. The general topographic gradient slopes down gently from southwest to northeast with elevations ranging from 5,000 to 6,000 feet above sea level on the southern and western portions of the basin to less than 4,000 feet above sea level on the north and northeast along the Montana state line. The major drainages in the basin are the Tongue, Powder, Belle Fourche, and Cheyenne rivers. Most of the drainages in the area are intermittent and have flows during high precipitation events or during periods of snowmelt. The drainages are part of the upper Missouri River Valley drainage basin.

The disturbance associated with the majority of the past, present, and projected activities have resulted in or would result in the alteration of the surface topography. Surface coal mining, which is projected to continue in the area of the existing coal mines shown in Figure 4-4, permanently alters the topography by removing the overburden and coal and then replacing the overburden.

Recontouring during reclamation to match approximate original contours, as required by regulation, reduces the long-term impact to topography. After mined-out areas are reclaimed, the restored land surfaces are typically gentler, with more uniform slopes and restored basic drainage networks. Oil and gas exploration and development has occurred and is projected to continue throughout most of the Task 3 study area. It also results in the alteration of topography to accommodate facilities (e.g., well pads, power plants, etc.) and roads, but the disturbance tends to occur in smaller, more discrete areas than coal mining and the development is spread out over a larger area.

The disturbance and reclamation acreages associated with all existing and projected development in the Task 3 study area for the years 2003, 2007, 2010, 2015, and 2020 are given in Table 4-10.

4.2.2 Geology, Mineral Resources, and Paleontology

The cumulative effects study area for geology, mineral resources, and paleontology is the PRB Coal Review Task 3 study area (Figure 4-4).

The PRB is one of a number of structural basins in Wyoming and the Rocky Mountain area that were formed during the Laramide Orogeny. The basin is asymmetric with a structural axis that generally trends northwest to southeast along the western side of the basin (Flores et al. 1999). Natural earthquakes, landsides, and subsidence do not present a hazard in the PRB based on the lack of active faults in the study area (USGS 2004); the low risk of ground shaking in the region if a maximum credible earthquake were to occur (Frankel et al. 1997); and the absence of evidence of subsidence, landslides, or other geologic hazards in association with CBNG production. USGS monitors the magnitude of blasting activity in the PRB under the Routine Mining Seismicity Earthquake Hazards Program (USGS 2008). Coal mine blasting operations induced seismic activity does occur throughout the PRB and has reached a USGS local magnitude rating of 3.6 (USGS 2004).

4.2.2.1 Coal

Most of the coal resources of the basin are found in the Fort Union and Wasatch Formations. Although coals are present in the Wasatch, they are thinner and less continuous than the coals in the Fort Union and, therefore, they are not as economically important as the coals in the Fort Union for either coal mining or CBNG development. Projected levels of coal production and disturbance under the lower and upper coal production scenarios are shown in Tables 4-2 and 4-3.

In the coal mine areas, the overburden and coal would be removed and the overburden replaced, resulting in a permanent change in the geology of the area and a permanent reduction of coal resources.

4.2.2.2 Oil and Gas

Drilling for conventional oil and gas in the Wyoming PRB has declined considerably in the last 15 years. However, as discussed above, increasing prices have led to increased interest in drilling and there remains potential for finding and developing these resources in the deeper formations of the basin. Conversely, CBNG production increased rapidly from 1999 through 2002 but began to level off in 2003. Actual production rates for conventional oil and gas and CBNG in 2007 and projected rates for 2010, 2015, and 2020 are shown in Tables 4-6 and 4-7.

Oil and gas and related development accounts for most of the projected mineral disturbance outside of the coal mining areas. It generally would result in only shallow, discrete areas of surface disturbance, as discussed above. The acreages over which these impacts were occurring (as of 2003 and 2007) and are projected to occur in the years 2010, 2015, and 2020 are included in the totals shown in Table 4-10.

4.2.2.3 Other Mineral Resources

As discussed in Section 4.1.3.1, other mineral resources that are being mined in the Wyoming PRB include uranium, bentonite, clinker, and aggregate.

Production of uranium and bentonite is not likely to be affected by development of coal or CBNG in the PRB. Aggregate and clinker production levels are more likely to be affected by other mineral development levels because these resources would be used in construction projects related to other mineral development.

4.2.2.4 Paleontology

Scientifically significant paleontological resources, including vertebrate, invertebrate, plant, and trace fossils, are known to occur in many of the geologic formations within the Wyoming PRB. These fossils are documented in the scientific literature, in museum records, and are known by paleontologists and land managers familiar with the area.

The Wasatch Formation is the most geographically widespread unit exposed on the surface over most of the cumulative study area. It is underlain by the Fort Union Formation. The fossiliferous Morrison and Lance Formations crop out in the western portion of the basin but occur at depth in the vicinity of the coal mines and CBNG activity in the eastern portion of the basin. Within the cumulative study area, the highly fossiliferous White River Formation occurs only on Pumpkin Buttes in southwestern Campbell County.

As of 2007, no significant or unique paleontological localities had been recorded on federal lands in the PRB. However, the lack of localities in the PRB does not mean that scientifically significant fossils are not present, as much of the area within and surrounding the PRB has not been adequately explored for paleontological resources. As a result, development activities in the cumulative study area have the potential to adversely affect scientifically significant fossils, if they are present in or adjacent to disturbance areas.

The potential for impacts to scientifically significant fossils would be greatest in areas where Class 4 or 5 formations are present (see Section 3.3.3.1). The Wasatch Formation is classified as a Class 5 formation. The Fort Union Formation is classified as a Class 3 formation, which means that fossil content varies in significance, abundance, and predictable occurrence. The greatest potential impact to surface and subsurface fossils would result from disturbance of surface sediments and shallow bedrock during construction and/or operations, depending on the type of project. Potential subsurface disturbance of paleontological resources (e.g., during drilling operations) would not be visible or verifiable. The areas over which these impacts occurred as of 2003 and 2007, and are projected to occur as a result of all projected development in the years 2010, 2015, and 2020 are shown in Table 4-10. As only portions of the cumulative study area have been evaluated for the occurrence of paleontological resources, and discrete locations for development activities cannot be determined at this time, no accurate estimate can be made as to the number of paleontological sites that may be affected by cumulative development activities.

Development activities which involve federally owned surface and/or minerals are subject to federal guidelines and regulations protecting paleontological resources. Protection measures, permit conditions of approval, and/or mitigation measures would be determined on a project-specific basis at the time of permitting to minimize potential impacts to paleontological resources as a result of these activities.

4.2.3 Air Quality

There is substantial scientific evidence that increased atmospheric concentrations of greenhouse gases (GHG) and land use changes are contributing to an increase in average global temperature (IPCC 2007). However, since these gases are not regulated pollutants, a discussion of this subject has been included in Section 4.2.14.

The Task 1A Report for the PRB Coal Review (BLM 2005b) documents the modeled air quality impacts of operations during a baseline year, 2002, using actual emissions and operations for that year. Emissions from permitted minor sources were estimated, due to unavailability of actual emissions data. The baseline year analysis evaluated impacts both within the PRB itself and at selected sensitive areas surrounding the region. The analysis specifically looked at impacts of coal mines, power plants, CBNG development, and other development activities. Results were provided for both Wyoming and Montana at the individual receptor areas. The Task 2 Report for the PRB Coal Review (BLM 2005a) identifies reasonably foreseeable development activities for the years 2010, 2015, and 2020.

The Task 3A Report for the PRB Coal Review (BLM 2006b) evaluates the impacts on air quality and air quality-related values for the year 2010 using the development levels projected for 2010 and the same model and meteorological data that were used for the baseline year study in the Task 1A Report. BLM updated the model and conducted impact analysis for the year 2015 (BLM 2008h) The updated Task 3A report for the PRB Coal Review Cumulative Air Quality Effects for 2015 uses a revised baseline year of 2004 with revised projected 2015 scenarios. BLM subsequently updated the model and conducted impact analysis for the year 2020 (BLM 2009c). The updated Task 3A report for the PRB Coal Review Cumulative Air Quality Effects for 2020 uses the same baseline year of 2004 with revised projected 2020 scenarios. The revised baseline year emissions inventory was developed using 2004 actual emissions data or emissions estimates and has incorporated the recent analyses of emissions in Wyoming and Montana, which were not available when the 2010 modeling study was done.

Existing and projected emissions sources for the baseline year (2004) and 2015 and 2020 analyses were identified within a study area comprised of the following counties in the PRB in Wyoming and Montana:

- Campbell County, all of Sheridan and Johnson counties except the Bighorn National Forest lands to the west of the PRB, and the northern portion of Converse County, Wyoming.

- Rosebud, Custer, Powder River, Big Horn, and Treasure counties, Montana.

A state-of-the-art, guideline dispersion model was used to evaluate impacts of the existing and projected source emissions on several source groups, as follows:

- Near-field receptors in Wyoming and Montana covering the PRB Coal Review Task 1A and 3A study area in each state. Overall, the near-field receptor grid points were spaced at one kilometer intervals over the study area;

- Receptors in nearby federally designated pristine or "Class I" areas; and

- Receptors at other sensitive areas (Class II sensitive areas).

The EPA guideline CALPUFF model system version 5.8 (Scire et al. 1999a) was used for this study, which differs from the version used in the Task 1A and original Task 3A studies. The impacts for the baseline year (2004) and for 2015 and 2020 lower and upper coal production scenarios were directly modeled, and the criteria pollutants modeled were particulates (PM_{10} and $PM_{2.5}$), NO_2 and SO_2. As discussed above, the modeling domain extends over most of Wyoming, southeastern Montana, southwestern North Dakota, western South Dakota, and western Nebraska. An interagency group participated in developing the modeling protocol and related domain that were used for this analysis.

The modeling approach for the updated Task 3A Report used actual emissions from existing sources representative of 2004 operations and projected those emissions for the expected level of development in 2015 and in 2020. Year 2004 emission inventory data were previously developed for the Montana Statewide Oil and Gas Supplemental Environmental Impact Statement. No specific emissions data were available for the projected levels of development. The baseline year emissions data were gathered from a variety of sources, but mainly relied on data collected by the WDEQ/AQD and the Montana Department of Environmental Quality (MDEQ). Only actual emission sources inside the study area described above were included in the modeling. Key major sources were included, such as the coal-fired power plants, gas-fired power plants, and sources that were included in the Title V (operating permit) program. The Dave Johnston power plant, which is located outside of but adjacent to the study area in Converse County, was included in the baseline year study and in the projected emissions. Some operational adjustments were made to accommodate small sources with air permits that were presumed to be operating at less than full capacity. Emissions from other sources, including estimated construction-related fugitive dust emissions, were computed based on EPA emission factors and on input data from WDEQ/AQD.

The existing regional air quality conditions generally are very good in the PRB Coal Review Task 1A and Task 3A study area. There are limited air pollution emissions sources (few industrial facilities, including the surface coal mines, and few residential emissions in relatively small communities and isolated ranches) and good atmospheric dispersion conditions. The available data show that the region is in compliance with the ambient air quality standards for nitrogen dioxide (NO_2) and sulfur dioxide (SO_2). There have been no monitored exceedances of the annual particulates (PM_{10}) standard in the Wyoming PRB.

Air quality modeling indicates the projected mine activities at the three Wright area applicant mines will be in compliance with the PM_{10} and $PM_{2.5}$ near-field and short-term NO_2 air standards for the 2015 and 2020 modeled air quality impacts at their currently permitted mining rates. All applicants have indicated that they propose to mine the respective LBA tracts at a rate equal to or below the mines' current air quality permit levels. Visibility data collected around the region indicate that, although there are some days with notable impacts at Class I areas, the general trend in the region shows little change in visibility impacts at the Badlands and Wind Cave National Parks and the Bridger/Fitzpatrick and Cloud Peak Wilderness Areas over the period from 1989 to 2008 (Figure 3-19).

Predicted impacts from baseline year (2004) and projected 2015 and 2020 emissions were modeled for four air quality criteria pollutants (NO_2, SO_2, $PM_{2.5}$, and PM_{10}), along with changes in air quality-related values at Class I areas and at identified sensitive areas. For regulatory purposes, the Class I PSD (Prevention of Significant Deterioration) evaluations are not directly comparable to the air quality permitting requirements, because the modeling effort does not identify or separately evaluate increment consuming sources that would need to be evaluated under the PSD program. The cumulative impact analysis focuses on changes in cumulative impacts, but not on a comparison to PSD-related evaluations, which would apply to specific sources.

Table 4-11 presents the modeled impacts on ambient air quality at the near-field receptors in Montana and Wyoming. Results indicate the maximum impacts at any point in each receptor group, and data are provided for the baseline year (2004) analysis and for both coal production scenarios for 2015 and 2020. Peak impacts occur at isolated receptors and are likely due to unique source-receptor relationships. The model results should not be construed as predicting an actual exceedance of any standard, but are at best indicators of potential impacts.

The results of the modeling depict the anticipated changes under both development scenarios. For the Wyoming near-field receptors, the predicted impact of the 24-hour PM_{10} and $PM_{2.5}$ concentrations show localized exceedances of the National Ambient Air Quality Standard (NAAQS) for the

Table 4-11. Projected Maximum Potential Near-field Impacts (µg/m³).

Pollutant	Averaging Time	Base Year (2004) Impacts	2020 Lower Coal Development Scenario Impacts	2020 Upper Coal Development Scenario Impacts	NAAQS	Wyoming AAQS	Montana AAQS	PSD Class II Increments
Wyoming Near-field								
NO_2	Annual	31.3	30.5	30.6	100	100	---[1]	25
SO_2	Annual	15.3	16.4	16.5	80	60	---	20
	24-hour	112.3	143.3	143.3	365	260	---	91
	3-hour	462.0	936.7	936.7	1,300	1,300	---	512
$PM_{2.5}$	Annual	13.4	**16.3**	**16.3**	15	15	---	---
	24-hour	**87.6**	**218.4**	**218.4**	35	35	---	---
PM_{10}	Annual	38.4	46.6	46.6	---	50	---	17
	24-hour	**250.4**	**624.1**	**624.3**	150	150	---	30
Montana Near-field								
NO_2	Annual	3.3	2.5	2.6	100	---	100	25
	1-hour	409.0	440.1	442.7	188.1	---	564	---
SO_2	Annual	1.6	3.0	3.1	80	---	80	20
	24-hour	16.1	24.7	27.1	365	---	365	91
	3-hour	65.0	138.9	138.9	1,300	---	1,300	512
	1-hour	162.9	237.0	259.1	---	---	1,300	---
$PM_{2.5}$	Annual	1.0	0.9	0.9	15	---	15	---
	24-hour	10.2	10.2	10.2	35	---	35	---
PM_{10}	Annual	2.8	2.5	2.6	---	---	50	17
	24-hour	29.1	29.3	29.3	150	---	150	30

[1] Indicates no value, standard, or increment
Value units are microgram per cubic meter (µg/m³)
Bold values indicate projected exceedance of AAQS
Source: PRB Coal Review Task 3A Update Report (BLM 2009c)

baseline year (2004), as well as for both development scenarios for 2015 and 2020. The 2020 development scenarios show the concentration increases by a factor of 2.5 relative to the base year for these parameters. Additionally, while down about 10 percent from 2015, 2020 development scenarios show a 20 percent increase of annual PM_{10} and $PM_{2.5}$ concentrations at peak Wyoming near-field receptors. This level of increase indicated modeled exceedances of annual standards for $PM_{2.5}$. Impacts of NO_2 and SO_2 emissions are predicted to be below the NAAQS and Wyoming State Ambient Air Quality Standard (SAAQS) at the Wyoming near-field receptors.

Based on the modeling results, impacts at Montana near-field receptors would be in compliance with the Montana SAAQS for all pollutants and averaging periods. Importantly, the 1-hour NO_2 concentrations at Montana near-field receptors for 2015 were predicted to exceed the SAAQS at isolated locations due to CBNG development in Wyoming; however, with the anticipated southward progression of the CBNG wells, the 1-hour NO_2 concentrations in 2020 are predicted to remain below the SAAQS. However, the modeling results indicate that the 1-hour NO_2 concentrations at Montana near-field receptors for 2020 would exceed EPA's new 1-hour NAAQS (0.001 ppm or 188.1 $\mu g/m^3$). The southward progression of the CBNG wells also contributes to a predicted decrease in impacts for annual NO_2, PM_{10} and $PM_{2.5}$ relative to the baseline year. Although large percentage increases were predicted in SO_2 impacts, the levels would be below the ambient standards for all pollutants in the Montana near-field.

As discussed in Section 3.4.2.2.1, modeling tends to over-predict the 24-hour impacts of surface coal mining and, as a result, WDEQ/AQD does not consider short-term PM_{10} modeling to be an accurate representation of short-term impacts. In view of this, a Memorandum of Agreement between WDEQ/AQD and EPA Region VIII, dated January 24, 1994, allows WDEQ/AQD to conduct monitoring in lieu of short-term modeling for assessing coal mining-related impacts in the PRB. This agreement also requires "Best Available Work Practice" mitigation measures in all coal mine permits. The monitored exceedances at surface coal mines in the Wyoming PRB and the measures that WDEQ/AQD has implemented or is proposing to implement to prevent future exceedances of the PM_{10} NAAQS are discussed in Chapter 3, Sections 3.4.2.1 and 3.4.2.3.

The maximum modeled impacts on the annual $PM_{2.5}$ level is projected to be above the standard (15 $\mu g/m^3$) at near-field receptors in Wyoming for the 2015 and 2020 lower and upper coal production scenarios. Annual PM_{10} levels are projected to be above the standard (50 $\mu g/m^3$) at near-field receptors in Wyoming for 2015, and then to fall back below the standard for the 2020 lower and upper coal production scenarios. EPA has revoked the NAAQS annual PM_{10} standard of 50 $\mu g/m^3$, but until Wyoming enters into rule making to revise the WAAQS, that standard is still effective. WDEQ/AQD issues air quality permits for coal mining. AQD cannot issue any permit that violates Ambient Air Quality Standards. Impacts of NO_2 and SO_2 emissions are predicted to be below the NAAQS and Wyoming AAQS at all Wyoming near-field receptors. A large portion of the impacts for all scenarios would be associated with coal-related sources, although non-coal sources would contribute a notable portion of the impact.

Table 4-12 lists the three Class I areas and two Class II areas where the modeled impacts are the greatest. Table 4-12 includes a comparison to ambient air quality standards and PSD increments; however, it must be noted that this modeling analysis did not separate PSD increment-consuming sources from those that do not consume increment. The PSD-increment comparison is provided for informational purposes only and cannot be directly related to a regulatory interpretation of PSD increment consumption.

None of the modeled Class I areas currently have, or are predicted to have, NAAQS or SAAQS exceedances. Table 4-12 compares the modeled impacts to the PSD Class I and sensitive Class II increment levels. At the Northern Cheyenne Indian Reservation (IR), Badlands National Park (NP) and Wind Cave NP base year impacts are slightly above the Class I comparative levels for 24-hour PM_{10} in 2020. Additionally, the SO_2 impacts at the Northern Cheyenne IR for the 3-hour and 24-hour averaging period exceed the Class I PSD increment levels. In the other Class I areas, only the modeled 24-hour SO_2 impacts at Theodore Roosevelt NP and Fort Peck IR, and 3-hour SO_2 impacts at Theodore Roosevelt NP, are above the PSD increment levels for the 2020 development scenarios; the predicted exceedances for these areas are due to sources outside the PRB study area. In the sensitive Class II areas, there are no modeled exceedances of the Class II PSD Increments. The modeled annual NO_2 impacts at the Cloud Peak Wilderness Area (WA) and Crow IR are projected to increase by a factor of 2 to 4, respectively, in 2020 as a result of projected CBNG and coal hauling activities. For comparison purposes, modeling results for all sensitive Class II areas are below PSD increment levels for both 2020 development scenarios.

The projected modeled visibility impacts for the baseline year (2004) and for the lower and upper coal production scenarios for 2020 for all analyzed Class I and sensitive Class II areas are listed in Table 4-13. For the baseline year, the maximum visibility impacts at Class I areas were determined to be at the Northern Cheyenne Indian Reservation in Montana and at Wind Cave and Badlands National Parks in South Dakota. For these locations, modeling showed more than 200 days of impacts with a change of 10 percent or more in extinction. A 10 percent change in extinction corresponds to 1.0 deciview (dv).

Table 4-13 provides a detailed listing of visibility impacts for all analyzed Class I and sensitive Class II areas. As with the 2015 modeling results, 2020 modeled visibility impacts at the identified Class I areas continue to show a similar pattern as exhibited for the base year (2004), with a high number of days with a greater than 10 percent change in visibility at the most impacted Class I areas. Visibility impacts at Badlands NP, Northern Cheyenne IR, and Wind Cave NP all have greater than 10 percent change for more than 200 days

Table 4-12. Maximum Predicted PSD Class I and Sensitive Class II Area Impacts (μg/m³).

Location	Pollutant	Averaging Period	Base Year (2004) Impacts	2020 Lower Coal Development Scenario	2020 Upper Coal Development Scenario	PSD Class I/II Increments
			Class I Areas			
Northern Cheyenne Indian Reservation	NO_2	Annual	0.4	0.8	1.1	2.5
	SO_2	Annual	0.5	1.1	1.3	2
		24-hour	3.1	**7.1**	**12.8**	5
		3-hour	9.4	23.6	**39.7**	25
	$PM_{2.5}$	Annual	0.3	0.4	0.5	---[1]
		24-hour	3.4	4.5	4.6	---
	PM_{10}	Annual	0.9	1.2	1.5	4
		24-hour	**9.6**	**12.9**	**13.2**	8
Badlands National Park	NO_2	Annual	0.1	0.2	0.2	2.5
	SO_2	Annual	0.5	0.6	0.2	2
		24-hour	3.6	4.0	4.0	5
		3-hour	8.1	8.2	8.2	25
	$PM_{2.5}$	Annual	0.2	0.3	0.3	---
		24-hour	2.1	3.0	3.1	---
	PM_{10}	Annual	0.7	0.9	1.0	4
		24-hour	5.9	**8.5**	**8.8**	8
Wind Cave National Park	NO_2	Annual	0.2	0.3	0.3	2.5
	SO_2	Annual	0.7	0.8	0.8	2
		24-hour	3.7	4.6	4.7	5
		3-hour	7.0	7.5	7.7	25
	$PM_{2.5}$	Annual	0.4	0.5	0.5	---
		24-hour	3.8	4.6	4.7	---
	PM_{10}	Annual	1.0	1.4	1.4	4
		24-hour	**10.9**	**13.0**	**13.3**	8
			Sensitive Class II Areas			
Cloud Peak Wilderness Area	NO_2	Annual	0.06	0.12	0.12	25
	SO_2	Annual	0.2	0.3	0.3	20
		24-hour	2.0	2.5	2.5	91
		3-hour	8.0	8.9	9.0	512
	$PM_{2.5}$	Annual	0.2	0.2	0.2	---
		24-hour	2.6	3.2	3.39	---
	PM_{10}	Annual	0.5	0.7	0.7	17
		24-hour	7.4	9.1	9.3	30
Crow Indian Reservation	NO_2	Annual	0.9	3.6	4.2	25
	SO_2	Annual	2.3	2.4	2.7	20
		24-hour	14.4	14.8	14.8	91
		3-hour	76.8	77.0	77.0	512
	$PM_{2.5}$	Annual	0.8	0.8	0.8	---
		24-hour	7.2	7.2	7.2	---
	PM_{10}	Annual	2.2	2.3	2.4	17
		24-hour	20.5	20.6	20.6	30

[1] Indicates no increment
Value units are micrograms per cubic meter (μg/m³)
Bold values indicate exceedance of PSD increment
Source: PRB Coal Review Task 3A Update Report (BLM 2009c)

Table 4-13. Modeled Change in Visibility Impacts at Class I and Sensitive Class II Areas.

Location	Base Year (2004) No. of Days >10%	2020 Lower Coal Development Scenario Change in No. of Days >10%	2020 Upper Coal Development Scenario Change in No. of Days >10%
Class I Areas			
Badlands National Park	218	44	44
Bob Marshall WA	8	0	0
Bridger WA	144	5	5
Fitzpatrick WA	91	6	6
Fort Peck Indian Reservation	105	20	21
Gates of the Mountain WA	55	4	4
Grand Teton National Park	70	6	6
North Absaroka WA	61	8	8
North Cheyenne Indian Reservation	243	59	60
Red Rock Lakes	42	3	3
Scapegoat WA	27	2	2
Teton WA	57	8	8
Theodore Roosevelt National Park	178	24	24
UL Bend WA	77	18	18
Washakie WA	83	8	8
Wind Cave National Park	262	28	31
Yellowstone National Park	84	5	5
Sensitive Class II Areas			
Absaroka Beartooth WA	101	10	10
Agate Fossil Beds National Monument	251	26	26
Big Horn Canyon National Rec. Area	331	1	1
Black Elk WA	236	47	47
Cloud Peak WA	126	29	30
Crow Indian Reservation	360	3	3
Devils Tower National Monument	274	31	32
Fort Belknap Indian Reservation	66	14	15
Fort Laramie National Historic Site	260	15	16
Jedediah Smith WA	79	3	5
Jewel Cave National Monument	261	36	37
Lee Metcalf WA	97	2	2
Mount Naomi WA	51	1	1
Mount Rushmore National Monument	222	49	52
Popo Agie WA	139	6	6
Soldier Creek WA	268	19	19
Wellsville Mountain WA	130	17	17
Wind River Indian Reservation	217	9	10

Source: PRB Coal Review Task 3A Update Report (BLM 2009c)

a year during the base year. These Class I areas are the top three Class I areas with the highest predicted change in light extinction in 2020. All but four of the sensitive Class II areas have more than 100 days per year with greater than a 10 percent change during the base year. The most significant visibility change to sensitive Class II areas in 2020 is predicted for Black Elk WA and Mount Rushmore National Monument. Class II areas do not have any visibility protection under federal or state law. To provide a basis for discussing the modeled visibility impacts resulting from the projected increased production under the lower and upper coal production scenarios for 2020, the modeled visibility impacts for 2004 were subtracted from the model results for 2020. Table 4-13 shows the number of additional days that the projected impacts were greater than 1.0 dv (10 percent in extinction) for each site for the upper and lower coal production scenarios. Using Badlands Park as an example, the modeling analysis showed 218 days with impacts greater than 1.0 dv in 2004. Under the 2020 lower coal production scenario, the modeling analysis projects an additional 44 days with impacts greater than 1.0 dv, or a total of 262 days with impacts greater than 1.0 dv.

For acid deposition, all predicted impacts are below the deposition threshold values for both nitrogen and sulfur compounds. There are substantial percentage increases in deposition under the lower and upper coal production scenarios for 2015; however, impacts remain well below the nitrogen and sulfur levels of concern (1.5 and 5.0 kilograms per hectare per year, respectively).

The acid neutralizing capacity (ANC) of sensitive lakes also was analyzed, and results are summarized in Table 4-14. The base year study indicated that none of the lakes had predicted significant impacts except Upper Frozen Lake; however, the lower and upper development scenarios for 2020 show an increased impact at Florence Lake, leading to an impact above the 10 percent change in acid neutralizing capacity. Impacts also are predicted to be above 1 microequivalent per liter (μeq/L) for Upper Frozen Lake.

The study also modeled impacts of selected hazardous air pollutant emissions (benzene, ethyl benzene, formaldehyde, n-hexane, toluene, and xylene) on the receptors with the highest ambient impacts. The near-field receptors in Wyoming and Montana were analyzed for annual (chronic) and 1-hour (acute) impacts. Model results for the base year (2004) and 2020 development scenarios show that impacts are predicted to be well below the acute Reference Exposure Levels, non-carcinogenic Reference Concentrations for Chronic Inhalation, and carcinogenic risk threshold for all hazardous air pollutants. The maximally exposed individual's carcinogenic risk factor due to benzene exposure is predicted to increase 50 percent as a result of projected development in the PRB, however, even with this substantial increase, the predicted risk is well below U.S. Environmental Protection Agency (EPA) carcinogenic risk thresholds.

Comparing the PRB Coal Review updated Task 3A Report for 2020 (BLM 2009c) to the earlier update for 2015 shows a similar general increase in air quality

Table 4-14. Predicted Total Cumulative Change in Acid Neutralizing Capacity of Sensitive Lakes.

Location	Lake	Background ANC (µeq/L)	Area (hectares)	Base Year 2004 Change (percent)	2020 Lower Coal Development Scenario Change (percent)	2020 Upper Coal Development Scenario Change (percent)	Thresholds (percent)
Bridger Wilderness Area	Black Joe	67.0	890	4.00	4.26	4.27	10
	Deep	60.0	205	4.70	4.98	4.99	10
	Hobbs	70.0	293	3.95	4.14	4.15	10
	Upper Frozen	5.0	64.8	2.42	2.55	2.56	1[1]
Cloud Peak Wilderness Area	Emerald	55.3	293	5.24	6.69	6.30	10
	Florence	32.7	417	9.09	11.79	11.99	10
Fitzpatrick Wilderness Area	Ross	53.5	4,455	2.72	2.89	2.90	10
Popo Agie Wilderness Area	Lower Saddlebag	55.5	155	6.28	6.65	6.67	10

[1] Data for Upper Frozen Lake presented in changes in µeq/L rather than percent change. (For lakes with less than 25 µeq/L background ANC.)
Source: PRB Coal Review Task 3A Update Report (BLM 2009c)

effects over time compared to the base year. The production from conventional oil and gas activities is projected to peak at 2010, with slight declines predicted over the following decade. The production from CBNG activities was projected to peak at 2015, with slight declines predicted over the following decade; however the actual development has been slower than predicted and therefore the peak year has been shifted later. Therefore, from these sources, expected impacts have increased slightly from 2015 to 2020. The coal mining and CBNG sources would be the major contributors to PM_{10} and $PM_{2.5}$ impacts in the near-field between 2015 and 2020, and these impacts would result from the proximity of the receptors to the coal mining operations. As noted above, the general south and westward trend of CBNG activity has lowered NO_2 and particulate air quality effects projected in Montana by 2020.

Power plants currently are the major contributors to all SO_2 impacts in the near-field in both states. However, the projected impacts are well below any ambient standard or PSD increment. According to the PRB Coal Review Air Quality modeling analysis, predicted future expansion modeled to the year 2020 should not jeopardize the attainment of those standards. Impacts on NO_2 concentrations are the result of emissions from all the source groups. No one source group dominates the NO_2 impacts in the near-field.

A pattern that is similar to the near-field receptors holds true for the Class I and sensitive Class II receptor groups. Essentially, the mine operations would continue to dominate the PM_{10} and $PM_{2.5}$ impacts, the power plants would continue to dominate the SO_2 impacts (although they would continue to be below the standards), and the overall source groups would continue to contribute to NO_2 impacts. Impacts should remain below the annual NO_2 standard for 2015 and 2020 in Wyoming and Montana.

Based on modeling results, one of the lakes (Florence) in the Cloud Peak Class I area and one lake (Upper Frozen Lake) in the Bridger Class I area exceeded the acid deposition thresholds for both the lower and upper coal production scenarios for 2015. With the exception of Florence and Upper Frozen lakes, the projected increases in coal development (and power plants) are not expected to raise the deposition levels above the thresholds extended into 2020. The model results showed that the increased deposition, largely from SO_2 emissions from power plants, exceeded the thresholds of significance for the ANC at sensitive (high alpine) lakes. The results indicate that with increased growth in power plant operations, the reduced ANC of the sensitive lakes would need to be addressed carefully for each proposed major development project.

WDEQ/AQD and WDEQ/LQD mitigation and monitoring requirements for coal mine emissions are discussed in Sections 3.4.2.3 and 3.4.3.3. The discussion in these sections includes the operational control measures that are currently in place and would be required for mining operations on LBAs that are issued in the future, as well as measures that may be required to avoid future exceedances of the WAAQS and NAAQS and/or future mine-related impacts to the public.

4.2.4 Water Resources

Surface and groundwater are used extensively throughout the PRB for agricultural water supply, municipal water supply, and both domestic and industrial water supply. Surface water use is limited to major perennial drainages and agricultural areas within the basin are found mainly along these drainages. Reservoirs are also used throughout the basin for agricultural water supply. Municipal water supply comes from a combination of surface and groundwater. Domestic and industrial water supply primarily is from groundwater.

The PRB Coal Review Task 1B Report (BLM 2009d) describes the base year (2002) water resource conditions in the PRB study area, which comprises all of Campbell County, all of Sheridan and Johnson counties less the Bighorn National Forest lands to the west of the PRB, and the northern portion of Converse County (Figure 4-4). The Task 3B Report for the PRB Coal Review (BLM 2009e) presents potential future cumulative groundwater impacts in the area of CBNG development and coal mine expansion in the eastern PRB (Figure 4-4), and provides a cumulative impact assessment of surface water quality and channel stability from surface discharge of groundwater from CBNG development.

4.2.4.1 Groundwater

There are five main aquifers in the PRB Coal Review Task 1 and 3 study area (Figure 4-4) that can be used for water supply:

- Madison Aquifer System;
- Dakota Aquifer System;
- Fox Hills/Lance Aquifer System;
- Fort Union/Wasatch Aquifer System; and
- Quaternary Alluvial Aquifer System.

The Fort Union/Wasatch Aquifer System includes the coal and overburden aquifers that are directly affected by surface coal mining and CBNG development. It is also a major source of local water supply for domestic and stock water use. Table 4-15 shows the recoverable groundwater in the components of the Fort Union/Wasatch Aquifer System. The Wasatch Formation is more of a local aquifer, while the Fort Union Formation is a regional aquifer. The volumes of recoverable groundwater from the sandstones within the Wasatch/Tongue River Aquifer, the Lebo Confining Layer, and the Tullock Aquifer were determined from the volume of sandstone in each of these units multiplied by the 13 percent specific yield value for sandstone. Similarly, the volume of recoverable groundwater from the coals within the Wasatch/Tongue River was calculated from the volume of coal multiplied by the 0.4 percent specific yield value for coal.

Table 4-15. Recoverable Groundwater in the Fort Union/Wasatch Aquifer System in the PRB.

Hydrogeologic Unit	**Surface Area (acres)**	**Average Formation Thickness (ft)**	**Percentage of Sand/Coal**	**Average Sand/Coal Thickness (ft)**	**Specific Yield (percent)**	**Recoverable Groundwater (acre-feet)[1]**
Wasatch-Tongue River Aquifer Sandstones	5,615,609	2,035	50.0	1,018	13.0	743,121,790
Wasatch-Tongue River Aquifer Coals	4,988,873	2,035	6.2	126	0.4	2,516,519
Lebo Confining Layer Sandstones	6,992,929	1,009	33.0	250	13.0	227,137,339
Tullock Aquifer Sandstones	7,999,682	1,110	52.0	430	13.0	447,246,784

[1] Calculated by multiplying Surface Area × Average Sand/Coal Thickness × Specific Yield. These numbers vary slightly from the numbers presented in Table 3-5 of the Final Environmental Impact Statement and Proposed Plan Amendment for the PRB Oil and Gas Project.

Source: BLM 2003

As a result of statutory requirements and concerns, several studies and a number of modeling analyses have been conducted to help predict the impacts of surface coal mining on groundwater resources in the Wyoming portion of the PRB. Some of these studies and modeling analyses are discussed below.

In 1987, the U.S. Geological Survey (USGS), in cooperation with the WDEQ and Office of Surface Mining Reclamation and Enforcement (OSM), conducted a study of the hydrology of the eastern PRB. The resulting description of the cumulative hydrologic effects of all current and anticipated surface coal mining (as of 1987) was published in 1988 in the USGS Water-Resources Investigation Report entitled "*Cumulative Potential Hydrologic Impacts of Surface Coal Mining in the Eastern Powder River Structural Basin, Northeastern Wyoming,*" also known as the "USGS CHIA" (Martin et al. 1988). This report evaluates the potential cumulative groundwater impacts of surface coal mining in the area and is incorporated by reference into this EIS. The USGS CHIA analysis considered the proposed mining at the three applicant mines in the Wright area. It did not, however, evaluate potential groundwater impacts related to additional coal leasing in this area and it did not consider the potential for overlapping groundwater impacts from coal mining and CBNG development.

Each mine must assess the probable hydrologic consequences of mining as part of the mine permitting process. The WDEQ/LQD must evaluate the cumulative hydrologic impacts associated with each proposed mining operation before approving the mining and reclamation plan for each mine, and they must find that the cumulative hydrologic impacts of all anticipated mining would not cause material damage to the hydrologic balance outside of the permit area for each mine. As a result of these requirements, each existing approved mining permit includes an analysis of the hydrologic impacts of the surface coal mining proposed at that mine. If major amendments to mining and reclamation permits are proposed, then the potential cumulative impacts of the revisions must also be evaluated. If the six WAC LBA tracts are leased to the respective applicants, the existing mining and reclamation permits for each current mine must be revised and approved to include the new lease before it can be mined.

The PRB Oil and Gas Project FEIS (BLM 2003) includes a modeling analysis of the groundwater impacts if an additional 39,000 new CBNG wells are drilled in the PRB by the end of 2011. The project area for this EIS, which covers all of Campbell, Sheridan, and Johnson counties, as well as the northern portion of Converse County, is similar to the study area for the PRB Coal Review Task 1 and Task 2 study area (Figure 4-4).

The coal mine groundwater monitoring data are published each year by the Gillette Area Groundwater Monitoring Organization (GAGMO), a voluntary group formed in 1980. Members of GAGMO include most of the companies with operating or proposed mines in the Wyoming PRB, WDEQ, Wyoming State Engineer's Office (SEO), BLM, USGS, and OSM. GAGMO contracts with an independent firm each year to publish the annual monitoring results. GAGMO also periodically publishes reports summarizing the water monitoring data collected since 1980 in the Wyoming PRB (e.g., Hydro-Engineering 1991, 1996, 2001, and 2007).

Another source of data on the impacts of surface coal mining on groundwater is the monitoring that is required by WDEQ/LQD and administered by the mining operators. Each mine is required to monitor groundwater levels and quality in the affected coal aquifers, in the shallower aquifers (overburden and alluvium), and in the subcoal aquifers in the area surrounding their operations. Monitoring wells are also required to record water levels and water quality in reclaimed areas. Hydrologic monitoring data and analyses are submitted to the WDEQ/LQD annually.

The cumulative impacts to groundwater resources associated with large scale surface coal mining in the eastern PRB have been identified as five major issues:

1. The extent of the temporary lowering of static water levels in the aquifers around the mines due to dewatering associated with removal of aquifers within the mine boundaries.

2. Potential overlapping drawdown due to proximity of coal mining and CBNG development.

3. The effect of the removal of the coal aquifer and any overburden aquifers within the mine area and replacement of these aquifers with backfill material.

4. Changes in groundwater quality as a result of mining.

5. The effects of the use of water from the subcoal Fort Union Formation by the mines.

The first major issue is the extent of water level drawdown in the coal and shallower aquifers in the area surrounding the mines. In general, the saturated sand aquifers in the Wasatch Formation overburden have limited extent and, as a result, the drawdowns in the Wasatch Formation are much smaller and cover much less area than the coal drawdowns.

The GAGMO 25-year report provides actual groundwater drawdown information after 25 years of mining (Hydro-Engineering 2007). Of the 530 monitoring wells included in the GAGMO 25-year report, 195 are completed in the Upper Fort Union (or Wyodak) coal beds and 193 are completed in the overlying sediments or interburden between the coal beds located within and near the mine sites in the eastern PRB. The balance of the monitoring wells are completed in local alluvial aquifers or in strata below the lowest coal seam mined. Since 1996, some BLM monitor wells have been included in the GAGMO reports.

The USGS CHIA predicted the approximate area of 5 feet or more water level decline in the Wyodak coal aquifer which would result from "all anticipated coal mining." "All anticipated coal mining" included 16 surface coal mines operating at the time the report was prepared and six additional mines proposed at that time. All of the currently producing mines, including the three applicant mines in the Wright area, were considered in the USGS CHIA analysis (Martin et al. 1988). The study predicted that water supply wells completed in the coal may be affected as far away as 8 miles from mine pits, although the effects at that distance were predicted to be minimal.

As drawdown propagates to the west, available drawdown in the coal aquifer increases. Available drawdown is defined as the elevation difference between the potentiometric surface (elevation to which water will rise in a well bore) and the bottom of the aquifer. Proceeding west, the coal depth increases faster than the potentiometric surface declines, so available drawdown in the coal increases. Since the depth to coal increases, most stock and domestic wells are completed in units above the coal. Consequently, with the exception of CBNG wells, few wells are completed in the coal in the areas west of the mines. Those wells completed in the coal have considerable available drawdown, so it is unlikely that surface coal mining would cause adverse impacts to wells outside the immediate mine area.

Wells in the Wasatch Formation were predicted to be impacted by drawdown only if they were within 2,000 feet of a mine pit (Martin et al. 1988). Drawdown occurs farther from the mine pits in the coal than in the shallower aquifers because the coal is a confined aquifer that is areally extensive. The area in which the shallower aquifers (Wasatch Formation, alluvium, and clinker) experience a 5-feet drawdown would be much smaller than the area of drawdown in the coal because the shallower aquifers are generally discontinuous, of limited areal extent, and often unconfined.

When the USGS CHIA was prepared in 1988 there were about 1,200 water supply wells within the maximum impact area defined in that study. Of those wells, about 580 were completed in Wasatch aquifers, about 100 in the Upper Fort Union (or Wyodak coal) aquifer, and about 280 in strata below the coal. There were no completion data available for the remainder of the wells (about 240) at that time.

The WDEQ/LQD Cumulative Hydrologic Impact Assessment of Coal Mining in the Southern Powder River Basin (WDEQ-CHIA-19) (Ogle and Calle 2006) examined the cumulative hydrologic impact of coal mining in the Wright subregion to determine the potential for material damage to the hydrologic system. Analysis of the cumulative impacts as a result of mining was performed by qualitatively assessing the additive impacts of these mines. Each mine is required by WDEQ/LQD to evaluate the impacts to the hydrologic resources and will typically model groundwater level drawdown using the most conservative, worst-case scenario. The extent of the 5-feet drawdown contour is used by WDEQ/LQD to assess the extent of the impact to the groundwater system caused by mining operations. The predicted maximum 5-foot drawdown contour for the Wyodak coal aquifer from all four Wright area coal mines (Jacobs Ranch, Black Thunder, North Antelope Rochelle, and Antelope) was superimposed by Ogle and Calle (2006) to generate the 5-foot cumulative estimate. The areal extent of cumulative drawdown within the Wyodak coal aquifer with the addition of the six WAC LBA tracts to the Jacobs Ranch, Black Thunder and North Antelope Rochelle mines, as defined by the 5-foot drawdown contour, was extrapolated using the WDEQ-CHIA-19 prediction and is depicted in Figure 4-5.

If the six WAC LBA tracts are leased and mined, the groundwater drawdown would be extended into the area surrounding the proposed new leases. When a lease is issued to an existing mine for a maintenance tract, the mine must revise its existing mining permit to include the new tract in its mine and reclamation plans. In order to do that, the lessee would be required to conduct a detailed groundwater analysis to predict the extent of drawdown in the coal and overburden aquifers caused by mining the new lease. WDEQ/LQD would use the revised drawdown predictions to update their cumulative hydrologic impact analysis (WDEQ-CHIA) for this portion of the PRB. The applicants have installed monitoring wells that would be used to confirm or refute drawdown predicted by analysis. These analyses would be required as part of the WDEQ mine permitting procedure, which is discussed in Chapter 1 of this EIS.

The PRB Coal Review Task 2 Report (BLM 2009b) defines the past and present development actions in the PRB study area, which comprises all of Campbell County, all of Sheridan and Johnson counties less the Bighorn National Forest lands, and the northern portion of Converse County (Figure 4-4). The Task 2

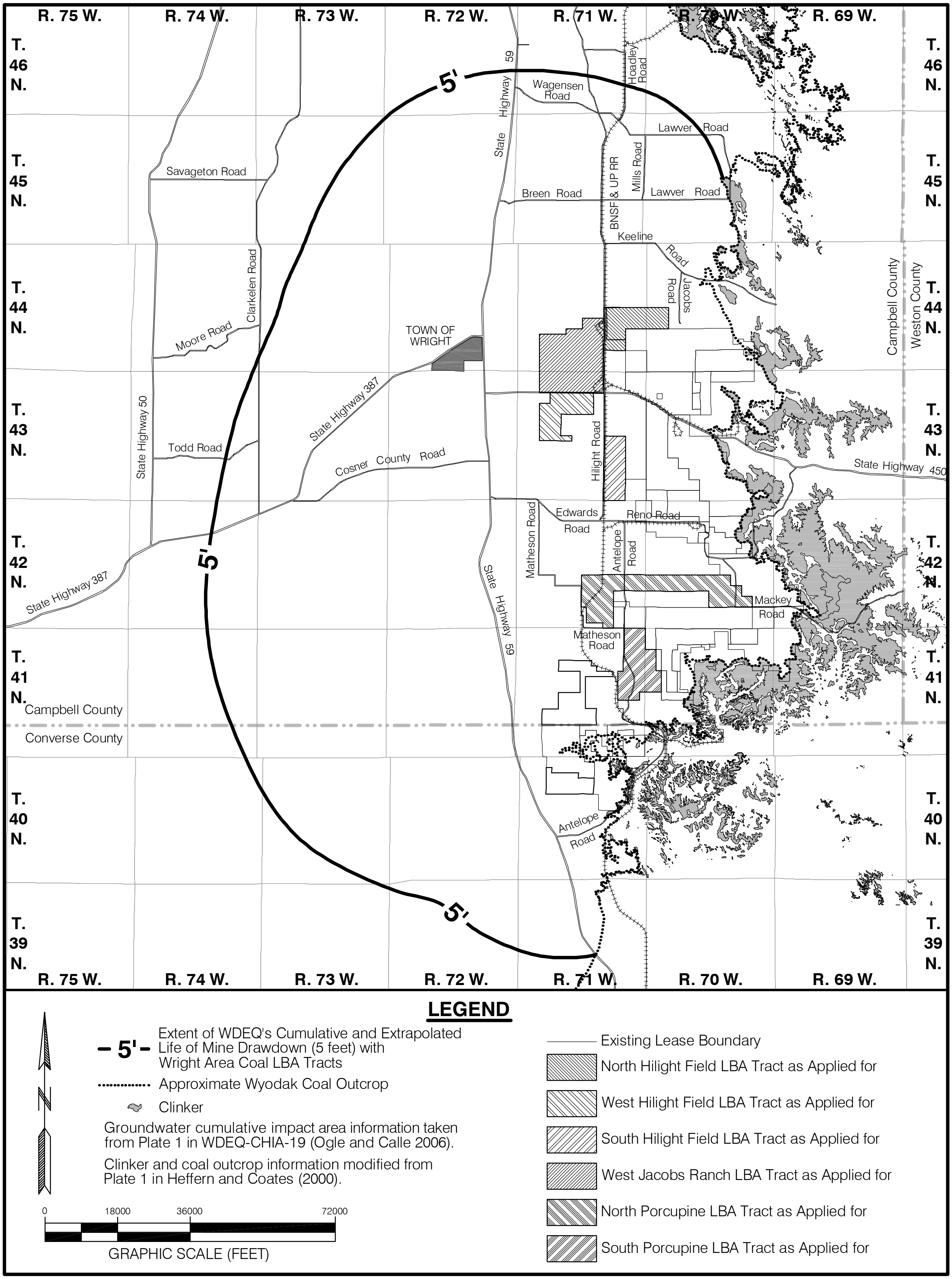


Figure 4-5. Extrapolated Extent of Life of Mine Cumulative Drawdown Within the Wyodak Coal Aquifer With the Addition of Wright Area Coal LBA Tracts.

report also defines the projected reasonably foreseeable development (RFD) scenarios in the PRB for years 2010, 2015, and 2020, and provides the basis for the analysis of potential cumulative impacts in the Task 3 component of the study.

The PRB Coal Review Task 3B Report (BLM 2009e) summarizes the modeled changes in groundwater levels projected for 2010, 2015, and 2020 in the eastern PRB within approximately 25 miles of the coal mines. The cumulative effects study area for water resources encompasses the groundwater model domain (Figure 4-4), with emphasis placed on the overlap in the coal mine- and CBNG-related groundwater drawdown area. Projected groundwater level changes primarily are due to CBNG groundwater withdrawal in the Upper Fort Union Formation and to both CBNG pumping and discharge along with coal mine pit dewatering in the Wasatch Formation. Near the coal mines, coal mine dewatering of the Upper Fort Union also has affected groundwater levels in that formation. Groundwater level recovery in the eastern PRB after the cessation of both CBNG development and coal mining, and the effect on groundwater flow paths associated with coal mine pit backfill and reclamation after the cessation of coal mining in the eastern PRB also were modeled and the results are included in the Task 3B report. For purposes of modeling groundwater recovery, it was assumed that CBNG development in the eastern PRB would cease by 2030 and surface coal mining would cease by 2050 (BLM 2009e).

The Task 3B report describes the modeled cumulative groundwater impacts associated with ongoing coal mine-related groundwater withdrawal in the eastern PRB for the time periods of 2010, 2015, and 2020, and the base years used for comparison of groundwater impacts were 2002 (the year used for calibration of the groundwater model) and 1990 (a time period prior to CBNG pumpage and before major expansion by the eastern PRB coal mines). The eastern PRB cumulative effects study area for water resources comprises the Coal Mine Groundwater Model (CMGM) domain as shown in Figure 4-4 (BLM 2009e). The CMGM was developed specifically for the PRB Coal Review study. The GAGMO databases for 1990 to 2002 were used to calibrate the groundwater model to best reflect conditions in the basin.

The primary objective of the Task 3B report is to provide an estimate of potential future cumulative impacts to water resources in the eastern PRB of Wyoming due to CBNG development and coal mining for the target years 2010, 2015, and 2020. To accomplish that objective, the Task 3B report evaluated the potential groundwater impacts due only to coal mine dewatering. The projected locations of coal mine pits from 2002 to 2020 were used for placement of drain cells in the groundwater model that represent pumpage of groundwater by the mines. The amount of water removed by the drain cells reflects calibration to GAGMO monitoring wells surrounding each mine, rather than estimated or recorded discharge rates (BLM 2009e).

Projected groundwater level changes in the Wasatch generally are due to coal mine dewatering and CBNG pumping and discharge, which generally result in local mounding of groundwater in the Wasatch near CBNG fields and drawdown near the coal mines (BLM 2009e). The Wasatch Formation is not a true aquifer in that it has only discontinuous water-bearing sand units not consistent and uniform groundwater level over the eastern PRB; therefore, groundwater level drawdowns due to mining are very localized and in close proximity to the mine operation. For the Upper Fort Union, groundwater level changes are due to CBNG pumpage and coal mine dewatering. Between 2002 and 2020, the projected reduction in coal mine dewatering and the expected reduction in CBNG pumpage from Wright northward toward Gillette are projected to result in a rebound of groundwater levels both within the coal mine boundaries and especially within the basin west of the coal mines (BLM 2009e).

Based on the results of the CMGM, the effect of coal mine dewatering on the Upper Fort Union from 1990 to 2010 in Subregion 3 is a cumulative drawdown ranging from approximately 50 to 250 feet in the vicinity of the Antelope and North Antelope Rochelle mines, and from 50 to 150 feet in the vicinity of the Black Thunder and Jacobs Ranch mines. The 25-foot drawdown contour was projected to be less than 3 miles west of the four Wright area mines' western-most boundaries (Figure 4-6). The modeled drawdown in the Upper Fort Union due to coal mine dewatering from 1990 to 2020 in Subregion 3 indicated there is approximately 50 to 100 feet of groundwater rebound in area of the Subregion 3 mines due to a reduction in coal mine dewatering and ongoing reclamation. Drawdown in the Upper Fort Union attributable to mining only from 1990 to 2020 ranges from 25 to 125 feet in the active mine areas with up to 125 feet of rebound in the reclaimed areas. The location of the 25-foot drawdown contour was projected to be essentially the same as the 25-foot drawdown limit in 2010; 3 miles or less west of the Subregion 3 mines (Figure 4-7) (BLM 2009e).

The second issue of concern is the potential for cumulative impacts to groundwater resources due to the proximity of coal mining and CBNG development. The Upper Fort Union (Wyodak) coal is being developed by mining and CBNG production in the same general area. Dewatering activities associated with CBNG development have overlapped with and expanded the area of groundwater drawdown in the coal aquifer in the PRB over what would occur due to coal mining development alone, and this would be expected to continue.

Numerical groundwater flow modeling was used to predict the impacts of the cumulative stresses imposed by mining and CBNG development on the Upper Fort Union Formation coal aquifer in the PRB Oil and Gas Project EIS (BLM 2003). Modeling was necessary because of the large areal extent, variability, and cumulative stresses imposed by mining and CBNG development on the Fort Union coal aquifers. Information from earlier studies was incorporated into the modeling effort for this analysis. As expected, the modeling indicated that the groundwater impacts from CBNG development and surface coal mining would be additive in nature and that the addition of CBNG development

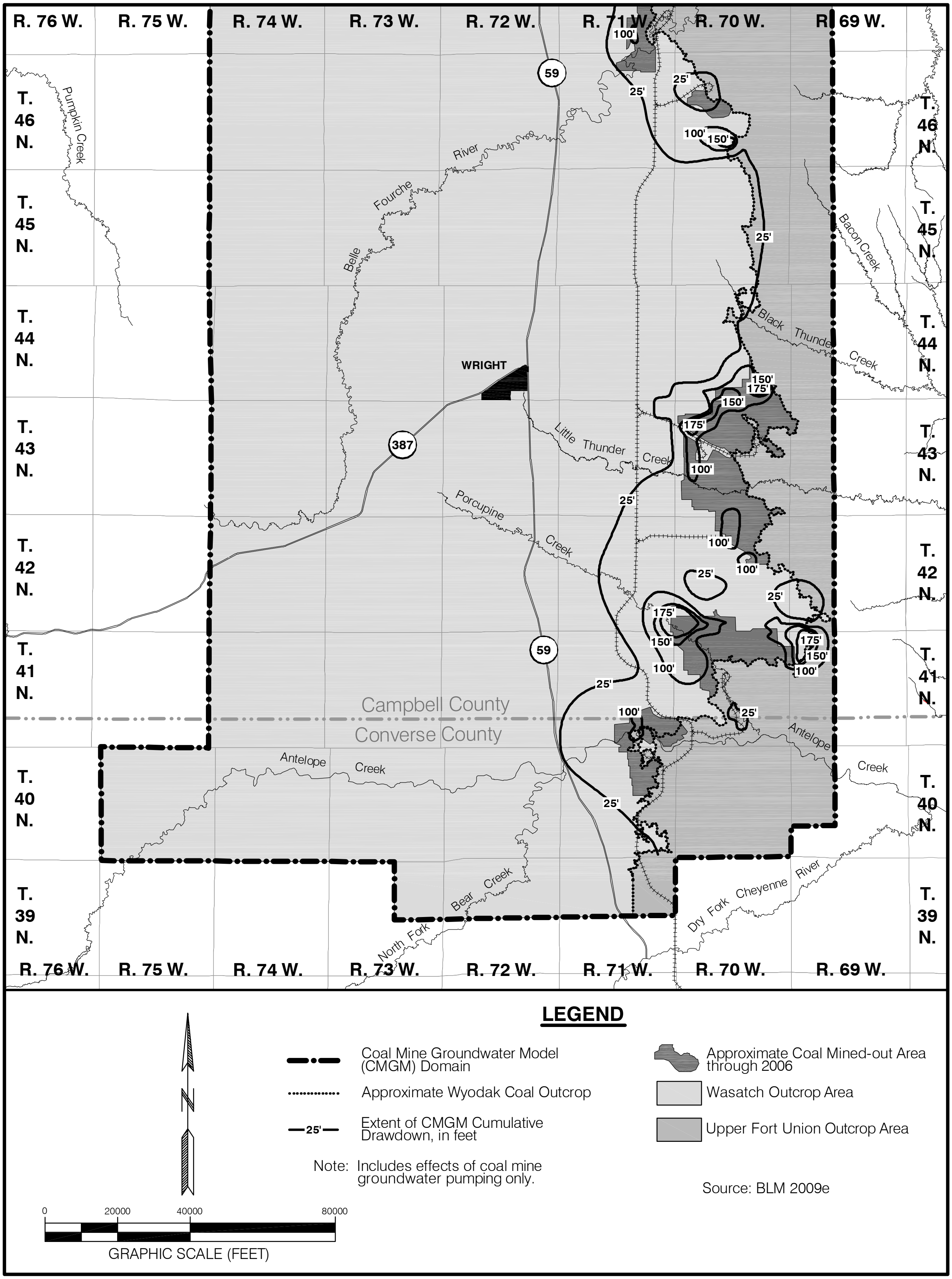


Figure 4-6. Coal Mine Groundwater Model, Upper Fort Union Formation, 1990-2010 Coal Mine-related Groundwater Level Drawdown.

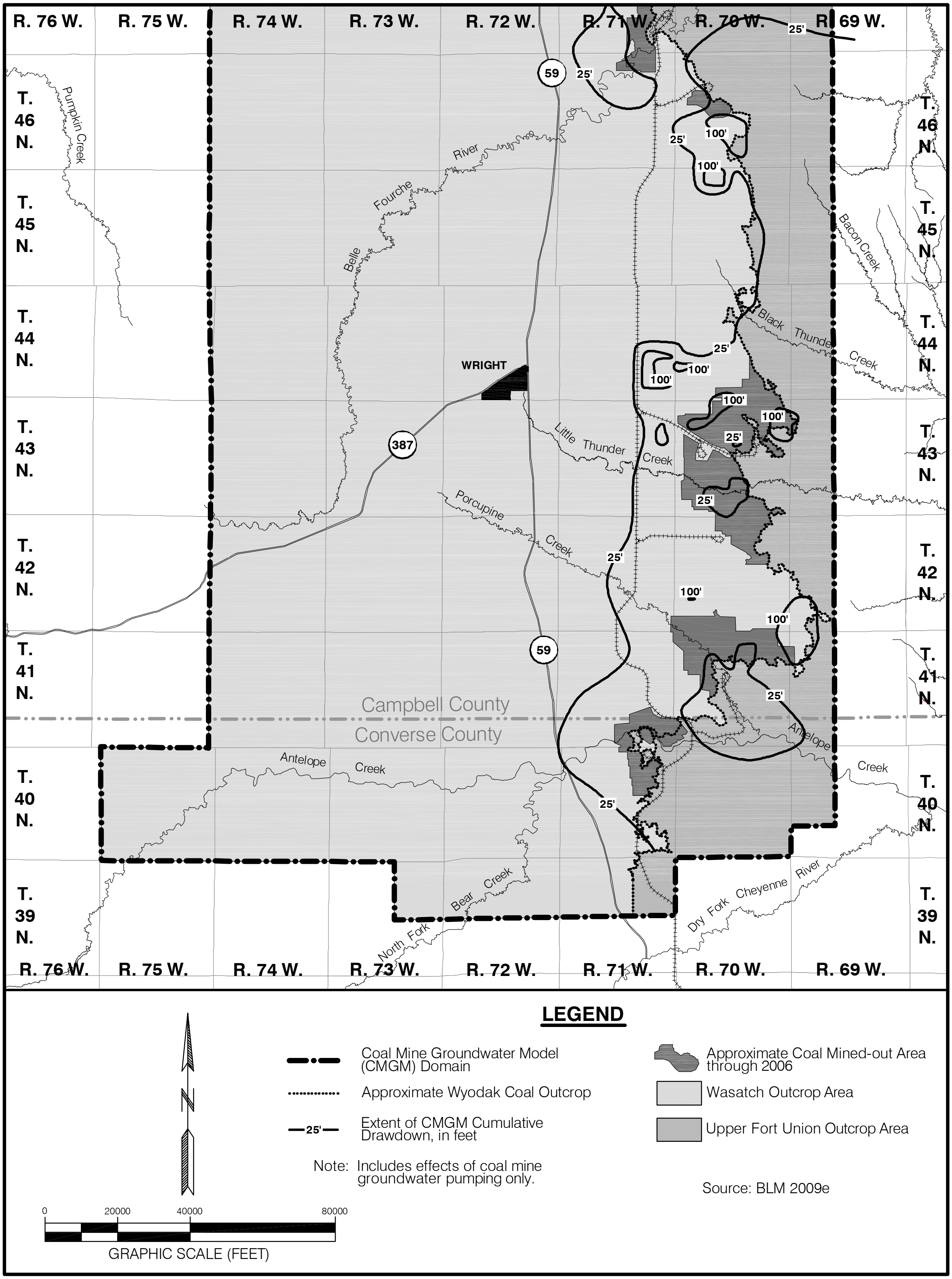


Figure 4-7. Coal Mine Groundwater Model, Upper Fort Union Formation, 1990-2020 Coal Mine-related Groundwater Level Drawdown.

would extend the area experiencing a loss in hydraulic head to the west of the mining area. The GAGMO 25-year Report stated that drawdowns in all areas have greatly increased due to the water production from the Wyodak coal aquifer by CBNG producers (Hydro-Engineering 2007).

As previously stated, the PRB Coal Review Task 2 Report (BLM 2009b) defines the projected RFD scenarios in the PRB for years 2010, 2015, and 2020, and provides the basis for the analysis of potential cumulative impacts in the Task 3 component of the study. The Task 3B Report (BLM 2009e) summarizes the modeled changes in groundwater levels projected for 2010, 2015, and 2020 in the eastern PRB within approximately 25 miles of the coal mines. Projected groundwater level changes primarily are due to CBNG groundwater withdrawal in the Upper Fort Union Formation and to both CBNG pumping and discharge along with coal mine pit dewatering in the Wasatch Formation. Groundwater level recovery in the eastern PRB after the cessation of both CBNG development and coal mining, and the effect on groundwater flow paths associated with coal mine pit backfill and reclamation after the cessation of coal mining in the eastern PRB also were modeled and the results are included in the Task 3B report. For purposes of modeling groundwater recovery, it was assumed that CBNG development in the eastern PRB would cease by 2030 and surface coal mining would cease by 2050 (BLM 2009e).

The Task 3B report describes the modeled cumulative groundwater impacts associated with ongoing CBNG-related groundwater withdrawal in the eastern PRB for the time periods of 2010, 2015, and 2020, and the base years used for comparison of groundwater impacts were 2002 (the year used for calibration of the groundwater model) and 1990 (a time period prior to CBNG pumpage and before major expansion by the eastern PRB coal mines).

The primary objective of the Task 3B report is to provide an estimate of potential future cumulative impacts to water resources in the eastern PRB of Wyoming due to CBNG development and coal mining for the target years 2010, 2015, and 2020. To accomplish that objective, the Task 3B report evaluated the potential groundwater impacts due only to CBNG development by estimating groundwater pumpage rates through analysis of past patterns in CBNG development and groundwater pumpage in the eastern PRB. The locations of surface discharge of groundwater (outfalls) were represented in the CMGM as recharge cells to allow for infiltration of discharge water into the Wasatch Formation (BLM 2009e).

Projected groundwater level changes in the Wasatch generally are due to coal mine dewatering and CBNG pumping and discharge, which generally result in local mounding of groundwater in the Wasatch near CBNG fields and drawdown near the coal mines (BLM 2009e). For the Upper Fort Union, groundwater level changes are due to CBNG pumpage and coal mine dewatering. Between 2002 and 2020, the expected reduction in coal mine dewatering and CBNG pumpage from Wright northward toward Gillette are projected to result in a rebound of groundwater levels both within the coal mine boundaries and especially within the basin west of the coal mines (BLM 2009e).

Based on the results of the CMGM, the effect of CBNG pumpage on the Upper Fort Union from 1990 to 2010 in Subregion 3 results in an extensive area of drawdown centered just southwest of Wright, covering nearly 15 townships and drawdowns range from 25 feet on the southern margin to 575 feet in the center of the depression (Figure 4-8). The modeled drawdown in the Upper Fort Union due to CBNG pumpage from 1990 to 2020 in Subregion 3 is projected to primarily be located southwest of Wright, producing a groundwater depression of between 25 to 425 feet that covers roughly eight to nine townships (Figure 4-9) (BLM 2009e).

There is a potential for conflicts to occur over who (coal mining or CBNG operators) is responsible for replacing or repairing private wells that are adversely affected by the drawdowns; however, the number of potentially affected wells completed in the coal is not large. As discussed previously, coal companies are required by state and federal law to mitigate any water rights that are interrupted, discontinued, or diminished by coal mining. In response to concerns about the potential impacts of CBNG development on water rights, a group of CBNG operators and local landowners developed a standard water well monitoring and mitigation agreement that can be used on a case-by-case basis as development proceeds. All CBNG operators on federal oil and gas leases are required to offer this water well agreement to the surface landowners (BLM 2003).

The effect of replacing the coal and overburden with backfill is the third major groundwater issue of concern. The following discussion of recharge, movement, and discharge of water in the backfill aquifer is excerpted from the USGS CHIA (Martin et al. 1988):

> Postmining recharge, movement, and discharge of groundwater in the Wasatch aquifer and Wyodak coal aquifer will probably not be substantially different from premining conditions. Recharge rates and mechanisms will not change substantially. Hydraulic conductivity of the spoil aquifer will be approximately the same as in the Wyodak coal aquifer allowing groundwater to move from recharge areas where clinker is present east of mine areas through the spoil aquifer to the undisturbed Wasatch aquifer and Wyodak coal aquifer to the west.

Monitoring data verify that recharge has occurred and is continuing in the backfill (Hydro-Engineering 1991, 1996, 2001, and 2007). The water monitoring summary reports prepared each year by GAGMO list current water levels in the monitoring wells completed in the backfill and compare them with the 1980 water levels, as estimated from the 1980 coal water-level contour maps. In the 1991 GAGMO 10-year report, some recharge had occurred in 88 percent of the 51 backfill wells reported at that time (Hydro-Engineering 1991). In the GAGMO 20-year report, 79 percent of the 82 backfill wells measured

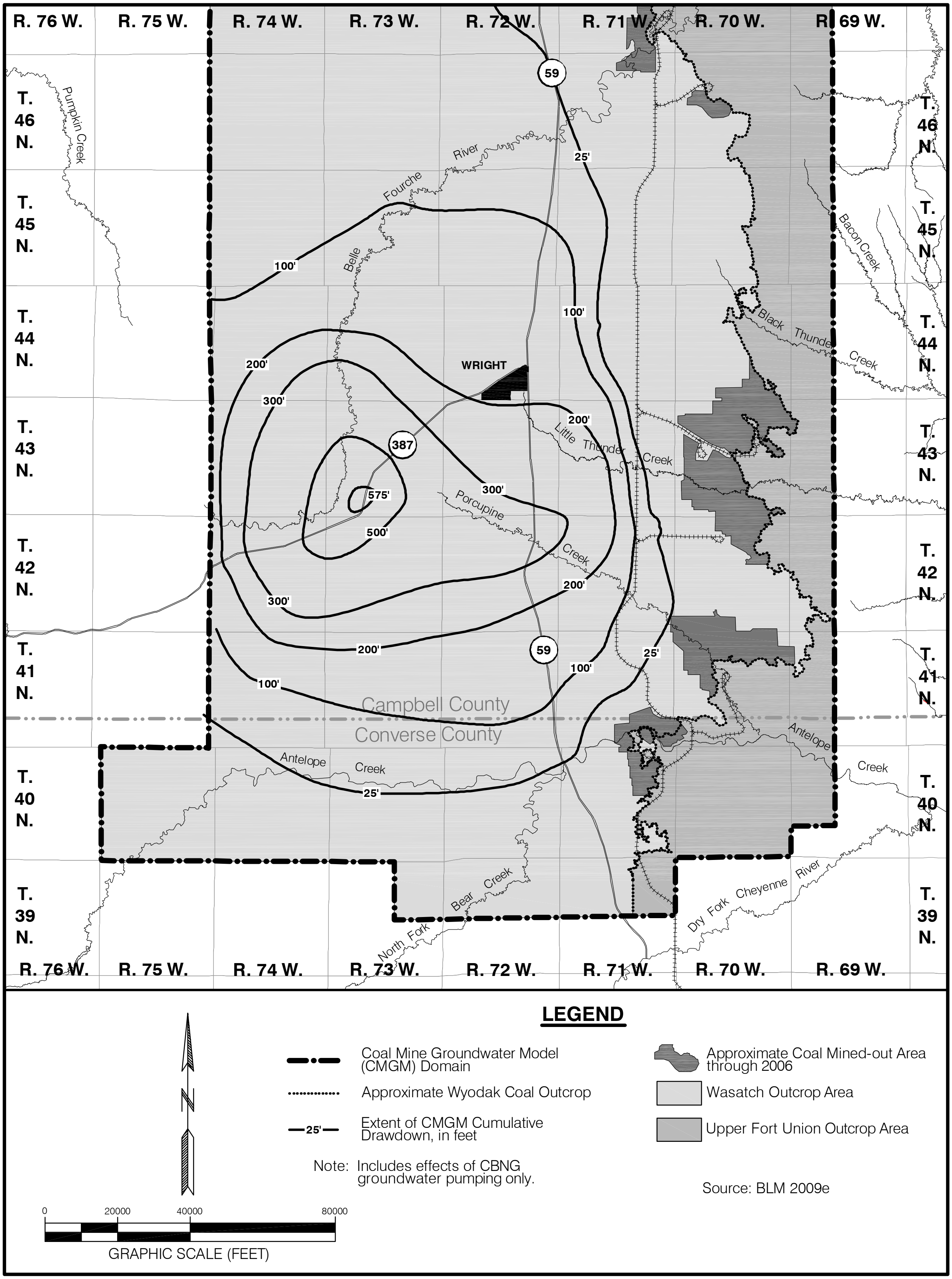


Figure 4-8. Coal Mine Groundwater Model, Upper Fort Union Formation, 1990-2010 Coal Bed Natural Gas-related Groundwater Level Drawdown.

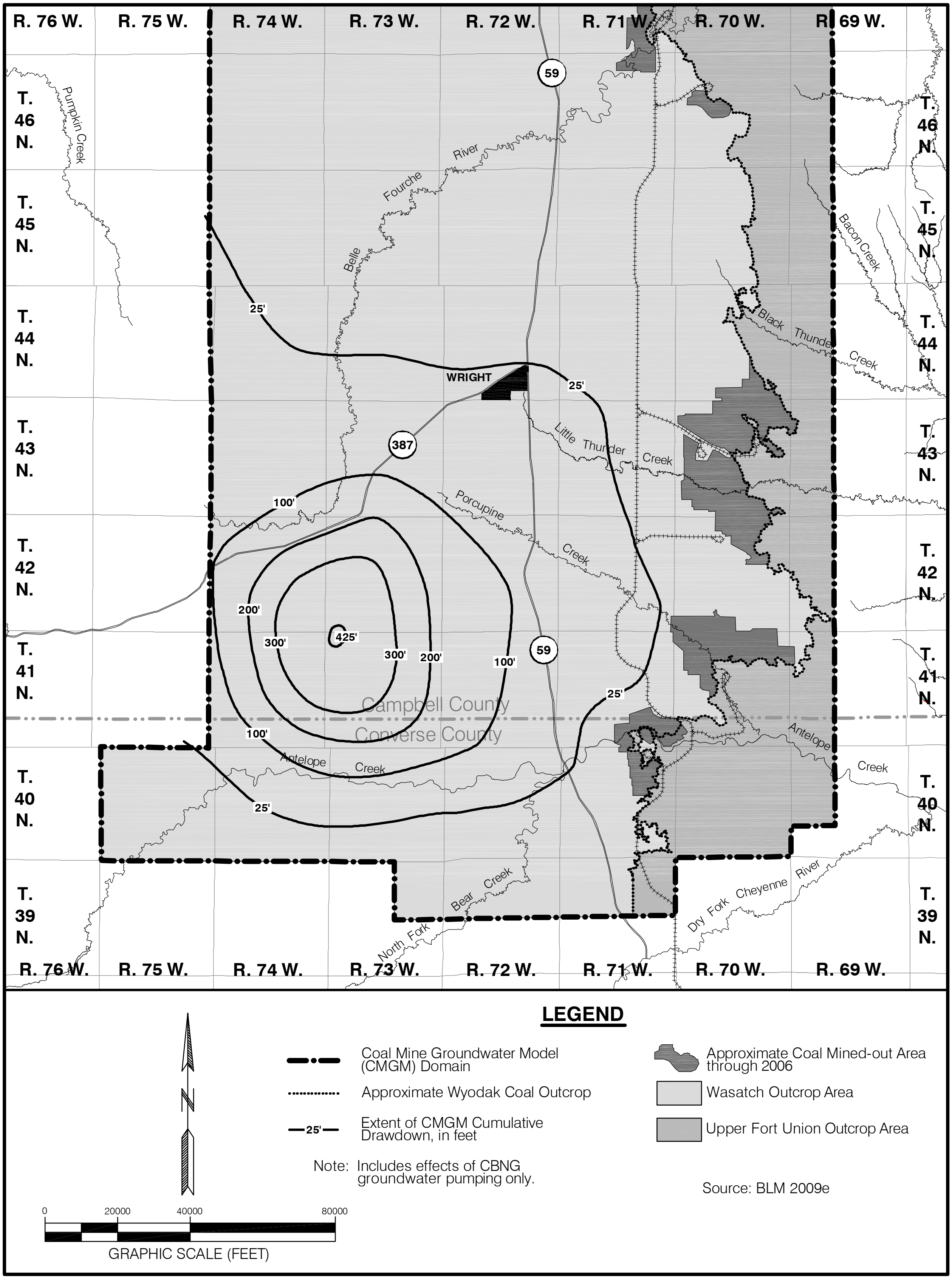


Figure 4-9. Coal Mine Groundwater Model, Upper Fort Union Formation, 1990-2020 Coal Bed Natural Gas-related Groundwater Level Drawdown.

contained water (Hydro-Engineering 2001). In the GAGMO 25-year report, 8.6 percent of the 101 backfill wells measured contained water (Hydro-Engineering 2007).

The outcrop areas of the Fort Union coal seams are zones of burned coal referred to as clinker (or scoria). These are zones of high secondary permeability and are the main recharge zones for the Fort Union Formation (BLM 2009d). Clinker occurs all along the coal outcrop at the eastern edge of the PRB study area, and is a major groundwater recharge source for the backfill just as it is for the coal aquifer. Some clinker is mined for road-surfacing material, but saturated clinker is not generally mined since abundant clinker exists above the water table and does not present the mining problems that would result from mining saturated clinker. Therefore, the major recharge source for the backfill aquifer is not being disturbed by current mining. Clinker occurs in localized areas on only the North Hilight Field and North Porcupine LBA Tracts configured under Alternative 2, BLM's preferred alternative.

The cumulative size of the backfill area in the PRB and the duration of mining activity would be increased by mining the currently pending LBA tracts, including the six WAC LBA tracts. Because the mined-out areas are being backfilled and the monitoring data demonstrate that recharge of the backfill is occurring, substantial additional cumulative impacts are not anticipated as a result of the pending leasing actions.

The PRB Coal Review Task 3B Report (BLM 2009e) summarizes the modeled recovery of groundwater levels once the CBNG development and coal mining operations have ceased. For CBNG development, it was assumed that groundwater pumping in the eastern PRB would end in 2030. For coal mining, it was assumed that open-pit dewatering in advance of mining, as well as mine reclamation, would end in 2050. Groundwater recovery related to the cessation of coal mining started in year 2050, with groundwater discharge rates remaining constant at the projected 2020 rate from year 2020 to 2050. The Upper Fort Union shows recovery after 50 to 100 years (2100 to 2150) and substantial recovery after 200 years (year 2250). Both the Wasatch and Upper Fort Union are projected to rebound and reach approximately 80 percent of steady-state after 300 to 500 years, or between years 2350 and 2550. When the Fort Union and Wasatch formations of the eastern PRB recover to near steady-state conditions, based on the resaturation modeling, groundwater will flow through the coal mine backfill aquifers and westward into the PRB (BLM 2009e).

The fourth issue of concern with respect to cumulative groundwater impacts is the effect of mining on water quality. Specifically, what effect does mining have on the water quality in the surrounding area, and what are the potential water quality problems in the backfill aquifer following mining?

In the Wyoming PRB, the backfill material gradually resaturates with water as groundwater from the Wasatch Aquifer and the Fort Union coal bed aquifers enters the backfill material. In a regional study of the cumulative impacts of coal mining, the median concentrations of dissolved solids and sulfates were found to be higher in water from backfill aquifers than in water from either the Wasatch Formation overburden or the Wyodak coal aquifer (Martin et al. 1988). This is expected because blasting and movement of the overburden materials exposes more surface area to water, increasing dissolution of soluble materials, particularly from the overburden materials that were situated above the saturated zone in the premining environment.

One pore volume of water is the volume of water that would be required to saturate the backfill following reclamation. The time required for one pore volume of water to pass through the backfill aquifer is greater than the time required for the postmining groundwater system to reestablish equilibrium. According to the USGS CHIA, estimates of the time required to reestablish equilibrium range from tens to hundreds of years (Martin et al. 1988).

The major current use of water from the aquifers being replaced by the backfill (the Wasatch Formation overburden and Fort Union coal aquifers) is for livestock because these aquifers are typically too high in dissolved solids for domestic use and well yields are typically too low for irrigation (Martin et al. 1988). Chemical analyses of 336 samples collected between 1981 and 1986 from 45 wells completed in backfill aquifers at 10 mines indicated that the quality of water in the backfill will, in general, meet the state standard for livestock use of 5,000 milligrams per liter (mg/L) for total dissolved solids (TDS) when recharge occurs (Martin et al. 1988).

Water quality samples from coal mine backfill monitor wells in along the eastern PRB typically have a pH between 6.0 and 7.8, TDS in the range of 1,000 to 4,000 mg/L, bicarbonate values ranging from 500 to 1,300 mg/L, sodium in the range of 200 to 800 mg/L, high sulfate values ranging from 1,000 to 3,500 mg/L, and SAR values in the range of 2.0 to 7.0 (Hydro-Engineering 2001). The 2000 Annual GAGMO report (Hydro-Engineering 2001) evaluated samples from 48 backfill wells in 1999 and found that the TDS in 75 percent were less than 5,000 mg/L, TDS in 23 percent were between 5,000 and 10,000 mg/L, and TDS in one well was above 10,000 mg/L. An analysis of about 2,000 samples collected from 95 backfill monitoring wells between 1986 and 2002 found that the water quality in 75 percent of the wells were within the acceptable range for the Wyoming livestock standard, with 25 percent exceeding that standard (Ogle 2004).

WDEQ/LQD calculated a median TDS concentration of 3,293 mg/L for the backfill aquifer in the east-central area of the PRB, which includes the four mines located immediately south of Gillette, based on 1,384 samples (Ogle et al. 2005). These results suggest that the TDS in the backfill aquifer in the middle group of mines meets the requirements for livestock use and is similar to TDS found in the undisturbed Wasatch Formation overburden but typically larger than TDS found in the Wyodak coal aquifer. The 2005 Annual GAGMO report (Hydro-Engineering 2006) indicates that TDS concentrations in 2005 ranged from 656 mg/L at well RW2804 (at the Belle Ayr Mine) to 12,409 mg/L at well SP-4-NA (at the North Antelope Rochelle Mine). The GAGMO 25-Year Report (Hydro-Engineering 2007) reported samples collected from 57 backfill monitoring wells, and of the last samples that were collected from those wells in 2005, the TDS concentrations ranged from a low of 656 mg/L to and high of 12,409 mg/L, with an average of 3,800 mg/L and a median of 3,670 mg/L. 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). The incremental effect on groundwater quality due to leasing and mining the six WAC LBA tracts would be to increase the total volume of backfill and, thus, the time for equilibrium to reestablish.

The PRB Coal Review Task 3B Report (BLM 2009e) predicts that resaturation of coal mine pit backfill to form backfill aquifers may take approximately 100 years after cessation of mining and is projected to result in the westward migration of groundwater with elevated TDS levels. Modeling of this westward migration indicates that TDS levels should be down to the average background value of 1,000 mg/L within 2,000 feet of the final westward extent of the coal mine boundaries. Thus, no impact to groundwater quality in either the Wasatch or Upper Fort Union aquifers is expected beyond approximately 2,000 feet west of the final coal mine boundaries (BLM 2009e).

Potential water-level decline in the subcoal Fort Union Formation is the fifth major groundwater issue. Water level declines in the Tullock Aquifer have been documented in the Gillette area. According to Crist (1991), these declines are most likely attributable to pumpage for municipal use by Gillette and for use at subdivisions and trailer parks in and near the city of Gillette. Most of the water-level declines in the subcoal Fort Union wells occur within one mile of the pumped wells (Crist 1991, Martin et al. 1988). Most of the mines have water supply wells completed in zones below the lowest coal seam mined (e.g., subcoal Fort Union Formation and the underlying Lance-Fox Hills aquifer), but the mine facilities in the PRB are separated by a distance of one mile or more, so little interference between mine supply wells would be expected (refer to Section 3.5.1.2).

In response to concerns voiced by regulatory personnel, several mines have conducted impact studies of the subcoal Fort Union Formation. The OSM also commissioned a cumulative impact study of the subcoal Fort Union Formation to address the effects of mine facility wells on this aquifer (OSM 1984). Conclusions from these studies are similar and may be summarized as follows:

- Because of the discontinuous nature of the sands in this formation and because most large-yield wells are completed in several different sands, it is difficult to correlate completion intervals between wells.

- In the Gillette area, water levels in this aquifer have probably declined because the city of Gillette and several subdivisions have utilized water from the formation (Crist 1991). (Note: Gillette is mixing Fort Union Formation water with water from wells completed in the Madison Formation. Also, because drawdown has occurred, some operators are able to dispose of CBNG water by injecting it into the subcoal Fort Union Formation near the city of Gillette.)

- Because large saturated thicknesses are available (locally) in this aquifer unit, generally 500 feet or more, a drawdown of 100 to 200 feet in the vicinity of a pumped well would not dewater the aquifer.

Most of the existing coal mines in the PRB have permits from the Wyoming SEO for subcoal Fort Union Formation water supply wells. Four industrial water supply wells are completed in the Fort Union Formation and one industrial supply well is completed in the underlying Lance-Fox Hills aquifer within Black Thunder Mine's existing permit area. The Jacobs Ranch Mine uses five wells completed in the subcoal Fort Union Formation for industrial water supply. The North Antelope Rochelle Mine uses four wells completed in the subcoal Fort Union Formation and one well completed in the Lance-Fox Hills aquifer for industrial water supply. Locations of the three applicant mines' water supply wells are shown on Figures 3-20, 3-21, and 3-22, respectively. Extending the life of the three WAC mines by issuing new leases would result in additional water being withdrawn from the subcoal Fort Union Formation and Lance-Fox Hills aquifer systems, but no new subcoal water supply wells would be required. The additional water withdrawal would not be expected to extend the area of water level drawdown over a substantially larger area due to the discontinuous nature of the sands in the Tullock Member and the fact that drawdown and yield reach equilibrium in a well due to recharge effects. Due to the distances separating subcoal Fort Union Formation and Lance-Fox Hills aquifer wells used for mine water supply, these wells have not experienced interference and are not likely to in the future.

Water requirements and sources for proposed power plants are not currently known, however, there are no proposed power plants in the immediate vicinity of the three WAC mines. The Wyoming SEO is discouraging further development of the lower Fort Union Formation aquifers, so the most likely groundwater source for future power plants is the Lance-Fox Hills aquifer system. This would reduce the chances that the power plants would add to cumulative hydrologic impacts of mining and CBNG production.

4.2.4.2 Surface Water

The Powder River structural basin of Wyoming, often referred to as the PRB, encompasses five major drainages. The drainages in the northern portion of the basin include the Powder River, Tongue River, and Little Powder River. In the central and southern parts of the basin, the major drainages are the Belle Fourche and Cheyenne rivers. Surface water flows to the north into Montana in the northern part of the basin and to the east-northeast into South Dakota in the southern and central parts of the basin. The discussion of water resources in the PRB focuses on two main issues: 1) current water use in the basin, and 2) industrial use of water resources by the coal mines and CBNG industries. The discussion of water use in Wyoming PRB study area is divided into two major water planning areas: the Powder/Tongue River Basin and the Northeast Wyoming River Basins (BLM 2009d).

The main rivers in the Powder/Tongue River Basin are the Tongue River and the Powder River. The Powder/Tongue River Basin receives substantial surface water runoff from the Big Horn Mountains, leading to major agricultural development along drainages in the Tongue River and Powder River basins. Reservoirs are used throughout the basin for agricultural water supply and for municipal water supply in the Powder/Tongue River Basin. Water use in the Powder/Tongue River Basin as of 2002 is summarized in Table 4-16.

Table 4-16. Water Use as of 2002 in the Powder/Tongue River Basins (acre-feet per year).

	Dry Year		**Normal Year**		**Wet Year**	
Water Use Categories	**Surface Water**	**Ground-water**	**Surface Water**	**Ground-water**	**Surface Water**	**Ground-water**
Agricultural	178,000	200	184,000	200	194,000	300
Municipal	2,700	500	2,700	500	2,700	500
Domestic	---	4,400	---	4,400	---	4,400
Industrial[1]	---	68,000	---	68,000	---	68,000
Recreation			Non-consumptive			
Environmental			Non-consumptive			
Evaporation	11,300	--	11,300	--	11,300	--
Total	**192,000**	**73,100**	**198,000**	**73,100**	**208,000**	**73,200**

[1] Includes conventional oil and gas production water and CBNG production water.
Source: HKM Engineering et al. 2002a

The Little Bighorn River, Tongue River, Powder River, Crazy Woman Creek, and Piney Creek carry the largest natural flows in the Powder/Tongue River Basin. Many of the other major drainages are affected by irrigation practices to the extent that their flows are not natural (HKM Engineering et al. 2002a). Water availability in the major sub-basins of the Powder/Tongue River Basin is summarized in Table 4-17. This table presents the amount of surface water in acre-feet that is physically available above and beyond allocated surface water in these drainages. As a result of the Yellowstone River Compact, Wyoming

Table 4-17. Surface Water Availability in the Powder/Tongue River Basins.

Sub-basin	Surface Water Availability (acre-feet per year) Wet Years	Normal Years	Dry Years
Little Bighorn River	152,000	113,000	81,000
Tongue River	473,000	326,000	218,000
Clear Creek	213,000	124,000	80,000
Crazy Woman Creek	69,000	32,000	16,000
Powder River	547,000	324,000	16,000
Little Powder River	48,000	12,000	3,000
Total	**1,502,000**	**931,000**	**414,000**

Source: HKM Engineering et al. 2002a

must share some of the physically available surface water in the Powder/Tongue River Basin with Montana.

The main rivers in the Northeast Wyoming River Basins are the Belle Fourche in Campbell and Crook counties and the Cheyenne River in Converse, Weston, and Niobrara counties. Water in these rivers and their tributaries comes from groundwater baseline flow and from precipitation, especially from heavy storms during the summer months. Most surface flow in Northeast Wyoming River Basins is intermittent to ephemeral and streamflows are typically dominated by irrigation practices to the extent that their flows are unnatural (HKM Engineering et al. 2002a). Water use in the Northeast Wyoming River Basins as of 2002 is summarized in Table 4-18.

Table 4-18. Water Use as of 2002 in the Northeast Wyoming River Basins (acre-feet per year).

Water Use Categories	Dry Year		Normal Year		Wet Year	
	Surface Water	Ground-water	Surface Water	Ground-water	Surface Water	Ground-water
Agricultural	65,000	11,000	69,000	17,000	71,000	17,000
Municipal	---	9,100	---	9,100	---	9,100
Domestic	---	3,600	---	3,600	---	3,600
Industrial[1]	---	46,000	---	46,000	---	46,000
Industrial (Other)[2]	---	4,700	---	4,700	---	4,700
Recreation	Non-consumptive					
Environmental	Non-consumptive					
Evaporation (Key Reservoirs)	14,000	---	14,000	---	14,000	---
Evaporation (Stock Ponds)	6,300	---	6,300	---	6,300	---
Total	**85,300**	**74,400**	**89,300**	**80,400**	**91,300**	**80,400**

1 Includes conventional oil and gas production water and CBNG production water.
2 Includes electricity generation, coal mining, and oil refining.
Source: HKM Engineering et al. 2002b

Stream flow in the major drainages of the Northeast Wyoming River Basins is much less than in the Powder/Tongue River Basin, due to the absence of a major mountain range to provide snow melt runoff. Water availability in the major sub-basins of the Northeast Wyoming Rivers Basin is summarized in Table 4-19.

Table 4-19. Surface Water Availability in the Northeast Wyoming River Basins.

Sub-basin	Surface Water Availability (acre-feet per year) Wet Years	Normal Years	Dry Years
Redwater Creek	34,000	26,000	17,000
Beaver Creek	30,000	20,000	14,000
Cheyenne River	103,000	31,000	5,000
Belle Fourche River	151,000	71,000	13,000
Total	**318,000**	**148,000**	**49,000**

Source: HKM Engineering et al. 2002b

The PRB Coal Review Task 3B Report (BLM 2009e) summarizes the modeled changes in surface water quality as a result of CBNG, conventional oil and gas, and surface coal mining development projected for 2010, 2015, and 2020 in the eastern PRB within approximately 25 miles of the coal mines. The base year used for comparison of surface water quality impacts was 2003. A stream channel stability analysis was also conducted to evaluate the potential effects to stream channels due to projected CBNG production water discharge. The surface water resources in the cumulative study area consist primarily of intermittent and ephemeral streams and scattered ponds and reservoirs. A major impact of the projected development activities would be direct surface disturbance of these surface water features. Projected cumulative surface water impacts primarily include the impacts of CBNG production water discharge to ephemeral drainages and the surface disturbance and subsequent reclamation of drainages that result from coal mine expansion.

Surface water quality impacts for target years 2010, 2015, and 2020 were estimated using a linear model developed by ACE (2009) and the projected water discharge volumes presented in the PRB Coal Review Task 2 Report (BLM 2009b). Projected changes in surface water quality are due to mixing of predicted CBNG production water discharge with natural flow in the modeled drainages. For CBNG discharge, the direct discharge to ephemeral drainages for each drainage basin was used as a guide for modeling water quality or estimating impacts to channel stability and channel properties. For the coal mines, most of the water produced was expected to be consumed, according to estimates provided by the mine operators and included in the Task 2 report. Where production exceeded estimated consumption for the coal mines in any given drainage basin, it was assumed that the discharged water would go first to holding ponds and then to nearby ephemeral drainages in accordance with Wyoming Pollution Discharge Elimination System (WYPDES) permits, thereby minimizing the potential for degradation of water quality and impacts to channel stability.

Table 4-10 summarizes the cumulative baseline (2003), actual (2007), and projected (in 2010, 2015, and 2020) acres of surface disturbance and reclamation. The projected activities would result in surface disturbance in each of the six subwatersheds in the cumulative study area (Figure 4-4). Discrete locations for development disturbance and reclamation areas cannot be determined based on existing information. However, the projected disturbance would primarily involve the construction of additional linear facilities, product gathering lines, and road systems associated with conventional oil and gas and CBNG activities, plus additional disturbance associated with extending coal mining operations onto lands adjacent to the existing mines.

Surface disturbing activities can result in sediment input to water bodies, which affects water quality parameters such as turbidity and bottom substrate composition. Contaminants also can be introduced into water bodies through chemical characteristics of the sediment. Studies have shown that TDS levels in streams near reclaimed coal mine areas have increased from 1 to 7 percent (Martin et al. 1988). Typically, sedimentation effects are short-term in duration and localized in terms of the affected area. Suspended sediment concentrations would stabilize and return to typical background concentrations after construction or development activities have been completed. It is anticipated that sediment input associated with development disturbance areas would be minimized by implementation of appropriate erosion control measures, as would be determined during future permitting.

Future coal mining could remove intermittent or ephemeral streams and stock ponds in the Little Powder River, Upper Belle Fourche River, Upper Cheyenne River, and Antelope Creek subwatersheds. As discussed in Section 3.5.2, the WAC mines are in the Cheyenne River subwatershed. Coal mine permits provide for removal of first- through fourth-order drainages. During reclamation, third- and fourth-order drainages must be restored; first- and second-order drainages often are not replaced (Martin et al. 1988).

Coal mining-related surface water would be discharged into intermittent and ephemeral streams in four subwatersheds (Antelope Creek, Little Powder River, Upper Belle Fourche River, and Upper Cheyenne River). Based on current trends, it is assumed that most, if not all, of the coal mine-produced water would be consumed during operation. As discussed in Section 3.5.2.2, changes in surface runoff would occur as a result of the destruction and reconstruction of drainage channels as mining progresses. Sediment control structures would be used to manage discharges of surface water from the mine permit areas. State and federal regulations require treatment of surface runoff from mined lands to meet effluent standards.

Of particular importance is the amount of production water that is directly conveyed to the receiving drainages. Based on information and data presented in the PRB Coal Review Task 1B and Task 2 reports (BLM 2009d and 2009b, respectively), it is assumed that the production water discharged directly to the receiving drainages would be limited to CBNG water discharge. The PRB Coal Review assumes that future permitting would allow a portion of CBNG-produced water to be discharged to intermittent and ephemeral drainages as is currently allowed in the six subwatersheds in the cumulative study area (Antelope Creek, Dry Fork Cheyenne River, Upper Cheyenne River, Upper Belle Fourche River, Upper Powder River, and Little Powder River) (Figure 4-4).

The PRB Coal Review Task 3B Report utilizes the surface water model described in the Surface Water Quality Analysis Technical Report (Greystone and ALL Consulting 2003), which was prepared in support of the PRB Oil and Gas Project EIS (BLM 2003), to evaluate the cumulative impacts to surface water quality from surface discharge of CBNG development. The linear model used by ACE (2009) to predicted future cumulative surface water quality impacts combined stream flows and stream water quality with the predicted CBNG discharge water quantity and quality for each subwatershed for 2010, 2015, and 2020, and the base year for comparison for surface water quality impacts was 2003.

Based on past monitoring in receiving streams, most (70 to 90 percent) CBNG discharge water either infiltrates or evaporates within a few miles of the discharge points and generally is not recorded at USGS stream gaging stations. Impacts to surface water flow and quality are therefore generally limited to within a few miles of the discharge point. In view of this, the PRB Coal Review Task 3B water quality impact analysis assumes a conveyance loss of 70 percent for the water quality assessment and modeling analysis.

Key water quality parameters for predicting the potential effects of CBNG development in the surface water quality impact analysis focused on the suitability of surface water for agricultural irrigation. Consequently, the sodium adsorption ratio (SAR) and salinity, measured by electrical conductivity (EC), were utilized for the prediction. SAR is a measure of the amount of sodium in the water that can react with clays and, thus, reduce infiltration into soils and the ultimate use of the soil for growing crops. EC is a measure of the total dissolved solids. The most restrictive proposed limit (MRPL) and least restrictive proposed limit (LRPL) regulatory standards for EC and SAR are set for each subwatershed by the WDEQ in conjunction with neighboring states that receive flow across state boundaries from the specified stream in the watershed. These limits refer to the desired concentrations for SAR and EC and are used as guidelines for evaluating potential impacts to water quality. The limits presented in Table 4-20 were used during the comparison of EC and SAR values for resulting mixtures of existing streamflows and discharges from CBNG wells under various flow conditions and reasonably foreseeable development (RFD) projections for 2010, 2015, and 2020.

The cumulative impacts to surface water quality focused on RFD scenarios for normal and dry year conditions to show the difference based on streamflow and climate. Wet years were not analyzed because increased runoff and stream flow would result in potential water quality impacts considerably less than normal and dry year RFD scenarios. The impact analysis, conducted using monthly flows, comparatively evaluated the water quality parameters (SAR and

Table 4-20. Summary of Proposed Limits for SAR and EC.

Subwatershed	Most Restrictive Proposed Limit (MRPL)		Least Restrictive Proposed Limit (LRPL)	
	SAR	EC (µS/cm[1])	SAR	EC (µS/cm[1])
Little Powder	5	2,000	9.75	2,500
Upper Powder	2	2,000	9.75	2,500
Belle Fourche	6	2,000	10	2,500
Cheyenne River & Antelope Creek	10	2,000	10	2,500

[1] µS/cm = microsiemens per centimeter
Source: Wyoming DEQ, Montana DEQ, and South Dakota Legislative Council

EC) of the receiving drainage before and after mixing with discharge water generated by the CBNG wells within that drainage. In general, the water discharged from the CBNG wells reflected increased levels of SAR and reduced levels of EC compared to the water quality of the receiving drainages. Impacts to water quality are likely to be maximized during the low flow months; consequently, the comparative evaluation of water quality focused on the minimum monthly flow associated with the dry year and normal year conditions.

The water quality impact analysis made several observations regarding the overall effects of mixing CBNG well production water with surface water in the cumulative study area. These general observations are summarized below.

Normal Year Conditions

Antelope Creek: Before mixing, the SAR values are relatively low and do not exceed the MRPL. The EC values exceed the MRPL during the low-flow months, but are typically less than the LRPL all year. After mixing, from 2003 to 2020, EC is projected to decline, and SAR values are projected to increase. The data indicate that the MRPL and LRPL would not be exceeded for either EC or SAR after mixing or CBNG production waters. Based on the data, surface water is projected to be suitable for irrigation use in all months.

Dry Fork of the Cheyenne River: Before mixing, the SAR values are relatively low and do not exceed the MRPL. The EC values exceed the MRPL during the low-flow months, but are typically less than the LRPL all year. There is no projected discharge of CBNG production water to the drainage through 2020. Therefore, surface water quality conditions for 2010, 2015, and 2020 would be the same as for the base year (2003).

Upper Cheyenne River: Before mixing, the SAR levels do not exceed the MRPL and the EC levels exceed the MRPL for 11 months of the year and the LRPL for 9 months of the year. After mixing, from 2003 to 2010, EC is projected to decrease, and SAR values would not change. There is no projected discharge of CBNG production water to the drainage in 2015 and 2020. Based on the data, EC values would exceed the MRPL, except for August 2010, and exceed the LRPL, except for July through September 2010. SAR values would not exceed the MRPL and LRPL. Based on the data, surface water would remain suitable for irrigation from 2010 to 2020.

Upper Belle Fourche: Before mixing, the SAR levels exceed the MRPL from November through January while meeting the LRPL throughout the year. The EC levels exceed the MRPL from September through January and exceed the LRPL from November through January. After mixing, from 2003 to 2015, EC is projected to decline and SAR is projected to increase slightly. There is no projected discharge of CBNG production water to the drainage in 2020; therefore, EC and SAR values for this time period would be the same as projected for the base year (2003). The data indicate that EC would not exceed the MRPL, except for October in 2010 and October through January in 2015, and would not exceed the LRPL. The projected SAR values would exceed the MRPL from August to January in 2010 and from September to January of 2015, and would not exceed the LRPL for all months. Based on the data, surface water is projected to be suitable for irrigation to 2020.

Upper Powder River: Before mixing, surface water in the Upper Powder River exceeds the MRPL for both EC and SAR throughout the majority of the year. Levels of SAR are less than the LRPL while EC values generally exceed the LRPL from July through December. After mixing, from 2003 to 2015, EC is projected to decrease slightly, and SAR values would increase slightly. There is no projected discharge of CBNG production water to the drainage in 2020; therefore, EC and SAR values for this time period would be the same as projected for the base year (2003). The data indicate that EC values would exceed the MRPL, except for May and June for 2010 and 2015, and would exceed the LRPL during July through December from 2010 to 2015. SAR values would exceed the MRPL, except for March in 2010 and 2015 and May in 2015, and would not exceed the LRPL. Based on the data, surface water is projected to remain suitable for irrigation from 2010 to 2010.

Little Powder River: Before mixing, the surface water in the Little Powder River exceeds the MRPL for EC and SAR throughout the majority of the year. SAR levels remain below the LRPL throughout the year, but EC levels exceed the LRPL during the low flow months. After mixing, from 2003 to 2020, EC is projected to increase slightly. The data indicate that EC values would exceed the MRPL except for March and May during 2010, and March during 2015 and 2020; however, it would not exceed the LRPL except for January and August from 2010 to 2020, and also in September, November, and December from 2015 to 2020. SAR values are projected to exceed the MRPL and not exceed the LRPL. Based on the data, surface water is projected to remain suitable for irrigation to 2020.

<u>Dry Year Conditions</u>

Antelope Creek: After mixing, from 2003 to 2020, EC values would be reduced due to mixing with CBNG waters and SAR values would increase. The data indicate that the MRPL and LRPL would not be exceeded fro either EC or SAR for all years. Based on the data, surface water would remain suitable for irrigation except for June and August from 2010 to 2020.

Dry Fork of the Cheyenne River: There is no projected discharge of CBNG production water to the drainage through 2020. Therefore, surface water quality conditions would be the same as for the base year (2003), for all years to 2020.

Upper Cheyenne River: After mixing, from 2003 to 2010, EC values would decline, and SAR values would increase slightly. There is no projected discharge of CBNG production water to the drainage in 2015 and 2020. EC values would exceed the MRPL except for August 2010; the LRPL would be exceeded except for July to September 2010. For SAR, neither the MRPL nor the LRPL would be exceeded. Based on the data, surface water would remain suitable for irrigation to 2020.

Upper Belle Fourche: After mixing, from 2003 to 2015, EC values would decline, and SAR values would increase slightly. There is no projected discharge of CBNG production water to the drainage in 2020. EC values would not exceed the MRPL or LRPL from 2010 to 2015. SAR values would exceed the MRPL in 2010, except for March and July, and also would exceed the MRPL from August to January 2015. Based on the data, surface water would be unsuitable for irrigation from August to October during 2010 and in October 2015.

Upper Powder River: After mixing, from 2003 to 2015, EC vales would decrease slightly, and SAR values would increase slightly. There is no projected discharge of CBNG production water to the drainage in 2020. EC values would exceed the MRPL except for the months of May and June 2010 and 2015, and the LRPL would be exceeded July through December for 2010 and 2015. SAR values would exceed the MRPL, except for May and June 2015, and would not exceed the LRPL for all years. Based on the data, surface water would remain suitable for irrigation to 2020.

Little Powder River: After mixing, from 2003 to 2020, the EC would be reduced and the SAR would increase. The MRPL would be exceeded for all years for EC during the months of February, April, June, and August in 2010; during November through February and during April, June, and August in 2015; and all months except March in 2020. EC values would exceed the LRPL in September 2010; August 2015; and January, August November, and December 2020. SAR values would exceed the MRPL in all months and years except March 2015 and March and May 2020. The LRPL for SAR would be exceeded in September 2010. The water would remain suitable for irrigation from 2010 to 2020 except for September and October 2010.

In summary, the suitability of the mixed water for irrigation purposes is related to EC and SAR. In general, the water most suitable for irrigation has a relatively low SAR and a relatively high EC. Elevated SAR values may reduce permeability in clayey soils, which reduces the rate of water infiltration. As discussed above, the water discharged from the CBNG wells is generally characterized by higher levels of SAR and reduced levels of EC compared to the water quality of the receiving drainages. In those cases where mixing results in a significant increase in SAR and the EC is moderately low, the water was considered unsuitable. For these six drainages, the projected water quality after mixing demonstrated adequate suitability for irrigation in most months during normal year conditions. The MRPL and LRPL may be exceeded for EC and SAR in 1 or more years and in any given year for 1 or more months, but not for all months in the year. During dry year conditions, the suitability of surface waters in the six drainages for irrigation generally would be reduced due to the greater percentages of CBNG water in the drainage after mixing. Both the EC and SAR values would exceed the MRPL and LRPL more frequently compared to normal year flows. Even though the waters' suitability for irrigation would be reduced (except for the Belle Fourche River) surface water generally would remain suitable for irrigation during the majority of months of the irrigation season.

4.2.5 Channel Stability

In general, cumulative impacts to channel stability largely relate to changes in water quantity associated with discharges from existing and projected development activities as compared to the natural runoff characteristics of the receiving drainages. For this evaluation, ACE (2009) assumed that water discharged directly to the receiving drainages would be limited to CBNG activities, which are projected to be the primary source of discharge water in the PRB study area through 2020.

To the extent possible, the impact to perennial drainages was addressed quantitatively at the subwatershed level using regression equations related to discharge and channel width. Geomorphic relationships between mean annual discharge, channel gradient and geometry, bed load, and median sediment size also were used to provide a qualitative assessment of potential impacts associated with the discharge of CBNG production water.

To have an impact on channel stability that is manifested in active channel erosion, CBNG production water discharge likely would have to represent a substantial portion of the channel-forming discharge in watersheds where the channel slope is steep enough and the width, depth, and sinuosity low enough to impact channel morphology. Channel-forming discharge was estimated using the peak annual discharge recurrence interval and the common range for channel-forming discharge between the 1.5- to 2.0-year recurrence interval. Based on the magnitude of the projected CBNG production water discharges compared to the channel-forming discharge (1.5- to 2.0-year recurrence interval), the impact more likely would be evident in small ephemeral drainages that are characterized by steep channel gradients, lower sinuosity, and smaller widths and depths. Overall, as the drainage area increases, the channel slope typically decreases along with an increase in sinuosity, thereby reducing the impact of CBNG production water discharge on channel stability.

The channel-forming discharge for both the Little Powder River and Belle Fourche River is given in Table 4-21. The perennial stream evaluation calculated the change in channel width for the Little Powder River as less than 0.3 percent. For the Belle Fourche River, it was calculated to be less than 0.2 percent (Table 4-21) (ACE 2009). Given the low increase in mean annual discharge from introduced CBNG water, changes in channel geomorphology (width, depth, gradient, bed material transport and meander wavelength) are considered imperceptible. These results suggest that for the larger perennial streams the effect of CBNG production water discharge would be minimal.

Table 4-21. Projected Impact of CBNG Production Water Discharge on Perennial Streams.

Location	**Channel Forming Discharge[1] (cfs)**	**CBNG Discharge**		**Estimated Width**		**Potential Impact [Increased Channel Width]**	
		(cfs)	**(%)**	**Existing Conditions (ft)**	**Combined Discharge (ft)**	**(ft)**	**(%)**
Little Powder River above Dry Creek near Weston, Wyoming (USGS Gage 06324970)	270 to 420	2.2	0.5 to 0.8	47.3 to 56.3	47.4 to 56.4	0.15 to 0.12	0.3
Belle Fourche River below Moorcroft, Wyoming (USGS Gage 06426500)	652 to 789	3.9	0.5 to 0.6	66.9 to 72.1	67.0 to 72.2	0.16 to 0.14	0.2

[1] Discharge associated with the 1.5- to 2-year recurrence interval.

Discharge of CBNG well production water into ephemeral drainages may start or exacerbate erosion in the ephemeral stream channel. Given the potentially greater increase in stream flow due to a lower natural flow, channel geomorphology is more likely to be perceptible. Smaller drainages may be more likely to exhibit channel erosion depending on the magnitude of the flow contribution from CBNG water production compared to the channel-forming discharge. However, field observations in these watersheds found an increase in vegetation diversity and density along the channel.

According to the BLM Task 3B Report (BLM 2009e), a special study was done of the Caballo Creek drainage in the Belle Ayr Mine permit area, to see how reclaimed drainages were impacted by increased CBNG discharges. It was determined that CBNG discharge represented less than 1 percent of the 2-year peak discharge. No active erosion was noted in the natural or diverted portions of the Caballo Creek channel, while an increase in vegetative diversity and density was noted. Based on the relative magnitude of the flow contribution from CBNG production water discharge to the flow in Caballo Creek, the minor amount of flow increase would not likely result in increased erosion to its channel or in streams similar to Caballo Creek. While it is more likely that creeks with smaller drainage areas, like Duck Nest or Bone Pile Creeks may experience more erosion due to relatively larger flow increases due to CBNG discharge, such effects were not observed in the field (BLM 2009e).

4.2.6 Alluvial Valley Floors

The identified AVFs for all coal mines in the PRB Coal Review study area are described in the PRB Coal Review Task 1D Report (BLM 2005d), based on individual mine State Decision Documents. Regulatory determinations of AVF occurrence and location are completed as part of the permitting process for coal mining operations, because their presence can restrict mining activities under SMCRA and Wyoming laws. The WDEQ/LQD administers the AVF regulations for coal mining activities in Wyoming. Coal mine-related impacts to designated AVFs generally are not permitted if the AVF is determined to be significant to agriculture. If an AVF is determined not to be significant to agriculture or if the permit to affect the AVF was approved prior to the effective date of SMCRA, the AVF can be disturbed during mining but must be restored to essential hydrologic function during reclamation.

The formal AVF designation and related regulatory programs described above are specific to coal mining operations; however, other development-related activities in the study area would potentially impact AVF resources. The portions of the cumulative study area that lie outside of the mine permit areas have generally not been surveyed for the presence of AVFs; therefore, the locations and extent of the AVFs outside of the mine permit areas have not been determined.

4.2.7 Soils

The PRB Coal Review Task 3D Report (BLM 2009f) discusses potential cumulative impacts to soils as a result of projected development activities in the PRB Coal Review Task 3 study area. The area of actual surface coal mining disturbance and reclamation for the years 2003 and 2007, and the projected cumulative areas of disturbance and reclamation for 2010, 2015, and 2020 are shown in Tables 4-2 and 4-3. The area of actual disturbance and reclamation for all development in 2003 and 2007, and the projected cumulative total areas of disturbance and reclamation for 2010, 2015, and 2020 are shown in Table 4-10.

Development activities such as increased vehicle traffic, vegetation removal, soil salvage and redistribution, discharge of CBNG produced groundwater, and construction and maintenance of project-specific components (e.g., roads, ROWs, well pads, industrial sites, and associated ancillary facilities) would result in cumulative impacts to soils in the study area. In general, soil disturbance and handling from these activities would generate both long-term and short-term impacts to soil resources through accelerated wind or water erosion, declining soil quality factors, compaction, and the removal and replacement of soil resources at mining sites.

Of the types of development projects in the study area, coal mining activities would create the most concentrated cumulative impacts to soils. This is due to the large acreages involved and the tendency of mining operations to occur in contiguous blocks. These factors would encourage widespread accelerated wind and water erosion. Extensive soil handling would cause compaction and a corresponding loss of permeability to water and air; a decline in microbial populations, fertility, and organic matter; and potential mixing of saline and/or alkaline soil zones into seedbeds, which would reduce soil quality. There would be a limited availability of suitable soil resources for reclamation uses in some areas.

However, for surface coal mining operations, there are measures that are either routinely required or can be specifically required as necessary to reduce impacts to soil resources and to identify overburden material that may be unsuitable for use in reestablishing vegetation, as discussed in Sections 3.3.1.3, 3.4.2.3, and 3.8.3.

As described in Appendix E of the PRB Coal Review Task 2 Report (BLM 2009b), a variety of CBNG water disposal methods may be employed in the cumulative study area. The potential impacts to soils would depend on the water treatment method, if any, and the nature of the disposal method. As discussed in the PRB Coal Review Task 3D Report (BLM 2005e), due to elevated SAR levels in water produced from the Wyodak-Anderson coal zone in the Upper Powder River and Little Powder River subwatersheds, land applications of CBNG-produced water in those areas could increase soil alkalinity. As discussed above in Section 4.2.4.2, the SAR values are generally low for the Upper Belle Fourche subwatershed and tend to exceed the MRPL after mixing with discharged CBNG water during six months of the year while meeting the LRPL throughout the year. Land application of CBNG-produced water is not anticipated in this area. The specific approaches to CBNG water discharges, the resource conditions and locations in which they occur, the timing of discharges, and the discharge permit stipulations from regulatory and land management agencies would determine the extent and degree of potential impacts to soils.

4.2.8 Vegetation, Wetlands and Riparian Areas

The PRB Coal Review Task 3D Report (BLM 2009f) discusses potential cumulative impacts to vegetation, wetlands, and riparian areas as a result of projected development activities in the cumulative study area. The area of actual surface coal mining disturbance and reclamation for the years 2003 and 2007, and the projected cumulative areas of disturbance and reclamation for 2010, 2015, and 2020 are shown in Tables 4-2 and 4-3. The area of actual disturbance and reclamation for all development in 2003 and 2007, and the projected cumulative total areas of disturbance and reclamation for 2010, 2015, and 2020 are shown in Table 4-10.

4.2.8.1 Vegetation

The PRB is characterized as a mosaic of general vegetation types, which include prairie grasslands, shrublands, forested areas, and riparian areas. These broad categories often represent several vegetation types that are similar in terms of dominant species and ecological importance. Fourteen vegetation types were identified within the PRB Coal Review Task 1 study area, of which 10 primarily consist of native vegetation and are collectively classified as rangeland. These vegetation types include short-grass prairie, mixed-grass prairie, sagebrush shrubland, other shrubland, coniferous forest, aspen, forested riparian, shrubby riparian, herbaceous riparian, and wet meadow. The remaining vegetation types support limited or non-native vegetation and include cropland, urban/disturbed, barren, and open water. The vegetation types are described in more detail in the Task 1D Report for the PRB Coal Review (BLM 2005d).

Impacts to vegetation can be classified as short-term and long-term. Potential short-term impacts arise from the removal and disturbance of herbaceous species during a project's development and operation (e.g., coal mining, CBNG drilling and production, etc.), which would cease upon project completion and successful reclamation in a given area. Reclaimed mine land is defined by WDEQ/LQD as affected land that has been backfilled, graded, topsoiled, and permanently seeded in accordance with the approved practices specified in the reclamation plan (Christensen 2002). Species composition on the reclaimed lands may be different than on the surrounding undisturbed lands. The removal of woody species would be considered a long-term impact since these species take approximately 25 years or longer to attain a size comparable to woody species present within proposed disturbance areas. Potential long-term impacts would also include permanent loss of vegetation and vegetative productivity in areas that would not be reclaimed in the near term (e.g., power plant sites, etc.).

4.2.8.2 Special Status Plant Species

Special status plant species are those species for which state or federal agencies afford an additional level of protection by law, regulation, or policy. Included in this category are federally listed and federally proposed species (species that are protected under the ESA), BLM Sensitive Species, U.S. Department of Agriculture-Forest Service (USFS) Sensitive Species, and Wyoming Game and Fish Department (WGFD) Species of Special Concern in Wyoming. Further discussions of species that are protected under the ESA, BLM Sensitive Species, and USFS Sensitive Species are included in Appendix H of this EIS. Two federally listed species (Ute ladies'-tresses orchid and blowout penstemon) and three USFS sensitive species (Barr's milkvetch, Rosy palafox, and Lemonscent) are known to occur or may have potentially suitable habitat in the cumulative study area. Three BLM sensitive species (Nelson's milkvetch and Laramie columbine [Casper Field Office] and William's wafer-parsnip [Buffalo Field Office]) may occur in the cumulative study area.

Potential direct impacts to special status plant species in the study area could include the incremental loss or alteration of potential or known habitat, associated with past and projected activities. Direct impacts also could include the direct loss of individual plants within the cumulative study area, depending on their location in relation to development activities. Indirect impacts could occur due to increased dispersal and establishment of noxious weeds, which may result in the displacement of special status plant species in the long term.

4.2.8.3 Noxious and Invasive Weed Species

Once established, invasive and non-native plant species can out-compete and eventually replace native species, thereby reducing forage productivity and the overall vigor and diversity of existing native plant communities. The state of Wyoming has currently designated the following 25 plant species as noxious weeds:

- Field bindweed (*Convolvulus arvensis*)
- Canada thistle (*Cirsium arvense*)
- Leafy spurge (*Euphorbia esula*)
- Perennial sowthistle (*Sonchus arvensis*)
- Quackgrass (*Agropyron repens*)
- Hoary cress (*Cardaria draba*)
- Perennial pepperweed (giant whitetop) (*Lepidium latifolium*)
- Ox-eye daisy (*Chrysanthemum leucanthemum*)
- Skeletonleaf bursage (*Franseria discolor Nutt.*)
- Russian knapweed (*Centaurea repens L.*)
- Yellow toadflax (*Linaria vulgaris*)
- Dalmatian toadflax (*Linaria dalmatica*)
- Scotch thistle (*Onopordum acanthium*)
- Musk thistle (*Carduus nutans*)
- Common burdock (*Arctium minus*)
- Plumeless thistle (*Carduus acanthoides*)
- Dyers woad (*Isatis tinctoria*)
- Houndstongue (*Cynoglossum officinale*)
- Spotted knapweed (*Centaurea maculosa Lam.*)
- Diffuse knapweed (*Centaurea diffusa Lam.*)
- Purple loosestrife (*Lythrum salicaria L.*)
- Saltcedar (*Tamarix spp.*)
- Common St. Johnswort (*Hypericum perforatum*)
- Common Tansy (*Tanacetum vulgare*)
- Russian olive (*Elaeagnus angustifolia L.*)

Campbell County does not have a declared list of weeds.

Development-related construction and operation activities would potentially result in the dispersal of noxious and invasive weed species within and beyond the surface disturbance boundaries, which would result in the displacement of native species and changes in species composition in the long term. The potential for these impacts would be higher in relation to the development of linear facilities (e.g., pipeline ROWs, oil- and gas-related road systems, etc.) than for site facilities (e.g., mines, power plants, etc.) due to the potential for dispersal of noxious weeds over a larger area.

Chapter 4, Section 2(d)(xiv) of the WDEQ/LQD rules and regulations requires that surface coal mines address weed control on reclaimed areas as follows:

> The operator must control and minimize the introduction of noxious weeds in accordance with federal and state requirements until bond release.

Accordingly, the reclamation plans for all surface coal mines in the Wyoming PRB include steps to control invasion by weedy (invasive nonnative) plant species. As discussed in Chapter 3, Section 3.9.4, the WAC mines work with the Campbell County Weed and Pest Department and conduct an active noxious weed control program on their existing coal leases. Similar measures to identify and control noxious weeds are used at all of the surface coal mines in the Wyoming PRB as a result of the WDEQ/LQD regulatory requirements.

Mitigation to control invasion by noxious weeds for CBNG developers is determined on a site-specific basis and may include spraying herbicides before entering areas and washing vehicles before leaving infested areas. BLM reviews weed educational material during preconstruction on-site meetings with CBNG operators, subcontractors, and landowners. BLM also attaches this educational information to approved Applications for Permit to Drill (APDs) or Plans of Development (PODs) (BLM 2003). BLM also participates in a collaborative effort with the South Goshen Cooperative Extension Conservation District, the U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS), private surface owners, WGFD, and the Weed and Pest District in a prevention program that includes a long-term integrated weed management plan, public awareness and prevention programs, and a common inventory (BLM 2003).

4.2.8.4 Wetland and Riparian Species

Operations associated with development activities in the study area would result in the use of groundwater. Annually, during 2010-2020, from 30,000-42,000 mmgpy of CBNG-produced water would be discharged to impoundments or intermittent and ephemeral streams or reinjected. The discharge of produced water could result in the creation of wetlands in containment ponds, landscape depressions, and riparian areas along segments of drainages that previously supported upland vegetation. In addition, existing wetlands and riparian areas that would receive additional water would become more extensive and potentially support a greater diversity of wetland species in the long term. Alternately, the discharge of abnormally high flows or water with SARs of 13 or more could impact existing vegetation as discussed in the Task 1D Report for the PRB Coal Review (BLM 2005d). For agricultural uses, the current Wyoming water quality standard for SAR is 8.0 (WDEQ/WQD 2009). SARs of 5 to 10 have been observed in discharge waters in the study area (BLM 2003). Once water discharges have peaked and subsequently decrease in the long term, the extent of wetlands and riparian areas and species diversity would decrease accordingly. After the complete cessation of water discharges, artificially-created wetland and riparian areas once again would support upland species and previously existing wetland and riparian areas would decrease in areal extent.

4.2.9 Wildlife and Fisheries

The PRB Coal Review Task 3D Report (BLM 2009f) discusses potential cumulative impacts to wildlife as a result of projected development activities in the cumulative study area. The area of habitat disturbance and reclamation for the years 2003 and 2007, and the projected cumulative areas of disturbance and reclamation for 2010, 2015, and 2020 are shown in Tables 4-2 and 4-3. The area of actual habitat disturbance and reclamation for all development in 2003 and 2007, and the projected cumulative total habitat disturbance and reclamation for 2010, 2015, and 2020 are shown in Table 4-10.

Impacts to wildlife can be classified as short-term and long-term. Potential short-term impacts arise from habitat disturbance associated with a project's development and operation (e.g., coal mines, CBNG wells, etc.) and would cease upon project completion and successful reclamation in a given area. Potential long-term impacts consist of long-term or permanent changes to habitats and the wildlife populations that depend on those habitats, irrespective of reclamation success, and habitat disturbance related to longer term projects (e.g., power plant facilities, rail lines, etc.). Direct impacts to wildlife populations as a result of development activities in the study area could include direct mortalities, habitat loss or alteration, habitat fragmentation, or animal displacement. Indirect impacts could include increased noise, additional human presence, and the potential for increased vehicle-related mortalities.

Habitat fragmentation from activities such as roads, well pads, mines, pipelines, and electrical power lines also can result in the direct loss of potential wildlife habitat. Other habitat fragmentation effects such as increased noise, elevated human presence, dispersal of noxious and invasive weed species, and dust deposition from unpaved road traffic can extend beyond the surface disturbance boundaries. These effects result in overall changes in habitat quality, habitat loss, increased animal displacement, reductions in local wildlife populations, and changes in species composition. However, the severity of these effects on terrestrial wildlife would depend on factors such as sensitivity of the species, seasonal use, type and timing of project activities, and physical parameters (e.g., topography, cover, forage, and climate).

4.2.9.1 Game Species

Big game species that are present within the cumulative study area include pronghorn, white-tailed deer, mule deer, and elk. Potential direct impacts to these species would include the incremental loss or alteration of potential forage and ground cover associated with construction and operation of the past, present and reasonably foreseeable future development discussed in Section 4.1. Development associated with coal mining, drilling for CBNG, ancillary facilities, agricultural operations, urban areas, and transportation and utility corridors result in vegetation removal. Assuming that adjacent habitats would be at or near carrying capacity and considering the variabilities associated with drought conditions and human activities in the study area, the PRB Coal Review Task 3D study concluded that displacement of wildlife species (e.g., big game) as a result of development activities would create some unquantifiable reduction in wildlife populations.

There are a number of big game habitat ranges within the cumulative study area. In Wyoming, the WGFD and the BLM have established habitat classifications based on seasonal use. Classification types include crucial winter, severe winter, winter yearlong, and yearlong. Crucial winter range areas are considered essential in determining a game population's ability to maintain itself at a certain level over the long term. As discussed in the PRB Coal Review Task 2 Report, discrete locations for most of the disturbance related to the projected development could not be determined based on the available information. However, identified future coal reserves were used for the Task 3D Report to provide some level of quantification of potential future impacts to big game ranges. Tables 4-22 through 4-25 summarize the effects on pronghorn, deer, and elk game ranges as a result of the predicted lower and upper levels of coal production through 2020.

Table 4-22. Potential Cumulative Disturbance to Pronghorn Ranges from Development Activities—Lower and Upper Coal Production Scenarios (acres/percent affected).

Time Period/Scenario	**Pronghorn Ranges[1]**			
	Crucial Winter	**Severe Winter**	**Winter Yearlong**	**Yearlong**
2010/Lower	N/A	1,472 / 3%	33,196 / 2%	32,099 / 1%
2010/Upper	N/A	1,472 / 3%	34,760 / 2%	33,172 / 1%
2015/Lower	N/A	1,460 / 3%	32,649 / 2%	34,828 / 1%
2015 Upper	N/A	1,460 / 3%	34,177 / 2%	36,999 / 1%
2020/Lower	N/A	1,422 / 3%	33,637 / 2%	35,714 / 1%
2020/Upper	N/A	1,422 / 3%	33,580 / 2%	37,437 / 2%

[1] Potential coal mine related impacts to big game ranges were determined based on GIS information as follows: the total acres of a big game range (e.g., crucial winter, severe winter, winter yearlong, and yearlong) within the PRB Coal Review Task 3 study area was divided by the sum of the potential disturbance acreage for the time period (based on GIS mapping of coal reserves for the lower coal production scenario) and 2006 disturbance from coal mine development.
Source: PRB Coal Review Task 3D Update Report (BLM 2009f)

Table 4-23. Potential Cumulative Disturbance to White-tailed Deer Ranges from Development Activities—Lower and Upper Coal Production Scenarios (acres/percent affected).

Time Period/Scenario	White-tailed Deer Ranges[1]			
	Crucial Winter	Severe Winter	Winter Yearlong	Yearlong
2010/Lower	N/A	N/A	N/A	1,411 / 0.6%
2010/Upper	N/A	N/A	N/A	1,411 / 0.6%
2015/Lower	N/A	N/A	N/A	1,497 / 0.7%
2015 Upper	N/A	N/A	N/A	1,495 / 0.7%
2020/Lower	N/A	N/A	N/A	1,704 / 0.7%
2020/Upper	N/A	N/A	N/A	1,707 / 0.8%

1 Potential coal mine-related impacts to big game ranges were determined based on GIS information as follows: the total acres of a big game range (e.g., crucial winter, severe winter, winter yearlong, and yearlong) within the PRB Coal Review Task 3 study area was divided by the sum of the potential disturbance acreage for the time period (based on GIS mapping of coal reserves for the lower coal production scenario) and 2006 disturbance from coal mine development.
Source: PRB Coal Review Task 3D Update Report (BLM 2009f)

Table 4-24. Potential Cumulative Disturbance to Mule Deer Ranges from Development Activities—Lower and Upper Coal Production Scenarios (acres/percent affected).

Time Period/Scenario	Mule Deer Ranges[1]			
	Crucial Winter	Severe Winter	Winter Yearlong	Yearlong
2010/Lower	N/A	N/A	6,808 / 0.4%	25,390 / 1%
2010/Upper	N/A	N/A	6,924 / 0.4%	26,641 / 1%
2015/Lower	N/A	N/A	6,956 / 0.4%	26,420 / 1%
2015 Upper	N/A	N/A	7,285 / 0.5%	27,205 / 1%
2020/Lower	N/A	N/A	6,958 / 0.4%	27,004 / 1%
2020/Upper	N/A	N/A	7,413 / 0.5%	27,990 / 1%

1 Potential coal mine-related impacts to big game ranges were determined based on GIS information as follows: the total acres of a big game range (e.g., crucial winter, severe winter, winter yearlong, and yearlong) within the PRB Coal Review Task 3 study area was divided by the sum of the potential disturbance acreage for the time period (based on GIS mapping of coal reserves for the lower coal production scenario) and 2006 disturbance from coal mine development.
Source: PRB Coal Review Task 3D Update Report (BLM 2009f)

Table 4-25. Potential Cumulative Disturbance to Elk Ranges from Development Activities—Lower and Upper Coal Production Scenarios (acres/percent affected).

Time Period/Scenario	Elk Ranges[1]			
	Crucial Winter	Severe Winter	Winter Yearlong	Yearlong
2010/Lower	24 / 0.4%	N/A	375 / 1%	1,444 / 0.9%
2010/Upper	24 / 0.4%	N/A	375 / 1%	1,444 / 0.9%
2015/Lower	24 / 0.4%	N/A	351 / 1%	1,161 / 0.7%
2015 Upper	24 / 0.4%	N/A	351 / 1%	1,162 / 0.7%
2020/Lower	24 / 0.4%	N/A	351 / 1%	1,121 / 0.7%
2020/Upper	24 / 0.4%	N/A	351 / 1%	1,168 / 0.7%

1 Potential coal mine-related impacts to big game ranges were determined based on GIS information as follows: the total acres of a big game range (e.g., crucial winter, severe winter, winter yearlong, and yearlong) within the PRB Coal Review Task 3 study area was divided by the sum of the potential disturbance acreage for the time period (based on GIS mapping of coal reserves for the lower coal production scenario) and 2006 disturbance from coal mine development.
Source: PRB Coal Review Task 3D Update Report (BLM 2009f)

Direct and indirect effects to small game species (i.e., upland game birds, waterfowl, small game mammals) within the cumulative study area as a result of development activities would be the same as discussed above for big game species. Impacts would result from the incremental surface disturbance of potential wildlife habitat, increased noise levels and human presence, dispersal of noxious and invasive weed species, and dust effects from unpaved road traffic.

Operations associated with development activities in the cumulative study area would result in the use of groundwater. The PRB Coal Review assumes that most, if not all, of the coal mine-produced water would be consumed during operation and anticipates that up to approximately 31,000 mmgpy of water would be produced in association with oil and gas production in 2010, increasing to about 42,000 mmgpy by 2020. The portion of the water that is produced in association with the CBNG and discharged to impoundments or intermittent and ephemeral streams would be available for area wildlife (e.g., waterfowl). Although much of the water would evaporate or infiltrate into the ground, it is anticipated that substantial quantities of water would remain on the surface and would result in the expansion of wetlands, stock ponds, and reservoirs, potentially increasing waterfowl breeding and foraging habitats. The median sodium concentration of CBNG-produced water from the Fort Union Formation is 270 mg/L. If sodium concentrations are maintained below 17,000 mg/L in the evaporation ponds, the potential adverse effects to waterfowl would be minimal.

4.2.9.2 Non-game Species

Potential direct impacts to non-game species (e.g., small mammals, raptors, passerines, amphibians, and reptiles) would include the incremental loss or alteration of existing or potential foraging and breeding habitats from construction and operation of past, present and reasonably foreseeable future development activities (e.g., vegetation removal for coal mines and CBNG wells, ancillary facilities, and transportation and utility corridors). Impacts also could result in mortalities of less mobile species (e.g., small mammals, reptiles, amphibians, and invertebrates), nest or burrow abandonment, and loss of eggs or young in the path of vehicles and heavy equipment. Indirect impacts would include increased noise levels and human presence, dispersal and invasion of noxious weeds, and dust effects from unpaved road traffic. Assuming that adjacent habitats would be at or near carrying capacity, and considering variable factors such as drought conditions and human activities in the study area, the PRB Coal Review concluded that displacement of wildlife species from the cumulative study area would result in an unquantifiable reduction in wildlife populations.

Numerous migratory bird species have been documented within the PRB over the last two to three decades of wildlife monitoring. Development activities that occur during the migratory bird breeding season (April 1 through July 31) could cause the abandonment of a nest site or territory or the loss of eggs or young, resulting in the loss of productivity for the breeding season. Loss of an active nest site, incubating adults, eggs, or young would not comply with the intent of the Migratory Bird Treaty Act and could potentially affect populations of important migratory bird species that may occur in the PRB.

Breeding raptor species that occur within the cumulative study area include the bald eagle, golden eagle, ferruginous hawk, red-tailed hawk, rough-legged hawk, Swainson's hawk, American kestrel, prairie falcon, northern harrier, great horned owl, short-eared owl, burrowing owl, and long-eared owl (*Asio otus*). Bald eagles and long-eared owls are rare nesters in the area.

One potential direct impact to raptors is habitat (nesting and foraging) loss due to additional surface disturbance within the cumulative study area. In the event that development activities were to occur during the breeding season (February 1 through July 31), these activities could result in nest or territory abandonment, or loss of eggs or young. Such losses would reduce productivity for the affected species during that breeding season. As discussed above, loss of an active nest site, incubating adults, eggs, or young would not comply with the intent of several laws, including the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act.

Additional direct impacts could result from construction of new overhead power lines in the region. New power line segments in the study area would incrementally increase the collision and/or electrocution potential for migrating and foraging bird species (e.g., raptors and waterfowl) (APLIC 1994). However, the potential for avian collisions with overhead power lines is typically dependent on variables such as the location of the structures relative to high-use areas (e.g., nesting, foraging, staging, and roosting habitats), the orientation of the power line to flight patterns and movement corridors, species composition, line visibility, and structure design.

In addition, new power lines could pose an electrocution hazard for raptor species attempting to perch on the structure. Configurations greater than 69 kV typically do not present an electrocution potential, based on conductor placement and orientation (APLIC 2006). It is assumed that future permitting for power lines would require the use of appropriate raptor-deterring designs, thereby minimizing potential impacts. For example, SMCRA requires that surface coal mine operators use the best technology available to ensure that electric power lines are designed and constructed to minimize electrocution hazards to raptors. Power line impacts to raptors can be reduced with the increased use of underground power lines wherever possible. Many of the power lines for CBNG development currently are being constructed underground.

4.2.9.3 Fisheries

Potential cumulative effects on fisheries as a result of development activities in the cumulative study area would be closely related to impacts on ground and surface water resources. In general, development activities could affect fish species in the following ways: 1) alteration or loss of habitat as a result of surface disturbance; 2) changes in water quality as a result of surface disturbance or introduction of contaminants into drainages; and 3) changes in available habitat as a result of water withdrawals or discharge. The potential effects of development activities on aquatic communities are discussed below for each of these impact topics.

The predominant aquatic habitat type in the cumulative study area consists of intermittent and ephemeral streams and scattered ponds and reservoirs. In general, perennial streams within the study area are limited to the Little Powder River and Belle Fourche River. Warm water game fish and non-game species are present in some perennial stream segments and numerous scattered reservoirs and ponds. However, the latter features are typically stocked artificially either following construction or annually, depending on the depth of the water body. Due to the lack of constant water in most of the potentially affected streams and static water bodies, existing aquatic communities are mainly limited to invertebrates and algae that can persist in these types of habitats. The removal of stock ponds would eliminate habitat for invertebrates and possibly fish species. This loss would be temporary if the stock ponds are replaced during reclamation.

Development activities could result in the loss of aquatic habitat as a result of direct surface disturbance. Table 4-10 summarizes the cumulative acres of surface disturbance and reclamation as of 2003 and 2007, and projects cumulative acres of surface disturbance and reclamation in 2010, 2015, and 2020. Discrete locations for development disturbance and reclamation areas cannot be determined based on existing information. However, projected development that could result in the loss of aquatic habitat would involve the construction of additional linear facilities, product gathering lines and road systems associated with conventional oil and gas and CBNG activities, as well as any additional disturbance that would be associated with extending coal mine operations onto lands adjacent to the existing mines. The removal of aquatic habitat eliminates existing and potential habitat for invertebrates and some fish species. This loss would be temporary if such ponds are reconstructed and recharged as part of the reclamation process.

Projected activities would result in surface disturbance in each of the six cumulative study area sub-watersheds. Information relative to the stream crossing locations for the majority of the linear facilities is not available at this time. The initial phases of the proposed Bison Pipeline Project commenced in April 2008 and is projected to be completed by November 2010. If the project is constructed as planned, it would cross Cottonwood Creek, a tributary of the Little Powder River. Typically, the associated disturbance corridor would consist of a 100-foot-wide construction ROW; however, site-specific stream crossing methods and reclamation would be determined at the time of project permitting.

Future coal mining also could remove intermittent or ephemeral streams and stock ponds in the Antelope Creek, Upper Cheyenne River, Upper Belle Fourche River, and Little Powder River sub-watersheds. Coal mine permits provide for removal of first- through fourth-order drainages. During reclamation, third- and fourth-order drainages must be restored; first- and second-order drainages often are not replaced (Martin et al. 1988). As discussed in Section 3.5.2, the Cheyenne River and its tributaries drain the general Wright analysis area. All streams within the LBA tracts and adjacent applicant mine permit areas are typical for the region, in that flow events are ephemeral. Under natural conditions, aquatic habitat is limited by the ephemeral nature of surface waters in the general Wright analysis area. The results of fish surveys conducted in the Belle Fourche River, Caballo Creek, Antelope Creek, and various area stock ponds during baseline studies for the mines in the South Gillette and Wright subregions that started in the mid-1970s were discussed in Section 3.10.7.1; no uncommon species were documented during those efforts.

The PRB Coal Review assumes that surface disturbing activities would not be allowed in perennial stream segments or reservoirs on public lands that contain game fish species. It also assumes that other types of development operations would not occur within stream channels nor would they remove ponds or reservoirs as part of construction or operation and, therefore, would not result in the direct loss of habitat for these species.

Water quality parameters such as turbidity and bottom substrate composition can be impacted by surface disturbing activities through erosion of sediment into water bodies. Contaminants can also be introduced into those systems through the chemical characteristics of the eroded sediment. Potential related effects on aquatic biota could include physiological stress, movement to avoid affected areas, or alterations of spawning or rearing areas (Waters 1995). Studies have shown that TDS levels in streams near reclaimed coal lands have increased from one percent to seven percent (Martin et al. 1988). Typically, sedimentation effects are short-term in duration and localized in terms of the affected area. TDS concentrations would stabilize and return to more typical concentrations after construction or development activities have been completed. The PRB Coal Review anticipated that the use of appropriate erosion and spill control measures during both development and reclamation activities, as determined during the permitting process, would minimize the introduction of additional sediments into the sub-watershed.

The removal of streamside vegetation would impact both riparian vegetation and stream parameters in those locations. Loss of vegetation along stream channels would reduce the shade and increase bank erosion, both of which would degrade aquatic habitats. Effects on aquatic habitats from linear projects, such as ROWs, would be limited to a relatively small portion of the stream (generally no more than 100 feet in width), whereas mine-related disturbance could affect considerably larger stretches. Because perennial streams are protected from development by a buffer zone on either side of center, these types of impacts would presumably be limited to intermittent and ephemeral creeks. It is anticipated that reclamation practices to restore riparian vegetation would be required during future project permitting, thereby minimizing such impacts.

CBNG and coal mining are the primary types of development activities that use or manage water as part of their operations. Based on current trends, the PRB Coal Review assumes that most, if not all, of the water produced during coal mining would be consumed during operation. As discussed in Section 3.5.2.2, changes in surface runoff characteristics and sediment discharges would occur during surface coal mining as a result of the destruction and reconstruction of drainage channels as mining progresses, and the use of sediment control structures to manage discharges of surface water from the mine permit area. State and federal regulations require treatment of surface runoff from mined lands to meet effluent standards. After treatment, coal mine-related surface water in the region would ultimately be discharged into intermittent and ephemeral streams in four sub-watersheds (Antelope Creek, Upper Cheyenne River, Belle Fourche River, and Little Powder River). The PRB Coal Review assumes that most, if not all, of the coal mine-produced water would be consumed during operation and anticipates that approximately 31,000 mmgpy of water would be produced in association with oil and gas production in 2010, increasing to about 42,000 mmgpy by 2020, and assumes that a portion of the water that is produced in association with the CBNG would be discharged to intermittent and ephemeral drainages in the general analysis area, much as is currently allowed in the six sub-watersheds in the study area. Based on past monitoring in receiving streams, no change in surface flows would be expected beyond approximately two miles from the discharge points (BLM 2003). Water discharged from CBNG wells has supplied some drainages and water bodies in the PRB nearly continuously for several years. Within the general analysis area, Spring Creek has experienced an influx of CBNG water in recent years, but has not become perennial. The same is true for other streams elsewhere in the PRB that receive CBNG discharge water.

4.2.9.4 Special Status Species

Special status species are those species for which state or federal agencies afford an additional level of protection by law, regulation, or policy. Included in this category are federally listed and federally proposed species (species that are protected under the ESA), BLM Sensitive Species, USFS Sensitive Species, and WGFD Species of Special Concern in Wyoming. Further discussions of species that are protected under the Endangered Species Act (ESA), as well as BLM and USFS Sensitive Species, are included in Appendices G and H, respectively, of this EIS. The U.S. Fish and Wildlife Service (USFWS) also has a list of Migratory Bird Species of Management Concern in Wyoming, which is discussed in Section 3.10.6. Special status species potentially occurring in the Task 1 study area are identified in Section 2.4.3.5 of the PRB Coal Review Task 1D Report (BLM 2005d). Additional information about the occurrence of these species in the general Wright analysis area can be found in the Annual Wildlife

Reports for the Black Thunder, Jacobs Ranch and North Antelope Rochelle mines, which are on file with the WDEQ/LQD in Cheyenne, Wyoming.

Potential impacts to special status terrestrial species would be similar to those discussed above for non-game wildlife (e.g., small mammals, birds, amphibians, and reptiles). Potential direct impacts would include the incremental loss or alteration of potential habitat (native vegetation and previously disturbed vegetation) from construction and operation of development activities (e.g., vegetation removal for coal mines and CBNG wells, ancillary facilities, and transportation and utility corridors). Impacts could also result in mortalities of less mobile species (e.g., small mammals, reptiles, and amphibians), nest or burrow abandonment, and loss of eggs or young in the path of vehicles and heavy equipment. Indirect impacts would include increased noise levels and human presence, introduction and dispersal of noxious weeds, and dust effects from unpaved road traffic.

In general, direct and indirect impacts to special status species would result in a reduction in habitat suitability and overall carrying capacity for species currently inhabiting the cumulative study area. Development within potential habitat for special status species likely would decrease its overall suitability, and potentially would reduce or preclude use by some species due to increased activity and noise. Future use by a special status species of habitats subject to development would be strongly influenced by the quality and composition of remaining habitat, with the degree of impact dependent on variables such as breeding phenology, nest and den site preferences, the species' relative sensitivity to disturbance, and possibly the presence of visual barriers (e.g., topographic shielding) between nesting efforts and disturbance activities.

Bird species that have been identified as occurring within the PRB and are on two or more of the special status species lists include common loon, American bittern, white-faced ibis, trumpeter swan, Greater sandhill crane, mountain plover, upland sandpiper, long-billed curlew, black tern, yellow-billed cuckoo, Lewis' woodpecker, pygmy nuthatch, sage thrasher, loggerhead shrike, Baird's sparrow, sage sparrow, Brewers sparrow, and Greater sage-grouse. Any development activities (oil and gas, coal mining, other operations and associated infrastructure) that occur during the breeding season (April 1 through July 31) could result in the abandonment of a nest site or territory, or the loss of eggs or young. As discussed previously, loss of an active nest site, incubating adults, eggs, or young as a result of any of these development activities would not comply with the intent of the Migratory Bird Treaty Act and could potentially impact populations of important migratory bird species that are known to or may occur in the PRB.

A number of raptor species have been documented in the PRB and are on two or more of the special status species lists including bald eagle, ferruginous hawk, northern goshawk, merlin, peregrine falcon, western burrowing owl, and short-eared owl. Those species that have been documented in the general Wright analysis area are discussed at length in Appendices G and H of this

EIS. Potential direct impacts to raptors would result from the surface disturbance of nesting and foraging habitat, as well as injury or mortalities due to collisions with vehicles and equipment. Breeding raptors in or adjacent to development activities could abandon their nest sites or territories, or lose eggs or young. As previously described, such losses would constitute non-compliance with the intent of several laws including the Migratory Bird Treaty Act, and the Bald and Golden Eagle Protection Act, and could potentially affect populations of important migratory bird species that are known to or may occur within the region. Incremental construction of new overhead power lines in the area to support energy industries would increase risks of electrocution and collision for perching, migrating, and foraging bird species such as the larger raptors. Use of current APLIC guidelines for construction designs and retrofitting measures for new and existing utility structures would help mitigate these impacts.

The USFWS announced on March 5, 2010 its decision to classify the Greater sage-grouse as a candidate species under the Endangered Species Act. Candidate species receive no statutory protection under the ESA, but the USFWS encourages voluntary cooperative conservation efforts for these species because they are, by definition, species that warrant future protection under the ESA (USFWS 2010). A total of 239 sage-grouse strutting grounds (leks) were identified in the six sub-watersheds in the cumulative study area as of 2003, though that study did not evaluate the status (i.e., active or inactive) of those leks. As discussed in Section 3.10.5 and in the PRB Coal Review Task 1D Report, the trend in the sage-grouse population for the Sheridan Region suggests about a 10-year cycle with periodic highs and lows. More recent population peaks have been lower than previous highs, suggesting a steadily declining sage-grouse population with the Sheridan Region (Oedekoven 2001). Direct and indirect impacts to sage-grouse as a result of development activities would result from the incremental surface disturbance of existing and potential habitat, increased levels of noise and human presence, introduction or dispersal of noxious and invasive weed species, and effects of dust from increased traffic on unpaved roads. In addition to disturbance-related impacts, sage-grouse are susceptible to infection with West Nile Virus, and the incidence of infection is much higher in northeastern Wyoming than the rest of the state.

As discussed in Section 3.10.5.1, ten sage-grouse leks have been documented within the six combined general analysis areas for the six LBA tracts analyzed in this EIS. 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 leks; Kort leks 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 leks). 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 leks, 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 leks, 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, no sage-grouse nests or 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. Direct and indirect effects to Greater sage-grouse within the general Wright analysis area as a result of development activities are outlined in Appendix H.

Based on existing information, the spatial relationship between projected future disturbance and reclamation areas for the coal production scenarios and the resource-specific information in the Geographic Information Systems (GIS) layers could not be determined for the PRB Coal Review. However, the analysis did use GIS layers for future coal reserves to provide some quantification of potential future coal mining-related impacts to Greater sage-grouse. The results of this analysis are summarized in Table 4-26. The difference in the number of lek sites that would occur within 2 miles of coal mining activities under the lower coal production scenario versus the upper coal production scenario is due to slight variations in the projected disturbance areas. An unquantifiable number of lek sites initially could be impacted by CBNG activity, which would occur in advance of coal mine development. Potential direct impacts to sage-grouse, if present, could include loss of foraging areas, abandonment of a lek site, or loss of eggs or young as a result of development activities.

Table 4-26. Potential Cumulative Impacts to Greater Sage-grouse Leks from Coal Mine Development - Upper and Lower Coal Production Scenarios.

Lek Categories	**2010/ Lower**	**2010/ Upper**	**2015/ Lower**	**2015/ Upper**	**2020/ Lower**	**2020/ Upper**
Number of Directly Affected Leks	3	3	4	4	1	4
Number of Leks within 2 Miles of Coal Mining Activity	30	30	31	35	28	27

Source: PRB Coal Review Task 3D Update Report (BLM 2009f)

Seven special status fish species potentially occur in the cumulative study area sub-watersheds: the flathead chub (*Platygobio gracilis*) (Antelope Creek, Upper Cheyenne River, and Little Powder River sub-watersheds), plains topminnow (*Fundulus sciadicus*) (Upper Cheyenne River), goldeye (*Hiodon alosoides*) (Little Powder River), lake chub (*Couesius plumbeus*) (Little Powder River), mountain sucker (*Catostomus platyrhynchus*) (Little Powder River), silvery minnow (*Hybognathus argyritis*) (Little Powder River), and plains minnow (Upper Cheyenne River, Upper Belle Fourche River, and Little Powder River). Potential impacts to special status fish species as a result of development activities would be similar to effects discussed above for fisheries. Surface disturbance in three sub-watersheds (Upper Cheyenne River, Upper Belle Fourche River, Little Powder River) could alter habitat or affect water quality conditions for special status fish species. Erosion control measures, as required by existing (2003) and future permits, and National Pollution Discharge Elimination System (NPDES) permit requirements would be implemented for each project. These efforts would help decrease disturbance-related sediment input into stream segments that may contain one or more of the special status fish species. Therefore, it is anticipated that impacts to special status fish species would be low.

4.2.10 Land Use and Recreation

The PRB Coal Review Task 3D Report (BLM 2009f) discusses potential cumulative impacts to land use and recreation as a result of projected development activities in the PRB Coal Review Task 3 study area (Figure 4-4). The area of actual surface coal mining disturbance and reclamation for the years 2003 and 2007, and the projected cumulative areas of disturbance and reclamation for 2010, 2015, and 2020 are shown in Tables 4-2 and 4-3. The area of actual disturbance and reclamation for all development in 2003 and 2007, and the projected cumulative total areas of disturbance and reclamation for 2010, 2015, and 2020 are shown in Table 4-10.

The PRB is a predominantly rural, wide open landscape. With little rainfall and limited alternative sources of water, the primary land use is grazing. Nevertheless, there is a range of other land uses. The major categories include agriculture, forested, mixed rangeland, urban, water, wetlands, coal mines, and barren land. The relative amounts of these lands in the PRB Coal Review Task 1 and Task 2 study area (Figure 4-1) is tabulated in Table 4-27.

Table 4-27. Land Use by Surface Ownership.

Use Category	Surface Ownership (acres)				Total	
	BLM	**USFS**	**State**	**Private**	**Acres**	**Percent**
Agriculture	2,627	14,197	13,770	472,811	503,405	6.3
Barren	165	205	187	9,396	9,953	0.1
Forested	137,555	14,604	48,645	332,062	532,866	6.7
Mixed Rangeland	732,014	218,156	561,363	5,271,644	6,783,177	86.0
Urban	893	17	1,039	25,469	27,418	0.3
Water	35	73	334	4,773	5,215	<0.1
Wetlands	0	104	559	1,566	2,229	<0.1
Coal Mines	149	7,236	2,805	40,917	51,107	0.6
Total	**873,438**	**254,592**	**628,702**	**6,158,638**	**7,915,370**	**100.0**

Source: PRB Coal Review Task 1D Report (BLM 2005d)

A large part of the PRB consists of split estate lands (privately owned surface lands underlain by federally owned minerals). This results in conflicts between surface users, which are mainly ranching interests, and mineral developers. There also may be conflicts with some dispersed rural residences, although specific locations cannot be identified until development is proposed.

Much of the study area is also used for dispersed recreational activities such as hunting. The study area includes surface lands that are federally, state, and privately owned. With nearly 80 percent of the area privately owned, public lands provide important open space and recreation resources including both developed recreation facilities and areas to pursue dispersed recreation activities. The private sector contributes the elements of commercial recreation opportunities and tourism services such as motels and restaurants. Some private land owners also allow hunting with specific permission, sometimes for a fee.

4.2.10.1 Grazing and Agriculture

Potential impacts to grazing in the cumulative study area as a result of development activities can be classified as short-term and long- term. Potential short-term impacts arise from:

- the temporary loss of forage as a result of vegetation removal/ disturbance;
- temporary loss of AUMs;
- temporary loss of water-related range improvements, such as improved springs, water pipelines, and stock ponds;
- temporary loss of other range improvements, such as fences and cattle guards; and

- restricted movement of livestock within an allotment due to the development and operation of projects like surface coal mines, which would cease after successful reclamation had been achieved and replacement of water-related and other range improvements had been completed.

The discharge of produced water could increase the availability of water to livestock, which may offset the temporary loss of water-related range improvements. Potential long-term impacts consist of permanent loss of forage and forage productivity in areas, such as power plants, that would not be reclaimed in the near term. Indirect impacts may include dispersal of noxious and invasive weed species within and beyond the surface disturbance boundaries, which decreases the amount of desirable forage available for livestock grazing in the long term.

Development activities could result in short- and long-term impacts to agricultural land, depending on their spatial relationship. Short-term impacts would include the loss of crop production during development and operational phases of the projects. Long-term impacts would result from the permanent loss of agricultural land due the development of permanent facilities such as power plants and railroads.

Table 4-28 contains an estimate of the number of AUMs unavailable on lands disturbed and not yet reclaimed through 2020 for the high and low levels of predicted development activity, along with the acreage of cropland estimated to be affected.

Table 4-28. AUMs and Acres of Cropland Estimated Unavailable on Lands Disturbed and Not Yet Reclaimed as a Result of Development Activities.

Category	**2003/ Baseline**	**2007/ Actual**	**2010/ Lower**	**2010/ Upper**	**2015/ Lower**	**2015/ Upper**	**2020/ Lower**	**2020/ Upper**
Unavailable AUMs[1]	18,150	22,108	19,820	20,145	22,389	22,905	22,131	22,950
Unavailable Crop Land (acres)	48	---[2]	59	60	134	139	206	289

[1] Based on an average stocking rate of 6 acres per AUM.
[2] Not reported.
Source: PRB Coal Review Task 3D Update Report (BLM 2009f)

4.2.10.2 Urban Use

It is expected that there would be additional expansion of urban residential and commercial development as a result of the projected 48 percent growth in population (between 2003 and 2020) in Campbell County. Section 4.2.12 and the Task 3C Report of the PRB Coal Review (BLM 2005f) contain additional information on employment and population issues in the study area. A majority of the new urban development would be expected to occur adjacent to existing communities, primarily Gillette, which accounts for approximately 60 percent of the Campbell County population and, to a lesser extent, Wright and other small communities. Most of this development would occur on land that is currently in use for grazing or agriculture.

4.2.10.3 Recreation

Accessible public lands provide diverse opportunities for recreation, including hunting, fishing, off road vehicle (ORV) use, sightseeing, and wildlife observation. The National System of Public Lands generally provides dispersed recreational uses in the study area. Some developed recreational facilities occur in special management areas, including recreation areas. While opportunities are available on public lands throughout the PRB, the majority of dispersed recreational uses occur in the western part of the PRB Coal Review Task 1 and Task 2 study area, including the south Big Horn Mountains area and along the Powder River. Public lands elsewhere consist mainly of isolated tracts of land that are too small to provide a quality recreational experience. Larger parcels of public lands occur in the southwest part of Johnson County and along the Powder River (administered by BLM) and in the Thunder Basin National Grassland (administered by the USFS). Public lands are accessible via public roads or across private land with the landowner's permission.

Hunting is a major recreation use of state and federal lands in the study area. Various big game and upland game bird species are hunted in the region. Fishing is a popular year-round activity for residents of the study area.

Mule deer and pronghorn hunting are by far the most popular hunting activities in the Task 1 study area, accounting for 35,529 and 21,304 hunter days, respectively, in 2003 (Stratham 2005). The next highest were cottontail rabbit (2,348 hunter days) and elk (2,055 hunter days), followed by wild turkey (1,019), sharp-tailed grouse (508), and sage-grouse (38). Consistent trends in hunter activity over the past decade are not discernible from the WGFD data considered in the PRB Coal Review. All of the most prominent species hunted in the study area have had high years and low years. Pronghorn hunting, for example, was greatest from 1993 to 1996, while elk hunting was at its peak in 2001 and 2002. Mule deer hunting has been the most consistent, ranging from a low of 28,311 hunter days in 1996 to a high of 37,307 hunter days in 2002.

ORV use in the Task 1 study area is available on most BLM-managed lands. Most of the public land in Johnson, Sheridan, and Campbell counties has been inventoried and designated as open, limited, or closed to ORV use. For the baseline year, approximately 20,386 acres were open to unlimited vehicle travel on and off roads. There were 4,680 acres in the area that were closed to all ORV use and approximately 867,534 acres were available for limited use. Limited use typically means ORVs are restricted to existing roads and vehicle routes.

Recreational use of public lands in the Task 1 study area has increased substantially over the past two decades, and is expected to continue to increase by about five percent every 5 years for most recreational activities (BLM 2003). Total visitor use by residents and nonresident visitors in Campbell and Converse counties in 1980 was projected at 1,276,000 visitor days (BLM 1979). The total visitor days of 1,881,763 estimated for 1990 was approximately 47 percent higher than the 1980 visitor days (BLM 2001a). Fewer than three percent of visitor days were estimated to occur on public lands.

Few, if any, of the developed recreation sites in the PRB Coal Review Task 3 study area would be affected by development related disturbance. As most of the projected disturbance area would occur on privately owned surface land, the extent of effects on dispersed recreation activities largely would depend on whether the disturbance areas had been open to public or private lease hunting. It is projected that cumulative development activities, especially the dispersed development of CBNG and, to a lesser extent, conventional oil and gas, would tend to exacerbate the trend toward a reduction in private land available for public hunting, which has been observed by WGFD in recent years (Shorma 2005). A reduction in available private land for dispersed recreation would contrast with the anticipated increase in demand for recreational opportunities and would tend to push more recreationists toward public lands where the BLM has projected a five percent increase in use every 5 years (BLM 2001a). After coal- and oil and gas-related development activities have been completed and the disturbed areas have been reclaimed, many of the adverse effects on dispersed recreation activities would be reduced.

It is expected that the development activities also would tend to expand and exacerbate the qualitative degradation of the dispersed recreation experience, in general, and of the hunting experience, in particular, as reported by the WGFD (Jahnke 2005). As noted in the Task 1D Report of the PRB Coal Review (BLM 2005d), reductions in land available for hunting also make herd management more difficult for the WGFD and reduce its hunting-derived revenues (Shorma 2005).

No direct effects on wilderness or roadless areas would be expected from the projected development activities. There are no designated wilderness areas in the study area, and mineral development would not be permitted in the Fortification Creek Wilderness Study Area until and unless Congress acts to remove it from Wilderness consideration.

There would be no effects on Wild and Scenic Rivers as the only river segment identified as both “eligible” and “suitable” in the Task 1D Report of the PRB Coal Review is not in the cumulative study area.

4.2.11 Cultural Resources and Native American Concerns

The PRB Coal Review Task 3D Report (BLM 2009f) discusses potential cumulative impacts to cultural resources as a result of projected development activities in the cumulative study area. The area of actual surface coal mining disturbance and reclamation for the years 2003 and 2007, and the projected cumulative areas of disturbance and reclamation for 2010, 2015, and 2020 are shown in Tables 4-2 and 4-3. The area of actual disturbance and reclamation for all development in 2003 and 2007, and the projected cumulative total areas of disturbance and reclamation for 2010, 2015, and 2020 are shown in Table 4-10.

Cultural sites occur throughout the cumulative study area. Surface disturbing activities can result in the loss or destruction of these sites. Table 4-29 contains an estimate of the amount of projected disturbance through 2020 for the projected lower and upper levels of coal development activity, along with the number of cultural sites estimated to be affected. The sites fall into two categories; prehistoric sites and historic sites, as described below. Also below are description of Native American traditional cultural places and a summary of the program to protect sites in any of these categories.

4.2.11.1 Prehistoric Sites

All recognized prehistoric cultural periods, from Clovis through Protohistoric (about 11,500 to 200 years ago), are represented in the cumulative study area (see Section 3.12 for additional discussion about the prehistoric cultural periods.) The earliest prehistoric cultural periods, Paleoindian through Early Plains Archaic, are represented by only a small number of sites. Archaic and later prehistoric period sites (Archaic to Protohistoric) are represented in increasing numbers as a result of higher populations through time and better preservation of more recent sites. Important prehistoric site types in the region include artifact scatters, campsites, stone circles, faunal kill and processing sites, rock alignments and cairns, and stone material procurement areas.

Artifact scatters dominate prehistoric sites in the study area. When there is adequate information to evaluate these types of sites, most are not eligible to the NRHP. However, complex sites and sites with buried and dateable material can yield important information and are often field evaluated as eligible. The proportion of unevaluated sites is lower in the subwatersheds in which more studies and more follow-up studies have been conducted, such as Antelope Creek, Upper Cheyenne River, and Upper Belle Fourche River. Some portions of some of the subwatersheds which have more varied habitats or conditions more conducive to preservation are very rich in significant prehistoric sites. Within the cumulative study area, these areas include the lower Antelope Creek drainage and eastern portions of the Upper Belle Fourche River. While prehistoric sites do exist in the general Wright analysis area, it does not appear to be particularly plentiful in significant prehistoric sites. More detailed information on the known cultural sites that are present in the PRB based on the existing surveys is included in the Task 1D Report for the PRB Coal Review (BLM 2005d).

Table 4-29. Square Miles of Projected Cumulative Disturbance and Number of Potentially Affected Cultural Resource Sites in the PRB Coal Review Task 3 Study Area – Lower and Upper Coal Production Scenarios.

		Lower Coal Production Scenario						Upper Coal Production Scenario					
		Year 2010		Year 2015		Year 2020		Year 2010		Year 2015		Year 2020	
Sub-watershed	**Average Number of Sites per Square Mile[1]**	**Square Miles[2]**	**Sites[3]**	**Square Miles[2]**	**Sites[3]**	**Square Miles[2]**	**Sites[3]**	**Square Miles[2]**	**Sites[3]**	**Square Miles[2]**	**Sites[3]**	**Square Miles[2]**	**Sites[3]**
Antelope Creek	4.7	59	277	76	357	94	442	61	287	79	371	98	461
Dry Fork Cheyenne River	8.9	2.2	20	2.7	24	3.1	28	2.2	20	2.7	24	3.1	28
Little Powder River	4.6	76	350	85	391	89	409	77	354	86	396	91	419
Upper Belle Fourche River	4.3	135	580	148	636	156	671	137	589	154	662	166	714
Upper Cheyenne River	5.2	57	296	66	343	76	395	58	302	68	354	78	406
Upper Powder River	5.0	160	530	175	875	242	1,210	106	530	175	875	242	1,210
Total		**435**	**2,053**	**553**	**2,626**	**660**	**3,155**	**441**	**2,082**	**565**	**2,682**	**678**	**3,283**

[1] Average number of sites per square mile based on previous surveys in the study area.
[2] Calculated, based on database disturbance acreages prepared for the Task 2 Report for the PRB Coal Review, Past and Present and Reasonably Foreseeable Development Activities (Appendices A and D) (BLM 2009b).
[3] The number of sites was calculated by multiplying the average density of known cultural sites per square mile (based on previous surveys) by the number of square miles of projected cumulative disturbance.
Source: PRB Coal Review Task 3D Update Report (BLM 2009f)

4.2.11.2 Historic Sites

In the PRB region, sites are documented within the broad contexts of Rural Settlement, Urban Settlement, Mining, Transportation, Military, Exploration, and Communication. Each of these site categories and the types of sites they include are detailed in the Task 1D Report for the PRB Coal Review (BLM 2005d). Evaluation of the importance of historic sites, districts, and landscapes must consider aspects of both theme and period in assessing the historic character and contributing attributes of the resources.

4.2.11.3 Native American Traditional Cultural Places

General ethnographies of the tribes that may have had traditional ties to this region do not provide information on specific resources in the study area that are likely to be traditional cultural concerns because these resources are considered confidential by the tribes. Within this region, there are prominent and identifiable places such as the Medicine Wheel to the west in the Bighorn Mountains and Devils Tower to the east in the Black Hills area. These known sites offer some indication of the types of places valued by the Plains Indian horse cultures in the historic period. Any identification of sacred or traditional localities must be verified in consultation with authorized tribal representatives.

4.2.11.4 Site Protection

At the time an individual project is permitted, the development activities considered in this study would be subject to the following regulations relative to cultural resources. Section 106 of the National Historic Preservation Act of 1966 as amended, its implementing regulations (including but not limited to 36 CFR 800, 36 CFR 61, and Executive Order 11593), and NEPA and its implementing regulations, including 40 CFR 1500 - 1508, provide the legal environment for documentation, evaluation, and protection of historic properties (i.e., cultural resources eligible for inclusion on the National Register of Historic Places) that may be affected by development activities. In cases of split estate (where surface ownership and mineral ownership differ), surface resources, such as cultural sites, belong to the surface owner. The surface owner must be consulted about investigation, mitigation, or monitoring.

4.2.12 Transportation and Utilities

The PRB Coal Review Task 3D Report (BLM 2009f) discusses potential cumulative impacts to transportation and utilities systems as a result of projected development activities in the cumulative study area. The area of actual surface coal mining disturbance and reclamation for the years 2003 and 2007, and the projected cumulative areas of disturbance and reclamation for 2010, 2015, and 2020 are shown in Tables 4-2 and 4-3. The area of actual disturbance and reclamation for all development in 2003 and 2007, and the projected cumulative total areas of disturbance and reclamation for 2010, 2015, and 2020 are shown in Table 4-10.

Generally, transportation systems in the cumulative study area would not be directly affected by the disturbance associated with projected development. Site-specific instances of disturbance may require that segments of highways, pipelines, transmission lines, or railroads be moved to accommodate expansion of certain coal mines. In such cases, the agencies authorized to regulate such actions would have to approve any proposal to move any segments of any transportation systems and construction of alternative routing would be required prior to closing existing links so that any disruptive effects on transportation systems would be minimized.

The coal mines in the North Gillette subregion currently ship most of their coal via the east-west BNSF rail line through Gillette. That subregion produced 55 mmtpy in the baseline year (2003), which was just 22 percent of the estimated 250 mmtpy capacity of the BNSF rail line (BLM 2005a). The coal mines in the South Gillette and Wright subregions produced approximately 308 mmtpy in 2003, which was 88 percent of the estimated 350 mmtpy capacity of the joint BNSF & UP line serving those areas in the baseline year.

Potential effects of development activities on transportation and utilities may be either short- or long-term in nature, varying with the type of development. A power plant or an urban community development would be considered long-term, and the demand for transmission line capacity would be virtually permanent, lasting for the economic life of the activity. The effects of coal production and the related demand for rail capacity would vary with market changes. In recent years, coal production has been increasing and the PRB Coal Review projects that the trend would continue, as shown in Tables 4-2 and 4-3. Similarly, the demand for pipeline capacity would vary with market conditions as well as with the rate of depletion of the oil or gas resource.

Potential direct effects of projected development on roads and highways would include increased vehicular traffic and risk of traffic accidents on existing roadways in the cumulative study area from daily travel by workers and their families. Indirect effects would include increased wear and tear on existing roads, additional air emissions from vehicles, additional fugitive dust from roads, noise, increased potential access to remote areas, and an increased risk of vehicle collisions with livestock and wildlife. Direct effects on railroads, pipelines, and transmission lines primarily would include increased demand for capacity to move coal, oil and gas, and electricity from production locations in the study area to markets outside the area. Indirect effects would include potential impacts of the accumulation of coal dust and fines blowing or sifting from moving, loaded rail cars. A collaborative effort between the National Coal Transportation Association, the mines, and the BNSF & UP Railroads is resulting in measures to reduce coal dust emissions from loaded, moving rail cars.

The socioeconomic analysis conducted as a part of Task 3C of the PRB Coal Review projects a population increase of approximately 48 percent between 2003 and 2020 in Campbell County under the upper coal production scenario (BLM 2005f). Campbell County accounts for most of the population in the PRB Coal Review Task 3 study area. Based on traffic studies conducted independently of the PRB Coal Review, vehicle miles traveled tend to increase at or above the rate of population growth. Consequently, highway traffic would be expected to increase by at least 48 percent by 2020. Approximately 60 percent of the population growth would occur in or near Gillette, which would indicate that the same proportion of traffic would originate in the Gillette area. The remainder of the traffic growth would be dispersed throughout the study area. Under this scenario, the greatest impact on traffic would occur in the Gillette area, where existing traffic volume to capacity ratios are highest. The increased traffic would be expected to cause delays in the Gillette area and might require widening of some streets and roads or other measures to increase traffic capacity. It is anticipated that there would be an increase in the risk of traffic accidents approximately proportional to the increase in traffic. Highway capacity on major routes away from Gillette would be expected to be sufficient to accommodate the growth without substantial constraints.

Existing rail lines, together with proposed upgrades on the joint BNSF & UP line, would be expected to accommodate the projected coal transportation traffic through 2015 (Table 4-30). The PRB Coal Review Task 2 Report (BLM 2009b) projects that the proposed DM&E line would be built and operational by 2015 (pending completion of additional environmental analysis), which would add 100 mmtpy in additional shipping capacity for the South Gillette and Wright subregions.

Table 4-30. PRB Rail Lines Coal Hauling Capacity and Projected Use.

	2010 Projected			**2015 Projected**			**2020 Projected**		
Rail Line	**2010 Capacity mmtpy**	**Rail Use Increase[1] mmtpy**	**Rail Use Increase[1] %**	**2015 Capacity mmtpy**	**Rail Use Increase[1] mmtpy**	**Rail Use Increase[1] %**	**2020 Capacity mmtpy**	**Rail Use Increase[1] mmtpy**	**Rail Use Increase[1] %**
North BNSF	250	62-78	25-31	250	74-104	30-42	250	78-121	31-48
South BNSF & UP	450	349-398	79-88	600	381-439[2]	64-73[2]	600	417-455[2]	70-76[2]
DM&E	0	0	0	---[2]	---[3]	---[3]	---[2]	---[3]	---[3]

[1] The range of increase in use shown for each year reflects the increases that are projected for the Lower and Upper Coal Production Scenarios, respectively.
[2] The DM&E is assumed to be built and operational by 2015, adding 100 mmtpy of capacity for the mines served by the BNSF & UP South line.
[3] The BNSF & UP South line figures represent the projected combined traffic and percent capacity on the BNSF & UP South line and the projected DM&E line.
Source: PRB Coal Review Task 3D Update Report (BLM 2009f)

The Task 2 Report for the PRB Coal Review originally projected that basin-wide production of CBNG could potentially double by 2020, which would suggest that additional pipelines could be built. The recent update of the Task 2 report

(BLM 2009b) revised the projections. As noted in Section 4.1, trends in CBNG development since 2007 indicate that this estimate may be lowered as new forecasting is done. Current gas pipeline capacity out of the PRB is approximately 2.05 bcf per day; average conventional natural gas and CBNG production in 2007 was approximately 1.24 bcf per day. Based on the information in the update of the Task 2 report, potential total gas production (conventional natural gas and CBNG) has been projected at 2.06 bcf per day by 2010. This potential is pipeline capacity limited, suggesting additional pipelines could be built. There are no specific projects under way; however, two potential additional pipeline projects (Bison and Pathfinder) have been identified for potential completion in 2010 (see Section 4.1.2.3.1). These projects would increase the take-away capacity by 0.50 and 1.60 bcf, respectively, for a total of approximately 4.15 bcf per day.

By 2010, an estimated 99 megawatts (MW) of additional power would be provided by a new wind energy project. An estimated 1,380 MW of new power plant production capacity and 250 MW of new wind energy production capacity are anticipated in the cumulative study area by 2015. One new 300-MW wind energy project and potentially up to 700 MW of additional power generation provided by coal-fired power plants is projected for 2020. This level of production would require construction of additional transmission line capacity. It is assumed that new transmission lines would be constructed to connect new power plants to the grid. It is projected that these transmission lines would be constructed by 2015 to connect to outside markets. However, specific location(s), capacities, and effects on the existing system cannot be determined at this time.

4.2.13 Socioeconomics

The cumulative socioeconomic impact analysis focuses on Campbell County, but also considers Converse, Crook, Johnson, Sheridan, and Weston counties as directly affected and Niobrara and Natrona counties as indirectly affected. Recent and projected socioeconomic conditions are described in more detail in the Task 1C and 3C reports for the PRB Coal Review (BLM 2005c and 2005f).

REMI Policy Insight (REMI), a professionally recognized regional economic model, was used to develop the cumulative employment and population projections presented below. The version of the REMI model for the Coal Review was comprised of two economic regions: one being Campbell County alone, the second composed of those Wyoming counties bordering Campbell County and linked to its economy by established industrial and consumer trade linkages and by work force commuting patterns. Results for the second region were analyzed to focus on the five counties, Converse, Crook, Johnson, Sheridan, and Weston, that are the most directly linked. Collectively, these five counties are referred to in the PRB Coal Review Task 3C Report (BLM 2005f) as the surrounding counties. Additional analysis was undertaken to translate the population and employment forecasts for each of the surrounding counties into housing needs and to project future school enrollment.

During the 1970s and early 1980s, the PRB emerged as a major coal producing region. Federal coal leasing has been a high profile activity because over 90 percent of the coal resources in the PRB are federally owned. The surface coal mines that developed during the 1970s and early 1980s are now mature operations, providing a stable economic and social foundation for the region. While energy development has produced periodic surges in population, followed occasionally by population declines in some communities, the growth in domestic energy consumption, coupled with the PRB's vast energy resource base, has resulted in a 50-year growth trend in the region without the severe economic dislocations that have characterized other western U.S. resource booms.

This period of extended energy development has been accompanied by substantial economic changes and benefits, including economic growth, employment opportunity, tax revenue growth, and infrastructure development for local governments, both locally and across Wyoming, funded by tax revenues generated by production of coal and other energy resources. At the same time, periods of rapid growth have stressed communities and their social structures, housing resources, and public infrastructure and service systems.

The emergence of the coal and other energy resource development industries in the PRB has had long-term cumulative affects on regional social and economic conditions. In general, Campbell County and the entire PRB region have developed an enhanced capacity to respond to and accommodate growth. The regional coal industry also provides a measure of insulation from dramatic economic and social dislocations. Key cumulative social and economic conditions identified in the PRB Coal Review are described below.

4.2.13.1 Employment and the Economic Base

Energy resource development since 1970 has resulted in substantial economic expansion across the PRB. Total employment expanded by 163 percent as 40,674 net new jobs were added between 1970 and 2004. The most rapid expansion occurred between 1975 and 1980. After modest growth and slight decline in the 1980s and early 1990s, employment growth resumed in the late 1990s, led by increases in coal mine employment, including subcontractors, and CBNG development. Across the six-county area, total employment was 65,597 in 2004. Nearly half of the net job gain occurred in Campbell County, where total employment increased from 6,026 jobs in 1970 to 25,921 jobs in 2004. Strong gains also were posted in Sheridan County (9,821 jobs) and Converse County (4,421 jobs).

The economic stimuli associated with the gains in mining and CBNG employment and the long-term population growth triggered secondary job gains in construction, trade, services, and government. In 2004, business and consumer services accounted for 51 percent of all jobs in the region, while mining and government accounted for 14 percent and 16 percent of all jobs, respectively. Farm employment in the region, as a share of total employment, declined from 14 percent in 1970 to 5.0 percent in 2004. However, that shift is primarily due to growth in non-farm employment rather than declines in farming, as total farm employment in the PRB recorded a net decline of only 375 jobs, from 3,571 to 3,196 (U.S. Bureau of Economic Analysis 2006).

The largest impetus to future growth over the PRB Coal Review study period (2003 to 2020) is expected to occur by 2010. Under the lower production scenario, employment in 2010 related to coal mining, oil and gas production, and oil field services is projected to increase by one-third, or more than 2,300 jobs, as compared to 2003 levels. Many of the jobs gained would be the result of increased oil and gas development. While the number of coal mining jobs would increase, the projected coal mine-related productivity gains would limit increases in the number of mine employees required for operations.

Beyond 2010, total mining industry employment would decline as major infrastructure development (e.g., additional CBNG compression capacity) is completed and the pace of conventional oil and gas drilling decreases. Increases in CBNG production and coal mining employment would occur thereafter, such that total mining employment would approach pre-2010 levels by the end of the forecast period (2020). Under the development scenarios, construction of three new power plants, having a combined capacity of 1,000 MW and a peak work force of approximately 1,550 in 2007-2008, is assumed to occur concurrently with the increases in mining employment. Under the upper production scenario, a second temporary construction work force impact would occur between 2016 and 2020 in conjunction with the construction of an additional 700-MW power plant.

The net effects of these activities, including secondary effects on suppliers, merchants, service firms, state agencies and local government in the region, would be the creation of more than 8,700 new jobs in the region between 2003 and 2010. Of those, more than 5,600 jobs (a 22 percent increase over 2003) would be based in Campbell County. The pace of economic expansion, at least in terms of jobs, would moderate after 2010. Total employment growth of 2,017 additional jobs is projected in Campbell County between 2010 and 2020, with 1,741 additional jobs projected in the surrounding counties.

However, to achieve the projected levels of energy and mineral development activity through 2010 assumes that industry has access to the necessary equipment, materials, labor, and other vital inputs. Current oil and gas exploration and development across the Rocky Mountain region has absorbed the available inventory of drilling rigs and crews. A lack of access to resources could delay or limit the job gains below the levels projected, even though prospects for such growth remain. Furthermore, competition for equipment, combined with tight labor markets, could negate the productivity gains that underlie the projections, such that the employment and associated impacts do materialize, but are associated with lower levels of activity (e.g., a lengthier construction period for a power plant or fewer new wells drilled each year).

Employment effects associated with the upper coal production scenario, assuming productivity gains in coal mining equivalent to those in the lower coal production scenario, would result in total employment gains of 11,563 jobs by 2010 in the six-county study area, with an additional 3,667 jobs by 2020[2]. As compared to the employment projections under the lower coal production scenario, those gains include 2,821 additional jobs in 2010 and 3,214 additional jobs in 2020. Most of the incremental gains would be in Campbell County, further stressing labor markets, housing, and other community resources. Such pressures could delay or affect the development plans of individual firms and operators, such that the projected employment levels would not be realized in the time frames shown. Nonetheless, substantial growth in employment is expected to occur, and even if the projected total employment levels are not realized, substantial social and economic impacts still would be anticipated.

The economic stimuli associated with the projected development also would stimulate increases in employment in other nearby counties beyond the five surrounding counties identified above. However, the potential effects in these areas are not addressed in the PRB Coal Review Task 3C Report because most of the effects would comprise indirect or induced growth that would be limited in scale relative to the size of the respective economies. Furthermore, the economic outlook for those areas is influenced by factors that are beyond the scope of this study, such as the role of the oil and gas support services industry based in Natrona County in supporting energy development in the south-central and southwestern portions of Wyoming.

4.2.13.2 Labor Market Conditions

Labor market conditions in the PRB reflect a generally healthy economy, with average annual county unemployment rates between 2.1 percent (Campbell) and 3.5 percent (Weston) in 2006. Statewide and national unemployment rates for the period were 3.2 percent and 4.6 percent, respectively (U.S. Bureau of Labor Statistics 2007).

Over time, local unemployment levels and rates have reflected the influences of the large, relatively stable employment baseline associated with the region's coal mining industry and the more transitory and variable influences of natural gas development. Prior to the onset of CBNG development in 1989, unemployment in Campbell County fluctuated between 4.8 and 5.3 percent, slightly above the corresponding statewide averages. Labor demand associated with CBNG development contributed to a decline in unemployment to below 3.0 percent in the 2001. As the pace of CBNG development stabilized, labor

[2] The number of jobs in the coal mining industry under the upper production scenario was estimated assuming future productivity gains comparable to those used for the lower production scenario. This approach differs from that described for the upper production scenario in the Task 2 report of the coal study, whereby a 16 percent higher production would be achieved with a 2.5 percent increase in workforce. Although that assumption reflects a continuation of historic productivity gains, it may underestimate population and employment growth and related socioeconomic effects if the production levels are achieved but productivity lags. Using the productivity gains from the lower production scenario provides a more conservative perspective on potential long-term population growth for purposes of the cumulative analysis.

demand eased and unemployment rates climbed to 3.7 percent in 2003, before again falling to current record lows.

The employment effects identified above indicate substantial pressures on local labor markets. Strong demand for labor would maintain low unemployment, creating upward pressure on wages and salaries. Those influences would stimulate substantial economic migration into Campbell County, causing impacts to population, housing demand, and other economic and social conditions. Similar influences would occur in surrounding counties, although the implications are less severe because the scale of effects would be smaller and would be distributed over multiple communities and service providers.

4.2.13.3 Personal Income

A benefit associated with energy resource development, whether it is mineral mining or oil and gas development, is local wages and salaries that are among the highest in the state. Personal income registered strong gains across the region, but especially in Campbell County, during the late 1970s and early 1980s. In 1981, per capita personal income in Campbell County was $17,520, compared to the national average of $11,280 and the statewide average of $12,879. Personal income growth was tempered by several years of economic stagnation during the late 1980s. Renewed economic vitality since then resulted in per capita personal income in Campbell County reaching $33,388 in 2004. Those gains notwithstanding, per capita income among Campbell County's residents was below statewide and national norms, as well as that for Sheridan ($35,716) County. When measured on a median household or family income basis in the 2000 census, Campbell County led statewide, national, and other counties in the PRB by considerable margins. That pattern has been maintained due to the strong economic growth in the region; in 2006 the median household income in Campbell County was $60,800 compared to a statewide median of $43,785 and national median of $44,374. Median household incomes for the other five PRB counties ranged from $40,195 to $46,883 (U.S. Census Bureau 2006a).

In terms of total personal income, Campbell County led the six-county region with $1.22 billion in 2004. Sheridan County residents recorded aggregate personal income of $972 million in 2004. Total personal income in the other counties was substantially lower, ranging from $193 million in Crook County to $389 million in Converse County.

Personal incomes in the region would increase over the time period 2007-2020, both in aggregate and on a per capita basis, in conjunction with the economic outlooks foreshadowed by the projected development scenarios. In 2004, total personal income in the six-county area was $3.24 billion. Under the lower production scenario, total personal income would more than double to $7.57 billion in 2020 (in nominal dollars). The upper production scenario would generate an additional $266 million per year in Campbell County and an additional $35 to $40 million per year in the surrounding counties by 2020.

Annual per capita incomes are projected to increase by approximately 27 percent (in real terms) across the region between 2003 and 2020. Households with one or more workers employed directly in the energy industry, associated service firms, and the construction industry likely would realize larger shares of the gains (BLM 2005f).

4.2.13.4 Population and Demographics

Population change over time is perhaps the single best indicator of cumulative social and economic change in the PRB. Campbell County was not among the original 13 counties when Wyoming was admitted to statehood, but was carved from Weston and Crook counties in 1911. Campbell County's 1920 population of 5,233 ranked it seventeenth among Wyoming's counties. Forty years later and prior to the onset of coal development in the region, Campbell County ranked eighteenth among Wyoming's counties in terms of population, with a 5,861 residents. Neighboring Converse, Sheridan, and Weston counties all had larger populations.

By 1980, Campbell County's population had increased by more than 300 percent, to 24,367, seventh among Wyoming's counties. Energy development contributed to population growth in Sheridan, Converse, Johnson, and Crook counties during that period. Weston County recorded a population decline during the period; however, the combined population of the PRB climbed from 49,311 in 1960 to 82,598 in 1980.

Annual coal production in the PRB has increased by nearly 560 percent since 1980, accompanied by expanded mine service and rail transportation capacity, stimulating further growth. The impetus for growth in local employment was tempered by substantial productivity increases in the mining industry, coupled with declining production of other energy resources. Consequently, the region's population gained a relatively modest 11 percent, 9,318 residents, between 1980 and 2000, reaching 91,916. Campbell County registered a net gain of 9,331 residents during that period, raising its total population to 33,698 in 2000, fourth highest in the state. Across the PRB, the loss of about 2,000 residents in Converse County was offset by modest gains in the other four counties (U.S. Census Bureau 2001).

More recently, the PRB has seen renewed population growth, primarily linked to CBNG development. Population estimates for 2006 indicate a total regional population of 100,504, a 9.3 percent increase over the 2000 census population. Gains were reported for all six counties, ranging from 118 persons in Weston County to 5,236 persons in Campbell County (Table 4-31).

The magnitude and timing of projected employment changes from 2003-2020 under either coal production scenario would trigger corresponding effects to population across the PRB, particularly in Campbell County (Figure 4-10).

Table 4-31. Recent and Projected PRB Population.

Year	Campbell County	Converse County	Crook County	Johnson County	Sheridan County	Weston County	Six County PRB Total
Census							
2000	33,698	12,104	5,895	7,108	26,606	6,642	92,053
2003	36,381	12,326	5,971	7,530	27,116	6,665	95,989
2006	38,934	12,866	6,255	8,014	27,673	6,762	100,504
Lower Coal Production Scenario							
2010	45,925	13,103	6,542	8,389	28,459	7,108	109,526
2015	48,905	13,671	6,759	8,867	30,016	7,174	115,392
2020	50,995	14,193	6,989	9,326	31,467	7,208	120,178
Upper Coal Production Scenario							
2010	47,662	13,160	6,570	8,424	28,579	7,137	111,532
2015	51,558	13,763	6,802	8,924	30,214	7,219	118,480
2020	54,943	14,313	7,045	9,403	31,733	7,266	124,703

Source: U.S. Census Bureau (2006a) and PRB Coal Review Task 3C Report

Under the lower coal production scenario, Campbell County's population is projected to increase by more than 14,550 residents between 2003 and 2020, nearly 9,500 of which are anticipated by 2010. Growth over the next 3 years will maintain pressures on housing and other community resources. The projected energy and mineral development in the lower coal production scenario would also result in substantial population growth elsewhere in the PRB, with Sheridan, Johnson, and Converse counties all projected to gain substantial population. Population growth, like employment growth, would moderate after 2010. Projected population growth between 2003 and 2020 ranges from 0.5percent compounded annual growth rate (CAGR) in Weston County to 2.0 percent CAGR in Campbell County. In absolute terms, the net change ranges from 537 additional residents in Weston County to a gain of 14,557 residents in Campbell County. The total population of the six-county study area is projected to climb to 120,178 in 2020, a 1.3 percent CAGR.

As with employment, changing development conditions could result in actual population growth varying from projected growth. If project schedules or levels of development vary from the projected levels, corresponding effects on population growth could result (e.g., lower growth). Population demographics could also change due to migration and commuting, with more immigrating construction workers being single-status, rather than accompanied by families. Another possibility is that the spatial distribution of population growth could shift as a result of housing or labor constraints, such that less growth would occur in Gillette and Campbell County, and more growth would occur elsewhere.

Projected population growth through 2020 under the upper coal production scenario is approximately 19 percent higher than under the lower coal production scenario (28,625 compared to 24,100, with the six-county population reaching 124,703 by 2020). Much of the incremental population

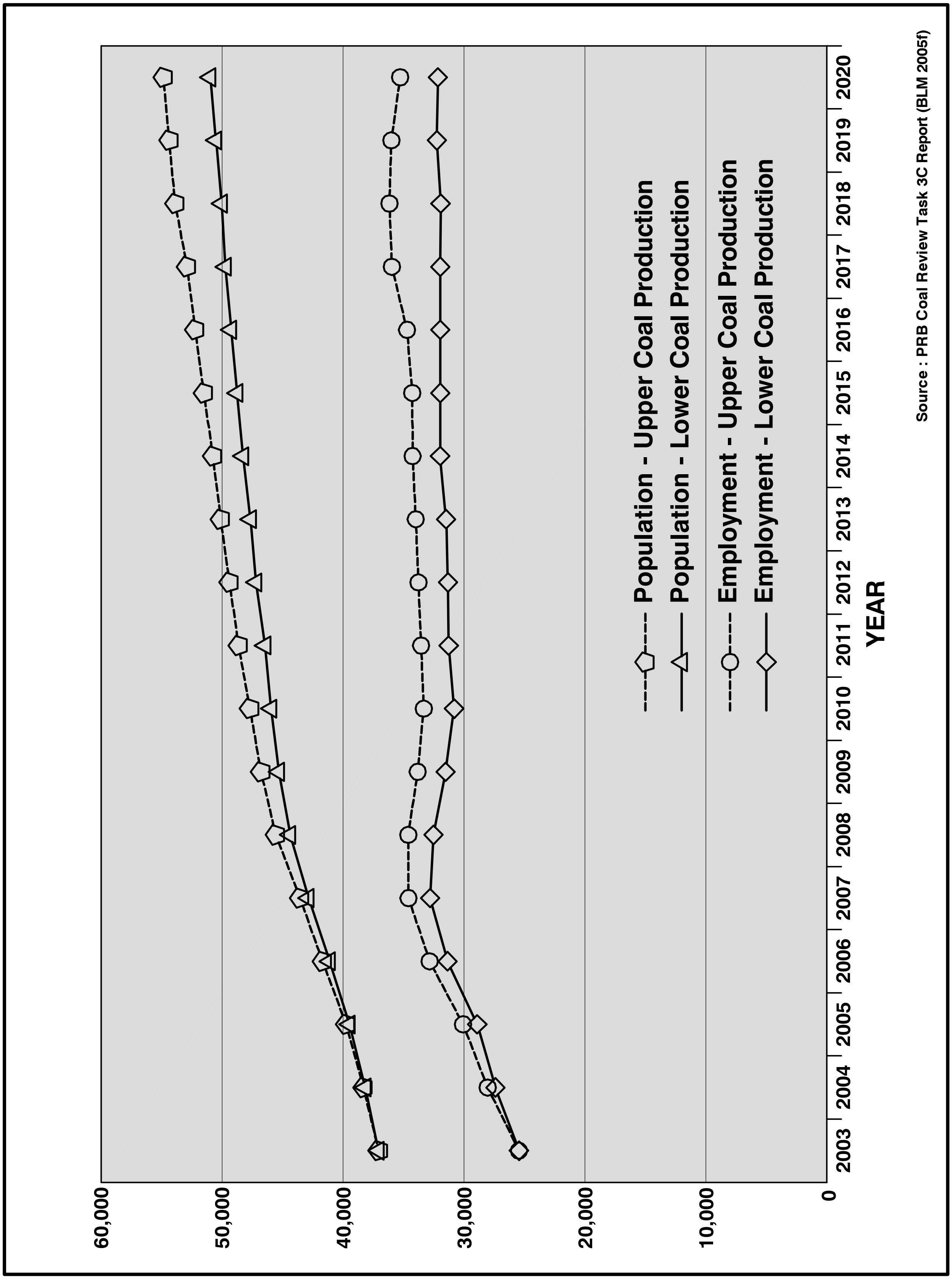


Figure 4-10. Projected Campbell County Population and Employment to 2020.

growth would occur by 2010 in Campbell County, and in particular in and near Gillette.

Community population growth under the upper coal production scenario generally would mirror growth under the lower coal production scenario but with higher growth in Wright, Douglas, and Newcastle due to the effects of higher coal production, coal transportation, and power generation concentrated in the southern portion of Campbell County.

4.2.13.5 Housing

While the population grew by 55 percent in the 1970s, the housing stock in the study area grew by almost 78 percent. Housing growth was especially rapid during the 1970s in Campbell County, where population grew by 88 percent and the housing stock grew by 140 percent. The expansion in housing supply, combined with the slowdown in the rate of population growth, produced double-digit vacancy rates for rental housing in the late 1980s and early 1990s. After growth resumed in the mid-1990s, most county-level vacancy rates for ownership units were at or below the state levels in 2000. Vacancy rates for rental units declined even more sharply. Vacancy rates have fallen even more as a result of recent growth, with current rates below 1.5 percent in five of the six-county study area, and that in Johnson County at only 2.8 percent (Table 4-32).

Table 4-32. Rental Housing Vacancy Rates, 2004 4Q and 2006 4Q.

Year	Campbell County	Converse County	Crook County	Johnson County	Sheridan County	Weston County	Wyoming
2004 4Q	2.8%	8.3%	10.4%	2.1%	4.5%	5.0%	4.8%
2006 4Q	0.4%	1.4%	1.0%	2.8%	0.5%	0.0%	2.4%

Source: Wyoming Housing Database Partnership (2007)

In 2000, the housing inventory in the six-county study area was 41,203 units (Table 4-33). Total housing inventory had expanded to 43,363 units in 2005, a net addition of 2,160 since 2000. However, new construction hasn't kept pace with population growth, resulting in tighter market conditions in terms of availability, and higher prices.

Table 4-33. Total Housing Stock in 2000 and 2005.

Year	Campbell County	Converse County	Crook County	Johnson County	Sheridan County	Weston County	Six-county PRB Region
2000	13,288	5,669	2,935	3,503	12,577	3,231	41,203
2005	14,085	5,852	3,132	3,694	13,283	3,317	43,363
Change	797	183	197	191	706	86	2,160

Source: U.S. Census Bureau (2006b)

In 2005, the average sales price of homes in the study area varied from $80,303 in Weston County to $186,095 in Sheridan County. The average home price statewide in 2006 was $178,183 (Wyoming Housing Database Partnership 2007). In addition to Sheridan County, Campbell ($185,874) and

Johnson ($180,209) counties also had average home sale prices above the statewide average in 2006. The average sales price in Converse County was $149,096, 17 percent below the statewide average.

Monthly costs for rental housing in the PRB, measured in the fourth quarter of 2006, were highest in Campbell County (Table 4-34).

Table 4-34. Monthly Housing Rents in 2006[1] in the PRB Study Area and Percent Change from 2004.

County	Apartments		Mobile Home Lots		Houses		Mobile Homes on a Lot	
	Rent	Change	Rent	Change	Rent	Change	Rent	Change
Campbell	$697	25.8%	$283	22.0%	$975	23.0%	$758	20.5%
Converse	$515	31.4%	$152	1.3%	$545	2.8%	$452	22.5%
Crook	$391	17.4%	$125	5.9%	NA	NA	NA	NA
Johnson	$477	-5.4%	$170	16.4%	$700	15.3%	$518	5.5%
Sheridan	$571	14.0%	$285	4.4%	$857	27.9%	$650	26.7%
Weston	$459	47.1%	$119	17.8%	$567	36.3%	$505	27.5%
Wyoming	$567	14.1%	$225	15.4%	$782	13.0%	$561	15.2%

[1] Data are for the fourth quarter of 2006. Change is the percent change since fourth quarter of 2004.
NA = information not available due to insufficient sample size.
Source: Wyoming Department of Administration and Information (2006)

Temporary housing resources are available in the PRB in the form of hotel-motel rooms, private and public campgrounds, and vacant spaces in mobile home parks. In all, there are more than 70 lodging establishments with a total of more than 2,500 rooms. These temporary housing resources, supplemented by whatever apartments, townhouses, and mobile home spaces are available in Gillette, Wright and Douglas, have accommodated temporary housing needs associated with natural resource and energy projects in the past.

Both projected coal production scenarios indicate a strong demand for housing across the six-county study area through 2020. Net housing requirements under the lower coal production scenario are for approximately 9,110 units through 2020, a 21 percent increase above the 2006 existing inventory (Figure 4-11). New housing requirements under the upper coal production scenario are estimated at 10,900 units, a 25 percent increase compared to the 2006 inventory and 1,790 units more than for the lower coal production scenario. Approximately 60 percent of the overall demand for new housing through 2010 would be in Campbell County.

A substantial portion of the near-term housing demand in Campbell County would be associated with the assumed concurrent construction of three power plants. If that occurs, one or more project sponsors may be required by the Wyoming Industrial Siting Administration to pro-actively provide housing (e.g., a construction camp for single-status workers). Such actions could temper the needs for more housing; however, the remaining needs would nonetheless be

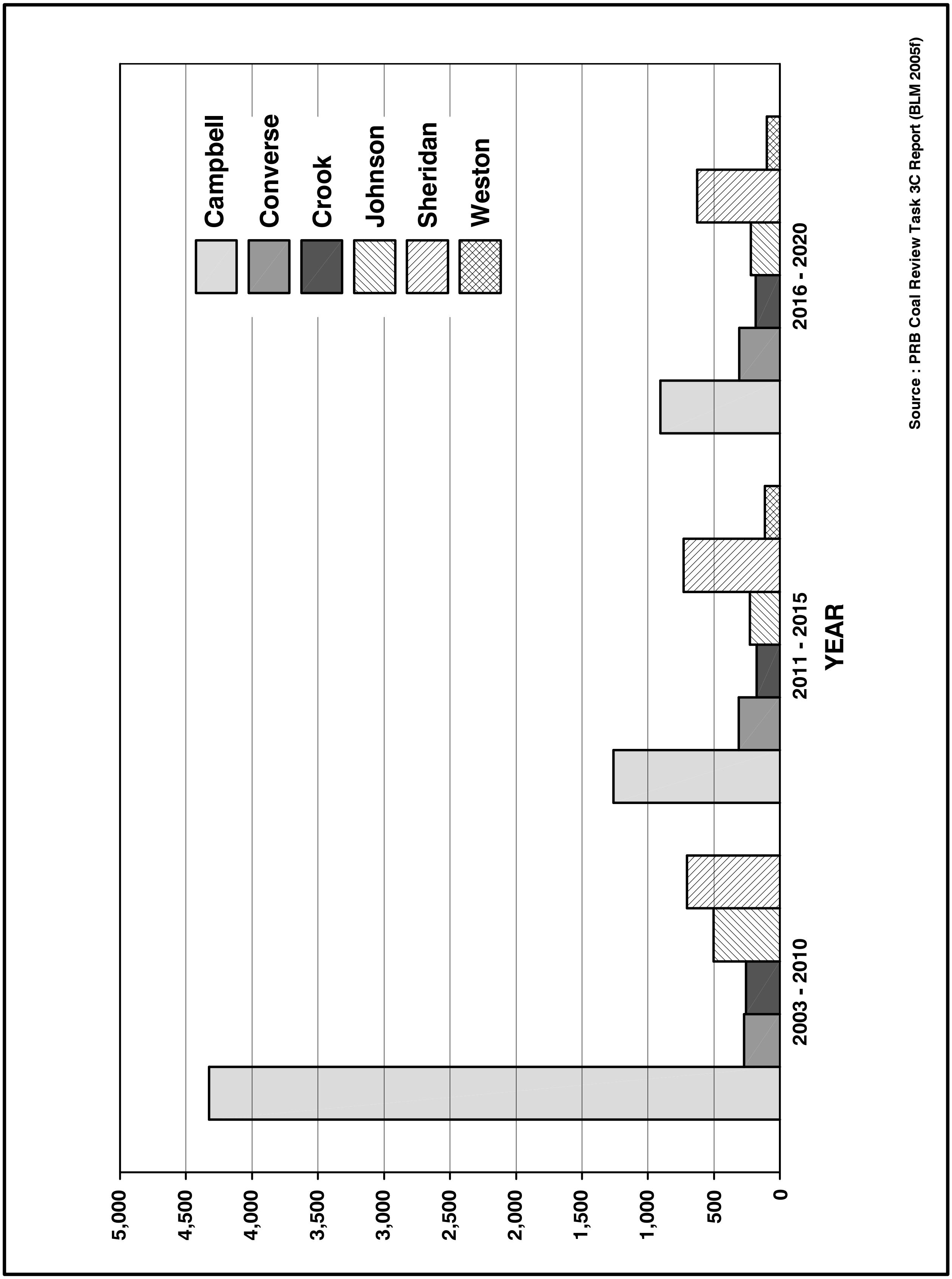


Figure 4-11. Projected Housing Demand in the PRB Study Area Under the Lower Coal Production Scenario.

substantial, straining public and private sector residential development capacity.

Although smaller in scale than those in Campbell County, housing demands in the surrounding counties may also strain the capabilities of the residential construction sector to respond. Furthermore, residential contractors would be competing for available labor, contributing to the population growth and housing demand, and fueling increases in construction costs and housing prices.

The relative scale of the housing needs can be evaluated in comparison to past growth in the study area. One benchmark for comparison is the rapid growth that occurred in the PRB in the 1970s. During that decade, the number of housing units in the six-county study area rose by approximately 14,900 units, approximately 1,500 units per year on average compared to the 850 to 975 new units per year projected under the upper and lower coal production scenarios through 2010. The rapid pace of development in the 1970s coincided with a period of economic expansion and strained the region’s construction trade and building supply industries. Although the underlying economies of the region are now larger, the projected needs would tax the ability of communities to respond Signs of strain are apparent in Gillette and could surface elsewhere as greater housing needs arise in the remaining counties of the six-county study area under the low coal production scenario.

Projected housing demands under either coal production scenario, although lower than what Campbell County and the region experienced in the “boom” years of the 1970s, would exert substantial pressure on housing markets, prices, and the real estate development and construction industries, all at a time when demand for labor and other resources would be high overall.

4.2.13.6 Public Education

There are 10 school districts in the six-county PRB study area, ranging in size from CCSD #1 with 7,337 students in the 2005 school year to Sheridan County School District # 3 (based in Clearmont, Wyoming) with fewer than 100 students. CCSD #1, based in Gillette, and Converse #1 in Douglas, serve the primary energy and resource development region.

Public school enrollment trends generally mirrored population trends during the period of rapid population growth. District-wide enrollment in Campbell County grew by more than 4,600 students (131 percent) between 1975 and 1985. Enrollment increased in all districts in Converse and Sheridan counties as well. Enrollment in Campbell County School District (CCSD) #1 subsequently peaked, but remained near record high levels for nearly a decade. Elsewhere in the region enrollments generally declined with a combined enrollment of 9,525 in the other study area districts in 2005, the lowest since 1975 (Wyoming Department of Education 2006). Recent natural gas and mining development has tempered, but not reversed, the trend of declining school enrollments across the region.

Communities across the PRB study area would see population growth due to economic migration from 2003 to 2020; however, the effects of such migration on public school enrollments would vary. As the demographics of the population change, school districts in the PRB would be affected by new trends. In some counties, the size of the school-age population (generally aged 5 to 17 years) may even trend in the opposite direction of total population in the short-term due to underlying demographics of the established resident population.

The demographic projections for the two coal production scenarios forecast growth in elementary school enrollments in Campbell County through 2010 and after 2010 for most PRB school districts. Projected enrollments in CCSD #1 would be approximately 10 percent higher by 2020 under the upper coal production scenario, with those in the surrounding districts about one percent higher. However, several districts still may experience enrollment levels in 2020 below current levels, as growth from 2010 to 2020 would not offset recent declines or those projected to occur before 2010.

Under the lower coal production scenario, Campbell County would experience an increase of 1,587 students, or 22 percent above recent levels, in school enrollment through 2020. However, the net impact on CCSD #1 would be composed of two trends; a substantial increase in grades K-8 but only small increases in grades 9-12 (Figure 4-12). School districts in the surrounding counties are projected to experience declining elementary and middle school enrollments through 2010 and declining high school enrollments through 2015. Thereafter, growth and the associated influences on demographics would generate renewed enrollment growth, particularly in the elementary grades in Johnson, Sheridan, and Converse counties.

Under either scenario, projected enrollments may cause short-term school capacity shortages, depending on the specific grade levels and residential locations of the additional students. Under the Wyoming School Facilities Commission planning guidelines, impacted school districts generally need to accommodate minor capacity shortages through the use of temporary facilities, such as portable classrooms. For larger and more long-term increases, the Commission's policy is to fund capital expansion where warranted by projections developed during updates of school districts' 5-year plans. The approved 5-year plan for CCSD #1 has a $57.4 million budget covering construction of several new schools and numerous major maintenance and facility upgrade projects. The approved 5-year plans for the other school districts have combined cost of $163 million. Capital investment in public education facilities has been a statewide priority in Wyoming for the past decade, with taxes and royalties on mineral and energy resources the primary source of program funding (Wyoming School Facilities Commission 2007, Wyoming CREG 2007).

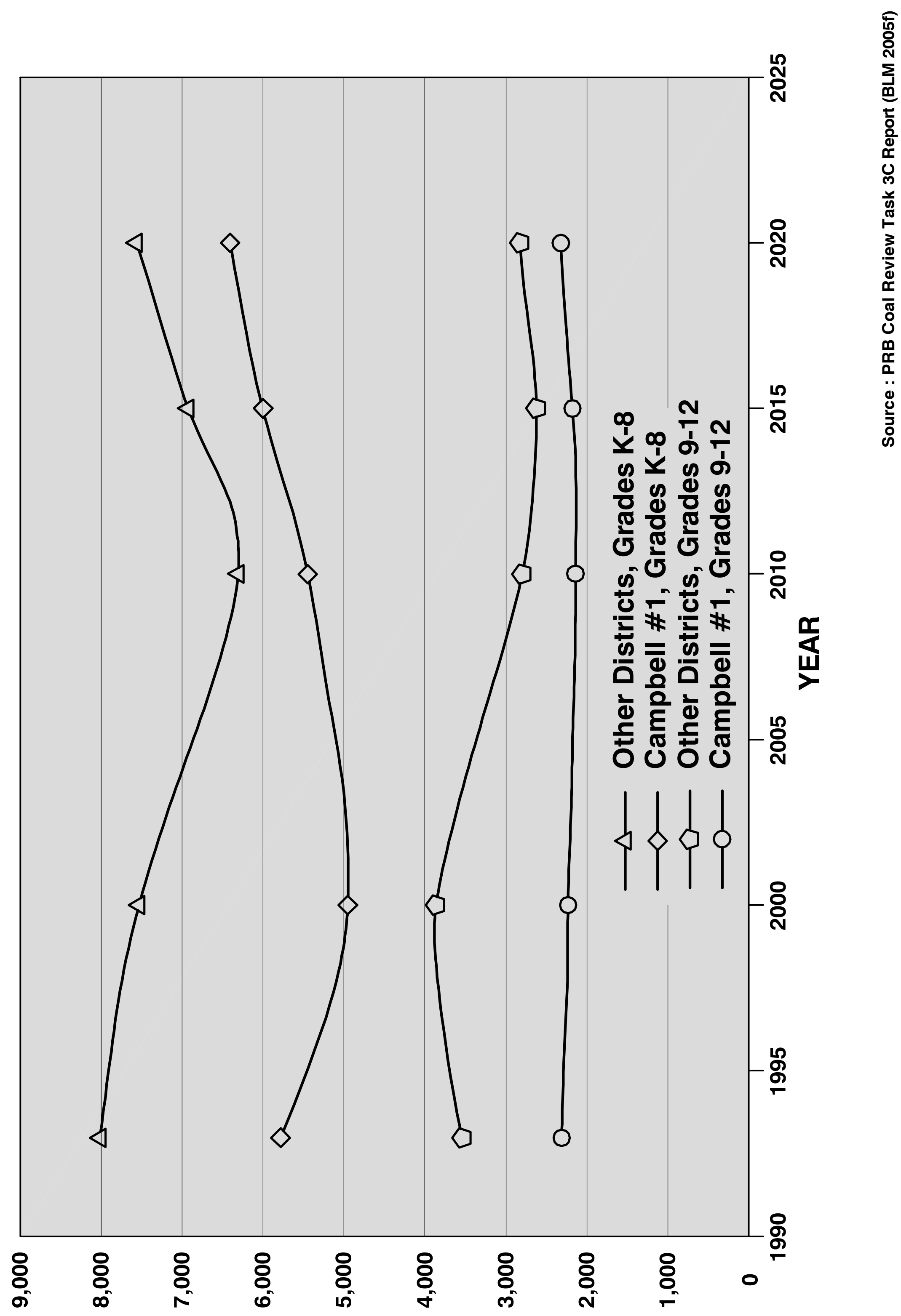


Figure 4-12. Projected School Enrollment Trends to 2020 Under the Lower Coal Production Scenario.

4.2.13.7 Facilities and Services

The types and levels of facilities and services provided by local governments reflect service demand, revenue availability, and community values regarding appropriate services and service standards. As with most socioeconomic characteristics, the level and availability of local government facilities and services varies by county and community across the PRB. There are literally several hundred separate service providers in the region. Although virtually all local government facilities and services are affected by energy development and the demand related thereto, the critical facilities and services include municipal water and sewer systems, law enforcement at the county level, and hospitals. A comprehensive assessment of facilities and services is beyond the scope of the PRB Coal Review. However, an initial screening revealed no critical needs or shortfalls and indicated that most providers are engaged in an ongoing long-term process to maintain and improve facilities and services to meet community needs and to comply with various regulations and standards.

The PRB Coal Review socioeconomic analysis focuses on water supply and wastewater systems (two essential services that are costly and have the longest lead times to develop) and law enforcement, emergency response, and road maintenance (three services that typically are most affected by energy development).

Water supply and wastewater systems in most communities have the capacity to accommodate the cumulative population growth associated with either projected coal production scenario through 2020, assuming ongoing or planned improvements are completed. In Gillette, there may be a timing issue with planned water supply system expansions, as completion of planned improvements would occur when substantial growth is anticipated under both projected coal production scenarios. Consequently, Gillette may experience water shortages in the summer months for several years, particularly if growth follows that under the upper coal production scenario. Douglas is looking to add water treatment capacity to provide additional capacity and management flexibility to address needs during times of drought.

The ability to provide desired levels of services to the projected energy-related population and development is less clear in Campbell County, Gillette, Wright, and outlying rural communities. Campbell County and its communities would experience a 25 percent increase in population between 2003 and 2010 under the lower coal production scenario and 30 percent under the upper coal production scenario.

Growth rates and the resultant facility and service demand in other counties within the study area would be substantially less during the 2003 to 2010 period under either scenario; all communities other than Johnson County and Buffalo would grow substantially less than 10 percent during the period. The populations of Johnson County and Buffalo would increase 10 percent by 2010, driven primarily by CBNG development.

Growth rates and resultant increases in service demands would slow substantially during both the 2011 to 2015 and 2016 to 2020 periods under either projected coal production scenario. In most communities except Sheridan County and the city of Sheridan, there would be little difference in population growth and service demand between the two scenarios.

4.2.13.8 Fiscal Conditions

Federal mineral royalties and state and local taxes levied on coal and other mineral production are vitally important sources of public revenue in Wyoming. Taxes, fees, and charges levied on real estate improvements, retail trade, and other economic activity supported by energy development provide additional revenues to support public facilities and services. These revenues benefit not only those jurisdictions within which the production or activity occurs, but also the federal treasury, state coffers, school districts, and local governments across the state through revenue-sharing and intergovernmental transfer mechanisms.

Coal and other minerals produced in Wyoming, regardless of ownership, are subject to ad valorem taxation by local taxing entities and a statewide levy to support public education. Statewide ad valorem taxable valuation on coal production in 2005 was $2,280.1 million. Of that total, 88 percent was based on production in the PRB.

The total assessed valuation of Campbell County, boosted by recent increases in CBNG production, was $4,264 million in 2006. Valuations on aggregate mineral production accounted for 87 percent of that total. Because Campbell County has been the primary beneficiary of mineral production gains over the past three decades and the recent gains tied to CBNG, the county's assessed valuation in 2006 was nearly 38 times that of Weston County ($112.5 million) and 31 times that of Crook County ($137.2 million). The 2006 valuation of 2005 coal production in Campbell County was $1,995.3 million (Wyoming Department of Revenue 2006).

Wyoming levies a severance tax on coal and many other minerals produced in the state. The severance tax rate, levied on the value of production, has varied from 1.0 percent to 10.5 percent over time. The current rate of 7.0 percent was established in 1992. Cumulative statewide severance tax proceeds on coal production since 1970 exceed $2.8 billion. Cumulative severance tax revenues on coal produced in Campbell County total $1.89 billion. Cumulative severance tax revenues for the corresponding period total $96.5 million from Converse County, $60.5 million from Sheridan County, and $758.0 million from the remainder of the state (Wyoming CREG 2007 and Wyoming Department of Revenue 2006).

Producers pay a 12.5 percent royalty to the federal treasury on the value of all surface coal production from federal leases. Total federal mineral royalties of nearly $3.3 billion have been paid on coal produced in Wyoming since 1970, approximately half of which is returned to the state. Estimated 2005 mineral royalties of about $377 million were paid on federal coal produced in the PRB (Minerals Management Service 2006).

At the foundation of the mineral development revenue projections for the period 2003 to 2020 are projected levels of future energy and mineral resource production. The projected total value of annual mineral production under the lower coal production scenario will climb by $3.49 billion (2004 dollars) over 2003 levels, reaching $8.54 billion by 2020, a 69 percent increase over the 2003 value. The aggregate value of energy and mineral resource production under the upper coal production scenario would increase to $9.21 billion in 2020. The incremental difference, compared to the value under the lower coal production scenario, would be $670 million per year, all of which represents the value of higher annual coal output.

The overwhelming majority of future mineral production value is anticipated to be in Campbell County. Over time, the future value of production in Sheridan and Johnson counties would climb. Total annual mineral production value by 2020 is projected to reach $6.37 billion in Campbell County and $2.17 billion in the surrounding counties. Between 2005 and 2020, total royalty and tax receipts derived from the key selected sources range between $21.1 and $22.6 billion for the lower and upper coal production scenarios, respectively. Receipts derived from coal production would account for the majority of the totals under either scenario, with federal mineral royalties on coal at $4.9 to $5.7 billion being the single largest source. Severance taxes, ranging from $6.3 to $6.7 billion, also would accrue to the state (Tables 4-35 and 4-36).

Table 4-35. Summary of Mineral Development Tax Revenues Associated with Energy Resource Production Under the Lower Coal Production Scenario (million $).

Industry and Taxes	2005-2010	2011-2015	2016-2020	Total
Coal[1]	3,164.8	3,178.9	3,756.3	10,100.0
CBNG	2,915.2	3,076.4	3,288.7	9,280.3
Conventional Oil and Gas	568.5	576.4	614.0	1,759.0
Totals	**6,648.5**	**6,831.7**	**7,659.0**	**21,139.3**
Severance Tax	1,995.9	2,012.4	2,249.3	6,257.6
Federal Mineral Royalties	2,754.1	2,839.4	3,166.3	8,759.8
State Mineral Royalties	233.5	225.8	251.4	710.7
Ad Valorem Tax (Counties)	417.6	443.0	502.8	1,363.3
Ad Valorem Tax (Schools)	1,247.5	1,311.1	1,489.3	4,047.9
Totals	**6,648.6**	**6,831.7**	**7,659.1**	**21,139.3**

[1] Does not include coal lease bonus bids due to the uncertainty regarding timing.
Source: PRB Coal Review Task 3C Report (BLM 2005f)

The federal and state governments also benefit from coal lease bonus bids derived from future coal leasing. Bonus bids have risen over time, with successful bids for recent sales ranging from 30 cents per ton to 97 cents per ton. There is no guarantee of that trend continuing. Considerable uncertainty also exists with respect to the timing and scale of future leases, although BLM

Table 4-36. Summary of Mineral Development Tax Revenues Associated with Energy Resource Production Under the Upper Coal Production Scenario (million $).

Industry and Taxes	2005-2010	2011-2015	2016-2020	Total[1]
Coal[1]	3,538.0	3,703.0	4,350.0	11,591.0
CBNG	2,915.2	3,076.4	3,288.7	9,280.3
Conventional Oil and Gas	568.5	576.4	614.0	1,759.0
Totals	**7,021.7**	**7,355.8**	**8,252.7**	**22,630.3**
Severance Tax	2,104.1	2,159.0	2,415.4	6,678.5
Federal Mineral Royalties	2,946.3	3,099.9	3,461.4	9,507.6
State Mineral Royalties	233.5	225.8	251.4	710.7
Ad Valorem Tax (Counties)	435.8	472.0	535.0	1,442.8
Ad Valorem Tax (Schools)	1,302.3	1,398.9	1,589.8	4,291.0
Totals	**7,022.0**	**7,355.6**	**8,253.0**	**22,630.6**

[1] Does not include coal lease bonus bids due to the uncertainty regarding timing.
Source: PRB Coal Review Task 3C Report (BLM 2005f)

currently has pending applications for more than four billion tons of federal coal, including this application. The state receives 50 percent of the bonus bid revenue.

Taxes and mineral royalties levied on energy and mineral resource production accruing to the state are disbursed to the Permanent Water Development Trust Fund, Wyoming School Foundation and Capital Facilities funds, capital construction fund for state and local government facilities, and other programs according to a legislatively-approved formula. Through these funds, the revenues derived from resource development benefit the entire state, not just agencies, businesses, and residents of the PRB.

County governments and school districts would realize benefits from future energy and mineral resource development in the form of ad valorem taxes. Such taxes, estimated on the basis of future coal, oil, and natural gas production, are estimated to range between $5.4 billion and $5.7 billion through 2020. Those sums do not include future property taxes levied on the new power plants, expanded rail facilities, or new residential and commercial development associated with future growth, or sales and use taxes levied on consumer and some industrial purchases. These latter revenues are not estimated in this study, but would be substantially lower than those on resource production.

Local governments would benefit from property taxes on new development, as well as from sales and use taxes on taxable sales within their boundaries. Such revenues are not estimated for this study due to the large number of jurisdictions and other analytical considerations.

4.2.13.9 Social Setting

The past 30 years have seen sweeping social change in the U.S. and throughout much of the world. But in addition to the broad forces that have driven social change in the U.S. as a whole, social conditions in some PRB communities have been substantially influenced by energy development. Factors that have affected social conditions in the PRB include industrial and natural resource development, economic and demographic change, housing and public infrastructure development, and institutional change at the local and state government levels.

One of the key drivers of social change in the PRB has been energy-related population growth. When the first oil boom occurred in the late 1950s, Campbell County was a relatively stable, sparsely-populated rural county. Like many places in Wyoming and throughout the rural west, Campbell County was a small, relatively homogeneous ranching community (ROMCOE 1982). The oil booms of the 1950s and 1960s brought an influx of new people. Development of coal mines, continued oil and gas drilling, and power plant construction precipitated another round of growth. In all, Campbell County population grew by almost 600 percent between 1950 and 2000.

On the one hand, this population growth, combined with a robust economy, generated a variety of positive social effects. Financial and technical resources poured into the community as it mobilized to accommodate the new population. Job opportunities were created in the construction industry, as the community responded to demands for housing, public facilities, and retail goods and services. The large and rapid influx of new residents, eager to take advantage of the employment opportunities, created energy, vitality, and a sense of economic optimism about the community. Where economic advancement had been limited before the boom, there was now opportunity (Gardiner 1985).

On the other hand, it is likely that many residents had mixed feelings about these changes (Heinecke 1985). New residents brought new ideas, new ways of doing things, new preferences for goods and services, and new demands for government services. Some long-time residents, particularly those who were not directly participating in the economic benefits of energy development, viewed these changes as negative.

Today, almost any organization, committee, or government body is made up of a cross-section of energy employees, ranchers, and other community members whose tenure in the community may be long or short (Bigelow 2004, Spencer 2004). Moreover, because of the turnover in the energy companies, the community has become accustomed to newcomers.

Cumulative energy development in the PRB through the year 2020 has the potential to generate both beneficial and adverse effects on community social conditions. Social effects of development activities in the PRB would vary from county to county and community to community under the coal production scenarios developed for this study, based on the existing social setting and the type of development that would occur.

Beneficial social effects would be associated with an expanding economy and employment opportunities associated with energy development and resulting improvements in living standards for those employed in energy-related industries. Adverse social effects could occur as a result of conflicts over land use and environmental values. Negative social effects also could occur if the pace of growth exceeds the abilities of affected communities to accommodate energy-related employees and their families with housing and community services.

In the PRB, social conditions in Campbell County, the city of Gillette, and the town of Wright are most likely to be affected because the county would host much of the cumulative energy development workforce, and the county and its municipalities would receive the largest increments in population growth. Campbell County and its municipalities have a long history of energy development, and they have developed infrastructure and management systems to plan for and manage growth; consequently, major adverse social effects would not be anticipated. However, under either scenario, the county and the two municipalities may face challenges in providing adequate housing and expanding community services in anticipation of population growth through 2010, particularly if several power plant and coal mine construction projects occur simultaneously. As municipalities receive only sales and use tax revenues directly from development and purchases made within their boundaries, Gillette and Wright could face challenges in securing the necessary funding to improve municipal facilities and services. Housing shortages and limitations in public services could contribute to adverse community social effects in these communities.

Many of the people who would immigrate to Campbell County for energy-related jobs are likely to share characteristics with much of the current population; therefore, few barriers to social integration are anticipated.

Social effects on other communities in the PRB are likely to be minimal to moderate. Energy-related population growth is anticipated to be moderate in other communities. Sheridan County, also familiar with coal mining, is the only other county anticipated to host a major construction project under the development assumptions used for either projected coal production scenario. Converse, Weston, and Crook counties could experience spillover growth from projects in Campbell County.

Johnson, Sheridan, and Campbell counties could experience continued conflict over split estate and water issues associated with CBNG development, and the pace and scale of energy development across the PRB is likely to continue to generate social and political conflict over environmental issues under either coal production scenario.

4.2.14 Coal Mining and Coal-Fired Power Plant Related Emissions and By-Products

As discussed in Chapter 1, BLM does not authorize mining by issuing a lease for federal coal, but the impacts of mining the coal are considered in this EIS because it is a logical consequence of issuing a maintenance lease to an existing mine. The use of the coal after it is mined is also not determined at the time of leasing or mining, the use is determined by the purchaser and the end user. However, almost all of the coal that is currently being mined in the Wyoming PRB is being used by coal-fired power plants to generate electricity. As a result, a discussion of emissions and by-products that are generated by burning coal to produce electricity is included in this section of the EIS.

As discussed in Chapter 2, under the currently approved mining plan, which represents Alternative 1 (the No Action Alternative), from 2009 on, the Black Thunder Mine would be able to produce coal at an average production level of 135.0 mmtpy for another 9.2 years, compared with an average of 135.0 mmtpy for 11.2 years under the Proposed Action, or an average of 135.0 mmtpy for another 14.0 years under Alternative 2 for the North Hilight Field LBA Tract (Table 2-2). The Black Thunder Mine would be able to produce coal at an average production level of 135.0 mmtpy for another 10.8 years under the Proposed Action, or an average of 135.0 mmtpy for another 11.5 years under Alternative 2 for the South Hilight Field LBA Tract (Table 2-4). The Black Thunder Mine would be able to produce coal at an average production level of 135.0 mmtpy for another 12.0 years under the Proposed Action, or an average of 135.0 mmtpy for another 16.3 years under Alternative 2 for the West Hilight Field LBA Tract (Table 2-6).

As discussed in Chapter 2, from 2009 on, the Jacobs Ranch Mine would be able to produce coal at an average production level of 40.0 mmtpy for another 9.6 years under Alternative 1 (No Action Alternative), compared with an average of 40.0 mmtpy for 26.3 years under the Proposed Action, or an average of 40.0 mmtpy for another 32.4 years under Alternative 2 for the West Jacobs Ranch LBA Tract (Table 2-8).

As discussed in Chapter 2, under the currently approved mining plan, which represents Alternative 1 (No Action Alternative), from 2009 on, the North Antelope Rochelle Mine would be able to produce coal at an average production level of 95.0 mmtpy for another 9.9 years, compared with an average of 95.0 mmtpy for 16.2 years under the Proposed Action, or an average of 95.0 mmtpy for another 17.7 years under Alternative 2 for the North Porcupine LBA Tract (Table 2-10). The North Antelope Rochelle Mine would be able to produce coal at an average production level of 95.0 mmtpy for another 13.2 years under the Proposed Action, or an average of 95.0 mmtpy for another 13.5 years under Alternative 2 for the South Porcupine LBA Tract (Table 2-12).

Section 3.18.2 contains estimates of greenhouse gas emissions resulting from the specific mine operations at the three applicant mines (Black Thunder, Jacobs Ranch, and North Antelope Rochelle) from projected operations under the Proposed Actions and alternatives over the life of the actions.

4.2.14.1 Greenhouse Gas Emissions, Global Warming and Climate Change

Ongoing scientific research has identified the potential impacts of anthropogenic (man-made) greenhouse gas (GHG) emissions and changes in biological carbon sequestration due to land management activities on global climate. Although GHG levels have varied for millennia, recent industrialization and burning of fossil carbon sources have caused the carbon dioxide equivalent (CO_2e) concentrations to increase in our lower atmosphere. As with any field of scientific study, there are uncertainties associated with the science of climate change. This does not imply that scientists do not have confidence in many aspects of climate change science. Some aspects of the science are known with virtual certainty, because they are based on well-known physical laws and documented trends (EPA 2008a). However, the science is not settled and there is strong debate among the scientific community that natural variability is the overwhelming factor influencing climate rather than the accumulation of anthropogenic GHG emissions in the atmosphere.

The National Assessment of the Potential Consequences of Climate Variability and Change, an interagency effort initiated by Congress under the Global Change Research Act of 1990, Public Law 101-606, has confirmed that climate changes, while impacts in and of themselves, can affect other aspects of the environment. The Synthesis Report, the final part of the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) (available online at http://www.ipcc.ch), was released in preliminary form on November 17, 2007. The Synthesis Report (Bernstein et al. 2007) summarizes the results of the assessment carried out by the three working groups of the IPCC. Observations and projections addressed in the report include:

- "Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperature, widespread melting of snow and ice, and rising global average sea level."

- "Observational evidence from all continents and most oceans show that many natural systems are being affected by regional climate changes, particularly temperature increases."

The term global warming is commonly used to refer to surface air temperature changes that are a response to increasing atmospheric GHG concentrations, along with other climate-influencing factors (NOAA 2007). From 1850 to present, historic trend data show an increase of 1° Centigrade (C) (1.8° Fahrenheit) in global mean temperature. However, the warming is not expected to be uniform over the globe, nor is it expected to be the same during all seasons of the year. There have been extended periods (decades) where temperature has dropped or stayed constant. This historic warming over that same period has caused sea levels to rise by about 20 centimeters on average, and has also resulted in changes in climate patterns on land. In some areas near the equator, temperatures have cooled by about 5°C, while closer to the poles, temperatures have risen by equal amounts (Hansen and Lebedeff 1987). In northern latitudes (above 24° N), temperature increases of nearly 1.2°C (2.1° Fahrenheit) have been documented since 1900. The IPCC Fourth Assessment Report found that the "…projected warming in the 21st century shows scenario-independent geographical patterns similar to those observed over the past several decades. "Warming is expected to be greatest over land and at most high northern latitudes, and least over the Southern Ocean and parts of North Atlantic Ocean." Observations and computer models agree that arctic surface air temperatures are warming twice as fast as the global average, which is due partly to what is called the ice-albedo feedback (albedo is a term used to describe the fraction of sunlight reflected by an object) (NOAA 2007). Because temperature is a part of climate, the phenomenon of global warming is both an element of and a driving force behind climate change.

There has been, and continues to be, considerable scientific investigation and discussion as to the causes of the recent historic rise in global mean temperatures, and whether the warming trend will continue. Several activities contribute to the phenomena of climate change, including emissions of GHGs (especially carbon dioxide and methane) from fossil fuel development, large wildfires and activities using combustion engines; changes to the natural carbon cycle; and changes to radiative forces and reflectivity (albedo). It is important to note that GHG emissions will have a sustained climatic impact over different temporal scales (EPA 2008a).

Solar variability may play a role in global climate change, though the magnitude of the influence of increased sun activity is not well understood. Physical aspects of the sun, like sunspots and solar radiation output, are known to vary over time. The intensity of energy from the sun has varied through time and has resulted in global temperature variation.

Human population doubled to two billion from the period 1780 to 1930, then doubled again by 1974. The atmospheric concentrations of GHGs have increased as human populations have increased. More land and resources were used to provide for the needs of these populations. As human activities have increased, carbon-based fuels have been used to provide for those additional energy needs. Forests and vegetation were cleared in order to provide for food production and human use.

Carbon dioxide (CO_2), methane (CH_4), water vapor (H_2O), ozone (O_3), and nitrous oxide (N_2O) are recognized as the major GHGs, although there are other gases that are considered GHGs. These are called "greenhouse gases" because, when released into the atmosphere, they prevent the escape of reflected solar radiation and heat from the Earth's surface. Through complex interactions on a regional and global scale, these GHG emissions and net losses of biological carbon sinks (i.e., forests) cause a net warming effect of the atmosphere, primarily by decreasing the amount of heat energy radiated by the earth back into space. In this way, the accumulation of GHGs in the atmosphere exerts a "greenhouse effect" on the earth's temperature. Like glass in a greenhouse, these gases trap radiation from the sun and act as an insulator around the Earth, holding in the planet's heat. The present CO_2 concentration of about 385 parts per million (ppm) is about 30 percent above its highest level over at least the last 800,000 years. U.S. average temperature has increased by about 2° Fahrenheit over the last 50 years, which is more than the global average temperature increase (U.S. Global Change Research Program 2009).

According to the IPCC's Synthesis Report (Bernstein et al. 2007):

- "Global atmospheric concentrations of carbon dioxide, methane, and nitrous oxide have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice cores spanning many thousands of years."

- "Most of the observed increase in globally-averaged temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations. It is likely there has been significant anthropogenic warming over the past 50 years averaged over each continent (except Antarctica)."

- "There is high agreement and much evidence that with current climate change mitigation policies and related sustainable development practices, global greenhouse gas emission will continue to grow over the next few decades."

- "Continued greenhouse gas emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would be very likely to be larger than those observed during the 20th century."

- "There is high confidence that by mid-century, annual river runoff and water availability are projected to increase at high latitudes and in some tropical wet areas and decrease in some dry regions in the mid-latitudes and tropics. There is also high confidence that many semi-arid areas (e.g., Mediterranean Basin, western U.S., southern Africa and northeast Brazil) will suffer a decrease in water resources due to climate change."

- "Anthropogenic warming and sea level rise would continue for centuries due to the time scales associated with climate processes and feedbacks, even if greenhouse gas concentrations were to be stabilized."

- "Anthropogenic warming and sea level rise could lead to some impacts that are abrupt or irreversible, depending upon the rate and magnitude of the climate change."

- "There is high agreement and much evidence that all stabilization levels assessed can be achieved by deployment of a portfolio of technologies that are either currently available or expected to be commercialized in coming decades, assuming appropriate and effective incentives are in place for their development, acquisition, deployment and diffusion and addressing related barriers."

The National Academy of Sciences has confirmed these findings, but also has indicated there are uncertainties regarding how climate change may affect different regions. Computer model predictions indicate that increases in temperature will not be equally distributed, but are likely to be accentuated at higher latitudes. Warming during the winter months is expected to be greater than during the summer, and increases in daily minimum temperatures is more likely than increases in daily maximum temperatures. Increases in temperatures would increase water vapor in the atmosphere, and reduce soil moisture, increasing generalized drought conditions, while at the same time enhancing heavy storm events. Although large-scale spatial shifts in precipitation distribution may occur, these changes are more uncertain and difficult to predict (EPA 2008a).

Relatively steep elevation gradients between valley floors and adjacent mountain ranges in the western U.S. produce considerable geographic climate variability. Warm, dry, semiarid conditions are typical on valley floors; moist and cool conditions are typical in higher parts of mountain ranges. Different plant communities occur within specific elevation zones. There also have been patterns of historic climatic variation in these areas for more than 10,000 years, during which plant communities gradually shift to higher or lower elevations depending on the direction of temperature and precipitation changes (Tausch et. al. 2004).

Temperature changes can result in shifts of weather patterns (rainfall and winds), which may then affect vegetation and habitat. If global warming trends continue into the foreseeable future, Chambers (2006) and the 2008 report by the U.S. Climate Change Science Program (U.S. Climate Change Science Program 2008a) indicate that the following changes may be expected to occur in the West:

- The amount and seasonal variability of precipitation will increase over most areas. IPCC (2001) climate model scenarios indicate that by 2100, precipitation will increase about 10 percent in summer, about 30 percent in fall, and 40 percent in winter. Less snowfall will accumulate in higher elevations, more precipitation will occur as rain, and snowmelt will occur earlier in the spring because of higher temperatures.

- Streamflow patterns will change in response to reduced snowpacks and increasing precipitation. Peak flows in spring are expected to occur earlier and be of lower magnitude because of snowpack changes. Runoff from greater amounts of winter rainfall will cause higher winter flows.

Summer flows will be lower, but with higher variability depending on the severity of storm events.

- Some populations of native plants, invasive species, and pests will expand. Increasing amounts of atmospheric carbon dioxide and precipitation during the growing season will provide favorable growth conditions for native grasses, perennial forbs, woody species, and invasive annuals such as cheatgrass. Insect populations also will likely increase because milder winter temperatures will improve reproduction and survival rates.

- Fire frequency, severity, and extent will increase because of the increased availability of fine fuels (grasses, forbs, and invasives) and accumulation of fuels from previous growing seasons. Higher temperatures will extend the length of fire seasons. Expansion of pinyon-juniper species and increasing tree densities could increase the number of high severity crown fires. Higher rates of insect damage and disease also may increase fuel accumulations.

- Sensitive species and overall biodiversity will be reduced. High-elevation habitats will shrink in area or disappear as lower-elevation plant communities expand. It is probable that some mammalian, avian, and other species that currently inhabit these high-elevation habitats may become extinct. Higher rates of disease and insect damage also may pose threats to other sensitive plant and animal species.

Global climate models exist that project/predict future temperature changes under various scenarios. For example, atmospheric CO_2 concentration increasing by 1 percent per year would be an idealized scenario. The sensitivity of any climate model is generally calculated as the amount of temperature change the model produces for a doubling of atmospheric CO_2 concentration. Most recent models have sensitivities of more than 2°C for a doubling of CO_2 concentration (U.S. Climate Change Science Program 2008b). Scenarios however cannot include unknowable events such as volcanic eruptions and variations in solar activity. Perhaps the single largest uncertainty in determining the climate sensitivity to either natural or anthropogenic changes is clouds; their effects on radiation and their role in the hydrological cycle (IPCC 2007). The rate of heat uptake by the oceans is also an uncertainty when considering climate responses on time scales shorter than 100 years (U.S. Climate Change Science Program 2008b). Despite such uncertainties, models are however consistent in their prediction of climate warming under GHG increases (IPCC 2007).

Climate change models cannot be used to predict future climate changes at any particular scale less than globally. According to IPCC's Fourth Assessment Report (2007), there is considerable confidence that climate models provide credible quantitative estimates of future climate change, particularly at continental scales and above, but the changes projected by global models decreases at smaller scales. Models are becoming more comprehensive and sophisticated in representing observed climate and past climate changes; however, models continue to have significant limitations that lead to uncertainties in magnitude and timing, as well as regional details of predicting climate change (IPCC 2007). By taking the average of all models, known as the ensemble approach, a more accurate representation of the climate emerges (U.S. Climate Change Science Program 2008b). Global climate models are at this time imperfect and due to their uncertainties should not be used as a basis for public policy.

4.2.14.2 Cumulative Effects of Combustion of PRB Coal by Power Plants

Historically, the coal mined in the PRB has been used as one of the sources of fuel to generate electricity in power plants located throughout the U.S. Relatively little PRB coal, about 2 percent, is burned in Wyoming. Wyoming PRB coal is shipped primarily nationwide. In 2005, Wyoming coal went to 35 states besides Wyoming, although it can also be shipped overseas. The mines in the PRB have sold, and are expected to sell coal into the open coal market. Each mine's ability to sell coal in this market will determine annual production rates at that mine. Historically, the coal buyers have been domestic electric producers, although the coal could be used in other coal applications and it has been exported.

Coal sales are made on short term contracts, generally to individual power generators, or coal is sold on a spot market. This market is very dynamic and competitive. During the coal leasing EIS process, it is uncertain and speculative to predict who might purchase future PRB coal, how it would be used, and where the coal might be transported to. In the Northern American Electric Reliability Council (NERC) power regions where PRB coal is sold, coal use ranges from 74.2 percent in the upper Midwest, to 15.6 percent in the northeast U.S. (EPA 2007e).

Coal-burning power plants currently supply about 50 percent of the electric power generated in the U.S. The demand for power is increasing in the U.S. and throughout the world. According to a recent report by NERC, peak demand for electricity in the U.S. is expected to double in the next 22 years (Associated Press 2007). Many developing countries, including China and India, are also relying heavily on coal to meet their rapidly increasing power demands as coal is more economical and more available than other sources of electrical generation.

The regulatory mechanisms proposed under the Climate Security Act of 2008, as well as the past regulation of pollutants under the CAA, are imposed at the point when coal is burned and converted to electric energy. Over 95 percent of coal produced in the PRB is sold in an open market where coal is purchased on short term contracts or spot prices based on a coal feed stock that is suitable for each buyer's power generating facility. Coal production at any one mine is not tied in any predictable way over a period of time to any one power plant.

Power plant buyers attempt to buy coal from suppliers at the most economical prices that meet their needs. PRB coal has competed well in this market due to its low sulfur content, providing a way for electric generators to achieve acid rain reduction requirements. This makes it valuable in lowering sulfur dioxide (SO_2) pollution, as well as competitive mining costs when compared to delivered costs of coal from other coal producing areas.

Wyoming coal production has increased at a more rapid rate than other domestic coal. Coal coming out of the Wyoming PRB is mined using surface mining methods which are generally safer and less labor intensive than underground mining. Rural rangelands are the areas that are mainly mined; they are reclaimed according to WDEQ/LQD's standards (see Section 3.9.4). PRB coal reserves are in thick seams, resulting in more production from areas of similar land disturbance, and lower mining and reclamation costs.

Coal-fired power plants have been identified as principal sources of anthropogenic GHG emissions. Assuming that all coal produced from all coal mines in the Wyoming PRB would be burned to generate electricity; the amount of GHG emissions that could be attributed to that coal production can be estimated. This is done by relating the portion of coal mined in the PRB to the total emission of GHG from all coal mined in the U.S. It is assumed that all PRB coal is used for coal-fired electric generation as part of the total U.S. use of coal for electric generation. This gives an upper estimate of the GHG emissions resulting from the use of the total PRB coal production to produce electricity.

U.S. coal production increased from 1,029.1 million tons in 1990, when the Powder River Federal Coal Region was decertified, to 1,161.4 million tons in 2006, an increase of 12.9 percent (USDOE 2007a). Wyoming coal production increased from 184.0 million tons in 1990 to 444.9 million tons in 2006, an increase of 242 percent (Wyoming Department of Employment 1990 and 2006). The share of electric power generated by burning coal was consistently around 50 percent during that time frame. Also, the percentage of total U.S. CO_2 emissions related to coal consumption was consistently around 36 percent during that same time frame. The percentage of U.S. CO_2 emissions related to the coal electric power sector increased from about 30 percent in 1990 to about 33 percent in 2006 (USDOE 2009c).

In 2008, the Wyoming PRB coal mines produced approximately 451.7 million tons of coal. Using factors derived from laboratory analyses, it is estimated that approximately 749.6 million metric tons (tonnes) of CO_2 would be generated from the combustion of all of this coal (before CO_2 reduction technologies are applied). This number is based on an average Btu value of 8,600 per pound of Wyoming coal and using a CO_2 emission factor of 212.7 pounds of CO_2 per million Btu (USDOE 1994). The estimated 749.6 million tonnes of CO_2 represents approximately 35.3 percent of the estimated 2,125.2 million tonnes of U.S. CO_2 emission from coal combustion in 2008 (USDOE 2009c). In 2008, Wyoming PRB mines accounted for approximately 38.5 percent of the coal produced in the U.S. (USDOE 2009a).

According to the U.S. Department of Energy (USDOE), Energy Information Administration's (EIA's) 2008 Emissions of Greenhouse Gases in the U.S. report (USDOE 2009c) and EIA's 2008 U.S. Coal Report (USDOE 2009a):

- CO_2 emissions represent about 83 percent of the total U.S. greenhouse gas emissions.

- Estimated CO_2 emissions in the U.S. totaled 5,839.3 million tonnes in 2008, which was a 1.5 percent decrease from 2006 (which was 5,928.7 million tonnes).

- Estimated CO_2 emissions from the electric power sector in 2008 totaled 2,359.1 million tonnes, or about 40.6 percent of total U.S. energy-related CO_2 emissions in 2008 (which was 5,814.4 million tonnes).

- Estimated CO_2 emissions from coal electric power generation in 2008 totaled 1,945.9 million tonnes or about 33.5 percent of total energy-related CO_2 emissions and about 82.5 percent of CO_2 emissions from the U.S. electric power sector in 2008.

- Coal production from the Wyoming PRB represented approximately 43.4 percent of the coal used for power generation in 2008, which means that combustion of Wyoming PRB coal to produce electric power was responsible for about 12.8 percent of the estimated U.S. CO_2 emissions in 2008.

As discussed earlier in this chapter, Task 2 of the PRB Coal Review projects coal development in the PRB into the future for the years 2010, 2015, and 2020. Due to the variables associated with future coal production, two projected coal production scenarios (representing an upper and a lower production level) were developed to bracket the most likely foreseeable regional coal production level. In the low scenario, the percentage of coal use for electric generation would stay about the same, assuming that all forms of electric generation would grow at a proportional rate to meet forecast electric demand. In the high scenario, percentage of coal use would also remain about the same, but with PRB coal displacing coal from other domestic coal regions. Table 4-37 shows the estimated annual CO_2 emissions that would be produced from the combustion of all of this coal (before CO_2 reduction technologies are applied).

In the following analysis, the contribution of the pending LBAs (Table 1-2) to cumulative effects on the environment by historic and projected development activity is evaluated. To do this, it is assumed that coal mining will proceed in accordance with existing permit conditions. It is further assumed that this coal will be sold to coal users in response to forecasts of demand for this coal. Historically these users have been electric utilities in the U.S., although there is potential for sales outside the U.S. This coal market is open and competitive and users can buy from the most cost effective suppliers that meet their needs.

Table 4-37. Estimated Annual CO_2 Emissions from Projected PRB Coal Production Levels According to Task 2 or the PRB Coal Review[1].

Projected Coal Production Scenario	Year	Coal Production Rate (million tons per year)	CO_2 Emissions (million tonnes per year)
Lower	2010	411	682
	2015	467	775
	2020	495	821
Upper	2010	479	795
	2015	543	901
	2020	576	956

[1] BLM 2005a

The BLM does not determine the destination of this coal, and the use of the coal is determined by the coal consumer. The electric utilities where this coal has historically been used are throughout the U.S., and have a variety of coal combustion technologies and emission control, but all are licensed by the appropriate regulatory authorities in their locale, and operate under necessary permit requirements, and in compliance with regulation.

Table 4-38 shows the estimated cumulative annual CO_2e emissions produced by all mines in the PRB that currently have LBAs pending (listed in Table 1-2). The cumulative emissions calculated are those associated with the actual mining operations and not from the combustion of the coal produced and sold on the open coal market. The LBA tracts are addressed individually in the following EISs: the South Gillette Area Coal (SGAC) Lease Applications FEIS (BLM 2009g), the Wright Area Coal (WAC) Lease Applications EIS (this document), the West Antelope II Coal Lease Application FEIS (BLM 2008d), and the Hay Creek II Coal Lease Application DEIS (BLM 2010). Under the Proposed Actions and Alternatives 2 and 3, the three applicant mines (Black Thunder, Jacobs Ranch, and North Antelope Rochelle) anticipate producing coal included in the North Hilight Field, South Hilight Field, West Hilight Field, West Jacobs Ranch, North Porcupine, and South Porcupine LBA Tracts at or less than currently permitted levels using existing production and transportation facilities. Estimates of greenhouse gas emissions resulting from the specific mine operations at the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines from projected operations under the Proposed Actions and alternatives are also included in Section 3.18.2.

The CO_2 emissions related to burning coal that is produced from the three applicant mines to generate electricity would be extended as a result of leasing and mining the WAC LBA tracts. Table 4-39 shows the estimated annual coal production of each of the three applicant mines and the related annual CO_2 emissions that would be produced from the combustion of the coal produced from each of the six WAC LBA tracts as applied for and as reconfigured under Alternative 2 (BLM's preferred alternative), if this coal is burned to generate electric power. The total contribution of CO_2 emissions that would be produced

Table 4-38. Estimated Annual CO_2 Equivalent Emissions* from Coal Production at PRB Mines With Pending LBAs.

Source	2007	With LBA Tracts
Four SGAC Mines/Four LBA Tracts	0.716	1.182
Three WAC Mines/Six LBA Tracts	1.245	2.503
Antelope Mine/West Antelope II Tract	0.225	0.348
Buckskin Mine/Hay Creek II Tract	0.197	0.197
Total	**2.535**	**4.229**

* CO_2e in million metric tons (tonnes)
Source: BLM 2008g, J&S 2009, WWC 2009

from the combustion of all the coal produced from each tract, if this coal is burned to generate electricity, are shown in Table 4-39. A scenario resulting in the maximum possible annual CO_2 emissions from burning the coal produced from the WAC LBA tracts would occur assuming all six tracts were leased under Alternative 2, and that coal removal from all six tracts were to be sequenced to maintain each of the three applicant mines at full permitted production until the new reserves were fully depleted. Under this scenario, the Black Thunder Mine would be able to extend production for 14.2 years, the North Antelope Rochelle Mine for 11.4 years, and the Jacobs Ranch Mine for 22.8 years.

It is not possible to accurately project the level of CO_2 emissions that burning the coal from the six WAC LBA tracts would produce due to the uncertainties about what emission limits would be in place at that time or where and how the coal in these LBA tracts would be used if they are leased and the coal is mined. Furthermore, the rate of mining and the timing of when coal removal from the tracts would actually begin are only the applicant mines' best estimate. As shown in Tables 2-2 through 2-13, under the No Action alternatives the mines are projecting that after 2008 approximately 10 to 11 years of currently permitted mine life remains. Therefore, coal removal from these six proposed maintenance lease tracts would not begin until approximately 2018 or 2019. More rapid improvements in technologies that provide for less CO_2 emissions, new CO_2 mitigation requirements, or an increased rate of voluntary CO_2 emissions reduction programs could result in significantly lower CO_2 emissions levels than are projected here.

The three WAC applicant mines produced 228.3 million tons of coal in 2008, which represents about 50.5 percent of the coal produced in the Wyoming PRB in 2008. Combustion of those 228.3 million tons of coal to produce electricity produced approximately 378.7 million tonnes of CO_2 emissions, or about 5.4 percent of the total estimated anthropogenic CO_2 emissions produced in the U.S. in 2008, which was approximately 7,052.6 million tonnes (USDOE 2009c). Under the No Action Alternative, CO_2 emissions attributable to burning coal produced by the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines would be extended at about this level for up to approximately 10 years

Table 4-39. Estimated Annual CO_2 Emissions Produced from Combustion of Coal Produced from WAC LBA Tracts.

Applicant Mine/ LBA Tract	Anticipated Average Annual Coal Production by Applicant Mine[1] (mmtpy)	CO_2 Emissions Related to Annual Coal Production[2] (million tonnes)	Recoverable Coal Added Under Proposed Action[1] (mmt)	Mine Life Added Under Proposed Action[1] (years)	CO_2 Emissions Added by Proposed Action[2] (million tonnes) Total per LBA Tract	CO_2 Emissions Added by Proposed Action[2] (million tonnes) Average per Year	Recoverable Coal Added Under Alternative 2[1] (mmt)	Mine Life Added Under Alternative 2[1] (years)	CO_2 Emissions Added by Alternative 2[2] (million tonnes) Total per LBA Tract	CO_2 Emissions Added by Alternative 2[2] (million tonnes) Average per Year
Black Thunder/ North Hilight Field	135	224.0	263.4	2.0	437.1	218.5	652.8	4.8	1,083.0	225.6
Black Thunder/ South Hilight Field	135	224.0	213.6	1.6	354.4	221.5	304.3	2.3	504.8	219.5
Black Thunder/ West Hilight Field	135	224.0	377.9	2.8	626.9	223.9	965.2	7.1	1,601.3	225.5
Jacobs Ranch/ West Jacobs Ranch	40	66.4	669.6	16.7	1,110.9	66.5	912.6	22.8	1,514.0	66.4
North Antelope Rochelle/ North Porcupine	95	157.6	601.2	6.3	997.4	158.3	745.4	7.8	1,236.6	158.5
North Antelope Rochelle/ South Porcupine	95	157.6	309.7	3.3	513.8	155.7	339.3	3.6	562.9	156.4

[1] Anticipated coal production rates at each applicant mine, coal tonnages within each LBA tract, and anticipated mine life added by each LBA tract are addressed in Chapter 2.
[2] Determined using emission factor of 1.659 tonnes CO^2/ton of coal burned (USDOE 1994).

beyond 2008, while the mines recover their remaining estimated 2,483 million tons of currently leased coal reserves.

It is not likely that selection of the No Action alternatives would result in a decrease of U.S. CO_2 emissions attributable to coal mining and coal-burning power plants in the longer term, because there are multiple other sources of coal that, while not having the cost, environmental, or safety advantages, could supply the demand for coal beyond the time that the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines complete recovery of the coal in their existing leases.

In 2006, transportation sources accounted for approximately 29 percent of total U.S. GHG emissions (EPA 2008b). Transportation is the fastest growing source of U.S. GHGs, accounting for 47 percent of the net increase in total U.S. emissions since 1990. Transportation is also the largest end-use source of CO_2, which is the most prevalent GHG (EPA 2008b). Transportation is also the largest end-use source of CO_2, which is the most prevalent anthropogenic GHG (EPA 2008b, NOAA 2007).

Carbon dioxide is not the only GHG of concern. Another GHG, methane, in the form of coal bed natural gas (CBNG), is released into the atmosphere when coal is mined. The other major sources of U.S. methane emissions are from agriculture and waste management. According to the EIA (USDOE 2009a and 2009c):

- U.S. anthropogenic methane emissions totaled 722.7 million tonnes CO_2e in 2007 and 737.4 million tonnes CO_2e in 2008.

- U.S. 2008 methane emissions from coal mining were estimated at 82.0 million tonnes CO_2e, which represents approximately 11.1 percent of the U.S. total anthropogenic methane emissions in 2008.

- Surface coal mining operations in the U.S. were estimated to be responsible for methane emissions of about 15.7 million tonnes of CO_2e in 2008, which represents about 2.1 percent of the estimated U.S. anthropogenic methane emissions in 2008, and about 19.1 percent of the estimated methane emissions attributed to coal mining of all types.

- The Wyoming PRB produced approximately 55.5 percent of the coal mined in the U.S. in 2008 using surface mining techniques, which means that Wyoming PRB surface coal mines were responsible for approximately 1.17 percent of the estimated U.S. anthropomorphic methane emissions in 2008. The three applicant mines (Black Thunder, Jacobs Ranch, and North Antelope Rochelle) contributed about 50.5 percent of the Wyoming PRB production in 2008, which is the equivalent of about 4.4 million tonnes CO_2e vented methane emissions. It should be noted that the estimated amount of annual methane emissions vented from the applicant mines based on the gas content analyses of local coal cores (Section 3.18.2) is more than 20 times less than this estimate that is based on EIA's 2009 report (USDOE 2009c).

Since 1990, when BLM began leasing using the lease by application (LBA) process, total U.S. anthropogenic methane emissions declined from 783.5 million tonnes CO_2e to 737.4 million tonnes CO_2e in 2008. Total coal mining related emissions declined from 106.4 million tonnes CO_2e to 82.0 million tonnes CO_2e during the same time period. The EIA attributes the overall decrease in coal mine emissions of methane since 1990 to the fact that the coal production increases during that time had been largely from surface coal mines that produce relatively little methane (USDOE 2009c).

CBNG is currently being commercially produced on a large scale by oil and gas operators from wells located within and near the WAC LBA tracts. CBNG that is not recovered prior to mining would be vented to the atmosphere during the mining process. Selection of the No Action alternatives would potentially allow more complete recovery of the CBNG from the six WAC LBA tracts in the short term (roughly 10 years), during the time that the three applicant mines' currently leased coal is being recovered. However, BLM's analysis suggests that a large portion of the CBNG resources that are currently present on the tract would be recovered prior to mining under the Proposed Action or Alternatives 2 or 3 (a complete discussion is included in Section 3.3.2.1.2.1). Selection of the No Action alternatives would not be likely to directly decrease U.S. methane emissions attributable to coal mining in the long term because there are multiple other sources of coal that could supply the coal demand beyond the time that the Black Thunder, Jacobs Ranch, and North Antelope Rochelle mines recover the coal in their existing leases.

Nitrous oxide (N_2O) is the one other GHG of concern that is associated with coal mining; however, the largest source in the U.S. is agricultural (about 76 percent comes from fertilization of soils and about 24 percent from management of animal waste) (USDOE 2009c).

Specific levels of significance have not yet been established for GHG emissions, and given the current state of science, it is not yet possible to associate specific actions with the specific climate impacts. As a consequence, impact assessments of effects of specific anthropogenic activities cannot be performed. Tools necessary to quantify incremental climatic changes associated with these GHG emission estimates for the projected coal mine development activities in the PRB are presently unavailable. Technology to conduct such an analysis at this spatial and temporal scale simply does not exist; therefore, conclusions as to the magnitude or significance of the emissions on climate change cannot be reached. The impacts of climate change represent the cumulative aggregation of all worldwide GHG emissions, land use management practices, and the albedo effect. The analysis does provide a meaningful context and measure of the relative significance of coal use from the overall projected PRB coal production on total GHG emissions. Therefore, climate change analysis in this EIS is limited to accounting for and disclosing of factors that contribute to climate change. To the extent that emission data were available or could be inferred from representative type data, potential GHG emissions that could result from development of the pending LBA tracts in the PRB (Table 1-2) have been identified, as well as emissions that would result from selection of the No Action alternatives.

Although the effects of GHG emissions and other contributions to climate change in the global aggregate are estimable, given the current state of science it is impossible to determine what effect any given amount of GHG emissions resulting from an activity might have on the phenomena of global warming, climate change, or the environmental effects stemming from it. It is therefore not currently possible to associate any particular action and its specific project-related emissions with the creation or mitigation of any specific climate-related effects at any given time or place. However, it is known that certain actions may contribute in some way to the phenomenon (and therefore the effects of) climate change, even though specific climate-related environmental effects cannot be directly attributed to them.

4.2.14.3 U.S. Actions and Strategies to Address Greenhouse Gas Emissions

Potential regulatory policies to address climate change are in various stages of development at the federal, state, and regional levels (USDOE 2009b). A number of bills have been introduced in the U.S. Congress related to global climate change. At this time, there is no national policy or law in place that regulates GHG emissions.

The Lieberman-Warner Climate Security Act, which was introduced in October 2007 by Senators Joseph I. Lieberman (ID-CT) and John W. Warner (R-VA), would establish a cap-and-trade within the United States. In short, the "cap" would set a legal limit on the quantity of greenhouse gases that a region can emit each year and "trade" would allow companies to exchange the permission – or permits – to emit greenhouse gases. The cap would get tighter over time, until by 2050, emissions would be reduced by 63 percent below 2005 levels. The bill was approved by the Senate Environment and Public Works Committee in December, 2007 (http://www.pewclimate.org, accessed 12/21/2007). The bill was introduced in the Senate and read the first time on May 20, 2008. The Boxer-Lieberman-Warner substitute amendment to the Climate Security Act of 2008 was subsequently released by the Senate Environment and Public Works Committee on May 21, 2008. The bill was then read a second time and placed on the Senate Legislative Calendar under General Orders, Calendar No. 742. In June 2008 the U.S. Senate voted to invoke cloture on the Boxer amendment but did not pass the cap-and-trade legislation.

On June 26, 2009, the U.S. House of Representatives passed The American Clean Energy and Security Act of 2009. The legislation includes a federal GHG emissions cap-and-trade program that would take effect in 2012. The declining emissions cap requires that total GHG emissions be 17 percent below 2005 levels by 2020 and 83 percent below 2005 levels by 2050. In November 2009, the Senate Environment and Public Works Committee passed a GHG cap-and-trade bill that borrows much from the House American Clean Energy and Security Act and tightens the GHG emissions cap to 20 percent below 2005 levels by 2020. Several other committees are expected to weigh in before the final bill is crafted and brought before the Senate floor (USDOE 2009c).

On April 2, 2007, in *Massachusetts v. EPA*, the U.S. Supreme Court found that GHGs are air pollutants covered by the Clean Air Act (CAA). The Court held that the Administrator of the EPA must determine whether or not emissions of GHGs from new motor vehicles cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare, or whether the science is too uncertain to make a reasoned decision. At that time, the court directed EPA to review the latest science on climate change in order to make a determination. On April 17, 2009, the Administrator signed Proposed Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the CAA. On December 7, 2009, the Administrator signed two distinct findings regarding GHGs under Section 202(a) of the CAA. The Administrator finds that the current and projected concentrations of the six key well-mixed greenhouse gases—carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6)—in the atmosphere threaten the public health and welfare of current and future generations and that the combined emissions of these well-mixed GHGs from new motor vehicles and new motor vehicle engines contribute to climate change. The findings do not in and of themselves impose any emission reduction requirements but rather allow EPA to finalize the GHG standards proposed earlier in 2009 (EPA 2009c). The agency is now poised to regulate CO_2 as a pollutant, and the findings allow EPA to begin regulating GHG emissions from power plants, factories and major industrial polluters, although the precise details of that regulation have yet to be worked out. An endangerment finding under one provision of the CAA would not by itself automatically trigger regulation under the entire Act.

As a result of the Supreme Court's decision in 2007, the EPA drafted the Prevention of Significant Deterioration/Title V Greenhouse Gas Tailoring Rule. The draft rule, published in the Federal Register on October 27, 2009, limits the applicability of CO_2 emissions standards to new and modified sources that emit more than 25,000 tonnes CO_2e annually, rather than applying the threshold of 250 tons per sources for triggering the regulation of criteria pollutants specified in Title V of the CAA. At the 25,000 tonnes CO_2e annual level, the EPA expects that 14,000 large industrial sources, which are responsible for 70 percent of the U.S. GHG emissions, will be required to obtain Title V operating permits. That threshold would cover large power plants, refineries, and other large industrial operations (USDOE 2009c).

EPA has issued the Final Mandatory Reporting of Greenhouse Gases Rule (EPA 2010). The rule requires reporting of GHG emissions from large sources and suppliers in the U.S., and is intended to collect accurate and timely emissions data to inform future policy decisions. Under the rule, suppliers of fossil fuels or industrial greenhouse gases, manufacturers of vehicles and engines, and facilities that emit 25,000 tonnes or more per year of GHG emissions are required to submit annual reports to EPA. The gases covered by the proposed rule are carbon dioxide, nitrous oxide, methane, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and other fluorinated gases including nitrogen trifluoride (NF_3) and hydrofluorinated ethers (HFE). The final rule was signed by the Administrator on September 22, 2009. EPA's new reporting system will provide a better understanding of where GHGs are coming from and will guide development of the best possible policies and programs to reduce emissions. Reporters must begin to monitor their emissions on January 1, 2010 and the first annual emissions reports will be due in 2011 (EPA 2010).

The American Recovery and Reinvestment Act of 2009 ("The Stimulus Bill") was signed into law by President Obama on February 17, 2009, and under the Act, the U.S. DOE received $36.7 billion to fund renewable energy, carbon capture and storage, energy efficiency, and smart grid projects, among others. The projects are expected to provide reductions in both energy use and GHG emissions (USDOE 2009c).

Federal, state, and local governments are also developing programs and initiatives aimed at reducing energy use and emissions. The 2002 Clear Skies and Global Climate Change Initiative is a voluntary national program to reduce greenhouse gas emissions. There are federal tax incentives for energy efficiency and conservation, and some states have renewable energy and energy efficiency policies. Regional initiatives have been started in the northeast (Northeast Regional Greenhouse Gas Initiative) as well as the Western Climate Initiative in the western states. At this time, it is not possible to predict how all of these programs would be melded into a national regulatory process if one were to be enacted.

A number of U.S. financial and corporate interests have acknowledged that enactment of federal legislation limiting the emissions of CO_2 and other greenhouse gases seems likely (NARUC 2007). There is uncertainty about anticipated CO_2 emission limits and carbon capture/sequestration regulations. This has caused some proponents to cancel or delay their proposed projects that use existing and emerging technologies to produce electricity from coal (Casper Star Tribune 2007c). Capacity planning decisions for new generating plants and investment behavior in the electric power sector are being affected by the potential impacts of policy changes that could be made to limit or reduce GHG emissions (USDOE 2009b).

4.2.14.4 Current and Future Energy Sources and Emissions of Greenhouse Gases in the U.S.

The key determinant of energy consumption is population. Population influences demand for goods, services, housing, and travel. In the U.S. the population has increased by about 20 percent and energy consumption by a comparable 18 percent since 1990, with variations in energy use per capita depending on factors such as weather and the economy. To meet the nationwide consumer demand and requirement for energy, coal is burned in power plants to produce electricity. Coal is an important component of the U.S. energy supply partly because it is the most abundant domestically available fossil fuel (USGS 2002b). One-quarter of the world's coal reserves are found within the U.S.; the energy content of U.S. coal resources exceeds that of all the world's known recoverable oil; and coal resources supply more than half of the electricity consumed by Americans (USDOE 2008 and 2009d). Many countries are even more reliant on coal for their energy needs than is the United States. More than 70 percent of the electricity generated in China and India comes from coal (USGS 2000). The value of coal is partially offset by the environmental impacts of coal combustion (USGS 2000).

In the USDOE 2007 Annual Energy Outlook, energy-related CO_2 emissions were projected to grow by about 35 percent from 2006 to 2030 (USDOE 2007b). By comparison, the USDOE 2008 Annual Energy Outlook projected energy-related CO_2 emissions to grow by 16 percent, from 5,890 million tonnes in 2006 to 6,851 million tonnes in 2030 (USDOE 2008). However, USDOE's 2009 Annual Energy Outlook projects energy-related CO_2 emissions to grow by 7 percent, from 5,991 million tonnes in 2007 to 6,414 million tonnes in 2030. The mix of sources for these generation projections include coal, natural gas, nuclear, liquids (petroleum), hydro-power, and non-hydro renewables (wind, solar, etc.). The most recent, lower projected emissions growth rate is due to a slower demand growth combined with increased use of renewables and a declining share of electricity generation that comes from fossil fuels (USDOE 2009b).

Total U.S. anthropogenic GHG emissions in 2008 were 2.2 percent below the 2007 total. The decline in total emissions–from 7,209.8 million tonnes CO_2e in 2007 to 7,052.6 million tonnes in 2008–was largely the result of a 177.8 million tonne CO_2e drop in CO_2 emissions. There were small percentage increases in emissions of other GHGs, but those increases were more than offset by the drop in CO_2 emissions. The decrease in U.S. CO_2 emissions in 2008 resulted from higher energy prices, economic contraction, and lower demand for electricity (USDOE 2009c).

Energy-related CO_2 emissions dominate (about 81 percent in 2008) the total U.S. GHG emissions. Petroleum is the largest fossil fuel source for energy-related CO_2 emissions, contributing 41.9 percent of the total, whereas coal is the second-largest fossil fuel contributor, at 36.5 percent. Petroleum made up 44.6 percent of total fossil fuel energy consumption in 2008, as compared with coal's 26.8 percent. Natural gas accounted for 28.5 percent of the fossil fuel energy use in 2008, but only 21.4 percent of total energy-related CO_2 emissions. Energy-related CO_2 emissions account for 98 percent of the total U.S. CO_2 emissions (USDOE 2009c).

The U.S. emits about 1,900 million tonnes annually from coal-fired power plants–33 percent of total energy-related CO_2 emissions and 81 percent of CO_2 emissions from the U.S. electric power sector (USDOE 2009c). If public sentiment results in changed electric demand, or if GHG emissions are ultimately regulated, the demand forecast for coal for electric generation could change. The potential impacts of policy changes that could be made to limit or reduce GHG emissions is affecting planning decisions for new power plants, particularly with respect to new coal-fired capacity.

To assess the national electric generation portfolio and the mix of future electric generation technologies, BLM reviewed the Annual Energy Outlook 2010 Report (USDOE 2009e). An independent study representing a forecast to the year 2035, it examined the ability of the domestic electric generation industry to alter the present electric generation portfolio (mix of electric generation technologies). This report compares the 2035 projection to the electric generation mix that existed in 2008. This most recent report incorporates the 2009 downturn in electric demand, which resulted from lowered electric demand for manufacturing in the depressed domestic economy of 2009. This forecast estimated the percentage of coal-fired electric generation in the domestic electric generation portfolio at 44 percent by 2035, based on a slowing in electric demand through 2035, and a doubling, to 17 percent, of renewable electric generation in the domestic electric generation portfolio by 2035. Based on this study, even with a considerably more optimistic projection for renewable sources, coal use continues to be projected as the largest portion of the domestic electric fuel mix.

Technologies for producing cleaner, more efficient and more reliable power from coal are currently available and are being improved. These include advanced pulverized coal, circulating fluidized bed, coal gasification or Integrated Gasification Combined Cycle (IGCC), and carbon sequestration or carbon capture and storage (CCS) technologies. Systems that utilize carbon capture technologies are being developed to capture at least 90 percent of emitted CO_2, which would be stored within geological formations (i.e., oil and gas reservoirs, saline formations, unmineable coal seams). These technologies are not yet commercially established due to extremely high capital costs and low system reliability, which are the biggest obstacles to integration of these technologies into the power market. However, regulatory uncertainties are affecting planning decisions, for example, unless new coal-fired power plants are equipped with CCS equipment they could incur higher costs as a result of higher expenses for siting and permitting. However, costs would not be directly affected by regulatory uncertainty for nuclear and renewable power plants because they do not emit GHGs (USDOE 2009c).

The Electric Power Research Institute (EPRI) has also attempted to identify a scenario of how the full portfolio of technologies to provide for electric energy would respond if national policy were to require that CO_2 emissions be reduced to 1990 levels (James 2007). EPRI updated this research in an October 2009 report, The Power to Reduce CO_2 Emissions: The Full Portfolio (EPRI 2009), which used the EIA's Annual Energy Outlook 2009 Report for comparison.

The EPRI study predicts that national policy that forces a reduction of CO_2 emissions to 1990 levels would promote increased energy efficiency, and the growth of "non carbon" sources such as nuclear and renewable. Renewable sources include wind and solar, as well as emerging technologies like tidal power, river turbines and others reported in the media. Hydropower is limited because most opportunities for hydropower have been used or require large infrastructure. Use of carbon based sources such as natural gas and petroleum are less than forecasted by the USDOE EIA, while coal use remains about the same in the EPRI forecast, mostly due to forecasted improvement in GHG emission reduction in coal-fueled generation. Both EIA and EPRI forecast increases in electricity cost.

Figure 4-13 shows the current (2008) electric generation mix, compared to the 2035 EIA forecast (USDOE 2009e) as well as the older 2030 EPRI forecast (EPRI 2009). Both forecasts are consistent that the amount of electric generation fueled by coal is expected to drop from nearly fifty percent of the total presently to about 40 percent of the total in future years. Coal is forecast to remain as the major electric generation component until at least 2035. Renewable energy (other than hydroelectric) and nuclear are forecast to increase, while natural gas and other fossil fuels (i.e., oil) are forecast to remain stable or decrease to a degree.

In 2003 the USDOE initiated the FutureGen project–a commercial-scale coal-fired power plant incorporating IGCC with CCS–thus being the first facility of its kind to combine and test several cutting-edge technologies. FutureGen is a public-private partnership between the USDOE and the FutureGen Alliance, a non-profit organization that represents some of the world's largest coal producers and electric utilities, to build a first-of-its-kind coal-fired near-zero emissions power plant. The FutureGen Alliance and the USDOE reached an agreement in June 2009 to proceed with the project, which will be located at Mattoon, Illinois. The project proposes to produce electricity by turning coal into gas, remove impurities, extract CO_2 from the waste stream, and then sequester the CO_2 underground. The Alliance is responsible for design, construction, and operation of the facility, and USDOE is responsible for independent oversight and coordinating participation of international governments. USDOE's financial contribution will come from the American Recovery and Reinvestment Act. The USDOE issued a NEPA Record of Decision (ROD) on July 14, 2009 to move forward toward the first commercial scale, fully integrated, carbon capture and sequestration project in the country (USDOE 2009f). The ROD allows the Alliance to proceed with site-specific activities, and over the following 8 to 10 months the project design, costs and funding plan will be refined. The USDOE and the Alliance will then decide in early 2010 whether to continue the project through construction and operation. When fully operational the FutureGen facility will produce 275 MW

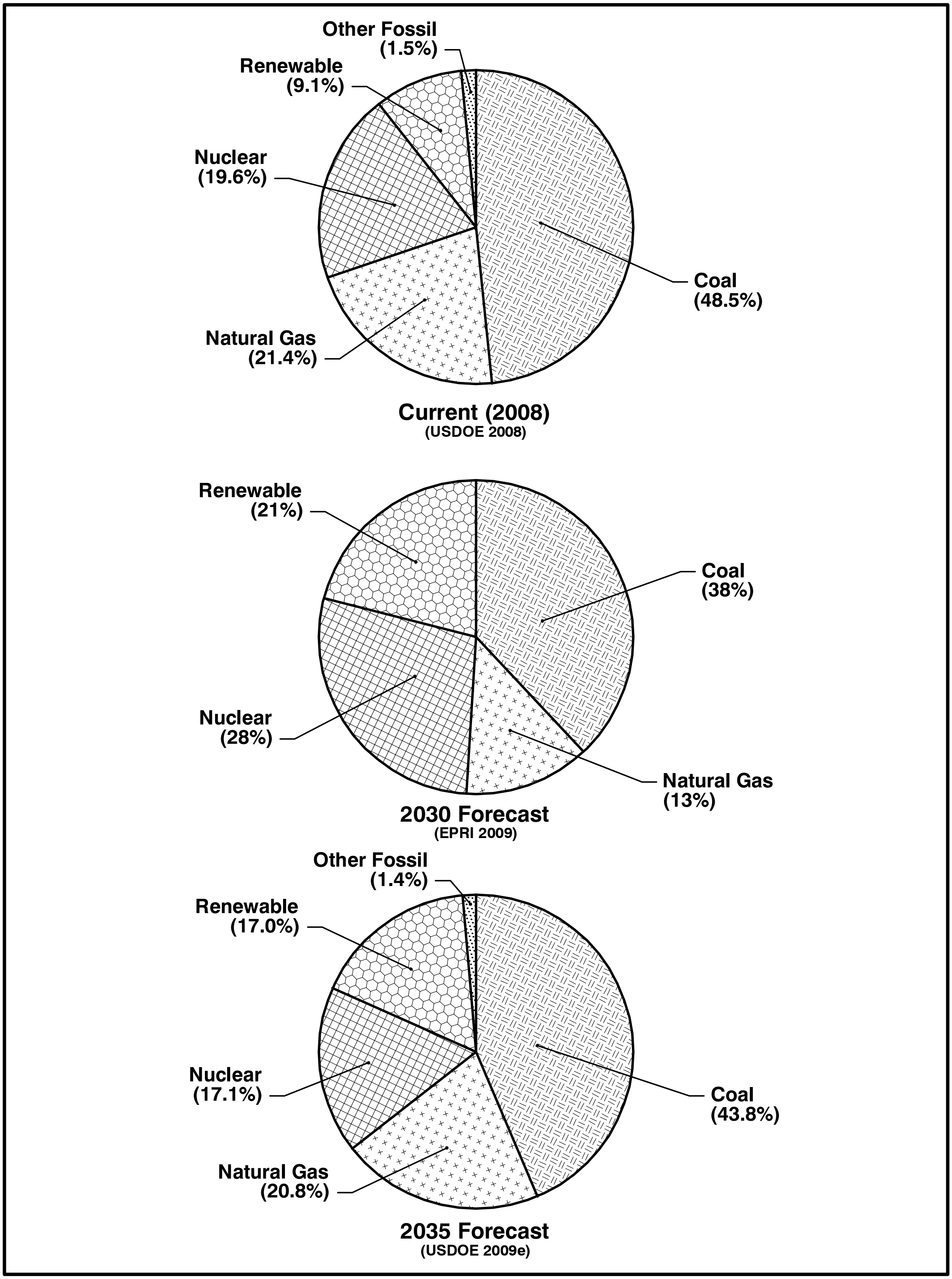


Figure 4-13. Current and Forecast Mix of Electric Generation Sources.

of power and capture 90 percent of the carbon emissions; however, it may be operated at a 60 percent capture rate in the first 3 years to validate plant integration and sequestration capability, as well as manage the startup risks and costs. This technology should sequester a million tons of CO_2 annually (USDOE 2009f).

Other methods of generating electricity that result in fewer GHG emissions than burning coal include natural gas, nuclear, hydroelectric, solar, wind, and geothermal resources.

Natural gas plays a key role in meeting U.S. energy demands. Natural gas, coal and oil supply about 85 percent of the nation's energy, with natural gas currently supplying about 22 percent of the total. The percent contribution of natural gas to the U.S. energy supply is expected to remain fairly constant for the next 20 years. According to EIA's 2010 Annual Energy Outlook (USDOE 2009e), concerns about GHG emissions have little effect on construction of new capacity fueled by natural gas.

Unconventional natural gas resources are expected to play a larger role in the demand for natural gas for electricity generation (USDOE 2009b and 2009e). Natural gas production from hydrocarbon rich shale formations, known as "shale gas" is one of the most rapidly expanding trends in onshore domestic oil and gas exploration and production today. Analysts estimate that by 2011, most new natural gas reserves will come from unconventional shale gas reservoirs (NETL 2009). From 2007 to 2030, domestic production of natural gas is expected to increase by 22 percent (USDOE 2009b).

The nuclear share of power generation is projected by EPRI (2009) to increase to about 28 percent by 2030 as the addition of new power plants and upgrades at existing units increases overall capacity and generation, and the nuclear power share of total electricity generation remains somewhat constant at 17-19 percent by 2035 according to EIA (USDOE 2009e).

The share the nation's total electricity generation from renewables (i.e., biomass-based diesel, hydroelectricity, geothermal, solar, wind, ethanol), supported by federal tax incentives and state renewable programs, is expected to increase from 9 percent in 2008 to 17 percent in 2035 (USDOE 2009e). EPRI (2009) is more optimistic with renewable sources reaching 21 percent by 2030.

The estimated cumulative CO_2 emissions that would be produced annually from the conventional combustion of the coal produced from the six WAC LBA tracts, if they are all leased under either the Proposed Action or Alternative 2 (Section 4.2.14.2) are based on the applicant mines' projected future mining rates. Those estimates present a scenario that assumes the demand for coal in the future would not differ from current demand, technologies for producing cleaner, more efficient and more reliable power from coal (i.e., advanced pulverized coal, circulating fluidized bed, IGCC, and CCS) would not yet be commercially established, and an explicit federal policy has not been enacted to limit or reduce U.S. GHG emissions. However, if there is a strong shift toward natural gas, nuclear, and renewable power generation, as well as fossil technologies with CCS equipment, those estimates of CO_2 emissions from the combustion of coal produced from the PRB would be lower than estimated in the prior discussion (Section 4.2.14.2).

4.2.14.5 Mercury, Coal Combustion Residues, and Other By-Products

One of the concerns associated with burning coal for the production of electricity is the release of elements from coal to the environment (USGS 2000). When coal is burned, GHGs as well as mercury and other compounds and elements, including lead and cadmium, that may have direct or indirect effects on human health are released (EPA 2009d). The principal pollutants generated by coal combustion that can cause health problems are particulates, sulfur and nitrogen oxides, trace elements (including arsenic, fluorine, selenium, and radioactive uranium and thorium), and organic compounds generated by incomplete coal combustion (USGS 2000).

In coal combustion, concentrations of these elements and compounds vary depending on the chemistry of the coal deposits and on the type of air pollution controls in place when the coal is burned. Coal use in developing countries can potentially cause serious human health impacts (USGS 2000). Some coal mined in China is known to have caused severe health problems in several local populations because the coal was mined and burned with little regard to its chemical composition (USGS 2000). Chinese coals that contained high levels of arsenic, fluorine, selenium, and polycyclic aromatic hydrocarbons have caused severe, life-threatening health impacts to some residents that burned the coal in unvented stoves in their homes (USGS 2000).

Coal that is burned in the U.S. generally contains low to modest concentrations of potentially toxic trace elements and sulfur (USGS 2000). Specifically, PRB coal is recognized as being a clean burning coal due to its low sulfur and low ash properties. In a 2002 analysis conducted by USGS (2002b), PRB coal was found to contain, on average, approximately eight times less sulfur than coals being utilized from the Appalachian and Illinois basins to supply U.S. power plants (feed coal). PRB feed coal was also found to contain nearly half as much uranium (8.9 ppm), seven times less arsenic (17 ppm), five times less lead (19 ppm), and three times less cadmium (1.1 ppm) as compared to Appalachian and Illinois basin feed coals. When burned, PRB coal produced, on average, 38 percent less fly ash than Appalachian and Illinois basin coals (USGS 2002b). The fly ash resulting from combusted PRB coal contained approximately 39 times less mercury than fly ash that was generated from combusted Appalachian and Illinois basin coal (USGS 2002b).

Additionally, many U.S. coal burning power plants use sophisticated pollution-control systems that efficiently reduce the emission of hazardous elements (USGS 2000). The EPA conducted a detailed study of possible health impacts from exposure to emissions of approximately 20 potentially toxic substances from U.S. coal-burning power plants (USGS 2000). The EPA concluded that, with the exception of possibly mercury, there is no compelling evidence to indicate that emissions from U.S. coal-burning power plants cause human health problems (USGS 2000).

Mercury is a naturally occurring element and enters the environment as a result of natural sources, such as active volcanoes, and through human activities such as industrial combustion and mining (EPA 2006). Natural sources of mercury, such as volcanic eruptions and emissions from the ocean, have been estimated to contribute about 33 percent of the current worldwide mercury air emissions; anthropogenic (human-caused) mercury emissions account for the remaining 67 percent, though these estimates are highly uncertain (EPA 2009e).

When fossil fuels burn, mercury vapor can be released into the atmosphere where it may drift for a year or more, spreading with air currents over vast regions of the globe (USDOE 2006). In 1995, an estimated 5,500 tons of mercury was emitted globally from both natural and human sources, and coal-fired power plants in the U.S. contributed to less than one percent of that total (USDOE 2006).

Mercury is a global problem that knows no national or continental boundaries. It can travel thousands of miles in the atmosphere before it is eventually deposited back to the earth in rainfall or in dry gaseous forms. EPA estimates that about one-third of the U.S. anthropogenic mercury emissions are deposited within the contiguous U.S. and the remainder enters the global cycle (EPA 2009e).

Table 4-40 summarizes how the various continents contributed to the worldwide anthropogenic mercury emissions in 2004. The 2004 U.S. anthropogenic mercury emissions were estimated to account for about three percent of the global total (EPA 2009e). EPA estimates that 83 percent of the mercury deposited in the U.S. originates from international sources, with the remaining 17 percent coming from the U.S. and Canada. These figures include mercury from natural and anthropogenic sources (EPA 2006).

Table 4-40. 2004 Percent Contribution to Worldwide Anthropogenic Mercury Emissions.

Continent	**Percent**
Asia	53
Africa	18
Europe	11
North America	9
Australia	6
South America	4

Source: EPA 2009e

In 2006, EPA estimated that 50-70 percent of current global anthropogenic atmospheric emissions came from fuel combustion, and much of it came from China, India, and other Asian countries. Coal consumption in Asia is expected to grow significantly over the next 20 years. This international source of mercury emissions may grow substantially if left unaddressed (EPA 2006).

Over the past decade, addressing environmental and human health mercury risks has been a focus for EPA. Overall U.S. mercury air emissions have been reduced by 45 percent since 1990. EPA is most concerned with methyl mercury, a potent form of mercury and the form to which humans are primarily exposed (EPA 2006).

Atmospheric mercury can settle into water or onto land where it can be washed into the water. Certain microorganisms can transform mercury into methyl mercury, a highly toxic mercury compound that builds up in fish and shellfish when they feed. Methyl mercury is the only form of mercury that biomagnifies in the food web. Concentrations of methyl mercury in fish are generally on the order of a million times the methyl mercury concentration in the water. The primary pathway of human exposure to mercury is through eating fish containing methyl mercury (EPA 2006).

There are adverse health effects to humans and other animals that consume these fish and shellfish. Birds and mammals that eat fish may be more exposed to mercury more than other animals in water ecosystems (EPA 2008c). At high levels of exposure, methyl mercury's harmful effects may include death, reduced reproduction, slower growth and development, and abnormal behavior (EPA 2008c). Research has shown that most people's fish consumption does not cause a health concern, but high levels of methyl mercury in the bloodstream of unborn babies and young children may harm the developing nervous systems of those children (EPA 2006).

The USDOE's Office of Fossil Energy has been sponsoring studies on mercury emissions from coal-based power generators to identify effective and economical control options for the past decade. The Office of Fossil Energy manages the largest funded program in the U.S. for developing an understanding of mercury emissions and developing emission control technologies for the coal-fired electric generating industry in the U.S. (USDOE 2006). Research on advanced and improved mercury control technology is ongoing.

In the U.S., coal-burning power plants are the largest human-caused source of mercury emissions being released into the air, accounting for about 40 percent of all domestic human-caused mercury emissions (EPA 2008c). However, these emissions contribute little to the global mercury pool. EPA estimated that mercury emissions from U.S. coal-fired power plants account for about 1 percent of the global total (EPA 2009e).

Coal production from the Wyoming PRB represented approximately 42 percent of the coal used for power generation in 2006, which would represent about 0.4 percent of the global anthropogenic mercury emissions. The three applicant mines (Black Thunder, Jacobs Ranch and North Antelope Rochelle) produced about 45.4 percent of the coal produced in the Wyoming PRB in 2006, which would represent about 0.2 percent of the global mercury emissions. Under the No Action alternatives, mercury emissions attributable to burning coal produced by the three applicant mines would be extended at about current levels of up to approximately 11 years beyond 2008, while the mines recover their remaining leased coal reserves. Under the Proposed Actions or Alternatives 2 or 3, the three applicant mines contribution to global mercury emissions would be extended from about 1.6 to 22.8 additional years, depending on the tract and alternatives selected. Uncertainties about future regulatory requirements and the use of the coal mined from the six WAC LBA tracts make it difficult to project the impacts of mercury emissions produced by burning coal produced from these tracts.

Additionally, burning coal in electric utility boilers generates residual materials which are referred to as coal combustion residues. These residues include non-combustible materials left in the furnaces and ash that is carried up the smokestacks and collected by air pollution control technologies. As previously referenced, coal and coal combustion residues can contain a variety of compounds, metals, and other elements depending on the coal deposit and upon the site-specific characteristics of where the coal originated from. Coal-fired boilers are required to have control devices to reduce the amount of emissions that are released into the atmosphere (EPA 2007f). The use of air pollution control equipment at power plants has resulted in fewer emissions but has also increased the amount of solid residues.

In the past, coal combustion residues have generally been recycled or disposed of in landfills or surface impoundments. More recently, these residues have been disposed of in mines as part of the reclamation process. There can potentially be risks of contamination of drinking water supplies and surface water bodies by coal combustion residues, particularly when they are disposed of in mines (National Academy of Science 2006, EPA 2002). The EPA is evaluating management options for solid wastes from coal combustion, including whether current management practices pose risks to human health or ecological receptors. A draft report, dated August 6, 2007, prepared for the EPA Office of Solid Waste, and entitled "Human and Ecological Risk Assessment of Coal Combustion Wastes," is available at http://www.earthjustice.org/library; however, the report is labeled as a draft document that is not to be cited or quoted.

As discussed above, the WAC applicant mines produced about 45.4 percent of the coal produced in the Wyoming PRB in 2006. Under the No Action alternatives, production of coal combustion residue attributable to burning coal produced from the coal mines would be extended at about current levels for up to approximately 11 years beyond 2008, while the mines recover their remaining leased coal reserves. Under the Proposed Action or Alternatives 2 or 3, coal combustion residue related to burning coal mined at the applicant mines would be extended from 1.6 to 22.8 additional years, depending on the tract and alternatives selected. Uncertainties about future regulatory requirements and the use of the coal mined from the six WAC LBA tracts make it difficult to project the impacts of disposing coal combustion residues produced by burning coal produced from these tracts.

Depending on the size, shape, and chemical composition, some coal combustion residues can be recycled and beneficially reused as components of building materials or as replacement to raw materials that would ordinarily need to be mined such as sand, gravel, or gypsum (EPA 2007f). Coal combustion products (CCPs) are the materials produced primarily from the combustion of coal in coal-fired power plants and can include the following materials: fly ash, bottom ash, boiler slag, and flue gas desulfurization material (EPA 2007f). Studies and research conducted or supported by the EPA, Electric Power and Research Institute (EPRI), other government agencies, and universities have indicated that the beneficial uses of coal combustion products have not been shown to present significant risks to human health or the environment (EPA 2008d).

Fly ash is a byproduct of burning finely ground coal in a boiler to produce electricity. Physically, fly ash is a fine, powdery material composed mostly of silica and nearly all particles are spherical in shape. Fly ash is a pozzolan—a siliceous material which, in the presence of water, will react with calcium hydroxide at ordinary temperatures to produce cementitious compounds. Because of its spherical shape and pozzolanic properties, fly ash can be useful in cement and concrete applications (EPA 2007g).

Bottom Ash is agglomerated ash particles, formed in pulverized coal furnaces that are too large to be carried in the flue gases. Bottom ash is coarse with grain sizes spanning from fine sand to fine gravel. It can be used as a replacement for aggregate and is usually sufficiently well-graded in size to avoid the need for blending with other fine aggregates to meet gradation requirements (EPA 2007h).

Boiler slag is the molten bottom ash collected at the base of slag tap and cyclone type furnaces. Boiler slag particles are uniform in size, hard, and durable with a resistance to surface wear. The permanent black color of this material is desirable for asphalt applications and aids in the melting of snow (EPA 2007i).

Flue Gas Desulfurization (FGD) material is a product of a process typically used for reducing SO_2 emissions from the exhaust gas system of a coal-fired boiler (EPA 2007j). These materials can be used as embankment and road base material, wallboard manufacturing, and in place of gypsum for the production of cement. Currently, the largest single market for FGD material is in wallboard manufacturing (EPA 2007j).

Utilizing CCPs can generate significant environmental and economic benefits (EPA 2009f). CCPs can be used for raw feed for cement, concrete, grout, flowable fill, structural fill, road base/sub-base, soil modification, mineral filler, snow and ice traction control, blasting grit and abrasives, roofing granules, mining applications, wallboard, waste stabilization/solidification, and soil amendment. Using CCPs can reduce energy consumption and GHG emissions and can help reduce the need for landfill space. Economic benefits include reduced costs associated with managing coal ash and slag disposal, potential revenue from the sale of CCPs, and savings from using CCPs in place of other more costly raw materials (EPA 2009f).

CCPs offer product-performance benefits as well. Boiler slag is a sought-after replacement for sand in blasting grit because it is free of silica and eliminates the potential health risk of silicosis (EPA 2007i). High coal ash-content concrete is used for building long-lived pavements designed to last 50 years—twice the lifetime of conventional pavements. Coal fly ash can create superior products because of its self-cementing properties. Using coal fly ash in concrete can also produce stronger and longer-lasting buildings (EPA 2007g). This not only reduces the costs of maintaining buildings, but provides the additional environmental benefit of reducing the need for new concrete to repair or replace aging buildings. This translates to a significant reduction in future energy consumption and GHG emissions (EPA 2007g).

In 2005, demand had become so strong for coal ash that some power plants were selling all the ash they produced (EPA 2005b). EPA estimated that through the utilization of 15 million tons of coal fly ash, the U.S. reduced its GHG emissions equivalent to the annual emissions of nearly 2.5 million passenger vehicles (EPA 2008e).

Because of the many potential uses of CCPs, EPA has sponsored the Coal Combustion Products Partnership (C^2P^2) Program to further the beneficial use of these coal combustion by-products (EPA 2003b). With more than 170 private and public partners (EPA 2009g), the C^2P^2 Program is a cooperative effort between EPA and various organizations to help promote the beneficial use of CCPs and the environmental benefits that can result from the proper use of these potentially recyclable materials (EPA 2003b). The C^2P^2 Program will help meet the national waste reduction goals of the Resource Conservation Challenge—an EPA effort to find flexible yet more protective ways to conserve valuable natural resources through waste reduction, energy recovery, and recycling (EPA 2009g).

In 2007, the U.S. used approximately 43 percent of its coal combustion products (EPA 2009f). The C^2P^2 Program aims to reduce adverse effects on air and land by increasing the use of coal combustion products to 50 percent in 2011 from 32 percent in 2001 (EPA 2009g). The program also plans to increase the use of CCPs as a supplementary cementitious material in concrete by 50 percent, from 12.4 million tons in 2001 to 18.6 million tons in 2011; this would decrease GHG emissions from avoided cement manufacturing by approximately 5 million tons (EPA 2009g).