3.0 PAST, PRESENT, AND REASONABLY FORESEEABLE DEVELOPMENT

This section presents a brief description of the industries evaluated in this study. Past and present and RFD coal and coal-related industries (e.g., railroads and power plants) are described below for both the Wyoming and Montana PRB study areas. Non-coal-related industries (e.g., oil and gas, etc.) only are described for the Wyoming PRB study area.

A summary of the data sources that were used to define the past and present conditions and RFD scenarios is presented for each industry following the past and present and RFD descriptions. Where information relative to project-specific, impact-causing parameters was unavailable, industry-specific assumptions have been developed to assist in defining existing conditions and to facilitate preparation of the cumulative impact analyses. These industry-specific assumptions are summarized at the end of each of the following sections.

The impact-causing parameters have been tabulated in the supporting updated database for the Task 2 report. A summary of the impact-causing parameters associated with each Wyoming coal mine subregion under both the lower and upper production scenarios is presented in **Tables A-1** and **A 2**, respectively, in Appendix A. Impact-causing parameters associated with the Montana coal mine subregions under the lower and upper production scenarios are summarized in **Tables A-3** and **A-4**. **Tables C-1** through **C-6** in Appendix C summarize by subwatershed the impact-causing parameters associated with all past and present and RFD actions (including coal mining activity) in the previously established Wyoming PRB Task 1D study area (**Figure C-1**). **Tables D-1** through **D-6** in Appendix D summarize by subwatershed the impact-causing parameters associated with all past and present and RFD actions (including coal mining activity) in the previously established Wyoming PRB Task 3D study area (**Figure D-1**). As discussed in Chapter 2.0, GIS data for base year 2003 were used to facilitate the resource-specific disturbance acreage estimates for the Task 1D Report for the PRB Coal Review, Current Environmental Conditions (ENSR 2005a). **Table B-1** in Appendix B summarizes the GIS-derived coal mine-related disturbance for the Wyoming PRB study area for the original base year (2003); **Table B-2** summarizes by subwatershed the GIS-derived disturbance acreages associated with all past and present actions for the original base year (2003).

3.1 Coal

3.1.1 Past and Present Development

3.1.1.1 Wyoming

The first coal mine in the Wyoming PRB was developed near Glenrock, in Converse County, in 1883 (Foulke et al. 2002). During the 1970s and early 1980s, the PRB emerged as a major coal production region. As a result, federal coal leasing became a high profile activity since the PRB's coal is over 90 percent federally owned. In 1982, the BLM temporarily halted further coal leasing; however, the existing mines continued producing coal, which depleted their leased federal coal reserves. As a result, interest in leasing federal coal to extend mining operations at existing mines

in the PRB increased in the late 1980s. However, there was little to no interest in opening new mines, and therefore, there was not enough interest in leasing to justify a regional coal sale. In early 1990, the Powder River Regional Coal Team decertified the Powder River Federal Coal Region, which allowed BLM to begin processing applications by existing mines to lease maintenance tracts of federal coal using the LBA process.

The 13 currently operating coal mines in the Wyoming PRB are grouped by subregion as shown in **Figure 3-1** and as described below. For purposes of this study, the mines in the Sheridan, Wyoming, area have been included in Subregion 4 (Sheridan/Decker), which is discussed in Section 3.1.1.2 of this report.

- Subregion 1 (North Gillette) – Buckskin, Dry Fork (which includes the old Fort Union), Eagle Butte, Rawhide, and Wyodak mines.

- Subregion 2 (South Gillette) – Belle Ayr, Caballo, Coal Creek, and Cordero-Rojo mines.

- Subregion 3 (Wright) – Antelope, North Rochelle/Black Thunder, Jacobs Ranch, and North Antelope/Rochelle mines.

Of these operations, the Coal Creek Mine was inactive in 2005 when the original Task 2 report was prepared; however, it has since resumed operations.

Other coal mines within the Wyoming PRB study area and their status are described below. Based on their status, these facilities are not analyzed further in this study.

- Clovis Point Mine – part of operating Wyodak and Dry Fork mines

- Izita – permitted dragline walkway from the Coal Creek Mine to the Black Thunder Mine

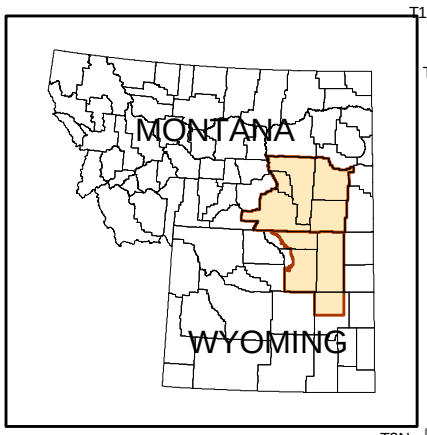
- KFx – haul road to supply coal from the Wyodak Mine to the adjacent KFx facilities located at the old Fort Union Mine (now part of Dry Fork) area

3.1.1.2 Montana

For purposes of this study, Subregion 4 encompasses the coal mining activities in the Sheridan, Wyoming, and Decker, Montana, areas. Subregion 5 encompasses mining activity in the Ashland/Colstrip, Montana, area. The currently active mines in these subregions are shown in **Figure 3-1** and are identified below.

- Subregion 4 (Sheridan/Decker) – Decker (east and west pits) and Spring Creek mines.

- Subregion 5 (Ashland/Colstrip) – Absaloka and Rosebud mines.



Legend

- Approximate Coal Mined-out Area through 2006
- Active surface mine locations in Montana
- Existing power plants
  - A - Hardin power plant
  - B - Colstrip power plant
    - Rosebud power plant
  - C - Neal Simpson power plants
    - (Units 1 and 2)
    - WYGEN 1 power plant
    - WYGEN 2 power plant
    - WYODAK power plant
  - D - Dave Johnston power plant
- River or stream
- Railroad

Coal Mine Subregions

1	Subregion 1	- Buckskin, Dry Fork, Eagle Butte, Rawhide, and Wyodak mines
2	Subregion 2	- Belle Ayr, Caballo, Coal Creek, and Cordero-Rojo mines
3	Subregion 3	- Antelope, North Rochelle/Black Thunder, Jacobs Ranch, and North Antelope/Rochelle mines
4	Subregion 4	- Decker and Spring Creek mines
5	Subregion 5	- Absaloka and Rosebud mines

Powder River Basin Coal Review

Figure 3-1

Existing Coal Mine, Power Plant, and Railroad Development

Note: The Dave Johnston power plant, which is included in this study, is located outside of but adjacent to the study area. Approximate coal mined-out areas were not available for the Montana mine sites.

Source: BLM 2003, 2009.

N W E S

0 8 16 24 Miles

0 8 16 24 Kilometers

11/11/09

Other coal mines in Subregions 4 and 5 and their status are described below. These mines are shown in **Figure 3-1**. Based on their status, these facilities are not analyzed further in this study.

- Big Horn Mine – in final reclamation and awaits final bond release
- Welch Mine – in final reclamation, for final bond release part of an exchange with the Pittsburg & Midway Coal Mining Company (P&M)
- Public Service Company of Oklahoma's (PSO) Ash Creek Mine – has been reclaimed and awaits final bond release
- Big Sky Mine – idle and in final reclamation stages
- Other historic underground mines - Many square miles of historic underground workings exist to the south-southwest of the historic Welch Mine lands. These mines were closed and sealed off in 1953. Subsequent roof collapses over one of these mines (the Acme Mine No. 42) led to the development of underground coal fires in the Monarch and possibly Carney coal beds, which may have spread to other overlying coal beds (i.e., Dietz 2 and Dietz 3). These fires may have been the cause of the 5,207-acre Thunder Child Range Fire in 2001, although the actual cause has not been determined. The WDEQ/Abandoned Mine Land Division has conducted a number of reclamation and emergency rehabilitation projects in recent years in attempts to extinguish the underground coal bed fires; however, based on BLM's 2003 site visit, the fires continue to burn (BLM 2003b). Due to the lack of information relative to the extent of the underground burn area and the uncertainty of the cause of the Thunder Child Range Fire, these historic workings have been eliminated from further analysis in this study.

3.1.2 Reasonably Foreseeable Development

Due to the variables associated with future coal production, two coal production levels (an upper and a lower production level) were projected for the PRB Coal Review to bracket the most likely foreseeable regional coal production level and to provide a basis for quantification of associated impact-causing parameters. **Figures A-1** through **A-6** in Appendix A show projected coal development under the lower and upper development scenarios. Figures A-6 and A-7 graphically compare the production levels for Wyoming and Montana, respectively. The basis for the projected production ranges included: 1) an analysis of historic PRB production levels in comparison to the gross domestic product (GDP) and national coal demand; 2) an analysis of current PRB coal market forecasts that model the impact of GDP 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 coal mine subregions in the PRB 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.

The methodology used to develop the future coal mine projections for both the lower and upper production scenarios is summarized below.

- The upper end of the range of total PRB coal mine production was increased from the MWH Coal Planning Estimates Report of March 2003 to bracket higher production forecasted by the Hill and Associates PRB Coal Demand Study of 2003. The Hill and Associates 2003 data were not available at the time of the MWH study.

- The upper end of the production range by coal mine closely resembles the Hill and Associates 2003 study, with the exception that mine production was not curtailed in the latter years of the study. This adjustment was made to account for a published "glitch" in the Hill and Associates modeling technique ("caused by the fact that we used reserves listed in the state mining permit applications… In many cases, the coal producer simply lists enough reserves to satisfy his 20 year mine plan in the permit application [instead of true geologic reserves] [Hill and Associates 2003a].")

- The lower end of the range of total PRB coal mine production was decreased slightly from the MWH Coal Planning Estimates Report of March 2003 to bracket Platts data and better account for a potential downward market adjustment forecasted in the Hill and Associates 2003 study resulting from possible clean air regulatory changes previously projected for 2009.

- Wright area coal mines were projected based on a number of limiting factors including WDEQ air quality permit levels. Since the time of this projection, there has been an increase in the air quality permit levels for these mines. As discussed below, the projected overall coal forecasts for the PRB have not been changed; however, it is recognized that the Wright area mines would now be able to compete for a larger portion of the overall forecast coal sales from the PRB.

- Specific mine loadout capacities were estimated from BNSF railroad reports and mine permit data. Some mines are forecasted to produce above these estimated capacities.

- The South Gillette and Wright subregion mines (Subregions 2 and 3, respectively) are served by Wyoming State Route (SR) 59, and the North Gillette subregion is serviced by U.S. Highway 14/16. Numerous spur roads, tied to these main highways, serve as access roads into the mines in the Wyoming PRB region. The acreages associated with the access roads have been accounted for in the mine-specific acreages for this study.

- The existing road infrastructure provides access to all existing mines and proposed development projects in Subregion 4. It is assumed that only minor upgrades to portions of these routes would be required to address possible increases in traffic and capacity of the routes.

3.1.2.1 Wyoming

Based on the analysis originally conducted for this study and included in the original Task 2 report (ENSR 2005b), the forecasted upper production range for the coal mines in the Wyoming PRB study area was projected to mirror the Hill & Associates (2003b) forecast, with a strong period of

growth through 2007, at which point production was projected to be 490 million tons per year (mmtpy). Coal production was projected to flatten in response to new environmental regulations scheduled to take effect in 2008 that would further limit electric power plant emissions. The growth in coal production was projected to resume in 2010 and continue through 2020, at which point production was projected to be 625 mmtpy. The forecasted lower production level was projected to mirror the more conservative forecasts by Platts (2004) and Global Insight (2004) and the lower production level identified by MWH (2003). Under the projected lower production level, a production of 490 mmtpy would not be realized until 2015, and production in 2020 would be 531 mmtpy. The resulting 2 percent annualized growth rate for the lower production level and 3 percent annualized growth rate for the upper production level through 2020 compared conservatively to the historic 6.8 percent annualized growth rate for the prior 20 years in the Wyoming PRB.

Based on more recent data collected for this update of the Task 2 report, the actual production in 2008 was 446.5 mmtpy. This is between the upper and lower production scenarios identified in the original 2005 Task 2 report, although it is closer to the upper production scenario. Currently, there is considerable uncertainty in coal demand forecasting due to the uncertainty of the regulation of coal use for electric generation in response to proposals to regulate greenhouse gas emissions. Coal production has been reduced in the immediate (2009) timeframe. Based on the fact that actual production has been tracking between the upper and lower production forecasts from the 2005 Task 2 report, and there is no clear indication of a substantial change in that trend, the upper and lower production forecasts to year 2020 were not modified for this updated report. However, as noted above, some of the Wright area mines have been permitted for increased production capacity under their air quality permits so they could compete for an increased share of the total forecast PRB coal sales.

Since the 2005 Task 2 report was completed, the School Creek Mine has been permitted in the Wright area (Subregion 3); however, it is not currently operating. The mine is composed of lands leased by Peabody in 2005 (West Roundup LBA), an existing lease acquired from Arch Minerals, and existing leases assigned from the North Antelope/Rochelle Mine. The loadout facilities already exist and were acquired from Arch Minerals (the original North Rochelle facilities). WDEQ approved the School Creek Mine permit application on July 17, 2009. WDEQ also has issued an air quality permit for the mine, for a production rate of 40 mmtpy. The U.S. Office of Surface Mining has not completed a license to mine for this operation. School Creek Mine representatives have indicated that coal production is not scheduled to occur until 2010. It is expected that this mine would compete with the other Subregion 3 coal mines for a portion of that subregion's forecast production. Also, in the fall of 2009, a sale of the Jacobs Ranch Mine to the owners of the Black Thunder Mine was approved. At this time, the operation of both mines remains the same. Therefore, the projected production rates under the upper and lower production scenarios were not revised for this update.

Following the projection of individual mine production levels for the upper and lower production scenarios, likely reserve and mining sequence layouts were developed based on geologic information, 2003 mine pit progressions and projected mine reserve sequence maps on file with the WDEQ/LQD, and recovery information provided by the PRB operators. The mapped areal extent of mine reserves subsequently were projected in 5-year increments and provided to the PRB coal operators for review and comment. Future coal mining in the Wyoming PRB through 2020 is considered certain/highly likely based on the anticipated production rates in relation to the available economic reserves.

Mine-related capital investment under both the projected lower and upper production scenarios is presented in **Table 3-1**.

Table 3-1
Projected Coal Mine Total Capital Investment by Year
(million dollars)

Mine Subregion	Year					
	Lower Production Scenario			Upper Production Scenario		
	2010	2015	2020	2010	2015	2020
Mobile Equipment						
Subregion 1 – North Gillette	18	56	6	56	89	9
Subregion 2 – South Gillette	35	89	31	68	91	50
Subregion 3 – Wright	110	140	150	150	153	129
Subregion 4 – Sheridan/Decker	32	0	0	34	7	0
Subregion 5 – Ashland/Colstrip	0	0	0	15	39	2
Subtotal	**195**	**285**	**187**	**323**	**379**	**190**
Rail Loadout Facilities[2]						
Subregion 1 – North Gillette	0	0	0	0	5	0
Subregion 2 – South Gillette	0	0	0	0	10	10
Subregion 3 – Wright	5	10	5	20	5	5
Subregion 4 – Sheridan/Decker	20	0	0	20	0	0
Subregion 5 – Ashland/Colstrip	0	0	0	20	20	0
Subtotal	**25**	**10**	**5**	**60**	**40**	**15**
Highway Transportation[3]						
Subregion 1 – North Gillette	0	5	0	0	5	0
Subregion 2 – South Gillette	0	0	5	0	0	5
Subregion 3 – Wright	0	0	0	0	0	0
Subregion 4 – Sheridan/Decker	0	0	0	0	0	0
Subregion 5 – Ashland/Colstrip	0	0	0	0	0	0
Subtotal	**0**	**5**	**5**	**0**	**5**	**5**
Total	**220**	**300**	**197**	**383**	**424**	**210**

[1] Calculate in 2003 dollars at $0.85 per bank cubic yard annual capacity.
[2] Calculate in 2003 dollars at $1.00 per ton annual capacity.
[3] Calculate in 2003 dollars at $5 million per mile relocated excluding land acquisition costs.

Other impact-causing parameters associated with Wyoming coal mine operations are summarized in Tables A-1 and A-2 in Appendix A of this report.

3.1.2.2 Montana

The projected upper and lower production trends for the coal mines in the Montana PRB study area would parallel those described in Section 3.1.2.1 for the mines in the Wyoming PRB study area.

Based on the analysis conducted for this study, it is estimated that the original base year (2003) production of 36.1 mmtpy of coal in the Montana PRB study area would increase to 56.0 mmtpy under the lower production scenario and to 83.0 mmtpy under the upper production scenario by 2020. Production at currently operating mines is projected to continue throughout the study period. Base on more recent data, the actual 2008 production in the Montana PRB was 43.8 mmtpy. This is between the upper and lower production scenarios identified in the 2005 Task 2 report; however, it

is closer to the upper production scenario. Currently, there is considerable uncertainty in coal demand forecasting due to the uncertainty of the regulation of coal use for electric generation in response to proposals to regulate greenhouse gas emissions. Coal production has been reduced in the immediate (2009) timeframe. Based on the fact that actual production has been tracking in between the upper and lower production forecasts from the 2005 Task 2 report, and there is no clear indication of a substantial change in that trend, the upper and lower production forecasts to year 2020 were not modified for this update.

The 2005 Task 2 report projected the potential development of the Ash Creek Mine by 2010. This mine is in the Sheridan/Decker area (Subregion 4). The mine is located in Wyoming just south of the Montana-Wyoming state line, with the coal to be shipped by a new rail spur in Montana. The WDEQ is expecting an application by December 2009. Based on more recent information, it is projected that the Ash Creek Mine would be developed by 2015. In addition, two other potential mines (i.e., Otter Creek Mine and the Many Stars Project) have been identified in the Montana PRB study area.

Under the lower production scenario, it is projected that production at the Ash Creek Mine would be initiated by 2015; and the Otter Creek and Many Stars mines would not be developed. Under the upper production scenario, it is projected that production would be initiated at the Ash Creek mine, and at either or both the Otter Creek Mine and the Many Stars Project by 2015. Development of these mines would be dependent on markets for the coal and may be tied to development of infrastructure including the Tongue River Railroad and/or power plants or coal-to-liquids plants. It is assumed that development of the Otter Creek Mine would require construction of Tongue River Rail Company's (TRRC's) proposed Tongue River Railroad and a power plant near Miles City, Montana. However, at this time, no application has been filed for a new power plant at this location. It is assumed that the Many Stars project would be developed in response to construction of a mine-mouth coal-to-liquids plant; however, an application for a new plant at this location has not been filed at this time. In late 2009, the Ark Land Company leased the privately owned coal at the Otter Creek Mine area. The state reserves at Otter Creek presently are unleased.

Following the development of individual mine production levels for the two scenarios, individual mine reserves and mining sequence layouts were developed based on geologic information and 2003 mine pit progressions on file with the MDEQ. Reserves beyond the current mine permit boundaries and existing mine lease boundaries (e.g., potential developments including P&M Ash Creek and Otter Creek) were sequenced based on strip ratio and proximity to past mining. The mapped areal extent of mine reserves subsequently were projected in 5-year increments (**Figures A-3** and **A-4** in Appendix A). Future coal mining in the Montana PRB study area is considered certain/highly likely based on the anticipated production rates in relation to the available economic reserves. However, the likelihood for the Otter Creek Mine is considered low under the upper production scenario due to its inter-dependency on other developments. The Many Stars project is not projected due to insufficient information to identify a discrete location or production rate. These two mines would not be developed under the lower production scenario.

Four additional properties (Kinsey, CX Ranch, Young's Creek, and North Ashland) were identified by Hill and Associates (2003) as potential coal mine sites. However, based on the lack of information for these potential mine sites, their likelihood for development is speculative. As a result, they have been eliminated from further analysis in this study.

Mine-related capital investment under both the projected lower and upper production scenarios is presented in **Table 3-1**.

3.1.3 Data Sources

Public information in the form of permit documents, annual reports, permit applications, LBAs, EISs, correspondence, and articles was obtained from the WDEQ (Land Quality and Air Quality divisions), MDEQ, BLM High Plains District Office and Wyoming State Office, BLM Montana State Office and Miles City Field Offices, Wyoming State Mine Inspector's Office, USDOE, STB, Federal Energy Regulatory Commission (FERC), and numerous trade and industry publications.

Proprietary economic reports forecasting regional coal market activity from Hill and Associates Inc., Platts, Global Insight, and proprietary industry input from the individual coal mine operators in the Wyoming and Montana PRB study area, also were used in the preparation of the coal resources sections of this report.

3.1.4 Assumptions

In addition to the information obtained from the identified data sources, the following assumptions were used to define specific impact-causing parameters for coal mines:

Past and Present Development:

- Existing operations are not part of the abandoned mine lands programs.

- Annual groundwater production rates for 2003 through 2007 are assumed to be the same as previously reported for 2002/2003.

RFD:

- It is assumed that Ash Creek and the other Decker area mines would obtain new WDEQ- and MDEQ-approved air quality permits, as applicable, consistent with their forecasted production levels.

- Consistent with historical trends, it is assumed that currently idle mines would be brought back into production during periods of high growth in the projected upper end of the production range.

- Under the lower production scenario, it is assumed that the Ash Creek Mine would initiate production by 2015; the Otter Creek and Many Stars mines would not be developed. Under the upper production scenario, it is assumed that production would be initiated by 2015 at the Ash Creek mine and at either or both the Otter Creek and Many Stars mines. However, development of the TRRC's proposed rail line and construction of a power plant near Miles City would be required for the Otter Creek Mine to become operational. Development of the Many Stars Project would be dependent on construction of a mine mouth coal-to-liquids plant. No permits have been submitted at this time for plants in either of these locations.

- It is assumed that production from the Ash Creek Mine in Wyoming would be serviced by a new spur line connecting to rail service at the Decker and Spring Creek mines.

- It is anticipated that TRRC's construction of 130 miles of new rail line between Miles City and Decker, Montana, would be completed and operational by 2015; however, construction of the rail line would be dependent on the development of the Otter Creek Mine, which only would be developed under the upper production scenario. The new rail line would have a capacity of approximately 100 mmtpy.

- No major state or interstate highways would be impacted by future mining activities in Montana.

- Construction of the proposed DM&E rail line is estimated to be completed between 2010 and 2014 (or when production in the Wyoming PRB approaches 450 mmtyp); operation is assumed starting with the 2015 time period. The rail line would add approximately 100 mmtpy of rail transportation capacity for the Wright and South Gillette subregion mines.

- Projections for groundwater production beyond 2002 assume that groundwater production rates under both the lower and upper production scenarios would remain the same as during the period between 2000 and 2002.

- Based on information provided by the coal mines, it is assumed that the majority of groundwater pumpage would come from the Wasatch Formation.

3.2 Power Plants

3.2.1 Past and Present Development

3.2.1.1 Wyoming

Currently, there are five coal-fired power plants in the PRB study area (see **Figure 3-1**). Black Hills Power Corporation owns and operates the Neal Simpson Units 1 and 2 (21.7-megawatts [MW] and 80-MW, respectively), WYGEN 1 (80-MW), WYGEN 2 (90-MW), and Wyodak (330-MW) power plants, all of which are located approximately 5 miles east of Gillette, Wyoming. WYGEN 2 began operation in 2008. Pacific Power and Light's Dave Johnston Power Plant is located near Glenrock, Wyoming, outside of, but adjacent to, the study area.

Hartzog, Arvada, and Barber Creek are three separate interconnected gas-fired power plants located near Gillette, Wyoming. Each contains three separate 5-MW rated turbines to provide electric power to Basin Electric and its customers. All units are in operating condition, although they do not operate at maximum capacity.

3.2.1.2 Montana

Three coal-fired power plants currently operate in the Montana PRB study area (**Figure 3-1**). The major existing coal-fired power plant in the Montana PRB study area is the Colstrip Power Plant, which is located near Colstrip, Montana, in Rosebud County. The facility consists of four separate

coal-fired units on the same plant site. Units 1 and 2 are estimated at 450 MWs of power generation capacity each, and units 3 and 4 each are 778-MW design capacity. The facility has a permit to burn up to 28 percent petroleum coke in its Units 1 and 2 boilers, replacing coal as a fuel source.

A smaller coal-fired power plant (Colstrip Energy Limited's Rosebud Power Plant) is in operation at a site approximately 1.5 miles north of Colstrip (**Figure 3-1**). The facility generally burns waste coal and has operated below maximum capacity in recent years. Permitting officials indicate that it has approximately 120 MW of electric generation capacity.

The Hardin Generation Project initiated operation in 2007 (Wheeler 2008) at a site approximately 1.2 miles northeast of Hardin, Montana. This coal-fired boiler unit has a capacity of 113 MWs of electric generation capacity.

3.2.2 Reasonably Foreseeable Development

Coal-fired power plants have been, and likely would continue to be, constructed in the PRB to avoid high shipping costs for coal. Currently, adequate transmission line capacity exists to deliver the existing generating capacity to market; however, that capacity would need to be increased in order to provide adequate markets for new power plants.

Construction of new coal-fired power plants may involve some of the largest capital investments undertaken by industry, and substantial time would be required for obtaining permits and constructing such facilities. Recent estimates for a major coal-fired power plant are that a project would require 2 to 4 years to obtain the required permits, with an additional 4 to 6 years for construction. An estimated development cost of over $1 billion would apply to most major coal-fired power plants (based on an estimated $1,500 per installed kilowatt [$1.5 million per installed MW] generating capacity). A workforce of up to 1,500 personnel would be required at peak construction, with a likely operating workforce of 100 to 150 for each operating plant, based on estimates from current operating facilities.

Air emissions from coal-fired power plants are undergoing intense scrutiny by regulatory agencies, environmental groups, and the general public. Recent proposed legislation in the U.S. Congress and proposed regulations by the USEPA may influence air emissions, including limits on carbon dioxide, which is not currently regulated but will require reporting for some facilities. Even a well-regulated facility would have major emissions of criteria air pollutants. For example, for a 1,000-MW plant using the Best Available Control Technology (BACT) for this industry, the estimate of sulfur dioxide and nitrogen oxides emissions would be approximately 2,500 tons per year for each pollutant. Particulate matter emissions likely would be 600 to 700 tons per year from the power plant stack, with additional fugitive and handling emissions for coal and waste. The air permit for each facility would need to demonstrate BACT for each of the major criteria air pollutants, including lead.

Water requirements for each coal-fired power plant would involve both a determination of the control technologies (wet scrubber versus dry scrubber for sulfur dioxide [SO_2]) and the facility cooling operations (wet or dry cooling towers, or a potential hybrid). An approximate estimate of the maximum water supply requirements for a wet scrubber and a wet cooling tower is 10,000 to 12,000 acre-feet per year for a typical 1,000-MW coal-fired power plant, based on recent analyses at other facilities.

3.2.2.1 Wyoming

There are no new coal-fired power plants currently being constructed; therefore, no new plants are projected for operation by 2010. Any proposed coal-fired power plant that plans to initiate operation by 2015 currently would have to be undergoing air permit review in order to obtain the required construction permits and complete construction by 2015. The following four identified projects currently are considered likely for 2015 development (**Figure 3-2**).

- Black Hills Power and Light has received an air permit for the start of construction of WYGEN 3; issues related to that permit currently are being resolved. WYGEN 3 would be a 100-MW facility located adjacent to WYGEN 2. Operation of this facility by 2015 is considered highly likely.

- North American Power Group has permitted a 280-MW coal-fired power plant (Two-Elk Unit 1) at a 40-acre site located approximately 15 miles southeast of Reno Junction (near 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.

- Basin Electric Power Cooperative has obtained an air construction permit for a 250-MW coal-fired power plant (Dry Fork) 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.

- Wyoming Power Company (a subsidiary of North American Power Group) 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 is expected to be issued in 2008, and operation of this unit is considered moderately likely in 2015.

It is estimated that under the upper production scenario, a maximum of one additional 700-MW coal-fired power plant would be constructed through 2020. It is assumed the additional unit, if developed, would be constructed in the Gillette area or near operating coal mines. The main restriction appears to be the lack of electric power transmission capacity from the area to customers outside the state. All existing power plants in the PRB region are assumed to remain operational through 2020.

3.2.2.2 Montana

In the original Task 2 report (ENSR 2005b), the Otter Creek Energy Project (**Figure 3-2**) (previously projected for potential construction near Ashland, Montana) was identified as having a low likelihood for development for both 2015 and 2020. Based on updated information, the likelihood for development of this facility currently is considered speculative throughout the 2010-2015 period. It is assumed there would be a low likelihood for development by 2020, with an expected capacity of

750 MW under the lower production scenario and a capacity of 1,500 MW under the upper production scenario.

By 2015, under both the lower and upper production scenarios, it is assumed that only the Colstrip Units 1-4, the Rosebud Power Plant, and the Hardin Generation Project would be operating in the Montana PRB study area.

As discussed in Section 3.1.2.2, construction of a new power plant near Miles City, Montana, would be required for development of the Otter Creek Mine. However, due to the lack of a permit application or project-specific information, the likelihood for development of a new power plant in this location currently is considered speculative. As a result, it has been eliminated from further analysis in this study.

Bull Mountain Development Company has permitted the Roundup Power Project, a coal-fired power plant that would operate two 390-MW pulverized coal-fired boilers. This mine-mouth power plant, if constructed, would be located adjacent to the Bull Mountains Mine, approximately 12 miles south-southeast of Roundup, Montana, and just east of U.S. Highway 87 in Musselshell County. As this power plant would be located greater than 30 miles west of the Montana PRB study area, the facility has been eliminated from further analysis in this study.

3.2.3 Data Sources

Information relative to existing power plants in the Wyoming PRB study area was obtained from construction and operating permits on file with the WDEQ and direct contact with power plant operators. Data for existing power plants in the Montana PRB study area were obtained from the facility permits available through the MDEQ web site and from discussions with MDEQ staff.

Information relative to reasonably foreseeable power plants through 2015 was obtained from existing permit applications either under review or extended for a start of construction and news releases. Data also were obtained from identified proponents (Black Hills Power and Light and North American Power Group).

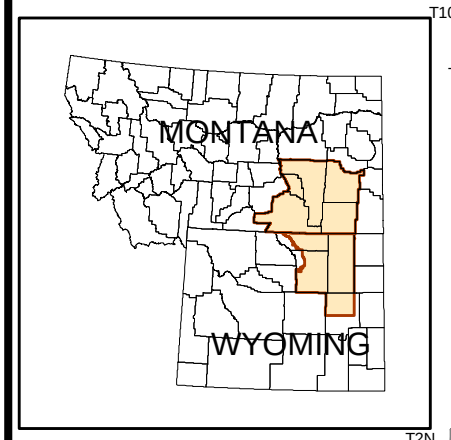
3.2.4 Assumptions

In addition to the information obtained from the identified data sources, the following assumptions were used to define specific impact-causing parameters for power plants:

Past and Present Development:

- Surface disturbance associated with a typical power plant facility would be 60 to 200 acres, based on available acreage data from other power plants.

- Annual emissions for the Colstrip Power Plant would be approximately 16,000 tons per year of SO_2, 32,000 ton per year of oxides of nitrogen (NO_x), and 500 tons per year of particulate matter with an aerodynamic diameter of 10 microns or less (PM_{10}) from the main stacks.



Powder River Basin Coal Review

RFD Power Plants, Wind Energy Projects, and Railroad Development

Figure 3-2

Legend

- Proposed power plants
- Proposed wind energy projects
- Perennial river or stream
- RFD Railroad (DM&E RR is shown in Figure 3-3)

Note: Final site selection for the Otter Creek Energy Project is pending.

Source: BLM 2003, 2009; STB 2004.

N W E S

0 8 16 24 Miles

0 8 16 24 Kilometers

11/11/09

RFD (2015):

- New power plants would comply with BACT for maximum controls.

- Existing power plants would be required to apply additional controls for NO_x, SO_2, PM_{10}, and particulate matter with an aerodynamic diameter of 2.5 microns or less in response to the regional haze rule.

- As originally permitted, annual emissions for the WYGEN 3 power plant would be 2,028 ton per year of NO_x, 3,381 ton per year of SO_2, and 421 ton per year of PM_{10}. Construction of the WYGEN 3 power plant would require a workforce of 750 to 1,000 construction workers, employed over a 4- to 5-year period, and an additional 75 to 100 employees for operations.

- As originally permitted, annual emissions for the Two-Elk Unit 1 power plant would be 1,756 ton per year of NO_x, 1,991 ton per year of SO_2, and 234 ton per year of PM_{10}. Project construction would occur over a 2-year period, with a temporary peak workforce of 750 workers. The estimated operating workforce would include 50 full-time equivalent staff. Total expected capital investment would be approximately $450 million.

- As currently being permitted, annual emission limits for the Two-Elk Unit 2 power plant would be 1,375 ton per year of NO_X, 1,927 ton per year of SO_2, and 1,100 ton per year of PM_{10}. Project construction would occur over a 2 to 3 year period, with a temporary work force up to 750 workers. The estimated operating workforce would include 50 full-time equivalent staff. Total estimated capital investment would be approximately $1.2 billion.

- As currently being permitted, Basin Electric Power Cooperative's 250-MW Dry Fork power plant would be constructed near Gillette, Wyoming.

- Assume minimal added rail shipping and associated emissions.

RFD (2020):

- Under the upper production scenario, one additional 700-MW power plant also could be constructed in the Wyoming PRB by 2020.

- Under the lower coal production scenario, it is assumed that one 750-MW (Otter Creek Energy Project) coal-fired power plant would be constructed in the Montana PRB study area by 2020. Under the upper production scenario, it is assumed that two 750-MW units would be constructed by 2020, bringing the total capacity to 1,500 MW. The Otter Creek Energy Project size could reach 2,000 acres, depending on design issues such as disposal of coal combustion wastes and local terrain limitations.

- Construction would require a workforce of 750 to 1,000 construction workers employed over a 4-year period. The operating workforce is estimated at 75 to 100 workers.

- The new power plant would comply with BACT for maximum controls. These current factors would be used to estimate emissions from any proposed new project. (For example 0.06 pounds per million British thermal unit [lb/MMBtu] for NO_X and sulfur oxides, and 0.025 lb/MMBtu for PM_{10} emissions controls.)

- For the proposed power plant, the modeling assumes representative stack parameters, such as a stack height of 500 feet, diameter of 30 feet, and temperature and flow rate similar to other coal-fired power plants with wet scrubbers.

3.3 Wind Energy

3.3.1 Past and Present Development

No wind energy generating projects currently exist in the Wyoming PRB study area.

3.3.2 Reasonably Foreseeable Development

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 the 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. Examples of the above include: XCEL Energy (a leading electricity and natural gas energy company with major operations in Colorado) plans to meet 20 percent of its energy sales in Colorado from renewable resources; a decision by New Belgium Brewing Company to buy all of its commercial power from wind generated sources; and, Vestas Americas has begun manufacturing blades for wind turbines at a new facility in Windsor, Colorado (New Belgium Brewing Company 2008; Jackson 2008; XCEL Energy 2007).

Wyoming ranks among the top states in terms of wind energy potential. 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 currently is under development in the Wyoming PRB study area, and another is under active consideration. PacifiCorp is constructing a three-phase project in Converse County, approximately 15 miles north of the existing Dave Johnston Power Plant, on and near the site of the former Dave Johnson Mine (**Figure 3-2**). The first two phases, known as the Glenrock Wind Energy Project and the Rolling Hills Wind Energy Project, initiated construction in 2008 and began operations in 2008 and 2009, respectively (Pacificorp 2009). The third, currently unnamed phase is anticipated to be constructed between 2009 and 2011, depending on market demands and the performance of the first two phases. Each phase would consist of 66 wind turbine generators (each rated at 1.5 MW [99-MW total]) mounted on 80-meter-tall tubular towers, plus ancillary support facilities (PacifiCorp 2007). This project is considered highly likely.

Third Planet Windpower is in the initial development phase of a wind generating project (Reno Junction Wind Farm) in the Pumpkin Buttes area of southwestern Campbell County (**Figure 3-2**). Third Planet Windpower has actively pursued land leases for the project, installed meteorological towers on site, and initiated environmental and feasibility studies. Contingent upon the meteorological data and other results, the company could install up to 167 1.5-MW towers, yielding a total capacity of 250 MW, if fully constructed (Gartrell 2008b). The project is considered moderately likely to occur in the 2013 to 2015 timeframe, which would coincide with the anticipated development of one or more new electrical transmission lines in the region.

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.

3.3.3 Data Sources

Information regarding wind generation potential was obtained from the Wyoming Infrastructure Authority, PacifiCorp permit applications posted on the Wyoming Industrial Siting Administration's website, news coverage on the internet, and from posting on the Wyoming Legislative Services Office.

3.3.4 Assumptions

Past and Present Development: There are no assumptions relative to past and present wind energy projects.

RFD:

- It is assumed that the third phase of Pacificorp's wind energy project (99 MW) would be completed and brought on line in 2010.

- It is assumed that Third Planet Windpower would construct a 250-MW wind generating facility near Pumpkin Buttes between 2013 and 2015.

- It is assumed that an additional 500 MW of commercial wind generation would be constructed in the PRB study area and brought on line between 2015 and 2020. Of this total, it is assumed that 300 MW would be located in southern Campbell County, with an additional 200 MW located in Converse County. These projects would coincide with the anticipated expansion of transmission line capacity in and adjacent to the PRB study area.

- Disturbance acreage assumptions include:

    - Substations: 3 acres per 100-MW phase or project
    - Roads/power lines: 0.25 mile per tower, with a combined 50-foot-wide ROW
    - Tower foundations: 0.5 acre per tower

3.4 Transportation

Information relative to past and present and RFD railroad activities is presented below. Information relative to highways is presented in Section 3.14.

3.4.1 Past and Present Development

3.4.1.1 Wyoming

The Wright and South Gillette subregion coal mines located south of Interstate (I) 90 are serviced by a joint Union Pacific (UP)/BNSF rail line (see **Figure 3-1**). In 2003, the shipping capacity of the joint line was estimated at approximately 350 mmtpy. The 2003 coal production from the same mines totaled 308 mmtpy, equating to an 88 percent utilization of the available rail capacity. By the end of 2007, the capacity of the line was estimated at over 400 mmtpy as the result of a series of capacity expansion projects. The 2007 coal production from the same mines totaled 359 mmtpy, equating to a 90 percent utilization of the existing rail capacity. In July 2008, expansion work was completed to increase capacity to approximately 450 mmtpy.

In 2003, the capacity of the BNSF line servicing the Subregion 1 coal mines north of I-90 (see **Figure 3-1**) was estimated at 250 mmtpy. The 2003 coal production from the Subregion 1 mines totaled 55 mmtpy, equating to an approximate 22 percent utilization of the available rail capacity. No major expansion projects had been constructed on this line by the end of 2007. The 2007 coal production from these same mines totaled 78 mmtpy, equating to 31 percent utilization of the existing rail capacity. An unknown amount of coal shipped from the Subregion 1 mines on the BNSF line is transported farther south along the joint UP/BNSF line. This unknown amount was not included in the estimated utilization of the joint UP/BSNF line, and therefore, current actual utilization of the joint line could be higher.

3.4.1.2 Montana

Existing BNSF rail lines are in place with adequate capacity for all existing mines. The existing BNSF rail line extends from the mainline to both the Decker and Spring Creek mines. It is assumed that the existing railroad infrastructure has capacity for approximately 100 mmtpy from the region.

3.4.2 Reasonably Foreseeable Development

3.4.2.1 Wyoming

UP/BNSF Expansion. The single largest capital and infrastructure cost related to the projected future coal mining rates is rail expansion for the mines south of Gillette. Work to improve sections of

the existing joint UP/BNSF rail line and to increase capacity from 350 to 450 mmtpy was completed by July 2008, with plans to improve additional sections of the existing joint UP/BNSF rail line and to further increase capacity to 500 mmtpy by 2012. This would accommodate the projected upper and lower production rates at the southern mines, which are projected to produce 439 mmtpy by 2015 and 455 mmty by 2020. This further expansion has a likelihood rating of highly likely.

DM&E Rail Line. The proposed DM&E rail line, which 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, would provide additional rail capacity for the coal mines in the Wyoming PRB (**Figure 3-3**), primarily those in the south Gillette and Wright areas (i.e., Subregions 2 and 3). Approximately 78 miles of the new rail construction would occur in the PRB study area.

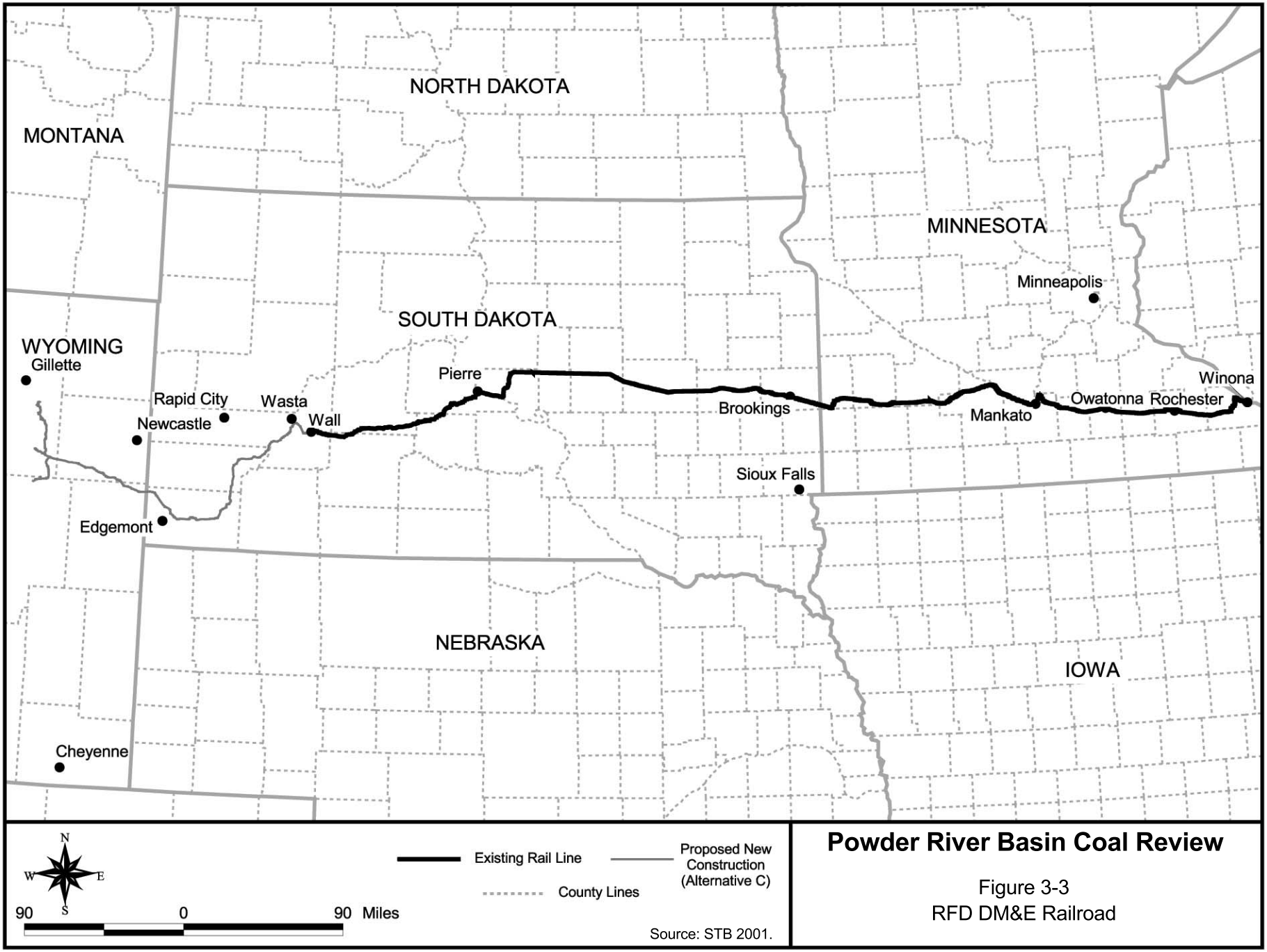
On January 28, 2002, the STB issued a final written decision granting DM&E authority to construct and operate the line subject to 147 environmental conditions, including an environmental oversight period that would continue through the first 2 years of operation. The Record of Decision was successfully appealed, and additional environmental analysis was required as a result. The additional environmental analysis was completed in 2005, and the STB granted approval to construct in 2006.

In 2007, Canadian Pacific Railway acquired DM&E with plans to integrate DM&E's operations into their operations as soon as they receive STB approval. Last year, the Canadian Pacific Railway said it would pay almost $1.5 billion for the DM&E and its subsidiaries. It would cost another $1 billion or more if the company expands to Wyoming's PRB coal fields. The Canadian Pacific Railway is concentrating on the DM&E acquisition before moving on to a PRB decision.

Construction of the DM&E rail line in the PRB would provide 100 mmtpy of new rail capacity for the southern PRB mines and open new markets for this coal. The project also would provide new rail spur services to the Jacobs Ranch, Black Thunder, Caballo-Rojo, Coal Creek, Cordero, and Belle Ayr mines. It is projected that when the total rail haulage requirement from the eastern Wyoming PRB reaches between 450 to 500 mmtpy, the DM&E line would be constructed. Although the timing would depend on actual production, haulage contracts, and near-term forecasts from the southern portion of the PRB, it is assumed for this study that the new rail line would be operational by 2015. The construction of this rail line has a likelihood rating of moderately likely.

3.4.2.2 Montana

It is anticipated that future production rates from the currently operating mines in Subregion 4 would not exceed the capacity of the existing BNSF rail line (100 mmtpy) through 2020. It also is anticipated that the existing capacity (100 mmtpy) of the currently operating BNSF rail line would be sufficient to accommodate additional production from the P&M Ash Creek Mine in the Wyoming portion of Subregion 4. Any upgrades would be minor and limited to spur track connections.



Powder River Basin Coal Review

Figure 3-3
RFD DM&E Railroad

3.4.2.3

It is anticipated that reasonably foreseeable railroad development within the Montana PRB study area would be limited to the construction of TRRC's proposed rail line. The proposed route for TRCC's rail line generally follows the Tongue River from near the Spring Creek Mine to Miles City, Montana (**Figure 3-2**). The rail line would provide for transportation of coal from existing and future mines to markets in the midwest and northeastern states. It also would be required to facilitate development of the proposed Otter Creek Mine and would supplement existing transportation choices available to the existing Decker and Spring Creek mines. It also may alter the existing coal transport patterns from these operations. TRRC's proposed rail line received STB approval in 2007. In 2008, a request was submitted to lease two tracts of state coal at Otter Creek. However, it is projected that construction of the railroad would not occur unless the Otter Creek Mine is developed. There may be some phased development of the railroad.

The $109 million project would provide 100 mmtpy of new rail capacity. Based on the inter-dependency of this rail line with the development of the Otter Creek Mine, it is assumed for this study that development of the rail line would not occur under the lower development scenario. Under the upper development scenario, it is assumed that the rail line would be operational by 2015; a low likelihood has been assigned to this action.

3.4.3 Data Sources

Information from the BNSF Railway Coal Business Unit, DM&E Railroad Corporation Final EIS, Canadian Pacific Railway announcements, Tongue River Railroad STB Application, Surface Transportation Board web site, Hill and Associates, CANAC (a presentation at Coal Marketing Days in Pittsburgh in 2007), MWH Coal Planning Estimates Report, and media reports were used in the preparation of the coal railroad transportation sections of this report.

3.4.4 Assumptions

In addition to the information obtained from the identified data sources, the following assumptions were used to define specific impact-causing parameters for transportation:

Past and Present Development:

- Existing railroad disturbance rights-of-way are assumed to be 150 feet in width.

RFD:

- It is assumed that the UP/BNSF rail capacity for the southern portion of the PRB would increase from 450 mmtpy in 2008 to 500 mmtpy by 2012; associated construction would include the addition of sidings and trackage parallel to existing facilities within the existing right-of-way.

- The construction right-of-way for the portion of the DM&E rail line in the Wyoming PRB study area would be approximately 78 miles long and 100 feet wide. Although the timing would depend on final STB approval, Canadian Pacific Railway's final decision relative to extension of

the rail line into the PRB, and production and near-term forecasts from the southern portion of the PRB, it is assumed for this study that the new rail line would be operational by 2015.

- The construction right-of-way for TRRC's new rail line in the Montana PRB study area would be 130 miles long and 100 feet wide. It is assumed this new rail line would be operational by 2015. However, project financing and construction would be dependent on the development of the Otter Creek Mine, which only would be developed under the upper production scenario. Under the lower production scenario, it is assumed that the rail line would not be constructed.

- It is assumed that the initial use of TRRC's rail line would be for the transport of coal from the Otter Creek Mine to a yet-to-be proposed power plant near Miles City, Montana.

3.5 Coal Technology

3.5.1 Past and Present Development

3.5.1.1 Wyoming

There are no existing commercial-scale coal technology projects operating in the Wyoming PRB study area. Test facilities previously were constructed by AMAX (predecessor to Foundation Coal West, Inc.) at the Belle Ayr Mine and ENCOAL at the Buckskin Mine. No commercial production has occurred, and these facilities either have 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.

3.5.1.2 Montana

A coal processing facility used to reduce moisture content and remove sulfur previously was associated with the Rosebud Mine. However, this facility has been dismantled and removed from the mine site. Therefore, it is not considered further in this analysis.

3.5.2 Reasonably Foreseeable Development

The PRB has long been a focal point for coal enhancement technologies. In part, this interest has been driven by the vast reserves of sub-bituminous coal in the PRB, which represent a substantial supply of energy resources. Coal enhancement technologies have been viewed as a means to expand the market for PRB coal by addressing its distance from major markets, relative lower energy content, high transportation costs, and associated environmental concerns. Interest in coal enhancement technology in general, and other energy technologies, has risen in response to concerns regarding the supply and price of crude, the possibility of "peak oil" (a concept that the global annual output of crude oil has peaked or will soon peak), rising prices of natural gas, and

global climate change. However, such facilities are costly and competition exists for available capital, other resources, and current markets for production. There have been a number of recent developments in the area of coal enhancement technologies, including the successful completion of several demonstration/pilot projects that have shifted the immediate focus away from the PRB. Nonetheless, the initiation of several commercial-scale facilities and infusion of private capital and joint development agreements, appear to have increased the overall likelihood of one or more coal technology facilities being developed in the PRB prior to 2020.

3.5.2.1 Wyoming

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. Evergreen Energy has raised the possibility of developing a new facility incorporating the recently redesigned plant and process. The new design (developed in conjunction with Bechtel Power Corporation) would offer improved operating economics and would raise the potential output capacity above the prototype plant's 750,000 tons per year. The company, however, currently is focused on completing two international projects and is evaluating other domestic locations for new facilties. The company has indicated that rail access at economically supportable rates is important to its decision. As a result, Evergreen Energy may be waiting on further resolution of plans for the DM&E rail line into the PRB (see Section 3.4, Transportation) (Associated Press 2008; Evergreen Energy 2008,a,b,c). Given the various uncertainties regarding economics, markets, and transportation, the likelihood of Evergreen Energy re-opening or developing a new facility in the Wyoming PRB study area currently is considered speculative. Therefore, it has been eliminated from further analysis in this study.

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. The latter served as a demonstration and test facility to evaluate the process and suitability of alternative feedstocks. More recently, Rentech's development activities have been focused outside of the PRB, including the company's first commercial-scale project, a synthetic fuels plant near Natchez, Mississippi. The company also licensed its technology to DKRW, which plans to employ it at a new coal-to-liquids facility currently under development in the Hanna Basin in southcentral Wyoming. Rentech also has a joint development agreement with Peabody Energy to develop a coal-to-liquids plant using Peabody's extensive coal reserves in Montana. Rentech's various commercialization initiatives appear to have drawn its immediate attention away from the PRB. However, based on the substantial coal reserves in the PRB, it is anticipated that future development of a coal-to-liquids plant in the Wyoming PRB study area is a potential, although the timing and level of development currently are unknown (Rentech 2008a,b). As a result, the likelihood for project development currently is considered speculative. Therefore, it has been eliminated from further analysis in this study.

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. The plant would use White Energy's patented mechanical

coal upgrading process, which essentially pulverizes and dries sub-bituminous coal and forms the bulk output into briquettes with lower moisture and higher British thermal unit value per pound. According to White Energy, the process and product offer a number of benefits including relatively low processing costs, higher energy content and energy generation efficiencies, lower spontaneous combustion risk, relatively lower transportation costs, and reduced levels of fines and dust resulting in lower environmental and safety issues during handling, shipping, and storage. Pilot tests by White Energy reportedly concluded that the coal produced at the Buckskin Mine is suited to the process. (NRG Energy currently burns coal from the Buckskin Mine at one of its generating plants in Louisiana.) If the initial plant proves successful, White Energy's business plan envisions upgrading capacity, eventually expanding to 8 mmtpy. White Energy recently completed a commercial-scale facility overseas and has joint venture agreements for several more. However, the timetable for completing the study and tentative target date for plant construction and operation in the PRB currently is unknown (bnet business network 2008; NRG 2008; White Energy 2008). As a result, the likelihood for project development currently is considered speculative. Therefore, it has been eliminated from further analysis in this study.

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. GreatPoint Energy is in the early stages of planning a facility that would use a proprietary catalytic conversion process to produce pipeline quality gas. According to GreatEnergy, its process also would allow it to capture carbon dioxide (CO_2), which then could be sequestered (see Section 3.6). Per GreatPoint Energy, its product is as clean as natural gas and could be used in the same applications as natural gas (e.g., residential heating and power generation). A demonstration project testing the process was completed at a facility in Illlinois, where a pilot test plant is under construction. Studies to validate the feasibility of a commercial-scale facility in Wyoming presumably are ongoing. GreatPoint Energy has raised $100 million from various corporate investors for potential development of a commercial-scale facility. A company spokesman noted "…that such a project is no sure thing for Wyoming..." and, if constructed, would not be operational before 2012 (Gartrell 2008; GreatPoint Energy 2008). As a result, the likelihood for project development currently is considered speculative. Therefore, it has been eliminated from further analysis in this study.

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. In addition to its coal- and gas-fired generating facilities, PacifiCorp is actively developing substantial wind generating capacity (see Section 3.3). 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.

Following the conclusion of several internal feasibility studies, WIA and PacifiCorp announced that the project was on hold, although WIA plans to remain active in efforts to promote coal beneficiation related to electrical generation. Factors contributing to the decision to put the project on hold

included remaining technology risks, concerns regarding the lack of a federal legal and policy framework regarding long-term liability associated with carbon sequestration, and financing (WIA 2008b). As a result, the likelihood for project development currently is considered speculative, and it currently has been eliminated from further consideration in this study. However, since WIA will remain active in promoting coal beneficiation related to electric generation, a project of this type could be proposed in the PRB in the future.

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.

3.5.2.2 Montana

Rentech Inc. Coal Liquefaction Project. Rentech has a commercially-viable process for converting coal to synthetic ultra-clean diesel and aviation fuels. Rentech has a joint development agreement with Peabody Energy to develop a coal-to-liquids plant intended to use Peabody's coal reserves near Colstrip Montana. This project is one of two to be undertaken under the joint development agreement; the other project would be located in the Midwest. The two projects are characterized as having production capacities of 10,000 and 30,000 barrels per day; however, it is not clear at this time which capacity plant would be in which location. An exact location and timetable for the Montana project has not been announced; however, a mine-mouth facility is one possibility as are locations near Billings and Miles City that have good rail access (Rentech 2008a,b). Based on this information, the likelihood for project development currently is considered speculative. Therefore, it has been eliminated from further analysis in this study.

The Crow Tribe and Australian-American Energy Company, LLC. The two parties announced an agreement to pursue a $7 billion project involving construction of a new coal mine (see Section 3.1) and a coal-to-liquids conversion plant on the Tribe's reservation. Based on preliminary information, the initial production capacity of the Many Stars Project would include the conversion of 38,000 tons per day of coal into 50,000 barrels per day of fuels and naphta, with potential expansion to 125,000 barrels per day. Australian-American Energy is engaged in ongoing evaluation of the coal resources and facility site location studies. Current project planning efforts indicate a construction workforce of up to 4,000 workers, with 900 permanent workers during production. Australian-American Energy is a privately held company that has initiated two other coal conversion projects in Australia. At this time, an application for the coal-to-liquids plant has not been submitted. In addition, the plant would be inter-dependent on development of the Many Stars coal mine project. As discussed in Section 3.1, development of the Many Stars coal mine project is considered speculative due to insufficient information to identify a discrete location or production rate. As a result, the coal-to-liquids plant also is considered speculative at this time and has been eliminated from further analysis in this study.

3.5.3 Data Sources

Information on the status of coal enhancement projects was derived from the corporate websites of Evergreen Energy, Rentech, White Energy, GreatPoint Energy, NRG, the Crow Tribe, and the WIA. Information also was obtained from published news articles.

3.5.4 Assumptions

RFD:

- Although a specific project has not been identified, based on the substantial coal reserves in the PRB, it is assumed that one commercial-scale coal beneficiation project would begin construction in the Wyoming PRB study area by 2015, with production occurring by 2020. Based on the coal-to-liquids project now being developed in Carbon County, it is assumed that construction of a similar plant in the Wyoming PRB study area would take approximately 3 to 4 years. It is assumed the facility would employ approximately 2,000 workers during construction and 400 workers at full operation. It is assumed the total site would occupy approximately 400 to 500 acres.

3.6 Carbon Sequestration

3.6.1 Past and Present Development

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 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 (USDOE 2008).

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 (see Section 3.9.2.2).

3.6.2 Reasonably Foreseeable Development

The 59th Session of the Wyoming 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. Therefore, carbon sequestration has been eliminated from further consideration in this study.

3.6.3 Data Sources

Information relative to the carbon sequestration legislation was collected from news coverage posted on the internet and the Wyoming Legislative Services Office and USDOE's websites.

3.6.4 Assumptions

Past and Present Development: There are no assumptions relative to past and present carbon sequestration.

RFD:

- It is assumed that no commercial-scale carbon sequestration projects would be developed in the PRB study area during the 2010 to 2020 timeframe.

3.7 Transmission Lines

3.7.1 Past and Present Development

Major transmission lines in the Wyoming PRB study area that support the regional distribution system are associated with PacifiCorp's Dave Johnston power plant located near Glenrock, Wyoming; the power plants operated by Black Hills Power and Light, located east of Gillette; and also will support Basin Electric's Dry Fork Station now under construction north of Gillette (**Figure 3-4**). These 230-kilovolt 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 CBNG development also occur within the study area; for purposes of this study, these power lines have been factored in proportionally on a per well basis as discussed in Appendix E.

3.7.2 Reasonably Foreseeable Development

Transmission lines are a necessary supporting infrastructure for power generating facilities, including wind energy projects, to provide interconnections to the national grid. As a result, it is assumed that transmission line capacity expansion would be required as part of the overall system development for the RFD power plants identified in Section 3.2.2.1 and other industrial development in Section 3.13.2.

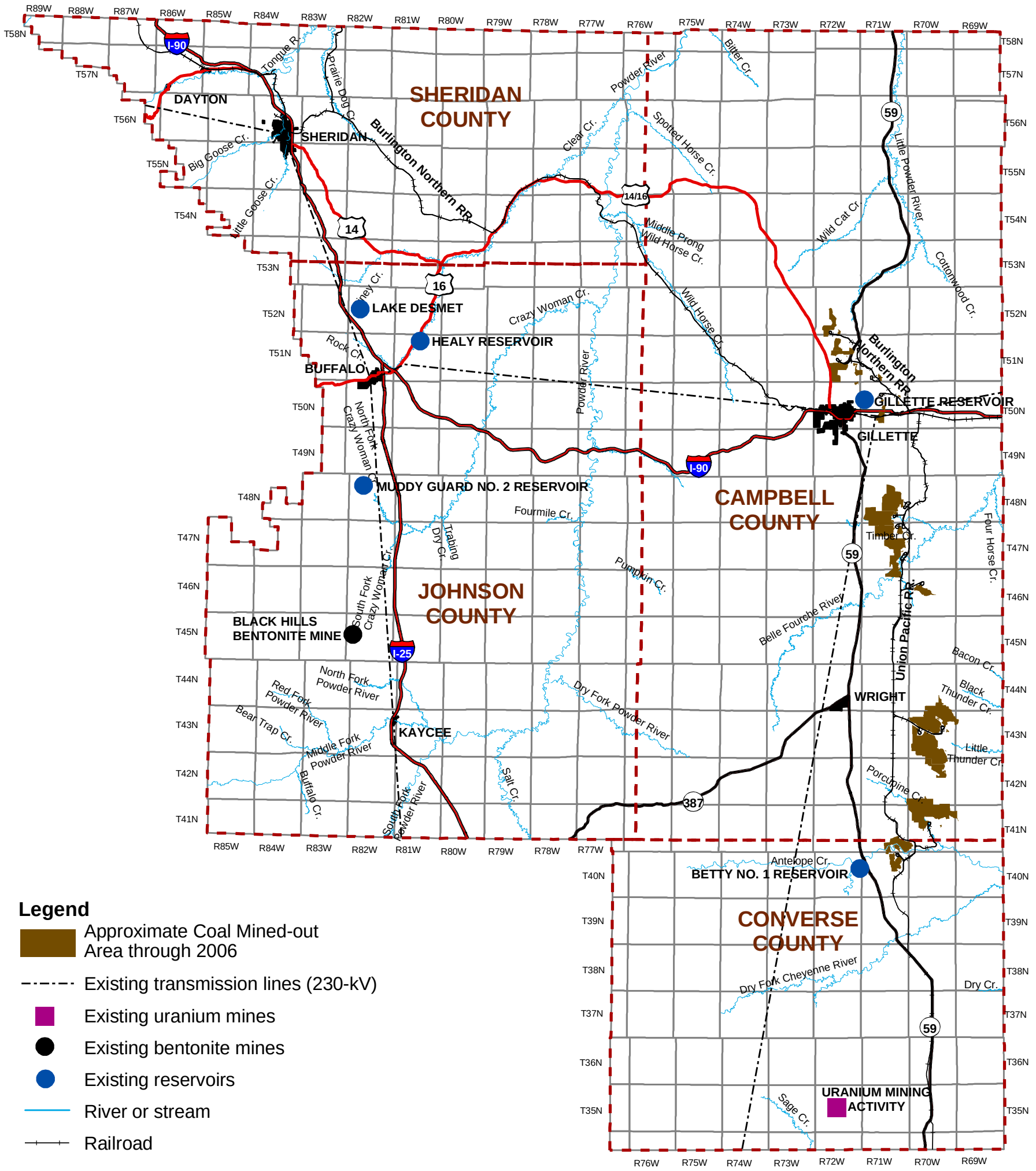
Several new transmission line projects currently are under consideration in or adjacent to the PRB at present. These include:

- Wyoming-Colorado Intertie (previously known as the TOT-3) - multiple sponsors including the WIA, proposed from the PRB to the Colorado Front Range
- TransWestern Express - multiple sponsors, proposed from the southern PRB to Arizona, either through Colorado or Utah
- High Plains Express - proposed from the southern PRB through Colorado to New Mexico and Arizona
- Gateway West - proposed by PacifiCorp from the southern PRB to Idaho
- Gateway South - proposed by PacifiCorp from the southern PRB to Nevada
- Northern Lights - proposed by TransCanada from the southern PRB to Nevada

All but the Wyoming-Colorado Intertie project have a proposed terminus, requiring construction of a substation/grid interties, in the vicinity of the Dave Johnston power plant near Glenrock, Wyoming.

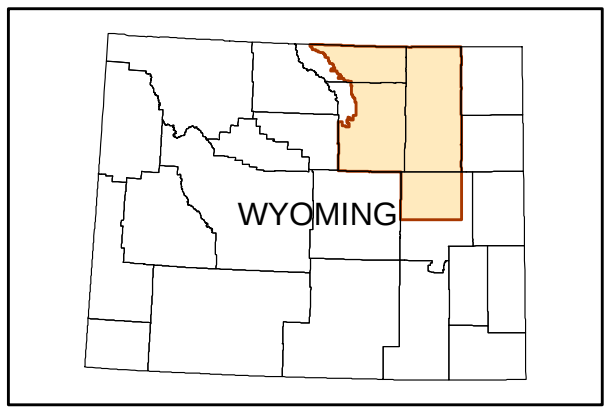
It is anticipated that during the timeframe of this study (through 2020), as many as four major new transmission lines would be built within the PRB; one major transmission line constructed running south to Colorado markets, one running south into Colorado then westward, and two heading westward or to the southwest. Markets would dictate the size and timing of such facilities, although several of the projects have progressed beyond the basic feasibility analysis. For example, an open-season for the Wyoming-Colorado Intertie project, which essentially allows power companies to bid for capacity on the line and ultimately determines its fate, was held in early 2008. The two PacifiCorp projects are intended to address the firm's long-term market demands in its service territory and are considered highly likely (WIA 2007, 2008; PacifiCorp 2008).

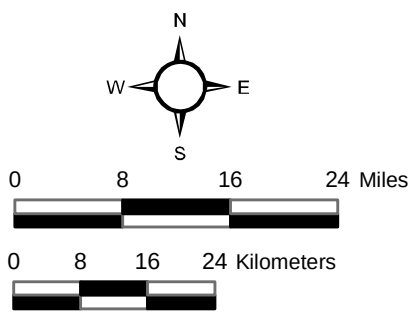
However, based on the lack of specific alignment information for these transmission lines, the relatively limited length of corridors located in the PRB study area, and the minimal amount of long-term disturbance following post-construction reclamation, they are not analyzed further in this study.



Legend

- Approximate Coal Mined-out Area through 2006
- Existing transmission lines (230-kV)
- Existing uranium mines
- Existing bentonite mines
- Existing reservoirs
- River or stream
- Railroad





Note: Transmission line corridors are approximate.

Sources: BLM 2003, 2009; HKM et al. 2002 a, b; Western Electric Coordinating Council 2004; WDEQ 2004.

Powder River Basin Coal Review

Figure 3-4
Existing Transmission Lines, Other Mines, and Reservoirs

11/09/09

3.7.3 Data Sources

Information relative to RFD transmission line projects was based on information provided by the WIA and posted on various government and industry websites.

3.7.4 Assumptions

Past and Present Development: No assumptions relative to past and present transmission lines have been identified.

RFD:

- It is assumed that the Wyoming-Colorado Intertie would be completed in 2012/13 and that it would include a length of approximately 130 miles within the Wyoming PRB study area, beginning at the Wyodak generating station.
- It is assumed that PacifiCorp's Gateway West project would be constructed in the 2011/2013 timeframe.
- It is assumed that PacifiCorp's Gateway South and one other transmission line would be constructed post-2015.
- Depending on the final alignments, it is assumed that short segments of the two other transmission lines potentially could be included in the PRB study area, depending on the locations of substations/grid interties.
- It is assumed that the long-term disturbance associated with future construction of transmission lines in the PRB would be minimal.

3.8 Other Mines

3.8.1 Past and Present Development

Past and present uranium, sand, gravel, bentonite, clinker, and scoria mines exist in the Wyoming PRB study area. There are three defined uranium districts in the PRB, including Pumpkin Buttes, Southern Powder River, and Kaycee (BLM 2003a). Numerous uranium mining sites occurred in these districts; however, they were mined out or uneconomic. Uranium currently is produced via the in situ leach method in the Southern Powder River district at Smith Ranch and Highland/Morton Ranch (Harris 2003) (**Figure 3-4**).

There are several bentonite localities in the PRB study area, and bentonite is mined at Kaycee (Wyoming Mining Association 2008) (**Figure 3-4**).

The more important aggregate mining localities are in Johnson and Sheridan counties (Wyoming State Geological Survey/U.S. Geological Survey [USGS] 2004). The largest identified aggregate

operation is located in the Lighting Creek subwatershed. It has an associated total disturbance area of approximately 67 acres, of which 4 acres have been reclaimed. The remainder of the identified operations are relatively small (less than 5 acres each) and are scattered throughout Campbell and Converse counties.

Scoria or clinker (which is formed when coal beds burn and the adjacent rocks become baked) is used as aggregate where alluvial gravel or in-place granite/igneous rock is not available. Scoria generally is mined in the Converse and Campbell counties portion of the Wyoming PRB study area.

The smaller operations are not considered further in this study due to the lack of information relative to their specific locations and the low overall associated acreage (approximately 100 acres), which per subwatershed would be minimal.

3.8.2 Reasonably Foreseeable Development

Increased sand, gravel, and scoria production and associated surface disturbance are anticipated in the Wyoming PRB study area in the future. The likelihood of increased production of these materials is high, as aggregate would be required for road maintenance and new construction activities. As other primary resources (e.g., coal and oil and gas) are developed, aggregate would need to be produced to support these ongoing activities. New quarries and increased production from existing operations are expected. It is anticipated that these operations would vary in size based on the immediate need from the primary industries. However, based on the lack of specific information relative to related impact-causing parameters, these activities are not analyzed further in this analysis.

In the original Task 2 report (ENSR 2005b), RFD 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. Due to increased overall demand for energy in recent years, uranium prices have increased from a low of $7.00 a pound in 2001 to over $138 a pound in 2007 (Barry 2008). The price fell precipitously after that, but appears to be stabilizing at approximately $75 per pound.

In response to the increased price of uranium, a number of uranium mine developments currently are proposed in the Wyoming PRB study area (**Table 3-2**). These include seven new proposed developments, two proposed expansions, and one proposed restart, all of which would use in situ recovery. Most of the proposed developments are in the Pumpkin Buttes uranium district in southwestern Campbell County. The actual number of the proposed developments that would become operational would depend on several factors including price and approval of permits.

It is assumed that bentonite mining would continue throughout the study period. It is anticipated that production would continue from existing active mines, with no new mines developed through 2020.

3.8.3 Data Sources

The information for past, present, and RFD sand, gravel, scoria, and uranium operations was obtained from public information available through WDEQ, USNRC, and industry-related websites. Where operations are large enough to file annual reports, acreages of disturbance and reclamation

were tabulated. Information relative to bentonite mines was based on WDEQ/LQD permit information and annual reports.

Table 3-2
U.S. Nuclear Resources Commission Applications for In Situ Recovery Uranium Projects in the Wyoming PRB Study Area

Project/Company	Location	Type Application	Subwatershed/ Mining District	Likelihood/ Rationale
Moore Ranch/Uranium One (formerly Energy Metals Corporation)	T41-42N, R74-75W; Campbell and Converse counties	New	Antelope Creek, Upper Powder River/Pumpkin Buttes District	Moderate for 2010/application filed with U.S. Nuclear Regulatory Commission (USNRC) October 2007
Nichols Ranch-Hank Unit/ Uranerz	Nichols Ranch: T43N, R76W; Campbell and Johnson counties Hank Unit: T43-44N, R75W; Campbell County	New	Upper Powder River/Pumpkin Buttes District	Moderate for 2010/ applications filed with USNRC and WDEQ
Christensen Ranch/Cogema	T44N, R76W; Johnson County	Restart	Upper Powder River/Pumpkin Buttes District	Moderate for 2010/USNRC application pending, received April 2007
Smith Ranch/Cameco (Power Resources)	T36N, R74W; Converse County	Expansion	Middle North Platte River/South Powder	Moderate for 2015/expansion of existing facility, letter of intent March 2008, application expected 2009
North Butte/Cameco	T44N, R76W; Campbell County	Expansion	Upper Powder River/Pumpkin Buttes District	Moderate for 2015/letter of intent to USNRC March 2008, application expected 2009
Collins Draw/Uranerz	T42N, T43N, R76W; Campbell County	New	Upper Powder River/Pumpkin Buttes District	Moderate for 2015/letter of intent to USNRC March 2008, application expected 2009
Ludeman-Allemand-Ross/Uranium One	Converse County	New	Antelope Creek	Moderate for 2015/letter of intent to USNRC March 2008, application expected 2009
Ruby Ranch/Cameco	T43N, R75W; Campbell County	New	Upper Belle Fouche River/Pumpkin Buttes District	Moderate for 2015/letter of intent to USNRC March 2008, application expected 2009
Reno Creek/Strathmore Minerals Corporation	T43N, R73; Campbell County	New	Upper Belle Fourche River, Antelope Creek/Pumpkin Buttes District	Moderate for 2015/letter of intent to USNRC March 2008, application expected 2010
Southwest Reno Creek/Strathmore Minerals Corporation	T42-43N, R73-74W	New	Antelope Creek/Pumpkin Buttes District	Speculative/no information on applications available.

Sources: Strathmore Minerals Corporation 2008; USNRC 2008a,b,c; World Information Service on Energy 2007.

3.8.4 Assumptions

In addition to the information obtained from the identified data sources, the following assumptions were used to define specific impact-causing parameters for sand, gravel, scoria, and uranium mines:

Past and Present Development: No assumptions relative to past and present sand, gravel, scoria, or uranium mines have been identified.

RFD:

- It is assumed that growth in demand for aggregates for use as construction materials would occur.

- It is assumed that demand for uranium would encourage the development of in situ leach method recovery facilities. Currently three projects have a likelihood rating of moderate for 2010; six projects have a likelihood rating of moderate for 2015.

- It is assumed that any new uranium mining would be conducted by in situ leach method recovery, not surface or underground mining.

- A nominal 40 acres of long-term disturbance for each uranium in situ recovery project is assumed (International Atomic Energy Agency 2005).

3.9 Oil and Gas

3.9.1 Past and Present Development

3.9.1.1 Conventional Oil and Gas

Early oil exploration in the PRB was based on direct evidence of surface seeps or drilling anticlinal structures that were exposed on the surface. Oil was first produced from the PRB in 1887 from the Newcastle Formation on the east side of the basin near Moorcroft, Wyoming (MacGregor 1972). In 1889, oil seeps led to the discovery of oil production at Shannon Field on the north end of the Salt Creek anticline. In 1908, the crest of the anticline was drilled resulting in the discovery of the Salt Creek Oil Field. Salt Creek had produced over 669 million barrels (bbls) of oil to the end of 2002 and is still in production. The discovery of Salt Creek led to the drilling of other large anticlines located on the southern periphery of the basin. Big Muddy was discovered in 1916, and Lance Creek was discovered in 1918 (WOGCC 2004).

During the 1930s, low prices depressed exploration in the basin. After World War II, a new round of exploration began with extensive use of seismic surveys to look for structural traps that could not be readily verified from surface mapping (McGregor 1972). Also in the early 1950s, stratigraphic trapping of oil was discovered in the Newcastle Sandstone on the east side of the basin. A number of other Cretaceous reservoirs formed by stratigraphic trapping were discovered in the 1950s; however, with a few exceptions, drilling generally was confined to relatively shallow targets. In the

late 1950s, oil production was found in sandstones of the Minnelusa Formation. Minnelusa production has been prolific over the years with the main production fairway being in the northeast portion of the basin. However, the Minnelusa equivalents ("Leo" Sands) also produce on the southeast side of the basin. Pennsylvanian rocks also produce along the basin axis in the western part of the basin.

In the 1960s and 1970s, drilling moved into deeper parts of the basin that resulted in the discovery of some prolific oil fields in stratigraphic traps in upper and lower Cretaceous rocks (McGregor 1972). The discovery of giant Bell Creek in 1967 (reserves greater than 150 million barrels of oil from the Muddy Sandstone) on the Montana side of the basin set off a wave of exploration that resulted in a number of discoveries in Wyoming in the Muddy Sandstone (Drew 1990). Such Muddy fields included Recluse, Kitty, and Highlight. Drilling continued for deeper targets and resulted in the discovery of upper Cretaceous fields such as House Creek, Hartzog Draw, Holler Draw, and Jepson Draw, all characterized by long narrow reservoirs that were deposited as marine bars. Stratigraphic traps in upper Cretaceous rocks remained as prime targets for drillers in the late 1970s into the early 1980s with discoveries such as Well Draw and Scott Field, located in southern Converse County. The Minnelusa also provided a mainstay for wildcat drillers during that time period.

Very little conventional oil and gas activity has occurred in the last 15 years in the study area, and only approximately 1,500 wells were drilled from 1990 to 2003. The 1,500 wells include producing, injection, and wildcat (exploration) wells. The only significant discovery has been the African Swallow Field, discovered in 2000, which produced over a million barrels of oil and 14 billion cubic feet (BCF) of gas from two wells by the end of 2003 (WOGCC 2004).

As of the end of 2003, there were approximately 3,500 productive conventional oil and gas wells in the Wyoming PRB study area plus 1,386 seasonally active wells (IHS 2004). **Figure 3-5** shows the location of all wells (producing, non-producing, and plugged and abandoned). Approximately 13 million barrels of oil and 41 BCF of conventional gas (20.24 million barrels of oil equivalent [BOE]) were produced from these wells in 2003 based on WOGCC (2004) data; IHS (2004) data report approximately 13 million barrels of oil and approximately 40 BCF of conventional gas. The USGS (2002) estimated that the mean undiscovered non-coal bed hydrocarbon resource in the PRB (including Montana) is 1.8 BOE.

By the end of 2007, there were approximately 3,857 productive conventional oil and gas wells in the Wyoming PRB study area plus an estimated 1,500 seasonally active wells (IHS 2008). Approximately 11.4 million barrels of oil and 22.0 BCF of conventional gas were produced from these wells in 2007 based on WOGCC (2008) data.

3.9.1.2 CBNG

CBNG activity began in the 1980s, however it took a number of years before commercially viable production was established. A total of three Applications for Permit to Drill (APDs) were issued in 1986 for CBNG wells in Campbell County (WOGCC 2004). The first commercial gas production directly from coal seams occurred in 1989 at Rawhide Butte north of Gillette (Debruin and Jones 1989). Annual submission of APDs did not exceed 100 until 1992 when 110 APDs were filed. By the late 1990s, after commercially viable production was proven, the number of APDs submitted began to soar: 561 in 1996, 808 in 1997, 1,494 in 1998, and 5,101 in 1999 (WOGCC 2004). In the

1-year period from June 2003 to May 2004, over 6,700 APDs were received statewide by the WOGCC.

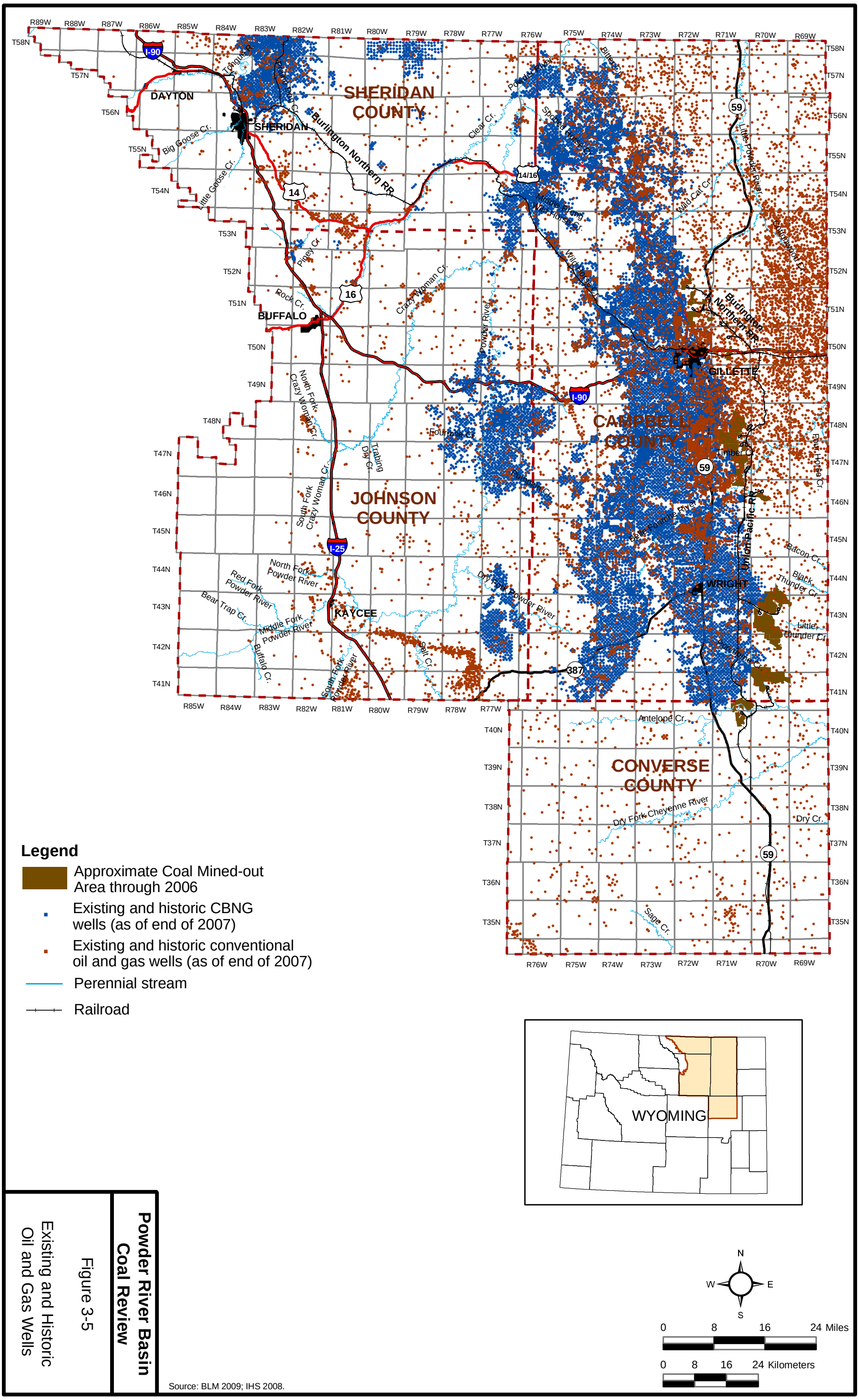
The initial coal bed development in the early 1990s was concentrated in the area between Gillette and Wright, Wyoming, and SRs 59 and 50 in the Marquiss and Lighthouse project areas (Flores et al. 2001). The development soon moved out of that area and spread to the west and northwest. At the end of 2003, there were 14,758 producing CBNG wells in the study area (IHS 2004), and total production for 2003 was 346 BCF, or 88 percent of the total gas production from the basin (WOGCC 2004). 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. Annual methane production has increased rapidly since 1999 and as of 2003 appeared to have started to level off or even decrease. Water production decreased slightly; however, it still was more than 500 million barrels during 2003. In 2003, the average CBNG production was 900 million cubic feet per day (MMcfpd) (Holcomb 2003). CBNG production appeared to have peaked from a high of 977 MMcfpd in October 2003 to 899 MMcfpd in March 2004 (Oil and Gas Journal 2004). In 2007, the annual CBNG production was 432 MMcf. CBNG wells in the Wyoming PRB study area as of the end of 2007 are shown in **Figure 3-5**.

3.9.2 Reasonably Foreseeable Development

Conventional oil and gas and CBNG development does not fit in the capital project likelihood of occurrence classifications as discussed in Section 2.1. Oil and gas exploration and development have inherent characteristics that set it apart from other capital projects. These characteristics include the following:

- The activities are conducted by multiple companies or entities;
- The activities cover broad geographic areas;
- Generally, permitting can take place in a relatively short timeframe compared to other capital projects;
- The activities are extremely price sensitive and, therefore, hard to predict over long periods of time; and
- Technological advancements can be rapidly implemented resulting in sudden increases of activity in a relatively short period of time.

The probability for new oil and gas activities (including CO_2 enhanced oil recovery [EOR] and associated pipelines) to occur in the future is a certainty; however, the level of activity is uncertain. The following discussions of reasonably foreseeable activity for conventional oil and gas and CBNG are estimates of the level of activity that could be expected to occur, based on recent trends analyzed for this study and the methodology and assumptions presented in Appendix E.



Legend

- Approximate Coal Mined-out Area through 2006
- Existing and historic CBNG wells (as of end of 2007)
- Existing and historic conventional oil and gas wells (as of end of 2007)
- Perennial stream
- Railroad

N
W E
S

0 8 16 24 Miles

0 8 16 24 Kilometers

Powder River Basin Coal Review

Figure 3-5

Existing and Historic Oil and Gas Wells

Source: BLM 2009; IHS 2008.

11/06/09

3.9.2.1 Conventional Oil and Gas

Table 3-3 summarizes the projected production, number of wells, and long-term disturbance associated with conventional oil and gas development through 2020. From 1990 to 2004, a total of approximately 1,500 wells were drilled in the study area (IHS 2004). Of those, 60 percent were development wells drilled in established producing areas. The other 40 percent of wells were classified as wildcat wells or wells drilled outside of producing areas or wells drilled to test non-producing prospective zones in producing areas. Of the wildcat wells, approximately 75 percent were plugged and abandoned. From 1990 through 2003, new field wildcat wells resulted in the discovery of 61 new fields that provided 719,000 barrels of oil and 1.45 BCF of non-CBNG in 2003 (WOGCC 2004).

Table 3-3
Projection of Conventional Oil and Gas Activity

Wells and Production	Actual		Projected		
	2003	2007	2010	2015	2020
Annual Gas Production (BCF)	39.9	22.0	42.7	39.0	35.1
Annual Oil Production (million barrels)	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] The total includes approximately 1,500 seasonally active wells.
[2] The total includes approximately 1,500 seasonally active wells and an unknown number of inactive wells.
[3] Unknown.

In a departure from the trend of the last 15 years, it is expected that the increases in oil prices would reverse the decline in oil production, with production increasing and peaking at approximately 18.5 million barrels (BLM Reservoir Management Group [RMG] 2005). (Refer to Appendix E for assumptions used in well numbers, production, and disturbance projections.)

The active wells identified in **Table 3-3** include wells that produce year-round, seasonally producing wells, and service wells (mainly injection wells). It was estimated that in 2005 there were approximately 2,000 idle conventional oil and gas wells in the PRB study area (WOGCC 2005a); however, these wells gradually have been and would continue to be reduced through aggressive plugging programs, and the idle well locations (once the wells are abandoned) would be reclaimed and no longer represent a disturbance.

A typical drilling location, including access road, is assumed to initially disturb approximately 2.75 acres. Long-term disturbance at existing well sites is assumed to be 2.0 acres, following partial reclamation (BLM 2003a). If a well is abandoned, the entire disturbance area is reclaimed. If a well is productive, a portion of the disturbance area is reclaimed initially, with final reclamation occurring at the end of production.

It is certain that conventional oil and gas exploration and development would continue, but at a rate far below previous levels in the basin's history. If the trends of the last 10 to 15 years are indicative

of future activity, conventional oil and gas would continue to be produced but at ever decreasing rates.

The USGS (2002) estimated that the mean undiscovered non-coal bed hydrocarbon resource in the PRB (including Montana) is 1.8 billion BOE. This number indicates that the PRB, as well as the study area, has a potentially important non-coal bed hydrocarbon resource base. Whether that resource is exploited is dependent upon a number of factors. At present, the economics favor the shallow and easier exploitable CBNG resource. The low oil prices and preferential investment in CBNG resources probably has resulted in the investment into other plays in the basin, with an associated decline of oil and non-CBNG activity over the past 15 years. If the non-coal bed resource is to be exploited to any great degree in the future, industry would have to invest in those plays. As the CBNG play moves into maturity, and if oil prices stabilize over $45 per barrel, then oil and non-CBNG resources potentially could become attractive exploration targets. However, it is not likely that the PRB ever would reach a producing rate of 30 million barrels of oil per year again (BLM 2001).

As of the end of 2004, there were no readily available data concerning incremental production data from CO_2 flooding (WOGCC 2004). There is a potential for additional EOR activity in the study area, but so far the projects that have been conducted are pilot scale and involve the “huff and puff” process whereby the gas is brought to individual injection wells by tanker truck. Possible EOR candidates in the PRB include Harzog Draw, House Creek, Hilight, Raven Creek, Rozet, Kitty, Gas Draw, and Recluse Fields (DeBruin 2001). These fields could qualify for EOR because they had 50 million barrels or more of original oil in place; however, many smaller fields also could qualify. The potential for additional EOR activity would be dependent upon the availability of a CO_2 source. Wyoming has a large resource of CO_2 produced from the La Barge Anticline in the Green River Basin. There also are abundant CO_2 resources at the Madden Unit in the Wind River Basin. In total, Wyoming has a CO_2 production capacity in excess of 500 MMcfpd (DeBruin 2001). Pipelines would need to be constructed to transport this available CO_2 into the PRB (see Section 3.10, Pipelines). The State of Wyoming has a severance tax break of 2 percent on oil produced from WOGCC-approved CO_2 EOR projects to encourage producers to take advantage of the CO_2 resource and to encourage oil production. However, there are no proposals to extend the CO_2 pipeline that ends at Salt Creek and Sussex Fields in the near term (the next 5 years). The likelihood rating of any such CO_2 EOR project would be low, since the CO_2 pipeline at Salt Creek originally was proposed to end at Hartzog Draw (DeBruin 2002).

3.9.2.2 CBNG

The future of CBNG development is highly sensitive to the price of gas. For a number of years, Wyoming natural gas production has been affected by the so-called price differential. The price differential is the difference in the gas price at the Opal and Cheyenne hubs in Wyoming and the national benchmark price recorded at the Henry Hub in Louisiana. The differential results when there is inadequate pipeline capacity to move Rocky Mountain region gas to markets outside of the area. Historically, the differential has been as high as $2.40 per million British thermal units (MMbtus) (Holcomb 2003) (1 thousand cubic feet [Mcf] is roughly equivalent to 1 MMBtus). This disparity in price has resulted in an estimated loss of more than $2 billion dollars to producers and attendant fiscal impacts for state and federal governments (Holcomb 2004). The lack of interstate pipeline transmission capacity in Wyoming is cited as the major reason for the price differential. The differential was somewhat eased in 2003 with the opening of the Kern River Pipeline expansion that

moves gas from southwestern Wyoming, northwestern Colorado, and northeastern Utah. At that time, the differential went from $1.86 per MMbtus to $0.60 per MMbtus (Holcomb 2004). However, the addition of the Kern River system capacity did not completely solve the differential problem.

The consequences of the price differential were researched by Advanced Resources, International (ARI) (2002). ARI evaluated the impacts to the CBNG resource associated with various water disposal methods. ARI (2002) also evaluated the effects of three price scenarios on the CBNG resource as follow:

- Under a status quo price scenario (basin price differential of $1.80 per Mcf), the economically recoverable CBNG resource only would be 1.5 trillion cubic feet (Tcf), with the primary water disposal option being surface discharge. No other disposal options were economical under this price scenario. ARI (2002) states that much of this development already has occurred, and if the differential does not change, not much increase in development would be expected.

- In a transitional price scenario, where the basin differential narrows to $0.80 per Mcf after a number of years and beyond, variable amounts of the resource would be economical for a number of disposal options. Under this scenario, the economically recoverable resource ranges were projected to be 22.4 Tcf with surface discharge, 20.0 Tcf with impoundment infiltration, 18.8 Tcf with shallow re-injection, and 7.1 to 10.2 Tcf with active treatment.

- In the third scenario, the basin differential immediately would go to $0.80 per Mcf. Under this scenario, the economically recoverable resource ranges would be 29.1 Tcf with surface discharge, 27.8 Tcf with impoundment infiltration, 27.1 Tcf with shallow re-injection, and 17.8 to 2.6 Tcf with active treatment.

In the Final EIS and Proposed Plan Amendment for the PRB Oil and Gas Project (BLM 2003a), the preferred alternative favored the disposal of produced CBNG water in infiltration impoundments to be accompanied by groundwater and surface water monitoring, except in the Belle Fourche and Cheyenne River drainages where direct discharge to ephemeral streams was allowed. The disposal of produced coal bed water in infiltration impoundments would fit with the second or third ARI scenarios described above. The recoverable CBNG resource would be in the range of 20 to 29 Tcf if the price differential remains at $0.80 per Mcf or less, and gas prices in general remain at reasonable long-term levels ($3.56 per Mcf or equivalent to crude oil at $25 per barrel). In spite of recent record highs for crude oil, the long-term forecast (10 years or more) for crude oil prices is expected to be around $25 per barrel (Winnecke 2003). The size of the differential would be dependent upon the magnitude of production capacity in the Wyoming PRB and available pipeline capacity to deliver the gas to external markets. As a comparison to the ARI estimate, the USGS (2002) estimated that the undiscovered CBNG resource in the PRB is 14.3 Tcf.

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 2003a). 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. (Refer to Appendix E for assumptions used in the analysis of CBNG activity.) As shown in **Table 3-4**, there would be 31,943 CBNG wells basin-wide by 2010, much 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 2003a). 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.

Table 3-4
Projection of CBNG Activity

Wells and Production	Actual		Projections		
	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

3.9.3 Data Sources

The data and information for conventional oil and gas and CBNG resource development projections were derived from several sources including: WOGCC on-line well files, BLM public documents, IHS well data, Wyoming Geological Survey publications, and the BLM Wyoming State Office RMG.

3.9.4 Assumptions

Assumptions relative to past and present and reasonably foreseeable oil and gas activity are presented in Appendix E.

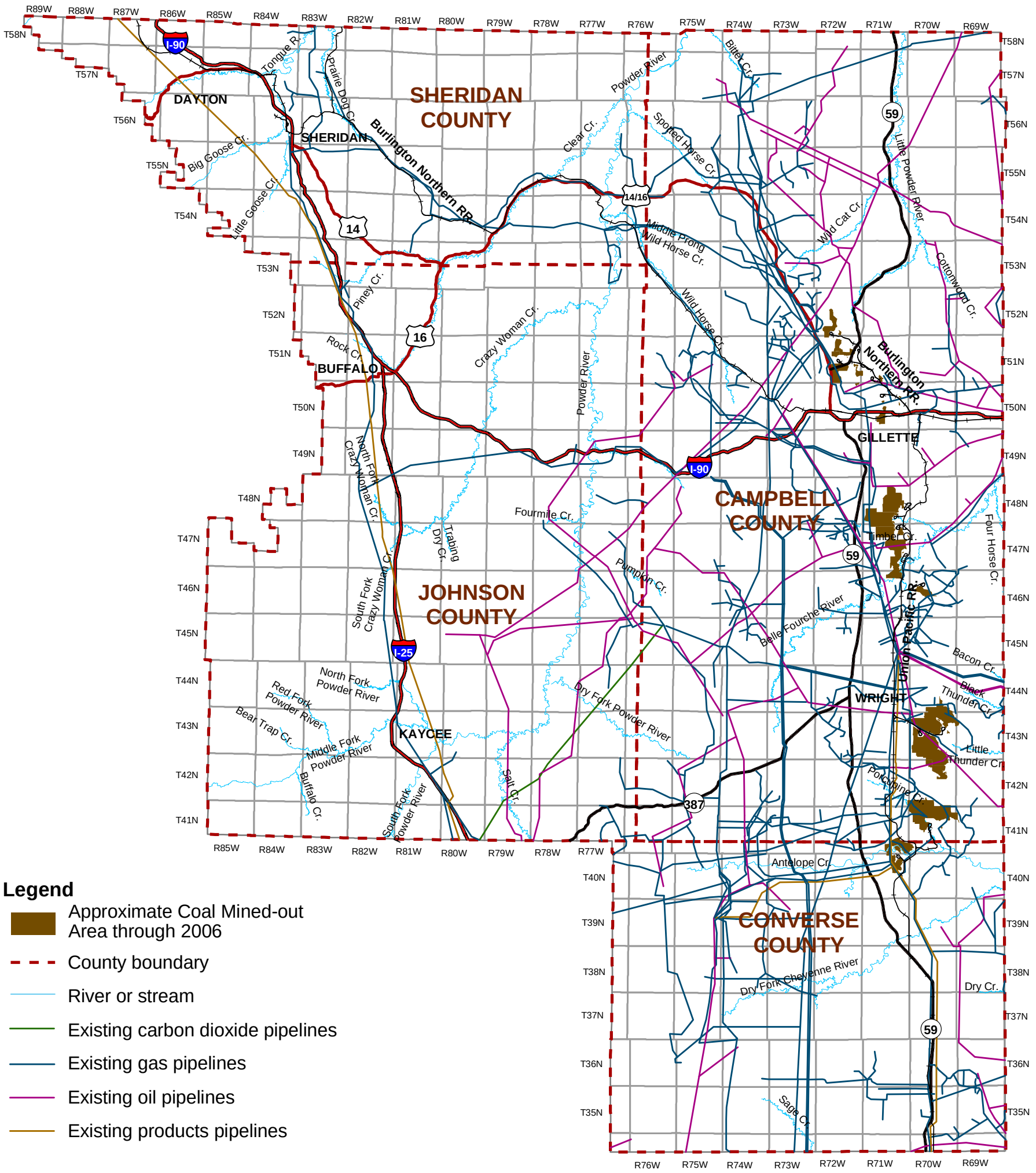
3.10 Pipelines

3.10.1 Past and Present Development

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. Since preparation of the original Task 2 report (ENSR 2005b), no major natural gas transportation lines have been constructed in the Wyoming PRB study area. 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. As shown in **Figure 3-6**, there also are numerous oil, gas, and products pipelines in the study area. Gathering lines associated with conventional oil and gas and CBNG development also occur within the study area; for purposes of this study, these gathering lines have been factored in proportionally on a per well basis as discussed in Appendix E.

3.10.2 Reasonably Foreseeable Development

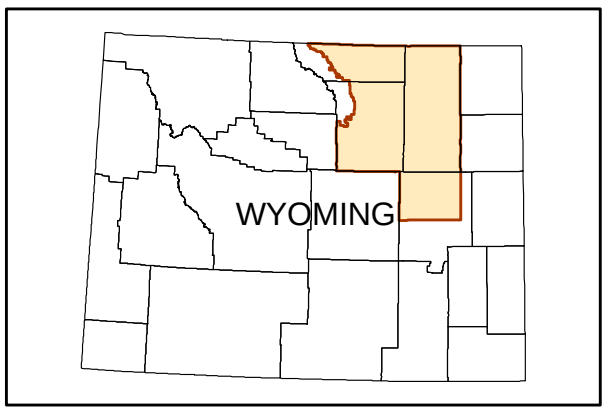
The availability of major transportation pipeline capacity is a key factor in the future development of CBNG and conventional gas resources in the Wyoming PRB study area. Increased recovery of crude oil also may depend somewhat on the availability of CO_2 for EOR projects.



Legend

- Approximate Coal Mined-out Area through 2006
- County boundary
- River or stream
- Existing carbon dioxide pipelines
- Existing gas pipelines
- Existing oil pipelines
- Existing products pipelines

Note: Existing pipelines as of end of 2007.



N W E S

0 8 16 24 Miles

0 8 16 24 Kilometers

Source: BLM 2009; Debruin 2002.

Powder River Basin Coal Review

Figure 3-6
Existing Pipelines

11/11/09

Currently, there are two proposed natural gas transportation pipeline projects (Bison and Pathfinder) that would cross the study area (**Figure 3-7** and **Table 3-5**). Northern Border Pipeline (50 percent owner of the proposed Bison Pipeline Project) was actively seeking shippers through an open season that began in April 2008 (TC Pipelines 2008). The Bison Pipeline would originate in the Wyoming PRB study area and transport gas from the PRB to outside markets. The proposed Pathfinder Pipeline Project would cross the Wyoming PRB study area; however, its main supply of gas would come from the Green River Basin, where it would originate. An open season for Pathfinder also commenced in April 2008 (TransCanada 2008). It is possible that an interconnect at Dead Horse Creek might provide an outlet for PRB-produced gas into Pathfinder. 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 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.

Table 3-5
Proposed Pipeline Projects in the Wyoming PRB Study Area

Project/Company	Location	Product	Description	Watersheds	Likelihood
Bison/Northern Border Pipeline	Campbell County	Natural gas	24-inch, 289-mile pipeline, 400 to 660 MMcfpd, from Dead Horse Creek, Wyoming, to Morton County, North Dakota.	Upper Powder River (12 miles), Upper Belle Fouche River (15 miles), Little Powder River (30 miles), Little Missouri River (5 miles).	Low. Project previously was proposed but not constructed due to market uncertainties. Project now has firm shipper (Anadarko); however, submittal of FERC application is pending. In-service estimate of 2010.
Pathfinder/Trans-Canada	Campbell and Johnson counties	Natural gas	42-inch, 500-mile, 1.2 to 2.0 BCF per day, from Wamsutter, Wyoming, to Morton County, North Dakota.	Salt Creek (15 miles), Upper Powder River (57 miles), Little Powder River (51 miles).	Low. FERC application expected in 2009. In-service estimate of 2010.

Sources: FERC 2008; TC Pipelines 2008; TransCanada 2008.

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.

In the original Task 2 report (ENSR 2005b), reported estimates of the growth of Wyoming PRB CBNG production ranged from a 2003 level of 900 MMcfpd to 3 to 4 BCF per day around 2007, and it was anticipated that production would 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 Projects would increase the take-away capacity of the PRB by approximately 0.5 BCF per day, resulting in total take-away capacity for the basin 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 Appendix E, 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.

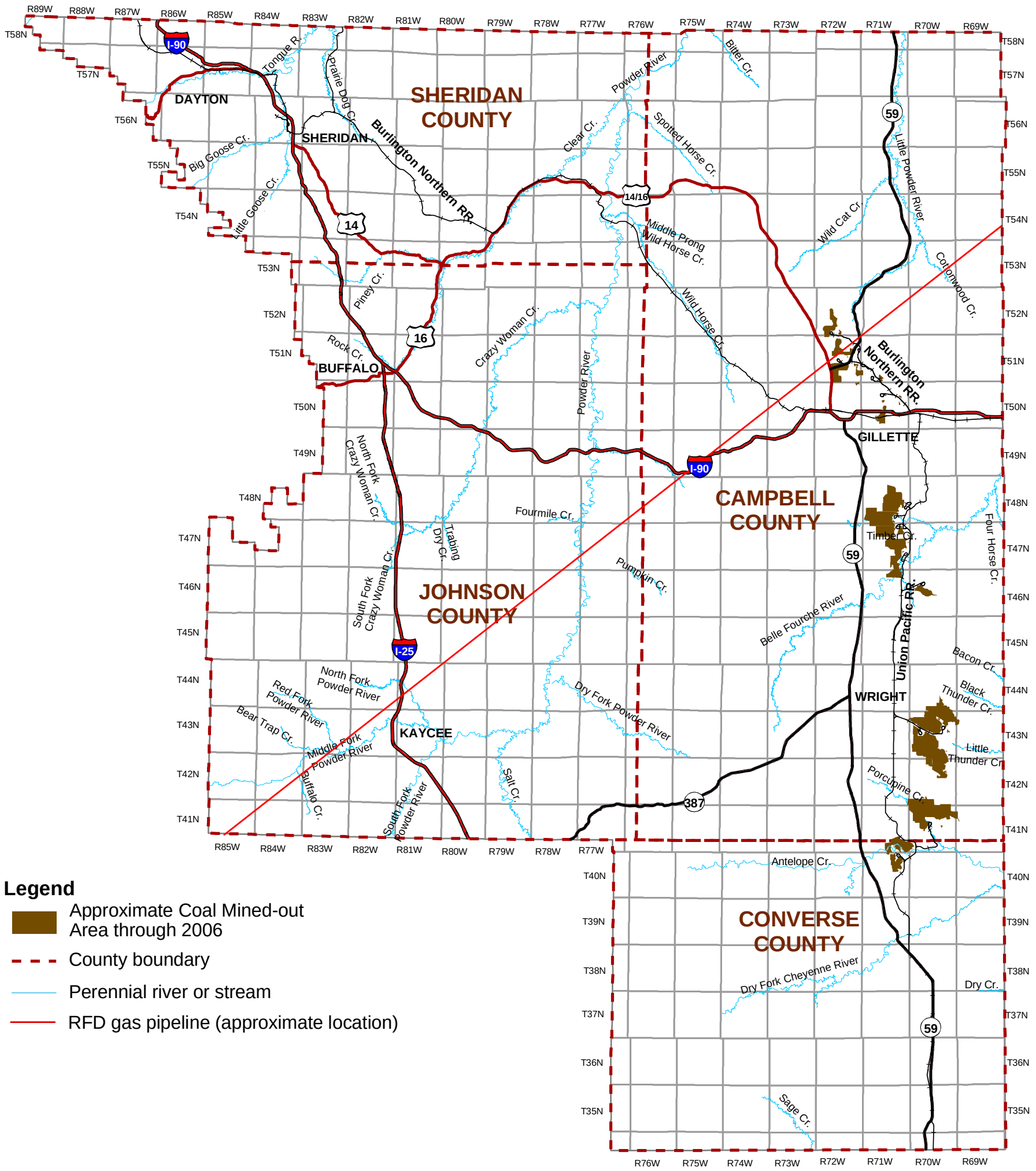
In the original Task 2 report (ENSR 2005b), it was indicated that Anadarko Petroleum Corporation was planning to extend its CO_2 pipeline that runs between Bairoil, Wyoming, and Salt Creek, Wyoming, to the Sussex Field located in the southern Johnson County portion of the Wyoming PRB study area. However, 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.

3.10.3 Data Sources

Information on major natural gas transportation pipelines was derived from FERC website data, the Wyoming Pipeline Authority website, applicant websites, BLM documents, and published sources.

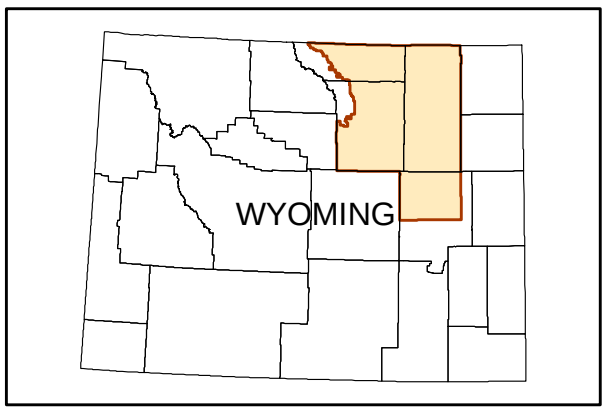
3.10.4 Assumptions

In addition to the information obtained in the identified data sources, the following assumptions were used to define specific impact-causing parameters for pipelines:



Legend

- Approximate Coal Mined-out Area through 2006
- County boundary
- Perennial river or stream
- RFD gas pipeline (approximate location)



N
W E
S

0 8 16 24 Miles

0 8 16 24 Kilometers

Source: BLM 2009; Debruin 2002; FERC 2004.

Powder River Basin Coal Review

Figure 3-7
RFD Major Pipelines

11/11/09

Past and Present Development:

- Present pipeline capacity out of the PRB is 2.1 BCF per day, and daily production as of 2007 was 1.24 BCF.

- It is assumed that existing pipeline rights-of-way have a disturbance width of 50 feet, which conservatively accounts for access roads, ground-disturbing maintenance activities, and permanent facilities (e.g., compressor stations, valves, etc.) located at intervals along the rights-of-way.

- In the study area, there are 2,672 miles of natural gas transportation pipelines, 906 miles of crude oil pipelines, 210 miles of petroleum product pipelines, and 37 miles of CO_2 pipeline.

RFD:

- Any new major transportation pipelines would incur a disturbance area based on an average construction right-of-way width of 100 feet during the year of construction. It is assumed that in subsequent years there would be a potential right-of-way disturbance width of 50 feet, which conservatively accounts for access roads, ground-disturbing maintenance activities, and permanent facilities (e.g., compressor stations, valves, etc.) located at intervals along the rights-of-way.

3.11 Refineries

3.11.1 Past and Present Development

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, Wyoming. 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 SH 59, with the joint UP/BNSF 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).

3.11.2 Reasonably Foreseeable Development

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.

3.11.3 Data Sources

Data sources that were reviewed for potential information relative to refineries in the Wyoming PRB study area included databases maintained by the USDOE Energy Information Administration and WDEQ, input from the Cambell County Economic Development Corporation (CCEDC) and Wyoming Business Council, and online internet data searches. Information relative to the NorthCut Refinery was obtained from Interline Resources.

3.11.4 Assumptions

In addition to the information obtained from the identified data sources, the following assumptions were used to define specific impact-causing parameters for refineries:

Past and Present Development: There are no assumptions for past and present refineries.

RFD:

- It is assumed that potential additional expansion at the NorthCut Refinery would be within the currently owned 32-acre site.

3.12 Reservoirs and Other Water Developments

Reservoirs in the PRB study area were identified based on the Powder/Tongue River Basin Water Plan (HKM et al. 2002a) and Northeast Wyoming River Basins Water Plan (HKM et al. 2002b). These plans, which encompass the PRB study area, were prepared for the Wyoming Water Development Commission for their Basin Planning Program. The plans identified the key water supply reservoirs (generally 1,000 acre-feet or greater) in these basins; industrial ponds and impoundments were not addressed in the plans.

Industrial ponds or impoundments associated with mining and CBNG development occur within the study area. For purposes of this study, impoundments associated with coal mining activity have been accounted for in the mine-related disturbance areas. The disturbance area associated with CBNG-related impoundments has been factored in on a per well basis as discussed in Appendix E. As of 2000, there were a total of 1,976 stock water ponds in the study area (BLM 2003a); however,

based on the assumed low overall associated acreage per subwatershed, they have been eliminated from further analysis.

3.12.1 Past and Present Development

Currently, there are 14 key water storage reservoirs in the Powder/Tongue River Basin and 5 key water storage reservoirs in the Northeast Wyoming River Basins (HKM Engineering et al. 2003a,b). Three of the key water storage reservoirs located in the Powder/Tongue River Basin planning area (Healy, Lake Desmet, and Muddy Guard No. 2) and two of the key water storage reservoirs in the Northeast Wyoming River Basins planning area (Gillette and Betty No. 1) occur in the Wyoming PRB study area (**Figure 3-4)**. These reservoirs provide for irrigation water and recreational activities.

3.12.2 Reasonably Foreseeable Development

Based on the Powder/Tongue River Basin Water Plan (HKM Engineering et al. 2002a) and the Northeast Wyoming River Basins Water Plan (HKM Engineering et al. 2002b) that were prepared for the Wyoming Water Development Commission for its Basin Planning Program, there are long-range projections for development of additional reservoirs in the Wyoming PRB study area. However, no new reservoirs are currently proposed (Besson 2008); therefore, their likelihood is currently considered speculative. As a result, they have been eliminated from further analysis.

3.12.3 Data Sources

Information presented in the Powder/Tongue River Basin Water Plan (HKM Engineering et al. 2002a) and the Northeast Wyoming River Basins Water Plan (HKM Engineering et al. 2002b) was used to develop the reservoirs and other water developments section of this report. These plans were developed for the Wyoming Water Development Commission for their Basin Planning Program. Information also was obtained directly from the Wyoming Water Development Commission.

3.12.4 Assumptions

No assumptions were required for this study to define specific impact-causing parameters for reservoirs and water developments.

3.13 Other Industrial Manufacturing

3.13.1 Past and Present Development

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 (Dun & Bradstreet 2008). 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.

3.13.2 Reasonably Foreseeable Development

Local economic development organizations, including 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 have been eliminated from analysis in this study.

3.13.3 Data Sources

Information relative to potential major industrial development was obtained from state and local business and economic development organizations.

3.13.4 Assumptions

There are no assumptions relative to other industrial manufacturing.

3.14 Other Development

3.14.1 Past and Present Development

In addition to the specific projects and developments described above, the PRB hosts a vast network of additional public and private physical infrastructure, private businesses, and public activities that has developed 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.

The construction, maintenance, and continuing operations associated with this network of development represent an extensive series of public and private investments, as well as changes in land use, surface disturbances, water consumption, and the factors that characterize local air quality. Those investments and changes have occurred over a period of time and in response to many different influences.

3.14.2 Reasonably Foreseeable Development

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. A number of planned investments are summarized below. Given the timing, scale, year-to-year variability, relatively short construction timetables associated with such public 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 RFD database. 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.

3.14.2.1 Highways and Airports

Public highways and airports are important components of the public infrastructure in the PRB. The Wyoming Department of Transportation (WYDOT) prepares an annual State Transportation Improvement Program (STIP) based on an ongoing process of needs assessment, priority rating, fiscal analysis, and manpower analysis. The 2008 STIP includes planned construction for the 2008 fiscal year and preliminary engineering estimates for projects with anticipated construction dates through 2013. 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. No construction of new highways is scheduled, and no new airports are proposed.

The estimated 2008 through 2013 construction costs for highway and airport maintenance, reconstruction, improvement projects, and preliminary engineering studies in the study area total approximately $219.5 million, of which $55.6 million was obligated toward projects in fiscal year 2008. Overall, these activities primarily include reconstruction, overlays, widenings, and bridge replacements, as opposed to new construction. Approximately $19.6 million of the total is obligated for airport improvements, the majority of which are planned for airports in Sheridan and Gillette. The level of construction and location of the projects included in these estimates would vary from year to year, and the actual completion of projects funded in a given year may extend into subsequent years (WYDOT 2008).

In addition to highway projects included in the 2008 STIP, the Eagle Butte Mine is proposing the relocation of U.S. Highway 14/16 in the vicinity of the Gillette/Campbell County Airport, north of the City of Gillette. The relocation is proposed to facilitate the recovery of approximately 40 million tons of additional coal recently acquired by the mine through a LBA coal sale. Three alternative alignments, involving the construction of up to 6.8 centerline miles of new roadway, have been identified. Assuming an affirmative decision to proceed with relocation, construction of the new highway segment is anticipated in 2011/2012 (WYDOT and Foundation Coal Company 2008). The likelihood for the relocation is considered moderate under both the upper and lower production scenarios.

3.14.2.2 Other Public Facilities

Local governments, school districts, and other special service districts and public entities continually engage in long-term planning. A vital element of such planning assesses the condition of existing facilities and infrastructure and outlines a capital improvement plan to ensure adequate capacity to meet future needs, and in some case to provide new services to residents and businesses, Capital improvement plans reflect a balance between needs and available funding resources. Constrained fiscal times tend to focus spending on maintenance of core administrative, utility, and transportation facilities. Increases in anticipated revenues generally allow more consideration to service expansion, community development, parks and recreation, and other more "discretionary" projects. Depending on a community's fiscal health and resources, capital spending may be funded by transfers from general tax revenues, a local option sales and use tax, ad valorem tax revenues generated by a specific electorate approved mill levy, or state and federal governmental grants. The cumulative level of capital investment spending can be substantial; however, individual projects are seldom sufficiently extensive enough to warrant analysis in the RFD scenario. Such is the case at present. Examples of some of the larger public projects that recently have been completed, are ongoing, or anticipated in the near future are listed below:

- A new $10 million headquarters for the Campbell County Fire Department providing administrative, training, and storage space in addition to multiple parking bays for firefighting apparatus.

- An expansion and renovation of the county courthouse were completed in 2006, and a new public health building was completed in 2007.

- Expansion of the county's detention center and remodeling of the sheriff's office were undertaken in 2007.

- A $55 million county recreation center is being planned, with opening expected in 2010.

- Construction for a major expansion of the CAM-Plex conference and multi-event center was initiated in 2006 and 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.

- Multiple transportation and drainage system improvements by the City of Gillette.

- Completion of a wastewater treatment facility upgrade and completion of water system improvements.

- The city completed construction of a new Health Sciences Center at Gillette College. The facility will house 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.

- The county, city, and Gillette College are partnering on a Campus Housing Complex and Industrial Technical Education Center. These facilities are 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 in the planning stage for a major expansion and renovation project (City of Gillette 2008).

- 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).

3.14.2.3 General Industrial and Commercial Development

Additional private sector industrial and commercial development is expected to occur within the context of normal community and economic development. With the strong economic base provided by the coal mines, oil and gas companies, and power plant construction, major goals for local economic development currently include workforce recruitment and training, diversification of the economic base, expansion of retail trade and personal services to serve the growth in consumer demand, and development of affordable housing. The strong growth and relatively high income of residents is being used to recruit 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 2008).

While these economic stimuli are collectively noteworthy in the context of local economic development, there is no single employer or event warranting inclusion in the RFD analysis.

3.14.3 Data Sources

Information regarding public sector infrastructure plans was compiled from published state and local documents and discussions with local officials.

3.14.4 Assumptions

- It is assumed that a portion of U.S. Highway 14/16 would be relocated to accommodate coal mining activities at the Eagle Butte Mine under both the upper and lower production scenarios. Mining of coal from a recently acquired LBA tract is projected to begin in 2013/2014. Pending WYDOT approval to proceed with the relocation, it is assumed highway construction would occur in 2011/2012. For purposes of this analysis, it is assumed that the relocation would involve approximately 2.7 miles of miles of new construction, with a right-of-way width of 100 feet.

- Any new surface disturbance associated with highway and airport maintenance projects (e.g., resurfacing) would be minimal or would involve previously disturbed lands that have since been revegetated.

- New surface disturbance associated with future public infrastructure and private commercial and industrial development would be limited and occur primarily within or adjacent to the presently urbanized areas in the study area.

3.15 Relationship Among Projects

Many of the energy-related and industrial projects in the PRB study area are interdependent. In addition, many of the RFD activities in the PRB are interrelated or dependent upon other types of industries to provide the necessary infrastructure to support their development and operation. For example, coal mines are dependent on rail lines with sufficient capacity to transport coal to power plants outside of the PRB, or on the presence of mine-mouth coal-fired power plants. Power plants in turn are dependent on the availability of sufficient transmission line capacity for the transport of electricity to markets. The oil and gas industry is dependent upon the availability of sufficient transportation pipeline capacity for the transport of product to markets outside of the basin. Alternately, some of the identified projects are related from the standpoint of resource impacts, such as the potential cumulative effects of groundwater drawdown associated with the coal mine and CBNG industries. As a result, the PRB Coal Review has included the array of projects identified above to define the development limitations that exist as a result of their interdependency (a factor in determining the likelihood for development of the RFDs) and to fully analyze the potential impacts in the study area.