4.0 CUMULATIVE ENVIRONMENTAL CONSEQUENCES

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

This section summarizes the cumulative impacts that are occurring as a result of existing development in the PRB[1] and considers how those impacts would change if other projected development in the area occurs and if the Eagle Butte West LBA Tract is leased and mined.

BLM completed three regional EISs evaluating the potential cumulative impacts of surface coal development in the 1970s and early 1980s (BLM 1974, 1979, and 1981). A draft document for a fourth regional EIS was prepared and released in 1984 (BLM 1984). Since those regional EISs were prepared, BLM has prepared a number of NEPA analyses evaluating coal leasing actions and oil and gas development in the PRB. Each of these NEPA analyses includes an analysis of cumulative impacts in the Wyoming PRB.

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

- Task 1 identifies current resource conditions in the PRB and, for applicable resources, updates the BLM's 1996 status check for coal development in the PRB. The baseline year for the Task 1 evaluation of the current conditions is 2003.

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

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

A series of reports has been prepared to present the results of the PRB Coal Review task studies. The Task 1, 2, and 3 reports represent components of a technical study of cumulative development in the PRB; they do not evaluate specific proposed projects, but they provide information that BLM is using to

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

evaluate the cumulative impacts that would be expected to occur if specific projects or applications, such as the Eagle Butte West coal lease application, are approved. The Task 1 reports, which include air quality conditions, water resources conditions, social/economic conditions, and other resource conditions, and the Task 2 reports have been completed. The Task 3 reports for air quality conditions, social/economic conditions, and other resource conditions have been completed. The Task 3 evaluation of water resource conditions is in progress. The information in these reports is summarized later in this chapter, and the completed reports are available for viewing at the BLM offices in Casper and Cheyenne and on the Wyoming BLM website at http://www.blm.gov/wy/st/en/programs/energy/Coal_Resources/PRB_Coal/prbdocs.html.

The PRB includes portions of northeastern Wyoming and southeastern Montana. The Wyoming portion of the PRB is the primary focus of the PRB Coal Review reports. The Montana portion of the PRB is included in the Task 2 report and in the Task 1 and 3 air resources studies. For the majority of resources in the Task 1 report and for the Task 2 report, the Wyoming portion of the PRB Coal Review study area encompasses all of Campbell County, all of Sheridan and Johnson Counties outside of the Bighorn National Forest, and the northern portion of Converse County (Figure 4-1). For some components of the Task 2 report and for the Task 1 and 3 air resource studies, the Montana PRB Coal Review study area includes portions of Big Horn, Custer, Powder River, Rosebud, and Treasure Counties. For several resources, the Task 1 and Task 3 study areas include only potentially affected portions of the Wyoming PRB Coal Review study area; for other resources, the study area extends outside of Wyoming and Montana because the impacts would extend beyond the PRB. For example, the groundwater drawdown is evaluated in the area surrounding and extending west of the mines, because that is the area where surface coal mining operations would impact groundwater resources; but air quality impacts are evaluated over a multi-state area because they would be expected to extend beyond the PRB.

Section 4.1 summarizes the information presented in the PRB Coal Review Task 1 and Task 2 reports. Section 4.2 summarizes the predicted cumulative impacts to air, water, socioeconomic, and other resources presented in the PRB Coal Review Task 3 reports.

4.1 Past, Present, and Reasonably Foreseeable Development

Past, present, and reasonably foreseeable development in the Wyoming PRB are considered in the Task 1 and Task 2 reports for the PRB Coal Review. The Task 1 reports describe the current situation, which reflects the past and present levels of development. The Task 2 report defines the past and present development activities in the PRB as of the end of 2003 and projects reasonably foreseeable development in the Wyoming PRB through 2020.

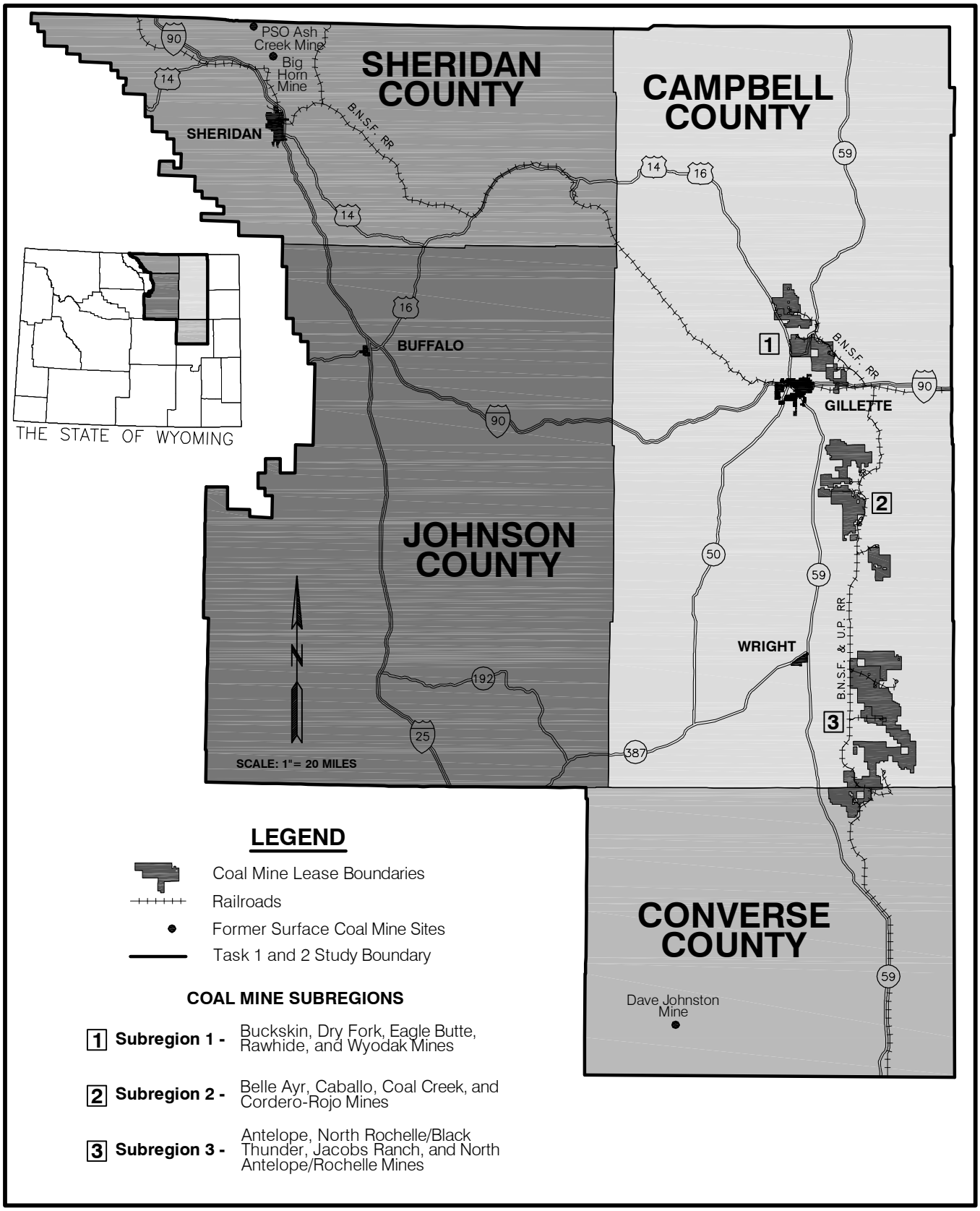


Figure 4-1. Wyoming Study Area for PRB Coal Review Studies Evaluating Current and Projected Levels of Development.

4.1.1 Coal Development

4.1.1.1 Coal Mine Development

The Powder River Federal Coal Region was decertified as a federal coal production region by the PRRCT in 1990. Decertification of the region allows leasing to take place on an application basis, as discussed in the regulations at 43 CFR 3425.1-5. Between 1990 and 2005, the BLM's Wyoming State Office held 23 competitive coal lease sales and issued 17 new federal coal leases containing almost 5.2 billion tons of coal using the LBA process. The lease sales are listed in Table 1-1, and the leased tracts are shown in Figure 1-1. This leasing process has undergone the scrutiny of two appeals to the IBLA and one audit by the GAO. As can be seen in Figure 4-2, leasing activity has generally paralleled production since decertification. This is consistent with the PRRCT's objective at the time of decertification, which was to use the LBA process to lease tracts of federal coal to maintain production at existing mines.

The Wyoming BLM has pending applications for 12 additional maintenance tracts for existing mines containing about 4.44 billion tons of coal (Table 1-2).

BLM has also completed three exchanges involving federal coal resources in the Wyoming PRB since decertification:

- Belco Exchange – an exchange of lease rights for a portion of the former Hay Creek federal coal tract for lease rights to coal near Buffalo, Wyoming, which became unmineable when Interstate 90 was constructed. This exchange was authorized by Public Law 95-554 and completed in 2000.

- Pittsburg and Midway Coal Mining Company (P&M) Exchange – an exchange of federal coal in Sheridan County, Wyoming, for land and mineral rights in Lincoln, Carbon, and Sheridan Counties, Wyoming, completed in 2004.

- Powder River Coal Company AVF Exchange - an exchange of lease rights underlying an AVF at the Caballo Mine, which cannot be mined, for lease rights of equal value adjacent to existing federal leases at Powder River Coal Company's North Antelope Rochelle Mine, completed in 2006.

Table 4-1 provides information about the status, ownership and production levels for the existing surface coal mines in the Wyoming PRB for 2003, which is the baseline year for the PRB Coal Review Task 1 and Task 2 studies. In the baseline year, there were 12 active surface coal mines and one inactive mine. The North Rochelle Mine was not operated as a separate mine in 2005 and 2006 following its purchase by the operator of the Black Thunder Mine. The North Rochelle Mine leases were divided between Black Thunder and North Antelope Rochelle Mines in 2006. These mines are all located in Campbell and Converse Counties, just west of the outcrop of the Wyodak coal, where the coal is at the shallowest depth (Figure 1-1). As indicated in Table 4-1, there have been

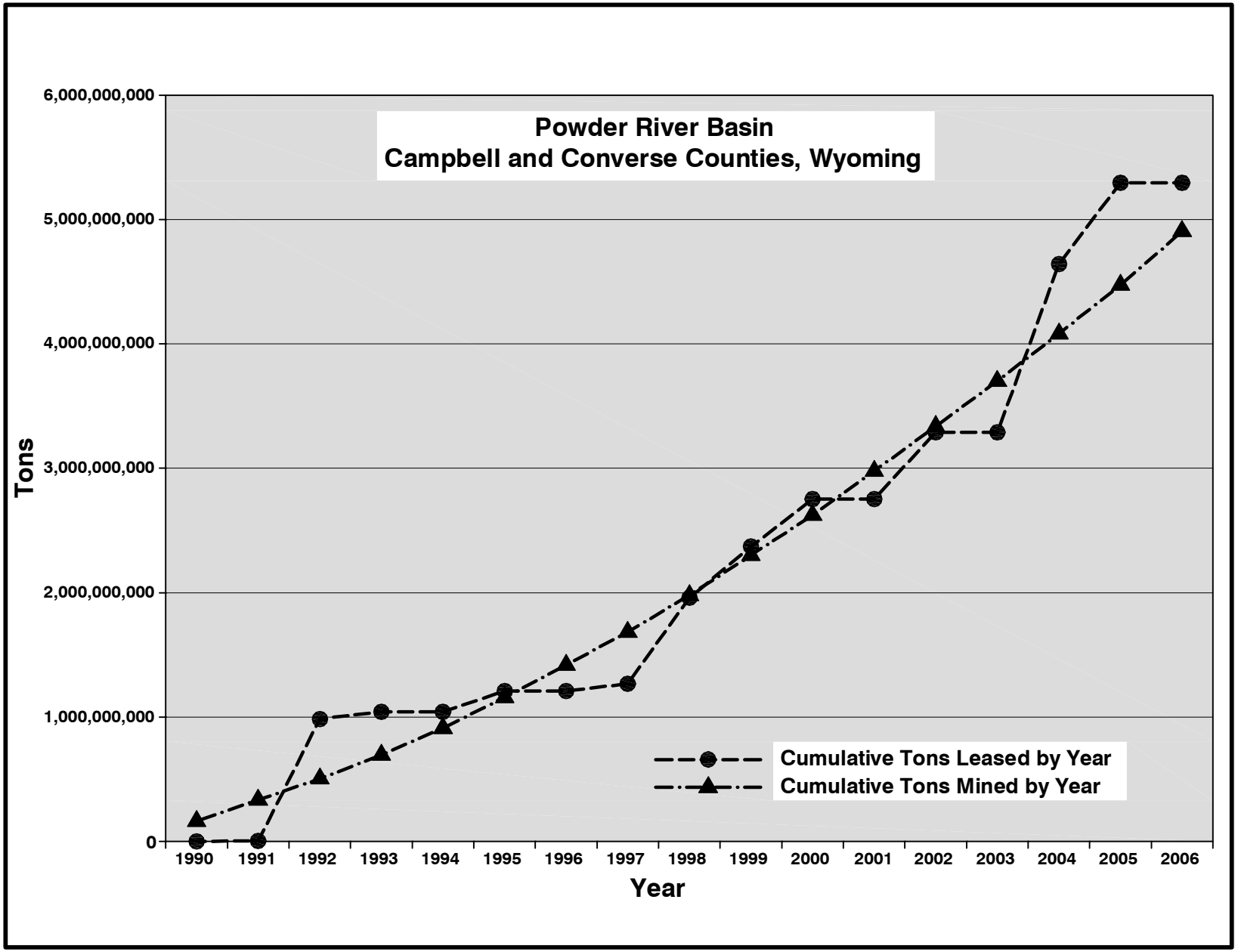


Figure 4-2. Tons of Federal Coal Leased Versus Tons of Coal Mined Since 1990.

Table 4-1. Status and Ownership of Wyoming PRB Coal Mines for 2003 the PRB Coal Review Baseline Year.

2003 Mine	1994 Mine Owner	2006 Mine Owner	Actual Coal Production (mm Tons)[1]	Permitted Production Level (mm Tons)[2]	Status and Additional Comments
SUBREGION 1 (North Gillette)					
Buckskin	SMC (Zeigler)	Kiewit Mining Properties	17.5	27.5	Active
Dry Fork	Phillips/WFA & Fort Union Ltd	WFA	4.4	24.4	Active (Includes former Fort Union Mine)
Eagle Butte	Cyprus-Amax	Foundation Coal West	24.5	35.0	Active
Rawhide	Carter (Exxon)	Peabody Holding Co.	3.6	24.0	Active
Wyodak	Wyodak Resources	Wyodak Resources	4.8	12.0	Active (Includes former Clovis Point Mine)
Total			**54.8**	**122.9**	
SUBREGION 2 (South Gillette)					
Belle Ayr	Cyprus-Amax	Foundation Coal West	17.9	35.0	Active
Caballo	Carter (Exxon) & Western Energy	Peabody Holding Co.	22.7	40.0	Active (Includes Rocky Butte and West Rocky Butte leases)
Cordero Rojo	Kennecott & Drummond	Rio Tinto Energy America[3]	36.1	65.0	Active (Consolidation of former Cordero and Caballo Rojo Mines)
Coal Creek	ARCO	Arch Coal Inc.	0	25.0	Inactive in 2003, operations resumed in 2006
Total			**76.7**	**165.0**	
SUBREGION 3 (Wright)					
Antelope	Kennecott	Rio Tinto Energy America[3]	29.5	32.0	Active
Black Thunder	ARCO	Arch Coal Inc.	62.6	90.0	Active
Jacobs Ranch	Kerr-McGee	Rio Tinto Energy America[3]	36.0	55.0	Active
N. Antelope/ Rochelle	Peabody	Peabody Holding Co.	80.1	85.0-105.0	Active (Consolidation of former North Antelope and Rochelle Mines)
N. Rochelle	SMC (Zeigler)	Arch Coal Inc.	23.9	35.0	Inactive since 2005, leases split between Black Thunder and North Antelope Rochelle Mines
Total			**232.1**	**297.0-317.0**	
TOTAL FOR 3 MINE GROUPS			**363.6**	**584.9-604.9**	

1 Wyoming State Inspector of Mines (Wyoming Department of Employment 2003).
2 WDEQ permitting levels.
3 Kennecott Energy Company changed its name to Rio Tinto Energy America in 2006.

numerous changes in mine ownership since decertification, which have resulted in mine consolidations and mine closings within the PRB.

Recently active surface coal mines in Sheridan County, (the Big Horn Coal Mine) and southern Converse County (the Dave Johnston Mine) have ended mining operations, relinquished their federal coal leases, and are reclaiming areas of disturbance.

There are existing permits for other surface coal mining-related operations in the PRB. These include the Ash Creek and Welch Mine permits in Sheridan County and the IZITA Mine permit in Campbell County. Operations at these sites are completed and disturbed areas have been reclaimed, but monitoring of the reclaimed areas is ongoing. The KFx Mine, located north of Gillette on privately owned coal, is mining coal for processing at the KFx coal enhancement plant, which is discussed in Section 4.1.1.2.4.

The active mines in the Wyoming PRB are geographically grouped into three subregions (Figure 4-1). For purposes of this cumulative impact discussion, these subregions are called the North Gillette, South Gillette, and Wright subregions. Table 4-1 lists the mines included in each subregion. A fourth subregion includes former and proposed mines in Sheridan County, Wyoming, and existing mines just north of Sheridan County, in Montana. There are currently no active mines in the Wyoming portion of the fourth subregion.

The surface coal mines listed in Table 4-1 currently produce over 96 percent of the coal produced in Wyoming each year. Since 1989, coal production in the PRB has increased by an average of six percent per year. The increasing production is primarily due to increasing sales of low-sulfur, low-cost PRB coal to electric utilities who must comply with the Phase I requirements of Title III of the 1990 Clean Air Act Amendments. Electric utilities account for 97 percent of Wyoming's coal sales. In 2003 (the baseline year for the PRB Coal Review), more than 33 percent of the coal mined in the United States came from the Wyoming PRB.

BLM estimates that the surface coal mines listed in Table 4-1 currently have about 122,280 acres of federal coal leased in Campbell and Converse Counties. This represents approximately 3.97 percent of Campbell County, where the majority of the leases are located.

Task 2 of the PRB Coal Review projected coal development into the future for the years 2010, 2015, and 2020. Due to the variables associated with future coal production, two projected coal production scenarios (representing an upper and a lower production level) were developed to bracket the most likely foreseeable regional coal production level. The basis for the projected production levels included:

1) an analysis of historic PRB production levels in comparison to the gross domestic product and national coal demand;

2) an analysis of current PRB coal market forecasts that model the impact of gross domestic product growth, potential regulatory changes affecting coal-fired power plants, and mining and transportation costs on PRB coal demand;

3) the availability, projected production cost, and quality of future mine-specific coal reserves within the PRB region; and

4) the availability of adequate infrastructure for coal transportation.

The projected upper and lower production levels subsequently were allocated to the Wyoming PRB subregions, discussed above, and to individual mines based on past market shares. Individual mine production levels were reviewed relative to potential future production constraints (e.g., loadout capacities), permitted production levels, mining costs, and coal quality. Then the projected future production was aggregated on a subregion basis. The actual 2003 production level and the two projected coal production scenarios for 2010, 2015, and 2020 are shown in Figure 4-3 and Tables 4-2 and 4-3.

Tables 4-2 and 4-3 also show the cumulative coal mining disturbance as of the baseline year and the cumulative coal mine disturbance projected for the future years for the upper and lower production scenarios. In these tables, the baseline year and cumulative projected disturbance areas are broken down into three categories:

- areas that are or are projected to be permanently reclaimed;

- areas that are or are projected to be undergoing active mining or which have been mined but are not yet reclaimed; and

- areas that are or are projected to be occupied by mine facilities, haul roads, stockpiles, and other long-term structures, and which are therefore unavailable for reclamation until mining operations are completed.

The two tables also include estimates of baseline year and projected future coal mining employment, water consumption, and water production.

As discussed in Section 1.2, based upon the current projected annual coal production over the life of the mine, FCW currently estimates that the existing recoverable reserves at the Eagle Butte Mine will be depleted within approximately 13.6 years at an average production rate of approximately 25 mmtpy. If they acquire a lease for the Eagle Butte West LBA Tract, FCW anticipates that the average rate of annual production would not increase, and that the mine would extend its productive life by eight or nine years, depending on whether U.S. Highway 14-16 is moved or not. The existing and projected coal development levels and associated disturbance shown in Tables 4-2 and 4-3 include production at the Eagle Butte Mine during the baseline year (2003) and projected production at the mine for 2010, 2015, and 2020. As discussed

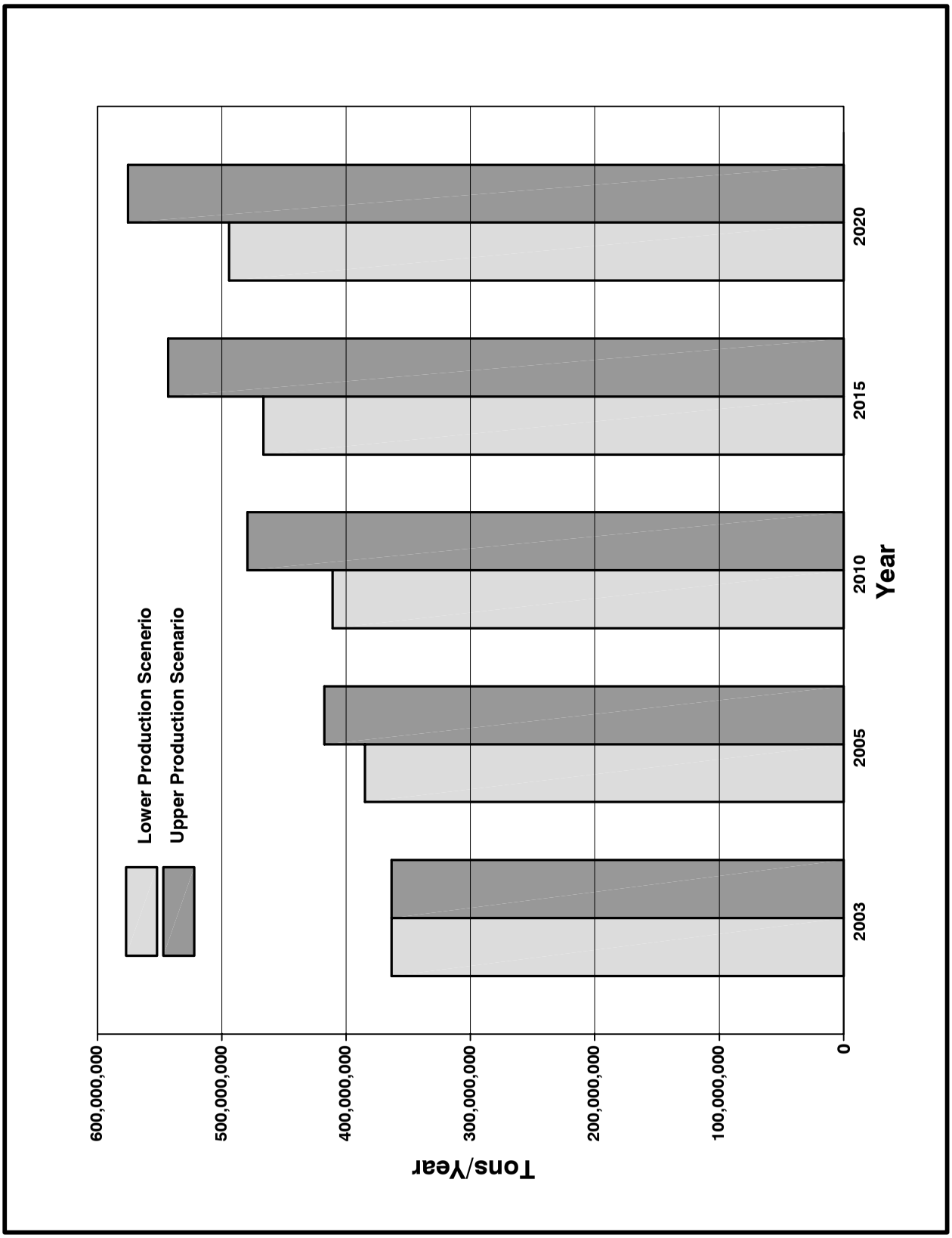


Figure 4-3. Projected Total Coal Production from Campbell and Converse Counties Under the Lower and Upper Production Scenarios.

Table 4-2. Current and Projected Wyoming PRB Coal Mine Development, Lower Production Scenario.

Subregion	Annual Production (million tons)	Cumulative Disturbed Area (acres)	Cumulative Permanently Reclaimed Area (acres)	Cumulative Active Mining Area and Unreclaimed Mined Area (acres)	Cumulative Area Disturbed and Unavailable For Reclamation[1] (acres)	Total Mine Employment	Annual Water Consumption (mmgpy)	Annual Water Production (acre-feet)
Baseline year (2003)								
North Gillette Subregion	55	12,047	3,054	3,360	5,633	746	387	586
South Gillette Subregion	77	21,249	6,783	6,107	8,359	1,174	544	1,373
Wright Subregion	231	35,498	11,401	13,992	10,105	3,090	1,709	2,295
Total for 2003	**363**	**68,794**	**21,238**	**23,459**	**24,097**	**5,010**	**2,640**	**4,254**
Reasonably Foreseeable Development for 2010								
North Gillette Subregion	62	15,231	5,004	3,968	6,260	787	441	505
South Gillette Subregion	95	28,021	12,183	6,830	9,008	1,323	656	2,072
Wright Subregion	254	55,410	27,751	16,588	11,070	3,153	1,874	4,354
Total for 2010	**411**	**98,662**	**44,938**	**27,386**	**26,338**	**5,263**	**2,971**	**6,931**
Reasonably Foreseeable Development for 2015								
North Gillette Subregion	74	17,457	6,654	4,202	6,601	830	543	505
South Gillette Subregion	112	32,356	15,683	7,314	9,359	1,369	764	2,072
Wright Subregion	281	67,423	38,851	16,983	11,589	3,186	2,077	4,354
Total for 2015	**467**	**117,236**	**61,188**	**28,499**	**27,549**	**5,405**	**3,384**	**6,931**
Reasonably Foreseeable Development for 2020								
North Gillette Subregion	78	19,729	8,429	4,350	6,950	840	569	505
South Gillette Subregion	126	36,994	19,683	7,589	9,723	1,476	845	2,072
Wright Subregion	291	80,720	51,351	17,243	12,124	3,215	2,157	4,354
Total for 2020	**495**	**137,443**	**79,463**	**29,182**	**28,797**	**5,531**	**3,571**	**6,931**

[1] Area unavailable for reclamation includes disturbed areas occupied by permanent or long-term facilities such as buildings, roads, topsoil stockpiles, etc.
Source: PRB Coal Review Task 2 Report (BLM 2005d)

Table 4-3. Current and Projected Wyoming PRB Coal Mine Development, Upper Production Scenario.

Subregion	Annual Production (million tons)	Cumulative Disturbed Area (acres)	Cumulative Permanently Reclaimed Area (acres)	Cumulative Active Mining Area and Unreclaimed Mined Area (acres)	Cumulative Area Disturbed and Unavailable For Reclamation[1] (acres)	Total Mine Employment	Annual Water Consumption (mmgpy)	Annual Water Production (acre-feet)
Baseline Year (2003)								
North Gillette Subregion	55	12,047	3,054	3,360	5,633	746	387	586
South Gillette Subregion	77	21,249	6,783	6,107	8,359	1,174	544	1,373
Wright Subregion	232	35,498	11,401	13,992	10,105	3,090	1,709	2,295
Total for 2003	**363**	**68,794**	**21,238**	**23,459**	**24,097**	**5,010**	**2,640**	**4,254**
Reasonably Foreseeable Development for 2010								
North Gillette Subregion	78	15,911	5,404	4,217	6,290	811	570	505
South Gillette Subregion	117	29,279	13,416	7,536	8,328	1,375	807	2,072
Wright Subregion	284	57,258	27,951	18,236	11,070	3,153	2,101	4,354
Total for 2010	**479**	**102,448**	**46,771**	**29,989**	**25,688**	**5,339**	**3,478**	**6,931**
Reasonably Foreseeable Development for 2015								
North Gillette Subregion	104	18,490	7,329	4,500	6,660	905	785	505
South Gillette Subregion	138	35,624	18,616	8,248	8,760	1,431	952	2,072
Wright Subregion	301	70,431	39,451	19,391	11,589	3,186	1,834	4,354
Total for 2015	**543**	**124,545**	**65,396**	**32,139**	**27,009**	**5,522**	**3,571**	**6,931**
Reasonably Foreseeable Development for 2020								
North Gillette Subregion	121	21,311	9,529	4,766	7,013	1,019	935	505
South Gillette Subregion	148	42,981	25,016	8,758	9,206	1,444	1,018	2,072
Wright Subregion	307	84,797	51,651	21,021	12,124	3,215	2,279	4,354
Total for 2020	**576**	**149,089**	**86,196**	**34,545**	**28,345**	**5,678**	**4,232**	**6,931**

[1] Area Unavailable for reclamation includes disturbed areas occupied by permanent or long-term facilities such as buildings, roads, topsoil stockpiles, etc.
Source: PRB Coal Review Task 2 Report (BLM 2005d)

above, the projected development levels shown in Tables 4-2 and 4-3 are based on projected demand and coal market forecasts, which are not affected by a decision to lease or not to lease the Eagle Butte West LBA Tract.

4.1.1.2 Coal-Related Development

Coal-related development as defined for this analysis includes railroads, coal-fired power plants, major (230-kV) transmission lines, and coal technology projects. Table 4-4 summarizes the estimated disturbance associated with coal-related development activities for the baseline year and the projected disturbance through 2020. The subsequent paragraphs summarize the existing coal-related development in the Wyoming PRB and the reasonably foreseeable development considered in the PRB Coal Review.

Table 4-4. Current and Projected Wyoming PRB Coal-Related Development Scenario.

	2003	**2010**	**2015**	**2020**
Coal-Related Disturbance (Acres)	4,891	4,966	5,911	5,911

Source: PRB Coal Review Task 2 Report (BLM 2005d)

4.1.1.2.1 Coal Transportation

As discussed above, electric utilities account for about 97 percent of Wyoming's coal sales. Most of the coal sold to electric utilities is transported to power plants by rail. The coal mines in the Wright and South Gillette subregions are served by a joint BNSF & UP rail line. The existing capacity of the line is estimated at approximately 350 mmtpy. The existing capacity of the BNSF line, which services the North Gillette subregion, including the Eagle Butte Mine, is estimated at 250 mmtpy.

The two projects related to coal transportation that are projected to be developed prior to 2020 are expansion of the BNSF & UP rail facilities south of Gillette and the construction of the DM&E rail line in Wyoming and South Dakota.

UP and BNSF are upgrading sections of their existing joint rail line, including construction of 14 miles of a third main line track completed in Spring 2005, 19 miles of a third main line track scheduled to be fully operational in September 2006, and an additional 40 miles of third and fourth main line track to be constructed by 2009. In 2005, the capacity of the BNSF & UP joint line was 325 million tons per year. The scheduled improvements will enable the joint line to handle more than 400 million tons of coal per year (UP and BNSF press release 2006). These expansion projects are considered highly likely to occur.

The proposed DM&E rail line would include new rail construction in South Dakota and Wyoming (approximately 15 and 265 miles, respectively) and 600 miles of rail line rehabilitation in South Dakota and Minnesota. Approximately 78 miles of the new rail construction would occur in the PRB study area, where

the project would provide new rail spur services to the mines in the South Gillette and Wright subregions. The STB released a final supplemental EIS for this project on December 30, 2005 and granted final approval to construct the rail line on February 15, 2006. The supplemental EIS addresses issues that were successfully appealed after an EIS was initially completed in 2001. Funding for the project is still pending. For the purposes of the PRB Coal Review, it was projected that the DM&E line would be constructed when the total rail haulage requirement from the eastern Wyoming PRB reaches 450 to 500 million tons per year and would potentially be operational by 2015. The construction of this rail line is considered moderately likely to occur.

4.1.1.2.2 Electric Power Generation

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

There are also three separate interconnected gas-fired power plants (Hartzog, Arvada, and Barber Creek) located near Gillette, Wyoming. Each contains three separate 5-MW-rated turbines that provide electric power to Basin Electric and its customers. In winter, the maximum capacity can reach 22.6-MW from each site. All units are in operating condition, although they do not operate at maximum capacity.

Several additional power plants are projected to be built prior to 2020 (Figure 1-1). Any proposed coal-fired power plant that plans to initiate operation by 2010 currently would have to be undergoing air permit review in order to obtain the required construction permits and complete construction by 2010. The following three identified projects currently are considered likely for development by 2010.

- Black Hills Power Corporation's WYGEN 2 coal-fired unit, located east of Gillette, currently is under construction and scheduled to be completed by the beginning of 2008. As originally permitted, this unit had a planned production capacity of 500-MW, which would consume approximately 2.8 million tons of coal per year. A permit modification has since dropped the initial phase to 90-MW. The facility would cover 60 acres within the existing 200-acre Black Hills Power and Light power plant area. Operation of this facility by 2010 is considered highly likely.

- North American Power Group has been working to permit and build a coal-fired power plant (Two-Elk Unit 1) since 1997 at a 40-acre site located approximately 15 miles southeast of Wright, Wyoming. Currently, the proposal is for a 320-MW coal-fired power plant. The original air

permit was issued in August 2002. The unit would be dry-cooled, requiring very little water. North American Power Group has received approval to receive several hundred million dollars in tax-exempt bonds from the state to help finance the project and is seeking additional funding. Operation of this facility by 2010 is considered moderately likely.

- Basin Electric Power Cooperative obtained a permit to construct and operate the Dry Fork Station Power Plant from the Wyoming Industrial Siting Council in June 2006. As proposed, the Dry Fork Station would be a coal-based, mine-mouth 385-MW power plant located near the Dry Fork Mine, north of Gillette. Basin Electric estimates that the plant will be operational by 2011 (WDEQ/ISC 2006). Construction and operation of this facility as scheduled is considered moderately likely.

The PRB Coal Review assumes that, under the upper development scenario, a maximum of one additional 700-MW coal-fired power plant would be constructed by 2020 in the Gillette area or near one or more of the operating coal mines. North American Power Group submitted an application in September, 2007, for a 750-MW coal-fired power plant, Two Elk 2, to be located at the same site as the proposed Two Elk plant, discussed above. Black Hills Power Corporation has also announced plans to permit the Wygen III power plant, which is planned to be similar in design to the Wygen II plant. The study assumes that all existing power plants in the PRB region would remain operational through 2020.

4.1.1.2.3 Transmission Lines

Major transmission lines in the Wyoming PRB study area that support the regional distribution system are associated with the Dave Johnston power plant located near Glenrock, Wyoming, and the power plants operated by Black Hills Power Corporation, which are located east of Gillette. These 230-kV transmission lines have been in place for several years, and their associated permanent disturbance is minimal. Distribution power lines associated with conventional oil and gas and CBNG development also occur within the study area. For the PRB Coal Review, these lines were included by factoring them in proportionally on a per well basis.

The PRB Coal Review estimates that by 2020, one major transmission line would be constructed running south to Colorado markets and one would be constructed eastward to mid-west markets. Markets would dictate the size and location of such facilities, and these are not known as of this time. Because transmission lines are a necessary supporting infrastructure for power generating facilities to provide connection to the grid, the PRB Coal Review assumes they would be required as part of the overall system development for the proposed power plants discussed in the previous section. However, there was insufficient information to analyze or assign a likelihood of development by 2020 when the PRB Coal Review analysis was conducted because no specific proposals for these transmission lines had been identified at that time. No

specific proposals have since been announced, but the governors of California, Nevada, Utah and Wyoming entered into a Memorandum of Understanding to encourage development of a high voltage power transmission line, the Frontier Line, connecting those states in April 2005. Since that time, no specific plans have been announced as to the location or timing of the Frontier Line.

4.1.1.2.4 Coal Conversion Technology

With rising energy prices, there has been considerable interest in either enhancing the quality of PRB coal and/or converting the coal to other fuels. Test facilities were previously constructed by KFx at the Fort Union Mine (now part of the Dry Fork Mine), by AMAX (predecessor to Foundation Coal West, Inc.) at the Belle Ayr Mine, and by ENCOAL at the Buckskin Mine, but no commercial production occurred and these facilities either have been dismantled or are no longer in use. Although several coal conversion projects have been proposed, as discussed below, only one (the KFx Coal Beneficiation Project) was considered to have a high enough likelihood of proceeding to include in the PRB Coal Review based on current status and available information.

The KFx coal beneficiation plant, located near the Dry Fork Mine north of Gillette, has been constructed but is not running at full capacity. KFx reported making a production run and shipping coal to two customers for test burns in late December, 2005, and reported that a trainload of enhanced coal had been loaded and sent to a customer in Ohio in August 2006. It is expected that the plant would eventually produce approximately 750,000 tons of enhanced coal per year. This operation has a high likelihood of proceeding with production given the technology being used and the forecast market conditions in the PRB. If the process and market prove competitive, the company has suggested that up to five additional units could be built in the PRB, but the likelihood for development of additional units is not known. As a result, the potential development of additional units was not analyzed in the PRB Coal Review.

The following coal conversion projects have been proposed, but were not included in the PRB Coal Review analysis because the likelihood of their occurrence was not known when the coal review analysis was conducted:

- Medicine Bow Fuel and Power, a subsidiary of DKRW Energy LLC, has announced that it plans to build a coal-to-liquids plant in northern Carbon County, Wyoming. GE Energy and Rentech Clean Energy Solutions are also involved in the project, which would obtain coal from Arch Coal's Hanna Mine facility. Both the plant location and mine are located outside of the PRB. As proposed, the plant would produce about 11,000 barrels per day; the primary product would be ultra-low-sulfur diesel fuel. The project is entering the design stage and no construction schedule has been announced.

- KFx has proposed joint ventures with Arch Coal, Inc. and Kiewit Mining Group to develop beneficiation plants at the Coal Creek and Buckskin Mines, respectively. The companies are evaluating these projects.

- Coal gasification development projects are being actively pursued in both Montana and Wyoming. While there appears to be substantial interest in these opportunities, it is unknown whether large-scale operations would be developed within the 2010 to 2020 timeframe, given permitting, engineering, and construction time requirements. A proponent with adequate financing to pursue a project that would utilize PRB coal had not been identified when the PRB Coal Review was prepared and has not been identified since.

A summary of past, present, and reasonably foreseeable coal mines, coal-related facilities, coal production, coal mine employment, and coal and coal-related disturbance in the Wyoming PRB is presented in Table 4-5.

Table 4-5. Past, Present, and Projected Wyoming PRB Coal Mine and Coal-Related Development Scenario.

Year	Coal Production (mmtpy)	Number of Active Coal Mines[1]	Number of Active Power Plants	Number of Active Coal Conversion Facilities[2]	Direct Coal Mine Employment	Total Coal Disturbance (acres)[3]
Past and Present						
1990	163	18	3	1	2,862	na
1995	247	19	4	1	3,177	na
2000	323	12	4	2	3,335	na
2003	363	12	4	0	5,010	73,685
Projected Development - Lower Production Scenario						
2010	411	13[1]	7	1[2]	5,263	103,628
2015	467	13[1]	7	1[2]	5,405	123,147
2020	495	13[1]	7	1[2]	5,531	143,354
Projected Development - Upper Production Scenario						
2010	479	13[1]	7	1[2]	5,339	107,414
2015	543	13[1]	7	1[2]	5,522	130,456
2020	576	13[1]	8	1[2]	5,678	155,000

[1] Mines have consolidated and may in the future. Also, new mines may be permitted to better access the coal reserves projected for mining by 2020.

[2] Several coal conversion facilities currently are being evaluated; however, there is only one for which the likelihood of future development currently can be assessed.

[3] Disturbance area includes coal mine and coal-related disturbance areas.

Source: Annual Report of the Wyoming State Mine Inspector (Wyoming Department of Employment 1990, 1995, 2000, and 2003) and PRB Coal Review Task 2 Report (BLM 2005d)

4.1.2 Oil and Gas Development

4.1.2.1 Conventional Oil and Gas

Conventional oil and gas development includes all non-CBNG development activity. Approximately 1,500 conventional oil and gas wells, including producing, non-producing and injection wells, were drilled between 1990 and 2003 (IHS 2004). Of those, 60 percent were development wells (drilled in established producing areas) and 40 percent were classified as wildcat wells or drilled to evaluate untested prospective zones in producing areas. Approximately 25 percent of the wildcat wells were successful and resulted in the discovery of 61 new fields that provided 719,000 barrels of oil and 1.45 bcf of non-CBNG in the baseline year for the PRB Coal Review (2003) (WOGCC 2004); the remaining 75 percent of the wildcat wells were plugged and abandoned.

As of the end of 2003, there were approximately 3,500 producing conventional oil and gas wells in the Wyoming PRB study area plus 1,386 seasonally active wells (IHS 2004). The WOGCC reported that these wells produced approximately 13 million barrels of oil and 40 bcf of conventional gas in 2003 (WOGCC 2004). The USGS (2002) estimated that the mean undiscovered non-coal bed hydrocarbon resource in the PRB (including Montana) is 1.8 billion BOE.

Most of Wyoming's current oil production is from old oil fields with declining production and the level of exploration drilling to discover new fields has been low (WSGS 2002). This situation is reflected in the PRB where, over the 10-year period from 1992 through 2002, oil production from conventional oil and gas wells in Campbell and Converse Counties decreased approximately 60.4 percent (from 32.8 million barrels in 1992 to 13.0 million barrels in 2002). A recent increase in oil prices is reversing projections of a continuing decline in oil and gas production; production is now expected to increase in the PRB, with a peak around 2010 of approximately 15.7 million barrels (WSO-RMG 2005b). Oil production in the short term may also be bolstered by some planned CO_2 flood projects in the PRB (WSGS 2003b). This projected temporary upward trend in conventional oil and gas development is reflected in the PRB Coal Review projections (Table 4-6). The active wells identified in Table 4-6 include wells that produce year-round, seasonally producing wells, and service wells (mainly injection wells). It is estimated that there are approximately 2,000 idle conventional oil and gas wells in the PRB study area (WOGCC 2005c); however, the number of idle wells gradually would be reduced in the future through plugging programs, and the idle well locations (once the wells are abandoned) would be reclaimed and no longer represent a disturbance.

4.1.2.2 CBNG Development

Natural gas production has been increasing in Wyoming. In the PRB, this is due to the development of shallow CBNG resources. Commercial development of these resources began in limited areas west of and adjacent to the northernmost surface coal mines in the late 1980s. Since that time, CBNG development has

Table 4-6. Current and Projected Wyoming PRB Conventional Oil and Gas Development Scenario.

Category	Existing		Projected for Task 3 Study Area		
	2003 Task 1 Study Area	2003 Task 3 Study Area	2010	2015	2020
Annual Gas Production (bcf)[1]	39.9	36.3	33.8	30.9	28.0
Annual Oil Production (mmbo)	12.9	11.4	13.8	12.5	11.2
Active and Seasonably Active Wells	5,067	3,890	5,603	5,115	4,625

[1] Future gas production per well was estimated based on 2003 production levels per subwatershed. A greater number of future well sites were assumed to occur in locations with historically lower production rates, so the projected future conventional gas production varies within the cumulative effects study area relative to the number of projected producing wells.

Source: PRB Coal Review Task 2 Report (BLM 2005d)

spread south to encompass most of the area west of the surface coal mines and is continuing to spread farther west into other parts of the PRB Coal Review Task 1 and Task 2 study area.

On private and state oil and gas leases, the WOGCC and the Wyoming SEO authorize CBNG drilling. On federal oil and gas leases, BLM must analyze the individual and cumulative environmental impacts of all drilling (federal, state, and private), as required by NEPA, before CBNG drilling can be authorized. BLM does not authorize drilling on state or private leases but must consider the impacts from those wells in their NEPA analyses. In many areas of the PRB, the coal estate is federally owned, but the oil and gas estate is privately owned. A June 7, 1999 Supreme Court decision (98-830) assigned the rights to develop CBNG on a piece of land to the owner of the oil and gas estate.

At the end of 2003 (the baseline year for the PRB Coal Review), 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 (96,600 million gallons). Annual methane production increased rapidly between 1999 and 2003. In 2003, the average CBNG production was 900 mmcf per day (Holcomb 2003). According to the WOGCC website (http://wogcc.state.wy.us), CBNG production in the PRB has fluctuated from just under 900 mmcf per day to over 1,100 mmcf per day since December 2003. Water production in 2003 amounted to more than 500 mm barrels (21,000 million gallons), or about 1.4 mm barrels per day. According to the WOGCC website, water production in the PRB associated with CBNG production has varied between just over 1.4 mm barrels per day and about 2.2 mm barrels per day since December 2003.

Since the early 1990s, the Wyoming BLM has completed numerous EAs and two EISs analyzing CBNG projects. The most recent of these is the four-volume Final EIS and Proposed Plan Amendment for the PRB Oil and Gas Project, which was completed in January 2003 (BLM 2003b). The level of CBNG development since 2003 appears to be lower than was forecast in that document. New CBNG well numbers fell from a high of slightly more than 4,600 in 2001 to approximately 2,000 in 2004. The PRB Coal Review Task 2 Report discusses the uncertain trends for future CBNG activity in recent years. The methodology used to project future activity is detailed in Appendix E of that report. Table 4-7 shows the current and projected levels of CBNG development levels used to evaluate projected cumulative environmental impacts in the PRB Coal Review.

Table 4-7. Current and Projected CBNG Development Scenario for the Wyoming PRB.

	Existing		Projected to Task 3 Study Area		
Category	**2003 Task 1 Study Area**	**2003 Task 3 Study Area**	**2010**	**2015**	**2020**
Annual Production (bcf)	338	284	480	500	443
Active Wells	14,758	12,152	20,899	21,831	19,366

Source: PRB Coal Review Task 2 Report (BLM 2005d)

4.1.2.3 Oil and Gas Related Development

Oil and gas related development activities considered in the PRB Coal Review include major transportation pipelines and refineries. Table 4-8, summarizes the net disturbance, reclamation, and water production associated with oil and gas activity (conventional oil and gas, CBNG, and major transportation pipelines) for 2003 (baseline year) and projects disturbance, reclamation, and water production for future years.

4.1.2.3.1 Pipelines

The availability of pipeline capacity for the transport of oil and gas to outside markets is a key factor in the development of CBNG and conventional oil and gas resources in the Wyoming PRB. As of the baseline year for the PRB Coal Review (2003), there were 13 major transportation pipeline systems in the PRB that transport gas resources to markets outside of the basin (Flores et al. 2001). The capacity of these pipeline systems was 1.9 bcf per day. The combined natural gas production (CBNG and conventional gas) in the Wyoming PRB Coal Review Task 1 and Task 2 study area was approximately 1.03 bcf per day.

Major transportation pipelines also provide for transport of CO_2 to conventional oil fields for EOR. Increased recovery of crude oil also may depend somewhat on the availability of CO_2 for EOR projects, as well as the availability of pipelines to transport oil to refineries for processing.

Table 4-8. Wyoming PRB Conventional Oil and Gas, CBNG, and Related Development Disturbance and Water Production.

	Existing[1]		Projected for Task 3 Study Area[1]		
Category	**2003 Task 1 Study Area**	**2003 Task 3 Study Area**	**2010**	**2015**	**2020**
Cumulative Disturbed Area (Acres)[2]	187,761	148,602	237,883	304,543	361,331
Cumulative Permanently Reclaimed Area (Acres)	115,045	90,548	160,175	225,426	288,536
Cumulative Unreclaimed Area (Acres)	72,715	58,053	77,707	79,108	72,794
Annual Water Production (mmgpy)	26,405	21,204	39,108	41,484	37,350

[1] Minor discrepancies in total acreages are the result of number rounding.
[2] Inclusive of conventional oil and gas and CBNG activities and major transportation pipelines. Disturbance associated with ancillary facilities (including gathering lines and distribution power lines) has been factored in a per well basis.
Source: PRB Coal Review Task 2 Report (BLM 2005d)

Gathering lines and power lines associated with conventional oil and gas and CBNG development also occur within the study area; disturbance from these ancillary facilities were factored into the PRB Coal Review analysis on a per well basis.

A 315-mile-long pipeline project, the Bison Pipeline Project, was proposed in 2004 to move natural gas northward, directly out of the PRB and into the Northern Border Pipeline system (FERC 2004). Approximately 53 miles of the proposed route is within the Wyoming PRB Coal Review study area. No filing has been made with FERC, and the project is not included as an active project in Wyoming on the FERC website. As a result, the Bison Pipeline project was assumed to have a low likelihood rating for the purposes of the PRB Coal Review.

Several other proposed pipeline projects in the PRB are listed on the Wyoming Pipeline Authority projects website (http://www.wyopipeline.com/projects.asp, accessed 7/6/2007). Information on pipeline projects proposed in Wyoming can be also found in the "For Citizens" section of the Federal Energy Regulatory Commission website (http://www.ferc.gov/for citizens.asp).

The amount of available pipeline capacity could limit the amount of future CBNG development. Based on Holcomb (2003), estimates of the growth of Wyoming PRB CBNG production range from a 2003 level of 900 mmcf per day to 3 to 4 bcf per day around 2007, and it is anticipated that they would remain at or above those levels until 2015. If CBNG production levels reach 3 to 4 bcf per day, it is reasonable to assume that four to five pipeline projects (up to 1.0 bcf

per day total capacity each) could be built in the near future. However, based on the assumptions in Appendix E of the PRB Coal Review Task 2 Report, the 2003 basin-wide CBNG production rate of 927 mmcf per day (IHS 2004) is projected to reach approximately 1.7 bcf per day in 2020. New pipeline construction projects were not considered in the PRB Coal Review analysis because the likelihood for additional new pipeline construction was unknown when the PRB Coal Review was prepared.

The CO_2 pipeline from Bairoil, Wyoming, to Salt Creek, Wyoming, may be extended into the study area to the Sussex Field to support additional EOR activity. Although it took many years for a CO_2 source to reach the Wyoming PRB, it is very likely that several pipelines could be built in the study area in the near future to provide additional gas for EOR projects. However, no pipeline projects were identified that would transport CO_2 beyond Salt Creek, and the likelihood for construction of additional CO_2 pipelines was unknown when the PRB Coal Review analysis was prepared, so they were not considered.

4.1.2.3.2 Refineries

There are no existing petroleum refineries in the Wyoming PRB study area, and no plans for the construction and operation of any petroleum refineries in the Wyoming portion of the PRB have been identified.

4.1.3 Other Development Activity

4.1.3.1 Other Mining

Uranium, sand, gravel, bentonite, and clinker (or scoria) have been and are being mined in the Wyoming PRB study area.

There are three defined uranium districts in the PRB: Pumpkin Buttes, Southern Powder River, and Kaycee (BLM 2003b). Numerous mined out or uneconomic uranium mining sites are present in these districts. Uranium is currently produced in the Southern Powder River District using the in-situ leach method. Until recently, there were two operating in-situ uranium recovery sites in the PRB, but they have been combined into one operation (WSGS 2005c). There has been a recent increase in interest in uranium for power plants here and abroad. Claims have been actively staked, but they have primarily been land position plays with no specifically defined projects. Based on commodity forecasts and uranium activity as of June 2004, the likelihood and potential timing of new uranium mining operations in the PRB was not known, and additional development was not projected in the PRB Coal Review analysis.

Bentonite is weathered volcanic ash that is used in a variety of products, including drilling mud and kitty litter, because of its absorbent properties. There are three major bentonite producing districts in and around the PRB: the Colony District in the Northern Black Hills, the Clay Spur District in the Southern Black Hills, and the Kaycee District west of Kaycee, Wyoming. Within

the PRB Coal Review study area, bentonite is mined at Kaycee (WMA 2006). The PRB Coal Review assumed that bentonite mining would continue throughout the study period and that production would continue at existing active mines, with no new mines developed through 2020.

Aggregate, which is sand, gravel, and stone, is used for construction purposes. In the PRB, the more important aggregate mining localities are in Johnson and Sheridan Counties (WSGS 2004b). The largest identified aggregate operation is located in northern Converse County. It has an associated total disturbance area of approximately 67 acres, of which four acres have been reclaimed.

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

Increased sand, gravel, and scoria production and associated surface disturbance are anticipated in the Wyoming PRB study area in the future because aggregate would be required for road maintenance and new construction activities as other primary resources, such as coal and oil and gas, continue to be developed. New operations and increased production from existing operations can be expected. These operations would vary in size based on the immediate need from the primary industries, but there is no specific information about these projected operations. As a result, new sand, gravel, or scoria operations were not analyzed in detail in the PRB Coal Review.

4.1.3.2 Industrial Manufacturing

There are a number of existing industrial manufacturing establishments located in the Wyoming PRB Coal Review study area. Most are relatively small with fewer than 25 employees; they predominately serve regional and local markets, and most are directly or indirectly related to energy resource development and production. Over the years, some of these firms have expanded such that they now support activities and serve markets outside of the region, but those operations remain dependent upon the local and regional markets to sustain their existing operations.

The PRB Coal Review anticipates that increased coal production would result in an increased demand for fuels and explosives. This increased demand could result in the need for the development of new off-site chemical feedstock plants in the study area. Project-specific information is not available, however, and the potential development of new chemical feedstock plants was not considered in the PRB Coal Review.

Local economic development organizations, including CCEDC and CANDO, are continually engaged in efforts to recruit or assist new business formation in the PRB study area. For example, CANDO has pursued development of long-term potential projects, however, the outcomes of those projects are uncertain and

little information and detail are available. As a result, they were not considered in the PRB Coal Review.

4.1.3.3 Reservoirs

Currently, there are five key water storage reservoirs in the Wyoming PRB Coal Review study area (Healy, Lake DeSmet, Muddy Guard No. 2, Gillette, and Betty No. 1) (HKM Engineering et al. 2002a and 2002b). The total disturbance associated with these five key water storage areas is 3,263 acres.

Based on the applicable water plans prepared for the Wyoming Water Development Commission for its Basin Planning Program (HKM Engineering et al. 2002a and 2002b), there are long range projections for development of additional reservoirs in the Wyoming PRB study area. However, none of these reservoirs have reached the planning stage; therefore, there was not enough information to analyze them in the PRB Coal Review.

4.1.3.4 Other Non-Energy Development

In addition to the specific projects and developments described above, a network of public and private physical infrastructure, private enterprises, and public activities has been developed in the PRB over time. Examples of infrastructure include the highway and road networks, airports, government offices, hospitals, public schools, municipal water systems, and extensive residential and commercial real estate development. Private enterprises include local retail and service establishments, newspaper publishing, and transportation and distribution firms.

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.

Some of the identified current and anticipated plans or proposals for future investment in public, private, and commercial infrastructure in the PRB are summarized below.

- The WYDOT State Transportation Improvement Program for 2004 includes anticipated 2005 through 2009 construction costs for highway and airport maintenance, reconstruction, and improvement projects in the PRB Coal Review Study area of approximately $215.4 million. No construction of new highways is scheduled and no new airports are proposed between now and 2009.

- A $10.7 million expansion and renovation of the Campbell County courthouse was completed in late 2005.

- Expansion of the CAM-PLEX conference and multi-event center facility in Gillette was approved in a special election in May 2005.

- The 2005 approved master plans for Wyoming public school facilities spending included a total of $72.3 million in new capital construction for the seven school districts that are completely or partially in the Wyoming PRB study area (WSFC 2005).

- Construction and maintenance projects for the City of Gillette include a recently completed project to renovate and expand the waste water treatment plant.

- Commercial development includes recently completed construction of a Home Depot store and expansion of the Wal-Mart store in Gillette.

A capital facilities tax ballot question in Campbell County in the 2004 election asking voters to approve the imposition of a $0.01 sales and use tax [(to be used for updated and expanded diesel mechanic and welding programs at the Gillette Campus of the Northern Wyoming Community College (now Gillette College) and for two community development projects in Wright)] and an increase in the lodging tax were defeated in 2004. A renewed attempt to get the lodging tax on the ballot for the 2006 primary election failed to gain the approval of the Campbell County Board of Commissioners. In their 2007 session, the Wyoming Legislature committed to pay half of the cost of a technical education center at Gillette College that will house diesel technology, welding and industrial electrician programs. The Campbell County Board of Commissioners has approved a tax increase to pay the other half of the cost of the project.

Given the timing, scale, year-to-year variability, relatively short construction timetables associated with such investments, the existence of a relatively large and diversified construction industry in the region and nearby areas, and the limited potential for these projects to alter long-term conditions in the PRB, they are not included in the PRB Coal Review analysis. However, one or more of these and similar projects could warrant consideration in a cumulative analysis for a site-specific project due to proximity or coincidental project schedules and timetables.

4.2 Cumulative Environmental Consequences

Section 4.1 of this chapter discusses current and projected levels of development in the Wyoming PRB, and includes summaries of the results of PRB Coal Review Task 2 studies. This section summarizes the current conditions resulting from baseline year (2003) development and the cumulative environmental consequences of the projected development for 2010, 2015, and 2020 based on the results of the analyses conducted for PRB Coal Review Task 1 and 3 reports, respectively.

As discussed in Section 4.1, the Wyoming portion of the PRB is the primary focus of the PRB Coal Review analyses. For the majority of resources in the Task 1 analysis, the Wyoming PRB Coal Review study area encompasses all of Campbell County, all of Sheridan and Johnson Counties outside of the Bighorn National Forest, and the northern portion of Converse County (Figure 4-1). The study areas for the Task 3 analyses are different. For the majority of the resources considered in the PRB Coal Review, the Task 3 study area is based on watershed boundaries in the PRB and includes the portions of the Upper Powder River, Little Powder River, Upper Belle Fourche River, Upper Cheyenne River, Antelope Creek, and Dry Fork Cheyenne River subwatersheds that lie within Sheridan, Johnson, Campbell and northern Converse Counties (Figure 4-4). This study area includes over 4 million acres. Table 4-9 summarizes the total disturbance and reclamation acreages for the baseline year of 2003 and the total projected disturbance and reclamation acreages for 2010, 2015, and 2020 within the Task 3 study area described above.

A total of approximately 220,688 acres of this land area had been disturbed by development activities as of 2003, which represents about 5.6 percent of the Task 3 study area. This is projected to increase to as much as 514,732 acres in 2020 under the upper coal production scenario. This area would represent approximately 13.1 percent of the Task 3 study area. This disturbance includes projected coal mining, coal-related development, and oil and gas and relate development disturbance in the Task 3 study area. Areas reclaimed during each future time period shown in Table 4-9 reflect how much of the disturbed acreage is projected to be permanently reclaimed by that point in time. The acres of unreclaimed disturbance would be reclaimed incrementally or following a project's completion, depending on the type of development activity and permit requirements. The acres currently not available for reclamation are occupied by long-term facilities that are needed to conduct mining operations or coal-related activities. These areas would be reclaimed near the end of each mine or facility's life.

Adjustments were made to the study area described above and shown in Figure 4-4 for several resources as described below:

- The potential air quality impacts were evaluated over a multi-state area (including most of Wyoming, southeastern Montana, southwestern North Dakota, western South Dakota, and northwestern Nebraska) because they would be expected to extend beyond the Wyoming and Montana PRB study area that was used to identify emissions sources for the air quality analysis.

- The groundwater drawdown was evaluated in the area surrounding and extending west of the surface coal mines, shown in Figure 4-4, because that is the area where groundwater drawdown related to surface coal mining operations and CBNG production operations would overlap.

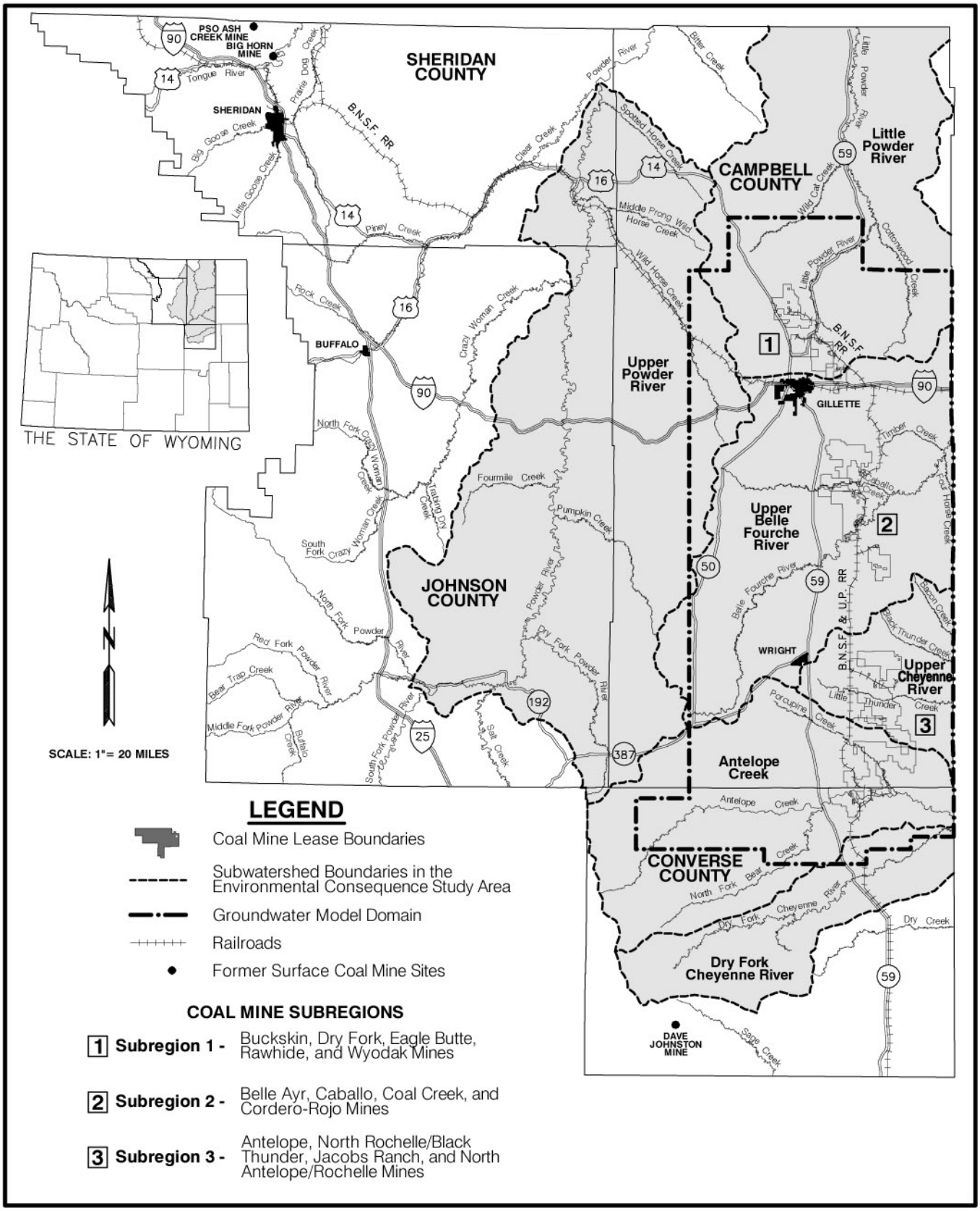


Figure 4-4. Wyoming Task 3 Study Area for PRB Coal Review Studies Evaluating Projected Environmental Consequences.

Table 4-9. Current and Projected Wyoming PRB Total Development Scenario – Task 3 Study Area.

Year	Total Acres Disturbed[1]	Acres Reclaimed[1]	Acres Unreclaimed[1]	Acres Unavailable for Reclamation[2]	Acres Affected by Coal Mining
			Current		
2003	220,688	111,786	108,901	27,073	68,794
			Projected Development - Lower Coal Production Scenario		
2010	339,912	205,113	134,799	29,389	98,662
2015	426,084	286,614	139,472	31,546	117,236
2020	503,085	367,999	135,085	32,794	137,443
			Projected Development - Upper Coal Production Scenario		
2010	343,698	206,946	136,752	28,739	102,448
2015	433,392	290,822	142,570	31,006	124,545
2020	514,732	374,732	139,998	32,342	149,089

[1] Minor discrepancies in total acreages are the result of number rounding.
[2] Includes coal mine and coal-related disturbance.
Source: PRB Coal Review Task 2 Report (BLM 2005d)

- The socioeconomic impact analysis focused on Campbell County, but also considered Converse, Crook, Johnson, Sheridan, and Weston Counties as directly affected and Niobrara and Natrona Counties as indirectly affected.

4.2.1 Topography and Physiography

The PRB is located within the Upper Missouri Basin Broken Lands physiographic subprovince that includes northeastern Wyoming and eastern Montana to the Canadian border. The topography generally is of low to moderate relief with occasional buttes and mesas. The general topographic gradient slopes down gently from southwest to northeast with elevations ranging from 5,000 to 6,000 ft above sea level on the southern and western portions of the basin to less than 4,000 ft above sea level on the north and northeast along the Montana state line. The major drainages in the basin are the Tongue, Powder, Belle Fourche, and Cheyenne rivers. Most of the drainages in the area are intermittent and have flows during high precipitation events or during periods of snowmelt. The drainages are part of the upper Missouri River Valley drainage basin.

The disturbance associated with the majority of the past, present, and projected activities have resulted in or would result in the alteration of the surface topography. Surface coal mining, which is projected to continue in the area of the existing coal mines shown in Figure 4-4, permanently alters the topography by removing the overburden and coal and then replacing the overburden. Recontouring during reclamation to match approximate original contour, as required by regulation, reduces the long-term impact to topography. After mined-out areas are reclaimed, the restored land surfaces are typically gentler, with more uniform slopes and restored basic drainage networks. Oil and gas exploration and development has occurred and is projected to continue

throughout most of the Task 3 study area. It also results in the alteration of topography to accommodate facilities (e.g., well pads, power plants, etc.) and roads, but the disturbance tends to occur in smaller, more discrete areas than coal mining and the development is spread out over a wider area.

The disturbance and reclamation acreages associated with all existing and projected development in the Task 3 study area for the years 2003, 2010, 2015, and 2020 are given in Table 4-9.

4.2.2 Geology, Mineral Resources, and Paleontology

The cumulative effects study area for geology, mineral resources, and paleontology is the PRB Coal Review Task 3 study area (Figure 4-4).

The PRB is one of a number of structural basins in Wyoming and the Rocky Mountain area that were formed during the Laramide Orogeny. The basin is asymmetric with a structural axis that generally trends northwest to southeast along the western side of the basin (Flores et al. 1999). Earthquakes, landsides, and subsidence do not present a hazard in the PRB based on the lack of active faults in the study area (USGS 2004); the low risk of ground shaking in the region if a maximum credible earthquake were to occur (Frankel et al. 1997); and the absence of evidence of subsidence, landslides, or other geologic hazards in association with CBNG production.

4.2.2.1 Coal

Most of the coal resources of the basin are found in the Fort Union and Wasatch Formations. The coals present in the Wasatch Formation are thinner and less continuous than the coals in the Fort Union and, therefore, they are not as economically important as the coals in the Fort Union for either coal mining or CBNG development. Projected levels of coal production and disturbance under the lower and upper coal production scenarios are shown in Tables 4-2 and 4-3.

In the coal mine areas, the overburden and coal would be removed and the overburden replaced, resulting in a permanent change in the geology of the area and a permanent reduction of coal resources.

4.2.2.2 Oil and Gas

Drilling for conventional oil and gas in the Wyoming PRB has declined considerably in the last 15 years. However, there remains potential for finding and developing these resources in the deeper formations of the basin. Conversely, CBNG production increased rapidly from 1999 through 2002 and leveled off in 2003. Projected production rates for conventional oil and gas and CBNG in 2010, 2015, and 2020 are shown in Tables 4-6 and 4-7.

Oil and gas and related development accounts for most of the projected mineral disturbance outside of the coal mining areas. It generally would result in

shallow, discrete areas of surface disturbance, as discussed above. The acreages over which these impacts currently occur (as of 2003) and are projected to occur in the years 2010, 2015, and 2020 are shown in Table 4-9.

4.2.2.3 Other Mineral Resources

As discussed in Section 4.1.3.1, other mineral resources that are being mined in the Wyoming PRB include uranium, bentonite, clinker, and aggregate. Production of uranium and bentonite is not likely to be affected by development of coal or CBNG in the PRB. Aggregate and clinker production levels are more likely to be affected by other mineral development levels because these resources would be used in construction projects related to other mineral development.

4.2.2.4 Paleontology

Scientifically significant paleontological resources, including vertebrate, invertebrate, plant, and trace fossils, are known to occur in many of the geologic formations within the Wyoming PRB. These fossils are documented in the scientific literature, in museum records, and are known by paleontologists and land managers familiar with the area.

The Wasatch Formation is the most geographically widespread unit exposed on the surface over most of the Task 3 study area. It is underlain by the Fort Union Formation. The fossiliferous Morrison and Lance Formations outcrop in the western portion of the basin but occur at depth in the vicinity of the coal mines and CBNG activity in the eastern portion of the basin. Within the Task 3 study area, the highly fossiliferous White River Formation occurs only on Pumpkin Buttes in southwestern Campbell County.

Based on 2003 information, no significant or unique paleontological localities have been recorded on federal lands in the PRB. However, the lack of localities in the PRB does not mean that no scientifically significant fossils are present, as much of the area within and surrounding the PRB has not been adequately explored for paleontological resources. As a result, development activities in the Task 3 study area have the potential to adversely affect scientifically significant fossils, if they are present in or adjacent to disturbance areas. The potential for impacts to scientifically significant fossils would be greatest in areas where Class 4 or 5 formations are present (see Section 3.3.3.1). The Wasatch Formation is classified as a Class 5 formation. The Fort Union Formation is classified as a Class 3 formation, which means that fossil content varies in significance, abundance, and predictable occurrence. The greatest potential impact to surface and subsurface fossils would result from disturbance of surface sediments and shallow bedrock during construction and/or operations, depending on the type of project. Potential subsurface disturbance of paleontological resources (e.g., during drilling operations) would not be visible or verifiable. The areas over which these impacts occurred as of 2003 and are projected to occur as a result of all projected development in the years 2010, 2015, and 2020 are shown in Table 4-9. As only portions of the Task 3 study

area have been evaluated for the occurrence of paleontological resources, and discrete locations for development activities cannot be determined at this time, no accurate estimate can be made as to the number of paleontological sites that may be affected by cumulative development activities.

Development activities which involve federally owned surface and/or minerals are subject to federal guidelines and regulations protecting paleontological resources. Protection measures, permit conditions of approval, and/or mitigation measures would be determined on a project-specific basis at the time of permitting to minimize potential impacts to paleontological resources as a result of these activities.

4.2.3 Air Quality

The Task 1A Report for the PRB Coal Review (BLM 2005a) documents the modeled air quality impacts of operations during a baseline year, 2002, using actual emissions and operations for that year. Emissions from permitted minor sources were estimated, due to unavailability of actual emissions data. The baseline year analysis evaluated impacts both within the PRB itself and at selected sensitive areas surrounding the region. The analysis specifically looked at impacts of coal mines, power plants, CBNG development, and other development activities. Results were provided for both Wyoming and Montana at the individual receptor areas. The Task 2 Report for the PRB Coal Review (BLM 2005d) identifies reasonably foreseeable development activities for the years 2010, 2015, and 2020. The Task 3A Report for the PRB Coal Review (BLM 2006b) evaluates the impacts on air quality and air quality-related values for the year 2010 using the development levels projected for 2010 and the same model and meteorological data that were used for the baseline year study in the Task 1A report. Impacts for 2015 and 2020 were projected qualitatively based on evaluation of anticipated changes in emissions and on modeled impacts for the 2010 lower and upper production scenarios. BLM is now proposing to update the model and conduct an impact analysis for the year 2015. As currently proposed, a revised baseline year emissions inventory would be developed using 2004 actual emissions data or emissions estimates and incorporating recent analyses of emissions in Wyoming and Montana, which were not available when the 2010 modeling study was done.

Existing and projected emissions sources for the baseline year (2002) and 2010 analyses were identified within a study area comprised of the following counties in the PRB in Wyoming and Montana:

- Campbell County, all of Sheridan and Johnson Counties except the Bighorn National Forest lands to the west of the PRB, and the northern portion of Converse County, Wyoming.

- Rosebud, Custer, Powder River, Big Horn, and Treasure Counties, Montana.

A state-of-the-art, guideline dispersion model was used to evaluate impacts of the existing and projected source emissions on several source groups, as follows:

- Near-field receptors in Wyoming and Montana covering the PRB Coal Review Task 1A and 3A study area in each state. Overall, the near-field receptor grid points were spaced at one kilometer intervals over the study area;

- Receptors in nearby federally designated pristine or "Class I" areas; and

- Receptors at other sensitive areas (Class II sensitive areas).

The EPA guideline CALPUFF model system (Scire et al. 1999a) and the same meteorological data set were used for the Task 1A and Task 3A studies. The impacts for the baseline year (2002) and for 2010 lower and upper coal production scenarios were directly modeled. As discussed above, the modeling domain extends over most of Wyoming, southeastern Montana, southwestern North Dakota, western South Dakota, and western Nebraska. An interagency group participated in developing the modeling protocol and related domain that were used for this analysis.

The modeling approach for the Task 3A report used actual emissions from existing sources representative of 2002 operations and adjusted those emissions for the expected level of development in 2010. No specific emissions data were available for the projected levels of development. The baseline year emissions data were gathered from a variety of sources, but mainly relied on data collected by the WDEQ/AQD and the MDEQ. Only actual emission sources inside the study area described above were included in the modeling. Key major sources were included, such as the coal-fired power plants, gas-fired power plants, and sources that were included in the Title V (operating permit) program. The Dave Johnston power plant, which is located outside of but adjacent to the study area in Converse County, was included in the baseline year study and in the projected emissions. Some operational adjustments were made to accommodate small sources with air permits that were presumed to be operating at less than full capacity. Emissions from other sources, including estimated construction-related fugitive dust emissions, were computed based on EPA emission factors and on input data from WDEQ/AQD.

Meteorological data were developed for 1996 for the modeling domain, using the guideline Version V of the CALMET (Scire et al. 1999b) diagnostic model, identical to that used in the PRB Oil and Gas EIS Project (BLM 2003b) and in the Task 1A report. These data provide a four-dimensional depiction that represents actual meteorological conditions for that year. The data baseline was enhanced by using data for specific surface stations and precipitation data. Terrain and land use data from the USGS also were used. Modeling data settings generally were set to default values. Baseline year ozone concentrations also were incorporated into the model using measured concentrations representative of the study area, and were not changed for this study.

The existing regional air quality conditions generally are very good in the PRB Coal Review Task 1A and Task 3A study area. There are limited air pollution emissions sources (few industrial facilities, including the surface coal mines, and few residential emissions in relatively small communities and isolated ranches) and good atmospheric dispersion conditions. The available data show that the region is in compliance with the ambient air quality standards for NO_2 and SO_2. There have been no monitored exceedances of the annual PM_{10} standard in the Wyoming PRB, although, as discussed in Chapter 3 (Section 3.4.2.1.1), monitoring sites at some of the surface coal mines have shown some exceedances of the 24-hour PM_{10} standard since 2000. However, as also discussed in Chapter 3, there have been no monitored exceedances of the annual or 24-hour PM_{10} ambient air standard at the Eagle Butte Mine. Air quality modeling indicates the currently projected mine activities at the Eagle Butte Mine will be in compliance with the PM_{10} ambient air standards for the life of the mine at the permitted mining rate of 35 mmtpy, and the applicant proposes to mine at an average rate of 25 mmtpy during the time the Eagle Butte West LBA Tract would be mined. Visibility data colleted around the region indicate that, although there are some days with notable impacts at Class I areas, the general trend in the region shows little change in visibility impacts at Badlands National Park and at the Bridger Wilderness area over the period from 1989 to 2003 (Figure 3-9).

Predicted impacts from baseline year (2002) and projected 2010 emissions were modeled for three air quality criteria pollutants (NO_2, SO_2, and PM_{10}), along with changes in air quality-related values at Class I areas and at identified sensitive areas. For regulatory purposes, the Class I PSD evaluations are not directly comparable to the air quality permitting requirements, because the modeling effort does not identify or separately evaluate increment consuming sources that would need to be evaluated under the PSD program. The cumulative impact analysis focuses on changes in cumulative impacts instead of on a comparison to PSD-related evaluations, which would apply to specific sources.

Table 4-10 presents the modeled impacts on ambient air quality at the near-field receptors in Montana and Wyoming. Results indicate the maximum impacts at any point in each receptor group, and data are provided for the baseline year (2002) analysis and for both development scenarios for 2010.

Based on the modeling results, the baseline year (2002) maximum impacts on ambient air quality were well below the ambient air quality standards, with an exception for PM_{10} emissions on some receptors near PRB sources. The results indicate the maximum modeled 24-hour PM_{10} levels are greater than the 150 $\mu g/m^3$ ambient air standard some near-field receptors in both Montana and Wyoming. The modeling also showed impacts on visibility in the surrounding Class I areas are above the detectable levels at many receptor areas.

For the Montana near-field receptors, the modeling for the 24-hour PM_{10} levels projects a maximum impact above the NAAQS for both coal development scenarios for 2010 for some receptors. The upper development scenario shows

Table 4-10. Projected Maximum Potential Near-field Impacts (µg/m³).

Pollutant	Averaging Time	Base Year (2002) Impacts	2010 Lower Development Scenario Impacts	2010 Upper Development Scenario Impacts	NAAQS	Wyoming AAQS	Montana AAQS	PSD Class II Increments[2]
Wyoming Near-field								
NO_2	Annual	37.3	42.4	49.0	100	100	--[1]	25
SO_2	Annual	3.9	4.8	5.6	80	60	--[1]	20
	24-hour	14.5	33.5	34.8	365	260	--[1]	91
	3-hour	37.9	148.0	154.2	1,300	1300	--[1]	512
PM_{10}	Annual	42.7	49.0	**56.6**	--[3]	50	--[1]	17
	24-hour	**335.5**	**378.8**	**439.9**	150	150	--[1]	30
Montana Near-field								
NO_2	Annual	8.85	11.3	11.8	100	--[1]	100	25
	1-hour	365.8	415.9	519.5	--	--[1]	564	--
SO_2	Annual	1.3	2.3	2.7	80	--[1]	80	20
	24-hour	18.9	19.5	20.4	365	--[1]	365	91
	3-hour	74.7	76.4	79.8	1,300	--[1]	1,300	512
	1-hour	240.7	246.4	257.3	--	--[1]	1,300	--
PM_{10}	Annual	19.6	22.5	27.7	--[3]	--[1]	50	17
	24-hour	**175.8**	**200.0**	**247.7**	150	--[1]	150	30

1 No standard or increment.

2 All NEPA analysis comparisons to the PSD increments are intended to evaluate a threshold of concern and do not represent a regulatory PSD Increments Consumption Analysis.

3 On September 21, 2006, the EPA announced final revisions to the NAAQS for particulate matter, which took effect December 18, 2006. The revision revoked the annual PM_{10} standard of 50 µg/m³. The revisions retained the 24-hour PM_{10} standard. The State of Wyoming will enter into rulemaking to revise the Wyoming Ambient Air Quality Standards. See additional discussion in Chapter 3, Section 3.4.2.1.

Bold values indicate projected exceedances of AAQS.

Source: PRB Coal Review Task 3A Report (BLM 2006b)

an increase in the impact of more than 40 percent above the baseline year for this parameter. Impacts at all other receptors show compliance with the NAAQS and the Montana AAQS. Large percentage increases in annual SO_2 impacts are projected, but the impacts themselves are well below the NAAQS.

For the Wyoming near-field receptors, the modeling projects maximum 24-hour PM_{10} levels greater than the 150 µg/m^3 ambient air standard for the 2010 lower and upper coal production scenarios at some receptors. For the 2010 upper development scenario, the modeled levels are above 150 µg/m^3 at seven of the near-field receptors in Wyoming; those receptors are confined in an area of intensive coal development. As shown in Table 4-10, the maximum modeled PM_{10} impacts from all sources are nearly three times the 24-hour standard for the 2010 upper production scenario. As discussed in Section 3.4.1.1.1, modeling tends to over predict the 24-hour impacts of surface coal mining and, as a result, WDEQ/AQD does not consider short-term PM_{10} modeling to be an accurate representation of short-term impacts. In view of this, a Memorandum of Agreement between WDEQ/AQD and EPA Region VIII, dated January 24, 1994, allows WDEQ/AQD to conduct monitoring in lieu of short-term modeling for assessing coal mining-related impacts in the PRB. This agreement also requires Wyoming to implement "Best Available Work Practice" mitigation measures at any mine where an exceedance of the PM_{10} NAAQS has occurred. The monitored exceedances at surface coal mines in the Wyoming PRB and the measures that WDEQ/AQD has implemented or is proposing to implement to prevent future exceedances of the PM_{10} NAAQS are discussed in Chapter 3, Sections 3.4.2.1.1 and 3.4.2.3.

The maximum modeled impacts on the annual PM_{10} levels are also projected to be above the standard (50 µg/m^3) at one near-field receptor in Wyoming for the 2010 upper production scenario. Impacts of NO_2 and SO_2 emissions are predicted to be below the NAAQS and Wyoming AAQS at all Wyoming near-field receptors. A large portion of the impacts for all scenarios would be associated with coal-related sources, although non-coal sources would contribute a notable portion of the impact.

As indicated in Chapter 3:

- There have been no monitored exceedances of the 24-hour PM_{10} ambient air standard at the Eagle Butte Mine.

- Air quality modeling indicates the currently projected mine activities at the Eagle Butte Mine will be in compliance with the annual PM_{10} or NO_x ambient air standards for the life of the mine at the permitted mining rate of 35 mmtpy. The applicant currently proposes to mine at an average rate of 25 mmtpy during the time the Eagle Butte West LBA Tract would be mined.

Table 4-11 lists the three Class I areas and two Class II areas where the modeled impacts are the greatest. Table 4-11 includes a comparison to ambient air

Table 4-11. Maximum Predicted PSD Class I and Sensitive Class II Area Impacts (µg/m³)[1].

Location	Pollutant	Averaging Period	Base Year (2002) Impacts	2010 Lower Development Scenario	2010 Upper Development Scenario	PSD Class I/II Increments
Class I Areas						
Northern Cheyenne Indian Reservation	NO_2	Annual	2.0	2.3	**2.7**	2.5
	SO_2	Annual	0.6	0.8	0.9	2
		24-hour	**6.1**	**6.5**	**6.9**	5
		3-hour	**26.8**	**27.9**	**29.3**	25
	PM_{10}	Annual	**5.0**	**5.8**	**7.0**	4
		24-hour	**42.0**	**47.8**	**59.4**	8
Washakie Wilderness Area	NO_2	Annual	0.1	0.1	0.1	2.5
	SO_2	Annual	0.0	0.1	0.1	2
		24-hour	1.0	3.0	3.3	5
		3-hour	2.0	5.1	5.6	25
	PM_{10}	Annual	0.3	0.4	0.4	4
		24-hour	**14.5**	**16.5**	**16.9**	8
Wind Cave National Park	NO_2	Annual	1.2	1.5	1.7	2.5
	SO_2	Annual	0.2	0.4	0.5	2
		24-hour	1.2	3.5	3.8	5
		3-hour	3.5	9.9	10.3	25
	PM_{10}	Annual	1.3	1.7	1.9	4
		24-hour	**10.7**	**14.0**	**15.7**	8
Sensitive Class II Areas						
Crow Indian Reservation	NO_2	Annual	5.7	6.2	6.7	25
	SO_2	Annual	0.8	0.9	0.9	20
		24-hour	4.7	5.1	5.3	91
		3-hour	14.7	15.1	15.7	512
	PM_{10}	Annual	3.0	3.7	4.0	17
		24-hour	**30.5**	**35.1**	**36.7**	30
Cloud Peak Wilderness Area	NO_2	Annual	0.5	0.7	0.7	25
	SO_2	Annual	0.1	0.2	0.3	20
		24-hour	1.4	3.3	3.7	91
		3-hour	3.6	6.5	7.9	512
	PM_{10}	Annual	0.8	1.1	1.2	17
		24-hour	13.3	17.1	17.9	30

[1] The PSD demonstrations serve information purposes only and do not constitute a regulatory PSD Increments Consumption Analysis.
Bold values indicate exceedance of PSD Class I or II standards.
Source: PRB Coal Review Task 3A Report (BLM 2006b)

quality standards and PSD increments; however, it must be noted that this modeling analysis did not separate PSD increment-consuming sources from those that do not consume increment. The PSD-increment comparison is provided for informational purposes only and cannot be directly related to a regulatory interpretation of PSD increment consumption. For the Class I Northern Cheyenne Indian Reservation, modeled impacts for the baseline year (2002) and the two production scenarios for 2010 are less than the annual SO_2 PSD Class I increment, slightly above the PSD Class I increment levels for annual PM_{10}, 24-hour SO_2, and 3-hour SO_2, and well above the Class I increments for 24-hour PM_{10}. For annual NO_2, the modeled impacts are less than the annual increment for the baseline year and lower production scenario and slightly above the annual increment for the upper production scenario. In the other two Class I areas, only the 24-hour PM_{10} impacts are higher than the comparison to the PSD increment levels. In the sensitive Class II areas, all modeled impacts are well below the Class II PSD increments, with the exception that the 24-hour PM_{10} impacts are greater than the Class II 24-hour PM_{10} increments at the Crow Indian Reservation.

The projected modeled visibility impacts for the baseline year (2002) and for the lower and upper coal production scenarios for 2010 for all analyzed Class I and sensitive Class II areas are listed in Table 4-12. For the baseline year, the maximum visibility impacts at Class I areas were determined to be at the Northern Cheyenne Indian Reservation in Montana and at Wind Cave and Badlands National Parks in South Dakota. For these locations, modeling showed more than 200 days of impacts with a change of 10 percent or more in extinction. A 10 percent change in extinction corresponds to 1.0 dv.

To provide a basis for discussing the modeled visibility impacts resulting from the projected increased production under the lower and upper coal production scenarios for 2010, the modeled visibility impacts for 2002 were subtracted from the model results for 2010. Table 4-12 shows the number of additional days that the projected impacts were greater than 1.0 dv (10 percent in extinction) for each site for the upper and lower coal production scenarios. Using Badlands Park as an example, the modeling analysis projects 238 days with impacts greater than 1.0 dv in 2002. Under the 2010 lower coal production scenario, the modeling analysis projects an additional 19 days with impacts greater than 1.0 dv, or a total of 257 days with impacts greater than 1.0 dv.

For acid deposition, all predicted impacts are below the deposition threshold values for both nitrogen and sulfur compounds. There are substantial percentage increases in deposition under the lower and upper coal development scenarios for 2010; however, impacts remain well below the threshold values. The acid neutralizing capacity of sensitive lakes also was analyzed, and results are summarized in Table 4-13. The baseline year study indicated that none of the lakes had predicted significant impacts; however, the lower and upper development scenarios for 2010 show an increased impact at Florence Lake, leading to an impact that is above the 10 percent ANC. Impacts also are predicted to be above the 1 μeq/L threshold for Upper Frozen Lake.

Table 4-12. Modeled Change in Visibility Impacts at Class I and Sensitive Class II Areas.

Location	2002 No. of Days >10%	2010 Lower Development Scenario Change in No. of Days > 10%	2010 Upper Development Scenario Change in No. of Days > 10%
Federally and Tribally Designated Class I Areas			
Badlands National Park[1]	238	19	26
Bob Marshall WA	12	2	4
Bridger WA	47	4	7
Fitzpatrick WA	42	3	5
Fort Peck Indian Reservation	69	8	9
Gates of the Mountain WA	14	6	7
Grand Teton National Park	26	2	5
North Absaroka WA	47	6	6
North Cheyenne Indian Reservation	305	5	10
Red Rock Lakes	16	3	5
Scapegoat WA	14	4	4
Teton WA	40	4	5
Theodore Roosevelt National Park	98	15	22
UL Bend WA	49	4	5
Washakie WA	53	2	3
Wind Cave National Park	261	11	15
Yellowstone National Park	42	7	8
Sensitive Class II Areas			
Absaroka Beartooth WA	53	3	5
Agate Fossil Beds National Monument	199	26	30
Big Horn Canyon National Rec. Area	108	7	8
Black Elk WA	263	16	22
Cloud Peak WA	137	8	8
Crow Indian Reservation	284	10	15
Devils Tower National Monument	279	15	21
Fort Belknap Indian Reservation	46	3	4
Fort Laramie National Historic Site	153	27	30
Jedediah Smith WA	23	1	2
Jewel Cave National Monument	267	14	18
Lee Metcalf WA	25	2	4
Mount Naomi WA	8	6	8
Mount Rushmore National Monument	248	19	25
Popo Agie WA	47	7	8
Soldier Creek WA	223	23	29
Wellsville Mountain WA	6	5	7
Wind River Indian Reservation	66	12	15

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

Source: PRB Coal Review Task 3A Report (BLM 2006b)

Table 4-13. Predicted Total Cumulative Change in Acid Neutralizing Capacity of Sensitive Lakes.

Location	Lake	Background ANC (µeq/L)	Area (hectares)	Base Year 2002 Change (percent)	2010 Lower Development Scenario Change (percent)	2010 Upper Development Scenario Change (percent)	Thresholds (percent)
Bridger Wilderness Area	Black Joe	67.0	890	1.3	1.88	1.97	10
	Deep	60.0	205	1.4	2.08	2.18	10
	Hobbs	70.0	293	0.9	1.37	1.43	10
	Upper Frozen	5.0	65	0.7[1]	0.99[1]	1.04[1]	1[1]
Cloud Peak	Emerald	55.3	293	5.3	6.59	6.89	10
	Florence	32.7	417	8.9	11.52	12.03	10
Fitzpatrick Wilderness Area	Ross	53.5	4,455	0.9	1.37	1.43	10
Popo Agie Wilderness Area	Lower Saddlebag	55.5	155	1.9	2.58	2.70	10

[1] Data for Upper Frozen Lake presented in changes in µeq/L rather than percent change. (For lakes with less than 25 µeq/L background ANC.)
Source: PRB Coal Review Task 3A Report (BLM 2006b)

The study also modeled impacts of selected hazardous air pollutant emissions (benzene, ethyl benzene, formaldehyde, n-hexane, toluene, and xylene) on the near-field receptors in Montana and Wyoming. Model results for the 2010 upper development scenario show that impacts were predicted to be above the acute Reference Exposure Level for formaldehyde (94 $\mu g/m^3$) at two receptors in Wyoming but are below all Reference Exposure and Reference Concentrations for Chronic Inhalation levels in Montana and for other compounds in Wyoming. Essentially, the modeled impacts for 2010 showed a continuation of the patterns exhibited for the baseline year analysis.

For 2015 and 2020, the PRB Coal Review Task 3A report includes a qualitative analysis of potential air quality impacts and the impacts from individual source groups, based on the projected changes from 2002 to 2010 for the respective production scenarios. The production from conventional oil and gas and CBNG activities is projected to peak at 2010, with slight declines predicted over the following decade. Therefore, from these sources, expected impacts would decrease slightly from 2010 to 2015 and 2020. The coal mining sources would be the major contributors to PM_{10} impacts in the near-field, and these impacts would result from the proximity of the receptors to the coal mining operations. If coal mines expand or relocate, those impacts likely would follow that development; however, the specific impacts would need to be addressed with a more refined modeling effort, specifically including accurate source parameters. Power plants currently are the major contributors to all SO_2 impacts in the near-field in both states. However, the impacts are well below any ambient standard or PSD increment, and continued expansion should not jeopardize the attainment of those standards. Impacts on NO_2 concentrations are the result of emissions from all the source groups. No one source group dominates the NO_2 impacts in the near-field.

A pattern that is similar to the near-field receptors holds true for the Class I and sensitive Class II receptor groups. Essentially, the mine operations would continue to dominate the PM_{10} impacts, the power plants would continue to dominate the SO_2 impacts (although they would continue to be below the standards), and the overall source groups would continue to contribute to NO_2 impacts, but impacts should remain below the NO_2 standard.

Based on modeling results, none of the acid deposition thresholds were exceeded at Class I areas for either the baseline year or for the lower or upper development scenarios for 2010. In general, the projected increases in coal development (and power plants) are not expected to raise the deposition levels above the threshold, extended into 2020. The only concern relates to the acid deposition into sensitive lakes. The model results showed that the increased deposition, largely from SO_2 emissions from power plants, exceeded the thresholds of significance for the ANC at two sensitive (high alpine) lakes. The results indicate that with increased growth in power plant operations, the reduced ANC of the sensitive lakes would become significant and would need to be addressed carefully for each proposed major development project.

WDEQ/AQD and WDEQ/LQD mitigation and monitoring requirements for coal mine emissions are discussed in Sections 3.4.2.3 and 3.4.3.3. The discussion in these sections includes the operational control measures that are currently in place and would be required for mining operations on LBAs that are issued in the future, as well as measures that may be required to avoid future exceedances of the WAAQS and NAAQS and/or future mine-related impacts to the public.

4.2.4 Water Resources

Surface and groundwater are used extensively throughout the PRB for agricultural water supply, municipal water supply, and both domestic and industrial water supply. Surface water use is limited to major perennial drainages and agricultural areas within the basin are found mainly along these drainages. Municipal water supply comes from a combination of surface and groundwater. Domestic and industrial water supply primarily is from groundwater.

The PRB Coal Review Task 3B (Cumulative Water Effects) report is currently in preparation. This report, which will describe projected effects on ground and surface water as a result of projected development in the PRB, will be incorporated into future EIS analyses when it is complete. The analysis area for groundwater modeling (PRB Coal Review Task 3B report) is shown in Figure 4-4.

The PRB Coal Review used publicly available and accessible data and publications in the surface water and groundwater analyses. The two principal studies used were the Powder/Tongue River Basin study (HKM Engineering et al. 2002a) and the Northeast Wyoming River Basins study (HKM Engineering et al. 2002b). The Powder/Tongue River Basin study includes the area drained by the Little Bighorn, Tongue, and Powder Rivers. The Belle Fourche and Cheyenne Rivers drain the area included in the Northeast Wyoming River Basins study.

4.2.4.1 Groundwater

There are five main aquifers in the Powder/Tongue River Basin study area and in the Wyoming portion of the Northeast Wyoming River Basin study area that can be used for water supply:

- Madison Aquifer System;
- Dakota Aquifer System;
- Fox Hills/Lance Aquifer System;
- Fort Union/Wasatch Aquifer System; and
- Quaternary Alluvial Aquifer System.

The Fort Union/Wasatch Aquifer System includes the coal and overburden aquifers that are directly affected by surface coal mining. It is a major source of local water supply for domestic and stock water use, and it is also the aquifer where the major pumpage from CBNG wells occurs. Table 4-14 shows the

Table 4-14. Recoverable Groundwater in the Fort Union/Wasatch Aquifer System.

Hydrogeologic Unit	Surface Area (acres)	Average Formation Thickness (ft)	Percentage of Sand/Coal	Average Sand/Coal Thickness (ft)	Specific Yield (percent)	Recoverable Groundwater (acre-feet)[1]
Wasatch-Tongue River Aquifer Sandstones	5,615,609	2,035	50.0	1,018	13.0	743,169,695
Wasatch-Tongue River Aquifer Coals	4,988,873	2,035	6.2	126	0.4	2,514,392
Lebo Confining Layer Sandstones	6,992,929	1,009	33.0	250	13.0	227,270,193
Tullock Aquifer Sandstones	7,999,682	1,110	52.0	430	13.0	447,182,224

[1] Calculated by multiplying Surface Area × Average Sand/Coal Thickness × Specific Yield. These numbers vary slightly from the numbers presented in Table 3-5 of the Final Environmental Impact Statement and Proposed Plan Amendment for the PRB Oil and Gas Project (BLM 2003b).
Source: BLM 2003b

estimated recoverable groundwater in the components of the Fort Union/Wasatch Aquifer System. The volumes of recoverable groundwater from the sandstones within the Wasatch/Tongue River Aquifer, the Lebo Confining Layer, and the Tullock Aquifer were determined from the volume of sandstone in each of these unites multiplied by the 13 percent specific yield value for sandstone. Similarly, the volume of recoverable groundwater from the coals within the Wasatch/Tongue River was calculated from the volume of coal multiplied by the 0.4 percent specific yield value for coal.

As a result of statutory requirements and concerns, several studies and a number of modeling analyses have been conducted to help predict the impacts of surface coal mining on groundwater resources in the Wyoming portion of the PRB. Some of these studies and modeling analyses are discussed below.

In 1987, the USGS, in cooperation with the WDEQ and OSM, conducted a study of the hydrology of the eastern PRB. The resulting description of the cumulative hydrologic effects of all current and anticipated surface coal mining (as of 1987) was published in 1988 in the USGS Water-Resources Investigation Report entitled "*Cumulative Potential Hydrologic Impacts of Surface Coal Mining in the Eastern Powder River Structural Basin, Northeastern Wyoming*", also known as the "USGS CHIA" (Martin et al. 1988). This report evaluates the potential cumulative groundwater impacts of surface coal mining in the area and is incorporated by reference into this EIS. The USGS CHIA analysis considered the proposed mining at the Eagle Butte Mine. It did not evaluate potential groundwater impacts related to additional coal leasing in this area and it did not consider the potential for overlapping groundwater impacts from coal mining and CBNG development.

Each mine must assess the probable hydrologic consequences of mining as part of the mine permitting process. The WDEQ/LQD must evaluate the cumulative hydrologic impacts associated with each proposed mining operation before approving the mining and reclamation plan for each mine, and they must find that the cumulative hydrologic impacts of all anticipated mining would not cause material damage to the hydrologic balance outside of the permit area for each mine. As a result of these requirements, each existing approved mining permit includes an analysis of the hydrologic impacts of the surface coal mining proposed at that mine. If revisions to mining and reclamation permits are proposed, then the potential cumulative impacts of the revisions must also be evaluated. If the Eagle Butte West LBA Tract is leased to the applicant, the existing mining and reclamation permit for the Eagle Butte Mine must be revised and approved to include the new lease before it can be mined.

The PRB Oil and Gas Project FEIS (BLM 2003b) includes a modeling analysis of the groundwater impacts if an additional 39,000 new CBNG wells are drilled in the PRB by the end of 2011. The project area for this EIS, which covers all of Campbell, Sheridan, and Johnson Counties, as well as the northern portion of Converse County, is similar to the study area for the PRB Coal Review Task 1 and Task 2 study area.

Another source of data on the impacts of surface coal mining on groundwater is the monitoring that is required by WDEQ/LQD and administered by the mining operators. Each mine is required to monitor groundwater levels and quality in the coal and in the shallower aquifers in the area surrounding their operations. Monitoring wells are also required to record water levels and water quality in reclaimed areas.

The coal mine groundwater monitoring data are published each year by GAGMO, a voluntary group formed in 1980. Members of GAGMO include most of the companies with operating or proposed mines in the Wyoming PRB, WDEQ, the Wyoming SEO, BLM, USGS, and OSM. GAGMO contracts with an independent firm each year to publish the annual monitoring results. GAGMO also periodically publishes reports summarizing the water monitoring data collected since 1980 in the Wyoming PRB (e.g., Hydro-Engineering 1991, 1996, 2001, and 2007).

The major groundwater issues related to surface coal mining that have been identified are:

- the effect of the removal of the coal aquifer and any overburden aquifers within the mine area and replacement of these aquifers with backfill material;

- the extent of the temporary lowering of static water levels in the aquifers around the mine due to dewatering associated with removal of these aquifers within the mine boundaries;

- the effects of the use of water from the subcoal Fort Union Formation by the mines;
- changes in water quality as a result of mining; and
- potential overlapping drawdown due to proximity of coal mining and CBNG development.

The impacts of large scale surface coal mining on a cumulative basis for each of these issues are discussed in the following paragraphs.

The effect of replacing the coal and overburden with backfill is the first major groundwater concern. The following discussion of recharge, movement, and discharge of water in the backfill aquifer is excerpted from the USGS CHIA (Martin et al. 1988):

> Postmining recharge, movement, and discharge of groundwater in the Wasatch aquifer and Wyodak coal aquifer will probably not be substantially different from premining conditions. Recharge rates and mechanisms will not change substantially. Hydraulic conductivity of the spoil aquifer will be approximately the same as in the Wyodak coal aquifer allowing groundwater to move from recharge areas where clinker is present east of mine areas through the spoil aquifer to the undisturbed Wasatch aquifer and Wyodak coal aquifer to the west.

Monitoring data verify that recharge has occurred and is continuing in the backfill (Hydro-Engineering 1991, 1996, 2001, and 2007). The water monitoring summary reports prepared each year by GAGMO list current water levels in the monitoring wells completed in the backfill and compare them with the 1980 water levels, as estimated from the 1980 coal water-level contour maps. In the 1991 GAGMO 10-year report, some recharge had occurred in 88 percent of the 51 backfill wells reported at that time (Hydro-Engineering 1991). In the GAGMO 20-year report, 79 percent of the 82 backfill wells measured contained water (Hydro-Engineering 2001).

Coal companies are required by state and federal law to mitigate any water rights that are interrupted, discontinued, or diminished by mining.

The cumulative size of the backfill area in the PRB and the duration of mining activity would be increased by mining the recently issued leases and the currently proposed LBA tracts, including the Eagle Butte West LBA Tract. Since the mined-out areas are being backfilled and the monitoring data demonstrate that recharge of the backfill is occurring, substantial additional impacts are not anticipated as a result of the pending leasing actions.

Clinker or scoria, the baked and fused rock formed by prehistoric burning of the Wyodak-Anderson coal seam, occurs all along the coal outcrop area (Figure 3-11) and is believed to be the major recharge source for the backfill aquifer, just

as it is for the coal. However, not all clinker is saturated. Some clinker is mined for road-surfacing material, but saturated clinker is not generally mined since abundant clinker exists above the water table and does not present the mining problems that would result from mining saturated clinker. Therefore, the major recharge source for the backfill aquifer is not being disturbed by current mining. Clinker is not present on the Eagle Butte West LBA Tract under the Proposed Action or under BLM's preferred tract configuration under Alternative 1.

The second major groundwater issue is the extent of water level drawdown in the coal and shallower aquifers in the area surrounding the mines. In general, the limited extent of the saturated sand aquifers in the Wasatch Formation overburden dictates that drawdowns in the Wasatch Formation are much smaller and cover much less area than the coal drawdowns. In this EIS, assessment of cumulative impacts to groundwater related to surface coal mining is based on impact predictions made by the Eagle Butte Mine and the other adjacent mines (Buckskin, Rawhide, Dry Fork, and Wyodak mines). Those drawdowns are extrapolated to evaluate the potential impacts of mining of the Eagle Butte West LBA Tract. Figure 4-5 depicts the extrapolated extent of the five-ft cumulative drawdown contour within the Wyodak coal aquifer resulting from the five mines in the North Gillette subregion. The extent of the five-ft drawdown contour is used by WDEQ/LQD to assess the cumulative extent of the impact to the groundwater system caused by mining operations.

The GAGMO 25-year report provides actual groundwater drawdown information after 25 years of mining (Hydro-Engineering 2007). Most of the 530 monitoring wells included in the GAGMO 25-year report are completed in the coal beds, in the overlying sediments, or in sand channels or interburden between the coal beds at 16 active and proposed mine sites. Since 1996, some BLM monitor wells have been included in the GAGMO reports.

The USGS CHIA predicted the approximate area of five feet or more water level decline in the Wyodak coal aquifer which would result from "all anticipated coal mining". "All anticipated coal mining" included 16 surface coal mines operating at the time the report was prepared and six additional mines proposed at that time. All of the currently producing mines, including the Eagle Butte Mine, were considered in the USGS CHIA analysis (Martin et al. 1988). The study predicted that water supply wells completed in the coal may be affected as far away as eight miles from mine pits, although the effects at that distance were predicted to be minimal.

As drawdowns propagate to the west, available drawdown in the coal aquifer increases. Available drawdown is defined as the elevation difference between the potentiometric surface (elevation to which water will rise in a well bore) and the bottom of the aquifer. Proceeding west, the coal depth increases faster than the potentiometric surface declines, so available drawdown in the coal increases. Since the depth to coal increases, most stock and domestic wells are completed in units above the coal. Consequently, with the exception of methane wells, few wells are completed in the coal in the areas west of the mines. Those wells

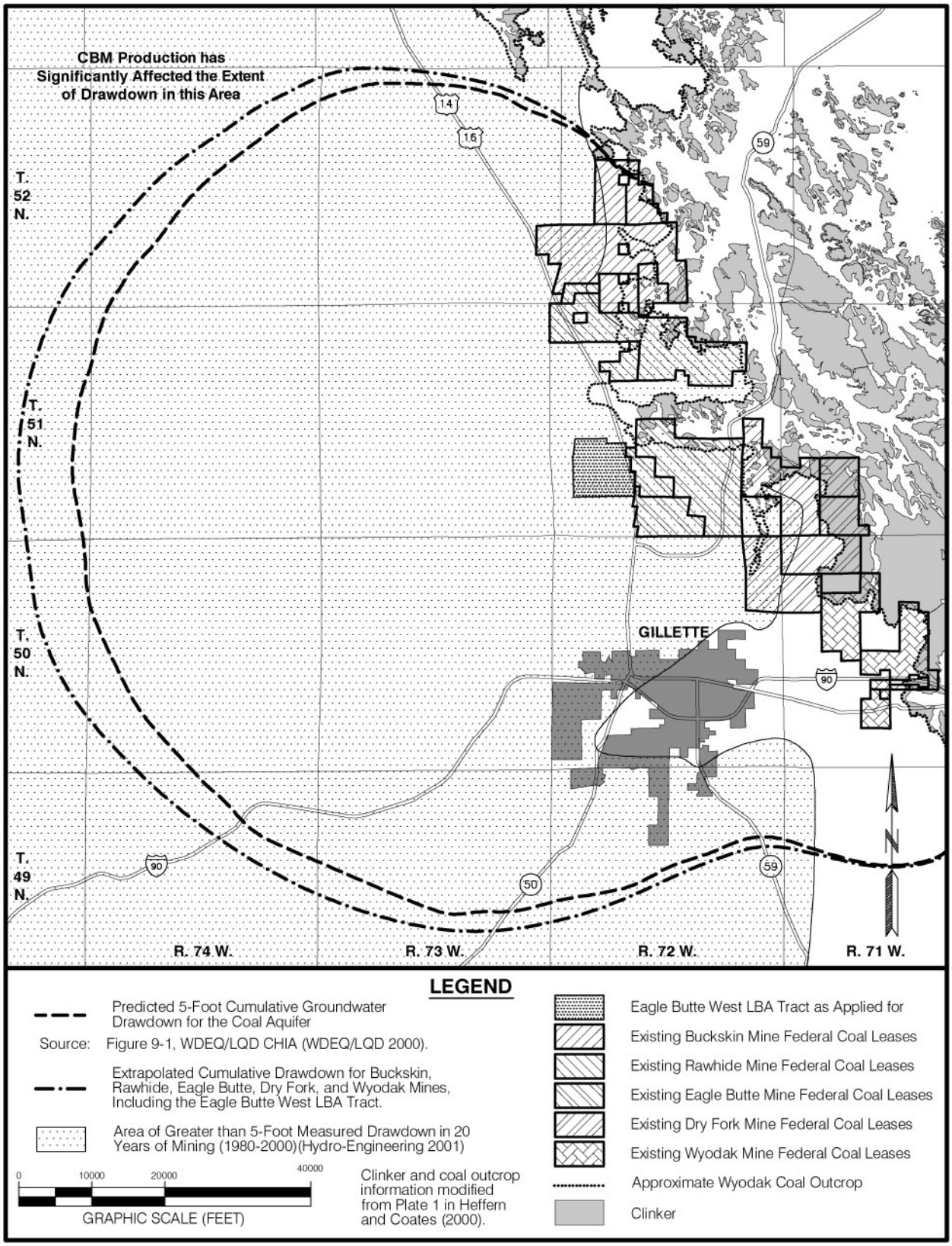


Figure 4-5. Extrapolated Extent of Cumulative Drawdown Within the Wyodak Coal Aquifer in the Coal Mine Subregion 1.

completed in the coal have considerable available drawdown, so it is unlikely that surface coal mining would cause adverse impacts to wells outside the immediate mine area.

Wells in the Wasatch Formation were predicted to be impacted by drawdown only if they were within 2,000 ft of a mine pit (Martin et al. 1988). Drawdowns occur farther from the mine pits in the coal than in the shallower aquifers because the coal is a confined aquifer that is areally extensive. The area in which the shallower aquifers (Wasatch Formation, alluvium, and clinker) experience a five-ft drawdown would be much smaller than the area of drawdown in the coal because the shallower aquifers are generally discontinuous, of limited areal extent, and often unconfined.

When the USGS CHIA was prepared, there were about 1,200 water supply wells within the maximum impact area defined in that study. Of those wells, about 580 were completed in Wasatch aquifers, about 100 in the Wyodak coal aquifer, and about 280 in strata below the coal. There were no completion data available for the remainder of the wells (about 240) at the time the USGS CHIA was prepared.

If the Eagle Butte West LBA Tract is leased and mined, the groundwater drawdown would be extended into the area surrounding the proposed new lease. When a lease is issued to an existing mine for a maintenance tract, the mine must revise its existing mining permit to include the new tract in its mine and reclamation plans. In order to do that, the lessee would be required to conduct a groundwater analysis to predict the extent of drawdown in the coal and overburden aquifers caused by mining the new lease. WDEQ/LQD would use the revised drawdown predictions to update their cumulative hydrologic impact analysis (WDEQ CHIA) for this portion of the PRB. The applicant has installed monitoring wells that would be used to confirm or refute drawdowns predicted by analysis. This analysis would be required as part of the WDEQ mine permitting procedure discussed in Section 1.2.

Potential water-level decline in the subcoal Fort Union Formation is the third major groundwater issue. Water level declines in the Tullock Aquifer have been documented in the Gillette area. According to Crist (1991), these declines are most likely attributable to pumpage for municipal use by Gillette and for use at subdivisions and trailer parks in and near the city of Gillette. Most of the water-level declines in the subcoal Fort Union wells occur within one mile of the pumped wells (Crist 1991, Martin et al. 1988). Many of the mines have water supply wells completed in zones below the coal, but the mine facilities in the PRB are separated by a distance of one mile or more, so little interference between mine supply wells would be expected.

In response to concerns voiced by regulatory personnel, several mines have conducted impact studies of the subcoal Fort Union Formation. The OSM also commissioned a cumulative impact study of the subcoal Fort Union Formation

to address the effects of mine facility wells on this aquifer (OSM 1984). Conclusions from these studies are similar and may be summarized as follows:

- Because of the discontinuous nature of the sands in this formation and because most large-yield wells are completed in several different sands, it is difficult to correlate completion intervals between wells.

- In the Gillette area, water levels in this aquifer have probably declined because the city of Gillette and several subdivisions have utilized water from the formation (Crist 1991). (Note: Gillette is mixing Fort Union Formation water with water from wells completed in the Madison Formation. Also, because drawdowns have occurred, some operators are able to dispose of CBNG water by injecting it into the subcoal Fort Union Formation near the city of Gillette.)

- Because large saturated thicknesses are available (locally) in this aquifer unit, generally 500 ft or more, a drawdown of 100 to 200 ft in the vicinity of a pumped well would not dewater the aquifer.

Most of the existing coal mines have permits from the Wyoming SEO for subcoal Fort Union Formation water supply wells. The Eagle Butte Mine uses two water supply wells completed in the Tullock aquifer below the Roland and Smith coal seams (NSERV1 and NSERV2) to supply water for human consumption and mining operations (Figure 3-10). Extending the life of the Eagle Butte Mine by issuing a new lease would result in additional water being withdrawn from the subcoal Fort Union Formation, but no new sub-coal water supply wells would be required. The additional water withdrawal would not be expected to extend the area of water level drawdown over a substantially larger area due to the discontinuous nature of the sands in the Tullock Member and the fact that drawdown and yield reach equilibrium in a well due to recharge effects. Due to the distances separating subcoal Fort Union Formation wells used for mine water supply, these wells have not experienced interference and are not likely to in the future.

Water requirements and sources for the proposed WYGEN 2 and Basin Electric Power Cooperative power plants, which would be located in the vicinity of the northern group of mines, are not currently known. The Wyoming SEO is discouraging further development of the lower Fort Union Formation aquifers, so the most likely groundwater source for these power plants would be the Lance-Fox Hills Aquifer System. This would reduce the chances that the power plants would add to cumulative hydrologic impacts of mining.

The fourth issue of concern with groundwater is the effect of mining on water quality. Specifically, what effect does mining have on the water quality in the surrounding area, and what are the potential water quality problems in the backfill aquifer following mining?

In a regional study of the cumulative impacts of coal mining, the median concentrations of dissolved solids and sulfates were found to be higher in water from backfill aquifers than in water from either the Wasatch Formation overburden or the Wyodak coal aquifer (Martin et al. 1988). This is expected because blasting and movement of the overburden materials exposes more surface area to water, increasing dissolution of soluble materials, particularly from the overburden materials that were situated above the saturated zone in the premining environment.

One pore volume of water is the volume of water that would be required to saturate the backfill following reclamation. The time required for one pore volume of water to pass through the backfill aquifer is greater than the time required for the postmining groundwater system to reestablish equilibrium. According to the USGS CHIA, estimates of the time required to reestablish equilibrium range from tens to hundreds of years (Martin et al. 1988).

The major current use of water from the aquifers being replaced by the backfill (the Wasatch Formation overburden and Wyodak coal aquifers) is for livestock because these aquifers are typically too high in dissolved solids for domestic use and well yields are typically too low for irrigation (Martin et al. 1988). Chemical analyses of 336 samples collected between 1981 and 1986 from 45 wells completed in backfill aquifers at 10 mines indicated that the quality of water in the backfill will, in general, meet the state standard for livestock use of 5,000 mg/L for TDS when recharge occurs (Martin et al. 1988). The 2000 annual GAGMO report (Hydro-Engineering 2000) evaluated samples from 48 backfill wells in 1999 and found that the TDS in 75 percent were less than 5,000 mg/L, TDS in 23 percent were between 5,000 and 10,000 mg/L, and TDS in one well was above 10,000 mg/L. An analysis of about 2,000 samples collected from 95 backfill monitoring wells between 1986 and 2002 found that the water quality in 75 percent of the wells were within the acceptable range for the Wyoming livestock standard, with 25 percent exceeding that standard (Ogle 2004). Water quality data for the backfill aquifer for the five mines in the North Gillette subregion (Buckskin, Rawhide, Dry Fork, Eagle Butte, and Wyodak) for the period from 1977 to 2004 was compiled by WDEQ/LQD and presented in the most recently prepared WDEQ CHIA for that mine group (Ogle et al. 2006). The median TDS concentration of groundwater from the backfill aquifer in that group of mines was 5,016 mg/L, based on 429 samples. The water type is similar to the pre-mining Wasatch and alluvial aquifers. Water quality data compiled and presented in the 2005 GAGMO Annual Report (Hydro-Engineering 2006) for the backfill aquifer for the northern group of mines for the 2000 through 2004 period of record indicate that the TDS concentrations range between approximately 1,500 mg/L to 8,800 mg/L. Exactly 50 percent of the 169 samples that were collected from 17 backfill monitoring wells during that five-year period had TDS concentrations that were greater than 5,000 mg/L. The median TDS concentration of groundwater from the backfill aquifer in that group of mines during that time was 4,849 mg/L. The incremental effect on groundwater quality due to leasing and mining the Eagle Butte West LBA Tract

would be to increase the total volume of backfill and, thus, the time for equilibrium to reestablish.

The fifth area of concern is the potential for cumulative impacts to groundwater resources due to the proximity of coal mining and CBNG development. The Wyodak coal is being developed by mining and CBNG production in the same general area. Dewatering activities associated with CBNG development have overlapped with and expanded the area of groundwater drawdown in the coal aquifer in the PRB over what would occur due to coal mining development alone, and this would be expected to continue.

Numerical groundwater flow modeling was used to predict the impacts of the cumulative stresses imposed by mining and CBNG development on the Fort Union Formation coal aquifer in the PRB Oil and Gas Project EIS (BLM 2003b). Modeling was necessary because of the large areal extent, variability, and cumulative stresses imposed by mining and CBNG development on the Fort Union coal aquifers. Information from earlier studies was incorporated into the modeling effort for this analysis.

As expected, the modeling has indicated that the groundwater impacts from CBNG development and surface coal mining would be additive in nature and that the addition of CBNG development would extend the area experiencing a loss in hydraulic head to the west of the mining area. The 20-year GAGMO report stated that drawdowns in all areas have greatly increased in the last few years due to the water production from the Wyodak coal aquifer by CBNG producers (Hydro-Engineering 2001).

Drawdowns in the coal caused by CBNG development would be expected to reduce the need for dewatering in advance of mining, which would be beneficial for mining operations. Wells completed in the coal may also experience increased methane emissions in areas of significant aquifer depressurization. There would be a potential for conflicts to occur over who (coal mining or CBNG operators) is responsible for replacing or repairing private wells that are adversely affected by the drawdowns; however, the number of potentially affected wells completed in the coal is not large.

As discussed previously, coal companies are required by state and federal law to mitigate any water rights that are interrupted, discontinued, or diminished by coal mining. In response to concerns about the potential impacts of CBNG development on water rights, a group of CBNG operators and local landowners developed a standard water well monitoring and mitigation agreement that can be used on a case-by-case basis as development proceeds. All CBNG operators on federal oil and gas leases are required to offer this water well agreement to the surface landowners (BLM 2003b).

After CBNG development and coal mining projects are completed, it will take longer for groundwater levels to recover due to the overlapping drawdown

impacts caused by the dewatering and depressuring of the coal aquifer by both operations.

4.2.4.2 Surface Water

The main rivers in the Powder/Tongue River Basin are the Tongue River and the Powder River. The Powder/Tongue River Basin receives substantial surface water runoff from the Big Horn Mountains, leading to major agricultural development along drainages in the Tongue River and Powder River basins. Reservoirs are used throughout the basin for agricultural water supply and for municipal water supply in the Powder/Tongue River Basin. Water use in the Powder/Tongue River Basin as of 2002 is summarized in Table 4-15.

Table 4-15. Water Use as of 2002 in the Powder/Tongue River Basin.

	Dry Year		Normal Year (acre-feet per year)		Wet Year	
Water Use Categories	**Surface Water**	**Ground-water**	**Surface Water**	**Ground-water**	**Surface Water**	**Ground-water**
Agricultural	178,000	200	184,000	200	194,000	300
Municipal	2,700	500	2,700	500	2,700	500
Domestic	---	4,400	---	4,400	---	4,400
Industrial[1]	---	68,000	---	68,000	---	68,000
Recreation			Non-consumptive			
Environmental			Non-consumptive			
Evaporation	11,300	--	11,300	--	11,300	--
Total	**192,000**	**73,100**	**198,000**	**73,100**	**208,000**	**73,200**

[1] Includes conventional oil and gas production water and CBNG production water.
Source: HKM Engineering et al. 2002a

The Little Bighorn River, Tongue River, Powder River, Crazy Woman Creek, and Piney Creek carry the largest natural flows in the Powder/Tongue River Basin. Many of the other major drainages are affected by irrigation practices to the extent that their flows are not natural (HKM Engineering et al. 2002a). Water availability in the major sub-basins of the Powder/Tongue River Basin is summarized in Table 4-16. This table presents the amount of surface water in acre-feet that is physically available above and beyond allocated surface water in these drainages. As a result of the Yellowstone River Compact, Wyoming must share some of the physically available surface water in the Powder/Tongue River Basin with Montana.

Table 4-16. Surface Water Availability in the Powder/Tongue River Basin.

	Surface Water Availability (acre-feet per year)		
Sub-basin	**Wet Years**	**Normal Years**	**Dry Years**
Little Bighorn River	152,000	113,000	81,000
Tongue River	473,000	326,000	218,000
Clear Creek	213,000	124,000	80,000
Crazy Woman Creek	69,000	32,000	16,000
Powder River	547,000	324,000	16,000
Little Powder River	48,000	12,000	3,000
Total	**1,502,000**	**931,000**	**414,000**

Source: HKM Engineering et al. 2002a

The main rivers in the Northeast Wyoming River Basins are the Belle Fourche in Campbell and Crook Counties and the Cheyenne River in Converse, Weston, and Niobrara Counties. Water in these rivers and their tributaries comes from groundwater baseline flow and from precipitation, especially from heavy storms during the summer months.

Water use in the Northeast Wyoming River Basins as of 2002 is summarized in Table 4-17.

Table 4-17. Water Use as of 2002 in the Northeast Wyoming River Basins.

	Dry Year		**Normal Year (acre-feet per year)**		**Wet Year**	
Water Use Categories	**Surface Water**	**Ground-water**	**Surface Water**	**Ground-water**	**Surface Water**	**Ground-water**
Agricultural	65,000	11,000	69,000	17,000	71,000	17,000
Municipal	---	9,100	---	9,100	---	9,100
Domestic	---	3,600	---	3,600	---	3,600
Industrial (Oil and Gas)	---	46,000	---	46,000	---	46,000
Industrial (Other)	---	4,700	---	4,700	---	4,700
Recreation			Non-consumptive			
Environmental			Non-consumptive			
Evaporation (Key Reservoirs)	14,000	---	14,000	---	14,000	---
Evaporation (Stock Ponds)	6,300	---	6,300	---	6,300	---
Total	**85,300**	**74,400**	**89,300**	**80,400**	**91,300**	**80,400**

[1] Includes conventional oil and gas production water and CBNG production water.
[2] Includes electricity generation, coal mining, and oil refining.
Source: HKM Engineering et al. 2002b

Stream flow in the major drainages of the Northeast Wyoming River Basins is much less than in the Powder/Tongue River Basin, due to the absence of a major mountain range to provide snow melt runoff. Water availability in the major sub-basins of the Northeast Wyoming Rivers Basin is summarized in Table 4-18.

Table 4-18. Surface Water Availability in the Northeast Wyoming River Basins.

	Surface Water Availability (acre-feet per year)		
Sub-basin	**Wet Years**	**Normal Years**	**Dry Years**
Redwater Creek	34,000	26,000	17,000
Beaver Creek	30,000	20,000	14,000
Cheyenne River	103,000	31,000	5,000
Belle Fourche River	151,000	71,000	13,000
Total	**318,000**	**148,000**	**49,000**

Source: HKM Engineering et al. 2002b

The surface water resources in the PRB Coal Review Task 3 study area consist primarily of intermittent and ephemeral streams and scattered ponds and reservoirs. The major impact of the projected development activities would be direct surface disturbance of these surface water features. Table 4-9 summarizes the cumulative baseline (2003) and projected (in 2010, 2015, and 2020) acres of surface disturbance and reclamation. The projected activities would result in surface disturbance in each of the six Task 3 study area subwatersheds (Figure 4-4). Discrete locations for development disturbance and reclamation areas cannot be determined based on existing information. However, the projected disturbance would primarily involve the construction of additional linear facilities, product gathering lines, and road systems associated with conventional oil and gas and CBNG activities, plus additional disturbance associated with extending coal mining operations onto lands adjacent to the existing mines.

Future coal mining could remove intermittent or ephemeral streams and stock ponds in the Little Powder River, Upper Belle Fourche River, Upper Cheyenne River, and Antelope Creek subwatersheds. As discussed in Section 3.5.2, the Eagle Butte Mine is in the Little Powder River subwatershed. Coal mine permits provide for removal of first-through fourth-order drainages. During reclamation, third- and fourth-order drainages must be restored; first- and second-order drainages often are not replaced (Martin et al. 1988).

Coal mining-related surface water would be discharged into intermittent and ephemeral streams in these same four subwatersheds (Antelope Creek, Little Powder River, Upper Belle Fourche River, and Upper Cheyenne River). Based on current trends, it is assumed that most, if not all, of the coal mine-produced water would be consumed during operation. As discussed in Section 3.5.2.2, changes in surface runoff would occur as a result of the destruction and reconstruction of drainage channels as mining progresses. Sediment control structures would be used to manage discharges of surface water from the mine permit areas. State and federal regulations require treatment of surface runoff from mined lands to meet effluent standards.

The PRB Coal Review assumes that future permitting would allow a portion of CBNG-produced water to be discharged to intermittent and ephemeral drainages as is currently allowed in the six subwatersheds in the PRB Coal Review Task 3 study area. It is estimated that up to 39,108, 41,899, and 37,390 mmgpy of water would be produced in 2010, 2015, and 2020, respectively. Based on past monitoring in receiving streams, no change in surface flows would be expected beyond approximately two miles from the discharge points (BLM 2003b). For example, water discharged from CBNG wells has supplied the Belle Fourche River and some tributaries, ponds, and playas with water nearly continuously for several years, but this reach of the Belle Fourche River has not become perennial, even with the addition of CBNG discharge water.

Surface disturbing activities can result in sediment input to water bodies, which affects water quality parameters such as turbidity and bottom substrate

composition. Contaminants also can be introduced into water bodies through chemical characteristics of the sediment. Studies have shown that TDS levels in streams near reclaimed coal mine areas have increased from one percent to seven percent (Martin et al. 1988). Typically, sedimentation effects are short-term in duration and localized in terms of the affected area. Suspended sediment concentrations would stabilize and return to typical background concentrations after construction or development activities have been completed. It is anticipated that sediment input associated with development disturbance areas would be minimized by implementation of appropriate erosion control measures, as would be determined during future permitting.

4.2.5 Alluvial Valley Floors

Currently identified AVFs for all coal mines in the PRB Coal Review study area are described in the PRB Coal Review Task 1D Report (BLM 2005c), based on individual mine State Decision Documents. Regulatory determinations of AVF occurrence and location are completed as part of the permitting process for coal mining operations, because their presence can restrict mining activities under SMCRA and Wyoming laws. The WDEQ/LQD administers the AVF regulations for coal mining activities in Wyoming. Coal mine-related impacts to designated AVFs generally are not permitted if the AVF is determined to be significant to agriculture. If an AVF is determined not to be significant to agriculture or if the permit to affect the AVF was approved prior to the effective date of SMCRA, the AVF can be disturbed during mining but must be restored to essential hydrologic function during reclamation. The portions of the PRB Coal Review Task 3 study area that are outside of the mine permit areas have generally not been surveyed for the presence of AVFs; therefore, the locations and extent of the AVFs outside of the mine permit areas have not been determined.

The formal AVF designation and related regulatory programs described above are specific to coal mining operations; however, other development-related activities in the study area would potentially impact AVF resources.

4.2.6 Soils

The PRB Coal Review Task 3D Report (BLM 2005f) discusses potential cumulative impacts to soils as a result of projected development activities in the PRB Coal Review Task 3 study area. The baseline year (2003) area of disturbance and reclamation and the projected cumulative areas of disturbance and reclamation for 2010, 2015, and 2020 related to surface coal mining are shown in Tables 4-2 and 4-3. The baseline year area of disturbance and reclamation and the projected cumulative total areas of disturbance and reclamation for all projected development for 2010, 2015, and 2020 are shown in Table 4-9.

Development activities such as increased vehicle traffic, vegetation removal, soil salvage and redistribution, discharge of CBNG produced groundwater, and construction and maintenance of project-specific components (e.g., roads,

ROWs, well pads, industrial sites, and associated ancillary facilities) would result in cumulative impacts to soils in the study area. In general, soil disturbance and handling from these activities would generate both long-term and short-term impacts to soil resources through accelerated wind or water erosion, other declining soil quality factors, compaction, and the essentially permanent removal of soil resources at industrial sites.

Of the types of development projects in the study area, coal mining activities would create the most concentrated cumulative impacts to soils. This is due to the large acreages involved and the tendency of mining operations to occur in contiguous blocks. These factors would encourage widespread accelerated wind and water erosion; extensive soil handling would reduce soil quality through compaction and corresponding loss of permeability to water and air; declining microbial populations, fertility, and organic matter; potential mixing of saline and/or alkaline soil zones into seedbeds; and the limited availability of suitable soil resources for reclamation uses in some areas.

However, for surface coal mining operations, there are measures that are either routinely required or can be specifically required as necessary to reduce impacts to soil resources and to identify overburden material that may be unsuitable for use in reestablishing vegetation, as discussed in Sections 3.3.1.3, 3.4.2.3, and 3.8.3.

As described in Appendix E of the PRB Coal Review Task 2 Report (BLM 2005d), a variety of CBNG water disposal methods may be employed in the Task 3 study area. The potential impacts to soils would depend on the water treatment method, if any, and the nature of the disposal method. As discussed in the PRB Coal Review Task 3D Report (BLM 2005f), due to elevated SAR levels in water produced from the Wyodak-Anderson coal zone in the Upper Powder River and Little Powder River subwatersheds, land applications of CBNG-produced water in those areas could increase soil alkalinity. Although elevated SARs are also observed in CBNG-produced waters in the Upper Belle Fourche River subwatershed, land application of CBNG-produced water is not anticipated there. The specific approaches to CBNG water discharges, the resource conditions and locations in which they occur, the timing of discharges, and the discharge permit stipulations from regulatory and land management agencies would determine the extent and degree of potential impacts to soils.

4.2.7 Vegetation, Wetlands and Riparian Areas

The PRB Coal Review Task 3D Report (BLM 2005f) discusses potential cumulative impacts to vegetation, wetlands, and riparian areas as a result of projected development activities in the PRB Coal Review Task 3 study area. The baseline year (2003) area of disturbance and reclamation and the projected cumulative areas of disturbance and reclamation for 2010, 2015, and 2020 related to surface coal mining are shown in Tables 4-2 and 4-3. The baseline year area of disturbance and reclamation and the projected cumulative total

areas of disturbance and reclamation for all projected development for 2010, 2015, and 2020 are shown in Table 4-9.

4.2.7.1 Vegetation

The PRB is characterized as a mosaic of general vegetation types, which include prairie grasslands, shrublands, forested areas, and riparian areas. These broad categories often represent several vegetation types that are similar in terms of dominant species and ecological importance. Fourteen vegetation types were identified within the PRB Coal Review Task 1 study area, of which 10 primarily consist of native vegetation and are collectively classified as rangeland. These vegetation types include short-grass prairie, mixed-grass prairie, sagebrush shrubland, other shrubland, coniferous forest, aspen, forested riparian, shrubby riparian, herbaceous riparian, and wet meadow. The remaining vegetation types support limited or non-native vegetation and include cropland, urban/disturbed, barren, and open water. The vegetation types are described in more detail in the Task 1D Report for the PRB Coal Review (BLM 2005c).

Impacts to vegetation can be classified as short-term and long-term. Potential short-term impacts arise from the removal and disturbance of herbaceous species during a project's development and operation (e.g., coal mining, CBNG drilling and production, etc.), which would cease upon project completion and successful reclamation in a given area. Reclaimed mine land is defined by WDEQ/LQD as affected land that has been backfilled, graded, topsoiled, and permanently seeded in accordance with the approved practices specified in the reclamation plan (Christensen 2002). Species composition on the reclaimed lands may be different than on the surrounding undisturbed lands. The removal of woody species would be considered a long-term impact since these species take approximately 25 years or longer to attain a size comparable to woody species present within proposed disturbance areas. Potential long-term impacts would also include permanent loss of vegetation and vegetative productivity in areas that would not be reclaimed in the near term (e.g., power plant sites).

4.2.7.2 Special Status Plant Species

Special status plant species are those species for which state or federal agencies afford an additional level of protection by law, regulation, or policy. Included in this category are federally listed and federally proposed species (species that are protected under the ESA), BLM Sensitive Species, USDA-FS Sensitive Species, and WGFD Species of Special Concern in Wyoming. Further discussions of species that are protected under the ESA and BLM Sensitive Species are included in Appendices F and G of this EIS. One federally listed species (Ute ladies'-tresses orchid) and one USDA-FS sensitive species (Barr's milkvetch) are known to occur in the PRB Coal Review Task 3 study area. Three BLM sensitive species [Nelson's milkvetch and Laramie columbine (Casper Field Office) and William's wafer-parsnip (Buffalo Field Office) may occur in the PRB Coal Review Task 3 study area.

Potential direct impacts to special status plant species in the study area could include the incremental loss or alteration of potential or known habitat, associated with past and projected activities. Direct impacts also could include the direct loss of individual plants within the PRB Coal Review Task 3 study area, depending on their location in relation to development activities. Indirect impacts could occur due to increased dispersal and establishment of noxious weeds, which may result in the displacement of special status plant species in the long term.

4.2.7.3 Noxious and Invasive Weed Species

Once established, invasive and non-native plant species can outcompete and eventually replace native species, thereby reducing forage productivity and the overall vigor of existing native plant communities. The State of Wyoming has designated the following 25 plant species as noxious weeds:

- Field bindweed (*Convolvulus arvensis*)
- Canada thistle (*Cirsium arvense*)
- Leafy spurge (*Euphorbia esula*)
- Perennial sowthistle (*Sonchus arvensis*)
- Quackgrass (*Agropyron repens*)
- Hoary cress (*Cardaria draba*)
- Hairy whitetop (*Cardaria pubescens*)
- Perennial pepperweed (giant whitetop) (*Lepidium latifolium*)
- Ox-eye daisy (*Chrysanthemum leucanthemum*)
- Skeletonleaf bursage (*Franseria discolor Nutt.*)
- Russian knapweed (*Centaurea repens L.*)
- Yellow toadflax (*Linaria vulgaris*)
- Dalmatian toadflax (*Linaria dalmatica*)
- Scotch thistle (*Onopordum acanthium*)
- Musk thistle (*Carduus nutans*)
- Common burdock (*Arctium minus*)
- Plumeless thistle (*Carduus acanthoides*)
- Dyers woad (*Isatis tinctoria*)
- Houndstongue (*Cynoglossum officinale*)
- Spotted knapweed (*Centaurea maculosa Lam.*)
- Diffuse knapweed (*Centaurea diffusa Lam.*)
- Purple loosestrife (*Lythrum salicaria L.*)
- Saltcedar (*Tamarix spp.*)
- Common St. Johnswort (*Hypericum perforatum*)
- Common Tansy (*Tanacetum vulgare*)

Campbell County does not have a declared county list of weeds.

Development-related construction and operation activities would potentially result in the dispersal of noxious and invasive weed species within and beyond the surface disturbance boundaries, which would result in the displacement of native species and changes in species composition in the long term. The

potential for these impacts would be higher in relation to the development of linear facilities (e.g., pipeline ROWs, oil- and gas-related road systems, etc.) than for site facilities (e.g., mines, power plants, etc.) due to the potential for dispersal of noxious weeds over a larger area.

Chapter 4, Section 2(d)(xiv) of the WDEQ/LQD rules and regulations requires that surface coal mines address weed control on reclaimed areas as follows:

> The operator must control and minimize the introduction of noxious weeds in accordance with Federal and State requirements until bond release.

Accordingly, the reclamation plans for the existing Eagle Butte Mine and for all other surface coal mines in the Wyoming PRB include steps to control invasion by weedy (invasive nonnative) plant species. As discussed in Chapter 3, Section 3.9.4, Eagle Butte Mine works with the Campbell County Weed and Pest Department and conducts an active noxious weed control program on their existing coal leases. Similar measures to identify and control noxious weeds are used at all of the surface coal mines in the Wyoming PRB as a result of the WDEQ/LQD regulatory requirements.

Mitigation to control invasion by noxious weeds for CBNG developers is determined on a site-specific basis and may include spraying herbicides before entering areas and washing vehicles before leaving infested areas. BLM reviews weed educational material during preconstruction on-site meetings with CBNG operators, subcontractors, and landowners. BLM also attaches this educational information to approved APDs or PODs (BLM 2003b). BLM also participates in a collaborative effort with the South Goshen Cooperative Extension Conservation District, the Natural Resources Conservation Service, private surface owners, WGFD, and the Weed and Pest District in a prevention program that includes a long-term integrated weed management plan, public awareness and prevention programs, and a common inventory (BLM 2003b).

4.2.7.4 Wetland and Riparian Species

Operations associated with development activities in the study area would result in the use of groundwater. Annually, during 2010-2020, from 30,000-35,000 mmgpy of CBNG-produced water would be discharged to impoundments or intermittent and ephemeral streams or reinjected. The discharge of produced water could result in the creation of wetlands in containment ponds, landscape depressions, and riparian areas along segments of drainages that previously supported upland vegetation. In addition, existing wetlands and riparian areas that would receive additional water would become more extensive and potentially support a greater diversity of wetland species in the long term. Alternately, the discharge of abnormally high flows or water with SARs of 13 or more could impact existing vegetation as discussed in the Task 1D Report for the PRB Coal Review (BLM 2005c). For agricultural uses, the current Wyoming water quality standard for SAR is 8.0 (WDEQ/WQD 2005). SARs of 5 to 10 have been

observed in discharge waters in the study area (BLM 2003b). Once water discharges have peaked and subsequently decrease in the long term, the extent of wetlands and riparian areas and species diversity would decrease accordingly. After the complete cessation of water discharges, artificially-created wetland and riparian areas once again would support upland species and previously existing wetland and riparian areas would decrease in areal extent.

4.2.8 Wildlife and Fisheries

The PRB Coal Review Task 3D Report (BLM 2005f) discusses potential cumulative impacts to wildlife as a result of projected development activities in the PRB Coal Review Task 3 study area. The baseline year (2003) area of habitat disturbance and reclamation and the projected cumulative areas of habitat disturbance and reclamation for 2010, 2015, and 2020 related to surface coal mining are shown in Tables 4-2 and 4-3. The baseline year area of total habitat disturbance and reclamation and the projected cumulative total areas of habitat disturbance and reclamation for 2010, 2015, and 2020 are shown in Table 4-9.

Impacts to wildlife can be classified as short-term and long-term. Potential short-term impacts arise from habitat disturbance associated with a project's development and operation (e.g., coal mines, CBNG wells, etc.) and would cease upon project completion and successful reclamation in a given area. Potential long-term impacts consist of long-term changes to habitats and the wildlife populations that depend on those habitats, irrespective of reclamation success, and habitat disturbance related to longer term projects (e.g., power plant facilities, rail lines, etc.). Direct impacts to wildlife populations as a result of development activities in the study area could include direct mortalities, habitat loss or alteration, habitat fragmentation, or animal displacement. Indirect impacts could include increased noise, additional human presence, and the potential for increased vehicle-related mortalities.

Habitat fragmentation from activities such as roads, well pads, mines, pipelines, and electrical power lines also can result in the direct loss of potential wildlife habitat. Other habitat fragmentation effects such as increased noise, elevated human presence, dispersal of noxious and invasive weed species, and dust deposition from unpaved road traffic can extend beyond the surface disturbance boundaries. These effects result in overall changes in habitat quality, habitat loss, increased animal displacement, reductions in local wildlife populations, and changes in species composition. However, the severity of these effects on terrestrial wildlife would depend on factors such as sensitivity of the species, seasonal use, type and timing of project activities, and physical parameters (e.g., topography, cover, forage, and climate).

4.2.8.1 Game Species

Big game species that are present within the Task 3 study area include pronghorn, white-tailed deer, mule deer, and elk. Potential direct impacts to these species would include the incremental loss or alteration of potential forage

and ground cover associated with development construction and operational activities. Development associated with coal mining, drilling for CBNG, ancillary facilities, agricultural operations, urban areas, and transportation and utility corridors result in vegetation removal. Assuming that adjacent habitats would be at or near carrying capacity and considering the variabilities associated with drought conditions and human activities in the study area, displacement of wildlife species (e.g., big game) as a result of development activities would create some unquantifiable reduction in wildlife populations.

A number of big game habitat ranges occur within the PRB Coal Review Task 3 study area. In Wyoming, the WGFD and the BLM have established habitat categories based on seasonal use. Category types include crucial winter, severe winter, winter yearlong, and yearlong. Crucial winter range areas are considered essential in determining a game population's ability to maintain itself at a certain level over the long term. As discussed in the PRB Coal Review Task 2 report, discrete locations for most of the disturbance related to the projected development could not be determined based on the available information. However, identified future coal reserves were used for the Task 3 report to provide some level of quantification of potential future impacts to big game ranges. Tables 4-19 through 4-22 summarize the effects on pronghorn, deer, and elk game ranges as a result of the predicted lower and upper levels of coal production through 2020.

Table 4-19. Potential Cumulative Disturbance to Pronghorn Ranges from Development Activities--Lower and Upper Coal Production Scenarios (acres/percent affected).

	Pronghorn Ranges[1]			
Time Period/Scenario	**Crucial Winter**	**Severe Winter**	**Winter Yearlong**	**Yearlong**
2010/Lower	N/A	1,472 / 3%	33,196 / 2%	32,099 / 1%
2010/Upper	N/A	1,472 / 3%	34,760 / 2%	33,172 / 1%
2015/Lower	N/A	1,460 / 3%	32,649 / 2%	34,828 / 1%
2015/Upper	N/A	1,460 / 3%	34,177 / 2%	36,999 / 1%
2020/Lower	N/A	1,422 / 3%	33,637 / 2%	35,714 / 1%
2020/Upper	N/A	1,422 / 3%	33,580 / 2%	37,437 / 2%

[1] Potential coal mine-related impacts to big game ranges were determined based on GIS information as follows: the total acres of a big game range (e.g., crucial winter, severe winter, winter yearlong, and yearlong) within the PRB Coal Review Task 3 study area was divided by the sum of the potential disturbance acreage for the time period (based on GIS mapping of coal reserves for the lower production scenario) and existing (2003) disturbance from coal mine development.

Source: PRB Coal Review Task 3D Report (BLM 2005f)

Direct and indirect effects to small game species (i.e., upland game birds, waterfowl, small game mammals) within the Task 3 study area as a result of development activities would be the same as discussed above for big game species. Impacts would result from the incremental surface disturbance of potential wildlife habitat, increased noise levels and human presence, dispersal of noxious and invasive weed species, and dust effects from unpaved road traffic.

Operations associated with development activities in the Task 3 study area would result in the use of groundwater. Most, if not all, of the coal mine-produced water would be consumed during operation. It is projected that up to

Table 4-20. Potential Cumulative Disturbance to White-tailed Deer Ranges from Development Activities--Lower and Upper Coal Production Scenarios (acres/percent affected).

	White-tailed Deer Ranges[1]			
Time Period/Scenario	**Crucial Winter**	**Severe Winter**	**Winter Yearlong**	**Yearlong**
2010/Lower	N/A	N/A	N/A	1,411 / 0.6%
2010/Upper	N/A	N/A	N/A	1,411 / 0.6%
2015/Lower	N/A	N/A	N/A	1,497 / 0.7%
2015/Upper	N/A	N/A	N/A	1,495 / 0.7%
2020/Lower	N/A	N/A	N/A	1,704 / 0.7%
2020/Upper	N/A	N/A	N/A	1,707 / 0.8%

[1] Potential coal mine-related impacts to big game ranges were determined based on GIS information as follows: the total acres of a big game range (e.g., crucial winter, severe winter, winter yearlong, and yearlong) within the PRB Coal Review Task 3 study area was divided by the sum of the potential disturbance acreage for the time period (based on GIS mapping of coal reserves for the lower production scenario) and existing (2003) disturbance from coal mine development.

Source: PRB Coal Review Task 3D Report (BLM 2005f)

Table 4-21. Potential Cumulative Disturbance to Mule Deer Ranges from Development Activities--Lower and Upper Coal Production Scenarios (acres/percent affected).

	Mule Deer Ranges[1]			
Time Period/Scenario	**Crucial Winter**	**Severe Winter**	**Winter Yearlong**	**Yearlong**
2010/Lower	N/A	N/A	6,808 / 0.4%	25,390 / 1%
2010/Upper	N/A	N/A	6,924 / 0.4%	26,641 / 1%
2015/Lower	N/A	N/A	6,956 / 0.4%	26,420 / 1%
2015/Upper	N/A	N/A	7,285 / 0.5%	27,205 / 1%
2020/Lower	N/A	N/A	6,958 / 0.4%	27,004 / 1%
2020/Upper	N/A	N/A	7,413 / 0.5%	27,990 / 1%

[1] Potential coal mine-related impacts to big game ranges were determined based on GIS information as follows: the total acres of a big game range (e.g., crucial winter, severe winter, winter yearlong, and yearlong) within the PRB Coal Review Task 3 study area was divided by the sum of the potential disturbance acreage for the time period (based on GIS mapping of coal reserves for the lower production scenario) and existing (2003) disturbance from coal mine development.

Source: PRB Coal Review Task 3D Report (BLM 2005f)

Table 4-22. Potential Cumulative Disturbance to Elk Ranges from Development Activities--Low and High Development Scenarios (acres/percent affected).

	Elk Ranges[1]			
Time Period/Scenario	**Crucial Winter**	**Severe Winter**	**Winter Yearlong**	**Yearlong**
2010/Lower	24 / 0.4%	N/A	375 / 1%	1,444 / 0.9%
2010/Upper	24 / 0.4%	N/A	375 / 1%	1,444 / 0.9%
2015/Lower	24 / 0.4%	N/A	351 / 1%	1,161 / 0.7%
2015/Upper	24 / 0.4%	N/A	351 / 1%	1,162 / 0.7%
2020/Lower	24 / 0.4%	N/A	351 / 1%	1,121 / 0.7%
2020/Upper	24 / 0.4%	N/A	351 / 1%	1,168 / 0.7%

[1] Potential coal mine-related impacts to big game ranges were determined based on GIS information as follows: the total acres of a big game range (e.g., crucial winter, severe winter, winter yearlong, and yearlong) within the PRB Coal Review Task 3 study area was divided by the sum of the potential disturbance acreage for the time period (based on GIS mapping of coal reserves for the lower production scenario) and existing (2003) disturbance from coal mine development.

Source: PRB Coal Review Task 3D (BLM 2005f)

approximately 39,108, 41,899, and 37,390 mmgpy of water would be produced in 2010, 2015, and 2020, respectively. The portion of that water that is produced in association with CBNG production would be discharged to impoundments or intermittent and ephemeral streams and would be available for area wildlife (e.g., waterfowl). Although much of the water would evaporate or infiltrate into the ground, it is anticipated that substantial quantities of water would remain on the surface and would result in the expansion of wetlands, stock ponds, and reservoirs, potentially increasing waterfowl breeding and foraging habitats. The median sodium concentration of CBNG-produced water from the Fort Union Formation is 270 mg/L. If sodium concentrations are maintained below 17,000 mg/L in the evaporation ponds, the potential adverse effects to waterfowl would be minimal.

4.2.8.2 Nongame Species

Potential direct impacts to nongame species (e.g., small mammals, raptors, passerines, amphibians, and reptiles) would include the incremental loss or alteration of potential foraging and breeding habitats from construction and operation of activities (e.g., vegetation removal for coal mines and CBNG wells, ancillary facilities, and transportation and utility corridors). Impacts also could result in mortalities of less mobile species (e.g., small mammals, reptiles, amphibians, and invertebrates), nest or burrow abandonment, and loss of eggs or young as a result of crushing from vehicles and equipment. Indirect impacts would include increased noise levels and human presence, dispersal of noxious weeds, and dust effects from unpaved road traffic. Assuming that adjacent habitats would be at or near carrying capacity and considering the variabilities associated with drought conditions and human activities in the study area, displacement of wildlife species from the Task 3 study area would result in an unquantifiable reduction in wildlife populations.

A number of migratory bird species have been documented within the PRB. In the event that development activities were to occur during the breeding season (April 1 through July 31), these activities could result in the abandonment of a nest site or territory or the loss of eggs or young, resulting in the loss of productivity for the breeding season. Loss of an active nest site, incubating adults, eggs, or young would not comply with the intent of the Migratory Bird Treaty Act and potentially could affect populations of important migratory bird species that may occur in the PRB.

Breeding raptor species that occur within the Task 3 study area include bald eagle, golden eagle, red-tailed hawk, Swainson's hawk, rough-legged hawk, American kestrel, prairie falcon, northern harrier, short-eared owl, and great horned owl. Potential direct impacts to raptors would result from the surface disturbance of nesting and foraging habitat in the PRB Coal Review Task 3 study area. In the event that development activities were to occur during the breeding season (February 1 through July 31), these activities could result in the abandonment of a nest site or territory or the loss of eggs or young, resulting in the loss of productivity for the breeding season. As discussed above, loss of an

active nest site, incubating adults, eggs, or young would not comply with the intent of several laws, including the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act.

New power line segments in the study area incrementally would increase the collision potential for migrating and foraging bird species (e.g., raptors and waterfowl) (APLIC 1994). However, collision potential typically is dependent on variables such as the location in relation to high-use areas (e.g., nesting, foraging, and roosting), line orientation to flight patterns and movement corridors, species composition, visibility, and design. In addition, new power lines could pose an electrocution hazard for raptor species attempting to perch on the structure. Configurations less than 1 kV or greater than 69 kV typically do not present an electrocution potential, based on conductor placement and orientation (APLIC 1996). It is assumed that future permitting for power lines would require the use of appropriate raptor-deterring designs, thereby minimizing potential impacts. For example, SMCRA requires that surface coal mine operators use the best technology currently available to ensure that electric power lines are designed and constructed to minimize electrocution hazards to raptors. In addition, many of the power lines for CBNG development currently are being constructed underground.

4.2.8.3 Fisheries

Potential cumulative effects on fisheries as a result of development activities in the Task 3 study area would be closely related to impacts on ground and surface water resources. In general, development activities could affect fish species in the following ways: 1) alteration or loss of habitat as a result of surface disturbance; 2) changes in water quality as a result of surface disturbance or introduction of contaminants into drainages; and 3) changes in available habitat as a result of water withdrawals or discharge. The potential effects of development activities on aquatic communities are discussed below for each of these impact topics.

The predominant type of aquatic habitat in the study area consists of intermittent and ephemeral streams and scattered ponds and reservoirs. In general, perennial stream habitat in the study area is limited to the Little Powder River. Warm water game fish and nongame species are present in the perennial stream segments and numerous scattered reservoirs and ponds. Due to a lack of water on a consistent basis in most of the potentially affected streams, existing aquatic communities are mainly limited to invertebrates and algae that can persist in these types of habitats. The removal of stock ponds would eliminate habitat for invertebrates and possibly fish species. This loss would be temporary if the stock ponds are replaced during reclamation.

Development activities could result in the loss of aquatic habitat as a result of direct surface disturbance. Table 4-9 summarizes the cumulative current (in 2003) and projected (in 2010, 2015, and 2020) acres of surface disturbance and reclamation. Discrete locations for development disturbance and reclamation

areas cannot be determined based on existing information. However, projected development that could result in the loss of aquatic habitat would involve the construction of additional linear facilities, product gathering lines and road systems associated with conventional oil and gas and CBNG activities and any additional disturbance that would be associated with extending coal mining operations onto lands adjacent to the existing mines.

Projected activities would result in surface disturbance in each of the six Task 3 study area subwatersheds. Information relative to the stream crossing locations for the majority of the linear facilities is not available at this time. The proposed Bison Pipeline project is not currently active. If the project is constructed, it would cross Cottonwood Creek, a tributary of the Little Powder River. Typically, the associated disturbance would consist of a 100-foot-wide construction ROW; however, site-specific stream crossing methods and reclamation would be determined at the time of project permitting. Future coal mining also could remove intermittent or ephemeral streams and stock ponds in the Little Powder River, Upper Belle Fourche River, Upper Cheyenne River, and Antelope Creek subwatersheds. Coal mine permits provide for removal of first- through fourth-order drainages. During reclamation, third- and fourth-order drainages must be restored; first- and second-order drainages often are not replaced (Martin et al. 1988). As discussed in Section 3.5.2, Little Rawhide Creek and its tributary, Prong Draw, drain the existing Eagle Butte Mine permit area and the general analysis area for the entire Eagle Butte West LBA Tract. All streams within and adjacent to the tract are typical for the region, in that flow events are ephemeral. Under natural conditions, aquatic habitat is limited by the ephemeral nature of surface waters in the general analysis area. The results of fish surveys that were conducted in Little Rawhide Creek during baseline studies for the Eagle Butte Mine in between 1977 and 1984 and again in 1985 are discussed in Section 3.10.7.1.

The PRB Coal Review assumes that surface disturbance activities would not be allowed in perennial stream segments or reservoirs on public land that contain game fish species. It also assumes that other types of development activities would not occur within stream channels nor remove ponds or reservoirs as part of construction or operation and, therefore, would not result in the direct loss of fish habitat.

Surface disturbing activities can result in sediment input to water bodies, which affects water quality parameters such as turbidity and bottom substrate composition. Contaminants also can be introduced into water bodies through chemical characteristics of the sediment. Potential related effects on aquatic biota could include physiological stress, movement to avoid the affected area, or alteration of spawning or rearing areas (Waters 1995). Studies have shown that TDS levels in streams near reclaimed coal mine areas have increased from one percent to seven percent (Martin et al. 1988). Typically, sedimentation effects are short-term in duration and localized in terms of the affected area. TSS concentrations would stabilize and return to typical background concentrations after construction or development activities have been completed. It is

anticipated that sediment input associated with development disturbance areas would be minimized by implementation of appropriate erosion control measures, as would be determined during future permitting.

The removal of streamside vegetation and the resultant reduction in shade and potential for increased bank erosion also could degrade aquatic habitats. It is assumed these types of impacts would be limited to intermittent and ephemeral streams, since a buffer protection zone typically is required for development activities near perennial streams. ROW clearing for linear projects could remove riparian vegetation at stream crossings. However, effects on aquatic habitat would be limited to a relatively small portion of the stream (up to 100 ft in width depending on the type of development). It is anticipated that reclamation procedures to restore riparian vegetation would be required during future project permitting, thereby minimizing impacts.

CBNG and coal mining are the primary types of development activities that use or manage water as part of their operations. Based on current trends, it is assumed that most, if not all, of the coal mine-produced water would be consumed during operation. As discussed in Section 3.5.2.2, changes in surface runoff characteristics and sediment discharges would occur during surface coal mining as a result of the destruction and reconstruction of drainage channels as mining progresses and the use of sediment control structures to manage discharges of surface water from the mine permit area. State and federal regulations require treatment of surface runoff from mined lands to meet effluent standards. Coal mining-related surface water would be discharged into intermittent and ephemeral streams in four subwatersheds (Antelope Creek, Little Powder River, Upper Belle Fourche River, and Upper Cheyenne River). It is assumed that future permitting would allow a portion of CBNG-produced water to be discharged to intermittent and ephemeral drainages as is currently allowed in the six subwatersheds in the study area. It is projected that up to approximately 39,108, 41,899, and 37,390 mmgpy of water would be produced in 2010, 2015, and 2020, respectively. The portion of that water that is produced in association with CBNG production would be discharged to impoundments or intermittent and ephemeral streams. Based on past monitoring in receiving streams, no change in surface flows would be expected beyond approximately two miles from the discharge points (BLM 2003b). For example, water discharged from CBNG wells has supplied the Belle Fourche River and some tributaries, ponds, and playas with water nearly continuously for several years, but this reach of the Belle Fourche River has not become perennial, even with the addition of CBNG discharge water.

4.2.8.4 Special Status Species

Special status species are those species for which state or federal agencies afford an additional level of protection by law, regulation, or policy. Included in this category are federally listed and federally proposed species (species that are protected under the ESA), BLM Sensitive Species, USDA-FS Sensitive Species, and WGFD Species of Special Concern in Wyoming. Further discussions of

species that are protected under the ESA and BLM Sensitive Species are included in Appendices E and F of this Final EIS. The USFWS also has a list of Migratory Bird Species of Management Concern in Wyoming, which is discussed in Section 3.10.6 and in the Supplementary Information Document for this EIS. Special status species potentially occurring in the Task 1 study area are identified in Section 2.4.3.5 of the PRB Coal Review Task 1D Report (BLM 2005c).

Potential impacts to special status terrestrial species would be similar to those discussed above for nongame wildlife (e.g., small mammals, birds, amphibians, and reptiles). Potential direct impacts would include the incremental loss or alteration of potential habitat (native vegetation and previously disturbed vegetation) from construction and operation of development activities (e.g., vegetation removal for coal mines and CBNG wells, ancillary facilities, and transportation and utility corridors). Impacts also could result in mortalities of less mobile species (e.g., small mammals, reptiles, and amphibians), nest or burrow abandonment, and loss of eggs or young as a result of crushing from vehicles and equipment. Indirect impacts would include increased noise levels and human presence, dispersal of noxious weeds, and dust effects from unpaved road traffic.

In general, direct and indirect impacts to special status species would result in a reduction in habitat suitability and overall carrying capacity in the study area. Development within potential habitat for special status species likely would decrease its overall suitability and potentially would reduce or preclude use of a species habitat due to increased activity and noise. Future use of habitat by a special status species would be strongly influenced by habitat quality, the degree of impact would depend on a number of variables including the location of the nest or den site, the species' relative sensitivity, breeding phenology, and possible topographic shielding.

Bird species that have been identified as occurring within the PRB and are on two or more of the special status species lists include common loon, American bittern, white-faced ibis, trumpeter swan, greater sandhill crane, mountain plover, upland sandpiper, long-billed curlew, black tern, yellow-billed cuckoo, Lewis' woodpecker, pygmy nuthatch, sage thrasher, loggerhead shrike, Baird's sparrow, sage sparrow, Brewers sparrow, and greater sage-grouse. Any development activities (oil and gas and related development, coal mining and related development, or other development) that occur during the breeding season (April 1 through July 31) could result in the abandonment of a nest site or territory or the loss of eggs or young, resulting in the loss of productivity for the breeding season. As discussed previously, loss of an active nest site, incubating adults, eggs, or young as a result of any of these development activities would not comply with the intent of the Migratory Bird Treaty Act and potentially could affect populations of important migratory bird species that may occur in the PRB.

A number of raptor species have been documented in the PRB and are on two or more of the special status species lists including bald eagle, ferruginous hawk, northern goshawk, merlin, peregrine falcon, western burrowing owl, and short-eared owl. Potential direct impacts to raptors would result from the surface disturbance of breeding and foraging habitat. Breeding raptors in or adjacent to development activities could abandon breeding territories, nest sites, or lose eggs or young. As discussed previously, loss of an active nest site, incubating adults, eggs, or young would not comply with the intent of several laws, including the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act, and potentially could affect populations of important migratory bird species that may occur within the study area. New power line segments in the study area incrementally would increase the collision potential for migrating and foraging bird species such as raptors.

A total of 239 greater sage-grouse strutting ground (lek) sites were identified in the six subwatersheds in the PRB Coal Review Task 3 study area as of 2003; however, the PRB Coal Review did not evaluate the status of these leks (i.e., active or inactive). Sage-grouse are susceptible to infection with West Nile virus, and the incidence of infection is much higher in northeastern Wyoming than the rest of the state. As discussed in Section 3.10.5 and in the PRB Coal Review Task 1D report, the trend in the sage-grouse population for the Sheridan Region suggests about a 10-year cycle with periodic highs and lows. Subsequent population peaks appear lower than the previous peak, suggesting a steadily declining sage-grouse population within the Sheridan Region (Oedekoven 2001). Direct and indirect effects to greater sage-grouse within the study area as a result of development activities would be the similar to the impacts discussed above for big game species. Impacts would result from the incremental surface disturbance of potential habitat, increased noise levels and human presence, dispersal of noxious and invasive weed species, and dust effects from unpaved road traffic.

As discussed above for game species, based on existing information, the spatial relationship between projected future disturbance and reclamation areas for the projected coal development scenarios and the resource-specific information in the GIS layers could not be determined for the PRB Coal Review. However, the analysis did use GIS layers for future coal reserves to provide some quantification of potential future coal mining-related impacts. The results of this analysis are summarized in Table 4-23. The difference in the number of lek sites that would occur within two miles of coal mining activities under the lower production scenario verses the upper production scenario is due to slight variations in the projected disturbance areas. An unquantifiable number of the lek sites initially could be impacted by CBNG activity, which would occur in advance of coal mine development. Potential direct impacts to sage-grouse, if present, could include loss of foraging areas, abandonment of a lek site, or loss of eggs or young as a result of development activities.

Table 4-23. Potential Cumulative Impacts to Greater Sage-Grouse Leks from Coal Mine Development--Upper and Lower Coal Production Development Scenarios.

Lek Categories	**2010/ Lower**	**2010/ Upper**	**2015/ Lower**	**2015/ Upper**	**2020/ Lower**	**2020/ Upper**
Number of Directly Affected Leks	10	10	15	15	15	15
Number of Leks within Two Miles of Coal Mining Activity	47	47	47	49	50	49

Source: PRB Coal Review Task 3D Report (BLM 2005f)

Seven special status fish species potentially occur in the PRB Coal Review Task 3 study area subwatersheds: flathead chub (Little Powder River, Antelope Creek, and Upper Cheyenne River subwatersheds), plains topminnow (Upper Cheyenne River subwatershed), goldeye (Little Powder River subwatershed), lake chub (Little Powder River subwatershed), mountain sucker (Little Powder River subwatershed), silvery minnow (Little Powder River subwatershed), and plains minnow (Little Powder River, Upper Cheyenne River, and Upper Belle Fourche River subwatersheds). Potential impacts to special status fish species as a result of development activities would be similar to effects discussed above for fisheries. Surface disturbance in three subwatersheds (Little Powder River, Upper Belle Fourche River, and Upper Cheyenne River) could alter habitat or affect water quality conditions for special status fish species. Erosion control measures, as required by 2003 (PRB Coal Review baseline year) and future permits, and NPDES permit requirements would be implemented for each project. These measures would help decrease disturbance-related sediment input to stream segments that may contain one of more of the special status fish species. Therefore, it is anticipated that impacts to special status fish species would be low.

4.2.9 Land Use and Recreation

The PRB Coal Review Task 3D report (BLM 2005f) discusses potential cumulative impacts to land use and recreation as a result of projected development activities in the PRB Coal Review Task 3 study area (Figure 4-4). The baseline year (2003) area of disturbance and reclamation and the projected cumulative areas of disturbance and reclamation for 2010, 2015, and 2020 related to surface coal mining are shown in Tables 4-2 and 4-3. The baseline year area of total disturbance and reclamation and the projected cumulative total areas of disturbance and reclamation for 2010, 2015, and 2020 are shown in Table 4-9.

The PRB is a predominantly rural, wide open landscape. With little rainfall and limited alternative sources of water, the primary land use is grazing. Nevertheless, there is a range of other land uses. The major categories include agriculture, forested, mixed rangeland, urban, water, wetlands, coal mines, and barren land. The relative amounts of these lands in the PRB Coal Review Task 1 and Task 2 study area (Figure 4-1) is tabulated in Table 4-24.

Table 4-24. Land Use by Surface Ownership.

Use Category	Surface Ownership				Total	
	BLM	**USDA-FS[1]**	**State**	**Private**	**Acres**	**Percent**
Agriculture	2,627	14,197	13,770	472,811	503,405	6.3
Barren	165	205	187	9,396	9,953	0.1
Forested	137,555	14,604	48,645	332,062	532,866	6.7
Mixed Rangeland	732,014	218,156	561,363	5,271,644	6,783,177	86.0
Urban	893	17	1,039	25,469	27,418	0.3
Water	35	73	334	4,773	5,215	<0.1
Wetlands	0	104	559	1,566	2,229	<0.1
Coal Mines	149	7,236	2,805	40,917	51,107	0.6
Total	**873,438**	**254,592**	**628,702**	**6,158,638**	**7,915,370**	**100.0**

[1] Thunder Basin National Grassland, administered by the Medicine Bow – Routt National Forest.
Source: PRB Coal Review Task 1D Report (BLM 2005c)

A large part of the PRB consists of split estate lands (privately owned surface lands underlain by federally owned minerals). This results in conflicts between surface users, which are mainly ranching interests, and mineral developers. There also may be conflicts with some dispersed rural residences, although specific locations cannot be identified until development is proposed.

Much of the study area is also used for dispersed recreational activities such as hunting. The study area includes surface lands that are federally, state, and privately owned. With nearly 80 percent of the area privately owned, public lands provide important open space and recreation resources including both developed recreation facilities and areas to pursue dispersed recreation activities. The private sector contributes the elements of commercial recreation opportunities and tourism services such as motels and restaurants. Some private land owners also allow hunting with specific permission, sometimes for a fee.

4.2.9.1 Grazing and Agriculture

Potential impacts to grazing in the Task 3 study area as a result of development activities can be classified as short-term and long term. Potential short-term impacts arise from:

- the temporary loss of forage as a result of vegetation removal/ disturbance;
- temporary loss of AUMs;
- temporary loss of water-related range improvements, such as improved springs, water pipelines, and stock ponds;
- temporary loss of other range improvements, such as fences and cattle guards; and
- restricted movement of livestock within an allotment due to the development and operation of projects like surface coal mines, which would cease after successful reclamation had been achieved and replacement of water-related and other range improvements had been completed.

The discharge of produced water could increase the availability of water to livestock, which may offset the temporary loss of water-related range improvements. Potential long-term impacts consist of permanent loss of forage and forage productivity in areas, such as power plants, that would not be reclaimed in the near term. Indirect impacts may include dispersal of noxious and invasive weed species within and beyond the surface disturbance boundaries, which decreases the amount of desirable forage available for livestock grazing in the long term.

Development activities could result in short- and long-term impacts to agricultural land, depending on their spatial relationship. Short-term impacts would include the loss of crop production during development and operational phases of the projects. Long-term impacts would result from the permanent loss of agricultural land due the development of permanent facilities such as power plants and railroads.

Table 4-25 contains an estimate of the number of AUMs unavailable on lands disturbed and not yet reclaimed through 2020 for the high and low levels of predicted development activity, along with the acreage of cropland estimated to be affected.

Table 4-25. AUMs and Acres of Cropland Estimated Unavailable on Lands Disturbed and Not Yet Reclaimed as a Result of Development Activities.

Category	**2003/ Baseline**	**2010/ Lower**	**2010/ Upper**	**2015/ Lower**	**2015/ Upper**	**2020/ Lower**	**2020/ Upper**
Unavailable AUMs[1]	18,150	22,467	22,792	23,245	23,761	22,514	23,333
Unavailable Crop Land (acres)	48	59	60	134	139	206	289

[1] Based on an average stocking rate of six acres per AUM.
Source: PRB Coal Review Task 3D Report (BLM 2005f)

4.2.9.2 Urban Use

It is expected that there would be additional expansion of urban residential and commercial development as a result of the projected 48 percent growth in population (between 2003 and 2020) in Campbell County. Section 4.2.12 and the Task 3C Report of the PRB Coal Review (BLM 2005e) contain additional information on employment and population issues in the study area. A majority of the new urban development would be expected to occur adjacent to existing communities, primarily Gillette, which accounts for approximately 60 percent of the Campbell County population and, to a lesser extent, Wright and other small communities. Most of this development would occur on land that is currently in use for grazing or agriculture.

4.2.9.3 Recreation

Accessible public lands provide diverse opportunities for recreation, including hunting, fishing, ORV use, sightseeing, and wildlife observation. Public lands generally provide dispersed recreational uses in the study area. Some developed recreational facilities occur in special management areas, including recreation areas. While opportunities are available on BLM lands throughout the PRB, the majority of dispersed recreational uses occur in the western part of the PRB Coal Review Task 1 and Task 2 study area, including the South Big Horn Mountains area and along the Powder River. BLM lands elsewhere consist mainly of isolated tracts of land that are too small to provide a quality recreational experience. Within the PRB Coal Review Task 1 and Task 2 study area, the larger parcels of federal public lands occur in the southwest part of Johnson County and along the Powder River (administered by BLM) and in the Thunder Basin National Grassland (administered by the Forest Service). Public lands are accessible via public roads or across private land with the landowner's permission.

Hunting is a major recreation use of state and federal lands in the study area. Various big game and upland game bird species are hunted in the region. Fishing is a popular year-round activity for residents of the study area.

Mule deer and pronghorn hunting are by far the most popular hunting activities in the Task 1 study area, accounting for 35,529 and 21,304 hunter days, respectively, in 2003 (Stratham 2005). The next highest were cottontail rabbit (2,348 hunter days) and elk (2,055 hunter days), followed by wild turkey (1,019), sharp-tailed grouse (508), and sage-grouse (38). Consistent trends in hunter activity are not discernible from the WGFD data reviewed for the PRB Coal Review. All of the most prominent species hunted in the study area have had high years and low years. Pronghorn hunting, or example, was greatest from 1993 to 1996, while elk hunting was at its peak in 2001 and 2002. Mule deer hunting has been the most consistent, ranging from a low of 28,311 hunter days in 1996 to a high of 37,307 hunter days in 2002.

ORV use in the Task 1 study area is available on most BLM-managed lands. Most of the public land in Johnson, Sheridan, and Campbell Counties has been inventoried and designated as open, limited, or closed to ORV use. For the baseline year, approximately 20,386 acres were open to unlimited vehicle travel on and off roads. There were 4,680 acres in the area that were closed to all ORV use and approximately 867,534 acres were available for limited use. Limited use typically means ORVs are restricted to existing roads and vehicle routes.

Recreational use of public lands in the Task 1 study area has increased substantially over the past two decades, and is expected to continue to increase by about five percent every five years for most recreational activities (BLM 2003b). Total visitor use by residents and nonresident visitors in Campbell and Converse Counties in 1980 was projected at 1,276,000 visitor days (BLM 1979). The total visitor days of 1,881,763 estimated for 1990 was approximately 47

percent higher than the 1980 visitor days (BLM 2001c). Fewer than three percent of visitor days were estimated to occur on public lands.

Few, if any, of the developed recreation sites in the PRB Coal Review Task 3 study area would be affected by development related disturbance. As most of the projected disturbance area would occur on privately owned surface land, the extent of effects on dispersed recreation activities largely would depend on whether the disturbance areas had been open to public or private lease hunting. It is projected that cumulative development activities, especially the dispersed development of CBNG and, to a lesser extent, conventional oil and gas, would tend to exacerbate the trend toward a reduction in private land available for public hunting, which has been observed by WGFD in recent years (Shorma 2005). A reduction in available private land for dispersed recreation would contrast with the anticipated increase in demand for recreational opportunities and would tend to push more recreationists toward public lands where the BLM has projected a five percent increase in use every five years (BLM 2001a). After coal- and oil and gas-related development activities have been completed and the disturbed areas have been reclaimed, many of the adverse effects on dispersed recreation activities would be reduced.

It is expected that the development activities also would tend to expand and exacerbate the qualitative degradation of the dispersed recreation experience, in general, and of the hunting experience, in particular, as reported by the WGFD (Jahnke 2005). As noted in the Task 1D Report of the PRB Coal Review (BLM 2005c), reductions in land available for hunting also make herd management more difficult for the WGFD and reduce its hunting-derived revenues (Shorma 2005).

No direct effects on wilderness or roadless areas would be expected from the projected development activities. There are no designated wilderness areas in the study area, and mineral development would not be permitted in the Fortification Creek Wilderness Study Area until and unless Congress acts to remove it from Wilderness consideration.

There would be no effects on Wild and Scenic Rivers as the only river segment identified as both “eligible” and “suitable” in the Task 1D Report of the PRB Coal Review is not in the PRB Coal Review Task 3 study area.

4.2.10 Cultural Resources and Native American Concerns

The PRB Coal Review Task 3D report (BLM 2005f) discusses potential cumulative impacts to cultural resources as a result of projected development activities in the PRB Coal Review Task 3 study area. The baseline year (2003) area of disturbance and reclamation and the projected cumulative areas of disturbance and reclamation for 2010, 2015, and 2020 related to surface coal mining are shown in Tables 4-2 and 4-3. The baseline year area of total disturbance and reclamation and the projected cumulative total areas of disturbance and reclamation for 2010, 2015, and 2020 are shown in Table 4-9.

Cultural sites occur throughout the study area. Table 4-26 contains an estimate of the amount of projected disturbance through 2020 for the projected lower and upper levels of coal development activity, along with an estimate of the number of cultural sites that would potentially be affected. The sites fall into two categories; prehistoric sites and historic sites, as described below. A description of Native American traditional cultural places and a summary of the program to protect sites in any of these categories follow.

4.2.10.1 Prehistoric Sites

All recognized prehistoric cultural periods, from Clovis through Protohistoric (about 11,500 to 200 years ago), are represented in the PRB Coal Review study area. (See Section 3.12 for additional discussion about the prehistoric cultural periods.) The earliest prehistoric cultural periods, Paleoindian through Early Plains Archaic, are represented by only a small number of sites. Archaic and later prehistoric period sites (Archaic to Protohistoric) are represented in increasing numbers as a result of higher populations through time and better preservation of more recent sites. Important prehistoric site types in the region include artifact scatters, stone circles, faunal kill and processing sites, rock alignments and cairns, and stone material procurement areas.

Artifact scatters dominate prehistoric sites in the study area. When there is adequate information to evaluate these types of sites, most are not eligible to the NRHP. However, complex sites and sites with buried and dateable material are often field evaluated as eligible. The proportion of unevaluated sites is lower in subwatersheds in which more studies and more follow-up studies have been conducted, such as Antelope Creek, Upper Cheyenne River, and Upper Belle Fourche River. Some portions of some of the subwatersheds which have more varied habitats or conditions more conducive to preservation are very rich in significant prehistoric sites. Within the PRB Coal Review Task 3 study area, these areas include the lower Antelope Creek drainage and eastern portions of the Upper Belle Fourche River. More detailed information on the known cultural sites that are present in the PRB based on the existing surveys is included in the Task 1D Report for the PRB Coal Review (BLM 2005c).

4.2.10.2 Historic Sites

Historic site categories documented for the study area are based on broad historic themes. The site categories are Rural, Urban, Mining, Transportation, Military, Exploration, and Communication. Each of these site categories and the types of sites they include are detailed in the Task 1D Report for the PRB Coal Review (BLM 2005c). Evaluation of the importance of historic sites, districts, and landscapes must consider aspects of both theme and period in assessing the historic character and contributing attributes of the resources.

Table 4-26. Square Miles of Projected Cumulative Disturbance and Number of Potentially Affected Cultural Resource Sites in the PRB Coal Review Task 3 Study Area – Lower and Upper Coal Production Scenarios.

Sub-watershed	Average Number of Sites per Square Mile[1]	Lower Coal Production Scenario						Upper Coal Production Scenario					
		Year 2010		Year 2015		Year 2020		Year 2010		Year 2015		Year 2020	
		Square Miles[2]	Sites[3]	Square Miles[2]	Sites[3]	Square Miles[2]	Sites[3]	Square Miles[2]	Sites[3]	Square Miles[2]	Sites[3]	Square Miles[2]	Sites[3]
Antelope Creek	4.7	74	346	97	484	122	608	75	376	99	496	126	629
Dry Fork Cheyenne River	8.9	8.3	74	12	109	17	151	8.3	74	12	109	17	151
Little Powder River	4.6	90	415	108	495	123	567	91	419	109	502	125	577
Upper Belle Fourche River	4.3	164	704	186	801	209	899	166	713	192	824	219	940
Upper Cheyenne River	5.2	60	314	72	375	83	433	62	321	74	387	85	445
Upper Powder River	5.0	135	674	190	953	232	1,159	135	674	191	953	232	1,159
Total		**531**	**2,527**	**665**	**3,217**	**786**	**3,817**	**537**	**2,577**	**677**	**3,271**	**804**	**3,901**

1 Average number of sites per square mile based on previous surveys in the study area.
2 Calculated, based on database disturbance acreages prepared for the Task 2 Report for the PRB Coal Review, Past and Present and Reasonably Foreseeable Development Activities (Appendices A and D) (BLM 2005d).
3 The number of sites was calculated by multiplying the average density of known cultural sites per square mile (based on previous surveys) by the number of square miles of projected cumulative disturbance.
Source: Task 3D Report for the Powder River Basin Coal Review Cumulative Environmental Effects (BLM 2005f)

4.2.10.3 Native American Traditional Cultural Places

General ethnographies of the tribes that may have had traditional ties to this region do not provide information on specific resources in the study area that are likely to be traditional cultural concerns because these resources are considered confidential by the tribes. Within this region, there are prominent and identifiable places such as the Medicine Wheel to the west in the Big Horn Mountains and Devils Tower to the east in the Black Hills area. These known sites offer some indication of the types of places valued by the Plains horse cultures in the historic period. Any identification of sacred or traditional localities must be verified in consultation with authorized tribal representatives.

4.2.10.4 Site Protection

At the time an individual project is permitted, the development activities considered in this study would be subject to the following regulations relative to cultural resources. Section 106 of the National Historic Preservation Act of 1966 as amended, its implementing regulations, including but not limited to 36 CFR 800, 36 CFR 61, Executive Order 11593, and NEPA and its implementing regulations, including 40 CFR 1500 - 1508, provide the legal environment for documentation, evaluation, and protection of historic properties (i.e., cultural resources eligible for inclusion on the NRHP) that may be affected by development activities. In cases of split estate (where surface ownership and mineral ownership differ), surface resources, such as cultural sites, belong to the surface owner. The surface owner must be consulted about investigation, mitigation, or monitoring.

4.2.11 Transportation and Utilities

The PRB Coal Review Task 3D report (BLM 2005f) discusses potential cumulative impacts to transportation and utilities systems as a result of projected development activities in the PRB Coal Review Task 3 study area. The baseline year (2003) area of disturbance and reclamation and the projected cumulative areas of disturbance and reclamation for 2010, 2015, and 2020 related to surface coal mining are shown in Tables 4-2 and 4-3. The baseline year area of total disturbance and reclamation and the projected cumulative total areas of disturbance and reclamation for 2010, 2015, and 2020 are shown in Table 4-9.

Generally, transportation systems in the study area would not be directly affected by the disturbance associated with projected development. Site-specific instances of disturbance may require that segments of highways, pipelines, transmission lines, or railroads be moved to accommodate expansion of certain coal mines. In such cases, the agencies authorized to regulate such actions would have to approve any proposal to move any segments of any transportation systems and construction of alternative routing would be required prior to closing existing links so that any disruptive effects on transportation systems would be minimized.

The coal mines in the North Gillette subregion currently ship most of their coal via the east-west BNSF rail line through Gillette. That subregion produced 55 mmtpy in the baseline year (2003), which was just 22 percent of the estimated 250 mmtpy capacity of the BNSF rail line (BLM 2005f). The coal mines in the South Gillette and Wright subregions produced approximately 308 mmtpy in 2003, which was 88 percent of the estimated 350 mmtpy capacity of the joint BNSF & UP line serving those areas in the baseline year.

Potential effects of development activities on transportation and utilities may be either short- or long-term in nature, varying with the type of development. A power plant or an urban community development would be considered long-term, and the demand for transmission line capacity would be virtually permanent, lasting for the economic life of the activity. The effects of coal production and the related demand for rail capacity would vary with market changes. In recent years, coal production has been increasing and the PRB Coal Review projects that the trend would continue, as shown in Tables 4-2 and 4-3. Similarly, the demand for pipeline capacity would vary with market conditions as well as with the rate of depletion of the oil or gas resource.

Potential direct effects of projected development on roads and highways would include increased vehicular traffic and risk of traffic accidents on existing roadways in the PRB Coal Review Task 3 study area from daily travel by workers and their families. Indirect effects would include increased wear and tear on existing roads, additional air emissions from vehicles, additional fugitive dust from roads, noise, increased potential access to remote areas, and an increased risk of vehicle collisions with livestock and wildlife. Direct effects on railroads, pipelines, and transmission lines primarily would include increased demand for capacity to move coal, oil and gas, and electricity from production locations in the study area to markets outside the area.

The socioeconomic analysis conducted as a part of Task 3C of the PRB Coal Review projects a population increase of approximately 48 percent between 2003 and 2020 in Campbell County under the upper coal production scenario (BLM 2005e). Campbell County accounts for most of the population in the PRB Coal Review Task 3 study area. Based on traffic studies conducted independently of the PRB Coal Review, vehicle miles traveled tend to increase at or above the rate of population growth. Consequently, highway traffic would be expected to increase by at least 48 percent by 2020. Approximately 60 percent of the population growth would occur in or near Gillette, which would indicate that the same proportion of traffic would originate in the Gillette area. The remainder of the traffic growth would be dispersed throughout the study area. Under this scenario, the greatest impact on traffic would occur in the Gillette area, where existing traffic volume to capacity ratios are highest. The increased traffic would be expected to cause delays in the Gillette area and might require widening of some streets and roads or other measures to increase traffic capacity. It is anticipated that there would be an increase in the risk of traffic accidents approximately proportional to the increase in traffic. Highway capacity on major

routes away from Gillette would be expected to be sufficient to accommodate the growth without substantial constraints.

Existing rail lines, together with upgrades currently under way on the joint BNSF & UP line would be expected to accommodate the projected coal transportation traffic through 2015 (Table 4-27). The PRB Coal Review Task 2 Report (BLM 2005d) projects that the proposed DM&E line would be built and operational by 2015 (pending availability of funding), which would add 100 mmtpy in additional shipping capacity for the South Gillette and Wright subregions.

Table 4-27. PRB Rail Lines Coal Hauling Capacity and Projected Use.

Rail Line	2010 Projected 2010 Capacity mmtpy	2010 Projected Rail Use Increase[1] mmtpy	2010 Projected Rail Use Increase[1] %	2015 Projected 2015 Capacity mmtpy	2015 Projected Rail Use Increase[1] mmtpy	2015 Projected Rail Use Increase[1] %	2020 Projected 2020 Capacity mmtpy	2020 Projected Rail Use Increase[1] mmtpy	2020 Projected Rail Use Increase[1] %
North BNSF	250	62-78	25-31	250	74-104	30-42	250	78-121	31-48
South BNSF & UP	400	349-401	87-100	500	393-439[2]	79-88[2]	500	417-455[2]	83-91[2]
DM&E	0	0	0	-[2]	-[3]	-[3]	-[2]	-[3]	-[3]

[1] The range of increases in use shown for each year reflects the increases that are projected for the Lower and Upper Production Scenarios, respectively.
[2] The DM&E is assumed to be built and operational by 2015, adding 100 mmtpy of capacity for the mines served by the BNSF & UP South line.
[3] The BNSF & UP South figures represent the projected combined traffic and percent capacity on the BNSF & UP South line and the projected DM&E line.
Source: PRB Coal Review Task 3D Report (BLM 2005f)

Gas pipeline capacity out of the PRB for the PRB Coal Review baseline year (2003) was approximately 1.9 bcf per day; while total conventional natural gas and CBNG production was slightly below 1.1 bcf per day. The Task 2 Report for the PRB Coal Review projected that basin-wide production of CBNG would increase by about 54 percent by 2020. This potential is pipeline-capacity limited, suggesting additional pipelines could be built. One potential additional pipeline (Bison Project) was identified in the PRB Task 2 Report for completion by 2010, but no filing for the project has been made with FERC. Several other proposed projects are listed on the Wyoming Pipeline Authority projects website (http://www.wyopipeline.com/projects.asp, accessed 7/6/2007).

An estimated 1,700 MW of new power production capacity is anticipated in the cumulative effects area by 2020. This level of production would require construction of additional transmission line capacity. It is assumed that new transmission lines would be constructed to connect new power plants to the grid. However, no specific projects have been identified so the location(s), capacities, and effects on the existing system cannot be determined at this time.

4.2.12 Socioeconomics

The socioeconomic impact analysis focuses on Campbell County, but also considers Converse, Crook, Johnson, Sheridan, and Weston Counties as directly affected and Niobrara and Natrona Counties as indirectly affected. Current and projected socioeconomic conditions are described in more detail in the Task 1C and 3C reports for the PRB Coal Review (BLM 2005b and 2005e).

REMI Policy Insight (REMI), a regional economic model, was used to develop the cumulative employment and population projections presented below. The version of the REMI model for this study was calibrated to represent two economic regions: the first consisting of Campbell County alone, and the second composed of the counties in Wyoming that border Campbell County and are linked to its economy by established industrial and consumer trade linkages and by work force commuting patterns. Results for the second region were then analyzed to focus on the five counties, Converse, Crook, Johnson, Sheridan, and Weston, that are the most directly linked. Collectively, these five counties are referred to in the PRB Coal Review Task 3C report (BLM 2005e) as the surrounding counties. Additional analysis was undertaken to "disaggregate" REMI's population and employment forecasts for each of the surrounding counties and to derive housing requirements and project future school enrollment.

During the 1970s and early 1980s, the PRB emerged as a major coal producing region. Federal coal leasing has been a high profile activity since over 90 percent of the coal resources in the PRB are federally owned. The surface coal mines that were developed during the 1970s and early 1980s are now mature operations, providing a stable economic and social foundation for the region. While energy development has produced periodic surges in population, followed occasionally by population loss in some communities, the growth in domestic energy consumption, coupled with the PRB's vast energy resource base, has resulted in a 50-year growth trend in the region without the absolute economic busts that have characterized some other western U.S. resource booms. This period of extended energy development has been accompanied by substantial benefits, including economic growth, employment opportunity, tax revenue growth, and infrastructure development for local governments in the region and across Wyoming as tax revenues generated by production of coal and other energy resources have funded infrastructure development programs statewide. At the same time, periods of rapid growth have stressed communities and their social structures, housing resources, and public infrastructure and service systems.

The emergence of the coal and other energy resource development industries in the PRB has had a long-term cumulative influence on social and economic conditions in the region. In general, Campbell County and the entire PRB region have developed a greater capacity to respond to and accommodate growth. The regional coal industry also provides a measure of insulation from

dramatic economic and social dislocations. Key current cumulative social and economic conditions are described below.

4.2.12.1 Employment and the Economic Base

Energy resource development since 1970 has resulted in substantial economic expansion across the PRB. Total employment expanded by 156 percent as 38,948 net new jobs were added between 1970 and 2002. The most rapid expansion occurred between 1975 and 1980. After modest growth and slight decline in the 1980s and early 1990s, employment growth resumed in the late 1990s, led by increases in coal mine employment, including subcontractors, and CBNG development. Across the six-county area, total employment was 63,871 in 2002. Nearly half of the net job gain occurred in Campbell County, where total employment increased from 6,026 jobs in 1970 to 25,453 jobs in 2002. Strong gains also were posted in Sheridan County (9,052 jobs) and Converse County (4,323 jobs).

The economic stimuli associated with the gains in mining and CBNG employment and the long-term population growth triggered secondary job gains in construction, trade, services, and government. In 2002, business and consumer services accounted for 55.5 percent of all jobs in the region, while mining and government accounted for 10.7 percent and 14.5 percent of all jobs, respectively. Farm employment in the region, as a share of total employment, declined from 14.3 percent in 1970 to 5.0 percent in 2002. However, that shift is primarily due to growth in non-farm employment rather than declines in farming, as total farm employment in the PRB recorded a net decline of only 333 jobs, from 3,571 to 3,238.

The largest impetus to future growth over the PRB Coal Review study period (2003 to 2020) is expected to occur by 2010. Under the lower coal production scenario, employment in 2010 related to coal mining, oil and gas production, and oil field services is projected to increase by one-third, or more than 2,300 jobs, as compared to 2003 levels. A large portion of the jobs gained would be the result of increased oil and gas development. While the number of coal mining jobs would increase, the projected coal mine-related productivity gains would limit increases in the number of mine employees required for operations.

Beyond 2010, as major infrastructure development (e.g., additional CBNG compression capacity) is completed and the pace of conventional oil and gas drilling decreases, total employment related to coal mining, oil and gas production, and oil field services would decline. Increases in CBNG production and coal mining employment would occur thereafter, such that total mining employment would approach pre-2010 levels by the end of the forecast period (2020). Under the development scenarios, construction of the three new power plants, having a combined capacity of 1,000 MW, is assumed to occur concurrently with the increases in mining employment, with a peak work force of approximately 1,550 workers in 2007-2008. Under the upper coal production scenario, a second temporary construction work force impact would occur

between 2016 and 2020 in conjunction with the construction of an additional 700-MW power plant.

The net effects of these activities, including secondary effects on suppliers, retail merchants, service firms, and state agencies and local government in the region, would be the creation of more than 8,700 new jobs in the region between 2003 and 2010. Of those, more than 5,600 jobs (a 22 percent increase over 2003 employment) would be based in Campbell County. The pace of economic expansion, at least in terms of jobs, would moderate after 2010. Total employment growth of 2,017 additional jobs is projected in Campbell County between 2010 and 2020, with 1,741 additional jobs projected in the surrounding counties.

Several important issues arise in the context of the rapid economic expansion implied by the growth projections through 2010. One issue is that achieving the projected levels of energy and mineral development activity assumes that industry has access to the necessary equipment, materials, labor, and other vital inputs. Current oil and gas exploration and development interest across the Rocky Mountain region has absorbed the available inventory of drilling rigs and crews. A lack of additional resources could delay or limit the job gains below the levels projected, even though prospects for such growth remain. Secondly, the competition for equipment could combine with tight labor markets to negate the productivity gains that underlie the projections, such that the employment and associated impacts do materialize, but are associated with lower levels of activity (e.g., a lengthier construction period for a power plant or fewer new wells drilled each year).

Employment effects associated with the upper coal production scenario, assuming productivity gains in coal mining equivalent to those in the lower coal production scenario, would result in total employment gains of 11,563 jobs by 2010 in the six-county study area, with an additional 3,667 jobs by 2020. (Projected coal mining employment under the upper production scenario was estimated assuming future productivity gains comparable to those under the lower production scenario. This assumption reflects a departure from the assumptions established for the upper production scenario in the Task 2 report, whereby a 16 percent higher production rate would be achieved with a 2.5 percent increase in workforce. Those assumptions, although based on a continuation of historic productivity gains, may underestimate population and employment growth and related socioeconomic effects if the production is achieved but the productivity gains lag. Using the productivity gains from the lower production scenario thus provides a more conservative perspective on potential long-term population growth for the purposes of the cumulative analysis). As compared to the employment projections under the lower coal production scenario, those gains would include 2,821 additional jobs in 2010 and 3,214 additional jobs in 2020. Most of the incremental gains would be based in Campbell County, further stressing labor markets, housing, and other community resources. Such pressures could delay or affect the development plans of individual firms and operators, such that the projected employment

levels would not be realized in the time frames shown. Nonetheless, substantial growth in employment is expected to occur, and even if the projected total employment levels are not realized, substantial social and economic impacts still would be anticipated.

The economic stimuli associated with the projected development also would stimulate increases in employment in other nearby counties beyond the five surrounding counties identified above. However, the potential effects in these areas are not addressed in the PRB Coal Review Task 3C Report because most of the effects would comprise indirect or induced growth that would be limited in scale relative to the size of the respective economies. Furthermore, the economic outlook for those areas is influenced by factors that are beyond the scope of this study, such as the role of the oil and gas support services industry based in Natrona County in supporting energy development in the south-central and southwestern portions of Wyoming.

4.2.12.2 Labor Market Conditions

Labor market conditions in the PRB reflect a generally healthy economy, with average annual county unemployment rates between 3.2 percent and 4.8 percent in 2003. Johnson County recorded the lowest unemployment (3.2 percent) and Converse County registered the highest (4.8 percent). Statewide and national unemployment rates for the period were 4.4 percent and 6.0 percent, respectively.

Over time, local unemployment levels and rates have reflected the influences of the large, relatively stable employment baseline associated with the coal mining industry and the more transitory and variable influences of natural gas development and other industries. Prior to the beginning of CBNG development in 1989, unemployment in Campbell County fluctuated between 4.8 and 5.35 percent, slightly above the corresponding statewide averages. Labor demand associated with CBNG development contributed to a decline in unemployment to below 3.0 percent in 2001. As the pace of CBNG development has stabilized, labor demand eased and unemployment rates climbed to 5.2 percent in 2003, before abating.

The employment effects identified above from 2003-2020 imply substantial pressures on local labor markets. Strong demand for labor would lower local unemployment, creating upward pressure on wages and salaries. Those influences would stimulate substantial economic migration into Campbell County, causing impacts to population, housing demand, and other economic and social conditions. Similar influences would occur in the surrounding counties, although the implications are less severe because the scale of the effects would be smaller and would be distributed over multiple communities and service providers.

4.2.12.3 Personal Income

A benefit associated with energy resource development, whether it is mineral mining or oil and gas development, is wages and salaries that are among the highest in the state. Personal income registered strong gains across the region, but especially in Campbell County, during the late 1970s and early 1980s. In 1981, per capita personal income in Campbell County was $17,520, compared to the national average of $11,280 and the statewide average of $12,879. Personal income growth was tempered by several years of economic stagnation during the late 1980s. Renewed economic vitality since then resulted in per capita personal income in Campbell County reaching $30,253 in 2002. Those gains notwithstanding, per capita income among Campbell County's residents was below statewide and national norms, as well as that for Sheridan ($32,563) and Weston ($31,388) Counties. When measured on a median household or family income basis in the 2000 census, Campbell County led statewide, national, and other counties in the PRB by considerable margins.

In terms of total personal income, Campbell County leads the six-county region with $1.093 billion in 2002. Sheridan County residents recorded aggregate personal income of $878 million in 2002. Total personal income in the other counties was substantially lower, ranging from $177.8 million in Crook County to $347.8 million in Converse County.

Personal incomes in the region would increase over the time period 2003-2020, both in aggregate and on a per capita basis, in conjunction with the economic outlooks foreshadowed by the projected development scenarios. In 2003, total personal income was $1.12 billion in Campbell County and approximately $1.88 billion in the surrounding counties. Under the lower coal production scenario, total personal income would more than triple to $3.34 billion in 2020, and personal income in the surrounding counties would increase by approximately 136 percent to $4.43 billion (all in nominal dollars). The upper coal production scenario would generate an additional $266 million per year in Campbell County and an additional $35 to $40 million per year in the surrounding counties by 2020. Annual per capita incomes are projected to increase by approximately 27 percent (in real terms) across the region between 2003 and 2020. Households with one or more workers employed directly in the energy industry, associated key suppliers, and the construction industry likely would realize larger shares of the overall gains.

4.2.12.4 Population and Demographics

Population change over time is perhaps the single best indicator of cumulative social and economic change in the PRB. Campbell County was not among the original 13 counties when Wyoming was admitted to statehood, but it was carved from Weston and Crook Counties in 1911. Campbell County's population of 5,233 in the 1920 census ranked it seventeenth among Wyoming's counties. Forty years later and prior to the onset of coal development in the region, Campbell County, with a population of 5,861,

ranked eighteenth among Wyoming's counties in terms of population, with neighboring Converse, Sheridan, and Weston Counties each having a larger population.

By 1980, Campbell County's population had increased by more than 300 percent, to 24,367, seventh among Wyoming's counties. Energy development also contributed to population growth in Sheridan, Converse, Johnson, and Crook Counties during that period. Weston County recorded a population decline during the period; however, the combined population of the PRB climbed from 49,311 in 1960 to 82,598 in 1980.

Annual coal production in the PRB has increased by nearly 500 percent since 1980, accompanied by expanded mine service and rail transportation capacity, stimulating further growth. The impetus for growth was tempered by substantial productivity increases in the mining industry, coupled with declining production of other energy resources. Consequently, the region's population gained a relatively modest 11 percent, 9,318 residents, between 1980 and 2000, reaching 91,916. Campbell County registered a net gain of 9,331 residents during that period, raising its total population to 33,698 in 2000, fourth highest in the state. Across the rest of the PRB, the loss of about 2,000 residents in Converse County was offset by modest gains in the other four counties (U.S. Census Bureau 2001).

More recently, the PRB has seen renewed population growth, primarily linked to CBNG development. Population estimates for 2003 indicate a total regional population of 96,078, a 4.4 percent increase over the 2000 census population. Gains were reported for all six counties, ranging from 29 persons in Weston County to 2,740 persons in Campbell County (Table 4-28). City officials estimate that Gillette's populations grew by almost 2,000 people (6.2 percent) in 2006 (Gillette News-Record 2007).

The magnitude and timing of projected employment changes from 2003-2020 under either coal production scenario would trigger corresponding effects to population across the PRB, particularly in Campbell County (Figure 4-6).

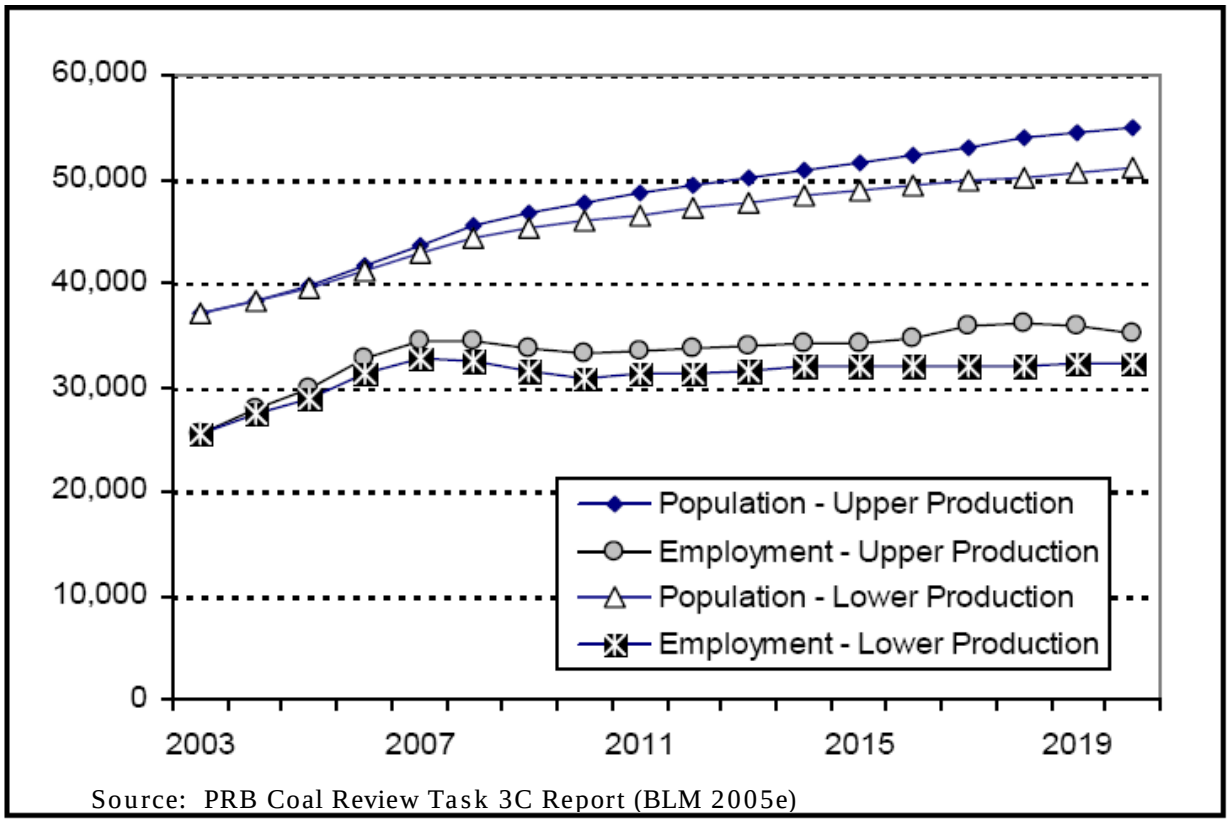
Under the lower coal production scenario, Campbell County's population is projected to increase by more than 14,550 residents between 2003 and 2020, of which nearly 9,500 additional residents are anticipated by 2010. Growth over the next five to six years would result in substantial pressures on housing and other community resources. The projected energy and mineral development in the lower coal production scenario would also result in substantial population growth elsewhere in the PRB, with Sheridan, Johnson, and Converse Counties all projected to gain substantial population. Population growth, like employment growth, would moderate after 2010.

Projected population growth between 2003 and 2020 ranges from 0.5 percent CAGR in Weston County to 2.0 percent CAGR in Campbell County. In absolute terms, the net change ranges from 537 additional residents in Weston County to

Table 4-28. Recent and Projected PRB Population.

Year	Campbell County	Converse County	Crook County	Johnson County	Sheridan County	Weston County	Total Study Area
Census							
2000	33,698	12,104	5,895	7,108	26,606	6,642	92,053
2003	36,438	12,314	5,986	7,554	27,115	6,671	96,078
Lower Coal Production Scenario							
2010	45,925	13,103	6,542	8,389	28,459	7,108	109,526
2015	48,905	13,671	6,759	8,867	30,016	7,174	115,392
2020	50,995	14,193	6,989	9,326	31,467	7,208	120,178
Upper Coal Production Scenario							
2010	47,662	13,160	6,570	8,424	28,579	7,137	111,532
2015	51,558	13,763	6,802	8,924	30,214	7,219	118,480
2020	54,943	14,313	7,045	9,403	31,733	7,266	124,703

Source: U.S. Census Bureau 2005 (2000 and 2003 data)



Source: PRB Coal Review Task 3C Report (BLM 2005e)

Figure 4-6. Projected Campbell County Population and Employment to 2020.

a gain of 14,557 residents in Campbell County. The combined population of the six-county study area is projected to climb from 96,078 in 2003 to 120,178 in 2020, a 1.3 percent CAGR.

As with employment, changing development conditions could result in actual population growth varying from projected population growth. If project schedules or levels of development vary from the projected levels, there could be corresponding effects on population growth (e.g., delays could result in lower growth). Another possibility is that population demographics could change in response to migration and commuting, with relatively more immigrating construction workers being single-status, rather than being accompanied by families. Another alternative is that the spatial distribution of population growth could shift as a result of housing or labor constraints, such that less growth would occur in Gillette and Campbell County, and more growth would occur elsewhere.

Projected population growth through 2020 under the upper coal production scenario is approximately 19 percent higher than under the lower coal production scenario (28,625 compared to 24,100, with the six- county population reaching 124,703 by 2020). Much of the incremental population growth would occur by 2010 in Campbell County, and in particular in and near Gillette.

Community population growth under the upper coal production scenario generally would mirror growth under the lower coal production scenario but with higher growth in Wright, Douglas, and Newcastle due to the effects of higher coal production, coal transportation, and power generation concentrated in the southern portion of Campbell County.

Demographic characteristics from the 2000 census reveal many similarities to the statewide population, but also many minor differences across the PRB as shown in Table 4-29.

Table 4-29. Demographic Characteristics.

Characteristic	Wyoming	Campbell County	Other PRB Counties
Median Age	36.2	32.2	37.5 – 43.0
Percent Residents < 18 Years Old	26.1	31.0	24.1 – 28.5
Average Household Size	2.48	2.73	2.31 – 2.55
Percent Minority Residents	7.9	3.9	3.0 - 5.3

Source: PRB Coal Review Task1C Report (BLM 2005b)

4.2.12.5 Housing

While the population grew by 55 percent in the 1970s, the housing stock in the study area grew by almost 78 percent. Housing growth was especially rapid during the 1970s in Campbell County, where population grew by 88 percent and the housing stock grew by 140 percent. In 2000, the housing inventory in the six-county study area was 41,203 units (Table 4-30).

Table 4-30. Total Housing Stock in 2000.

Campbell County	Converse County	Crook County	Johnson County	Sheridan County	Weston County	Six-county PRB Region
13,288	5,669	2,935	3,503	12,577	3,231	41,203

Source: U.S. Census Bureau (2001)

This expansion in housing supply, combined with the slowdown in the rate of population growth produced double-digit vacancy rates for rental housing in the late 1980s and early 1990s. At the same time, vacancy rates among ownership housing remained tight. After growth resumed in the mid-1990s, most county-level vacancy rates for ownership units were at or below the state levels in 2000. Vacancy rates for rental units declined even more sharply. By 2000, rental vacancy rates in Campbell County were below the state average and were well below the average in Johnson County and Sheridan County. Monthly costs for rental housing in the PRB, measured in the fourth quarter of 2003, generally were highest in Campbell County (Table 4-31).

Table 4-31. Monthly Housing Rents in 2003[1] in the PRB Study Area.

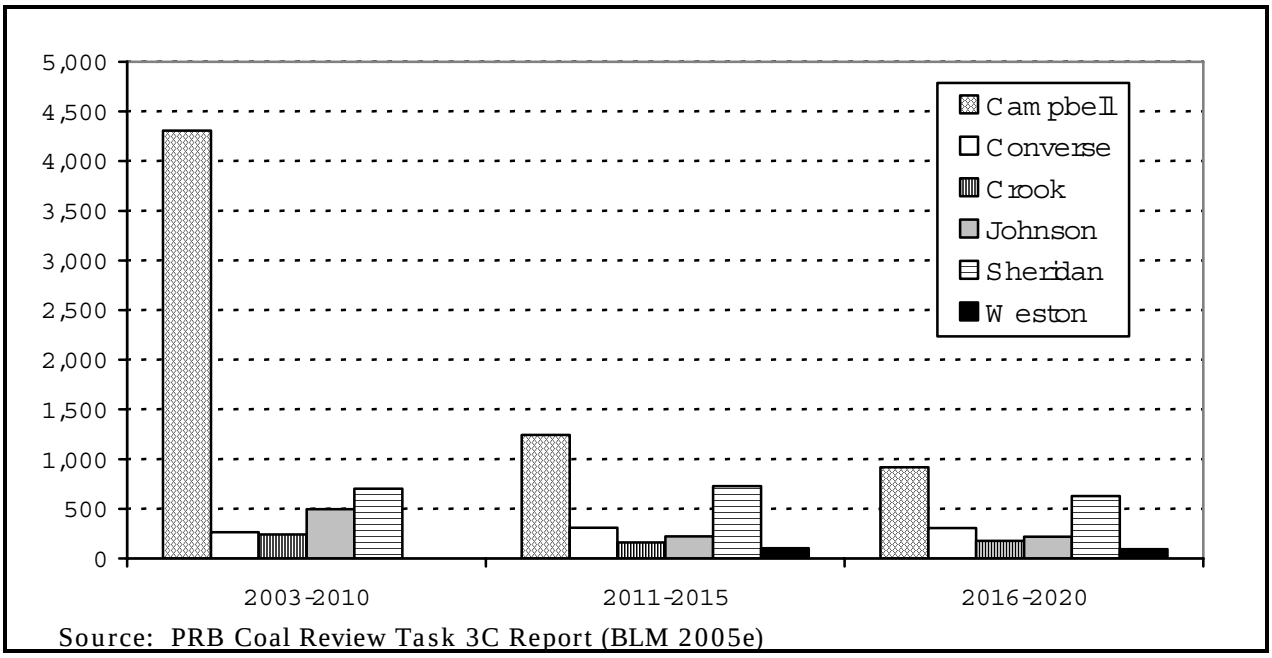
County	Apartments	Mobile Home Lots	Houses	Mobile Homes on a Lot
Campbell	$563	$228	$707	$590
Converse	$385	$150	$488	$374
Crook	$345	$120	-	-
Johnson	$443	$208	$606	$414
Sheridan	$465	$273	$667	$502
Weston	$333	$99	$380	$365
Wyoming	$466	$195	$658	$484

[1] 2003 data are for the fourth quarter.
Source: Wyoming Department of Administration and Information, Division of Economic Analysis (2004)

In 2002, the average sale price of homes in the study area varied from $70,674 in Weston County to $142,565 in Sheridan County. The average home price statewide in 2002 was $120,314. In addition to Sheridan County, Campbell ($133,482) and Johnson ($131,782) Counties also had average home sale prices above the statewide average in 2002. A combined total of 1,242 new housing units were issued permits from 1998 through 2002 in the PRB, including permits for 400 housing units in Campbell County and 509 units in Sheridan County. Although not all local governments in the study area issue permits, these data are general indicators of residential construction activity.

Temporary housing resources are available in the PRB in the form of hotel-motel rooms, private and public campgrounds, two large special event facilities, and vacant spaces in mobile home parks. In all, there are an estimated 71 lodging establishments with a total of more than 2,500 rooms. These housing resources, supplemented by pockets of persistently vacant apartments, townhouses, and mobile home spaces in Gillette and Wright, have accommodated temporary housing needs associated with natural resource and energy projects in the past.

Both projected coal development scenarios suggest a strong demand for housing across the six-county study area in the period 2003-2020. Net new housing requirements under the lower coal production scenario would include approximately 11,270 units through 2020, a 26 percent increase above the total existing inventory in 2003 (Figure 4-7). New housing requirements under the upper coal production scenario are estimated at 13,060 units, a 31 percent increase compared to the 2003 inventory and 1,790 units more than under the lower coal production scenario. From 2003 to 2010, the demand for new housing under the lower coal production scenario would concentrate in Campbell County, as approximately 60 percent of the overall demand for additional housing under either projected coal development scenario would occur in Campbell County, and approximately two-thirds of that (between 4,300 and 5,000 additional units) would be needed within the next three to five years.



Source: PRB Coal Review Task 3C Report (BLM 2005e)

Figure 4-7. Projected Housing Demand in the PRB Study Area Under the Lower Production Scenario.

A substantial portion of the near-term housing demand in Campbell County would be associated with the assumed concurrent construction of three power plants. If that occurs, one or more project sponsors may be required by the Wyoming Industrial Siting Administration to pro-actively provide housing (e.g., a construction camp for single-status workers). Such actions could temper the needs for additional housing; however, the remaining needs would nonetheless be substantial, straining public and private sector residential development capacity. Although smaller in scale than those in Campbell County, housing demands in the surrounding counties also could strain the capabilities of the residential construction sector to respond. Furthermore, residential contractors would be competing for available labor, contributing to the population growth and housing demand, and fueling increases in construction costs and housing prices.

The relative scale of the housing needs may be evaluated in comparison to past growth in the study area. One benchmark for comparison is the rapid growth that occurred in the PRB in the 1970s. During that decade, the number of housing units in the six-county study area grew by approximately 14,900 units, approximately 1,500 units per year on average compared to the 850 to 975 new units per year projected under these scenarios through 2010. The rapid pace of development in the 1970s also coincided with a period of economic expansion and strained the region's construction trade and building supplier industries. Although the underlying economies of the region are larger now, the projected needs would tax the ability of communities to respond. Signs of strain are apparent in Gillette and could surface elsewhere as relatively more housing need would arise in the remaining counties of the six-county study area during the second five-year period under the low scenario.

Projected housing demands under either scenario, although lower than what Campbell County and the region experienced in the "boom" years of the 1970s, would exert substantial pressure on housing markets, prices, and the real estate development and construction industries, all at a time when demand for labor and other resources would be high overall.

4.2.12.6 Public Education

There are 10 school districts in the six-county PRB study area, ranging in size from CCSD No. 1 with 7,368 students in the 2003 school year to SCSD No. 3 (based in Clearmont, Wyoming) with fewer than 100 students. CCSD No. 1, based in Gillette, serves the primary energy and resource development region.

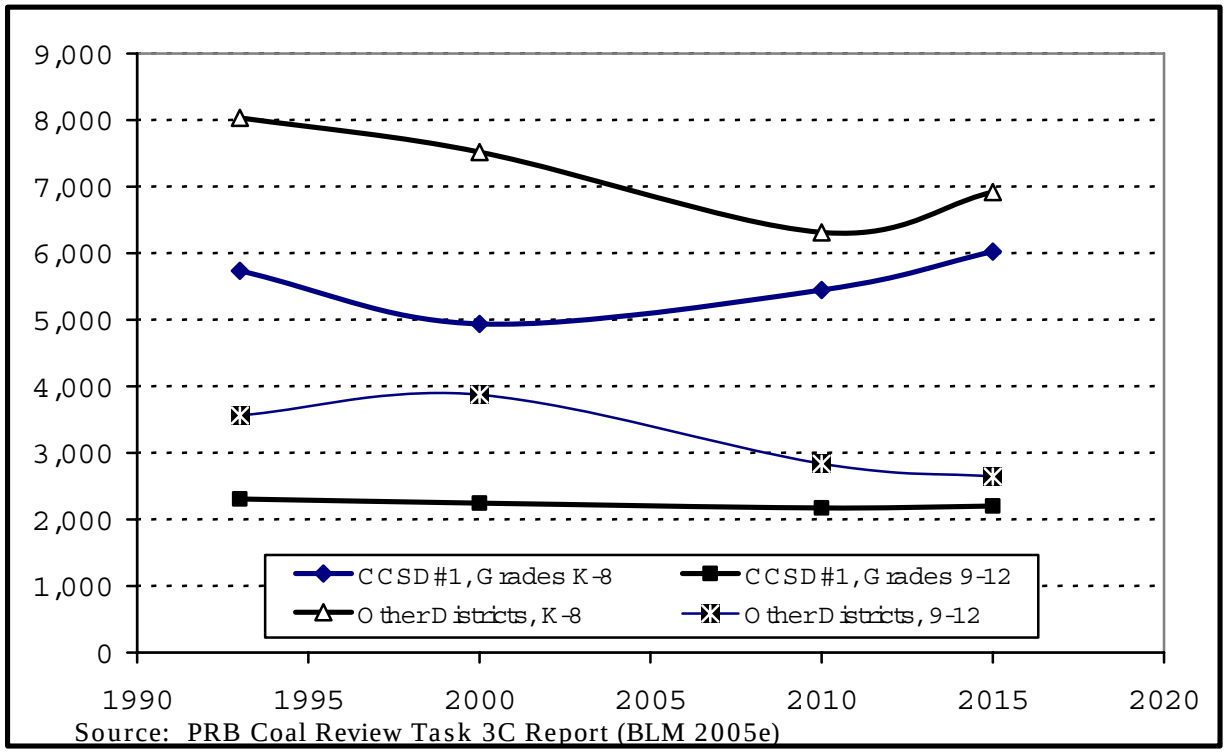
Trends in public school enrollment generally mirrored population trends during the period of rapid population growth. District-wide enrollment in Campbell County grew by more than 4,600 students (131 percent) between 1975 and 1985. Enrollment increased in all districts in Converse and Sheridan Counties as well. Enrollment in CCSD No. 1 subsequently peaked, but remained near the record high level for nearly a decade. Elsewhere in the region, enrollments generally have declined, and the combined enrollments in the study area's other districts are now below 10,000, its lowest level since 1975. Recent CBNG development has tempered, but not reversed, the trend of declining school enrollments across the region.

Communities across the PRB study area would see population growth due to economic migration from 2003 to 2020; however, the effect on public school enrollments would vary. As the demographic structure of the population changes, school districts in the PRB would be affected by new trends. In some counties, the size of that population (generally aged five to 17 years) may even trend in the opposite direction of total population in the short-term due to underlying demographics of the established resident population.

The demographic forecasts developed from the development scenarios project growth in the elementary school enrollments in Campbell County through 2010

and after 2010 for almost all PRB school districts. Projected enrollments in CCSD No. 1 would be approximately 10 percent higher by 2020 under the upper production scenario, with those in the surrounding districts only about one percent higher. However, several districts still may have enrollments in 2020 that would be below current levels, as growth from 2010 to 2020 would not offset recent declines or those projected to occur before 2010.

Under the lower coal production scenario, Campbell County would experience a substantial increase in school enrollment through 2020 (an added 1,587 students or 22 percent above recent levels). However, the impact on CCSD No. 1 would be composed of two trends, with a substantial increase in grades K-8 and small increases in grades 9-12 (Figure 4-8). School districts in the surrounding counties are projected to experience declining elementary and middle school enrollments through 2010 and declining high school enrollments through 2015. Thereafter, growth and the associated influences on demographics would generate renewed enrollment growth, particularly in the elementary grades in Johnson, Sheridan, and Converse Counties.



Source: PRB Coal Review Task 3C Report (BLM 2005e)

Figure 4-8. Projected School Enrollment Trends to 2020 Under the Lower Production Scenario.

Under either scenario, projected enrollments may cause short-term school capacity shortages, depending on the specific grade-levels and residential locations of the additional students. Under the Wyoming School Facilities Commission planning guidelines, impacted school districts generally would be asked to accommodate minor capacity shortages through the use of temporary facilities, such as portable classrooms. For larger and more long-term increases, the Commission's policy is to fund capital expansion where

warranted by projections developed during annual updates of school districts' five-year plans.

4.2.12.7 Facilities and Services

The types and levels of facilities and services provided by local governments reflect service demand, revenue availability, and community values regarding appropriate services and service levels. As with most socioeconomic characteristics, the level and availability of local government facilities and services varies by county and community across the PRB. There are literally several hundred different service providers in the region. Although all local government facilities and services are affected by energy development, the critical facilities and services include municipal water and sewer systems, law enforcement at the county level, and hospitals. A comprehensive inventory and assessment of facilities and services is beyond the scope of the PRB Coal Review socioeconomic analysis. However, an initial screening revealed no critical needs or shortfalls and indicated that most providers are engaged in an ongoing long-term process to maintain and improve facilities and services to meet community needs and to comply with various regulations and standards.

The PRB Coal Review socioeconomic analysis focuses on water supply and wastewater systems (two essential services that are costly and have the longest lead times to develop) and law enforcement, emergency response, and road maintenance (three services that typically are most affected by energy development).

Water supply and wastewater systems in all communities would have the capacity to accommodate the cumulative population growth associated with either projected coal development scenario through 2020, assuming ongoing or currently planned improvements are completed. In Gillette, there may be a timing issue with the water supply system, as completion of planned improvements in the 2005 to 2009 period would occur when substantial growth is anticipated to occur under both projected coal development scenarios. Consequently, Gillette may experience water shortages in the summer months during the 2003 to 2010 period, particularly under the upper coal development scenario.

The ability to provide desired levels of services to the anticipated energy-related population and development is less clear in Campbell County, Gillette, Wright, and outlying rural communities. Campbell County and its communities would experience a 25 percent increase in population between 2003 and 2010 under the lower coal production scenario and 30 percent under the upper coal production scenario.

Growth rates and the resultant facility and service demand in other counties within the study area would be substantially less during the 2003 to 2010 period under either scenario; all communities other than Johnson County and Buffalo would grow substantially less than 10 percent during the period. The

populations of Johnson County and Buffalo would increase 10 percent by 2010, driven primarily by CBNG development.

Growth rates and resultant increases in service demands would slow substantially during both the 2011 to 2015 and 2016 to 2020 periods under either projected coal development scenario. In most communities except Sheridan County and the city of Sheridan, there would be little difference in population growth and service demand between the two development scenarios.

4.2.12.8 Fiscal Conditions

Federal mineral royalties and state and local taxes levied on coal and other mineral production are major sources of public revenue in Wyoming. Taxes, fees, and charges levied on real estate improvements, retail trade, and other economic activity supported by energy development provide additional revenues to support public facilities and services. These revenues benefit not only those jurisdictions within which the production or activity occurs, but also the federal treasury, state coffers, school districts, and local governments across the state through revenue-sharing and intergovernmental transfer mechanisms.

Coal and other minerals produced in Wyoming, regardless of ownership, are subject to ad valorum taxation by local taxing entities and a statewide levy to support public education. Statewide ad valorum taxable valuation on coal production in 2003 was $1,760.3 million. Of that total, 91 percent was based on production in the PRB.

The total assessed valuation of Campbell County, boosted by increases in CBNG production, was $2,687 million in 2003. Valuations on aggregate mineral production accounted for 82 percent of that total. Because Campbell County has been the primary beneficiary of mineral production gains over the past three decades and the more recent gains tied to CBNG, the county's assessed valuation of $2,687 million in 2003 was nearly 35 times that of Weston County ($77.7 million) and 29 times that of Crook County ($92.1 million). The 2004 valuation of 2003 coal production in Campbell County was $1,561.2 million (Wyoming Business Council 2004).

Wyoming levies a severance tax on coal and many other minerals produced in the state. The severance tax rate, levied on the value of production, has varied from 1.0 percent to 10.5 percent over time. The rate has been 7.0 percent since 1992. Cumulative statewide severance tax proceeds total $2.22 billion since 1970. Cumulative severance tax revenues on coal produced in Campbell County total $1.42 billion. Cumulative severance tax revenues for the corresponding period total $67.4 million from Converse County, $60.5 million from Sheridan County, and $675.9 million from the remainder of the state.

Producers pay a 12.5 percent royalty to the federal treasury on the value of all surface coal production from federal leases. Half of this royalty is returned to the state. Cumulative royalty receipts on coal produced in Wyoming exceeded

$2.76 billion between 1970 and 2003. Estimated 2004 mineral royalties from federal coal in Campbell County were about $268.3 million, based on an average sale price of $6.10 per ton of coal (WSGS 2005b).

At the foundation of the mineral development revenue projections for the period 2003 to 2020 are projected levels of future energy and mineral resource production. The projected total value of annual mineral production under the lower coal production scenario will climb by $3.49 billion (2004 dollars) over 2003 levels, reaching $8.54 billion by 2020, a 69 percent increase over the current (2003) value. The aggregate value of energy and mineral resource production under the upper coal production scenario would increase to $9.21 billion in 2020. The incremental difference, compared to the value under the lower production scenario, would be $670 million per year, all of which represents the value of higher annual coal output.

Presently, the overwhelming majority of future mineral production value is anticipated to be in Campbell County. Over time, the future value of production in Sheridan and Johnson Counties would climb. Total annual mineral production value by 2020 is projected to reach $6.37 billion in Campbell County and $2.17 billion in the surrounding counties.

Between 2005 and 2020, total royalty and tax receipts derived from the key selected sources range between $21.1 and $22.6 billion for the lower and upper coal production scenarios, respectively. Receipts derived from coal production would account for the majority of the totals under either scenario, with federal mineral royalties on coal at $4.9 to $5.7 billion being the single largest source. Severance taxes, ranging from $6.3 to $6.7 billion, also would accrue to the state (Tables 4-32 and 4-33).

Table 4-32. Summary of Mineral Development Tax Revenues Associated with Energy Resource Production Under the Lower Production Scenario (million $).

Industry and Taxes	2005-2010	2011-2015	2016-2020	Total
Coal[1]	$3,164.8	$3,178.9	$3,756.3	$10,100.0
CBNG	$2,915.2	$3,076.4	$3,288.7	$9,280.3
Conventional Oil and Gas	$568.5	$576.4	$614.0	$1,759.0
Totals	**$6,648.5**	**$6,831.7**	**$7,659.0**	**$21,139.3**
Severance Tax	$1,995.9	$2,012.4	$2,249.3	$6,257.6
Federal Mineral Royalties	$2,754.1	$2,839.4	$3,166.3	$8,759.8
State Mineral Royalties	$233.5	$225.8	$251.4	$710.7
Ad Valorum Tax (Counties)	$417.6	$443.0	$502.8	$1,363.3
Ad Valorum Tax (Schools)	$1,247.5	$1,311.1	$1,489.3	$4,047.9
Totals	**$6,648.6**	**$6,831.7**	**$7,659.1**	**$21,139.3**

[1] Does not include coal lease bonus bids due to the uncertainty regarding timing.
Source: PRB Coal Review Task 3C Report (BLM 2005e)

Table 4-33. Summary of Mineral Development Tax Revenues Associated with Energy Resource Production Under the Upper Production Scenario (million $).

Industry and Taxes	2005-2010	2011-2015	2016-2020	Total[1]
Coal[1]	$3,538.0	$3,703.0	$4,350.0	$11,591.0
CBNG	$2,915.2	$3,076.4	$3,288.7	$9,280.3
Conventional Oil and Gas	$568.5	$576.4	$614.0	$1,759.0
Totals	**$7,021.7**	**$7,355.8**	**$8,252.7**	**$22,630.3**
Severance Tax	$2,104.1	$2,159.0	$2,415.4	$6,678.5
Federal Mineral Royalties	$2,946.3	$3,099.9	$3,461.4	$9,507.6
State Mineral Royalties	$233.5	$225.8	$251.4	$710.7
Ad Valorum Tax (Counties)	$435.8	$472.0	$535.0	$1,442.8
Ad Valorum Tax (Schools)	$1,302.3	$1,398.9	$1,589.8	$4,291.0
Totals	**$7,022.0**	**$7,355.6**	**$8,253.0**	**$22,630.6**

[1] Does not include coal lease bonus bids due to the uncertainty regarding timing.
Source: PRB Coal Review Task 3C Report (BLM 2005e)

The federal and state governments also would benefit from coal lease bonus bids derived from future coal leasing. Bonus bids have risen over time, with one recent bid of almost $1.00 per ton range. There is no guarantee of that trend continuing. Considerable uncertainty also exists with respect to the timing and scale of future leases, although BLM currently has pending applications for more than four billion tons of federal coal (Table 1-2). The state also receives 50 percent of the bonus bid revenue.

Taxes and mineral royalties levied on energy and mineral resource production accruing to the state are disbursed to the Permanent Water Development Trust Fund, Wyoming School Foundation and Capital Facilities funds, capital construction fund for state and local government facilities, and other programs according to a legislatively-approved formula. Through these funds, the revenues derived from resource development benefit the entire state, not just agencies, businesses, and residents of the PRB.

County governments and school districts also would realize benefits from future energy and mineral resource development in the form of additional property taxes. Such taxes, estimated on the basis of future coal, oil, and natural gas production, are estimated to range between $5.4 billion and $5.7 billion through 2020. Those sums do not include future property taxes levied on the new power plants, expanded rail facilities, or new residential and commercial development associated with future growth, or sales and use taxes levied on consumer and some industrial purchases. These latter revenues are not estimated in this study, but would be substantially lower than those on resource production.

Local governments would benefit from property taxes on new development, as well as from sales and use taxes on taxable sales within their boundaries. Such revenues are not estimated for this study due to the large number of jurisdictions and other analytical considerations.

4.2.12.9 Social Setting

The past 30 years have seen sweeping social change in the U.S. and throughout much of the world. But in addition to the broad forces that have driven social change in the U.S. as a whole, social conditions in some PRB communities have been substantially influenced by energy development. Factors that have affected social conditions in the PRB include industrial and natural resource development, economic and demographic change, housing and public infrastructure development, and institutional change at the local and state government levels.

One of the key drivers of social change in the PRB has been energy-related population growth. When the first oil boom occurred in the late 1950s, Campbell County was a relatively stable, sparsely-populated rural county. Like many places in Wyoming and throughout the rural west, Campbell County was a small, relatively homogeneous ranching community (ROMCOE 1982). The oil booms of the 1950s and 1960s brought an influx of new people. Development of coal mines, continued oil and gas drilling, and power plant construction precipitated another round of growth. In all, Campbell County population grew by almost 600 percent between 1950 and 2000.

On the one hand, this population growth, combined with a robust economy, generated a variety of positive social effects. Financial and technical resources poured into the community as it mobilized to accommodate the new population. Job opportunities were created in the construction industry, as the community responded to demands for housing, public facilities, and retail goods and services. The large and rapid influx of new residents, eager to take advantage of the employment opportunities, created energy, vitality, and sense of economic optimism about the community. Where economic advancement had been limited before the boom, there was now opportunity (Gardiner 1985).

On the other hand, it is likely that many residents had mixed feelings about these changes (Heinecke 1985). New residents brought new ideas, new ways of doing things, new preferences for goods and services, and new demands for government services. Some long-time residents, particularly those who were not directly participating in the economic benefits of energy development, viewed these changes as negative.

Today, almost any organization, committee, or government body is made up of a cross-section of energy employees, ranchers, and other community members whose tenure in the community may be long or short (Bigelow 2004, Spencer 2004). Moreover, because of the turnover in the energy companies, the community has become accustomed to newcomers.

Cumulative energy development in the PRB through the year 2020 has the potential to generate both beneficial and adverse effects on community social conditions. Social effects of development activities in the PRB would vary from county to county and community to community under the coal production

scenarios developed for this study, based on the existing social setting and the type of development that would occur.

Beneficial social effects would be associated with an expanding economy and employment opportunities associated with energy development and resulting improvements in living standards for those employed in energy-related industries. Adverse social effects could occur as a result of conflicts over land use and environmental values. Negative social effects also could occur if the pace of growth exceeds the abilities of affected communities to accommodate energy-related employees and their families with housing and community services.

In the PRB, social conditions in Campbell County, the city of Gillette, and the town of Wright are most likely to be affected because the county would host much of the cumulative energy development workforce, and the county and its municipalities would receive the largest increments in population growth. Campbell County and its municipalities have a long history of energy development, and they have developed infrastructure and management systems to plan for and manage growth; consequently, major adverse social effects would not be anticipated. However, under either coal production scenario, the county and the two municipalities may face challenges in providing adequate housing and expanding community services in anticipation of population growth through 2010, particularly if several power plant and coal mine construction projects occur simultaneously. As municipalities receive only sales and use tax revenues directly from development and purchases made within their boundaries, Gillette and Wright could face challenges in securing the necessary funding to improve municipal facilities and services. Housing shortages and limitations in public services could contribute to adverse community social effects in these communities.

Many of the people who would immigrate to Campbell County for energy-related jobs are likely to share characteristics with much of the current population; therefore, few barriers to social integration are anticipated.

Social effects on other communities in the PRB are likely to be minimal to moderate. Energy-related population growth is anticipated to be moderate in other communities. Sheridan County, also familiar with coal mining, is the only other county anticipated to host a major construction project under the development assumptions used for either projected development scenario. Converse, Weston, and Crook Counties could experience spillover growth from projects in Campbell County.

Johnson, Sheridan, and Campbell Counties could experience continued conflict over split estate and water issues associated with CBNG development, and the pace and scale of energy development across the PRB is likely to continue to generate social and political conflict over environmental issues under either coal production scenario.