

CHAPTER 4 - CUMULATIVE EFFECTS

This chapter explains and quantifies the levels of cumulative disturbance that would affect the vicinity of the Project Area for each of the alternatives considered. Cumulative effects are those determined by summarizing the incremental impacts of an action added to other past, present, and reasonably foreseeable future actions in the area of influence. Cumulative effects can be identified both quantitatively and qualitatively, by magnitude of single actions, by the number of single actions combined, and by a time period in which the actions occur and have an effect on the environment.

The Reasonably Foreseeable Development Scenario (RFDS) describes the resources identified within and adjacent to the Project Area, and how those resources may affect future management decisions within the Project Area. Resources, other than those currently located within the Project Area but likely to move into or inhabit the area in the foreseeable future, are also included in this discussion.

The principal activities which could affect resources within the vicinity of the Project Area and which have been examined for this cumulative impacts analysis include:

- Continued CBM development
- Surface coal mining
- Conventional oil and gas drilling and production
- Ranching activities
- Recreation activities, principally hunting

4.1 INTRODUCTION

The analysis supporting this EA references the Powder River Basin Oil and Gas FEIS (PRB O&G FEIS) (BLM, 2003) and the basin-wide analysis of impacts anticipated for the drilling and production of wells throughout the Wyoming portion of the Powder River Basin. Basin-wide impacts from the cumulative effects of oil and gas development, including the Big Porcupine CBM Project's Proposed Action, are presented in the cumulative impact analysis of this regional, programmatic NEPA document. Impacts to resources from oil and gas development plus other past, current, and foreseeable projects in the PRB, both direct/indirect impacts and cumulative, are addressed in the FEIS. Agency management plans, which are designed to mitigate development-associated effects, are derived from the analyses presented in the FEIS.

The BLM's Reasonably Foreseeable Development Scenario (RFDS) as discussed in the PRB O&G FEIS envisions development of nearly 40,000 CBM wells in the Powder River Basin study area within 10 years, with most development occurring between 2003 and 2011. Average well life is estimated at 7 years and reclamation would be completed 2 to 3 years following cessation of production (Bennett, 2003, p. 2). Impacts from the Proposed Action represent a very small fraction of the disturbance levels analyzed in the FEIS. A comparison of the Proposed Action to projected basin-wide development is indicated in **Table 4-1**.

Table 4-1 Comparison of Proposed Action to Cumulative Projected CBM Development, Powder River Basin

Facilities	PRB Oil & Gas FEIS Preferred Alternative ¹	Proposed Action	Proposed Action as a percent of FEIS Cumulative Impact
Federal wells	23,863	182	0.76
Non-federal wells	15,504	44	0.28
Total wells	39,367	226	0.57
Roads, improved (miles)	7,135	1.21	0.02
Roads, 2-track (miles)	10,619	39.35	0.37
Pipeline, polyethylene (miles)	19,438	101.93	0.52
Pipeline, steel (miles)	1,408	10.49	0.75
Overhead electric (miles)	5,311	29.99	0.56
First stage compressor stations	184	5	2.72
Second/third stage compressor stations	61	1	1.64
Surface discharge facilities	606	14	2.31
Total short-term disturbance (acres)	202,843	938	0.46
Total long-term disturbance (acres)	95,138	114	0.12

¹ Source: Powder River Basin FEIS, Table S-1

In addition to CBM development near the Project Area, a major source of potential impacts to resources would be the continued development and expansion of nearby surface coal mines. Analysis of those impacts has been considered in the Final South Powder River Basin Coal EIS (SPRB FEIS) (BLM, 2003b), and results of those studies have been incorporated within this EA.

Other past, present, and reasonably foreseeable actions that contribute to the assessment of the cumulative impacts for the proposed Project are roads and vehicle use, railroads and trains, electrical power generation and transmission, pipelines, ranching and livestock management, and recreational hunting and other dispersed recreational uses. Most increases in the mileage of new road, railroad, power, and pipeline construction have been and will likely be attributed to either CBM development or coal mining, and have been accounted for in direct and indirect impact analyses for previous NEPA compliance actions such as the PRB O&G FEIS (BLM, 2003) and the SPRB FEIS (BLM, 2003b). Past, current, and reasonably foreseeable ranching and recreational activities are expected to contribute only minimally to cumulative impacts. An increase in the level of minerals resource extraction activities, other than those associated with CBM or coal mining, is considered unlikely.

This cumulative impacts analysis has considered effects occurring during the life of the Proposed Action, estimated at approximately seven years. The area analyzed has varied depending upon the resource considered and is described more fully within the discussions for individual resources.

4.2 GEOLOGY, GEOHAZARDS, MINERAL RESOURCES, AND PALEONTOLOGY

Cumulative impacts to physiography and geologic resources would result mainly from mineral extraction activities within the vicinity of the Project Area. Some alterations to topography from construction of roads, compressor stations, and, to a lesser extent, disturbance from well sites, would result from additional CBM development near the Proposed Action. The generally low-relief topography in the Project Area would minimize the necessity for cut-and-fill construction methods. The Proposed Action would mainly occur within the Porcupine Creek drainage basin, a tributary to the Antelope Creek watershed that is a subunit of the PRB O&G FEIS' project area for which impacts are quantified. Within that watershed, long-term cumulative surface disturbance would impact approximately 2.52 percent of the area. Within the TBNG, long-term cumulative impacts to soils would impact approximately 1.30 percent of the Antelope watershed (BLM, 2003, p. 4-169).

Long-term surface disturbance resulting from implementation of the Proposed Action amounts to 114 acres, or 0.3 percent of the disturbance analyzed in the PRB O&G FEIS (BLM, 2003, pp. 4-166 and 4-167). Agency-required reclamation procedures would minimize the effects of this disturbance on federal lands. Reclamation of private surface would be at the discretion of individual landowners, but it seems reasonable to assume that these individuals would expect reclamation efforts to approximate, at a minimum, those procedures used on adjoining federal surface.

4.2.1 Coal Mining

Methane-bearing coal seams are currently mined in the vicinity of the Project Area, resulting in the total loss of the CBM reservoir and drainage of gas from adjacent seams through the surface mine highwall. Failure to develop the Proposed Action would result in the irretrievable loss of CBM resources over most or all of the Project Area.

The expected continued expansion of surface coal mines adjacent to the Project Area would have major impacts on topography. Following mining of the coal, reclamation would attempt to simulate the appearance of the pre-mined landscape. Reclaimed areas behind the active mine would resemble the original topography except for more subdued slopes and reduced numbers of gullies.

The BLM's RFDS for surface coal mining in the vicinity of the Project Area is described in the Final South Powder River Basin Coal EIS (BLM, 2003b). This DEIS represents the required NEPA documentation for BLM's decision related to granting of expanded coal leases near four of the five existing mines in the South Powder River Basin area. Five Lease By Application (LBA) tracts are analyzed in the FEIS. Two of these, the NARO North Tract and the West Roundup Tract, would result in expansion into the Project Area. The NARO North Tract would total 2,369.38 acres and would overlap into the southern and southeastern portions of the Project Area (BLM, 2003b, pg. 2-5), adjacent to the existing NARC mine. The West Roundup Tract Proposed Action and various possible alternatives to the Proposed Action under consideration by

the BLM would total up to 6,407.02 acres. Expansion would be into the northern portion of the Project Area from the vicinity of the existing North Rochelle mine (BLM, 2003b, pgs. 2-27 to 2-35).

The SPRB FEIS tracts represent portions of a nearly continuous corridor of coal mines in southern Campbell and northern Converse counties approximately 24 miles long and eight miles wide. Production in the area began at the Black Thunder mine in 1977 (BLM, 2003b, pg. 4-107). The five active mines in this area consist of approximately 47,500 leased acres. Mining and reclamation rates in the area are expected to increase through 2015. The current acreage under lease represents a 75 percent increase in leased acreage since 1990. The Proposed Actions analyzed in the SPRB FEIS would represent a 28 percent increase in the current leased acreage (BLM, 2003b, pg. 4-111 to 4-112).

A decision to lease based upon analysis from the SPRB FEIS would not directly affect cumulative impacts in the vicinity of the Project Area. There is sufficient coal leased in the vicinity of the Project Area to supply reasonably foreseeable market demand, irrespective of leasing expansion decisions, during the life of the CBM development analyzed by the PRB O&G FEIS. New lease tracts would extend mine life, not be developed contemporaneously with existing leases (BLM, 2003b, pg. 4-115 to 4-116). Therefore, the principal impacts resulting from expansion into new coal lease tracts would occur following the peak of CBM development in the PRB and after the life of the Proposed Action.

Expansion of the adjacent coal mines over much of the Project Area within the next 10-20 years is highly likely (Karbs, 2004, personal communication). BLM requires a successful LBA applicant to develop a minimum of 1 percent of the estimated coal reserve within the lease within 10 years, with ongoing 1 percent annual development requirements. In practice, all of the current mines recover the coal at much higher rates (Karbs, 2004, personal communication). Mining occurs at maximum rates determined by the mines' air permits (BLM, 2003b, pg. 2-9). The five existing mines currently disturb approximately 2,000 acres annually, and this disturbance rate would be expected to continue. The NARC and North Rochelle mines account for approximately 32 percent and 10 percent of this disturbance (approximately 840 acres), respectively (BLM, 2003b, pg. 4-112).

Almost all of the Project Area has been previously covered (at considerable expense) by coal mine-sponsored Class III cultural resource inventories, indicating the intention of the North Rochelle and NARC mines to pursue surface mining within the Project Area. In recent years, the NARC mine has expanded to the north and west at rates of approximately .25 to .50 miles annually. Aerial photography indicating this expansion has been included as **1 4.1**. The photos indicate planned expansions of the existing NARC mine lease through 2006-2010. The blocked areas north and west of the existing mine indicate the outline of the NARO North LBA Tract.

Figure 4.1 Sheet 1 of 3 - Northern NARC Coal Mine, December 2001 (11x17 inch foldout)

2nd page

Figure 4.1 Sheet 2 of 3 - Northern NARC Coal Mine, December 2002 (11x17 inch foldout)

2nd page

Figure 4.1 Sheet 3 of 3 - Northern NARC Coal Mine, December 2003 (11x17 inch foldout)

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4.2.2 Cumulative Impacts from Other Sources

As discussed in Chapter 3 of this EA, Project-related increases in any of several possible geologic hazards appear to be extremely unlikely. Development of additional CBM or conventional oil and gas wells in the general vicinity of the Project Area is unlikely to increase the risk of geological hazards from the Proposed Action.

Irreplaceable loss of the CBM resource would result from implementing the Proposed Action or from the failure to implement the Proposed Action. Development of the Proposed Action would result in the direct loss of coalbed methane to production. Within the Porcupine Creek drainage basin, approximately 800 CBM wells are expected to be drilled during 2003-2008 (Independent Production Company, 2002, p. 11). Project wells represent 0.59 percent of the total CBM well construction analyzed in the PRB O&G FEIS.

Development of the Proposed Action would not affect the recovery of other mineral resources, such as coal and conventional oil and gas. As discussed in Chapter 3, Geology and Minerals, the vicinity of the Project Area appears to be in a mature development phase with respect to conventional oil and gas, and extensive drilling and production for these resources is not expected in the foreseeable future. The BLM 10-year RFDS for non-CBM oil and gas development in the Powder River Basin (BLM, 2003, Appendix A) forecasts approximately 3,200 conventional wells over the entire 8 million acre PRB O&G FEIS Project Area, for an average density of one well every four square miles. Approximately 15 percent of these wells would be expected to be productive, based upon historical exploratory success rates, yielding nearly 500 productive wells, 80 percent of which would be assumed to be oil productive.

Surface disturbance associated with development of CBM resources could result in some permanent loss of paleontological information, particularly on private leases. As discussed in Chapter 3 of this EA, mitigation plans developed for construction on federal land would serve to minimize potential loss of paleontological resources. Surveys undertaken in association with the Proposed Action might lead to the discovery of previously unknown significant fossils. Expansion of existing coal mines would lead to the destruction of near-surface, potentially fossiliferous, rock units.

Livestock grazing, ranching operations, and recreational activities are not expected to affect geological resources. The geologic disturbances associated with construction of the Proposed Action represent a small fraction of the cumulative impacts analyzed in the PRB O&G FEIS.

4.3 WATER RESOURCES

Cumulative impacts to water resources in and near the Project area could result in changes to current water quantity and water quality. The Proposed Action is located mainly within the Porcupine Creek drainage basin which, in turn, occupies a portion of the Antelope Creek watershed, the area analyzed for cumulative impacts. Active surface coal mines are located within the Antelope Creek watershed. Collection of groundwater and discharge to surface drainages is an effect common to both mining and CBM development. Cumulative impacts to

water resources would be dominated by the effects of expansion of existing coal mines and CBM development in upstream portions of the Porcupine Creek drainage basin.

Water management plan guidance for federal CBM development was revised by the Bureau of Land Management (BLM), based upon analysis done for the PRB O&G FEIS. This guidance (BLM, 2003) requires consideration of the potential effects of probable upstream CBM discharge as well as discharge from the Project. Accordingly, a peak flow analysis has been conducted of the Porcupine Creek drainage basin upstream of the Proposed Action, an area of approximately 36,000 acres (Bill Barrett Corporation, 2003). That analysis has been incorporated into the cumulative impacts analysis for this EA.

4.3.1 Surface Water

Coal Mining

The NARC surface coal mine is located immediately downstream of the Project Area across the lower portions of Porcupine Creek. The Antelope mine, located southwest of the Project Area, occupies a part of the middle portion of the Antelope Creek watershed near the confluence of Spring Creek with Antelope Creek. Groundwater encountered during mining at the NARC mine is stored in sedimentation ponds. Stored water is used for dust suppression and other industrial purposes, as well as for reclamation efforts. Due to mine needs, stored water has not recently been discharged to surface drainages, except once during an exceptional storm event. As more water becomes available from CBM discharge, downstream releases to Porcupine Creek are possible.

Mine water requirements vary considerably by season, with highest usage (up to and exceeding 100,000 barrels/day) from May through August. During the months of December through February, requirements may be less than 40,000 barrels/day. Lowest usage has been recorded in February, with an average daily use of 31,405 barrels (Murphree, 2002a). Continued expansion of the mine accompanied by an increase in haul road length suggests that NARC will require increasing amounts of water in the future.

Released water would first pass through one or more sedimentation ponds operated by the mine. Discharges from the sedimentation ponds could contain higher concentrations of dissolved solids and be of lower quality because of sediment mixing during precipitation and concentration through evaporation. Suspended solids would be reduced during passage through the settling ponds. In contrast, CBM water produced from wells is essentially free of sediment, although discharge to surface drainages can increase sediment loading through increased stream erosion (BLM, 2003, p. 4-122). All discharges from the mine reservoirs into Porcupine Creek would be required to meet those standards mandated by the mine's NPDES permits.

The BLM's RFDS for surface coal mining in the vicinity of the Project Area is described in the Final South Powder River Basin Coal EIS (BLM, 2003b). Five LBA tracts are analyzed in the FEIS. The NARO North Tract would result in expansion into the Project Area and is located within the Antelope Creek watershed. The NARO North Tract would total 2,369.38 acres and would overlap into the southern and southeastern portions of the Project Area (BLM, 2003b, pg. 2-5), adjacent to the existing NARC mine. The West Antelope Tract, located adjacent to the existing Antelope mine southwest of the Project Area, is also located within the Antelope Creek watershed. The West Antelope Tract would, depending upon the chosen alternative, total 3,542.19 acres (BLM, 2003b, pg. 2-37). Ongoing development of the existing NARC and Antelope coal leases disturbs approximately 920 acres annually (BLM, 2003b, pg. 4-112).

There is sufficient coal leased in the vicinity of the Project Area to supply reasonably foreseeable market demand, irrespective of leasing expansion decisions, during the life of the CBM development analyzed by the PRB O&G FEIS. New lease tracts would extend mine life, not be developed contemporaneously with existing leases (BLM, 2003b, pg. 4-115 to 4-116). Therefore, the principal impacts resulting from expansion into new coal lease tracts would occur following the peak of CBM development in the PRB and after the life of the Proposed Action.

The current water resource effects resulting from surface coal mining would, therefore, be unaffected by the leasing decision. Therefore, the main foreseeable effect on surface water resources associated with coal mining within the vicinity of the Project Area would be an increase in requirements for industrial consumption within the Antelope Creek watershed and resultant discharge of return water to Antelope Creek and its tributaries. This increase would be due to longer haul road lengths associated with ongoing expansion of the existing mines. Prior to the institution of stricter water conservation measures in June 2002, the NARC mine haul road dust suppression water requirements had increased by 29 percent between 2000 and 2001 (Murphree, 2002, pg. 4). All discharge from mine settling ponds would be in compliance with the mines' NPDES permits.

CBM Development

Complete development of the Porcupine Creek drainage basin would result in additional flows in Porcupine Creek and its tributaries. As indicated in the Company's Water Management Plan (Independent Production Company, 2002, p. 11), ultimate CBM development of the basin is projected to result in approximately 800 producing wells. At the current rate of drilling, completion of development within the drainage basin is likely to occur within about five years. Reservoirs downstream of the Project Area, notably the 300 acre-foot Porcupine Reservoir, located approximately 1.5 miles downstream of the NARC mine, would probably receive more water as a consequence of CBM development. The quantities of water released to Porcupine Creek below the mine would be dependent upon the rate of upstream CBM development, the amount of CBM discharge released at outfalls, long-term infiltration rates in Porcupine Creek, the available capacity in mine reservoirs, and mine usage for industrial purposes and reclamation, values which are unknown at this time. These reservoirs would trap additional sediment that may be transported downstream.

A watershed boundary was determined for Porcupine Creek beginning at its confluence with Antelope Creek and extending to the basin divide. The watershed is 118.92 sq. miles (76,109 acres) in area and contains a number of existing stock ponds and reservoirs. The Porcupine Project falls within a watershed analysis conducted by the Company for the Big Porcupine Project Water Management Plan (Independent Production Company, 2002). Due to the large size of the Big Porcupine Project Area (nearly 18,000 acres), the Porcupine Creek watershed, and specific water management issues associated with the North Antelope/Rochelle Complex coal mine, the analysis of CBM discharge within this watershed was divided into smaller sub-watersheds. In addition, the watershed analysis for the Company's Porcupine POD Project has been incorporated into this EA (Bill Barrett Corporation, 2003).

The Project is located near the southeastern limit of current CBM exploration in the Powder River Basin. Examination of well permit data from the WOGCC and the Wyoming State Engineer's Office (WSEO) lists hundreds of active permits for the area of the Porcupine Creek Basin. Barring a dramatic change in the economics of CBM development, it is likely that most of the Porcupine Creek drainage area will be drilled. Data from WOGCC indicating a listing of CBM completed wells or permitted or processing locations as of October, 2003 has been included as **Appendix L**. The list references 457 locations, including approximately 25 downstream of the Proposed Action, and includes 213 federal, 40 State of Wyoming, and 204 private wells. Of the 457 locations, 191 are currently producing or shut in. Current (as of September, 2003) CBM development projects in addition to the Proposed Action located on the TBNG which contribute to the 800 well total development scenario are summarized in **Table 4-2**.

Table 4-2 Federal CBM Development Projects, Porcupine Creek Basin, 9/15/2003

Operator	Project	Location	Number of Wells
Coleman	Sioux Ranch	41N-72W	4
Merit Energy	S. Porcupine	42,43N-71W	41
Williams Production RMT	Thunderhead	43N-71W	32
Yates	Thunder Basin	42N, 70-71W	10
Williams Production RMT	Antelope	41,42N-71W	29
Bill Barrett Corp	Tuit	43N-72W	36
Bill Barrett Corp.	Porcupine	41,42N-71W	29
Total			181

Source: September 15, 2003 CBNG Tracking Sheet, BLM Buffalo Field Office and Bill Barrett Corp.

The watershed of the Porcupine Creek Basin upstream of the Project totals approximately 36,000 acres. It is assumed that this entire area will be developed on standard 80 acre spacing, yielding a total projected upstream development of approximately 450 wells (including most of the 191 existing wells). The upstream discharge analysis done for the Porcupine POD Water Management Plan assumed a worst case scenario, i.e., that all of these wells would commence production simultaneously at maximum water production rates. As indicated in Appendix L, approximately 160 of the projected ultimate upstream development of 450 wells are already

producing. Under the worst case scenario, the projected maximum CBM water discharge in Porcupine Creek expected to reach the upstream portion of the Big Porcupine CBM Project Area, would be approximately 391,000 BWPD (25.4 cfs). Discharge rates are in all cases very small (approximately 3 percent) compared to projected 2 year storm event flows (Bill Barrett Corporation, 2003, pg.8). Actual discharge from 160 existing wells in the upper Porcupine Creek watershed as of August , 2003, based upon WOGCC data for the entire Antelope Creek watershed, is estimated to be approximately 2.4 cfs (WOGCC, 2003, online data).

Assuming full basin development within about a five-year period, flow rates in Porcupine Creek would be expected to peak within two or three years. Flow conditions would be expected to return to pre-development conditions within about 10 years, depending upon development rates, water production decline rates, and initial production rates. However, during a five- to eight-year period, it is likely that there would be temporary perennial flow in Porcupine Creek.

Other cumulative effects from development of the Porcupine Creek drainage basin would include the potential necessity to resize existing culverts and diversion channels. A beneficial effect would be the increase in amounts of water available for wildlife and stock watering during Project life. Increased water availability could lead to initiation or increase of irrigation efforts in the vicinity of the Project.

The Porcupine Creek watershed comprises a portion (approximately 12.5 percent areally) of the Antelope Creek watershed analyzed in the PRB O&G FEIS. Modeling conducted for the PRB O&G FEIS (BLM, 2003 p. 4-81) indicates that annual water production in the Antelope Creek subwatershed would peak in 2004, from a projected total of 925 producing wells of a total development for the watershed estimated at 1,700 wells (BLM, 2003, pg.2-17). The model predicts that this discharge would increase flows in the main stem of Antelope Creek by about 12 cfs. Increased flows attributable to CBM produced water would be less in other years. During average flow conditions, essentially 100 percent of projected CBM discharge could occur without causing potential effects to use of Antelope Creek water for irrigation. CBM discharge to the Antelope Creek watershed has reached a peak average monthly rate of 6.3 cfs in December, 2002. As of August, 2003, the average monthly discharge rate was 5.2 cfs from 343 producing wells (WOGCC, 2003, online data). For this EA, revised maximum net (after conveyance losses) CBM discharge volumes from the Proposed Action projected to reach the NARC mine collection reservoir are estimated to be approximately 3.75 cfs, with peak monthly flow occurring between 11 and 15 months from start of production. This would represent approximately 30 percent of the modeled maximum flow for the Antelope Creek watershed.

In addition to effects on water quantity, upstream CBM production could also affect surface water quality. Discharge from approximately 800 upstream wells could require additional treatment of water in settling ponds at the NARC mine. However, conveyance losses in ephemeral streams and the limited duration of production-related discharge would limit the magnitude and duration of additional treatment efforts. Water quality at the mine's NPDES outfalls may be affected by the addition of CBM discharge to water from mine de-watering.

TDS values of mine discharges from sedimentation ponds to these drainages would be unlikely to cause any discernible effects to existing water quality compared with effects from CBM

discharges. Mine discharges are typically intermittent, and the water quality is similar in composition to the natural water quality in streams (BLM, 2003, p. 4-122). Discharges from the NARC surface coal mine are subject to the requirements of WDEQ's NPDES program. Water quality samples were obtained by the NARC mine staff from Porcupine Creek immediately downstream of the NARC mine's terminal settlement pond and from Porcupine Reservoir. The samples exhibit lower average SAR (2.5) and higher average TDS (1,367 mg/L) values than those obtained from CBM produced water. These surface water samples are within the WDEQ limits protective of agricultural uses.

During low flow conditions (7Q10 flow), almost all of the flow in Antelope Creek (approximately 13 cfs) would consist of produced water. The State of South Dakota has expressed concerns regarding effects to water quality in streams receiving CBM discharge water which are tributary to South Dakota streams, including Antelope Creek. Modeling for the PRB O&G FEIS indicated that during minimum mean monthly flow conditions, quality of the mixed natural and CBM discharge water would yield an SAR value of approximately 7.0 and an EC value of approximately 923 $\mu\text{mhos/cm}$. These values are within the strictest protective limits established by WDEQ for irrigation use waters flowing into South Dakota (SAR of 10 and EC of 2,000 $\mu\text{mhos/cm}$), and within protective limits established for irrigation use waters established by the State of South Dakota (SAR of 10 and EC of 2,500 $\mu\text{mhos/cm}$). In addition, low flow conditions typically occur between the months of September and February when little, if any, irrigation occurs.

The analysis for the PRB O&G FEIS used a mass balance model for prediction of surface water quality impacts. Water quality data for the Upper Belle Fourche and Little Powder sub-watersheds have not detected changes in ambient stream water quality which were predicted by the mass balance model. Actual impacts to water quality may be less than those predicted by the model and the predictions of the model can not be verified based upon measured water quality data (BLM, 2003, pp.4-81 to 4-82).

The water quality in Antelope Creek near Teckla, Wyoming, during all months of the year and during low flow conditions would be adequate to meet the limits for both EC and SAR that WDEQ has adopted to be protective of downstream irrigation (BLM, 2003, p. 4-81).

Other Impacts

As discussed in Section 4.2.2, major increases in drilling and production of conventional oil and gas in the vicinity of the Project Area are not expected, and no additional impacts to surface water are expected. No additional impacts to surface water resources from ongoing ranching and recreational activities are anticipated.

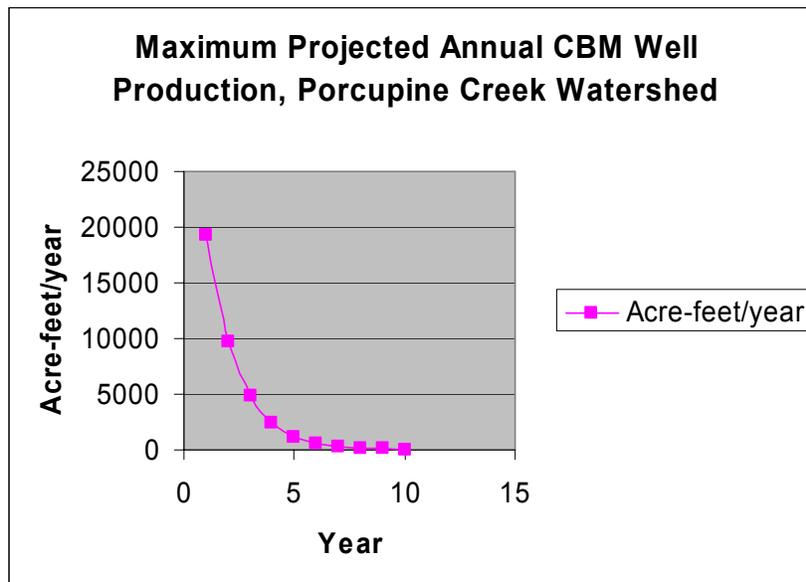
4.3.2 Groundwater

The main foreseeable effects on groundwater resources associated with coal mining within the vicinity of the Project Area would be:

- An increase in requirements for industrial consumption within the Antelope Creek watershed. This increase would be due to longer haul road lengths associated with ongoing expansion of the existing mines. Prior to the institution of stricter water conservation measures in June 2002, the NARC mine haul road dust suppression water requirements had increased by 29 percent between 2000 and 2001 (Murphree, 2002, pg. 4). Replacement of dust suppression groundwater pumped from mine wells by CBM produced water would reduce the needs for increased withdrawals from the mine's aquifers.
- Drawdown in the coal and overlying aquifers in the vicinity of active mines from seepage and pit dewatering. Drawdown is less in the overlying aquifers than in the highly transmissive coal. The degree of drawdown varies with geological conditions and distance from the active pit (BLM, 2003b, pg. 4-52).
- Removal of the coal aquifer during active mining and replacement with reclaimed unconsolidated backfill sediments.

Additional CBM production and mining in the vicinity of the Proposed Action could affect groundwater resources. Modeling conducted in support of the PRB O&G FEIS indicates that development of CBM through 2018 and coal mining through 2033 would remove 4 million acre-feet of groundwater from the Fort Union coal aquifers (BLM, 2003, p. 4-65). Of this total, approximately 3 million acre-feet would be removed during CBM production between 2002 and 2017 (BLM, 2003, p. 4-12). Projected water production from CBM development and projected groundwater removed during mining cumulatively represent approximately 0.5 percent of the estimated 750 million acre-feet of the recoverable groundwater stored in the Wasatch-Tongue River sands and coals. All of the groundwater estimated to be removed from mineral resource extraction during the time frame of the RFDS would represent less than 0.3 percent of the total recoverable groundwater in the Wasatch and Fort Union Formations within the Powder River Basin.

The volume of groundwater withdrawn from this project and from all future upstream development within the Porcupine Creek watershed is the same as the volumes, before conveyance losses, shown on Figure 3-2 and discussed in the Porcupine POD Water Management Plan (Bill Barrett Corporation, 2003a). As previously discussed, assuming full basin development within about a five-year period, flow rates would be expected to peak within two or three years and return to pre-development within about 10 years. Using these volumes for a 10 year period, it is estimated that 38,600 acre-feet of water would be removed from the aquifer, as indicated in Figure 4-1. This represents approximately 1.2 percent of the 3 million acre-feet which would be removed from Powder River Basin aquifers during CBM production between 2002 and 2017 (BLM, 2003, p. 4-12) and approximately 30 percent of the water projected to be removed from the Antelope Creek watershed (BLM, 2003, pg.2-26).

Figure 4-2 Maximum Porcupine Watershed Projected CBM Production

The Wasatch aquifer is hydrologically separated from the coals of the underlying Fort Union Formation by low-permeability claystones. Surface mining adjacent to the Project Area requires the shallower aquifers (the overburden) to be removed to expose the coal. Immediately adjacent to active mine pit areas, the Wasatch sands intercepted by excavations may drain into the pit and become dewatered. The areal extent of dewatering in the Wasatch aquifer associated with mining depends largely on the continuity of the sand units near the mine and whether these sand units are intercepted by mining.

The Wasatch aquifer would also be affected by additional CBM development in the vicinity of the Project Area. As the underlying coal is depressurized, water contained in deep Wasatch sands would leak into the coals. Water levels in the deep Wasatch sands would be lowered, but this drawdown that would occur within 100 vertical feet of a developed coal seam would be expected to be less than 10 percent of the drawdown that would occur in the coal (BLM, 2003, p. 4-47). Water levels in the deep Wasatch sands also would recover after development ends. Recovery to within 25 feet of preoperational levels would occur 25 years after development ends. Complete recovery of water levels would probably take tens to hundreds of years. Water levels in shallow Wasatch sands are not expected to be lowered during development except in areas of shallow coal and also would recover after water production ends. In some areas, water levels in very shallow Wasatch sands would rise in the immediate vicinity of impoundments or surface drainages that receive CBM discharge as a result of enhanced recharge from infiltration.

Both mining and CBM development result in partial removal of the water from the Fort Union coal seams and mining results in removal of the seam as well. Immediately adjacent to active mine pits, the water from the coal aquifer will drain into the pit, which would dewater the aquifer. The extent of coal aquifer dewatering and depressurization associated with mining depends largely on the continuity of the coal near the mine and its overall permeability, but

dewatering is required prior to mining. In areas of high coal permeability, which tend to coincide with major fracture trends, the extent of drawdown may be several miles. Depressurization within the coal caused by development of CBM would be more widespread than is caused by mining because development of CBM would cover a much larger area.

Redistribution of pressure within the coals after water production ends would allow the hydraulic pressure head to recover within approximately 50 feet or less of pre-project levels within 25 years after the project ends. Complete recovery of water levels would take tens to hundreds of years, depending on the location. This drop in hydraulic pressure head could cause a slight reduction in regional groundwater discharge to surface drainages.

Groundwater withdrawals from deeper aquifers for mine use also deplete groundwater. Development of CBM may affect lower aquifers by inducing upward leakage from them into the coal during coal depressurization.

During mining, the overburden (including Wasatch aquifer) and Fort Union coal aquifers are removed and replaced with backfill material (spoils). Infiltration and recharge would be facilitated through the spoils in comparison to undisturbed materials. Water discharged from CBM operations to areas underlain by mine spoil would increase recharge to alluvial aquifers and underlying Wasatch sands.

Existing activities including ongoing conventional oil and gas development, ranching, and recreation within the Antelope Creek watershed are not expected to result in major impacts to the groundwater resource.

4.4 AIR QUALITY

Principal cumulative impacts to air quality could result from activities associated with well construction and operation and maintenance activities, and from ongoing or expanded coal mining. Emissions from this Project would likely add cumulatively to existing and projected emissions in the basin. Construction-related emission sources are not expected to cause an impact on regional pollutant levels because of their small quantities and limited duration. Operational emissions would be regulated by the WDEQ AQD.

The PRB O&G FEIS evaluated the cumulative impacts associated with all emission sources in the Powder River Basin. This document is available for review from Buffalo, Wyoming, BLM Field Office upon request. Modeling was performed to determine whether applicable ambient air quality standards and PSD increments would be exceeded as a result of developing CBM projects in the Powder River Basin. The modeling results indicated that most PSD increments would not be exceeded (BLM 2003, Appendix F, p. F-16, 17). In those cases where the modeling results indicated that it may be possible to exceed the increments, the WDEQ AQD would ensure that the impacts would be limited by adhering to its standards, regulations, and implementation plans established under the CAA.

Wyoming air quality regulations require that proposed new or modified existing air pollutant sources undergo a permitting review before construction begins. The performance of a regulatory PSD increment consumption analysis would determine whether ambient air quality standards are in danger of exceedance as proposed new facilities are reviewed for conformance with air quality regulations (BLM, 2003, p. 4-382). Therefore, if this analysis were conducted, the WDEQ AQD would have the data necessary to monitor air quality impacts resulting from CBM development as well as other industrial operations in the basin, ensuring that changes to air quality would not result in long-term human health and safety effects.

Table 4-3 illustrates the percentage of wells proposed in the Big Porcupine project compared to the total number of wells analyzed in the PRB O&G FEIS. The number of wells associated with the Proposed Action comprises approximately 0.5 percent of the number of wells analyzed in the PRB O&G FEIS. This percentage indicates that the number of proposed wells is proportionally higher for the Project Area than the relative amounts of affected acreage would lead one to expect. This is likely a result of higher proposed well densities because of ongoing drainage in a portion of the Project Area. Both percentages, however, are very small in relation to development expected in the Powder River Basin.

Table 4-3 Big Porcupine CBM Proposed Action Compared to the PRB O&G FEIS Projected Development

Comparison	Big Porcupine CBM Project	PRB O&G FEIS	Big Porcupine Project as a Percent of PRB O&G FEIS
Area (acres)	17,940	8,636,000	0.2
Number of Wells	226	39,367	0.57
Number of 1st-stage Compressor Stations	5	184	2.7
Number of 2nd and 3rd stage Compressor Stations	1	61	1.6
Road Construction, New and Improved (miles)	40.6	17,754	0.23

Criteria pollutant concentrations predicted in the PRB O&G FEIS for the Reasonable Foreseeable Development Scenario (Alternative 1) in the PRB O&G FEIS are displayed in **Table 4-4**. Cumulative emissions include emissions from other sources not related to oil and gas development.

Compressors emit the majority of those project-related, non-particulate emissions not associated with construction operations. Predicted emission concentrations from the 1st stage compressors, for the Big Porcupine Project represent approximately 2.7 per cent of the emissions from all 1st stage compressors anticipated to be constructed and operated in the Wyoming portion of the Powder River Basin. Emissions from 1st stage compressors were selected as most representative of the Proposed Action because they would represent the majority of compressor emissions and because Project 1st stage compressors represent a proportionally larger fraction of compressors analyzed by the PRB O&G FEIS (2.7%) than do Project 2nd and 3rd stage compressors (1.6%). Therefore, the resulting estimates must be viewed as conservative because of the relatively larger amount of emissions generated by Project 1st stage compressors. In addition, the modeled emission concentrations for the PRB include emissions from other sources not related to oil and gas development. These estimates are shown in **Table 4-5**.

Table 4-4 Predicted Criteria Pollutant Impacts and Applicable Significance Thresholds (in $\mu\text{g}/\text{m}^3$) – PRB O&G FEIS

Pollutant	Averaging Time	Location	Background	Increment	Predicted Emissions	Cumulative Emissions	Total	NAAQS
CO	1 hour	near field	3,500	---	223	224	3724	40,000
		far field ¹	3,500	---	5	100	3600	40,000
	8 hours	near field	1,500	---	156	156	1656	10,000
		far field ²	1,500	---	19	78	1578	10,000
NO ₂	annual	near field	17	25	8.0	10.5	27	100
		far field ³	17	25	0.4	5.4	22	100
		far field ²	17	2.5	0.3	4.2 ^b	21	100
PM _{2.5}	24 hours	near field	19	---	16.0	24.4	43	65
		far field ³	19	---	5.1	14.7	34	65
	annual	near field	8	---	1.7	2.3	10	15
		far field ³	8	---	0.2	1.2	9	15
PM ₁₀	24 hours	near field	42	30	20.2	30.8 ^b	73	150
		far field ⁴	42	30	0.5	29.7	72	150
		far field ²	42	8	3.9	12.8 B	55	150
		far field ⁵	42	8	2.2	9.2 b	51	150
	annual	near field	17	17	3.3	4.1	21	50
		far field ⁴	17	17	<0.1	2.7	20	50
SO ₂	3 hours	near field	8	512	3.3	4.6	13	1,300
		far field ³	8	512	0.7	17.1	25	1,300
	24 hours	near field	8	91	1.7	3.2	11	365
		far field ³	8	91	0.3	5.3	13	365
	annual	near field	3	20	0.5	0.2	4	80
		far field ³	3	20	<0.1	0.4	3	80

Source: Adapted from Argonne, 2002, p. F-16

Notes: ^a Annual impacts are the first maximum value; short-term impacts are the second maximum value.

^b It is possible that **Other** and **Cum** emission sources could exceed the PSD Class I increment on the Northern Cheyenne Indian Reservation, and that **Cum** emission sources could exceed the PSD Class I increment in the Washakie Wilderness Area, and the PSD Class II increment near the maximum potential development; a regulatory “PSD Increment Consumption Analysis” should be conducted during permitting by the appropriate Air Quality Regulatory Agency.

Alt 1 - Direct modeled Alternative 1 impacts.

Other - Direct modeled “Non-project” impacts. The impact from all air pollutant emission sources not included in **Alt 1**, including the Montana Final Statewide Oil and Gas EIS and Proposed Amendment of the Powder River and Billings Resource Management Plans DEIS Alternative B/C/E sources. Potential impacts from Montana Alternatives A and D would be less.

Cum - Cumulative modeled impacts. Since these values represent the maximum cumulative impact location, they may not be a simple sum of the maximum direct **Alt 1** and **Other** impacts, which can occur at different locations.

Total - The sum of the cumulative modeled impact and the assumed background concentration.

National - Applicable National Ambient Air Quality Standard.

Wyoming - Applicable Wyoming Ambient Air Quality Standard.

Locations:

- ¹ Absaroka-Beartooth Wilderness Area
- ² Northern Cheyenne Indian Reservation
- ³ Crow Indian Reservation
- ⁴ Fort Belknap Indian Reservation
- ⁵ Washakie Wilderness Area

Table 4-5 Predicted Non-Particulate Criteria Pollutant Impacts and Applicable Significance Thresholds (in $\mu\text{g}/\text{m}^3$) – Big Porcupine Project (Estimated at 2.7 percent of Powder River Basin emissions)

Pollutant	Averaging Time	Location	Background	Increment	Predicted Concentrations	percent of Background	percent of Increment	NAAQS
CO	1 hour	near field	3,500	---	6.021	0.172029	---	40,000
		far field ¹	3,500	---	0.135	0.003857	---	40,000
	8 hours	near field	1,500	---	4.212	0.2808	---	10,000
		far field ²	1,500	---	0.513	0.0342	---	10,000
NO ₂	annual	near field	17	25	0.216	1.270588	0.864	100
		far field ³	17	25	0.0108	0.063529	0.0432	100
		far field ²	17	2.5	0.0081	0.047647	0.324	100
SO ₂	3 hours	near field	8	512	0.0891	1.11375	0.017402	1,300
		far field ³	8	512	0.0189	0.23625	0.003691	1,300
	24 hours	near field	8	91	0.0459	0.57375	0.05044	365
		far field ³	8	91	0.0081	0.10125	0.008901	365
	annual	near field	3	20	0.0135	0.45	0.0675	80
		far field ³	3	20	0.0027	0.09	0.0135	80

Source: Adapted from Argonne, 2002, p. F-16

Notes: ^a Annual impacts are the first maximum value; short-term impacts are the second maximum value.

^b It is possible that **Other** and **Cum** emission sources could exceed the PSD Class I increment on the Northern Cheyenne Indian Reservation, and that **Cum** emission sources could exceed the PSD Class I increment in the Washakie Wilderness Area, and the PSD Class II increment near the maximum potential development; a regulatory “PSD Increment Consumption Analysis” should be conducted during permitting by the appropriate Air Quality Regulatory Agency.

Alt 1 - Direct modeled Alternative 1 impacts.

Other - Direct modeled “Non-project” impacts. The impact from all air pollutant emission sources not included in **Alt 1**, including the Montana Final Statewide Oil and Gas EIS and Proposed Amendment of the Powder River and Billings Resource Management Plans DEIS Alternative B/C/E sources. Potential impacts from Montana Alternatives A and D would be less.

Cum - Cumulative modeled impacts. Since these values represent the maximum cumulative impact location, they may not be a simple sum of the maximum direct **Alt 1** and **Other** impacts, which can occur a different locations.

Total - The sum of the cumulative modeled impact and the assumed background concentration.

National - Applicable National Ambient Air Quality Standard.

Wyoming - Applicable Wyoming Ambient Air Quality Standard.

Locations:

- ¹ Absaroka-Beartooth Wilderness Area
- ² Northern Cheyenne Indian Reservation
- ³ Crow Indian Reservation
- ⁴ Fort Belknap Indian Reservation
- ⁵ Washakie Wilderness Area

A principal concern associated with CBM development is the increase in PM₁₀ emissions resulting from fugitive dust. Fugitive dust is also one of the primary pollutants emitted as a result of surface coal mining activities. As industrial development continues to expand in the PRB, fugitive dust emissions will continue to be of concern. As described in Section 3.4.3.1, potential near-field impacts resulting from construction activities are expected to be consistent with those estimated in the PRB O&G FEIS. As CBM development continues in the PRB, impacts to air quality from particulate emissions will likely continue to increase, approaching the levels estimated in the PRB O&G FEIS.

PM₁₀ concentrations were estimated for the Big Porcupine CBM Project to represent approximately 0.23 per cent of those analyzed in the PRB O&G FEIS. This estimate was derived by comparing the number of road miles that would be constructed for the Project to the total number of roads miles estimated for construction within the Wyoming portion of the PRB in the PRB O&G FEIS. The construction of roads results in the largest portion of disturbance related to Project development. The greatest portion of the amount of estimated particulates that would be generated by the Project would result from road construction, however, not road use. As discussed in Section 2.1.2.2, road use for well operations and maintenance would be periodic and limited. Therefore, most of the particulate emissions generated by Project operations would occur during construction operations and would dramatically decrease after construction is complete. When analyzing emissions sources within the PRB as a whole, most particulate emissions associated with oil and gas development would occur during those time periods when construction is occurring. Construction would occur intermittently and at locations throughout the PRB. In other words, the locations of the sources of particulate emissions associated with oil and gas activity would change temporally and spatially. They would not be continuous at high levels over time after well development is initiated.

Emissions from coal mining operations, however, would originate from defined locations and would result in emissions that reflect the level of mining activity, which can be assumed to be continuous over time. The estimated particulate emissions resulting from the Project must be viewed therefore as conservative because the modeled emission concentrations for the PRB include emissions from other development activities not related to oil and gas development. The nature of these other development activities, especially coal mining, lends itself to the continuous production of particulate emissions, unlike the intermittent production of the largest portion of particulate emissions associated with oil and gas development. These estimates are shown in **Table 4-6**.

Table 4-6 Predicted Particulate Criteria Pollutant Impacts and Applicable Significance Thresholds (in $\mu\text{g}/\text{m}^3$) – Big Porcupine Project (Estimated at 0.23 percent of Powder River Basin emissions)

Pollutant	Averaging Time	Location	Background	Increment	Predicted Concentrations	percent of Background	percent of Increment	NAAQS
PM _{2.5}	24 hours	near field	19	---	0.037	0.194	---	65
		far field ³	19	---	0.012	0.062	---	65
	annual	near field	8	---	0.004	0.049	---	15
		far field ³	8	---	0.001	0.006	---	15
PM ₁₀	24 hours	near field	42	30	0.046	0.111	0.155	150
		far field ⁴	42	30	0.001	0.003	0.004	150
		far field ²	42	8	0.009	0.021	0.112	150
		far field ⁵	42	8	0.005	0.012	0.063	150
	annual	near field	17	17	0.008	0.045	0.045	50
		far field ⁴	17	17	0.001	0.001	0.001	50

Source: Adapted from Argonne, 2002, p. F-16

Notes: ^a Annual impacts are the first maximum value; short-term impacts are the second maximum value.

^b It is possible that **Other** and **Cum** emission sources could exceed the PSD Class I increment on the Northern Cheyenne Indian Reservation, and that **Cum** emission sources could exceed the PSD Class I increment in the Washakie Wilderness Area, and the PSD Class II increment near the maximum potential development; a regulatory “PSD Increment Consumption Analysis” should be conducted during permitting by the appropriate Air Quality Regulatory Agency.

Alt 1 - Direct modeled Alternative 1 impacts.

Other - Direct modeled “Non-project” impacts. The impact from all air pollutant emission sources not included in **Alt 1**, including the Montana Final Statewide Oil and Gas EIS and Proposed Amendment of the Powder River and Billings Resource Management Plans DEIS Alternative B/C/E sources. Potential impacts from Montana Alternatives A and D would be less.

Cum - Cumulative modeled impacts. Since these values represent the maximum cumulative impact location, they may not be a simple sum of the maximum direct **Alt 1** and **Other** impacts, which can occur a different locations.

Total - The sum of the cumulative modeled impact and the assumed background concentration.

National - Applicable National Ambient Air Quality Standard.

Wyoming - Applicable Wyoming Ambient Air Quality Standard.

Locations:

- ¹ Absaroka-Beartooth Wilderness Area
- ² Northern Cheyenne Indian Reservation
- ³ Crow Indian Reservation
- ⁴ Fort Belknap Indian Reservation
- ⁵ Washakie Wilderness Area

In order to minimize the effects of continued development of coal mining and oil and gas activity, the WDEQ AQD has proactively taken steps to ensure that increases of PM₁₀ concentrations are minimized. The Final South Powder River Basin Coal EIS (BLM, 2003b) analyzed impacts to air quality from the expansion of coal mines near the Big Porcupine Project Area. As noted in that document, the WDEQ AQD continually reviews the data obtained from monitoring stations in the vicinity of the nearby coal mines and considers regulatory options to ensure that the standards are not exceeded. More intense monitoring and regulatory inspections have been implemented at all PRB coal mines. The Wyoming Air Quality Program requires the use of Best Available Control Technology (BACT) at all permitted facilities (BLM, 2003b, p. 3-25). BACT control measures that have been implemented on an area-wide basis include:

- Watering and chemical treatment of unpaved roads, including nearby county roads.
- Limiting the amount of surface area disturbed.
- Temporary revegetation of disturbed areas to reduce wind erosion.
- Timely final reclamation.

BACT technology applied to area coal mines includes:

- Use of baghouse dust collection systems and atomizers/foggers.
- Paving mine access roads.
- Imposition of speed limits.
- Limits on material drop heights for shovels and draglines.
- Use of stilling sheds on coal dump trucks (BLM, 2003, p. 3-22).

Air quality permits for the coal mines adjacent to the Project Area have been issued by WDEQ AQD. Based upon the prevailing wind directions, the mines most likely to add to PM₁₀ emissions within the vicinity of the Project Area would be the NARC and North Rochelle mines. For the NARC mine, the permit assumes a maximum annual production rate of 105 million tons. For the SPRB FEIS, long-term dispersion modeling indicated that currently projected mine activities would be in compliance with the annual PM₁₀ ambient air standard (50 ug/m³) for the anticipated life of the mine at proposed production rates (BLM, 2003b, pp. 4-27 to 4-28). The WDEQ AQD air quality permit issued for the North Rochelle mine assumes a maximum annual production rate of 35 million tons. Long-term dispersion modeling indicated that currently projected mine activities would be in compliance with the annual PM₁₀ ambient air standard for the anticipated life of the mine at proposed production rates. Exceedances near the North Rochelle mine in the 24-hr. PM₁₀ NAAQS standards in 2001 all occurred during periods of wind speeds in excess of 25 miles per hour, and two instances were almost certainly related to the relocation of an unpaved county road close to one of the monitors. WDEQ has suggested a relocation of the monitor to avoid repetitions and future collection of unrepresentative data (BLM, 2003b, pp. 4-39 to 4-42).

There is sufficient coal leased in the vicinity of the Project Area to supply reasonably foreseeable market demand, irrespective of leasing expansion decisions resulting from the SPRB FEIS, during the life of the CBM development analyzed by the PRB FEIS. The current air quality effects resulting from surface coal mining would, therefore, be unaffected by the leasing decision considered by the SPRB FEIS. A decision for leasing would act to extend the life of the coal

impacts, not increase them contemporaneously with forecast CBM development (BLM, 2003b, p. 4-115 to 4-116).

Using the PRB O&G FEIS modeling results, air impacts to AQRVs are not anticipated to result from implementation of the Big Porcupine CBM project alone. The PRB O&G FEIS determined that the emissions from that level of increased activity would not violate WAAQS. The Big Porcupine emissions would contribute a small amount to those emissions.

The PRB O&G FEIS predicted minor changes in acid neutralizing capacity, exceeding the applicable significance level by less than one percent due to cumulative sources at the Cloud Peak Wilderness Area. The amount generated by CBM development in the Powder River Basin contributed about 1/3 of the applicable threshold. CBM operations associated with the Proposed Action would contribute to a portion of the minor change in acid neutralizing capacity but would not exceed the modeled amount for CBM activities in the PRB (BLM, 2002, Appendix F, p. F-18).

The PRB O&G FEIS predicted that a “just noticeable change” in visibility would occur at 11 federal Class I areas. CBM operations for over 50,000 existing and projected CBM wells in the Powder River Basin are expected to impair visibility at the monument for up to nine days. CBM operations associated with the Proposed Action would contribute to a portion of the just noticeable change in visibility but would not exceed the modeled amount for CBM activities in the PRB.

As discussed in Section 4.2.1, extensive additional increases in conventional oil and gas exploration and development near the Project Area are not anticipated during the Project life. Impacts from conventional oil and gas development, ranching and livestock management, and recreational activities are expected to contribute minimally to cumulative air quality impacts in the vicinity of the Project Area.

4.5 SOILS, VEGETATION, AND WETLANDS

Cumulative impacts to soil, vegetation and wetlands would result mainly from mineral extraction activities within the vicinity of the Project Area. Impacts would include damaged or lost vegetative cover and soil disturbance from excavation and compaction, accelerated erosion, and loss of productivity within the Project Area. Effects would result principally from additional CBM development and ongoing coal mining activities. Impacts from conventional oil and gas development, ranching and livestock management, and recreational activities are expected to contribute minimally to the cumulative impacts in the Project Area.

The Project Area’s Porcupine Creek watershed is tributary to the Antelope Creek watershed that is a subunit of the PRB O&G FEIS’ project area for which impacts are quantified. Within that watershed, long-term cumulative impacts to soils would impact approximately 2.5 percent of the area. Within the TBNG, long-term cumulative impacts to soils would impact approximately 1.30 percent of the Antelope watershed (BLM, 2003, p. 4-169). Analysis for this EA indicates that short-term and long-term surface disturbances would amount to approximately 938 and 114 acres, respectively. These disturbance levels equate to 1.1 percent and 0.3 percent, respectively,

of the total short-term and long-term surface disturbances analyzed in the FEIS (BLM, 2003, pp. 4-166 and 4-167). Separately, these disturbance levels equate to 11.4 percent and 1.4 percent of those lands considered unavailable for land uses other than coal mining (approximately 8,200 acres) during active mining by the NARC and the North Rochelle mines over the next 10 years (BLM, 2003b, p. 4-112). Both mines are adjacent to, and are projected to encroach on, the Project Area over the next 10 years. Much of the area disturbed by CBM and conventional oil and gas development would again be disturbed by future surface coal mining (Figure 2-3).

With respect to conventional oil and gas development, the Project Area is located in a relatively mature area which reached its developmental peak in the late 1960s and early 1970s, as indicated in Chapter 3 of this EA, Geology and Minerals. The most recent APD for the Porcupine Field was issued by the WOGCC in 1993 (WOGCC, 2003, online data). Unless a new economically-attractive exploration target develops, a possibility which cannot be evaluated, it is probable that surface disturbance from foreseeable conventional oil and gas development within the Project Area would be minimal. As discussed in Section 4.2.2, the BLM 10-year RFDS for non-CBM oil and gas development in the Powder River Basin (BLM, 2003, Appendix A) forecasts approximately 3,200 conventional wells over the entire 8 million acre PRB O&G FEIS Project Area, for an average density of one well every four square miles. Approximately 15 percent of these wells would be expected to be productive, based upon historical exploratory success rates, yielding nearly 500 productive wells, 80 percent of which would be assumed to be oil productive. As indicated on **Figure 2-3 No Action Alternative Maps**, and as discussed in Section 4.2.1, continued expansion of surface coal mines into the Project Area is expected within the foreseeable future. Livestock grazing activity is expected to continue at approximately current levels.

The most serious cumulative impact to vegetative cover is expected to be the short-term and long-term loss of cover quantified above as acreage of disturbance and percentage of total disturbance from CBM and coal mining activity. With that exception, the greatest impact to vegetative cover is expected to be the increased potential for spread of non-native invasive species by increased vehicle traffic and use of new roads in the Project Area. Once established, such plants can be extremely difficult to remove (BLM, 2003, p. 4-179). Expansion of existing surface coal mines would destroy existing vegetative cover adjacent to the mines and expansion of conventional oil and gas activity could result in additional removal of cover through expanded road construction, well pads, and production facilities. As noted above, extensive conventional oil and gas development is not expected in the foreseeable future. Increased grazing activity or attempts by WGF to expand the sizes of existing pronghorn and/or mule deer herds could affect vegetative cover. Neither activity is anticipated and monitoring by USFS and WGF personnel would minimize the potential for overgrazing. Increased CBM development adjacent to the Project Area could result in some displacement of big game onto the Project Area with resultant increasing vegetation consumption, but such displacement would be a temporary effect lasting for the duration of the construction phase in neighboring areas. Reclamation of disturbed areas from both the oil and gas development and coal mining operations is expected to restore the vegetative cover and soil productivity of all affected upland areas.

Cumulative impacts from full CBM development (approximately 800 producing wells completed in the 2003-2008 time frame) within the Porcupine Creek basin would affect wetland and

riparian areas associated with the drainage. Because of the expected high quality of produced water in the Porcupine Creek basin, including the Project Area, it is not anticipated that water quality effects would result in negative impacts to these resource-sensitive areas. This could change, however, if wells farther west in the basin encounter more saline groundwaters or if upstream produced water were to encounter saline soils or sediments.

Most effects would be expected to result from temporary increased flows as CBM wells upstream of the Project Area come on production. As discussed previously under Water Resources, flow rates in Porcupine Creek would be projected to peak within two or three years and return to pre-development conditions within about 10 years. During a five- to eight-year period, it is estimated that there would be temporary perennial flow in Porcupine Creek. This would temporarily change the character of existing wetlands and could expand wetlands into new areas. Emergent, temporarily flooded wetlands, the most common type along the creek, could be transformed into types more tolerant of wetter conditions. If perennial flows were sufficient to increase sediment transport, this could also affect, and potentially cause temporary alterations to, existing wetlands. Effects would be ameliorated by being of limited duration. Increased flows could have the beneficial effect of flushing salts out of discharge channels (BLM, 2003, p. 4-171).

4.6 WILDLIFE, FISHERIES, AND SPECIAL STATUS SPECIES

Cumulative impacts to wildlife within the Project Area would result mainly from additional CBM development in the vicinity and ongoing coal mining activities. Conventional oil and gas development, ranching, and recreational activities are expected to contribute minimally to cumulative impacts to wildlife, fisheries, and special status species.

As discussed in Section 4.2.1, continued expansion of existing coal mines is expected for the foreseeable future. The dominant effects to wildlife from coal mines would be restricted mainly to the footprint of the mine expansion. The NARC and North Rochelle mines are actively expanding into the Project Area at average annual rates of approximately 820 acres. Over an estimated seven-year project life, the total impact from mine expansion, assuming current development rates, would be approximately 5,700 acres. Disturbance associated with mine expansion is considerably greater than the 938 acres of short-term and 114 acres of long-term surface disturbance associated with the Proposed Action. The mines are also adjacent to LBA lease tracts which would expand mining even farther into the Project Area. However, as indicated in Section 4.2.1, a decision for leasing would be unlikely to affect the total impacts occurring during the life of the Proposed Action since mining on the proposed LBA tracts would occur after the life of the Proposed Action (BLM, 2003b, pp. 4-115 to 4-116).

Ongoing energy development and continued stock grazing in the vicinity of the Project Area could lead to declining numbers or sexual diversity in pronghorn and mule deer populations. However, the small amounts of short-term surface disturbance associated with CBM development, and the fact that development does not occur simultaneously throughout the Porcupine Creek watershed, indicate that alternate forage areas would be available for big game species. As indicated in Chapter 3 of this EA, Geology and Minerals, and Section 4.2.2, conventional oil and gas development within the Project Area appears to be in a mature phase

and extensive additional development is not anticipated. Grazing activity should continue near current levels as the mines re-establish vegetation behind the open pits. Other long-term effects on big game would be due to natural forces, such as severe winters, drought conditions affecting forage productivity, or loss of habitat through range fires.

Following construction and field development, most additional impacts to raptors and other birds would result from CBM field operations (periodic well maintenance), conventional oil and gas development, and continued coal mining. CBM development beyond the Project Area would require additional primary power transmission lines. Above ground lines would be equipped with the best available protection against raptor electrocution (Avian Power Line Interaction Committee, 1996). Coal mining has resulted in short-term direct loss of ferruginous hawk nests in recent years, although habitat reclamation should provide for long-term viability of the species. Coal mining will have much greater potential for adverse effects to ferruginous hawks (Bill Barrett Corporation, 2003, Acceptance Certification p. 4). Again, other impacts to populations would result from natural forces. Increased road mileage within the Project Area could result in increased human interaction with various bird species, although the amount of additional long-term mileage would depend upon the degree of USFS-required reclamation of existing roads.

The PRB O&G FEIS forecasts a 25 percent increase in traffic resulting from CBM development (BLM, 2003, p. 4-216), most of which would occur during the construction phase. Collision-caused mortality of big game animals could increase by a comparable amount, particularly along paved roads capable of supporting higher vehicle speeds. Collisions with raptors and other bird species would tend to be less, although owls are particularly at risk (BLM, 2003, p. 4-216). The Company would monitor and remove carrion along roads to minimize the attraction of scavenging raptors.

Roads, railroads, livestock grazing, conventional oil and gas development, and coal mining are all currently occurring in the cumulative effects analysis area and likely have already affected sage grouse habitats and populations. Hunting and other dispersed recreation also occurs. However, hunting is regulated by the State to maintain sage grouse populations and likely does not contribute to adverse impacts. In fact, hunting success is used as a measure of population size and trend. The single greatest threat to sage grouse habitats and populations in the Big Porcupine Project Area and adjacent 2-mile buffer is the advance of the coal mine located to the east. If the coal mine continues to operate as it has in the past, within 10 years the mine is likely to have modified habitat in a large portion of the Project Area and the adjacent 2-mile buffer. Therefore, any adverse direct or indirect impacts from the Proposed Action are expected to be negligible with regard to long-term population and habitat trends (Bill Barrett Corporation, 2003, Acceptance Certification, p. 7).

Aquatic species or those associated with wetlands and riparian communities may experience cumulative impacts from CBM development. It is estimated that complete CBM development within the Porcupine Creek basin would occur within approximately five to six years. During that period, discharge of produced water down Porcupine Creek would temporarily transform the creek into a perennial stream. As development plans of other producers are unknown, the ability to accurately project flow volumes is limited. Quality of CBM produced water within the

Porcupine Creek watershed is, however, expected to be among the best in the entire Powder River Basin (BLM, 2003, Fig. 3-1). Water quality modeling conducted for the PRB Oil and Gas FEIS indicates that the annual water production in the Antelope Creek watershed would peak in 2004, when 925 wells would be producing at an average rate of 11.9 gpm (0.0265 cfs) per well (BLM, 2003, p. 4-81). Under modeled conditions, the amount of produced water assumed to reach the main stem of Antelope Creek during the peak year of CBM water production would be about 12 cfs (8,689 acre-feet/year).

The same model predicts that, following CBM development in the basin, the stream flow under low-flow conditions (12 cfs) would consist almost entirely of CBM produced water. The resultant salinity level measured as electrical conductivity (EC), in accordance with the model, would decrease to 924, whereas the SAR would increase to 7.0 (BLM, 2003, p. 4-81). The water quality in Antelope Creek near Teckla, Wyoming, during all months of the year and during low-flow conditions would be adequate to meet the limits for both EC and SAR that WDEQ has adopted to be protective of downstream irrigation. It should also be noted that samples collected since the onset of CBM production in other watersheds have not detected adverse changes in ambient stream SAR and EC concentrations of the magnitude predicted by the water quality model, and actual impacts may be less than the mass balance model predicts (BLM, 2003, p. 4-82). Following completion of development in upstream portions of the Porcupine Creek watershed, the normal decline in CBM water production would result in a gradual return of pre-development conditions and return of Porcupine Creek to ephemeral status.

Possible increases in sediment load associated with CBM produced water discharge from upstream portions of the Porcupine Creek drainage basin would affect aquatic invertebrate species in the vicinity of Porcupine Creek. The presence of constructed naturally-surfaced roads would increase the potential for vehicle-generated dust and increases in the sediment load of waters reaching Porcupine Creek. Streams within the Antelope Creek watershed are expected to exhibit some increase in sediment loading (BLM, 2003, p. 4-239).

During the period of increased flow down Porcupine Creek, expected to last somewhere between five and ten years, existing wetlands and riparian environments could be affected and, to some degree, displaced. Wetland types typical of perennial streams could succeed those typical of ephemeral situations. Populations dependent upon these communities could likewise be somewhat displaced. Overall, it is probable that the acreage of wetlands and riparian communities would expand in response to higher flows within Porcupine Creek. Based upon observations in mature CBM development areas of the Powder River Basin, dramatic impacts are not expected.

Effects to wildlife and special status species would be within the cumulative impacts considered in the PRB O&G FEIS.

4.7 CULTURAL RESOURCES

Destruction or degradation of uncurated cultural resources from the Project Area would represent a cumulative loss of information regarding history in the area. Surface disturbance within the vicinity of the Project Area would result mainly from CBM development and expansion of existing surface coal mines. Conventional oil and gas development, ranching, and recreational activities are expected to contribute minimally to cumulative impacts to cultural resources.

Continued advance of surface coal mines across the Project Area would result in destruction of uncurated artifacts and loss of heritage data. As discussed in Section 4.2.1, continued expansion of existing coal mines is expected for the foreseeable future. The dominant effects to cultural resources from coal mines would be restricted mainly to the footprint of the mine expansion. The NARC and North Rochelle mines are actively expanding into the Project Area at average annual rates of approximately 820 acres. Over an estimated seven-year project life, the total impact from mine expansion, assuming current development rates, would be approximately 5,700 acres. The mines are also adjacent to LBA lease tracts which would expand mining even farther into the Project Area. However, as indicated in Section 4.2.1, a decision for leasing would be unlikely to affect the total impacts occurring during the life of the Proposed Action (BLM, 2003b, p. 4-112).

The North and South NARO and West Roundup LBA tracts have been fully surveyed for cultural resources at a Class III level. The NARO tracts have been found to contain 79 historic and prehistoric sites. Four of these sites have been recommended as eligible for the NRHP. The West Roundup LBA tract has been found to contain 31 historic and prehistoric sites. None of the sites has been recommended as eligible for the NRHP (BLM, 2003b, pp. 3-77 to 3-78).

Data recovery plans are required for all sites recommended eligible to the NRHP following testing and consultation with the SHPO. Consultation with SHPO must be completed prior to approval of the MLA mining plan. Unevaluated or eligible sites would be protected prior to any disturbance and unevaluated sites would require evaluation. A data recovery plan must be written for any eligible sites which cannot be avoided and implementation of the plan is required prior to occurrence of any disturbance (BLM, 2003b, p. 4-84).

Mitigation measures required for federal oil and gas development, including CBM development, effectively protect existing heritage resources on federal lands. If such mitigation measures were not implemented, undiscovered cultural materials that could contribute to a broader understanding of the region could remain undocumented. Such measures are not required on state or private leases and cultural artifacts in these areas could be lost during drilling and construction operations. The increased road mileage associated with CBM development could allow greater access to previously isolated portions of the TBNG and could increase the amount of illegal collection of antiquities on federal surface by private individuals.

4.8 LAND USE, TRANSPORTATION, AND RECREATION

Cumulative impacts to surface uses near the Project Area would result mainly from mineral resource extraction and cattle and sheep ranching. The former includes both CBM and conventional oil and gas development as well as surface coal mining. Surface disturbance associated with CBM development would not be expected to interfere with ongoing coal extraction or conventional petroleum development.

Surface disturbance would affect the productivity of grazing allotments in the vicinity of the Project Area. Most of the allotments display productivity levels of 4-7 acres/animal unit month. Long-term disturbances of approximately 0.6 percent of the surface in and near the Project Area would result in small amounts of short-term and even less long-term productivity loss and reduced grazing carrying capacity.

Increased traffic associated with area CBM development and expansion of existing surface coal mines would add to existing levels of wear on major highways and local arterials. Roads subject to traffic from the Proposed Action and other developments would probably require additional levels of maintenance. Road wear would be greatest during the construction phase and decline significantly thereafter. Access to facilities would increase with expanded mileage of, principally, two-track roads. Increased traffic would potentially result in increased numbers of vehicle accidents. Accident levels have increased on some county and state roads in areas of CBM development (BLM, 2003, p. 4-302).

The principal recreational activity in the vicinity of the Project Area is hunting. CBM Development activities beyond the Project Area could affect hunting success by displacing game onto undeveloped or post-development portions of the Project Area. Increased road mileage associated with CBM development could improve access to areas near the Project Area affecting hunting success. Increased Project-associated vehicular traffic may result in some increased mortality of game animals. Long-term cumulative effects on hunting success, however, are expected to be minimal or non-existent and would be more subject to natural factors.

4.9 VISUAL RESOURCES

Cumulative impacts to visual resources within the Project Area would result mainly from additional CBM development and ongoing surface coal mining activities. Conventional oil and gas development, ranching operations, and recreational activities would be expected to contribute minimally to impacts. Some long-term impacts to lands within the Porcupine Creek drainage basin would be visible in the form of linear road or well site features to observers from points within the Project Area. The density associated with CBM development could alter some area landscapes from a dominantly rural to a more rural/industrial character. However, large portions of the Project Area are already heavily modified as a result of extensive conventional petroleum development and coal mining.

With respect to conventional oil and gas development, the Project Area is located in a relatively mature area which reached its developmental peak in the late 1960s and early 1970s, as indicated

in Chapter 3 of this EA, Geology and Minerals. Conventional oil and gas wells and associated production facilities tend to be more visually obtrusive, but less numerous, than CBM production facilities. Conventional oil development near the Project Area has been minimal in recent years. The BLM 10-year RFDS for non-CBM oil and gas development in the Powder River Basin (BLM, 2003, Appendix A) forecasts approximately 3,200 conventional wells over the entire 8 million acre PRB O&G FEIS Project Area, for an average density of one well every four square miles.

As indicated on the **No Action Alternative Maps (Figure 2-3)**, continued expansion of surface coal mines into the Project Area is expected within the foreseeable future. Surface mines provide highly visible and extensive impacts to the landscape. Reclaimed areas behind the active mine resemble the original topography except for more subdued slopes and reduced numbers of gullies. The NARC and North Rochelle mines adjacent to the Project Area are actively expanding at average annual rates of approximately 820 acres. Over an estimated seven year project life, the total impact from mine expansion, assuming current development rates, would be approximately 5,700 acres. The mines are also adjacent to LBA lease tracts which would expand mining even farther into the Project Area (BLM, 2003b, p. 4-112).

Visibility in the vicinity of the Project Area could be affected by increases in fugitive dust emissions associated with both CBM development and existing coal mining operations and mine expansion. For both types of resource extraction, permit requirements, mitigation efforts, and implementation monitoring enforced by WDEQ AQD act to minimize emissions and resultant degradation to area visibility.

4.10 SOCIOECONOMICS

Basin-wide cumulative impacts analysis of socioeconomic issues is provided in the PRB O&G FEIS (BLM, 2003, pp.4-364 to 4-370). As discussed in Chapter 3 of this EA, Geology and Minerals, minerals development, including mining and oil and gas production, is the largest employer in Campbell County and employees earn the highest average salaries among industrial workers. Energy-related businesses dominate the economy and most new businesses are energy-related. The total assessed valuation of mineral production in Campbell County in 1999 was \$1,294 million, 32 percent of the state's total (BLM, 2003, p. 3-285). Oil and gas development, representing approximately 24 percent of the valuation, has therefore been of critical importance to the economic health of the county. As indicated in Section 4.2.2, significant increases in conventional oil and gas exploration are not foreseen during the life of the Proposed Action. Ranching activities are expected to continue near current levels.

Four active surface coal mines located in southern Campbell and northern Converse counties have made application for expansion of existing coal leases. These mines (NARC, North Rochelle, Black Thunder, and Antelope) employ approximately 1,900 workers. Denial of new federal coal leases would still result in an increase of total employment to approximately 2,200 workers, with all of the increase occurring at the NARC mine (BLM, 2003b, ppp. 2-9, 2-23, 2-31, and 2-39). Granting of the new coal leases would extend mine life up to 11 years and increase employment by up to 186 workers, depending upon the selected alternative, with almost

all of the increase occurring at the North Rochelle mine. Cumulative revenues from mine expansion to the federal government and state of Wyoming are estimated at \$1.1 billion and \$1.5 billion, respectively. However, because the proposed LBA tracts would not be mined during the life of the Proposed Action, a leasing decision would not affect the cumulative impacts to employment levels or governmental revenues (BLM, 2003b, pp. 4-87 to 4-90).

Development of a boom/bust cycle is a concern for any area with large dependence upon minerals extraction. CBM development would add an important, albeit fractional, increment to local economies. Construction would be phased over a matter of a few years, and overall development activity would gradually decline. Major declines in natural gas prices could negatively affect development rates, but would also result in extended, lower development rates, reducing the boom potential. Greater impacts to local economies would result from significant declines in coal prices. Because of the heavy influence of minerals production on local economies, local governments tend to be more experienced with, and tolerant of, revenue fluctuations resulting from commodities price variations (BLM, 2003, p. 4-345).

CBM development in the Powder River Basin is projected to require employee levels of approximately 2,660 workers during the expected peak development in 2007. Most of the required employees are projected to reside in Campbell County and would be drawn largely from the local labor force. In the vicinity of the Project Area, it is probable, based upon current activity that development will peak earlier, probably by 2005-2006. Based upon the existing locations of many oilfield service companies, it is expected that most Project workers would be residents of the Gillette or Douglas areas. A large influx of outside labor is not expected, either for the Project or for basin-wide CBM development. Therefore, impacts to housing, transportation, and government services are expected to be minor, with the possible exception of the potential for limited housing shortages during peak development years (BLM, 2003, p. 4-345).

Analysis done for the FEIS suggests that "quality of life" issues would be expected to be minimally affected, if at all, by CBM development (BLM, 2003, pp. 4-353 to 4-355). While development would lead to some increased demands on local government services, the net economic effects of CBM exploitation in the vicinity of the Proposed Action are expected to be highly beneficial.