Task 3D Report for the Powder River Basin Coal Review Cumulative Environmental Effects

Prepared for

Bureau of Land Management
Casper Field Office and
Wyoming State Office

Submitted by

ENSR Corporation
Fort Collins, Colorado

Revised December 2005
(with errata)

TASK 3D REPORT
FOR THE POWDER RIVER BASIN COAL REVIEW
CUMULATIVE ENVIRONMENTAL EFFECTS

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ACRONYMS AND ABBREVIATIONS

µmhos/cm	micromhos per centimeter
APD	Applications for Permit to Drill
APE	area of potential effect
APLIC	Avian Power Line Interaction Committee
AUM	animal unit month
AVF	alluvial valley floors
BBO	billion barrels of oil
BCF	billion cubic feet
BLM	Bureau of Land Management
BNSF	Burlington Northern and Santa Fe Railroad
CBNG	coal bed natural gas
CFR	Code of Federal Regulations
DM&E	Dakota, Minnesota, & Eastern
EA	Environmental Assessment
EC	electrical conductivity
EIS	Environmental Impact Statement
FS	U.S. Department of Agriculture-Forest Service
GIS	Geographical Information System
kV	kilovolt
LBA	lease by application
LQD	Land Quality Division
MBTA	Migratory Bird Treaty Act
mg/L	milligrams per liter
MMBO	million barrels of oil
mmgpy	million gallons per year
mmhos/cm	millimhos per centimeter
mmtpy	million tons per year
MW	megawatts
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NPDES	National Pollution Discharge Elimination System
NRHP	National Register of Historic Places
POD	Plan of development
PRB	Powder River Basin
PRRCT	Powder River Regional Coal Team
RFD	reasonably foreseeable development
RMP	Resource Management Plan
SAR	Sodium absorption ratio
SHPO	State Historic Preservation Officer
SMCRA	Surface Mine Control and Reclamation Act
TBNG	Thunder Basin National Grasslands
TCF	trillion cubic feet
TDS	total dissolved solids
U.S.	United States
UP	Union Pacific
USACE	U.S. Army Corps of Engineers

VMT	vehicle miles traveled
WDEQ	Wyoming Department of Environmental Quality
WGFD	Wyoming Game and Fish Department
WSA	Wilderness Study Area

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1.0 INTRODUCTION

The Powder River Basin (PRB) of Wyoming is a major energy development area with diverse environmental values. The PRB is the largest coal-producing region in the United States (U.S.); PRB coal is used to generate electricity within and outside of the region. The PRB also has produced large amounts of oil and gas resources. Within the last decade, this region has experienced nationally significant development of natural gas from coal seams.

For the purpose of this study, the Wyoming PRB cumulative effects study area comprises the following subwatersheds[1] in portions of Sheridan, Johnson, Campbell, and Converse counties: Upper Powder River, Little Powder River, Upper Belle Fourche River, Upper Cheyenne River, Antelope Creek, and Dry Fork Cheyenne River (**Figure 1-1**). These subwatersheds encompass the projected groundwater drawdown area modeled for this study to account for potentially related effects to other environmental resources. The study area includes portions of the area administered by the Bureau of Land Management (BLM) Buffalo and Casper field offices and a portion of the Thunder Basin National Grasslands (TBNG), which is administered by the U.S. Department of Agriculture Forest Service (FS) (**Figure 1-2**). The surface estate within the study area is owned by private individuals, the state, and the federal government (**Figure 1-3**). As shown in **Figure 1-3**, the majority of the surface ownership in the PRB study area is private. Conversely, the majority of the mineral ownership in the study area is federal (**Figure 1-4**). The area of potential effect (APE) for the physical, biological, and human resources analyzed in this study varies by resource and in some cases extends outside of this study area, as appropriate.

During the 1970s and early 1980s, the PRB emerged as a major coal production region. Federal coal leasing was a high profile activity as over 90 percent of the PRB's coal is federally owned. The BLM is the lead agency responsible for leasing federal coal lands in the PRB study area. Between 1974 and 1982, the BLM issued three and started a fourth separate regional coal environmental impact statement (EIS), all addressing federal coal leasing and development, as well as other regional development.

In 1982, BLM temporarily halted coal leasing. However, the existing mines continued producing coal, which depleted their leased federal coal reserves. As a result, interest in leasing federal coal to extend mining operations at existing mines in the PRB increased in the late 1980s. There was little to no interest in opening new mines, however, and therefore, there was not enough interest in leasing to justify a regional coal sale. In early 1990, the Powder River Regional Coal Team (PRRCT) decertified the Powder River Federal Coal Region, which allowed BLM to begin processing applications by existing mines to lease maintenance tracts of federal coal using the lease by application (LBA) process.

BLM is required to complete a National Environmental Policy Act (NEPA) analysis (EIS or environmental assessment [EA]) for each coal lease application as part of the leasing process. In the coal leasing EAs and EISs that have been prepared since decertification, cumulative impacts

[1]Per the Wyoming Geographic Information Science Center at the University of Wyoming, the 4th level hydrologic unit boundaries used in this study are defined as sub-basins. However, for consistency with the PRB Oil and Gas EIS (BLM 2003), the term subwatershed has been retained for this study.

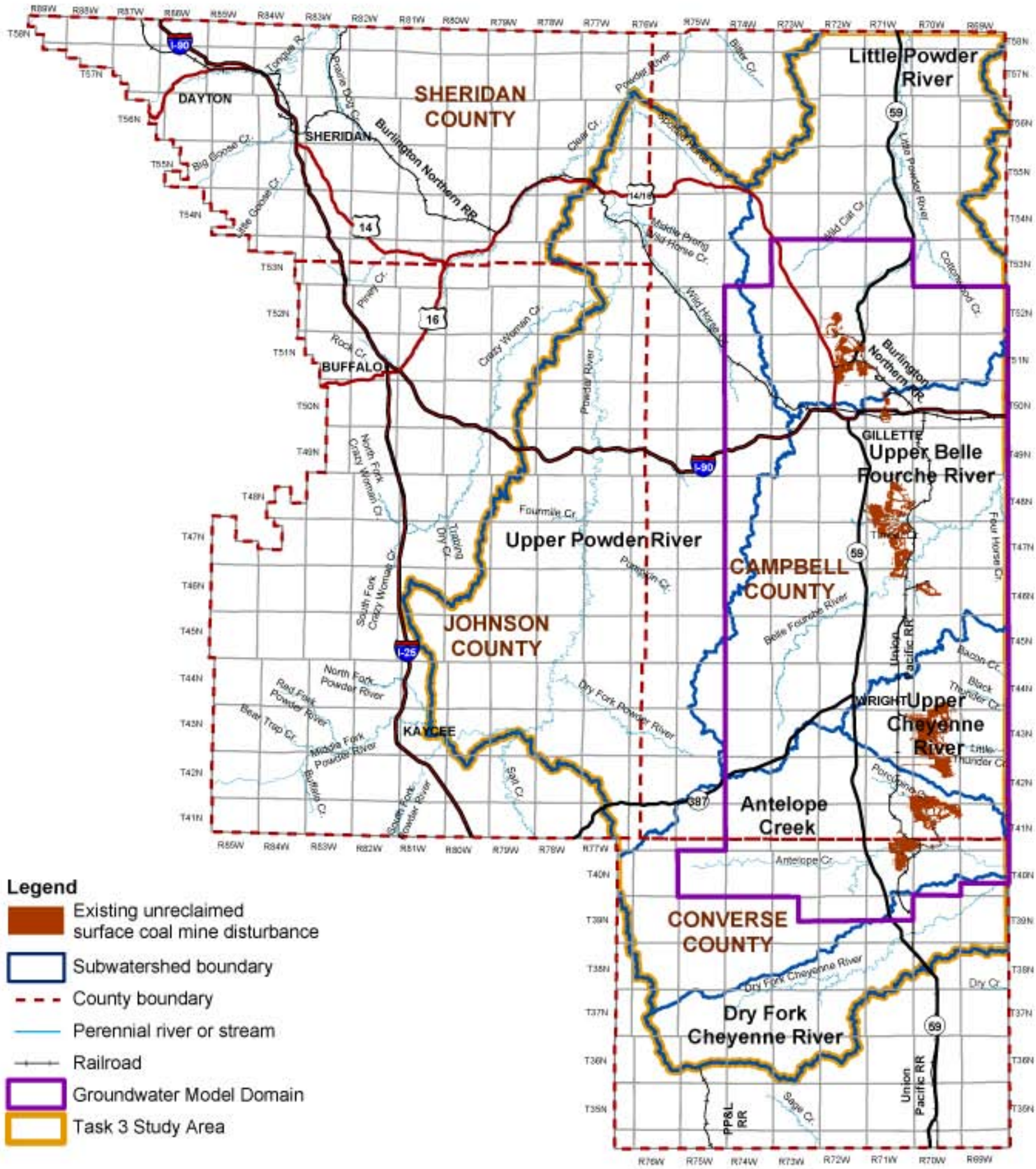
have been addressed in a separate section of the chapter that describes the expected environmental impacts of the proposed action. This approach was designed to highlight the distinction between site-specific and cumulative impacts.

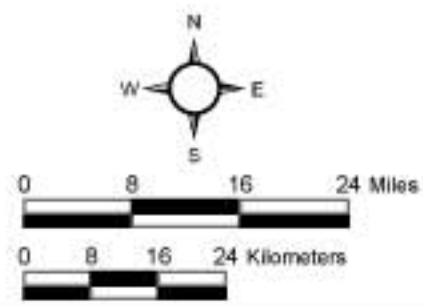
In the mid-1990s, BLM conducted a study called the PRB Coal Development Status Check (Status Check). The purpose of the Status Check was to compare actual cumulative development in the PRB with the levels of cumulative development that were predicted for 1990 and 1995 in the regional EISs discussed above. At the time the Status Check was prepared, the actual levels of cumulative development generally were within the levels that had been predicted. BLM continued updating key portions of the Status Chick and used the results in the cumulative impact section of the coal-leasing EAs and EISs. The status check updates indicated that the actual levels of coal development and associated impacts began to approach the predicted levels in the late 1990s. Around that same time, impacts related to oil and gas development began increasing due to the development of coal bed natural gas (CBNG) in the PRB.

BLM prepared the Wyodak EIS (BLM 2000b) and PRB Oil and Gas EIS (BLM 2003a) to address the impacts of projected CBNG development in the Wyoming PRB. Modeling was used to quantify potential cumulative impacts to air and water resources in these two EISs. Surface coal mining operations in Montana and Wyoming were included in the modeling analyses as reasonably foreseeable, non-project sources of impacts. For these analyses, future levels of coal development were estimated using market demand projections. BLM used these cumulative impact analyses in the coal leasing EISs as well as in the CBNG EISs.

In early 2003, BLM completed a study of PRB coal demand through 2020 (Montgomery Watson Harza 2003). The study projected production to increase at a steady pace with current mines able to meet the demand as long as the existing mines continue to have access to additional coal reserves; therefore, the need for leasing using the LBA will continue into the foreseeable future. As part of processing these LBAs, BLM will include a current cumulative impact analysis as part of the NEPA analysis. An initial step in that direction is this PRB Coal Review, which includes the identification of current (2003) conditions (Task 1 reports), identification of reasonably foreseeable development (RFD) actions and future coal production scenarios (Task 2 report), and predicted future cumulative impacts (Task 3 reports) in the PRB.

The Task 2 component of the PRB Coal Review defines the past and present development actions in the study area that have contributed to the current environmental and socioeconomic conditions in the PRB study area. This report also defines the projected RFD scenarios in the Wyoming and Montana PRB for years 2010, 2015, and 2020. For the Wyoming PRB, the past and present development and RFD scenarios include coal mine development as well as coal-related activities (i.e., railroads, coal-fired power plants, major transmission lines, and coal technology projects) and non-coal-related activities (i.e., other mines, CBNG, conventional oil and gas, major transportation pipelines, and key water storage reservoirs). Coal mine development and coal-related activities in the Montana PRB study area are included in this study to provide the basis for the analysis of cumulative air quality impacts and to facilitate the concurrent development of the Miles City Resource Management Plan. The past and present activities identified in this report are based on the most recent data available at the end of 2003 and provide the basis for the resource-specific descriptions of current conditions presented in the PRB Coal Review Task 1 reports.





Note: Groundwater model domain will be replaced by the modeled groundwater drawdown area, pending completion of modeling.

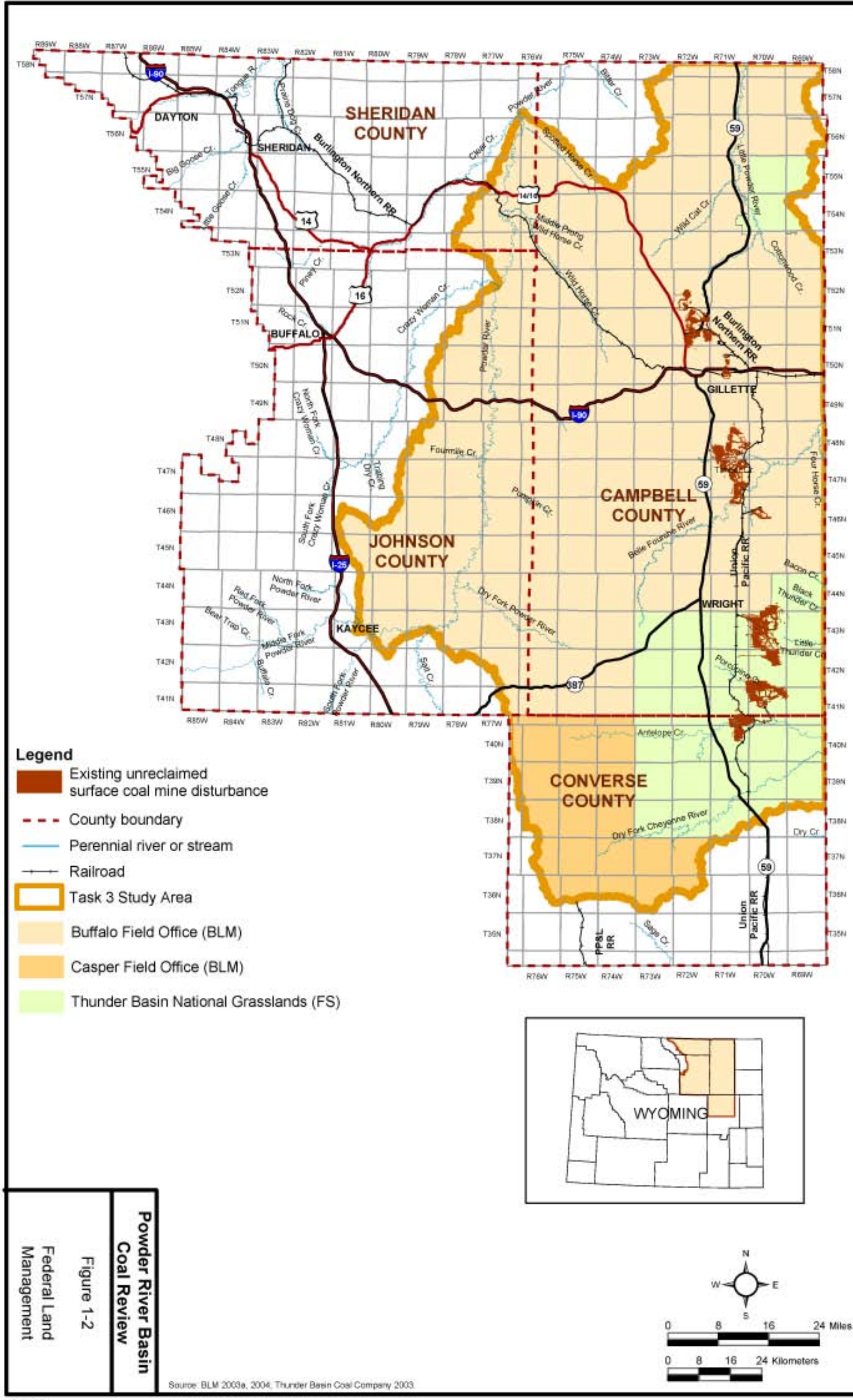
Source: BLM 2003a, 2004; Thunder Basin Coal Company 2003

Powder River Basin Coal Review

Figure 1-1

Study Area and Subwatersheds

10/11/05



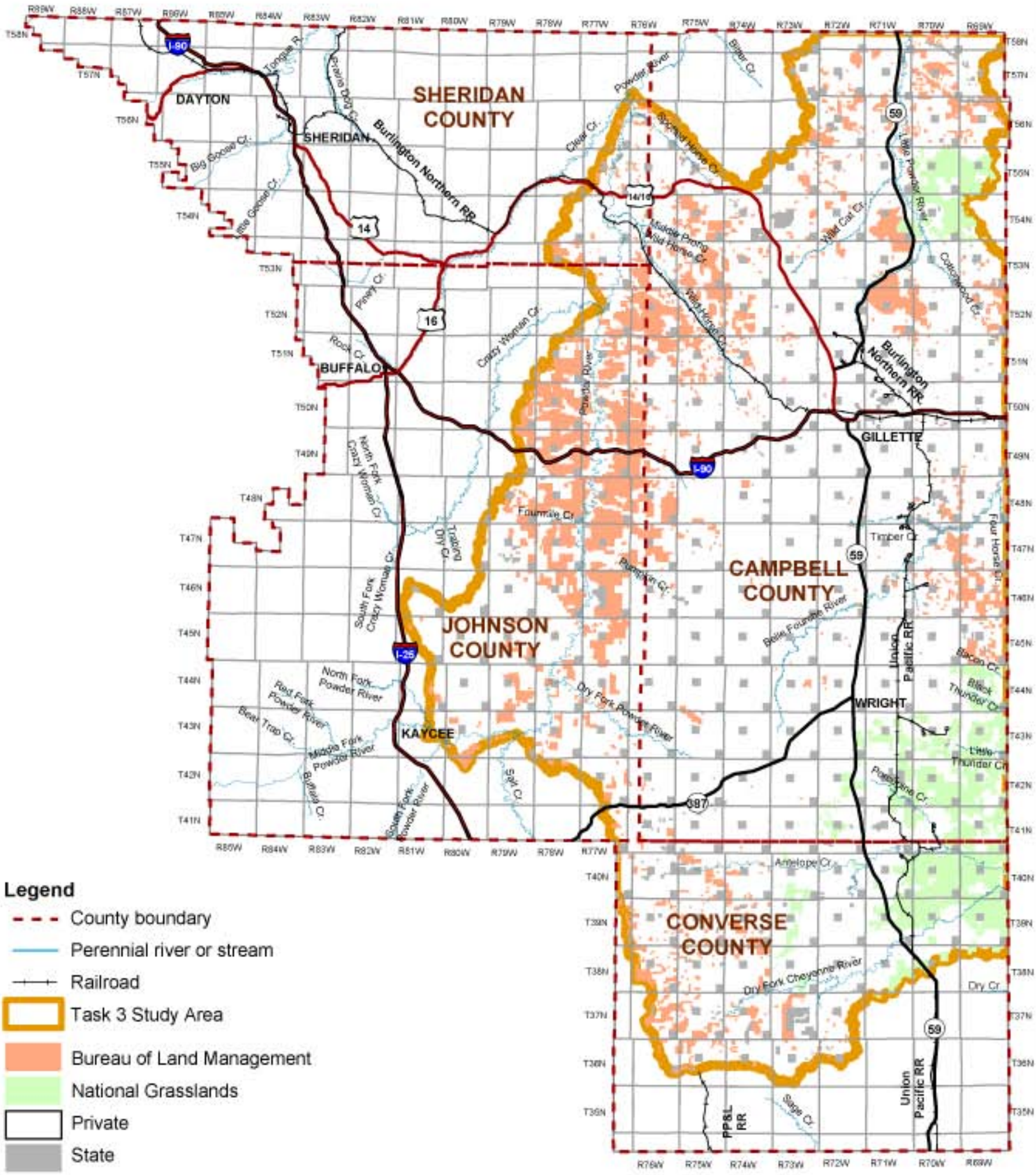
Source: BLM 2003a, 2004, Thunder Basin Coal Company 2003

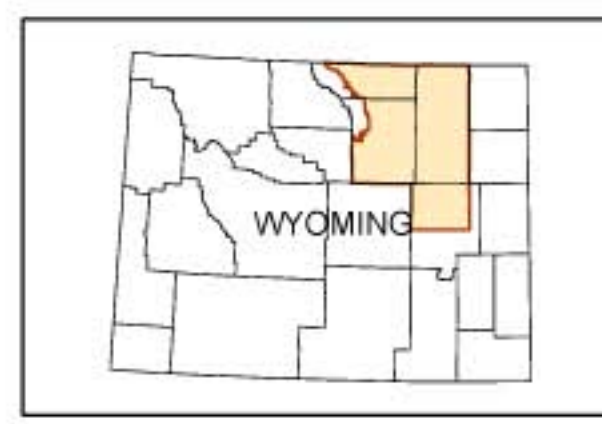
Powder River Basin Coal Review

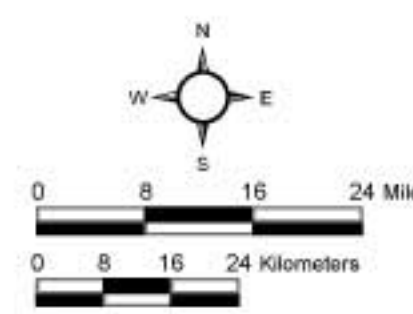
Figure 1-2

Federal Land Management

10/11/05







Source: BLM 2003a, 2004; Thunder Basin Coal Company 2003

Powder River Basin Coal Review

Figure 1-3

Surface Land Status

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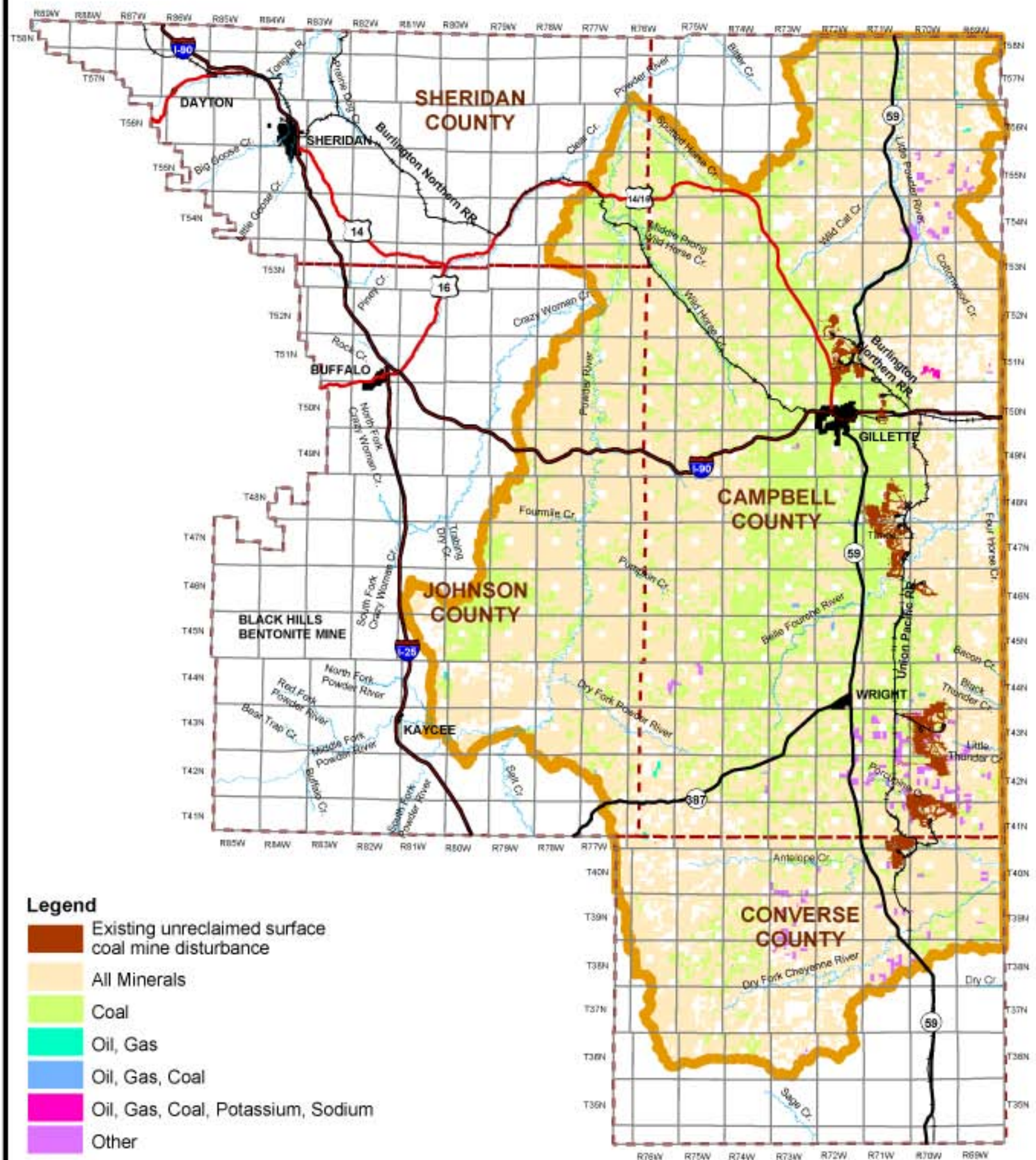
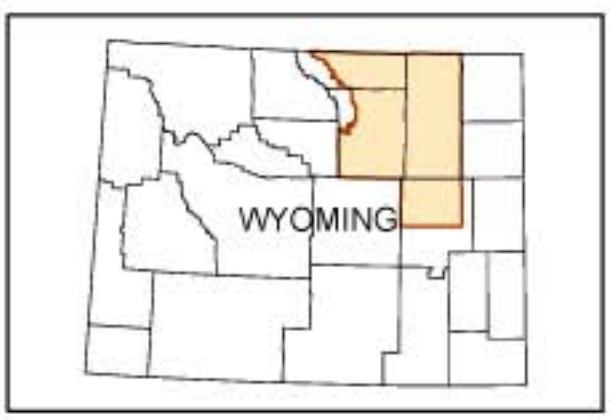
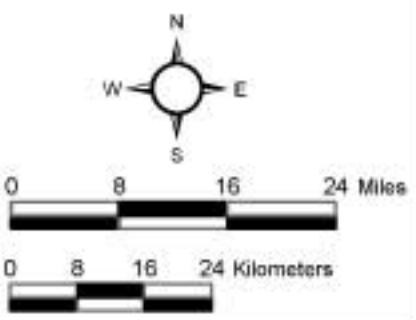


Legend

- Existing unreclaimed surface coal mine disturbance
- All Minerals
- Coal
- Oil, Gas
- Oil, Gas, Coal
- Oil, Gas, Coal, Potassium, Sodium
- Other
- Perennial river or stream
- Railroad
- Task 3D Study Area





Sources: BLM 2003

Powder River Basin Coal Review

Figure 1-4
Federal Mineral Ownership

12/20/05

The RFD scenarios presented in the Task 2 report provide the basis for the analysis of potential cumulative impacts in the Task 3 component of the study. The accuracy of any projected cumulative impact analysis is dependent on the adequacy and accuracy of information regarding potential future development activities in the affected area. While it is impossible to identify all potential future activities over the next 15 years, it is possible and desirable to identify reasonably foreseeable future actions based on current industry announcements, agency plans, economic trends, and technological advances affecting major industry sectors. Information regarding potential new development is constantly changing; however, to facilitate development of the information in this study, the RFDs identified in the Task 2 report reflect information available through the end of 2004.

The past and present actions in the Task 2 report were identified based on information in existing NEPA documents on file with federal and state agencies, and the Coal Development Status Check (BLM 1996). The RFD scenarios in the Task 2 report were developed based on recent information that identifies proposed and anticipated development in the PRB, including NEPA documents; various other technical reports and studies; federal, state, and local (county) agency management plans; and permit applications. The specific development scenarios and development activities identified in these sources were assessed as to their current status prior to inclusion in the RFD scenarios for the PRB Coal Review. In addition, potential additional projects were identified through interviews with agency and industry representatives, review of published news articles and trade publications, and discussions with community leaders.

The identified RFD activities subsequently were evaluated as to their probability for occurrence. Due to the lack of detailed information for many developments beyond the next few years, the degree of uncertainty associated with the predicted developments and trends increases as the timeframe extends further into the future.

For each of the past and present and RFD projects and activities, project-specific impact-causing parameters (e.g., disturbance acreage, emission levels, employment levels, etc.) have been compiled from the sources identified above. Where specific information was unavailable, assumptions were developed and included based on typical industry-specific standards, permit criteria for similar existing industries, and professional judgment. This information is summarized in the Task 2 report.

In order to account for the variables associated with future coal production, two detailed coal production scenarios (reflecting upper and lower production estimates) were projected for this study to bracket the most likely foreseeable regional coal production level and to provide a basis for quantification of related impact-causing parameters. These future production levels were derived from the analysis of historic production levels and current PRB coal market forecasts, public and private information sources, and input from individual PRB coal operators and are summarized in the Task 2 report.

1.1 Objectives

This PRB Coal Review is a regional technical study to assess cumulative impacts associated with past, present, and RFD in the PRB. The PRB Coal Review:

- Describes past and present (through 2003) development activities in the PRB that have affected the environmental conditions in the study area;

- Describes the current (through 2002-2003) environmental conditions in the study area and compares these conditions to the conditions described in the BLM's Coal Development Status Check (BLM 1996), as applicable;

- Estimates RFD in the study area through the year 2020, based on available information; and

- Estimates the environmental impacts associated with RFD through the year 2020.

The PRB Coal Review will provide data, models, and projections to facilitate cumulative analyses for future agency land use planning efforts and for future project-specific impact assessments for project development in compliance with NEPA. The PRB Coal Review is not a NEPA document or a policy study, or an analysis of regulatory actions, or an analysis of the impacts associated with the development of a specific project or projects in the PRB.

This report summarizes Task 3D of the PRB Coal Review, a description of predicted future cumulative impacts associated with RFD activities in the PRB cumulative effects study area. This report describes the predicted cumulative environmental impacts under two coal production scenarios (lower and upper) for the years 2010, 2015, and 2020 for the following resources:

- Topography, geology, minerals, and paleontological resources;
- Soil and alluvial valley floors (AVFs);
- Vegetation including wetland and riparian areas;
- Wildlife, fisheries, and related habitat values;
- Grazing;
- Cultural resources and Native American concerns;
- Land use; and
- Transportation and utilities.

The PRB Coal Review Task 3 descriptions of predicted cumulative impacts for air quality, water resources, and social and economic conditions are presented in separate stand-alone reports.

1.2 Agency Outreach, Coordination, and Review

The BLM directed the preparation of this PRB Coal Review. In order to ensure the technical credibility of the data, projections, interpretations, and conclusions of the study and ensure the study's usefulness for other agencies' needs, the BLM initiated contact with other federal and state agencies early in the study. This contact included meetings, periodic briefings, and written communications.

The BLM conducted an agency outreach program to solicit input from other agencies relative to their:

- Interested role and level of involvement in the study;
- Available data for use in the study;

- Input to the technical approach for resource evaluations; and
- Review of project deliverables.

The BLM provided periodic status updates to other agencies during the PRB Coal Review.

1.3 Methodology

The end of year 2003 existing disturbance acreages for this study were based on the database compiled for, and summarized in, the Task 2 Report for the PRB Coal Review, Past and Present and Reasonably Foreseeable Future Actions (ENSR 2005b) and, where resource-specific data were required, the associated Geographical Information System (GIS) information. The existing (2003) disturbance acreages generated through GIS vary from the disturbance acreages in the Task 2 database due to the following variables. The information in the database was compiled based on information obtained from the data sources and the applied assumptions identified in the Task 2 report. As a result, the database specifies a discrete disturbance acreage for each of the development activities (e.g., coal mines, individual oil and gas wells, etc.) identified for the study; however, it does not identify where those disturbance areas overlap. Conversely, the GIS analysis accounts for the spatial relationship of the various development activities, thereby avoiding double counting of disturbance acreages where mapped disturbance areas overlap.

Future disturbance and reclamation acreages for the RFD scenarios in this study were based on the database compiled for, and summarized in, the Task 2 Report for the PRB Coal Review, Past and Present and Reasonably Foreseeable Future Actions (ENSR 2005b) rather than on GIS information due to the following variables. The methodology and assumptions relative to oil and gas development (as summarized in Appendix E in the Task 2 report) provide a means of identifying the number of new wells to be developed and the number of existing wells to be plugged and abandoned within each of the subwatersheds for each of the target years for this study (i.e., 2010, 2015, and 2020). However, discrete locations for new and plugged and abandoned well sites for these future time periods are not available. For coal mines, the methodology and assumptions presented in Section 3.1 of the Task 2 report provide for calculation of future disturbance and reclamation acreages. However, although the general area of potential future coal mine-related disturbance can be identified based on projected reserves, the actual disturbance footprint associated with future mining and the actual locations of future reclaimed areas for the target years are not known. As a result, based on existing information, the spatial relationship between projected future disturbance and reclamation areas and the resource specific information in the GIS layers for these industries cannot be determined. Conversely, the database information does provide for quantification of future disturbance and reclamation acreages on a subwatershed basis and, with other information (e.g., projected locations of future coal reserves), a means of qualitatively analyzing to the extent possible future resource-specific impacts for those resources that are site-specific (e.g., vegetation, soils, wildlife habitat). The disturbance acreages for the RFD scenarios (based on the Task 2 database) are presented in Appendices A, C, and D of the Task 2 report. Minor discrepancies in the total acreages, as presented in the Task 2 appendices and in this report, are the result of rounding.

2.0 PREDICTED FUTURE CUMULATIVE IMPACTS

2.1 Topography, Geology, Minerals, and Paleontological Resources

2.1.1 Study Area

The cumulative effects study area for topography, geology, minerals, and paleontological resources includes the following subwatersheds in portions of Sheridan, Johnson, Campbell, and Converse counties: Upper Powder River, Little Powder River, Upper Belle Fourche River, Upper Cheyenne River, Antelope Creek, and Dry Fork Cheyenne River (**Figure 1-1**). It includes portions of the area administered by the BLM Buffalo and Casper field offices, and a portion of the TBNG, which is administered by the FS (**Figure 1-2**). Private lands comprise most of the surface ownership in the study area (**Figure 1-3**); the majority of the mineral ownership is federal (**Figure 1-4**). The State of Wyoming also owns a portion of the surface area (**Figure 1-3**), and generally owns the minerals where it owns the surface.

2.1.2 Cumulative Impacts

Based on the information in Appendices A and D of the Task 2 Report for the PRB Coal Review, Past and Present and Reasonably Foreseeable Development Activities (ENSR 2005c), a total of approximately 220,688 acres (5 percent) of land area have been disturbed by development activities in the cumulative effects study area (as of 2003). Of the 220,688 acres of total cumulative disturbance, approximately 68,794 acres of disturbance (31 percent) were associated with coal mine development.

Of the 220,688 acres of total cumulative disturbance, approximately 111,786 acres (51 percent) have been reclaimed. The remaining 108,901 acres of disturbance would be reclaimed incrementally or following a project's completion, depending on the type of development activity and permit requirements. Of the 68,794 total cumulative acres of disturbance directly associated with coal mine development, approximately 21,238 acres (31 percent) have been reclaimed (as of 2003). Of the remaining 47,556 acres of disturbance, approximately 24,097 acres currently are not available for reclamation, as they are occupied by long-term facilities which are needed to conduct mining operations. These areas would be reclaimed near the end of each mine's life. Reclamation of the remaining 23,459 acres, which represent areas of active mining and areas where coal has been recovered but reclamation has not been completed, would proceed concurrently with coal mining. (Note: minor discrepancies in acreages are the result of rounding.)

The effects to topography, geology, minerals, and paleontological resources from development activities within the PRB study area under two production scenarios (lower and upper production scenarios) for the years 2010, 2015, and 2020 are presented below.

2.1.2.1 Year 2010 – Lower Production Scenario

Topography

Potential impacts to topography as a result of RFD activities in the cumulative effects study area would be similar to those described in the Task 1D Report for the PRB Coal Review, Current Environmental Conditions (ENSR 2005b). Under the lower production scenario, it is projected that an additional 119,224 acres would be disturbed by RFD activities by 2010, which would result in a total of approximately 339,912 acres of cumulative disturbance to topography. Of the 339,912 acres of disturbance (7.6 percent of the study area), it is projected that 98,662 acres (29 percent) would be altered as a result of coal mining activities.

Of the 339,912 acres of total cumulative land disturbance, approximately 205,113 acres (60 percent) would be reclaimed by 2010. The remaining 134,799 acres of disturbance would be reclaimed incrementally or following a project's completion, depending on the type of development activity and permit requirements. Of the 98,662 acres of total cumulative disturbance associated with coal mine development, it is estimated that approximately 44,938 acres (46 percent) would be reclaimed by 2010. Of the remaining 53,724 acres of coal mining-related disturbance, it is estimated that approximately 26,338 acres would be unavailable for concurrent reclamation due to the presence of long-term facilities which would be reclaimed near the end of each mine's life. Reclamation of the remaining 27,386 acres of disturbance would proceed concurrently with mining operations.

The disturbance associated with the majority of the RFD activities would result in the general leveling of the surface to accommodate facilities (e.g., well pads, power plants, etc.) and roads. Recontouring during reclamation to match approximate original contour as required by regulation would minimize the long-term impact to topography. Coal mining would have a greater impact on topography than other types of development through changes in slope, lowering the general land surface, and changing the physical nature of the surficial materials and overburden, even after reclamation.

Geology

Under the lower production scenario, there would be approximately 339,912 acres of cumulative disturbance in the study area by 2010 as a result of past and projected development activities. Approximately 98,662 acres of the cumulative disturbance would be directly related to coal mining activities. 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. The remainder of the projected disturbance generally would result in only surficial surface disturbance.

No cumulative impacts have been identified in association with geologic hazards.

Mineral Resources

Coal Resources. Under the lower production scenario, coal production in 2010 would increase to 411 million tons per year (mmtpy). This would be an increase of 48 mmtpy over current (2003)

production levels. Ongoing production would result in the permanent reduction of coal resources available for future development in the study area.

Although prices of fluid minerals have fluctuated over the past 20 years, coal prices have been relatively stable in comparison. Coal production is expected to increase in spite of flat price projections to the year 2010 (Lyman 2005). Oil, natural gas, and CBNG are more sensitive to supply and demand fluctuations. As a result, the commodities are mutually exclusive with regard to one affecting the other. Ultimately, aggregate energy prices are related; however, development of oil, natural gas, and CBNG and related facilities (pipelines and compressor stations) would not be affected by coal leasing and production.

Conventional Oil and Gas Resources. By year 2010, annual oil production in the study area is projected to be approximately 13.8 million barrels of oil (MMBO), an increase of 2.4 MMBO over current (2003) production levels. The resulting cumulative oil production (1974 through 2010) from the study area would be 1.13 billion barrels of oil (BBO). Annual production of associated and conventional natural gas in 2010 is projected to be 33.9 billion cubic feet (BCF), resulting in a cumulative production (1974 through 2010) of 1.8 trillion cubic feet (TCF). (See Appendix E of the Task 2 Report for the PRB Coal Review, Past and Present and Reasonably Foreseeable Development Activities [ENSR 2005c] for information on the methodology and assumptions used for oil and gas projections in this study.) Ongoing production would result in the permanent reduction of these resources in the study area.

CBNG. By year 2010, annual CBNG production in the study area is projected to be approximately 480 BCF, 196 BCF higher than current (2003) production levels. The resulting cumulative CBNG production (1974 through 2010) from the study area would be 4.0 TCF. (See Appendix E of the Task 2 Report for the PRB Coal Review, Past and Present and Reasonably Foreseeable Development Activities [ENSR 2005c] for information on the methodology and assumptions used for oil and gas projections in this study.) Ongoing production would result in the permanent reduction of CBNG resources available for future development in the study area.

Coal production would have negligible impact on CBNG production. Most of the early CBNG development has occurred in shallower areas close to the outcrop and coal mining areas. Much of the CBNG may be depleted in these areas by 2010. There may be isolated areas where development of coal and CBNG would be in conflict; however, the effect on these resources would be very small.

Other Mineral Resources. Although sand, gravel, scoria, bentonite, and potentially uranium production are anticipated to continue in the study area, production levels cannot be determined based on current information. Ongoing production would result in the permanent reduction of these resources available for future development in the study area.

The development of other mineral resources with regard to coal production would be similar to the interaction with oil, natural gas, and CBNG as described under Coal Resources. Coal production levels are not likely to affect the development of other mineral resources in the study area. Sand and gravel resources are more likely to be affected to a greater degree by oil, natural gas, and CBNG development, due to the large quantity of these resources required for use in the construction of well field-related access roads and pads.

Paleontological Resources

Under the lower production scenario, it is projected that past and projected development-related impacts to the Wasatch and Fort Union formations by 2010 would include approximately 339,912 total cumulative acres of disturbance. Of the 339,912 acres, it is projected that 98,662 acres (29 percent) would be associated with coal mining activities.

Based on existing (2003) information, no significant or unique paleontological localities have been recorded 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, RFD activities in the study area could adversely affect scientifically significant fossils, if present in or adjacent to disturbance areas. The potential for impacts to scientifically significant fossils would be greatest in areas where Class 3, 4, or 5 formations are present. (See Section 2.1.3.4 of the Task 1D Report for the PRB Coal Review, Current Environmental Conditions [ENSR 2005b] for classification definitions as presented in BLM [1998] guidance.) The Wasatch and Fort Union formations underlie the cumulative effects study area and are classified as Class 5 and Class 3 formations, respectively. Both surface and subsurface fossils could be damaged or destroyed during RFD-related ground-disturbing activities. The greatest potential impact to surface and subsurface fossils would result from disturbance of surface sediments and shallow bedrock during construction and/or operation, depending on the type of project. As only portions of the cumulative effects study area have been evaluated for the occurrence of paleontological resources, and discrete locations for RFD 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 development activities. Potential subsurface disturbance of paleontological resources (e.g., during drilling operations) would not be visible or verifiable.

RFD activities which involve federally-owned surface and/or minerals would be 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 RFD activities. Specifically, the BLM's policy for paleontological resources is to manage them for their scientific, educational, and recreational values, and to mitigate adverse impacts to them. Data on the occurrence or potential for the occurrence of fossils is essential to land managers for compliance with the policy. For paleontological resources, the land-use planning process includes:

- Identifying areas and geological units (i.e., formations and members containing paleontological resources);
- Evaluating the potential of areas to contain vertebrate fossils or noteworthy occurrences of invertebrate or plant fossils;
- Developing management recommendations (including mitigation measures in specific locations) to promote the scientific, educational, and recreational uses of fossils on public lands and mitigate resources conflicts; and
- Developing strategies to regularly monitor public lands where important paleontological localities have been identified.

If no federal ownership (land or mineral) is involved, federal permits would not be required. In this case, protection measures for paleontological resources might not be mandated by the landowners or monitored as closely. Unprotected paleontological resources potentially could be disturbed, damaged, destroyed, or removed from the site, losing much or all of their preserved scientific information.

2.1.2.2 Year 2010 – Upper Production Scenario

Topography

Potential impacts to topography in the study area as a result of RFD activities would be similar to those described under the 2010 – Lower Production Scenario, except approximately 3,786 additional acres of land would be disturbed. Under this scenario, past and projected activities in the study area are projected to result in the total cumulative disturbance of approximately 343,698 acres of land (disturbance to 7.7 percent of the study area) by the year 2010. Of the 343,698 acres, it is projected that 102,448 acres (30 percent) would be associated with coal mining activities.

Of the 343,698 acres of total cumulative disturbance, approximately 206,946 acres (60 percent) would be reclaimed by 2010. The remaining 136,752 acres of disturbance would be reclaimed incrementally or following a project's completion, depending on the type of development activity and permit requirements. Of the 102,448 acres of disturbance associated with coal mining, it is projected that approximately 46,771 acres (46 percent) would be reclaimed by 2010. Of the remaining 55,677 acres of coal mining-related disturbance, it is estimated that approximately 25,688 acres would be unavailable for concurrent reclamation due to the presence of long-term facilities which would be reclaimed near the end of each mine's life. Reclamation of the remaining 29,989 acres of disturbance would proceed concurrently with mining operations.

Geology

The effects on geology as a result of RFD activities in the study area would be the same as described under the 2010 – Lower Production Scenario, with the following exception. Under this scenario, approximately 3,786 additional acres of disturbance associated with increased coal production would occur, resulting in an increased impact on geology.

Mineral Resources

Coal Resources. Impacts to coal resources in the study area would be the same as described under the 2010 – Lower Production Scenario, with the following exception. Under this scenario, coal production in 2010 is projected to be approximately 479 mmtpy, 68 mmtpy higher than production under the lower scenario in 2010.

Conventional Oil and Gas Resources. Under this scenario, impacts to conventional oil and gas resources in the study area would be the same as described under the 2010 – Lower Production Scenario.

CBNG. Under this scenario, impacts to CBNG resources in the study area would be the same as described under the 2010 – Lower Production Scenario.

Other Mineral Resources. Under this scenario, impacts to other mineral resources in the study area would be the same as described under the 2010 – Lower Production Scenario.

Paleontology

Potential impacts to paleontological resources in the study area as a result of RFD activities would be similar to those described under the 2010 – Lower Production Scenario, except approximately 3,786 additional acres would be disturbed. Under this scenario, past and projected development activities in the study area would result in the total cumulative disturbance of approximately 343,698 acres of land by the year 2010. Of the 343,698 acres, it is projected that 102,448 acres (30 percent) would be associated with coal mining activities.

2.1.2.3 Year 2015 – Lower Production Scenario

Topography

Potential impacts to topography in the study area as a result of RFD activities would be similar to those described under the 2010 – Lower Production Scenario, except approximately 86,172 additional acres of land would be disturbed. Under this scenario, past and projected development activities would result in the total cumulative disturbance of approximately 426,084 acres of land (disturbance to 9.5 percent of the study area) by year 2015. Of the 426,084 acres, it is projected that 117,236 acres (27 percent) would be associated with coal mine development.

Of the 426,084 acres of total cumulative disturbance, approximately 286,614 (67 percent) would be reclaimed by 2015. The remaining 139,472 acres of disturbance would be reclaimed incrementally or following a project's completion, depending on the type of development activity and permit requirements. (Minor discrepancies in total acreages are the result of rounding.) Of the 117,236 acres of disturbance associated with coal mining, it is projected that approximately 61,188 (52 percent) would be reclaimed by 2015. Of the remaining 56,048 acres of coal mining-related disturbance, it is estimated that approximately 27,549 acres would be unavailable for concurrent reclamation due to the presence of long-term facilities which would be reclaimed near the end of each mine's life. Reclamation of the remaining 28,499 acres of disturbance would proceed concurrently with mining operations.

Geology

The effects on geology as a result of RFD activities in the study area would be same as described under the 2010 – Lower Production Scenario, with the following exception. Under this scenario, approximately 86,172 additional acres of disturbance would occur, of which 22 percent would be related to coal mining.

Mineral Resources

Coal Resources. Impacts to coal resources in the study area would be the same as described under the 2010 – Lower Production Scenario, with the following exception. Under this scenario, coal

production in 2015 is projected to be approximately 467 mmtpy, 56 mmtpy higher than production in 2010.

Conventional Oil and Gas. Impacts to conventional oil and gas resources in the study area as a result of RFD activities would be the same as described under the 2010 – Lower Production Scenario, with the following exceptions. Under this scenario, annual oil production is projected to be approximately 12.5 MMBO. The resulting cumulative oil production (1974 through 2015) would be 1.20 BBO. Annual associated and conventional natural gas production is projected to be 30.9 BCF, with cumulative production (1974 through 2015) reaching 1.96 TCF. (See Appendix E of the Task 2 Report for the PRB Coal Review, Past and Present and Reasonably Foreseeable Development Activities [ENSR 2005c] for information on the methodology and assumptions used for oil and gas projections in this study.)

CBNG. Under this scenario, impacts to CBNG resources in the study area are projected to be the same as described under the 2010 – Lower Production Scenario, with the following exception. Annual CBNG production is projected to be approximately 500 BCF, resulting in 6.4 TCF of cumulative production (1974 through 2015). (See Appendix E of the Task 2 Report for the PRB Coal Review, Past and Present and Reasonably Foreseeable Development Activities [ENSR 2005c] for information on the methodology and assumptions used for oil and gas projections in this study.)

Other Mineral Resources. Under this scenario, impacts to other mineral resources in the study area would be the same as described under the 2010 – Lower Production Scenario.

Paleontology

Potential impacts to paleontological resources in the study area as a result of RFD activities would be similar to those described under the 2010 – Lower Production Scenario, except approximately 86,172 additional acres of land would be disturbed. Under this scenario, it is projected that past and projected development activities would result in the total cumulative disturbance of approximately 426,084 acres by the year 2015. Of the 426,084 acres, it is projected that 117,236 acres (27 percent) would be associated with coal mining activities.

2.1.2.4 Year 2015 – Upper Production Scenario

Topography

Potential impacts to topography in the study area as a result of RFD activities would be similar to those described under the 2010 – Lower Production Scenario, except approximately 93,480 additional acres of land would be disturbed. Under this scenario, past and projected development activities are projected to result in the total cumulative disturbance of approximately 433,392 acres of land (disturbance to 9.6 percent of the study area) by 2015. Of the 433,392 acres, it is projected that 124,545 acres (29 percent) would be associated with coal mine development.

Of the 433,392 acres of total cumulative disturbance, approximately 290,822 (67 percent) would be reclaimed by 2015. The remaining 142,570 acres of disturbance would be reclaimed incrementally or following a project's completion, depending on the type of development activity and permit requirements. Of the 124,545 acres of disturbance associated with coal mining, it is estimated that

approximately 65,396 (53 percent) would be reclaimed by 2015. Of the remaining 59,149 acres of coal mining-related disturbance, it is estimated that approximately 27,009 acres would be unavailable for concurrent reclamation due to the presence of long-term facilities which would be reclaimed near the end of each mine's life. Reclamation of the remaining 32,140 acres of disturbance would proceed concurrently with mining operations.

Geology

The effects on geology as a result of RFD activities in the study area would be same as described under the 2010 – Lower Production Scenario, with the following exception. Under this scenario, approximately 93,480 additional acres of disturbance would occur, of which 29 percent would be related to coal mining.

Mineral Resources

Coal Resources. Impacts to coal resources in the study area would be the same as described under the 2010 – Lower Production Scenario, with the following exception. Under this scenario, coal production in 2015 is projected to be approximately 543 mmtpy, 132 mmtpy higher than production in 2010.

Conventional Oil and Gas. Impacts to conventional oil and gas resources in the study area as a result of RFD activities would be the same as described under the 2015 – Lower Production Scenario, with the following exceptions. Under this scenario, annual oil production (1974 through 2015) is projected to be approximately 12.5 MMBO. The resulting cumulative oil production would be 1.20 BBO. Annual associated and conventional natural gas production is projected to be approximately 30.9 BCF, with cumulative production (1974 through 2015) reaching 1.96 TCF. (See Appendix E of the Task 2 Report for the PRB Coal Review, Past and Present and Reasonably Foreseeable Development Activities [ENSR 2005c] for information on the methodology and assumptions used for oil and gas projections in this study.)

CBNG. Under this scenario, impacts to CBNG resources in the study area are projected to be the same as described under the 2010 – Lower Production Scenario, with the following exception. Annual CBNG production is projected to be approximately 500 BCF, resulting in 6.4 TCF of cumulative production (1974 through 2015). (See Appendix E of the Task 2 Report for the PRB Coal Review, Past and Present and Reasonably Foreseeable Development Activities [ENSR 2005c] for information on the methodology and assumptions used for oil and gas projections in this study.)

Other Mineral Resources. Under this scenario, impacts to other mineral resources in the study area would be the same as described under the 2010 – Lower Production Scenario.

Paleontology

Potential impacts to paleontological resources in the study area as a result of RFD activities would be similar to those described under the 2010 – Lower Production Scenario, except approximately 93,480 additional acres of land would be disturbed. Under this scenario, it is projected that past and projected development activities in the study area would result in the total cumulative disturbance of

approximately 433,392 acres by the year 2015. Of the 433,392 acres, it is projected that 124,545 acres (29 percent) would be associated with coal development activities.

2.1.2.5 Year 2020 – Lower Production Scenario

Topography

Potential impacts to topography as a result of RFD activities in the study area would be similar to those described under the 2010 – Lower Production Scenario, except approximately 163,173 additional acres of land would be disturbed. Under this scenario, past and projected development activities are projected to result in the total cumulative disturbance of approximately 503,085 acres of land (disturbance to 11.2 percent of the study area) by 2020. Of the 503,085 acres, it is projected that 137,443 acres (27 percent) would be associated with coal mine development.

Of the 503,085 acres of total cumulative land disturbance, approximately 367,999 (73 percent) would be reclaimed by 2020. The remaining 135,085 acres of disturbance would be reclaimed incrementally or following a project's completion, depending on the type of development activity and permit requirements. Of the 137,443 acres of disturbance associated with coal mining, it is projected that approximately 79,463 (58 percent) would be reclaimed by 2020. Of the remaining 57,979 acres of coal mining-related disturbance, it is estimated that approximately 28,797 acres would be unavailable for concurrent reclamation due to the presence of long-term facilities which would be reclaimed near the end of each mine's life. Reclamation of the remaining 29,182 acres of disturbance would proceed concurrently with mining operations.

Geology

The effects on geology as a result of RFD activities in the study area would be same as described under the 2010 – Lower Production Scenario, with the following exception. Under this scenario, approximately 163,173 additional acres of disturbance would occur, of which 24 percent would be related to coal mining.

Mineral Resources

Coal Resources. Impacts to coal resources in the study area would be the same as described under the 2010 – Lower Production Scenario, with the following exception. Under this scenario, coal production in 2020 is projected to be approximately 495 mmtpy, 84 mmtpy higher than production in 2010.

Conventional Oil and Gas. Impacts to conventional oil and gas resources in the study area as a result of RFD activities would be the same as described under the 2010 – Lower Production Scenario, with the following exceptions. Under this scenario, annual oil production is projected to be approximately 11.3 MMBO. The resulting cumulative oil production (1974 through 2020) would be 1.26 BBO. Annual associated and conventional natural gas production is projected to be approximately 28 BCF, with cumulative production (1974 through 2020) reaching 2.1 TCF. (See Appendix E of the Task 2 Report for the PRB Coal Review, Past and Present and Reasonably Foreseeable Development Activities [ENSR 2005c] for information on the methodology and assumptions used for oil and gas projections in this study.)

CBNG. Under this scenario, impacts to CBNG resources in the study area are projected to be the same as described under the 2010 – Lower Production Scenario, with the following exception. Annual CBNG production is projected to be approximately 443 BCF, resulting in 8.8 TCF of cumulative production (1974 through 2020). (See Appendix E of the Task 2 Report for the PRB Coal Review, Past and Present and Reasonably Foreseeable Development Activities [ENSR 2005c] for information on the methodology and assumptions used for oil and gas projections in this study.)

Other Mineral Resources. Under this scenario, impacts to other mineral resources in the study area would be the same as described under the 2010 – Lower Production Scenario.

Paleontology

Potential impacts to paleontological resources in the study area as a result of RFD activities would be similar to those described under the 2010 – Lower Production Scenario, except approximately 163,173 additional acres of land would be disturbed. Under this scenario, it is projected that past and projected development activities would result in the total cumulative disturbance of approximately 503,085 acres by the year 2020. Of the 503,085 acres, it is projected that 137,443 acres (27 percent) would be associated with coal mining activities.

2.1.2.6 Year 2020 – Upper Production Scenario

Topography

Potential impacts to topography as a result of RFD activities in the study area would be similar to the 2010 – Lower Production Scenario, except approximately 174,820 additional acres of land would be disturbed. Under this scenario, past and projected development activities would result in the total cumulative disturbance of approximately 514,732 acres of land (disturbance to 11.5 percent of the study area) by 2020. Of the 514,732 acres, it is projected that 149,089 acres (29 percent) would be associated with coal mining activities.

Of the 514,732 acres of total cumulative disturbance, approximately 374,732 (73 percent) would be reclaimed by 2020. The remaining 139,998 acres of disturbance would be reclaimed incrementally or following a project's completion, depending on the type of development activity and permit requirements. Of the 149,089 acres of disturbance associated with coal mining, it is projected that approximately 86,196 (58 percent) would be reclaimed by 2020. Of the remaining 62,890 acres of coal mining-related disturbance, it is estimated that approximately 28,345 acres would be unavailable for concurrent reclamation due to the presence of long-term facilities which would be reclaimed near the end of each mine's life. Reclamation of the remaining 34,545 acres of disturbance would proceed concurrently with mining operations.

Geology

The effects on geology as a result of RFD activities in the study area would be same as described under the 2010 – Lower Production Scenario, with the following exception. Under this scenario, approximately 174,820 additional acres of disturbance would occur, of which 29 percent would be related to coal mining.

Mineral Resources

Coal Resources. Impacts to coal resources in the study area would be the same as described under the 2010 – Lower Production Scenario, with the following exception. Under this scenario, coal production in 2020 is projected to be approximately 576 mmtpy, 165 mmtpy higher than production in 2010.

Conventional Oil and Gas. Impacts to conventional oil and gas resources in the study area as a result of RFD activities would be the same as described under the 2010 – Lower Production Scenario, with the following exceptions. Under this scenario, annual oil production is projected to be approximately 11.3 MMBO. The resulting cumulative oil production (1974 through 2020) would be 1.26 BBO. Annual associated and conventional natural gas production is projected to be approximately 28 BCF, with cumulative production (1974 through 2020) reaching 2.1 TCF. (See Appendix E of the Task 2 Report for the PRB Coal Review, Past and Present and Reasonably Foreseeable Development Activities [ENSR 2005c] for information on the methodology and assumptions used for oil and gas projections in this study.)

CBNG. Under this scenario, impacts to CBNG resources in the study area are projected to be the same as described under the 2010 – Lower Production Scenario, with the following exception. Annual CBNG production is projected to be approximately 443 BCF, resulting in 8.8 TCF of cumulative production (1974 through 2020). (See Appendix E of the Task 2 Report for the PRB Coal Review, Past and Present and Reasonably Foreseeable Development Activities [ENSR 2005c] for information on the methodology and assumptions used for oil and gas projections in this study.)

Other Mineral Resources. Under this scenario, impacts to other mineral resources in the study area would be the same as described under the 2010 – Lower Production Scenario.

Paleontology

Potential impacts to paleontological resources in the study area as a result of RFD activities would be similar to those described under the 2010 – Lower Production Scenario, except approximately 174,820 additional acres of land would be disturbed. Under this scenario, it is projected that past and projected development activities would result in the total cumulative disturbance of approximately 514,732 acres by the year 2020. Of the 514,732 acres, it is projected that 149,089 acres (29 percent) would be associated with coal development activities.

2.2 Soils and Alluvial Valley Floors

2.2.1 Study Area

The cumulative effects study area for soils and AVFs includes the following subwatersheds in portions of Sheridan, Johnson, Campbell, and Converse counties: Upper Powder River, Little Powder River, Upper Belle Fourche River, Upper Cheyenne River, Antelope Creek, and Dry Fork Cheyenne River (**Figure 1-1**). It includes portions of the area administered by the BLM Buffalo and Casper field offices and a portion of the TBNG, which is administered by the FS (**Figure 1-2**).

2.2.2 Cumulative Impacts

2.2.2.1 General Impacts

Soils

As described in Section 2.2.3 of the Task 1D Report of the PRB Coal Review, Current Environmental Conditions (ENRS 2005b), soils information for the study area is available from published and ongoing soil surveys conducted predominantly at a county level by the Natural Resources Conservation Service. Detailed soils information from project-specific (e.g., coal mines and other industrial activities) state and federal permit applications, 1:24,000 scale soil survey maps, general soils maps from the Wyoming STATSGO, and SSURGO databases provide further documentation of soil resources within the study area. The occurrence and extent of STATSGO soil mapping units within the six study area subwatersheds are identified in **Table 2.2-1**. Additional information for these mapping units is presented in the Task 1D report.

Cumulative impacts to soils as a result of RFD activities in the study area primarily would result from increased vehicle traffic, vegetation removal, soil salvage and redistribution (including stripping, stockpiling, and redistribution), discharge of CBNG produced groundwater, and construction and maintenance of project-specific components (e.g., roads and rights-of-way, well pads, industrial sites, and associated ancillary facilities). 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, or the essentially permanent removal of soil resources at industrial sites.

Impact minimization approaches, best management practices, and restrictions on activities as defined through project-specific NEPA assessments and permitting requirements would reduce the level of RFD-related cumulative impacts to soil resources and AVFs in the study area. There are regulatory requirements from state and federal permitting agencies (e.g., WDEQ, BLM, Federal Energy Regulatory Commission, U.S. Army Corps of Engineers [USACE]) that include provisions for minimizing impacts to soils through erosion control practices, soil salvage and replacement, revegetation, and monitored stabilization practices. For example, measures that either are routinely required or can be required, if necessary, to reduce soil erosion during surface coal mining operations include: salvaging of soils suitable to support plant growth and stockpiling it or placing it directly on recontoured areas; protecting soil stockpiles from disturbance and erosional influences; interim seeding of topsoil stockpiles; watering of active work areas, inactive areas, and problem

areas; watering and/or using chemical dust suppression on haul roads and exposed soils; using sediment control structures, as needed, to trap eroded soil; promptly revegetating exposed soils; and using mulching, cover crops, or other approved measures to control erosion on reclaimed lands prior to seeding with a final seed mix. Disturbances to AVFs and resources that may occur in similar settings (wetlands and waters of the U.S.) are highly regulated by WDEQ and USACE, respectively. Compliance with such regulatory provisions and implementation of suitable management and control practices would minimize cumulative impacts to soil resources and AVFs over the short and long terms.

Table 2.2-1
Soil Occurrence and Extent within Study Area Subwatersheds
(acres)

Mapping Unit	Antelope Creek	Dry Fork Cheyenne River	Little Powder River	Upper Belle Forche River	Upper Cheyenne River	Upper Powder River
WY002	--	--	10,006	--	--	--
WY004	--	--	--	21,366	15,211	--
WY042	--	--	10,169	--	--	--
WY043	--	--	3,770	--	--	--
WY044	--	--	11,547	--	--	--
WY045	--	--	39,410	--	--	--
WY046	--	--	6,118	--	--	--
WY047	--	--	32,193	--	--	--
WY048	--	--	--	--	--	84,524
WY049	--	--	--	--	--	52,463
WY050	--	--	227,789	--	--	529,809
WY051	--	--	--	--	--	28,272
WY053	--	--	176,512	52,432	--	--
WY081	--	--	--	--	--	160
WY082	148	--	--	--	--	437,200
WY086	--	--	--	--	--	7,552
WY114	43	--	--	--	715	--
WY115	--	--	--	2,378	14,341	--
WY124	--	--	57,061	--	--	43,339
WY125	8,920	--	54,008	--	--	126,708
WY126	42,521	--	86,451	240,086	--	10,997
WY127	--	--	150,459	134,459	39,254	--
WY128	--	--	--	17,331	--	231,834
WY129	--	--	--	67,747	103,641	--
WY130	138,542	--	--	309,064	7,503	42,780
WY203	7,605	11,837	--	--	--	--
WY204	--	69,192	--	--	--	--
WY205	--	3,937	--	--	--	--
WY206	68,850	15,647	--	--	26,139	--
WY207	166,674	36,288	--	--	--	--
WY208	60,143	10,033	--	--	--	259
WY209	87,852	90,559	--	--	--	6,121
WY210	21,760	36,298	--	--	--	--
WY211	48,081	35,526	--	--	--	--
WY315	9,159	--	--	--	--	1,503

Note: Based on GIS analysis of the mapped soils layer prepared for the PRB Oil and Gas Final EIS (BLM 2003).

Accelerated Wind Erosion. As indicated in Appendix A of the Task 1D Report of the PRB Coal Review, Current Environmental Conditions (ENSR 2005b), severe wind erosion hazards are associated with STATSGO mapping units WY126 (Hiland-Vonalee-Maysdorf), WY203 (Clarkelen-Draknab-Haverdad), WY207 (Hiland-Bowbac-Tassel), WY209 (Hiland-Shingle-Tassel), and WY211 (Shingle-Tassel-Rock Outcrop). Related impacts would include the loss of topsoil resources. Accelerated wind erosion would occur as soil is denuded and soil structure is degraded during vegetation clearing and soil handling on these mapping units. Impacts would be particularly likely on windward slopes and where relatively extensive areas of these soils are disturbed. The five STATSGO soil associations identified as most susceptible to wind erosion are located primarily in the southeastern portion of the cumulative effects study area. They occupy approximately 56 percent of the Dry Fork Cheyenne River subwatershed, 47 percent of the Antelope Creek subwatershed, and 28 percent of the Upper Belle Fourche subwatershed. In addition, soil mapping unit WY 126 (Hiland-Vonalle-Maysdorf) occupies 10 percent of the Little Powder River subwatershed.

Impacts from accelerated wind erosion typically would be controlled by dust abatement practices (including water and/or tackifier applications); minimizing soil handling and the extent of bare ground; and the use of suitable cover crops, mulches, and revegetation species during concurrent and final reclamation.

Accelerated Water Erosion. Severe water erosion hazards, as indicated in Appendix A of Task 1D Report of the PRB Coal Review, Current Environmental Conditions (ENRS 2005b), are associated with STATSGO mapping units WY050 (Shingle-Taluce-Kishona), WY053 (Shingle-Cushman-Taluce), WY206 (Wibaux-Rock Outcrop-Shingle), WY208 (Shingle-Samday-Hiland), WY209 (Hiland-Shingle-Tassel), WY210 (Ulm-Renohill-Shingle), and WY211 (Shingle-Tassel-Rock Outcrop). In all of these cases, the hazard is associated with the Shingle soil component of the mapping unit. The Shingle soil is poorly developed, less than 20 inches deep over interbedded shale and sandstone, and typically has a clay loam texture throughout. Slopes can be steep for this soil component, ranging up to 60 percent, although more typically the slopes range from approximately 3 to 45 percent.

In a manner similar to that described for wind erosion, accelerated water erosion would occur as soil is denuded and soil structure is degraded during vegetation clearing, soil handling, and stockpiling of these materials. Sheet, rill, and gully erosion would occur on disturbed areas and nearby sites, with the type and severity of erosion depending on the slope steepness and length, soil texture and structure, organic matter content, plant cover and root density, and erosion control practices. Related impacts would include the loss of topsoil and subsoil resources and sediment deposition in downslope positions.

Potential impacts from accelerated water erosion would be most severe on moderately-coarse to moderately-fine textured soils that occur on steep slopes or on gentler but longer, unbroken slopes. The seven STATSGO soil associations identified as most susceptible to water erosion are not concentrated in any particular region of the cumulative effects study area. They occupy approximately 61 percent of the Dry Fork Cheyenne River subwatershed, approximately 47 percent of the Little Powder River subwatershed, 43 percent of the Antelope Creek subwatershed, and 34 percent of the Upper Powder River subwatershed. In addition, soil mapping unit WY 206 (Wibaux-Rock Outcrop-Shingle) occupies approximately 13 percent of the Upper Cheyenne River subwatershed.

Water discharged as a result of CBNG development would augment flows in drainages where releases are made near or directly to channels. In the case of direct discharges to channels, which are expected to account for between 35 and 55 percent of all CBNG water discharges, local channel bed degradation may occur due to the additional flow. In some cases, downcutting may lead to bank caving as well as gullying on uplands. Additional channel geometry changes may occur downstream due to bed aggradation from sediment deposition. However, due to high conveyance losses as discussed in the Task 1B Report for the PRB Coal Review, Current Water Resources Conditions (ENSR 2005d), the areal extent of potential down channel impacts would be minor.

Impacts from accelerated water erosion typically would be controlled by minimizing soil handling and the extent of bare ground; controlling the length and degree of recontoured slopes; temporary runoff controls such as silt fencing and hay bales; long-term drainage and runoff controls such as ditches and retention ponds; and the use of suitable cover crops, mulches, and revegetation species during concurrent and final reclamation. Control practices, including management of CBNG produced waters, would be determined on a project-specific basis during permitting.

In summary, based on STATSGO soil maps, the Dry Fork Cheyenne River and the Antelope Creek subwatersheds are the most severely susceptible to potential impacts from an overall combination of accelerated wind and water erosion. However, these areas are comparatively small (less than 1.0 million acres total) in relation to the cumulative effects study area. In addition, the Upper Belle Fourche subwatershed has a significant portion of land area that is severely susceptible to wind erosion. The Upper Powder River and Little Powder River subwatersheds have significant portions that are severely susceptible to water erosion. These last three subwatersheds are comparatively large (approximately 3.3 million acres) in relation to the cumulative effects study area, and thus, the actual acreage extent of accelerated erosion impacts may be greater in these areas.

Other Soil Quality Considerations. Additional cumulative impacts to soil resources would result from disturbance or modification of inherent soil characteristics such as salinity and alkalinity, microbial populations, organic matter and fertility, and soil texture and structure. The latter two characteristics particularly influence water infiltration, permeability, and aeration. Impacts to soil quality would result from increased root zone salinity or alkalinity from mixing of soil layers during salvage and redistribution; compaction or other disturbance to soil structure; and reductions in microbial populations, organic matter, and fertility from long-term soil stockpiling. In some cases (notably on Shingle soils), slope, depth to rock, and the presence of rock fragments limit the overall potential for reclamation use. In turn, these soil quality impacts may create impacts on vegetation establishment, crop growth and rangeland productivity, and surface water quality.

The control practices that typically mitigate such soil quality impacts generally include suitable soil salvage, stockpiling and redistribution practices, timely implementation of reclamation activities, and suitable seedbed preparation and amendment practices.

As indicated in Appendix E of the Task 2 Report for the PRB Coal Review, Past and Present and Reasonably Foreseeable Development Activities (ENSR 2005c), a variety of CBNG water disposal methods may be employed. As stated in the Task 1B Report, Current Water Resources Conditions (ENSR 2005d), Section 3.5.3 (CBNG Water Discharge), the major water quality issues pertaining to CBNG water discharges are sodium adsorption ratio (SAR) and total dissolved solids (TDS) which

generally may be indicated through field measurements of electrical conductivity (EC). Since these water quality constituents may occur at high levels, disposal of groundwater produced during CBNG recovery may generate impacts on soil resources. The potential impacts to soils would depend on the water treatment method (if any) and the nature of the disposal method.

Per Appendix E of the Task 2 Report, land application is anticipated to comprise approximately 5 percent of the CBNG water disposal in the Upper Powder River subwatershed, approximately 15 percent of the disposal in the Dry Fork Cheyenne River subwatershed, and approximately 10 percent of the disposal in the Little Powder River subwatershed. Impoundment disposal (via infiltration or containment and evaporation) is anticipated to comprise approximately 40 to 45 percent of the CBNG water disposal in these subwatersheds, as well as in the Antelope Creek and Upper Belle Fourche subwatersheds. Other disposal methods, including discharges to surface drainages, would account for approximately 45 to 55 percent of the CBNG water production in most of the subwatersheds (ENSR 2005d).

For agricultural uses, the Wyoming water quality standard for SAR is 8.0 (WDEQ 2005). The pH standard for agricultural water use is 4.5 to 9.0 standard units, and the TDS concentration is 2,000 milligrams per liter (mg/L). Depending on soil texture, chemistry, water availability, and plant adaptation, the growth of plants typically is severely restricted at soil SAR values of approximately 12 or more. As indicated in the Task 1B Report, Figure 3.5-1, the agricultural water quality standard for SAR typically is exceeded in Wyodak-Anderson coal zone waters produced in the Little Powder River subwatershed (mean SAR of 11.1), the Upper Belle Fourche subwatershed (mean SAR of 8.2), and the Upper Powder River subwatershed (mean SAR of 19.5). Land applications of CBNG water in the Upper Powder River and Little Powder River subwatersheds (estimated at 5 and 10 percent of CBNG water production, respectively) could reduce plant productivity by increasing soil alkalinity on areas where such applications are conducted. Such impacts would be long term and difficult to mitigate.

For agricultural uses, the Wyoming water quality standard for TDS is 2,000 mg/L (WDEQ 2005). EC, while not equivalent to TDS, may be used as a general TDS indicator and typically can be related to TDS through a highly-correlated statistical line of best fit. In water quality assessments, EC typically is measured in micromhos or microSiemens per centimeter at 25 degrees Centigrade (ºC). In addition, EC commonly is used as a salinity measure for soils and agricultural assessments. In such investigations, the common units of measure are millimhos per centimeter (mmhos/cm) (or deciSiemens per meter) at 25º C.

As a general working set of indicators, salinity effects on crop yields are mostly negligible at EC values of 0 to 2 mmhos/cm, and between 2 and 4 mmhos/cm, yields of very sensitive crops may be restricted. At EC of 4 to 8 mmhos/cm, yields of many crops are restricted, and with EC between 8 and 16 mmhos/cm, only tolerant crops yield satisfactorily. Above EC values of 16 mmhos/cm, only a very few tolerant crops yield satisfactorily (Salinity Laboratory Staff 1954). These classes are only general indicators; the actual growth and establishment of plants or crops under different salinity levels also varies with soil waterholding capacity, the actual amount of water supplied, plant adaptation (e.g., native range vegetation versus wheat) and other factors.

Land applications of CBNG water in the Upper Powder River and Little Powder River subwatersheds (estimated at 5 and 10 percent of CBNG water production, respectively), could reduce plant productivity by increasing soil salinity on areas where such applications are conducted.

Such impacts may be long term or costly to mitigate. As indicated in the Task 1B Report, Figure 3.5-1, Wyodak-Anderson coal zone waters typically produced EC values approaching or exceeding 1,000 micromhos per centimeter (µmhos/cm) (1 mmhos/cm) in the Little Powder River subwatershed (mean EC of 1,271 µmhos/cm), the Upper Belle Fourche subwatershed (mean EC of 970 µmhos/cm), and the Upper Powder River subwatershed (mean EC of 2,163 µmhos/cm). Per the information in Appendix E of the Task 2 Report, land applications of CBNG water are not anticipated in the Upper Belle Fourche River subwatershed (ENSR 2005c).

The occurrence of impacts and their potential severity would depend on a number of factors, including the number of discharges to a particular area as well as other soil, plant, and meteorological factors. Concentration of salts in the root zone may occur over time with repeated land applications, as a result of storage in the soil, water uptake by plants, and capillary rise. These interactions are complex. For example, repeated land applications of slightly saline and/or alkaline CBNG discharges to soils with restricted drainage may rapidly build up salts in the root zone. In contrast, more limited applications of severely saline and/or alkaline CBNG water may have much less impact if they are dispersed over a large, well-drained area or conducted during runoff events. Although the subwatersheds mentioned above may be the most susceptible to soil impacts from CNBG water discharges by land application, impacts may also occur on other areas depending on the management and timing of specific applications themselves. The specific approaches to CBNG water discharges, the resource conditions and locations in which they occur, the timing of discharges, and discharge permit stipulations from regulatory and land management agencies would determine the extent and degree of potential impacts.

Other CBNG water disposal methods may generate impacts on soils as well. Impoundments, whether for containment or infiltration, would disturb soils where they are built. In addition, soil liners or underlying soil materials may receive repeated discharges. Over time these materials would become increasingly saline and/or alkaline. Maintenance or closure of the facility may require removal and disposal of such materials in accordance with applicable regulations and/or agency guidelines.

Untreated discharges of CBNG waters to receiving streams is regulated in various PRB subwatersheds by WDEQ and agreements with the state of Montana. It is possible that soils in lower geomorphic positions (such as alluvial terraces) may receive additional inputs of salinity and/or alkalinity as a result of discharges during high flows. If they occur, the extent and degree of these impacts would vary according to other factors as discussed above.

Alluvial Valley Floors

In the semi-arid West, the soils, topography, and hydrologic capabilities of AVFs provide the conditions for valuable agricultural land uses and wildlife habitats. This prompted Congress to protect these areas with the passage of Surface Mine Control and Reclamation Act (SMCRA) in 1977. In the PRB, agricultural land use is primarily cattle or sheep ranching with some grain (typically wheat) being grown commercially (Rusmore et al. 1985). For most ranching operations, herd size and related economic conditions usually are limited by the land base or cash available to provide hay for winter feed. In the northern part of the study area, irrigated or subirrigated valley bottomlands produce almost all of this hay. (South of Gillette, upland pastures often are clear throughout the winter.) AVF also provide generally better stock water, shelter from adverse weather,

and the most suitable locations for calving, lambing, and feeding (Rusmore et al. 1985). In addition, AVFs provide habitat diversity, food, cover, and water for a variety of wildlife species.

As described in the Task 1D Report for the PRB Coal Review, Current Environmental Conditions (ENSR 2005b), AVF regulatory determinations are made on a site-specific basis for coal mining activities. These detailed determinations consider a number of geomorphic, hydrologic, soil, and land use factors. Although soil surveys may serve as broad indicators of potential AVF occurrence, and reconnaissance investigations have been conducted to assist in identifying AVFs (Rusmore, et. al. 1985), regulatory determinations of AVF occurrence and location are part of coal mine permitting activities. As such, the locations and extent of AVFs have not been determined for the study area overall. However, AVFs do occur within the study area as has been documented in existing coal mining permits and described in the Task 1D report. Discussion of the potential occurrence of AVFs in the study area is based on the regional reconnaissance conducted in the early 1980s (Rusmore et al. 1985). However, actual AVF occurrence has not been verified except in limited areas of more detailed permit investigations. Potential cumulative impacts are qualitatively discussed on the basis of these permit investigations and the reconnaissance study.

Cumulative impacts to AVFs that are deemed significant to agriculture would be restricted by SMCRA rules and regulations as administered by WDEQ and the Office of Surface Mining. The determination of significance to agriculture is made by WDEQ/Land Quality Division (LQD), and it is based on specific calculations related to the production of crops or forage on the AVF and the size of the existing agricultural operations on the land of which the AVF is a part. Impacts generally are not permitted if the AVF is determined to be significant to agriculture. If the AVF is determined not to be significant to agriculture, or if the permit to affect the AVF was issued prior to the effective date of SMCRA, the AVF can be disturbed during mining but must be restored as part of the reclamation process. As a result, cumulative impacts to AVFs that are deemed not significant to agriculture would be minimized by reclamation requirements, including restoration of the hydrologic balance.

Although the formal AVF definition and related regulatory programs pertain specifically to coal mining, impacts on AVF resources could result from other development-related activities in the study area. These activities may affect irrigated or subirrigated agricultural lands, jurisdictional waters of the U.S. (including wetlands), or floodplains. Minimization and/or mitigation of potential impacts to specific resources occurring in or along streams and floodplains would be required by the federal or state authorizing agencies (e.g., BLM, FS, USACE, WDEQ) at the time of permitting.

2.2.2.2 Year 2010 – Lower Production Scenario

Soils

Under this scenario, approximately 119,224 additional acres of soil in the study area would be disturbed as a result of RFD activities from 2004 through 2010, resulting in approximately 339,912 total cumulative acres of soil disturbances (or disturbance to approximately 7.6 percent of the soils in the study area). Of this total, it is projected that by 2010 approximately 205,113 acres would be permanently reclaimed. In the Dry Fork Cheyenne River and Upper Powder River subwatersheds (**Figure 1-1**), the permanently reclaimed acreage would be substantially greater than the unreclaimed acreage, and cumulative impacts to soil resources are expected to be less than in other subwatersheds. In the Little Powder River and Upper Belle Fourche subwatersheds, the cumulative reclaimed area would be roughly equal to the cumulative unreclaimed areas. In the

remaining subwatersheds (Antelope Creek and the Upper Cheyenne River), the unreclaimed acreage is projected to be greater than the permanently reclaimed acreage, with correspondingly greater impacts expected. In all subwatersheds, reclamation and stabilization activities are expected to minimize the severity and extent of disturbance-related impacts to soils and AVFs until successful permanent reclamation occurs.

The Antelope Creek subwatershed is dominated by STATSGO mapping units WY130 (Renohill-Bidman-Ulm) and WY207 (Hiland-Bowbac-Tassel). These units are subject to impacts from compaction and severe wind erosion hazards, respectively. The WY130 unit consists of moderately deep and deep clayey soils. The WY207 units consist of shallow to deep loamy soils. Prime farmlands may occur on the Hiland soil, and the Tassel soil has poor reclamation potential due to depth to rock, rock fragments, and slopes. All the soils have calcium carbonate accumulations at depth, which may create soil quality impacts from salinity in some locations. Additional mapping units that are extensive in the subwatershed include WY206 (Wibaux-Rock Outcrop- Shingle), WY208 (Shingle-Samday-Hiland), and WY209 (Hiland-Shingle-Tassel). Combined, these five mapping units occupy approximately 79 percent of the subwatershed area. Shingle and Tassel soils are shallow and occur on slopes. The Wibaux soil contains high volumes of hard rock fragments. These three soils have poor reclamation potential, which may create cumulative impacts in RFD-related disturbance areas due to limited availability of suitable soil materials for reclamation.

Major drainages in the Antelope Creek subwatershed are occupied by the WY203 (Clarkelen-Draknab-Haverdad) mapping unit. These soils are formed in calcareous sandy to moderately fine textured unconsolidated streamlain alluvium, and AVFs may occur along valleys or drainages with these or other soils. In some areas, soil salinity may be a concern relative to reclamation of disturbance areas. The WY203 mapping unit occupies approximately 1.2 percent of the subwatershed.

The Dry Fork Cheyenne River subwatershed is dominated by the WY204 (Hiland-Ustic Torriorthents-Bowbac) and WY209 (Hiland-Shingle-Tassel) STATSGO mapping units. These are shallow to deep loamy soils. The Shingle and Tassel soils are shallow over bedrock, may occur on steep slopes, and have limited potential for reclamation uses. Additional soil mapping units that are extensive in the subwatershed include WY207 (Hiland-Bowbac-Tassel), WY210 (Ulm-Renohill-Shingle), and WY211 (Shingle-Tassel-Rock Outcrop). Combined, these five mapping units occupy approximately 87 percent of the subwatershed. Hiland soils are deep, loamy soils with few limitations for reclamation uses, but are subject to accelerated water erosion. Bowbac, Ulm, and Renohill soils are moderately deep and deep, as well as clayey. They are subject to soil quality impacts from compaction. Bowbac and Tassel soils have severe wind erosion hazards, and the Shingle soil has severe water erosion hazard. RFD-related disturbance may result in cumulative impacts from accelerated erosion and limited availability of suitable soil materials for reclamation.

Major drainages in the Dry Fork Cheyenne River subwatershed are occupied by the WY203 (Clarkelen-Draknab-Haverdad) mapping unit, as described previously for the Antelope Creek subwatershed. The mapping unit occupies approximately 3.8 percent of this subwatershed.

The Little Powder River subwatershed is dominated by STATSGO mapping units WY050 (Shingle-Taluce-Kishona), WY053 (Shingle-Cushman-Taluce), WY127 (Kishona-Shingle-Theedle), and WY126 (Hiland-Vonalee-Maysdorf). In combination, these units occupy approximately

74 percent of the subwatershed. All of these soils have medium to moderately fine textures, and range from shallow to deep. Taluce and Shingle soils are loamy and shallow over sandstone and interbedded sedimentary rocks, respectively. Both are poorly suited to reclamation uses, and are extensive in the subwatershed. This may affect soil material availability and overall reclamation success in the region. In addition, accelerated water erosion may occur on areas occupied by these soils due to their geographic position on ridges and hills. Kishona, Maysdorf, Vonalee, and Hiland soils are deep with loamy textures. Cushman soils also are loamy, but are moderately deep over shale. These soils have few limitations for use as reclamation materials; however, Hiland and Vonalee soils have severe water erosion hazards, which may generate accelerated water erosion in RFD-related disturbance areas in this subwatershed.

Major drainages in the Little Powder River subwatershed are dominated by STATSGO mapping unit WY044 (Havre-Hanly-Glendive). This unit occupies approximately 1.3 percent of the subwatershed area. These soils are formed in calcareous sandy to moderately fine textured unconsolidated streamlain alluvium, and AVFs may occur along valleys or drainages with these or other soils. In some areas, cumulative impacts to soil quality as a result of soil salinity may be a concern relative to reclamation of disturbance areas.

The Upper Belle Fourche River subwatershed is expected to undergo the largest cumulative extent of disturbance under this scenario. The area is dominated by the WY126 (Hiland-Vonalee-Maysdorf), WY127 (Kishona-Shingle-Theedle), and WY130 (Renohill-Bidman-Ulm) mapping units. Combined, these STATSGO mapping units occupy approximately 81 percent of the subwatershed. Cumulative impacts from accelerated wind erosion are anticipated on Hiland and Vonalee soils in this subwatershed, as are soil quality impacts from compaction on the WY130 unit. However, these units generally are well suited to soil salvage and reconstruction with best management practices and compliance with regulatory programs. Major drainages in the Upper Belle Fourche River subwatershed are dominated by STATSGO mapping unit WY004 (Haverson-Glenberg-Bone). This unit occupies approximately 2.5 percent of the subwatershed area, and formed in calcareous unconsolidated streamlain alluvium. Cumulative impacts to soil quality as a result of soil salinity may be a concern relative to reclamation of disturbance areas.

The Upper Cheyenne River subwatershed is dominated by the WY127 (Kishona-Shingle-Theedle), WY129 (Bidman-Parmaleed-Renohill) and WY206 (Wibaux-Rock Outcrop-Shingle) mapping units. Combined, these STATSGO mapping units occupy approximately 82 percent of the subwatershed. Cumulative soil quality impacts from compaction on the WY129 unit may be anticipated as a result of the clayey nature of these soils. On steeper slopes, accelerated water erosion also may create cumulative impacts. In addition, the WY126 unit is poorly suited to reclamation uses due to shallow depth to rock, rock outcrops, and slope. This may make permanent reclamation of RFD-related disturbance areas more difficult in some areas.

Major drainages in the Upper Cheyenne River subwatershed are dominated by STATSGO mapping unit WY004 (Haverson-Glenberg-Bone). This unit occupies approximately 2.5 percent of the subwatershed area, and its soils formed in calcareous unconsolidated streamlain alluvium. Cumulative impacts to soil quality as a result of soil salinity may be a concern relative to reclamation of disturbance areas.

The Upper Powder River subwatershed is dominated by STATSGO mapping units WY050 (Shingle-Taluce-Kishona), WY082 (Renohill-Shingle-Parmaleed) and WY128 (Renohill-Cushman-

Cambria). Combined, these units occupy approximately 75 percent of the subwatershed area. Accelerated water erosion and soil quality declines from compaction are likely to be RFD disturbance-related impacts within this subwatershed, due to the extent of Shingle soils and clayey materials from the Renohill and Parmaleed soils.

Major drainages in the Upper Powder River subwatershed are dominated by STATSGO mapping unit WY048 (Riverwash-Haverdad-Clarkelen). This unit occupies approximately 5.3 percent of the subwatershed area, and its soils and land types formed in calcareous unconsolidated streamlain alluvium. Cumulative impacts to soil quality as a result of soil salinity may be a concern relative to reclamation of disturbance areas.

Of the approximately 339,912 total cumulative acres of soil disturbance under this scenario, approximately 98,662 acres would be associated with coal mining activities. By year 2010, approximately 44,938 acres (46 percent) of the coal mine-related disturbance would be permanently reclaimed. Of the remaining 53,724 acres of coal mining-related disturbance, it is estimated that approximately 26,338 acres would be unavailable for reclamation due to the presence of long-term facilities which would be reclaimed near the end of each mine's life. Reclamation of the remaining 27,386 acres of disturbance would proceed concurrently with mining operations.

Of the types of RFD 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 relatively contiguous, block nature of the anticipated mining activities. These factors would encourage widespread accelerated wind and water erosion, and 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. Potential measures that would be implemented to minimize these impacts are discussed in Section 2.2.2.1.

Alluvial Valley Floors

Soils occurring in major drainages are described above for each subwatershed in the study area. The extent of cumulative impacts to AVFs in the study area as a result of coal mining activities cannot be quantified, due to the site-specific nature of AVF determinations and the current lack of information relative to the actual disturbance area footprint that would be required for mining of future reserves. However, their potential extent is described in general terms below. Past site-specific determinations are described in the Task 1D Report for the PRB Coal Review, Current Environmental Conditions (ENSR 2005a).

Earlier intensive mine permitting studies indicate that within the Antelope Creek subwatershed, AVFs are located along Antelope Creek and Horse Creek in relation to the Antelope Mine, and an AVF existed within the original North Antelope permit area. Future activities at North Antelope/Rochelle may extend into the Upper Cheyenne River subwatershed. The regional reconnaissance indicates that the potential for AVF exists within the Antelope Creek subwatershed in narrow, sinuous delineations mainly along Antelope Creek, Sand Creek, the South Fork of Bear Creek, Bates Creek, Spring Creek, Horse Creek, and Porcupine Creek. Delineations range from a few tens of feet up to approximately 0.6 mile wide. These areas are thought to be largely

subirrigated, with potential or actual surface irrigation primarily located along the South Fork of Bear Creek, Bates Creek, Spring Creek, and Porcupine Creek in the northern part of the subwatershed (Rusmore et al. 1985).

In the Dry Fork Cheyenne River subwatershed, no AVFs were identified through site-specific determinations, and no coal mining is projected to occur within the area. Reconnaissance indicates that subirrigated AVF potential exists along the Dry Fork itself and along scattered tributaries. These delineations of potential AVF occurrence follow the relatively narrow, meandering course of the streams, in widths varying from a few tens of feet to approximately 0.4 mile. Off-channel areas that are surface irrigated, or have the potential to be, are located along the downstream third of the Dry Fork (Rusmore et al. 1985). Although no coal mining is projected to occur in this subwatershed, potential impacts to resources associated with alluvial valley settings could occur from other RFD activities as discussed in Section 2.2.2.1.

In the Little Powder River subwatershed, AVFs were declared in permit areas for the Buckskin, Eagle Butte, and Rawhide mines and at the former Fort Union Mine. These were determined not to be significant to agriculture, or else have been “grandfathered” with respect to this criterion. More extensive reconnaissance information indicates that additional potential for AVFs occurs along the Little Powder River itself, as well as along Rawhide Creek, Horse Creek, and Wildcat Creek. Fairly narrow, meandering, subirrigated potential zones occur along the creeks and the upper river, whereas the Little Powder River below Rawhide Creek has existing or potential surface irrigation in alluvial zones 0.5 mile wide or more (Rusmore et al. 1985).

Within the Upper Belle Fourche River subwatershed, AVFs were determined to occur at the Wyodak, Belle Ayre, Caballo, Cordero-Rojo (Caballo Rojo and Cordero) mines. These AVFs occur mainly along Caballo Creek and Donkey Creek. In the future, the Wyodak Mine permit area may extend into the Little Powder River subwatershed. Reconnaissance investigations in the upper Belle Fourche area indicate that the potential for additional AVF determinations occurs in narrow zones along Caballo Creek and its primary tributaries (notably Tisdale Creek and Gold Mine Draw, Bone Pile Creek, Bluegate Creek, and Hoe Creek). In addition, the potential for AVFs is extensive along the Belle Fourche River and its tributaries, including Timber Creek and several others in the vicinity of Reno Junction. Most of the potential AVF zones in this subwatershed are surface irrigated or may be suited to it. Small areas are likely to be subirrigated (Rusmore et al. 1985). Potential AVFs occupy zones up to approximately 0.5 mile wide along the streams.

In the Upper Cheyenne River subwatershed, AVF declarations were made at the Black Thunder and Jacobs Ranch mines, primarily along Little Thunder Creek and its North Prong tributary. These areas were “grandfathered” due to the early dates of mining operations, and WDEQ recently removed the AVF declaration for the North Prong of Little Thunder Creek. Reconnaissance investigations indicate that AVFs may occur elsewhere along both of these streams, as well as along School Creek and Black Thunder Creek (Rusmore et al. 1985). These zones typically are narrow (less than 0.2 mile wide), sinuous, alluvial terrace systems that may be suited for surface irrigation.

Currently no site-specific AVF determinations have been made in the Upper Powder River subwatershed, and no coal mining is projected to occur within the area. However, widespread areas having the potential for positive AVF declarations exist in this subwatershed within the study area. (It should be noted that Clear Creek, Crazy Woman Creek, Salt Creek, and the upper forks of the

Powder River are not within the cumulative effects study area.) Extensive areas of potential AVFs are delineated along the Powder River in reconnaissance studies, in zones up to 1 mile wide. Many of these areas along the river are based on the existence of surface irrigation or suitability for it. Based on the reconnaissance, subirrigated zones also occur all along the river. The potential for subirrigated or surface irrigated AVFs also occurs along every major Powder River tributary and several smaller tributaries. Such streams include Bitter Creek, SA Creek, LX Bar Creek, Spotted Horse Creek, Wild Horse Creek and its prongs, Fortification Creek, Barber Creek, Dead Horse Creek, and others. Potential AVF delineations along these streams typically are 0.2 mile wide or less (Rusmore et al. 1985). Although no coal mining is projected to occur in this subwatershed, potential impacts to resources associated with alluvial valley settings could occur from other RFD activities as discussed in Section 2.2.2.1.

Although the actual occurrence of regulated AVFs has not been verified within these subwatersheds, it is likely that expanding mining activities under this scenario would encounter AVFs and related issues. Impacts on agriculture, soils, surface water and groundwater resources, and wildlife habitats would vary with the characteristics of the specific site and watershed locale, as well as with the type of disturbance. The actual extent of impacts cannot be determined at this time, since AVF determinations are site-specific. In addition to considerations at a specific project location, impacts may extend upstream and downstream from the disturbance.

In general, potential impacts on AVFs as a result of coal mining or nearby mining activities would include disturbance of supporting hydrologic regimes, physicochemical alteration of underlying geologic materials, impacts to soils (as described above), alteration of vegetation communities; and modification of existing or potential land uses. The application of best management practices for reclamation and stabilization of such disturbance, in addition to compliance with regulatory programs and project-specific permit provisions, would minimize or mitigate these cumulative impacts over both the short and long terms.

2.2.2.3 Year 2010 – Upper Production Scenario

Soils

Under this scenario, cumulative impacts to soil resources as a result of RFD activities in the study area would be similar to, but slightly more extensive than, those described under the 2010 – Lower Production Scenario, due to an approximately 3,786 additional acres of disturbance. This additional acreage would be related to increased coal production.

Alluvial Valley Floors

It is anticipated that the overall acreage of AVFs affected by coal mining and the related impacts would be similar to those described under the 2010 – Lower Production Scenario. This assumption is based on the 3,786 total additional acres of coal mine-related disturbance projected for this scenario, a portion of which may occur on AVFs.

2.2.2.4 Year 2015 – Lower Production Scenario

Soils

Under this scenario, 86,172 additional acres of soils would be disturbed as a result of RFD activities in the study area, 27 percent of which would be related to coal mining. As a result, cumulative impacts to soil resources would be similar in nature, but more extensive, than those described under the 2010 – Lower Production Scenario.

Alluvial Valley Floors

It is anticipated that the overall acreage of AVFs affected by RFD activities would be greater than under the 2010 – Lower Production Scenario. This assumption is based on the 18,574 total additional acres of coal mine-related disturbance projected for this scenario, a portion of which may occur on AVFs. Whether from coal mining or other RFD activities, the types of impacts to AVFs (or resources in similar alluvial settings) would be similar to those described in Section 2.2.2.1.

2.2.2.5 Year 2015 – Upper Production Scenario

Soils

Under this scenario, 93,480 additional acres of soils would be disturbed as a result of RFD activities in the study area, 29 percent of which would be related to coal mining. As a result, cumulative impacts to soil resources would be similar in nature, but more extensive, than those described under the 2010 – Lower Production Scenario.

Alluvial Valley Floors

It is anticipated that the overall acreage of AVFs affected by RFD activities would be greater than under the 2010 – Lower Production Scenario. This assumption is based on the 25,883 total additional acres of coal mine-related disturbance projected for this scenario, a portion of which may occur on AVFs. Whether from coal mining or other RFD activities, the types of impacts to AVFs (or resources in similar alluvial settings) would be similar to those described in Section 2.2.2.1.

2.2.2.6 Year 2020 – Lower Production Scenario

Soils

Under this scenario, 163,173 additional acres of soils would be disturbed as a result of RFD activities in the study area, 27 percent of which would be related to coal mining. As a result, cumulative impacts to soil resources would be similar in nature, but much more extensive, than those described under the 2010 – Lower Production Scenario.

Alluvial Valley Floors

It is anticipated that the overall acreage of AVFs affected by RFD activities would be greater than under the 2010 – Lower Production Scenario. This assumption is based on the 38,780 total additional acres of coal mine-related disturbance projected for this scenario, a portion of which may occur on AVFs. Whether from coal mining or other RFD activities, the types of impacts to AVFs (or resources in similar alluvial settings) would be similar to those described in Section 2.2.2.1.

2.2.2.7 Year 2020 – Upper Production Scenario

Soils

Under this scenario, 174,820 additional acres of soils would be disturbed as a result of RFD activities in the study area, 29 percent of which would be related to coal mining. As a result, cumulative impacts to soil resources would be similar in nature, but much more extensive, than those described under the 2010 – Lower Production Scenario.

Alluvial Valley Floors

It is anticipated that the overall acreage of AVFs affected by RFD activities would be greater than under the 2010 – Lower Production Scenario. This assumption is based on the 50,427 total additional acres of coal mine-related disturbance projected for this scenario, a portion of which may occur on AVFs. Whether from coal mining or other RFD activities, the types of impacts to AVFs (or resources in similar alluvial settings) would be similar to those described in Section 2.2.2.1.

2.3 Vegetation Including Wetlands and Riparian Areas

2.3.1 Study Area

The cumulative effects study area for vegetation includes the following subwatersheds in portions of Sheridan, Johnson, Campbell, and Converse counties: Upper Powder River, Little Powder River, Upper Belle Fourche River, Upper Cheyenne River, Antelope Creek, and Dry Fork Cheyenne River (**Figure 1-1**). It includes portions of the area administered by the BLM Buffalo and Casper field offices and a portion of the TBNG, which is administered by the FS (**Figure 1-2**).

2.3.2 Cumulative Impacts

As described in the Task 2 Report for the PRB Coal Review, Past and Present and Reasonably Foreseeable Development Activities (Appendices A and D) (ENSR 2005c), a total of approximately 220,688 acres of vegetation have been disturbed by development activities in the cumulative effects study area (as of 2003). Of the 220,688 acres of total disturbance, approximately 68,794 acres (31 percent) were associated with coal mining activities.

Of the 220,688 acres of total cumulative disturbance, approximately 111,786 acres (51 percent) have been reclaimed. The remaining 108,901 acres of disturbance would be reclaimed incrementally or following a project's completion, depending on the type of development activity and permit requirements. Of the 68,794 total cumulative acres of disturbance associated with coal mine development, approximately 21,238 (31 percent) have been reclaimed (as of 2003). Of the remaining 47,556 acres of disturbance, approximately 24,097 acres currently are not available for reclamation, as they are occupied by long-term facilities which are needed to conduct mining operations. These areas would be reclaimed near the end of each mine life. Reclamation of the remaining 23,459 acres, which represent areas of active mining and areas where coal has been recovered but reclamation has not been completed, would proceed concurrently with coal mining. (Note: minor discrepancies in acreages are the result of rounding.)

Potential impacts to vegetation within the cumulative effects area would be similar to those described in Task 1D Report of the PRB Coal Review, Current Environmental Conditions (ENSR 2005b). In general, impacts to vegetation can be classified as short-term and long-term. Potential short-term impacts would arise from the removal and disturbance of herbaceous species during a project's development and operation (e.g., coal mines, CBNG wells, etc.), which would cease upon project completion and successful reclamation in a given area. Potential long-term impacts would consist of permanent loss of vegetation and vegetative productivity in areas that would not be reclaimed in the near term (e.g., power plant sites, etc.). The removal of woody species also 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. Indirect impacts may include 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. In addition to these impacts, 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, and the expansion of existing wetland/riparian areas, depending on the quality and quantity of water discharged. Alternately, the discharge of abnormally high flows or water with

sodium absorption ratios of 13 or more could impact existing vegetation as discussed in the Task 1D Report for the PRB Coal Review, Current Environmental Conditions (ENSR 2005b). However, for agricultural uses, the current Wyoming water quality standard for SAR is 8.0 (WDEQ 2005). SARs of 5 to 10 have been observed in discharge waters throughout the study area, with SARs of 13 or more observed in the Upper Powder River subwatershed and in some locations in the western portions of the Upper Belle Fourche and Little Powder River subwatersheds (BLM 2003).

The effects to vegetation communities as a result of RFD activities in the PRB study area under two production scenarios (lower and upper production scenarios) for the years 2010, 2015, and 2020 are discussed below.

2.3.2.1 Year 2010 – Lower Production Scenario

General Vegetation

Under this scenario, past and projected activities in the study area would result in the total cumulative disturbance of approximately 339,912 acres of vegetation (or approximately 7.6 percent of the study area) by 2010. Of the 339,912 acres, it is projected that 98,662 acres (29 percent) of the vegetation disturbance would be associated with coal mining activities. The primary vegetation communities impacted by coal mining would include mixed- and short-grass prairie and sagebrush shrubland (55 and 40 percent of the projected disturbance, respectively, based on GIS mapping of projected future coal reserves and existing [2003] disturbance from coal mine development). Based on these percentages, these vegetation communities would account for 54,264 and 39,465 acres, respectively, of the projected coal mine-related disturbance area.

Of the 339,912 acres of total cumulative vegetation disturbance, approximately 205,113 acres (60 percent) would be reclaimed by 2010. The remaining 134,799 acres of disturbance would be reclaimed incrementally or following a project's completion, depending on the type of development activity and permit requirements. Of the 98,662 acres of disturbance associated with coal mine development, it is projected that approximately 44,938 acres (46 percent) would be reclaimed by 2010. Of the remaining 53,724 acres of coal mining-related disturbance, it is estimated that approximately 26,338 acres would be unavailable for concurrent reclamation due to the presence of long-term facilities which would be reclaimed near the end of each mine's life. Reclamation of the remaining 27,386 acres of disturbance would proceed concurrently with mining operations.

Riparian and Wetland Vegetation

RFD activities in the study area would result in the removal or disturbance of wetland and riparian vegetation located within the projected disturbance areas. As the discrete locations of future CBNG-related facilities and actual disturbance footprints of future coal mine disturbance areas are not currently known, the spatial relationship between these activities and the isolated wetland and riparian communities in the study area cannot be determined at this time. As a result, potential impacts under this scenario cannot be quantified. However, based on the types of wetland and riparian communities in the vicinity of projected future coal reserves, it is anticipated that wet meadow and shrubby riparian areas would be the primary communities impacted as a result of coal mining activities. As discussed in Section 2.2.2.1 of this report, disturbances to AVFs and wetlands are regulated by WDEQ and USACE. In the case of coal mining, wetlands that meet the requirements for USACE regulatory review must be identified, and special permitting procedures

are required to assure that after mining there will be no net loss of wetlands. Wetlands that are not under USACE jurisdiction are restored as required by WDEQ/LQD (depending on the values associated with the wetland features), by the surface managing agency (on public land), or by the private landowner. For other types of development, such as oil and gas, disturbance of wetlands is avoided where possible. Where avoidance is not possible, mitigation for impacts to wetlands is evaluated on a project specific basis.

Operations associated with RFD activities in the cumulative effects study area would result in the use of groundwater. As of 2010, the annual water production associated with coal mine and CBNG activities would be approximately 36,803 million gallons per year (mmgpy). Most, if not all, of the coal mine-produced water would be consumed during operation. Approximately 34,545 mmgpy of CBNG-produced water would be discharged to impoundments or intermittent and ephemeral streams or reinjected. This discharge of water would result in the creation of wetlands in landscape depressions and riparian areas along 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. However, 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.

GROUNDWATER DRAWDOWN EFFECTS TO BE EVALUATED PENDING COMPLETION OF GROUNDWATER MODELING.

Invasive and Non-native Species

RFD-related construction and operation activities likely would 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 rights-of-way, 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. In the case of coal mining, the mining and reclamation plans approved by WDEQ include plans to control invasion by weedy (invasive nonnative) plant species. Oil and gas operators currently are required to submit an Integrated Pest Management Plan as part of their applications to drill on federal oil and gas leases.

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 that are protected under the ESA, or are sensitive species considered candidates for such listing by the USFWS, as well as BLM, FS, and WGFD sensitive species.

In accordance with the ESA, as amended, land management agencies in coordination with the USFWS must ensure that any action that they authorize, fund, or carry out would not adversely

affect a federally listed threatened or endangered species. In addition, as stated in Special Status Species Management Policy 6840 (6840 Policy) (Rel. 6-151), it also is BLM policy "to conserve listed species and the ecosystems on which they depend, and to ensure that actions requiring authorization or approval by the BLM are consistent with the conservation needs of special status species and do not contribute to the need to list any special status species, either under the provisions of the ESA or other provisions" identified in the 6840 Policy.

As discussed in Task 1D of the PRB Coal Review, Current Environmental Conditions (ENSR 2005b), special status species known to occur in the cumulative effects study area (**Figure 1-1**) include one federally listed species (Ute ladies-tresses), one BLM sensitive species (Nelson's milkvetch), and one FS sensitive species (Barr's milkvetch). In addition, two BLM sensitive species (Laramie columbine and William's wafer-parsnip) potentially may occur in the cumulative effects study area. Two BLM sensitive species (many-stemmed spider-flower and Laramie false-sagebrush) are not expected to occur in the cumulative effects 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, which would include an unquantifiable portion of the approximately 339,912 acres of vegetation disturbance (native vegetation and previously disturbed vegetation) associated with past and projected activities. Direct impacts also could include the direct loss of individual plants within the cumulative effects study area depending on their location in relation to RFD 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.

2.3.2.2 Year 2010 – Upper Production Scenario

General Vegetation

Potential impacts to vegetation as a result of RFD activities would be similar to those described under the 2010 – Lower Production Scenario, except approximately 3,786 additional acres would be disturbed. Under this scenario, past and projected activities in the cumulative study area are projected to result in the total cumulative disturbance of approximately 343,698 acres of vegetation (or approximately 7.7 percent of the study area) by the year 2010. Of the 343,698 acres, it is projected that 102,448 acres (30 percent) would occur in association with coal mining activities. Of the 102,448 acres of projected coal mine-related disturbance, approximately 55,322 acres (54 percent based on GIS) and 42,004 acres (41 percent based on GIS) would be associated with the short- and mixed-grass prairie and sagebrush shrubland communities, respectively.

Of the 343,698 acres of total cumulative vegetation disturbance, approximately 206,946 acres (60 percent) would be reclaimed by 2010. The remaining 136,752 acres of disturbance would be reclaimed incrementally or following a project's completion, depending on the type of development activity and permit requirements. Of the 102,448 acres of disturbance associated with coal mine development, it is projected that approximately 46,771 (46 percent) would be reclaimed by 2010. Of the remaining 55,677 acres of coal mining-related disturbance, it is estimated that approximately 25,688 acres would be unavailable for concurrent reclamation due to the presence of long-term facilities which would be reclaimed near the end of each mine's life. Reclamation of the remaining 29,989 acres of disturbance would proceed concurrently with mining operations.

Wetland and Riparian Areas

Potential impacts to wetland and riparian vegetation as a result of RFD activities would be the same as described under the 2010 – Lower Production Scenario, with the following exception. The probability of disturbance to wetland and riparian vegetation would be greater due to the increase in total projected disturbance acreage (an additional 3,786 acres) under this scenario.

Invasive and Non-native Species

Potential impacts related to invasive and non-native species would the same as described under the 2010 – Lower Production Scenario, with the following exception. The probability of dispersing invasive and non-native species within and beyond the surface disturbance boundaries would increase due to the increased surface disturbance (an additional 3,786 acres) that would occur under this scenario.

Special Status Species

Potential impacts to special status species as result of RFD activities would be the same as described under the 2010 – Lower Production Scenario, with the following exception. The probability of affecting potential or known habitat for special status plant species, or individual plants, would increase due to the increased surface disturbance (an additional 3,786 acres) that would occur under this scenario.

2.3.2.3 Year 2015 – Lower Production Scenario

General Vegetation

Potential impacts to vegetation as a result of RFD activities would be similar to those described under the 2010 – Lower Production Scenario, except approximately 86,172 additional acres would be disturbed. Under this scenario, past and present activities in the cumulative effects study area would result in the total cumulative disturbance of approximately 426,084 acres of vegetation (or approximately 9.5 percent of the study area) by the year 2015. Of the 426,084 acres, it is projected that 117,236 acres (27 percent) would occur in association with coal mining activities. Of the 117,236 acres of projected coal mine-related disturbance, approximately 64,480 acres (55 percent based on GIS) and 48,067 acres (41 percent based on GIS) would be associated with the short- and mixed-grass prairie and sagebrush shrubland communities, respectively.

Of the 426,084 acres of total cumulative vegetation disturbance, approximately 286,614 acres (67 percent) would be reclaimed by 2015. The remaining 139,472 acres of disturbance would be reclaimed incrementally or following a project's completion, depending on the type of development activity and permit requirements. (Minor discrepancies in total acreages are the result of rounding.) Of the 117,236 acres of disturbance associated with coal mine development, it is projected that approximately 61,188 acres (52 percent) would be reclaimed by 2015. Of the remaining 56,048 acres of coal mining-related disturbance, it is estimated that approximately 27,549 acres would be unavailable for concurrent reclamation due to the presence of long-term facilities which would be reclaimed near the end of each mine's life. Reclamation of the remaining 28,499 acres of disturbance would proceed concurrently with mining operations.

Wetland and Riparian Areas

Potential surface disturbance-related impacts to wetland and riparian vegetation as a result of RFD activities would be the same as described under the 2010 – Lower Production Scenario, with the following exception. The probability of disturbance to wetland and riparian vegetation would be greater due to the increase in total projected disturbance acreage (an additional 86,172 acres) under this scenario.

Potential impacts to wetland and riparian vegetation as a result of groundwater production and disposal would be the same as described under the 2010 – Lower Production Scenario with the following exception. An approximately 2,791 additional mmgpy of groundwater would be discharged in association with CBNG operations, a portion of which would be discharged to impoundments or intermittent and ephemeral streams.

Invasive and Non-native Species

Potential impacts related to invasive and non-native species would the same as described under the 2010 – Lower Production Scenario, with the following exception. The probability of dispersing invasive and non-native species within and beyond the surface disturbance boundaries would increase due to the increased surface disturbance (an additional 86,172 acres) that would occur under this scenario.

Special Status Species

Potential impacts to special status species as result of RFD activities would be the same as described under the 2010 – Lower Production Scenario, with the following exception. The probability of affecting potential or known habitat for special status plant species, or individual plants, would increase due to the increased surface disturbance (an additional 86,172 acres) that would occur under this scenario.

2.3.2.4 Year 2015 – Upper Production Scenario

General Vegetation

Potential impacts to vegetation as a result of RFD activities would be similar to those described under the 2010 – Lower Production Scenario, except approximately 93,480 additional acres would be disturbed. Under this scenario, past and projected activities in the cumulative study area would result in the total cumulative disturbance of approximately 433,392 acres of vegetation (or approximately 9.6 percent of the study area) by the year 2015. Of the 433,392 acres, it is projected that 124,545 acres (29 percent) would occur in association with coal mining activities. Of the 124,545 acres, approximately 67,254 acres (54 percent per GIS) and 51,063 acres (41 percent per GIS) would be associated with the short- and mixed-grass prairie and sagebrush shrubland communities, respectively.

Of the 433,392 acres of total cumulative vegetation disturbance, approximately 290,822 acres (67 percent) would be reclaimed by 2015. The remaining 142,570 acres of disturbance would be

reclaimed incrementally or following a project's completion, depending on the type of development activity and permit requirements. Of the 124,545 acres of disturbance associated with coal development, it is projected that approximately 65,396 acres (53 percent) would be reclaimed by 2015. Of the remaining 59,149 acres of coal mining-related disturbance, it is estimated that approximately 27,009 acres would be unavailable for concurrent reclamation due to the presence of long-term facilities which would be reclaimed near the end of each mine's life. Reclamation of the remaining 32,140 acres of disturbance would proceed concurrently with mining operations.

Wetland and Riparian Areas

Potential surface disturbance-related impacts to wetland and riparian vegetation as a result of RFD activities would be the same as described under the 2010 – Lower Production Scenario, with the following exception. The probability of disturbance to wetland and riparian vegetation would be greater due to the increase in total projected disturbance acreage (an additional 93,480 acres) under this scenario.

Potential impacts to wetland and riparian vegetation as a result of groundwater production and disposal would be the same as described under the 2010 – Lower Production Scenario with the following exception. An approximately 2,791 additional mmgpy of groundwater would be discharged in association with CBNG operations, a portion of which would be discharged to impoundments or intermittent and ephemeral streams.

Invasive and Non-native Species

Potential impacts related to invasive and non-native species would the same as described under the 2010 – Lower Production Scenario, with the following exception. The probability of dispersing invasive and non-native species within and beyond the surface disturbance boundaries would increase due to the increased surface disturbance (an additional 93,480 acres) that would occur under this scenario.

Special Status Species

Potential impacts to special status species as result of RFD activities would be the same as described under the 2010 – Lower Production Scenario, with the following exception. The probability of affecting known or potential habitat for special status plant species, or individual plants, would increase due to the increased surface disturbance (an additional 93,480 acres) that would occur under this scenario.

2.3.2.5 Year 2020 – Lower Production Scenario

General Vegetation

Potential impacts to vegetation as a result of RFD activities would be similar to those described under the 2010 – Lower Production Scenario, except approximately 163,173 additional acres would be disturbed. Under this scenario, past and projected activities in the cumulative study area would result in the total cumulative disturbance of approximately 503,085 acres of vegetation (or

approximately 11.2 percent of the study area) by the year 2020. Of the 503,085 acres, it is projected that 137,443 acres (27 percent) would occur in association with coal mining activities. Of the 137,443 acres of coal mine-related disturbance, approximately 76,968 acres (56 percent per GIS) and 54,977 acres (40 percent per GIS) would be associated with the short- and mixed-grass prairie and sagebrush shrubland communities, respectively.

Of the 503,085 acres of total cumulative vegetation disturbance, approximately 367,999 acres (73 percent) would be reclaimed by 2020. The remaining 135,977 acres of disturbance would be reclaimed incrementally or following a project's completion, depending on the type of development activity and permit requirements. Of the 137,443 acres of disturbance associated with coal mining activities, it is estimated that approximately 79,463 acres (58 percent) would be reclaimed by 2020. Of the remaining 57,979 acres of coal mining-related disturbance, it is estimated that approximately 28,797 acres would be unavailable for concurrent reclamation due to the presence of long-term facilities which would be reclaimed near the end of each mine's life. Reclamation of the remaining 29,182 acres of disturbance would proceed concurrently with mining operations.

Wetland and Riparian Areas

Potential surface disturbance-related impacts to wetland and riparian vegetation as a result of RFD activities would be the same as described under the 2010 – Lower Production Scenario, with the following exception. The probability of disturbance to wetland and riparian vegetation would be greater due to the increase in total projected disturbance acreage (an additional 163,173 acres) under this scenario.

Potential impacts to wetland and riparian vegetation as a result of groundwater production and disposal would be the same as described under the 2010 – Lower Production Scenario with the following exception. Approximately 914 fewer mmgpy of groundwater would be discharged in association with CBNG operations, a portion of which would be discharged to impoundments or intermittent and ephemeral streams.

Invasive and Non-native Species

Potential impacts related to invasive and non-native species would the same as described under the 2010 – Lower Production Scenario, with the following exception. The probability of dispersing invasive and non-native species within and beyond the surface disturbance boundaries would increase due to the increased surface disturbance (an additional 163,173 acres) that would occur under this scenario.

Special Status Species

Potential impacts to special status species as result of RFD activities would be the same as described under the 2010 – Lower Production Scenario, with the following exception. The probability of affecting potential or known habitat for special status plant species, or individual plants, would increase due to the increased surface disturbance (an additional 163,173 acres) that would occur under this scenario.

2.3.2.6 Year 2020 – Upper Production Scenario

General Vegetation

Potential impacts to vegetation as a result of RFD activities would be similar to the 2010 – Lower Production Scenario, except approximately 174,820 additional acres would be disturbed. Under this scenario, past and projected activities in the cumulative study area would result in the total cumulative disturbance of approximately 514,732 acres of vegetation (or approximately 11.5 percent of the study area) by the year 2020. Of the 514,732 acres, it is projected that 149,089 acres (29 percent) would occur in association with coal mining activities. Of the 149,089 acres of coal mining-related disturbance, approximately 83,490 acres (56 percent per GIS) and 59,636 acres (40 percent per GIS) would be associated with the short- and mixed-grass prairie and sagebrush shrubland communities, respectively.

Of the 514,732 acres of total cumulative vegetation disturbance, approximately 374,732 acres (73 percent) would be reclaimed by 2020. The remaining 139,998 acres of disturbance would be reclaimed incrementally or following a project's completion, depending on the type of development activity and permit requirements. Of the 149,089 acres of disturbance associated with coal mine development, it is projected that approximately 86,196 acres (58 percent) would be reclaimed by 2020. Of the remaining 62,890 acres of coal mining-related disturbance, it is estimated that approximately 28,345 acres would be unavailable for concurrent reclamation due to the presence of long-term facilities which would be reclaimed near the end of each mine's life. Reclamation of the remaining 34,545 acres of disturbance would proceed concurrently with mining operations.

Wetland and Riparian Areas

Potential surface disturbance-related impacts to wetland and riparian vegetation as a result of RFD activities would be the same as described under the 2010 – Lower Production Scenario, with the following exception. The probability of disturbance to wetland and riparian vegetation would be greater due to the increase in total projected disturbance acreage (an additional 174,820 acres) under this scenario.

Potential impacts to wetland and riparian vegetation as a result of groundwater production and disposal would be the same as described under the 2010 – Lower Production Scenario with the following exception. Approximately 914 fewer mmgpy of groundwater would be discharged in association with CBNG operations, a portion of which would be discharged to impoundments or intermittent and ephemeral streams.

Invasive and Non-native Species

Potential impacts related to invasive and non-native species would the same as described under the 2010 – Lower Production Scenario, with the following exception. The probability of dispersing invasive and non-native species within and beyond the surface disturbance boundaries would increase due to the increased surface disturbance (an additional 174,820 acres) that would occur under this scenario.

Special Status Species

Potential impacts to special status species as result of RFD activities would be the same as described under the 2010 – Lower Production Scenario, with the following exception. The probability of affecting potential or known habitat for special status plant species, or individual plants, would increase due to the increased surface disturbance (an additional 174,820 acres) that would occur under this scenario.

2.4 Wildlife, Fisheries, and Related Habitat Values

2.4.1 Study Area

The cumulative effects study area for wildlife, fisheries, and related habitat values includes the following subwatersheds in portions of Sheridan, Johnson, Campbell, and Converse counties: Upper Powder River, Little Powder River, Upper Belle Fourche River, Upper Cheyenne River, Antelope Creek, and Dry Fork Cheyenne River (**Figure 1-1**). It includes portions of the area administered by the BLM Buffalo and Casper field offices and a portion of the TBNG, which is administered by the FS (**Figure 1-2**).

2.4.2 Cumulative Impacts

Based on the information in Appendices A and D of the Task 2 Report for the PRB Coal Review, Past and Present and Reasonably Foreseeable Development Activities (ENSR 2005c), a total of approximately 220,688 acres (5 percent) of wildlife habitat have been disturbed by development activities in the cumulative effects study area (as of 2003). Of the 220,688 acres of total habitat disturbance, approximately 68,794 acres (31 percent) have been associated with coal mine development.

Of the 220,688 acres of total cumulative habitat disturbance, approximately 111,786 acres (51 percent) have been reclaimed. The remaining 108,901 acres of habitat would be reclaimed incrementally or following a project's completion, depending on the type of development activity and permit requirements. Of the 68,794 total cumulative acres of habitat disturbance associated with coal mine development, approximately 21,238 acres (31 percent) have been reclaimed (as of 2003). Of the remaining 47,556 acres of disturbance, approximately 24,097 acres currently are not available for reclamation, as they are occupied by long-term facilities which are needed to conduct mining operations. These areas would be reclaimed near the end of the mine life. Reclamation of the remaining 23,459 acres, which represent areas of active mining and areas where coal has been recovered but reclamation has not been completed, would proceed concurrently with coal mining. (Note: minor discrepancies in acreages are the result of rounding.)

Potential impacts to wildlife within the cumulative effects study area would be similar to those discussed in the Task 1D Report for the PRB Coal Review, Current Environmental Conditions (ENSR 2005b). In general, impacts to wildlife can be classified as short-term and long-term. Potential short-term impacts arise from habitat removal and 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 permanent changes to habitats and the wildlife populations that depend on those habitats, irrespective of reclamation success, and habitat disturbance related to longer term projects (e.g., power plant facilities, rail lines, etc.). Direct impacts to wildlife populations as a result of development activities in the study area could include direct mortalities, habitat loss or alteration, habitat fragmentation, or animal displacement.

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 indirect 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, climate) (see the Task 1D Report for the PRB Coal Review, Current Environmental Conditions [ENSR 2005b]).

The effects to terrestrial wildlife from development activities within the PRB study area under two production scenarios (lower and upper production scenarios) for the years 2010, 2015, and 2020 are presented below.

2.4.2.1 Year 2010 – Lower Production Scenario

Terrestrial Wildlife

Under this scenario, RFD activities in the study area are projected to result in disturbance to approximately 119,224 additional acres of habitat by 2010, resulting in a total cumulative disturbance of approximately 339,912 acres of habitat. Of the 339,912 acres (approximately 7.6 percent of the study area), it is estimated that 98,662 total acres (29 percent) of cumulative habitat disturbance would be associated with coal mining activities.

Of the 339,912 acres of total cumulative habitat disturbance, approximately 205,113 acres (60 percent) of habitat would be reclaimed by 2010. The remaining 134,799 acres of habitat disturbance would be reclaimed incrementally or following a project's completion, depending on the type of development activity and project-specific permit requirements. Of the 98,662 acres of total cumulative habitat disturbance associated with coal mining activities, it is projected that approximately 44,938 acres (46 percent) would be reclaimed by 2010. Of the remaining 53,724 acres of coal mining-related disturbance, it is estimated that approximately 26,338 acres would be unavailable for concurrent reclamation due to the presence of long-term facilities which would be reclaimed near the end of each mine's life. Reclamation of the remaining 27,386 acres of disturbance would proceed concurrently with mining operations.

Game Species. Potential direct impacts to big game species (i.e., pronghorn, white-tailed deer, mule deer, elk, and moose) would include the incremental loss or alternation of approximately 119,224 additional acres of potential forage (native vegetation and previously disturbed vegetation) and ground cover associated with construction and operation of RFD activities (e.g., vegetation removal for coal mines and CBNG wells, ancillary facilities, and transportation and utility corridors). The total cumulative area of potential habitat disturbance would be approximately 339,912 acres. Indirect impacts to big game species would include increased habitat fragmentation effects as a result of increased noise levels and human presence, dispersal of noxious and invasive weed species, and dust effects from unpaved road traffic.

Assuming that adjacent habitats would be at or near carrying capacity, the variabilities associated with drought conditions, and given the human activities in the study area, displacement of wildlife species (e.g., big game) as a result of RFD activities would create some unquantifiable reduction in wildlife populations.

As discussed in the Task 1D Report for the PRB Coal Review, Current Environmental Conditions (ENSR 2005b), a number of big game habitat ranges occur within the cumulative effects study area. Certain habitat ranges are considered crucial for maintenance of game populations. In Wyoming, the Wyoming Game and Fish Department (WGFD) and the BLM have established several categories based on seasonal use of the habitat. For example, 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. Big game ranges that could be affected by RFD activities would include up to 4,055,519 acres of pronghorn ranges, 216,801 acres of white-tailed deer ranges, 3,795,100 acres of mule deer ranges, and 198,711 acres of elk ranges within the cumulative effects study area. No designated moose ranges occur within the cumulative effects study area. As discussed in the Task 2 Report for the PRB Coal Review, Past and Present and Reasonably Foreseeable Activities (ENSR 2005c), discrete locations for most RFD disturbance and reclamation areas cannot be determined based on existing information. As a result, the spatial relationship between projected future disturbance and reclamation areas for the RFD scenarios and the resource-specific information in the GIS layers cannot be determined. However, GIS layers for future coal reserves are available and have been used to provide some level of quantification of potential future coal mining-related impacts to big game ranges. This information is presented in **Table 2.4-1**.

Table 2.4-1
Potential Cumulative Disturbance to Big Game Ranges from Coal Mine Development under the Year 2010 – Lower Production Scenario
(acres and percent affected)

Species	Big Game Ranges[1]			
	Crucial Winter	Severe Winter	Winter Yearlong	Yearlong
Pronghorn	N/A	1,472 (3 percent)	33,196 (2 percent)	32,099 (1 percent)
White-tailed Deer	N/A	N/A	N/A	1,411 (0.6 percent)
Mule Deer	N/A	N/A	6,808 (0.4 percent)	25,390 (1 percent)
Elk	24 (0.4 percent)	N/A	375 (1percent)	1,444 (0.9 percent)

[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 cumulative effects study area was divided by the sum of the potential disturbance acreage for 2010 (based on GIS mapping of coal reserves for the 2010 lower production scenario) and existing (2003) disturbance from coal mine development.

Direct and indirect effects to small game species (i.e., upland game birds, waterfowl, small game mammals) within the study area as a result of RFD activities would be the same as discussed above for big game species. Impacts would result from the incremental surface disturbance of approximately 339,912 total cumulative acres 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 RFD activities in the cumulative effects area would result in the use of groundwater. As of 2010, the annual water production associated with coal mine and CBNG activities would be approximately 36,803 mmgpy. Most, if not all, of the coal mine-produced water

would be consumed during operation. Up to approximately 34,545 mmgpy of CBNG-produced water would be discharged 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. As discussed in the Task 1D Report for the PRB Coal Review, Current Environmental Conditions (ENSR 2005b), the median sodium concentration of CBNG-produced water from the Fort Union Formation is 270 milligrams (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.

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 approximately 119,224 additional acres of potential foraging and breeding habitats (native vegetation and previously disturbed vegetation) from construction and operation of RFD activities (e.g., vegetation removal for coal mines and CBNG wells, ancillary facilities, and transportation and utility corridors). The total cumulative area of potential habitat disturbance would be approximately 339,912 acres. Impacts also could result in mortalities of less mobile species (e.g., small mammals, reptiles, amphibians, 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, the variability's associated with drought conditions, and given the human activities in the study area, displacement of wildlife species from the study area would result in an unquantifiable reduction in wildlife populations.

As discussed in the Task 1D Report of the PRB Coal Review, Current Environmental Conditions (ENSR 2005b), a number of migratory bird species have been documented within the cumulative effects area. In the event that RFD 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 (MBTA) and potentially could affect populations of important migratory bird species that may occur within the study area.

Breeding raptor species that occur within the cumulative effects study area include eagles (golden eagle), buteos (red-tailed hawk, Swainson's hawk, and rough-legged hawk), falcons (American kestrel and prairie falcon), northern harrier, and owls (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 cumulative effects study area. In the event that RFD 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 for migratory bird species, loss of an active nest site, incubating adults, eggs, or young would not comply with the intent of the MBTA.

New power line segments in the cumulative effects study area incrementally would increase the collision potential for migrating and foraging bird species (e.g., raptors and waterfowl) (Avian Power Line Interaction Committee [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 kilovolt (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 CBMG development currently are being constructed underground.

Fisheries

Potential cumulative effects on fisheries as a result of RFD activities in the study area would be closely related to impacts on groundwater and surface water resources, which are discussed in the Task 3B Report for the PRB Coal Review, Cumulative Water Resources Impacts (ENSR 2005e). In general, RFD 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. Under this scenario, approximately 134,799 total cumulative acres of unreclaimed surface disturbance would exist within the study area by 2010. This would be a 24 percent increase in unreclaimed surface disturbance in comparison to existing (2003) conditions. Approximately 40 percent of the unreclaimed acreage in the study area would be related to coal mining activities. The potential effects of RFD activities on aquatic communities are discussed below for each of these impact topics.

Habitat Loss. RFD activities under this scenario could result in the loss of aquatic habitat as a result of direct surface disturbance. As discussed in Chapter 2.0 of the Task 2 Report for the PRB Coal Review, Past and Present and Reasonably Foreseeable Activities (ENSR 2005c), discrete locations for RFD disturbance and reclamation areas cannot be determined based on existing information. However, the RFD would involve the construction of additional linear facilities (e.g., Bison Pipeline Project, product gathering lines and road systems associated with conventional oil and gas and CBNG activities) and site facilities (e.g., coal mine expansions) that could result in the loss of aquatic habitat. Although information relative to the stream crossing locations for the majority of the linear facilities is not available at this time, based on current information, it is assumed that the Bison Pipeline Project would cross Cottonwood Creek, a tributary of the Little Powder River. Typically, the associated disturbance would consist of a 100-foot-wide construction right-of-way; 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. As discussed in the Task 1B Report for the PRB Coal Review, Current Water Resources Conditions (ENSR 2005b), 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). Due to a lack of water on a consistent basis in the potentially affected streams, existing aquatic communities mainly are 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. It is assumed that surface disturbance activities would not be allowed in perennial stream segments or reservoirs on public land that contain game fish species. It is assumed that other types of RFD 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.

Water Quality Effects on Habitat. Past and projected activities would result in surface disturbance in each of the six study area subwatersheds, with unreclaimed disturbance areas ranging from 1,731 acres in the Dry Fork Cheyenne River Subwatershed to 40,180 acres in the Upper Belle Fourche River subwatershed. In general, perennial stream habitat in the study area is limited to the Little Powder River. Warmwater game fish and nongame species are present in the perennial stream segments and numerous scattered reservoirs and ponds. The predominant type of aquatic habitat in the study area consists of intermittent and ephemeral streams and scattered ponds and reservoirs.

Surface disturbance 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 total dissolved solids levels in streams near reclaimed coal mine areas have increased from 1 to 7 percent (Martin et al. 1988). Typically, sedimentation effects are short-term in duration and localized in terms of the affected area. Suspended sediment concentrations would stabilize and return to typical background concentrations after construction activities have been completed. It is anticipated that sediment input associated with RFD disturbance areas would be minimized by implementation of appropriate erosion control measures, as would be determined during future permitting.

The contribution of effects of coal mine development on fish species and their habitat was assessed using surface disturbance information. Of the approximately 134,799 acres of unreclaimed surface disturbance that is projected to exist within the study area subwatersheds under this scenario, approximately 53,724 acres (40 percent) would be associated with coal mine development. This percentage provides a relative indicator of coal mining's potential contribution to water quality effects on fish habitat. However, as discussed in the Task 1B Report for the PRB Coal Review, Current Water Resources Conditions (ENSR 2005d), the release of storm water runoff from mine disturbance areas would be regulated by each mine's National Pollution Discharge Elimination System (NPDES) permit and, therefore, should have little effect on drainages. Based on these permit requirements and implementation of required erosion control measures, it is assumed that coal mine-related impacts to fisheries as a result of storm water discharge would be low.

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 feet in width depending on the RFD activity). It is anticipated that reclamation procedures to restore riparian vegetation would be required during future project permitting, thereby minimizing impacts.

Water Quantity Effects on Habitat. Of the RFD activities, CBNG and coal mining are the main types of development that use or manage water as part of their operations. As of 2010, the annual water production associated with CBNG and coal mine activities would be approximately

water production associated with CBNG and coal mine activities would be approximately 36,803 mmgpy. Based on current trends, it is assumed that most, if not all, of the coal mine-produced water would be consumed during operation, and any discharge that would occur would report to intermittent and ephemeral streams in four subwatersheds (Antelope Creek, Little Powder, Upper Belle Fourche, and Upper Cheyenne). Increased flows in these drainages would be expected to have little or no effect on flows in the perennial streams due to high conveyance losses as discussed in the Task 1B Report for the PRB Coal Review, Current Water Resources Conditions (ENSR 2005a). As discussed in the Task 2 Report for the PRB Coal Review, Past and Present and Reasonably Foreseeable Future Activities (ENSR 2005c), although the number of future CBNG wells has been projected for each scenario in this study, the discrete locations for future well sites cannot be determined at this time. However, it is assumed that future permitting would allow a portion of CBNG-produced water to be discharged to intermittent and ephemeral drainages as currently allowed in the six subwatersheds in the study area. Under this scenario, it is projected that up to approximately 34,545 mmgpy of CBNG-produced water would be discharged. Based on past monitoring in receiving streams, no change in surface flows would be expected beyond approximately 2 miles from the discharge points (BLM 2003). Therefore, water quantity changes are not expected to affect fish populations in perennial streams in the study area subwatersheds.

POTENTIAL DRAWDOWN EFFECTS TO BE EVALUATED PENDING COMPLETION OF GROUNDWATER MODELING.

Special Status Species

Special Status Wildlife 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 that are protected under the Endangered Species Act (ESA), or are considered candidates for such listing by the USFWS, and BLM, FS, and WGFD sensitive species. Special status species potentially occurring in the PRB study are identified in Section 2.4.3.5 of the Task 1D Report of the PRB Coal Review, Current Environmental Conditions (ENSR 2005b).

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 alternation of approximately 119,224 additional acres of potential habitat (native vegetation and previously disturbed vegetation) from construction and operation of RFD activities (e.g., vegetation removal for coal mines and CBNG wells, ancillary facilities, and transportation and utility corridors). The total cumulative area of potential habitat disturbance would be approximately 339,912 acres (approximately 7.6 percent of the study area). 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 cumulative effects 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. Although

degree of these potential impacts 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.

As discussed in Task 1D of the PRB Coal Review, a number of special status bird species have been identified as occurring within the cumulative effects study area including water birds (common loon, American white pelican, snowy egret, American bittern, black-crowned night heron, white-faced ibis, trumpeter swan, greater sandhill crane, mountain plover, upland sandpiper, long-billed curlew, black tern) and perching birds (yellow-billed cuckoo, Lewis' woodpecker, olive-sided flycatcher, purple martin, pygmy nuthatch, sage thrasher, loggerhead shrike, Baird's sparrow, sage sparrow, fox sparrow, and Brewers sparrow). In the event that RFD 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.

A number of special status raptor species have been documented in cumulative effects study area including eagles (bald eagle), buteos (ferruginous hawk and osprey), accipiters (northern goshawk), falcons (merlin and peregrine falcon), and owls (western burrowing owl, flammulated owl) (see the Task 1D Report for the PRB Coal Review [ENSR 2005b]). Potential direct impacts to raptors would result from the surface disturbance of breeding and foraging habitat within the cumulative effects study area. If present in or adjacent to the RFD activities, breeding raptors could abandon breeding territories, nest sites, or lose eggs or young as a result of construction and operation of these activities. As discussed above for wildlife, loss of an active nest site, incubating adults, eggs, or young would not comply with the intent of the MBTA and potentially could affect populations of important migratory bird species that may occur within the study area.

New power line segments in the cumulative effects 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. As discussed above, 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.

As presented in the Task 1D Report for the PRB Coal Review, Current Environmental Conditions (ENSR 2005b), a total of 239 greater sage-grouse lek sites were identified in the six subwatersheds in the cumulative effects study area as of 2003. As discussed above for game species, based on existing information, the spatial relationship between projected future disturbance and reclamation areas for the RFD scenarios and the resource-specific information in the GIS layers cannot be determined. However, GIS layers for future coal reserves have been used to provide some quantification of potential future coal mining-related impacts. Based on the GIS mapping of future coal reserves and existing (2003) disturbance from coal mine development, 10 leks would be

directly disturbed by coal mine development and 47 lek sites would occur within 2 miles from coal mining activities by 2010. However, an unquantifiable number of these 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 abandonment of a lek site, or loss of eggs or young as a result of RFD activities.

Special Status Fish Species. Six special status fish species potentially occur in the 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 RFD activities would be similar to effects discussed for fisheries under the 2010 – Lower Development Scenario. Surface disturbance in three subwatersheds (Little Powder River, Upper Bell Fourche River, and Upper Cheyenne River) could alter habitat or affect water quality conditions for special status fish species. The projected total cumulative unreclaimed disturbance would be 22,688 acres for the Little Powder River, 40,180 acres for Upper Belle Fourche River, and 17,397 acres for the Upper Cheyenne River. Based on the Task 2 database information, approximately 37, 44, and 82 percent, respectively, of these disturbance areas would be related to coal mining activities. Erosion control measures, as required by existing (2003) and future permits, and NPDES permit requirements would be implemented for each project. These measures would help minimize increased 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.

2.4.2.2 Year 2010 – Upper Production Scenario

Terrestrial Wildlife

Potential impacts to wildlife habitat under this scenario would be similar to those described under the 2010 – Lower Production Scenario, except approximately 3,786 additional acres of habitat would be disturbed. Under this scenario, past and projected activities in the cumulative effects study area would result in the total cumulative disturbance of approximately 343,698 acres of habitat (or approximately 7.7 percent of the study area) by the year 2010. Of the 343,698 acres of total disturbance, it is estimated that 102,448 acres (30 percent) would be associated with coal mining activities.

Of the 343,698 acres of total cumulative habitat disturbance, approximately 206,946 acres (60 percent) would be reclaimed by 2010. The remaining 136,752 acres of habitat disturbance would be reclaimed incrementally or following a project's completion, depending on the type of development activity and permit requirements. Of the 102,448 acres of habitat disturbance associated with coal mining activity, it is estimated that approximately 46,771 acres (46 percent) would be reclaimed by 2010. Of the remaining 55,677 acres of coal mining-related disturbance, it is estimated that approximately 25,688 acres would be unavailable for concurrent reclamation due to the presence of long-term facilities which would be reclaimed near the end of each mine's life. Reclamation of the remaining 29,989 acres of disturbance would proceed concurrently with mining operations.

Game Species. Impacts to game species as a result of RFD activities would be the same as described under the 2010 – Lower Production Scenario, except there would be slightly higher impacts to pronghorn and mule deer ranges. Potential impacts to white-tailed deer and elk ranges would be the same as presented above under the 2010 - Lower Production Scenario. Potential impacts to big game ranges from coal mine development in the cumulative effects area are presented in **Table 2.4-2**. Impacts to small game species as a result of RFD activities would be the same as discussed under the 2010 – Lower Production Scenario, except approximately 3,786 additional acres of potential habitat would be disturbed under this scenario.

Table 2.4-2
Potential Cumulative Disturbance to Big Game Ranges from Coal Mine Development under the Year 2010 – Upper Production Scenario (acres and percent affected)

Species	Big Game Range[1]			
	Crucial Winter	Severe Winter	Winter Yearlong	Yearlong
Pronghorn	N/A	1,472 (3 percent)	34,760 (3 percent)	33,172 (1 percent)
Mule Deer	N/A	N/A	6,924 (0.4 percent)	26,641 (1 percent)

[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 cumulative effects study area was divided by the sum of the potential disturbance acreage for 2010 (based on GIS mapping of coal reserves for the 2010 upper production scenario) and existing (2003) disturbance from coal mine development.

Nongame Species. Potential impacts to nongame species as a result of RFD activities would be the same as discussed for the 2010 – Lower Production Scenario, except approximately 3,786 additional acres of potential habitat would be disturbed under this scenario.

Fisheries. Under this scenario, impacts to fisheries as a result of past and projected activities would be the same as described under the 2010 – Lower Production Scenario, except the amount of cumulative unreclaimed surface disturbance would be slightly higher (an additional 1,953 acres as a result of increased coal mine production). The higher level of unreclaimed surface disturbance could result in slightly higher sediment input to drainages. However, impacts to stream habitat that may support fish species would be low, based on implementation of erosion control measures and NPDES permit requirements.

Special Status Species

Special Status Wildlife Species. Potential impacts to special status species as a result of RFD activities would be the same as discussed for the 2010 – Lower Production Scenario, except that approximately 3,786 additional acres of potential habitat would be disturbed under this scenario.

Special Status Fish Species. Under this scenario, impacts to special status fish species as a result of RFD activities would be the same as described for the 2010 – Lower Production Scenario, except the amount of cumulative unreclaimed surface disturbance would be slightly higher (an additional 994 acres in the three subwatersheds where special status fish species potentially occur). The higher level of surface disturbance could result in slightly higher sediment input to drainages.

The higher level of surface disturbance could result in slightly higher sediment input to drainages. However, it is anticipated that impacts to special status fish species would be low, based on implementation of erosion control measures and NPDES permit requirements.

2.4.2.3 Year 2015 – Lower Production Scenario

Terrestrial Wildlife

Potential impacts to wildlife habitats under this scenario would be similar to those described under the 2010 – Lower Production Scenario, except that approximately 86,172 additional acres of habitat would be disturbed. Under this scenario, RFD activities in the cumulative effects study area are projected to result in the total cumulative disturbance of approximately 426,084 acres of habitat (or approximately 9.5 percent of the study area) by the year 2015. Of the 426,084 acres of total disturbance, it is estimated that 117,236 acres (27 percent) would be associated with coal mining activity.

Of the 426,084 acres of total cumulative habitat disturbance, approximately 286,614 acres (67 percent) would be reclaimed by 2015. The remaining 139,472 acres of habitat disturbance would be reclaimed incrementally or following a project's completion, depending on the type of development activity and permit requirements. (Minor discrepancies in total acreages are the result of rounding.) Of the 117,236 acres of habitat disturbance associated with coal mining activities, it is projected that approximately 61,188 acres (52 percent) would be reclaimed by 2015. Of the remaining 56,048 acres of coal mining-related disturbance, it is estimated that approximately 27,549 acres would be unavailable for concurrent reclamation due to the presence of long-term facilities which would be reclaimed near the end of each mine's life. Reclamation of the remaining 28,499 acres of disturbance would proceed concurrently with mining operations.

Game Species. Impacts to game species as a result of RFD activities would be the same as discussed under the 2010 – Lower Production Scenario, except there would be slightly higher impacts to some big game ranges. Potential impacts to big game ranges from coal mining activities in the cumulative effects study area are presented in **Table 2.4-3**. Impacts to small game species as a result of RFD activities would be the same as discussed for the 2010 – Lower Production Scenario, except approximately 86,172 additional acres of potential habitat would be disturbed under this scenario.

Potential impacts associated with RFD-related groundwater production and disposal would be the same as described under the 2010 – Lower Production Scenario with the following exception. Up to approximately 2,791 mmgpy of additional CBNG-produced water would be discharged and would be available for area wildlife (e.g., waterfowl).

Nongame Species. Potential impacts to nongame species as a result of RFD activities would be the same as described under the 2010 – Lower Production Scenario, except approximately 86,172 additional acres of potential habitat would be disturbed under this scenario.

Table 2.4-3
Potential Cumulative Disturbance to Big Game Ranges from Coal Mine Development under the Year 2015 – Lower Production Scenario (acres and percent affected)

Species	Big Game Range[1]			
	Crucial Winter	Severe Winter	Winter Yearlong	Yearlong
Pronghorn	N/A	1,460 (3 percent)	32,649 (2 percent)	34,828 (1 percent)
White-tailed Deer	N/A	N/A	N/A	1,497 (0.7 percent)
Mule Deer	N/A	N/A	6,956 (0.4 percent)	26,420 (1 percent)
Elk	24 (0.4 percent)	N/A	351 (1 percent)	1,161 (0.7 percent)

[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 cumulative effects study area was divided by the sum of the potential disturbance acreage for 2015 (based on GIS mapping of coal reserves for the 2015 lower production scenario) and existing (2003) disturbance from coal mine development.

Fisheries. Under this scenario, impacts to fisheries as a result of RFD activities would be the same as described under the 2010 – Lower Production Scenario, with the following exceptions. RFD activities would result in an additional 4,673 acres of unreclaimed surface disturbance. The higher level of unreclaimed surface disturbance and construction of a river crossing could result in higher sediment input to drainages. Most of the increased surface disturbance would occur in the Antelope Creek, Upper Belle Fourche River, and Upper Cheyenne River subwatersheds. The contribution of effects from coal mine development on fisheries would increase to 40 percent when comparing unreclaimed surface disturbance from coal mining to total unreclaimed surface disturbance within the six subwatersheds. However, it is anticipated that impacts to fish species would be low, based on implementation of erosion control measures and NPDES permit requirements.

Under this scenario, construction of an additional linear facility would result in the crossing of at least one perennial stream (Belle Fourche River). Related construction activities would result in temporary surface disturbance and potentially the loss of riparian vegetation on either side of the river. However, these impacts are not anticipated to affect habitat quality for fisheries in the overall section of the stream.

CBNG-related groundwater discharge would be slightly higher under this scenario (approximately 2,791 additional mmgpy); however, increased flows are not expected to reach perennial stream segments due to relatively low discharge volumes.

Special Status Species

Special Status Wildlife Species. Potential impacts to special status species as a result of RFD activities would be the same as described under the 2010 – Lower Production Scenario, except that approximately 86,172 additional acres of potential habitat would be disturbed under this scenario.

Based on GIS mapping of future coal reserves and existing (2003) disturbance from coal mining activities, potential impacts to sage grouse habitat would be similar to those described under the 2010 – Lower Production Scenario, except that 15 leks would be directly disturbed by coal mining activities in the cumulative effects study area. However, an unquantifiable number of these lek sites initially could be impacted by CBNG activity, which would occur in advance of coal mine development.

Special Status Fish Species. Under this scenario, impacts to special status fish species as a result of RFD activities would be the same as described under the 2010 – Lower Production Scenario, with the following exceptions. As a result of ongoing reclamation, approximately 1,566 fewer acres of unreclaimed surface disturbance would exist in the three subwatersheds where special status fish species potentially occur. Approximately 53 percent of the unreclaimed surface in these subwatersheds would be related to coal mining activities. The lower level of surface disturbance could result in slightly lower sediment input to intermittent drainages. It is anticipated that associated impacts to special status fish species would be low, based on implementation of erosion control measures and NPDES permit requirements.

Under this scenario, construction of an additional linear facility would result in the crossing of at least one perennial stream (Belle Fourche River). Related construction activities would result in temporary surface disturbance and potentially the loss of riparian vegetation on either side of the river. One special status fish species (plains minnow) occurs in the upper portion of this drainage. As habitat for the plains minnow is located upstream of the likely proposed crossing, no impacts to this species are expected.

CBNG-related groundwater discharge would be slightly higher under this scenario (approximately 2,791 additional mmgpy); however, increased flows are not expected to reach perennial stream segments due to relatively low discharge volumes.

2.4.2.4 Year 2015 – Upper Production Scenario

Terrestrial Wildlife

Potential impacts to wildlife habitat as a result of RFD activities would be similar to those described under the 2010 – Lower Production Scenario, except approximately 93,480 additional acres would be disturbed. Under this scenario, past and projected activities in the cumulative effects study area are projected to result in the total cumulative disturbance of approximately 433,392 acres of habitat (or approximately 9.6 percent of the study area) by the year 2015. Of the 433,392 acres, it is estimated that 124,545 acres (29 percent) would be associated with coal mining activities.

Of the 433,392 acres of total cumulative habitat disturbance, approximately 290,822 acres (67 percent) would be reclaimed by 2015. The remaining 142,570 acres of habitat disturbance would be reclaimed incrementally or following a project's completion, depending on the type of development activity and permit requirements. Of the 124,545 acres of habitat disturbance associated with coal mining activities, it is projected that approximately 65,396 acres (53 percent) would be reclaimed by 2015. Of the remaining 59,149 acres of coal mining-related disturbance, it is estimated that approximately 27,009 acres would be unavailable for concurrent reclamation due to the presence of long-term facilities which would be reclaimed near the end of each mine's life.

Reclamation of the remaining 32,140 acres of disturbance would proceed concurrently with mining operations.

Game Species. Impacts to game species as a result of RFD activities would be the same as described under the 2010 – Lower Production Scenario, except there would be slightly higher impacts to some big game ranges. Potential impacts to big game ranges from coal mine development in the cumulative effects study area are presented in **Table 2.4-4**. Impacts to small game species would be the same as discussed for the 2010 – Lower Production Scenario, except approximately 93,480 additional acres of potential habitat would be disturbed under this scenario.

Table 2.4-4
Potential Cumulative Disturbance to Big Game Ranges from Coal Mine Development under the 2015 – Upper Production Scenario (acres and percent affected)

Species	Big Game Range[1]			
	Crucial Winter	Severe Winter	Winter Yearlong	Yearlong
Pronghorn	N/A	1,460 (3 percent)	34,177 (2 percent)	36,999 (1 percent)
White-tailed Deer	N/A	N/A	N/A	1,495 (0.7 percent)
Mule Deer	N/A	N/A	7,285 (0.5 percent)	27,205 (1 percent)
Elk	24 (0.4 percent)	N/A	351 (1 percent)	1,162 (0.7 percent)

[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 cumulative effects study area was divided by the sum of the potential disturbance acreage for 2015 (based on GIS mapping of coal reserves for the 2015 upper production scenario) and existing (2003) disturbance from coal mine development.

Potential impacts associated with RFD-related groundwater production and disposal would be the same as described under the 2010 – Lower Production Scenario with the following exception. Coal mining and CBNG activities in the cumulative effects study area would result in the annual use of approximately 5,049 mmgpy of additional water than under the 2010 – Lower Production Scenario. Most, if not all, of the coal mine-produced water would be consumed during operation. Up to approximately 2,791 mmgpy of additional CBNG-produced water would be discharged and would be available for area wildlife (e.g., waterfowl).

Nongame Species. Potential impacts to nongame species as a result of RFD activities would be the same as discussed for the 2010 – Lower Production Scenario, except that approximately 93,480 additional acres of potential habitat would be disturbed under this scenario.

Fisheries. Under this scenario, impacts to fisheries as a result of RFD activities would be the same as described under the 2010 – Lower Production Scenario, with the following exceptions. RFD activities would result in an additional 7,771 acres of unreclaimed surface disturbance. The higher level of unreclaimed surface disturbance could result in higher sediment input to drainages. Most of the increased surface disturbance would occur in the Antelope Creek, Upper Belle Fourche River,

and Upper Cheyenne River subwatersheds. The contribution of effects from coal mine development on fisheries would increase slightly to 41 percent when comparing unreclaimed surface disturbance from coal mining to total disturbance within the six subwatersheds. However, it is anticipated that impacts to fish species would be low, based on implementation of erosion control measures and NPDES permit requirements.

Under this scenario, construction of one additional linear facility would cross the Belle Fourche River. Related construction activities would result in temporary surface disturbance and potentially the loss of riparian vegetation on either side of the river. However, these impacts are not anticipated to affect habitat quality for fisheries in the overall section of the stream.

CBNG-related groundwater discharge would be slightly higher under this scenario (approximately 2,791 additional mmgpy); however, increased flows are not expected to reach perennial stream segments due to relatively low discharge volumes.

Special Status Species

Special Status Wildlife Species. Potential impacts to special status species as a result of RFD activities would be the same as described under the 2010 – Lower Production Scenario, except that approximately 93,480 additional acres of potential habitat would be disturbed under this scenario.

Based on GIS mapping of future coal reserves and existing (2003) disturbance from coal development, potential impacts to sage grouse habitat would be similar to those described under the 2010 – Lower Production Scenario, except 15 leks would be directly disturbed by coal mine development and 49 lek sites would occur within 2 miles of coal mining activities in the cumulative effects study area by 2015. However, an unquantifiable number of these lek sites initially could be impacted by CBNG activity, which would occur in advance of coal mine development.

Special Status Fish Species. Under this scenario, impacts to special status fish species as a result of RFD activities would be the same as described under the 2010 – Lower Production Scenario, with the following exceptions. RFD activities would result in an additional 12 acres of cumulative unreclaimed surface disturbance in the three subwatersheds where special status fish species potentially occur. Approximately 55 percent of the unreclaimed surface in these subwatersheds would be related to coal mining activities. The higher level of surface disturbance could result in slightly higher sediment input to drainages. However, it is anticipated that impacts to special status fish species would be low, based on implementation of erosion control measures and NPDES permit requirements.

Under this scenario, construction of one additional linear facility would cross the Belle Fourche River. Related construction activities would result in temporary surface disturbance and potentially the loss of riparian vegetation on either side of the river. One special status fish species (plains minnow) occurs in the upper portion of this drainage. As habitat for the plains minnow is located upstream of the likely proposed crossing, no impacts to this species are expected.

CBNG-related groundwater discharge would be slightly higher under this scenario (approximately 2,791 additional mmgpy); however, increased flows are not expected to reach perennial stream segments due to relatively low discharge volumes.

2.4.2.5 Year 2020 – Lower Production Scenario

Terrestrial Wildlife

Potential impacts to wildlife habitat as a result of RFD activities would be similar to the 2010 - Lower Production Scenario, except approximately 163,173 additional acres would be disturbed. Under this scenario, past and projected activities in the cumulative effects study area are projected to result in the total cumulative disturbance of approximately 503,085 acres of habitat (or approximately 11.2 percent of the study area) by the year 2020. Of the 503,085 acres of total disturbance, it is projected that approximately 137,443 acres (27 percent) would be associated with coal mining activity.

Of the 503,085 acres of total habitat disturbance, approximately 367,999 acres (73 percent) would be reclaimed by 2020. The remaining 135,085 acres of habitat disturbance would be reclaimed incrementally or following a project's completion, depending on the type of development activity and permit requirements. Of the 137,443 acres of habitat disturbance associated with coal mining activities, it is estimated that approximately 79,463 acres (58 percent) would be reclaimed by 2020. Of the remaining 57,979 acres of coal mining-related disturbance, it is estimated that approximately 28,797 acres would be unavailable for concurrent reclamation due to the presence of long-term facilities which would be reclaimed near the end of each mine's life. Reclamation of the remaining 29,182 acres of disturbance would proceed concurrently with mining operations.

Game Species. Impacts to game species as a result of RFD activities would be the same as described under the 2010 – Lower Production Scenario, except there would be slightly higher impacts to some big game ranges. Potential impacts to big game ranges from coal mining activities in the cumulative effects study area are presented in **Table 2.4-5**. Impacts to small game species would be the same as described under the 2010 – Lower Production Scenario, except approximately 163,173 additional acres of potential habitat would be disturbed under this scenario.

Table 2.4-5
Potential Cumulative Disturbance to Big Game Ranges from Coal Mine Development under the Year 2020 – Lower Production Scenario (acres and percent affected)

Species	Big Game Range[1]			
	Crucial Winter	Severe Winter	Winter Yearlong	Yearlong
Pronghorn	N/A	1,422 (3 percent)	33,637 (2 percent)	35,714 (1 percent)
White-tailed Deer	N/A	N/A	N/A	1,704 (0.7 percent)
Mule Deer	N/A	N/A	6,958 (0.4 percent)	27,004 (1 percent)
Elk	24 (0.4 percent)	N/A	351 (1 percent)	1,121 (0.7 percent)

[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 cumulative effects study area was divided by the sum of the potential disturbance acreage for 2020 (based on GIS mapping of coal reserves for the 2020 lower production scenario) and existing (2003) disturbance from coal mine development.

Potential impacts associated with RFD-related groundwater production and disposal would be the same as described under the 2010 – Lower Production Scenario with the following exception. Approximately 914 fewer mmgpy of CBNG-produced water would be discharged, resulting in a slight reduction in water availability for area wildlife (e.g., waterfowl).

Nongame Species. Potential impacts to nongame species as a result of RFD activities would be the same as described under the 2010 – Lower Production Scenario, except approximately 163,173 additional acres of potential habitat would be disturbed under this scenario.

Fisheries. Under this scenario, impacts to fisheries as a result of RFD activities would be the same as described under the 2010 – Lower Production Scenario, with the following exceptions. RFD activities would result in an additional 286 acres of cumulative unreclaimed surface disturbance. The higher level of unreclaimed surface disturbance could result in higher sediment input to drainages. Most of the increased surface disturbance would occur in the Antelope Creek, Upper Belle Fourche River, and Upper Cheyenne River subwatersheds. The contribution of effects from coal mine development on fisheries would increase slightly to 43 percent when comparing unreclaimed surface disturbance from coal mining to total disturbance within the six subwatersheds. However, it is anticipated that impacts to fish species would be low, based on implementation of erosion control measures and NPDES permit requirements.

CBNG-related groundwater discharge would be slightly lower under this scenario (approximately 914 fewer mmgpy); however, there would be no effect to perennial streams as even the projected maximum discharge flows are not expected to reach perennial stream segments due to relatively low discharge volumes.

Special Status Species

Special Status Wildlife Species. Potential impacts to special status species as a result of RFD activities would be the same as described under the 2010 – Lower production Scenario, except approximately 163,173 additional acres of potential habitat would be disturbed under this scenario.

Based on GIS mapping of future coal reserves and existing (2003) disturbance from coal mining activities, potential impacts to sage grouse habitat would be similar to those discussed under the 2010 – Lower Production Scenario, except 15 leks would be directly disturbed by coal mine development and 50 lek sites would occur within 2 miles of coal mining activities in the cumulative effects study area by 2020. However, an unquantifiable number of these lek sites initially could be impacted by CBNG activity, which would occur in advance of coal mine development.

Special Status Fish Species. Under this scenario, impacts to special status fish species as a result of RFD activities would be the same as described under the 2010 – Lower Production Scenario, with the following exceptions. As a result of ongoing reclamation, approximately 4,230 fewer acres of unreclaimed surface disturbance would exist in the three subwatersheds where special status fish species potentially occur. Approximately 54 percent of the unreclaimed surface in these subwatersheds would be related to coal mining activities. The lower level of surface disturbance could result in slightly lower sediment input to drainages. It is anticipated that associated impacts to special status fish species would be low, based on implementation of erosion control measures and NPDES permit requirements.

CBNG-related groundwater discharge would be slightly lower under this scenario (approximately 914 fewer mmgpy); however, there would be no effect to perennial streams as even the projected maximum discharge flows are not expected to reach perennial stream segments due to relatively low discharge volumes.

2.4.2.6 Year 2020 – Upper Production Scenario

Terrestrial Wildlife

Potential impacts to wildlife habitat as a result of RFD activities would be similar to the 2010 - Lower Production Scenario, except approximately 174,820 additional acres would be disturbed. Under this scenario, past and projected development activities in the cumulative effects study area would result in the total cumulative disturbance of approximately 514,732 acres of habitat (or approximately 11.5 percent of the study area) by the year 2020. Of the 514,732 acres of total disturbance, it is estimated that 149,089 acres (29 percent) would be associated with coal mining activities.

Of the 514,732 acres of total cumulative habitat disturbance, approximately 374,732 (73 percent) would be reclaimed by 2020. The remaining 139,998 acres of habitat disturbance would be reclaimed incrementally or following a project's completion, depending on the type of development activity and permit requirements. Of the 149,089 acres of habitat disturbance associated with coal mining activities, it is projected that approximately 86,196 acres (58 percent) would be reclaimed by 2020. Of the remaining 62,890 acres of coal mining-related disturbance, it is estimated that approximately 28,345 acres would be unavailable for concurrent reclamation due to the presence of long-term facilities which would be reclaimed near the end of each mine's life. Reclamation of the remaining 34,545 acres of disturbance would proceed concurrently with mining operations.

Game Species. Impacts to game species as a result of RFD activities would be the same as described under the 2010 – Lower Production Scenario, except there would be slightly higher impacts to some big game ranges. Potential cumulative impacts to big game ranges from coal mining activities in the cumulative effects study area are presented in **Table 2.4-6**. Impacts to small game species would be the same as described under the 2010 – Lower Production Scenario, except approximately 174,820 additional acres of potential habitat would be disturbed under this scenario.

Potential impacts associated with RFD-related groundwater production and disposal would be the same as described under the 2010 – Lower Production Scenario with the following exception. Coal mining and CBNG activities in the cumulative effects study area would result in the annual production of approximately 3,705 fewer mmgpy of water than under the 2010 – Lower Production Scenario. Most, if not all, of the coal mine-produced water would be consumed during operation. Approximately 914 fewer mmgpy of CBNG-produced water would be discharged, resulting in a slight reduction in water availability for area wildlife (e.g., waterfowl).

Nongame Species. Potential impacts to nongame species as a result of RFD activities would be the same as described under the 2010 – Lower Production Scenario, except approximately 174,820 additional acres of potential habitat would be disturbed under this scenario.

Table 2.4-6
Potential Cumulative Disturbance to Big Game Ranges from Coal Mine Development under the Year 2020 – Upper Production Scenario (acres and percent affected)

Species	Big Game Range[1]			
	Crucial Winter	Severe Winter	Winter Yearlong	Yearlong
Pronghorn	N/A	1,422 (3 percent)	33,580 (2 percent)	37,437 (2 percent)
White-tailed Deer	N/A	N/A	N/A	1,707 (0.8 percent)
Mule Deer	N/A	N/A	7,413 (0.5 percent)	27,990 (1 percent)
Elk	24 (0.4 percent)	N/A	351 (1 percent)	1,168 (0.7 percent)

[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 cumulative effects study area was divided by the sum of the potential disturbance acreage for 2020 (based on GIS mapping of coal reserves for the 2020 upper production scenario) and existing (2003) disturbance from coal mine development.

Fisheries. Under this scenario, impacts to fisheries as a result of RFD activities would be the same as described under the 2010 – Lower Production Scenario, with the following exceptions. RFD activities would result in an additional 5,199 acres of cumulative unreclaimed surface disturbance. The higher level of surface disturbance could result in higher sediment input to drainages. Most of the increased surface disturbance would occur in the Antelope Creek, Upper Belle Fourche River, and Upper Cheyenne River subwatersheds. The contribution of effects from coal mine development on fisheries would increase slightly to 45 percent when comparing unreclaimed surface disturbance from coal to total disturbance within the six subwatersheds. However, it is anticipated that impacts to fish species would be low, based on implementation of erosion control measures and NPDES permit requirements.

CBNG-related groundwater discharge would be slightly lower under this scenario (approximately 914 fewer mmgpy); however, there would be no effect to perennial streams as even the projected maximum discharge flows are not expected to reach perennial stream segments due to relatively low discharge volumes.

Special Status Species

Special Status Wildlife Species. Potential impacts to special status species as a result of RFD activities would be the same as described under the 2010 – Lower Production Scenario, except approximately 174,820 additional acres of potential habitat would be disturbed under this scenario.

Based on GIS mapping of future coal reserves and existing (2003) disturbance from coal mine development, potential impacts to sage grouse habitat would be similar to those described under the 2010 – Lower Production Scenario, except 15 leks would be directly disturbed by coal mine development and 48 lek sites would occur within 2 miles of coal mining activities in the cumulative

effects area by 2020. (Note: The difference in the number of lek sites that would occur within 2 miles of coal mining activities under the lower production scenario versus the upper production scenario is due to slight variations in the projected disturbance areas for these scenarios.) However, an unquantifiable number of these lek sites initially could be impacted by CBNG activity, which would occur in advance of coal mine development.

Special Status Fish Species. Under this scenario, impacts to special status fish species as a result of RFD activities would be the same as described under the 2010 – Lower Production Scenario, with the following exceptions. As a aresult of ongoing reclamation, approximately 2,430 fewer acres of cumulative unreclaimed surface disturbance would exist in the three subwatersheds where special status fish species potentially occur. Approximately 57 percent of the unreclaimed surface in these subwatersheds would be related to coal mining activities. The lower level of surface disturbance could result in slightly lower sediment input to drainages. It is anticipated that associated impacts to special status fish species would be low, based on implementation of erosion control measures and NPDES permit requirements.

CBNG-related groundwater discharge would be slightly lower under this scenario (approximately 914 fewer mmgpy); however, there would be no effect to perennial streams as even the projected maximum discharge flows are not expected to reach perennial stream segments due to relatively low discharge volumes.

2.5 Grazing and Other Agricultural Uses

2.5.1 Study Area

The cumulative effects study area for grazing and other agricultural uses includes the following subwatersheds in portions of Sheridan, Johnson, Campbell, and Converse counties: Upper Powder River, Little Powder River, Upper Belle Fourche River, Upper Cheyenne River, Antelope Creek, and Dry Fork Cheyenne River (**Figure 1-1**). It includes portions of the area administered by the BLM Buffalo and Casper field offices, and a portion of the TBNG, which is administered by the FS (**Figure 1-2**). Private lands comprise most of the surface ownership in the study area (**Figure 1-3**).

2.5.2 Cumulative Impacts

As described in the Task 2 Report for the PRB Coal Review, Past and Present and Reasonably Foreseeable Development Activities (ENSR 2005c), a total of approximately 220,688 acres of vegetation has been disturbed by development activities in the six subwatersheds in the cumulative effects study area (as of 2003). Of the 220,688 acres of total disturbance, approximately 68,794 acres (31 percent) were associated with coal mine development.

Of the 220,688 acres of total cumulative disturbance, approximately 111,786 acres (51 percent) have been reclaimed. The remaining 108,901 acres of disturbance would be reclaimed incrementally or following a project's completion, depending on the type of development activity and permit requirements. Of the 68,794 total cumulative acres of vegetation disturbance associated with coal mine development, approximately 21,238 acres (31 percent) have been reclaimed (as of 2003). Of the remaining 47,556 acres of disturbance, approximately 24,097 acres currently are not available for reclamation, as they are occupied by long-term facilities which are needed to conduct mining operations. These areas would be reclaimed near the end of the mine life. Reclamation of the remaining 23,459 acres, which represent areas of active mining and areas where coal has been recovered but reclamation has not been completed, would proceed concurrently with coal mining. (Note: minor discrepancies in acreages are the result of rounding.)

In general, potential impacts to grazing and other agricultural uses in the cumulative effects study area as a result of RFD 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 animal unit months (AUMs), temporary loss of water-related range improvements (e.g., improved springs, water pipelines, stock ponds) and other range improvements (e.g., fences, cattle guards, etc.), and restricted movement of livestock within an allotment due to a project's development and operation (e.g., coal mines, etc.), 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/cropland productivity in areas that would not be reclaimed in the near term (e.g., power plant sites, etc.). 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.

Based on existing information, discrete locations for future well sites and actual disturbance footprints associated with mining of future coal reserves currently are unknown. As a result, the location of these future disturbance areas in relation to BLM- and FS-administered rangeland cannot be determined. However, in an effort to quantify potential impacts to grazing as a result of RFD activities, the total number of AUMs (regardless of land ownership) has been determined for each scenario and time period in this study.

Based on an average stocking rate of 6 acres per AUM, approximately 36,781 AUMs temporarily have been lost as a result of the 220,688 acres of total cumulative disturbance on BLM- and FS-administered, state, and private lands in the six subwatershed study area as of the end of 2003. Of the 36,781 AUMs, approximately 11,466 AUMs (31 percent) have been associated with coal mining activities. As of the end of 2003, approximately 18,631 AUMs had been regained as a result of reclamation. The majority of the remaining 18,150 AUMs would be regained following successful reclamation.

The effects to grazing and other agricultural uses from RFD activities in the study area under two production scenarios (lower and upper production scenarios) for the years 2010, 2015, and 2020 are discussed below.

2.5.2.1 Year 2010 – Lower Production Scenario

Grazing

General impacts to grazing would be the same as described in Section 2.5.2. Under this scenario, past and projected activities in the study area would result in approximately 339,912 acres of total cumulative disturbance on BLM- and FS-administered, state, and private lands by 2010. Based on an average stocking rate of 6 acres per AUM, this disturbance would result in the temporary loss of approximately 56,652 AUMs. Of the 56,652 AUMs temporary lost by 2010, approximately 34,185 AUMs would have been regained as a result of successful reclamation. The majority of the remaining 22,467 AUMs (40 percent of which would be related to coal mining activities) would be regained following successful reclamation, excluding permanent facilities such as power plants and railroads. Reclamation would occur concurrent with, or following the completion of, operations, depending on the type of project. Impacts to range improvements could occur, depending on their location in relation to the RFD activities.

Other Agricultural Uses

It is projected that approximately 98,662 acres of disturbance would occur in association with coal mining activities, of which approximately 59 acres (less than 1 percent) would affect agricultural land. Other RFD 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.

2.5.2.2 Year 2010 – Upper Production Scenario

Grazing

Potential impacts to livestock grazing as a result of RFD activities would be similar to those described under the 2010 – Lower Production Scenario, except an additional 631 AUMs temporarily would be lost as a result of 3,786 acres of additional surface disturbance. Of the approximately 57,283 total AUMs lost as a result of past and projected development-related disturbance, approximately 34,491 AUMs would have been regained as a result of successful reclamation. The majority of the remaining 22,792 AUMs (41 percent of which would be related to coal mining activities) would be regained following successful reclamation. Additional impacts to range improvements and water-related range improvements could occur as a result of the increased level of surface disturbance.

Other Agricultural Uses

Impacts to agricultural lands would be similar to those described under the 2010 – Lower Production Scenario, with the following exception. It is projected that under this scenario 102,448 acres of disturbance would be associated with coal mine development, of which approximately 60 acres (less than 1 percent) would affect agricultural land.

2.5.2.3 Year 2015 – Lower Production Scenario

Grazing

Potential impacts to livestock grazing as a result of RFD activities would be similar to those described under the 2010 – Lower Production Scenario, except an additional 14,362 AUMs temporarily would be lost as a result of 86,172 acres of additional surface disturbance. Of the approximately 71,014 total AUMs lost as a result of past and projected development-related disturbance, approximately 47,769 AUMs would have been regained as a result of successful reclamation. The majority of the remaining 23,245 AUMs (40 percent of which would be related to coal mining activities) would be regained following successful reclamation. Additional impacts to range improvements and water-related range improvements could occur as a result of the increased level of surface disturbance.

Other Agricultural Uses

Impacts to agricultural lands would be similar to those described under the 2010 – Lower Production Scenario, with the following exception. It is projected that under this scenario 117,236 acres of disturbance would be attributed to coal mine development, of which approximately 134 acres (less than 1 percent) would affect agricultural land.

2.5.2.4 Year 2015 – Upper Production Scenario

Grazing

Potential impacts to livestock grazing as a result of RFD activities would be similar to those described under the 2010 – Lower Production Scenario, except an additional 15,580 AUMs temporarily would be lost as a result of 93,480 acres of additional surface disturbance. Of the approximately 72,232 total AUMs lost as a result of past and projected development-related disturbance, approximately 48,470 AUMs would have been regained as a result of successful reclamation. The majority of the remaining 23,761 AUMs (41 percent of which would be related to coal mining activities) would be regained following successful reclamation. Additional impacts to range improvements and water-related range improvements could occur as a result of the increased level of surface disturbance.

Other Agricultural Uses

Impacts to agricultural lands would be similar to those described under the 2010 – Lower Production Scenario, with the following exception. It is projected that 124,545 acres of disturbance would be associated with coal mine development, of which approximately 139 acres (less than 1 percent) would affect agricultural land.

2.5.2.5 Year 2020 – Lower Production Scenario

Grazing

Potential impacts to livestock grazing as a result of RFD activities would be similar to those described under the 2010 – Lower Production Scenario, except an additional 27,195 AUMs temporarily would be lost as a result of 163,173 acres of additional surface disturbance. Of the approximately 83,847 total AUMs lost as a result of past and projected development-related disturbance, approximately 61,333 AUMs would have been regained as a result of successful reclamation. The majority of the remaining 22,514 AUMs (43 percent of which would be related to coal mining activities) would be regained following successful reclamation. Additional impacts to range improvements and water-related range improvements could occur as a result of the increased level of surface disturbance.

Other Agricultural Uses

Impacts to agricultural lands would be similar to those described under the 2010 – Lower Production Scenario, with the following exception. It is projected that 137,443 acres of disturbance would be associated with coal mine development, of which approximately 206 acres (less than 1 percent) would affect agricultural land.

2.5.2.6 Year 2020 – Upper Production Scenario

Grazing

Potential impacts to livestock grazing as a result of RFD activities would be similar to those described under the 2010 – Lower Production Scenario, except an additional 29,137 AUMs temporarily would be lost as a result of 174,820 acres of additional surface disturbance. Of the approximately 85,788 total AUMs lost as a result of past and projected development-related disturbance, approximately 62,455 AUMs would have been regained as a result of successful reclamation. The majority of the remaining 23,333 AUMs (45 percent of which would be related to coal mining activities) would be regained following successful reclamation. Additional impacts to range improvements and water-related range improvements could occur as a result of the increased level of surface disturbance.

Other Agricultural Uses

Impacts to agricultural lands would be similar to those described under the 2010 – Lower Production Scenario, with the following exception. It is projected that 149,089 acres of disturbance would be associated with coal development, of which approximately 289 acres (less than 1 percent) would affect agricultural land.

2.6 Cultural Resources and Native American Concerns

2.6.1 Study Area

The cumulative effects study area for cultural resources includes the following subwatersheds in portions of Sheridan, Johnson, Campbell, and Converse counties: Upper Powder River, Little Powder River, Upper Belle Fourche River, Upper Cheyenne River, Antelope Creek, and Dry Fork Cheyenne River (**Figure 1-1**). It includes portions of the area administered by the BLM Buffalo and Casper field offices and a portion of the TBNG, which is administered by the FS (**Figure 1-2**).

2.6.2 Cumulative Impacts

2.6.2.1 Cultural Resources Regulations, Evaluation Procedures, and Management Planning

Regulations

At the time of permitting, the RFD activities considered in this study would be subject to the following regulations relative to cultural resources.

The goal of the consideration of historic properties under Section 106 of the National Historic Preservation Act of 1966 (NHPA) as amended, its implementing regulations, including but not limited to 36 Code of Federal Regulations (CFR) 800, 36 CFR 61, Executive Order 11593, and NEPA and its implementing regulations including 40 CFR 1500—1508, is the preservation of the cultural values embodied in those historic properties. The BLM national cultural resource management objectives to meet the requirements of the latter statutory authorities and additional related authorities listed in BLM Manual M8100.03 are:

A. Respond in a legally and professionally adequate manner to (1) the statutory authorities concerning historic preservation and cultural resource protection, and (2) the principles of multiple use.

B. Recognize the potential public and scientific uses of, and the values attributed to, cultural resources on public lands, and manage the lands and cultural resources so that these uses and values are not diminished, but rather are maintained and enhanced.

C. Contribute to land use planning and the multiple use management of the public lands in ways that make optimum use of the thousands of years of land use history inherent in cultural resource information, and that safeguard opportunities for attaining appropriate uses of cultural resources.

D. Protect and preserve in place representative examples of the full array of cultural resources on public lands for the benefit of scientific and public use by present and future generations.

E. Ensure that proposed land uses, initiated or authorized by BLM, avoid inadvertent damage to federal and non-federal cultural resources.

The operational objectives to achieve this goal are:

1. Identification of historic properties within the APE of proposed actions that are part of or associated with the federal undertaking;

2. Evaluation of the cultural values of those historic properties within appropriate historic contexts; and

3. Avoidance or minimization of adverse effects to those cultural values.

The cultural resources management objective of the BLM, including stewardship considerations in addition to Section 106 and NEPA compliance, is to "Protect, preserve, interpret, and manage significant cultural resources for their informational, educational, scientific, and recreational values" (BLM 2001:4). However, 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.

These objectives are achieved through:

1. Inventory;
2. Evaluation;
3. Native American Consultation;
4. Management Options; and
5. Monitoring

Inventory is the process of gathering together information on the cultural resources that are present in the area of a proposed undertaking. Levels of inventory include an overview that reviews documentation of previously known resources and intensive pedestrian survey that inspects the APE for all evidence of previously known and undocumented cultural resources. Site-specific inventories are required before surface disturbing activities for all federal actions that involve federal surface ownership, federal minerals ownership, federal funding, or federal permits. Cultural resource inventories must conform to current Wyoming standards and guidelines, including the BLM Handbook H-8111-1 Cultural Resources Wyoming Handbook, guidance for completion of the Wyoming Cultural Properties Form, and the Buffalo BLM Coal Bed Methane Guidebook.

Evaluation is the process of assessing the importance of a cultural resource site. All cultural resource sites and many Native American traditional places are evaluated in accordance with the National Register Criteria (36 CFR 60.4 [a-d]) and within a defined historic context. The National Register Criteria assess whether a site is eligible for listing on the National Register of Historic Places (NRHP) at the national, state, or local level. A site that is listed on or is eligible for the NRHP is considered a historic property. Typically, the majority of cultural resource sites are evaluated as not eligible. Cultural resources are evaluated as completely as possible during initial documentation. If a site cannot be conclusively evaluated from surface evidence and limited testing, the additional information or specialized analysis necessary to complete the evaluation are identified, and a recommendation is made for the most prudent and expedient procedure to complete the evaluation. Additional studies might include archival or other documentary research, evaluation of the resource

by a specialist, analysis of specialized samples, subsurface test excavations, or other forms of well-defined research that are beyond the scope of surface survey.

During Native American consultation, the agency authorizing the federal action will contact tribes that may have legitimate concerns within or related to proposed undertakings and convey the major findings of cultural resource inventories. The tribes may raise concerns about the treatment of cultural resources, natural resources, or natural landscape features that have traditional religious or cultural value. These groups also have concerns about handling inadvertent discoveries of human remains. Consultation is the government-to-government identification of concerns and discussion of their resolution.

Management options are standard treatments of historic properties, Native American concerns, or inadvertent discoveries. The preferred option for the treatment of historic properties is avoidance and protection. In most cases, the historic property can be avoided and protected by minor adjustments or stipulations to the proposed undertaking, especially if an adequate area has been surveyed for cultural resources. If a historic property cannot feasibly be avoided, which is likely to occur in the case of properties located within surface coal mine permit areas, data recovery or other mitigation measures are proposed. The nature and level of mitigation depend on the nature and extent of the adverse effect to the historic property and must be approved by the federal agency authorizing the action, in consultation with the State Historic Preservation Officer (SHPO) and, if applicable, the surface owner. Any data recovery plan must discuss the property in terms of the historic context and identify the research questions that would be addressed by the anticipated data classes.

Monitoring is conducted to: 1) verify that actions have complied with constraints and stipulations; 2) verify that the constraints and stipulations have achieved the intended objectives; and 3) evaluate whether management plans and objectives have achieved their goals. Monitoring includes monitoring construction for compliance, monitoring for potential discovery situations, and monitoring of ongoing operations.

Inventory and Evaluation

Cultural resource sites are defined as discrete locations of past human activity, which can include artifacts, structures, works of art, landscape modifications, and natural features or resources important to history or cultural tradition. These sites can include extensive cultural landscapes (e.g., farm or ranch landscapes), linear landscapes (e.g., historic trails with associated towns, forts, and way stations), or railroad landscapes and traditional use areas. In this document, significant sites are defined as those sites that are listed on, determined eligible for, or recommended eligible for the NRHP under the Criteria for Evaluation (36 CFR 60.4), and sites that have not been evaluated.

Federal regulations require cultural resource inventory, recordation, and evaluation of resources in the APE as part of the approval process. Archaeological clearance is required by the Section 106 process prior to disturbance for all federal undertakings, including projects on federal surface, projects recovering federal minerals, and all projects requiring federal funding or permits. All areas of proposed ground-disturbing activity must be inventoried for cultural resources. Any discovered resources must be documented and evaluated for eligibility for the NRHP. In most cases and with proper planning, effects to eligible properties can be minimized. Indirect effects from changes to soil stability or drainage patterns cannot always be anticipated. Indirect effects can be minimized by soil

stabilization, fencing, or protective flagging to prevent inadvertent traffic in sensitive areas. Direct and indirect effects when eligible sites cannot be avoided would be subject to mitigation procedures. Adverse effects can be minimized by implementation of approved data recovery plans. There are a large number of unevaluated sites. In addition, specific procedures are established for the treatment of unanticipated discoveries and human remains that were not identified by surface investigation.

An important element of the inventory and evaluation process is the evaluation of previously known and newly discovered cultural resources and an assessment of potential effects. The following list represents the potential sequence in the evaluation of a cultural resource.

- A cultural resource is identified and documented or revisited.
- The resource does not meet any of the National Register Criteria. If the resource is evaluated as not eligible, no further work is required beyond the documentation of the site and its evaluation. Generally, the majority of cultural resources are evaluated as not eligible.
- Information available from surface survey and limited testing is inadequate to evaluate the resource. Additional historic documentation, specialized analysis, or subsurface testing is necessary to complete evaluation. If, after this additional work, the resource is evaluated as not eligible, no further work is required.
- The resource meets one or more of the National Register Criteria and is identified as a historic property.
- Assessment of the potential effects of the proposed actions indicates that the historic property will not be affected or that the proposed actions can be modified to avoid any adverse effects.
- Assessment of the potential effects of the proposed actions indicates that portions of the historic property may be affected, but that those portions of the historic property do not contribute to the eligibility of the historic property. Constraints are identified to protect the contributing portions of the historic property from adverse effects.
- If adverse effects to the historic property cannot feasibly be avoided, a treatment is recommended to minimize or mitigate adverse effects.

Adaptive Management and Planning Model

The Wyoming SHPO currently is developing a geoarchaeological model to help identify locations of deposits that might contain buried and intact archaeological material. The model will inform the user who wants to know if a particular known site is located within an area where the burial of subsurface cultural material is possible. Likewise, the model informs the user that certain landscapes have the geological qualities conducive to site burial. If applied properly, the burial model could lead to more efficient management of cultural resources so that both resource preservation and development activities are facilitated.

In the past, all Section 106 applications have been evaluated in the same manner, no matter where in the state the project was proposed. The model would vary the application process and mitigation requirements. Those areas where there is a high probability of encountering buried archaeological

sites either could be avoided by the developers using the model, or could require different mitigation from those sites located in areas with a low prediction of finding buried resources.

The goal of the model is to use soils mapping, surficial geology, and alluvial valley information to help predict the location of sediments that are the right age and type to contain significant buried archaeological sites. Sensitivity zones are classified as very high, high, very low, and low; the remaining areas are classified as moderate. The sensitivity classification system ranks areas according to potential geological conditions that favor buried site formation. Zones rated as very high and high predict locations where conditions are favorable for: 1) retention of archaeological behavioral-spatial context; 2) preservation of perishable archaeological materials (e.g., bone and charcoal); and 3) stratigraphic separation of archaeological occupation zones. It should be noted that the sensitivity model only predicts where site preservation conditions might be favorable, and not locations that may have been attractive to human activity.

Ultimately, the information supplied by the model should be supplemented by training in its use. The proper application of the information will require targeted field visits by agency and project archaeologists. It also should be noted that the model would not require any changes to minimum Section 106 management requirements. No reduction in cultural resources inventory would be recommended. Minimal testing requirements would be supported, and deeper testing would be recommended where indicated. As a way to fulfill the model's adaptive management goal, the model will be subjected to ongoing maintenance. In the future, the model could be used to allow for better planning and help reduce conflicts between management goals of site preservation and resource development.

2.6.2.2 Year 2010 – Lower Development Scenario

The potential number of cultural resource sites that could be affected by RFD activities was evaluated based on the average number of sites per square mile as determined by previous surveys in the study area. The total square miles, square miles previously surveyed, percent previously surveyed, and average number of known sites per square mile by subwatershed are shown in **Table 2.6-1**. The amount of land involved varies greatly by subwatershed, with the largest amount of acreage in the Upper Powder River subwatershed and the smallest in the Upper Cheyenne River. Previously surveyed areas and the percent of area previously surveyed also varied greatly. The average number of sites per square mile for the study area is 5.5, with the largest number of sites per square mile found in the Dry Fork Cheyenne River subwatershed and the smallest in the Upper Belle Fourche River subwatershed. However, in **Table 2.6-1**, the site density is inflated by thematic surveys that reported sites, but where no survey acreage is associated. The number of sites per square mile in each subwatershed in the study area appears low; however, it is likely a result of the amount of surveyed acreage being low rather than indicating a low site density. The most common sites in the study area are prehistoric artifact scatters and rural historic sites.

Table 2.6-1
Previously Surveyed Area and Average Density of Known Cultural Resource Sites per Square Mile by Subwatershed

Subwatershed	Total Square Miles	Square Miles Surveyed	Percentage Surveyed	Sites per Square Miles
Antelope Creek	1,031.7	206.4	20.0	4.7
Dry Fork Cheyenne River	483.3	64.0	13.2	8.9
Little Powder River	1,352.3	158.6	11.7	4.6
Upper Belle Fourche River	1,320.1	245.3	18.6	4.3
Upper Cheyenne River	323.1	131.2	40.6	5.2
Upper Powder River	2,505.5	229.4	9.2	5.0

Source: BLM 2003.

Adverse effects to cultural resources could result from the construction and operation of the RFD activities analyzed in this study. Effects to sites could be direct as a result of construction or other earth-disturbing activities, or could be indirect as a result of increased erosion, increased access, vibration from traffic or machinery, or alteration of the setting. Adverse effects to cultural properties may include alteration of visual, atmospheric, and auditory aspects of site setting, or site destruction by placement of facilities and infrastructure. Indirect effects could be particularly important in the consideration of sites that are eligible for their location, setting, and feeling, such as emigrant trails or locations of historic battles. Cultural sites are a nonrenewable resource and, if disturbed, lose potential information, integrity, and heritage value. Avoidance of eligible sites is the preferred mitigation. Although careful project planning could help alleviate inadvertent or unintentional effects to eligible sites, these effects still could occur. Data recovery plans could be undertaken in cases where eligible sites could not be avoided or would be unintentionally affected. Mitigation of adverse impacts may include, site avoidance through project relocation or redesign, visual resource management including adjustment of the color of facilities, landform screening, detailed mapping and recordation, historic documentation, or data recovery.

Due to the requirements for compliance with federal regulations including, but not limited to, Section 106 of the NHPA, NEPA, and the Archeological Resources Protection Act, all RFD-related disturbance areas on federal lands, or on lands that involve federal mineral ownership, would be inventoried for cultural resources prior to ground-disturbing activities. Equivalent regulatory mandates are not in place for activities on private or State of Wyoming lands that do not involve split estates. However, if a RFD activity involves a federal permit or authorization, federal historic preservation requirements would apply.

Split estates, where mineral ownership is federal and surface ownership is private, occur in much of the study area. In these areas, during the federal permitting process, the surface owners must be kept informed of activities planned on their property, including the identification and treatment of historic and prehistoric resources. They also must be made aware that resources on their property belong to them, that they would be consulted in the mitigation process, and that they would have the option of taking possession of any cultural materials recovered on their land after the completion of appropriate documentation and analysis. The responsibility of the authorizing federal agency is to consider the effects of the agency's permitting decision on historic properties. Where necessary and

possible, the authorizing federal agency, in consultation with the Wyoming SHPO, would address mitigation of adverse impacts to historic properties.

Under this scenario, past and projected activities would result in approximately 531 square miles of cumulative disturbance (approximately 7.6 percent of the study area). Assuming that site density is uniform throughout each subwatershed, the average number of sites per square mile from **Table 2.6-1** was used as a multiplier to estimate the average number of sites in the APE given the square miles of projected cumulative disturbance (**Table 2.6-2**). The average number of cultural resource sites identified would be greater because an area larger than the projected surface disturbance would be surveyed. The potential number of sites affected by subwatershed would vary from a high of 704 (Upper Belle Fourche River subwatershed) to a low of 74 in the Dry Fork Cheyenne River subwatershed. All areas of ground disturbance associated with federal actions would be surveyed for cultural resources during the Applications for Permit to Drill (APD) process. Until those surveys have been completed, only rough estimates can be made of the actual number of eligible cultural resource sites that would be affected by RFD activities.

As development progresses in the study area, the opportunities for avoiding direct or indirect effects to historic properties would diminish. With increased development (particularly oil and gas), it will become increasingly difficult to avoid visual and auditory impacts to cultural landscapes.

Of the projected 531 square miles of cumulative disturbance, approximately 154 square miles would be associated with coal mining activities. The average number of sites per square mile for the study area (5.5) was used as a multiplier to estimate the average number of sites in the APE given the square miles of cumulative disturbance. Based on these calculations, 848 sites potentially could be affected by coal mining in the study area. In the future, the coal mines frequently would be advancing into areas where CBNG development already would have occurred. Many of the sites in those areas may have been avoided or previously protected through BLM- or FS- and SHPO-approved mitigation measures for the CBNG development; however, it would be necessary to re-evaluate potential impacts to those resources that would occur as a result of coal mining operations. The surface coal mines must conduct cultural resource inventories for all areas included within their mining permit. Consultation with SHPO must be completed prior to approval of the required federal mining plan for each mine. Data recovery plans would be required for sites that are recommended as eligible for the NRHP following testing and consultation with SHPO and that cannot be avoided when the coal is mined.

2.6.2.3 Year 2010 – Upper Production Scenario

Under this scenario, cumulative impacts would be the same as described for the lower production scenario in 2010, with the following exceptions. Past and projected activities would result in approximately 537 square miles of cumulative disturbance (approximately 7.7 percent of the study area). Assuming that site density is uniform throughout each subwatershed, the average number of sites per square mile from **Table 2.6-1** was used as a multiplier to estimate the average number of sites in the APE given the square miles of projected cumulative disturbance (**Table 2.6-2**). The average number of cultural resource sites identified would be greater because an area larger than the projected surface disturbance would be surveyed. The average number of sites potentially affected by subwatershed would vary from a high of 713 (Upper Belle Fourche River subwatershed) to a low of 74 (Dry Fork Cheyenne River subwatershed). All areas of ground disturbance associated with federal actions would be surveyed for cultural resources during the APD process.

Table 2.6-2
Square Miles of Projected Cumulative Disturbance and Number of Potentially Affected Cultural Resource Sites by Year and Subwatershed[1]

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

[1] Calculated based on database disturbance acreages prepared for the Task 2 Report for the Powder River Basin Coal Review, Past and Present and Reasonably Foreseeable Development Activities (Appendices A and D) (ENSR 2005c).
[2] The number of sites was calculated by multiplying the average sites per square mile (as shown in **Table 2.6-1**) by the number of square miles of projected cumulative disturbance.

Until those surveys have been completed, only rough estimates can be made of the number of eligible cultural resource sites that would be affected by RFD activities.

Of the projected 537 square miles of cumulative disturbance, approximately 160 square miles would be associated with coal mining activities. The average number of sites per square mile for the study area (5.5) was used as a multiplier to estimate the average number of sites in the APE given the square miles of cumulative disturbance. Based on these calculations, 880 sites potentially could be affected by coal mining in the study area. Impacts to cultural resource sites in proposed mine disturbance areas would be mitigated as discussed under the 2010 lower production scenario in Section 2.6.2.2.

2.6.2.4 Year 2015 – Lower Production Scenario

Under this scenario, cumulative impacts would be the same as described for the lower production scenario in 2010, with the following exceptions. Past and projected activities would result in approximately 665 square miles of cumulative disturbance (approximately 9.5 percent of the study area). Assuming that site density is uniform throughout each subwatershed, the average number of sites per square mile from **Table 2.6-1** was used as a multiplier to estimate the average number of sites in the APE given the square miles of projected cumulative disturbance (**Table 2.6-2**). The average number of cultural resource sites identified would be greater because an area larger than the projected surface disturbance would be surveyed. The average number of sites potentially affected by subwatershed would vary from a high of 953 (Upper Powder River subwatershed) to a low of 109 in the Dry Fork Cheyenne River subwatershed. All areas of ground disturbance associated with federal actions would be surveyed for cultural resources during the APD process. Until those surveys have been completed, only rough estimates can be made of the number of eligible cultural resource sites that would be affected by RFD activities.

Of the projected 665 square miles of cumulative disturbance, approximately 183 square miles would be associated with coal mining activities. The average number of sites per square mile for the study area (5.5) was used as a multiplier to estimate the average number of sites in the APE given the square miles of cumulative disturbance. Based on these calculations, 1,007 sites potentially could be affected by coal mining in the study area. Impacts to cultural resource sites in proposed mine disturbance areas would be mitigated as discussed under the 2010 lower production scenario in Section 2.6.2.2.

2.6.2.5 Year 2015 – Upper Production Scenario

Under this scenario, cumulative impacts would be the same as described for the lower production scenario in 2010, with the following exceptions. Past and present activities would result in approximately 677 square miles of cumulative disturbance (approximately 9.6 percent of the study area). Assuming that site density is uniform throughout each subwatershed, the average number of sites per square mile from **Table 2.6-1** was used as a multiplier to estimate the average number of sites in the APE given the square miles of cumulative disturbance (**Table 2.6-2**). The average number of cultural resource sites identified would be greater because an area larger than the projected surface disturbance would be surveyed. The average number of sites potentially affected by subwatershed would vary from a high of 953 (Upper Powder River subwatershed) to a low of 109 in the Dry Fork Cheyenne River subwatershed. All areas of ground disturbance associated with federal actions would be surveyed for cultural resources during the APD process. Until those

surveys have been completed, only rough estimates can be made of the number of eligible cultural resource sites that would be affected by RFD activities.

Of the projected 677 square miles of cumulative disturbance, approximately 194 square miles would be associated with coal mining activities. The average number of sites per square mile for the study area (5.5) was used as a multiplier to estimate the average number of sites in the APE given the square miles of cumulative disturbance. Based on these calculations, 1,070 sites potentially could be affected by coal mining in the study area. Impacts to cultural resource sites in proposed mine disturbance areas would be mitigated as discussed under the 2010 lower production scenario in Section 2.6.2.2.

2.6.2.6 Year 2020 – Lower Production Scenario

Under this scenario, cumulative impacts would be the same as described for the lower production scenario in 2010, with the following exceptions. Past and present activities would result in approximately 786 square miles of cumulative disturbance (approximately 11.2 percent of the study area). Assuming that site density is uniform throughout each subwatershed, the average number of sites per square mile from **Table 2.6-1** was used as a multiplier to estimate the average number of sites in the APE given the square miles of cumulative disturbance (**Table 2.6-2**). The average number of cultural resource sites identified would be greater because an area larger than the projected surface disturbance is surveyed. The average number of sites potentially affected by subwatershed would vary from a high of 1,159 (Upper Powder River subwatershed) to a low of 151 in the Dry Fork Cheyenne River subwatershed. All areas of ground disturbance associated with federal actions would be surveyed for cultural resources during the APD process. Until those surveys have been completed, only rough estimates can be made of the number of eligible cultural resource sites that would be affected by RFD activities.

Of the projected 786 square miles of cumulative disturbance, approximately 214 square miles would be associated with coal mining activities. The average number of sites per square mile for the study area (5.5) was used as a multiplier to estimate the average number of sites in the APE given the square miles of cumulative disturbance. Based on these calculations, 1,181 sites potentially could be affected by coal mining in the study area. Impacts to cultural resource sites in proposed mine disturbance areas would be mitigated as discussed under the 2010 lower production scenario in Section 2.6.2.2.

2.6.2.7 Year 2020 – Upper Production Scenario

Under this scenario, cumulative impacts would be the same as described for the lower production scenario in 2010, with the following exceptions. Past and present activities would result in approximately 804 square miles of cumulative disturbance (approximately 11.5 percent of the study area). Assuming that site density is uniform throughout each subwatershed, the average number of sites per square mile from **Table 2.6-1** was used as a multiplier to estimate the average number of sites in the APE given the square miles of cumulative disturbance (**Table 2.6-2**). The average number of cultural resource sites identified would be greater because an area larger than the projected surface disturbance is surveyed. The average number of sites potentially affected by subwatershed would vary from a high of 1,159 (Upper Powder River subwatershed) to a low of 151 in the Dry Fork Cheyenne River subwatershed. All areas of ground disturbance associated with federal actions would be surveyed for cultural resources during the APD process. Until those

surveys have been completed, only rough estimates can be made of the number of eligible cultural resource sites that would be affected by RFD activities.

Of the projected 804 square miles of cumulative disturbance, approximately 233 square miles would be associated with coal mining activities. The average number of sites per square mile for the study area (5.5) was used as a multiplier to estimate the average number of sites in the APE given the square miles of cumulative disturbance. Based on these calculations, 1,281 sites potentially could be affected by coal mining in the study area. Impacts to cultural resource sites in proposed mine disturbance areas would be mitigated as discussed under the 2010 lower production scenario in Section 2.6.2.2.

2.6.2.8 Native American Concerns

Prior to approval of future federally permitted projects, effects to traditional cultural properties, localities of traditional concern, and sacred sites must be considered. Federal regulations that require consultation with recognized Native American tribes include, but are not limited to:

- NHPA, as amended. This act requires federal agencies to consult with Indian tribes regarding federal undertakings in order to identify properties with tribal, religious, or cultural significance that may be eligible for the NRHP, and to determine ways to avoid or minimize effects to those properties.

- NEPA. This act requires federal agencies to consult with Native American tribes regarding land use plans.

- Federal Land Policy and Management Act. This act provides Native American tribes and groups the opportunity to express their views and identify places of concern.

- American Indian Religious Freedom Act. This act requires federal land management agencies to identify, through consultation, the concerns of traditional Native American religious practitioners, and to accommodate access to and ceremonial use of sacred sites in the planning process.

- Archaeological Resources Protection Act. This act requires consideration of Native American concerns and requires that federal land management agencies notify appropriate tribes before approving permits for excavation of archaeological resources if the location may have cultural or religious importance to the tribes.

- Native American Graves Protection and Repatriation Act. This act requires federal agencies to consult with appropriate tribes before the authorization of excavation or removal of Native American human remains and funerary objects with the purpose of determining how the tribes would like the agency to treat these remains.

- Executive Order No. 13007 Indian Sacred Sites. This order requires federal agencies to accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners, to avoid adversely affecting the physical integrity, and to maintain the confidentiality of sacred sites.

For federal actions in the PRB study area, the following tribes would be considered interested parties for consultation: Cheyenne River Sioux, Crow, Crow Creek Sioux, Eastern Shoshone, Flandreau Santee Sioux, Lower Brule Sioux, Northern Arapaho, Northern Cheyenne, Ogalala Lakota, Rosebud Sioux, Santee Sioux, Southern Arapaho, Southern Cheyenne, and Standing Rock Sioux.

In carrying out their mandated responsibilities, all federal agencies that authorize disturbance which might affect traditional cultural properties, localities of traditional concern, and sacred sites are obligated to ensure that the concerns that Native Americans have regarding federal actions are adequately addressed. The federal agencies must foster and maintain credible government-to-government relationships with Native American tribes.

2.7 Land Use

2.7.1 Study Area

The cumulative effects study area for land use includes the following six subwatersheds in portions of Sheridan, Johnson, Campbell, and Converse counties: Antelope Creek, Dry Fork Cheyenne River, Little Powder River, Upper Belle Fourche River, Upper Cheyenne River, and Upper Powder River (**Figure 1-1**). It includes portions of the area administered by the BLM Buffalo and Casper field offices and portions of the TBNG, which is administered by the FS (**Figure 1-2**). Private lands comprise most of the surface ownership in the study area (**Figure 1-3**). The State of Wyoming also owns a portion of the area.

2.7.2 Cumulative Impacts

Based on the information in Appendices A and D of the Task 2 Report for the PRB Coal Review, Past and Present and Reasonably Foreseeable Actions (ENSR 2005c), a total of approximately 220,688 acres (5 percent) of land area have been disturbed by development activities in the study area as of the end of 2003. Of this total, approximately 68,794 acres of disturbance (31 percent of the total) were the result of activities associated with coal mining.

Of the total disturbance acreage, approximately 111,786 acres (51 percent) have been reclaimed. Reclamation of the remaining 108,901 acres of disturbance would occur concurrently with, or following the completion of, operations depending on the type of development activity. A coal mine, for example, would be reclaimed incrementally (with the exception of permanent facilities areas) as portions of the mine are completed. Oil and gas projects would be reclaimed following a project's or facility's completion. Disturbance from a power plant or other major industrial type project would continue for the life of the project. In general, reclamation would be guided by permit requirements, depending on the type of development activity. (Note: minor discrepancies in acreages are the result of rounding.)

Approximately 21,238 acres (31 percent) of the total 68,794 acres of disturbance associated with coal mine development have been reclaimed as of the end of 2003. Of the remaining 47,556 acres of disturbance, approximately 24,097 acres currently are not available for reclamation, as they are occupied by long-term facilities which are needed to conduct mining operations. These areas would be reclaimed near the end of the mine life. Reclamation of the remaining 23,459 acres, which represent areas of active mining and areas where coal has been recovered but reclamation has not been completed, would proceed concurrently with coal mining.

Potential effects of RFD activities on land use and recreation may be either short- or long-term in nature, although the time frames involved would not be consistent, varying with the type of development. The effects of a coal mine, for example, would be considered short-term as the use would change (most likely from rangeland or agriculture) to a mine, but would be reclaimed after the economically recoverable coal had been removed, at which time the land use would return to range or agriculture. In contrast, a power plant or an urban community development would be considered long-term as the change in use virtually would be permanent, lasting for the economic life of the activity, or longer. Even if a community becomes obsolete (ghost town scenarios are common in the

natural resource driven history of the West), there often are no requirements or standards for reclamation of urban developments.

In essence, short-term effects would be those with a definite end date, even though it may be many years in the future and, usually, with requirements and standards for reclamation that would return the land to its original use or end the effect on recreation opportunities. Long-term effects would be those with a long and indeterminate life expectancy and, usually, no expectation of future reclamation.

The potential effects of projected RFD activities on land use and recreation opportunities in the study area under two (lower and upper) coal production scenarios are discussed below for the years 2010, 2015, and 2020. 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, Current Environmental Conditions (ENSR 2005b) (the Middle Fork of the Powder River) is not in the cumulative effects study area.

2.7.2.1 Year 2010 – Lower Production Scenario

Land Use, Access, and Easements

Under the this scenario, past and projected development activities in the study area would result in a total disturbance of approximately 339,912 acres (approximately 7.6 percent of the study area) by 2010. Of the 339,912 acres, it is projected that 98,662 acres (29 percent) of the disturbance would be associated with coal mining activities. It is assumed that a substantial majority of the directly affected land use would be grazing land, with agricultural land disturbance following as a distant second. It is expected that this pattern would apply to both coal-related disturbance and total cumulative disturbance. In support of this assumption, the known, but undeveloped, coal reserves and both CBNG and conventional oil and gas development areas (which together represent a substantial majority of the total disturbance) largely would be located in grazing and agricultural areas.

Approximately 205,113 acres (60 percent) of the total 339,912 acres of disturbance would be reclaimed by 2010. The remaining 134,799 acres of disturbance would be reclaimed incrementally or following a project’s completion, depending on the type of development activity and permit requirements. A relatively small, but unquantifiable, portion of the total disturbance would remain disturbed over the long term. Of the 98,662 acres of disturbance associated with coal mine development, it is projected that approximately 44,938 acres (46 percent) would be reclaimed by 2010. Of the remaining 53,724 acres of coal mining-related disturbance, it is estimated that approximately 26,338 acres would be unavailable for concurrent reclamation due to the presence of long-term facilities which would be reclaimed near the end of each mine’s life. Reclamation of the remaining 27,386 acres of disturbance would proceed concurrently with mining operations.

A large, but unquantifiable, majority of the anticipated disturbance under this scenario would occur on split estates (privately owned surface lands with federally owned minerals). This would result in continued conflicts between surface users, which are mainly ranching interests, and minerals developers. There also may be conflicts with some dispersed rural residences, although specific locations cannot be identified at this time.

It is expected that there would be additional expansion of urban residential and commercial development as a result of the projected 25 percent growth in population (between 2003 and 2010) in the cumulative effects study area. (The population of Campbell County was used for this study as a proxy for the cumulative effects study area, as there are no significant population centers in other portions of the study area.) (See Task 3C Report of the PRB Coal Review, Social and Economic Effects [ENSR 2005f] for 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, including 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.

Mineral development would comply with state and federal laws and regulations, but would be exempt from local land use regulation as stipulated by state law.

Recreation

Few, if any, of the developed recreation sites in the cumulative effects study area would be affected by RFD-related disturbance under this scenario. 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 5 percent increase in use every 5 years (BLM 2001).

It is expected that the RFD 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, Current Environmental Conditions (ENSR 2005b), a reduction in land available for hunting also makes herd management more difficult for the WGFD and reduces its hunting derived revenues (Shorma 2005).

Approximately 205,113 acres (60 percent) of the cumulative total of 339,912 acres of disturbance would be reclaimed by 2010. The remaining 134,799 acres of disturbance would be reclaimed incrementally or following a project's completion, depending on the type of development activity and permit requirements. After coal and oil and gas related development activities have been completed, and reclamation has been accomplished, many of the adverse effects on dispersed recreation activities would be substantially reduced.

Recreation planning for the cumulative effects study area would be affected to the degree that assumptions used in previous planning efforts might no longer be valid. These assumptions, particularly regarding supply and demand considerations, should be revisited and updated as development proposals become more concrete.

Wilderness and Roadless Areas

No direct effects on Wilderness or roadless areas would be expected from development of RFD projects under this scenario. There are no designated Wilderness areas in the cumulative effects 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. (See the Task 3A Report for the PRB Coal Review, Air Quality Effects [ENSR 2005g] relative to potential visibility impacts in Wilderness areas.)

2.7.2.2 Year 2010 – Upper Production Scenario

Land Use, Access, and Easements

Potential land use effects resulting from RFD activities in the study area essentially would be the same as those described under the 2010 – Lower Production Scenario, except approximately 3,786 additional acres would be disturbed. Under this scenario, a total of approximately 343,698 acres (approximately 7.7 percent of the study area) would be disturbed by the year 2010. Of the 343,698 acres, it is projected that 102,448 acres (30 percent) would be associated with coal mining activities.

Of the 343,698 acres of total disturbance, approximately 206,946 (60 percent) would be reclaimed by 2010. The remaining 136,752 acres of disturbance would be reclaimed incrementally or following a project's completion, depending on the type of development activity and permit requirements. Approximately 46,771 acres (46 percent) of the coal mine-related disturbance would be reclaimed by 2010. Of the remaining 55,677 acres of coal mining-related disturbance, it is estimated that approximately 25,688 acres would be unavailable for concurrent reclamation due to the presence of long-term facilities which would be reclaimed near the end of each mine's life. Reclamation of the remaining 29,989 acres of disturbance would proceed concurrently with mining operations.

Under this scenario, the expected effects on land use in the cumulative effects study area would be the same as described under the 2010 – Lower Production Scenario, with the following exceptions. The cumulative disturbance area would be 1.1 percent larger, and the unreclaimed disturbance area would be 1.4 percent larger. Also, the projected population would be approximately 5 percent larger, which would result in a proportionately larger increase in the area for urban development uses.

Recreation

The effects of RFD activities in the study area on recreation resources and activities essentially would be the same as described under the 2010 – Lower Production Scenario, except the magnitude would be increased in approximate proportion to the 1.4 percent increase in unreclaimed acreage.

Wilderness and Roadless Areas

The effects on Wilderness and roadless areas under this scenario essentially would be the same as described under the 2010 – Lower Production Scenario. (See the Task 3A Report for the PRB Coal

Review, Air Quality Effects [ENSR 2005g] relative to potential visibility impacts in Wilderness areas.)

2.7.2.3 Year 2015 – Lower Production Scenario

Land Use, Access, and Easements

Potential effects on land use as a result of RFD activities in the study area would be similar to those described under the 2010 – Lower Production Scenario, except approximately 86,172 additional acres would be disturbed. Under this scenario, RFD activities in the cumulative effects study area are projected to result in the total disturbance of approximately 426,084 acres (approximately 9.5 percent of the study area) by the year 2015. Of the 426,084 acres, it is projected that 117,236 acres (27 percent) would occur as a result of coal mining activities.

Of the total disturbance area, approximately 286,614 acres would be reclaimed by 2015. The 139,472 acres remaining unreclaimed would be 3.5 percent greater than the unreclaimed area under the 2010 – Lower Production Scenario. This area would be reclaimed incrementally or following a project's completion, depending on the type of development activity and permit requirements. Of the 117,236 acres of disturbance associated with coal mine development, it is projected that approximately 61,188 acres (52 percent) would be reclaimed by 2015. Of the remaining 56,048 acres of coal mining-related disturbance, it is estimated that approximately 27,549 acres would be unavailable for concurrent reclamation due to the presence of long-term facilities which would be reclaimed near the end of each mine's life. Reclamation of the remaining 28,499 acres of disturbance would proceed concurrently with mining operations.

Under this scenario, the expected effects on land use in the study area would be the same as those described under the 2010 – Lower Production Scenario, except the total disturbance area would 25 percent larger, and the unreclaimed disturbance area would be 3.5 percent larger. The acreage increases in total disturbance and, especially, unreclaimed disturbance areas would result in proportionately greater conflicts with existing land uses, which would be primarily grazing and agricultural uses. The study area population is projected to increase by 33 percent, or 7 percent greater than under the 2010 – Lower Production Scenario, which would result in an approximately comparable increase in the urban development area.

Recreation

The effects on recreation resources and activities as a result of RFD activities in the study area essentially would be the same as described under the 2010 – Lower Production Scenario, except the magnitude would be increased in approximate proportion to the 3.5 percent increase in unreclaimed acreage.

Wilderness and Roadless Areas

The effects on Wilderness and roadless areas under this scenario essentially would be the same as described under the 2010 – Lower Production Scenario. (See the Task 3A Report for the PRB Coal Review, Air Quality Effects [ENSR 2005g] relative to potential visibility impacts in Wilderness areas.)

2.7.2.4 Year 2015 – Upper Production Scenario

Land Use, Access, and Easements

Under this scenario, potential effects on land use from RFD activities essentially would be the same as those described under the 2010 – Lower Production Scenario, except they would be of greater magnitude commensurate with approximately 93,480 acres of additional disturbance. Under this scenario, RFD activities in the study area are projected to result in a total disturbance of approximately 433,392 acres (approximately 9.6 percent of the study area) by the year 2015. Sixty-seven percent of the total disturbance, or approximately 290,822 acres, would be reclaimed by 2015. The remaining 142,570 acres of disturbance would be reclaimed incrementally or following a project's completion, depending on the type of development activity and permit requirements.

Approximately 124,545 acres (29 percent) of the disturbance would be associated with coal mining activities, of which 65,396 acres (53 percent) would be reclaimed by 2015. Of the remaining 59,149 acres of coal mining-related disturbance, it is estimated that approximately 27,009 acres would be unavailable for concurrent reclamation due to the presence of long-term facilities which would be reclaimed near the end of each mine's life. Reclamation of the remaining 32,140 acres of disturbance would proceed concurrently with mining operations.

Under this scenario, the expected effects on land use in the study area would be the same as those described under the 2010 – Lower Production Scenario, except the total disturbance area would be 27 percent larger, and the unreclaimed disturbance area would be 5.8 percent larger. The increases in total disturbance and, especially, unreclaimed disturbance area would result in proportionately greater conflicts with existing land uses, which would be primarily grazing and agricultural uses. The projected population would be approximately 12 percent larger than under the 2010 – Lower Production Scenario, which would result in an approximately proportional increase in the urban development area.

Recreation

The effects on recreation resources and activities under this scenario essentially would be the same as described above for the 2010 – Lower Production Scenario, except that the magnitude would increase in approximate proportion to the 5.8 percent increase in unreclaimed acreage.

Wilderness and Roadless Areas

The effects on Wilderness and roadless areas under this scenario essentially would be the same as described under the 2010 – Lower Production Scenario. (See the Task 3A Report for the PRB Coal Review, Air Quality Effects [ENSR 2005g] relative to potential visibility impacts in Wilderness areas.)

2.7.2.5 Year 2020 – Lower Production Scenario

Land Use, Access, and Easements

Potential land use effects from RFD activities in the study area would be similar to those described under the 2010 – Lower Production Scenario, except a total of approximately 503,085 acres (or

approximately 11.2 percent of the study area) would be disturbed. This would be an increase of 163,173 acres, or 48 percent higher than the disturbance under the 2010 – Lower Production Scenario. It is projected that 137,443 acres (27 percent of the total) would be associated with coal mining activities.

Approximately 367,999 acres (73 percent of the total disturbance) would be reclaimed by 2020, leaving 135,085 acres of unreclaimed disturbance. The unreclaimed area would be 0.2 percent greater than under in 2010 – Lower Production Scenario. The unreclaimed areas would be reclaimed incrementally or following a project's completion, depending on the type of development activity and permit requirements. A projected 57,979 acres (42 percent) of the coal mining-related disturbance would remain unreclaimed under the 2020 – Lower Production Scenario. Of this acreage, it is estimated that approximately 28,797 acres would be unavailable for concurrent reclamation due to the presence of long-term facilities which would be reclaimed near the end of each mine's life. Reclamation of the remaining 29,182 acres of disturbance would proceed concurrently with mining operations.

Under this scenario, the expected effects on land use in the cumulative effects study area would be the same as described under the 2010 – Lower Production Scenario, except the cumulative disturbance area would be 48 percent larger, and the unreclaimed disturbance area would be 0.2 percent larger. The increases in total disturbance and, especially, unreclaimed disturbance areas would result in proportionately greater conflicts with existing land uses, which would be primarily grazing and agricultural uses. The projected population would be approximately 13 percent higher than under the 2010 – Lower Production Scenario, which would result in a proportional increase in the urban development area.

Recreation

Under this scenario, the effects on recreation resources and activities essentially would be the same as described under the 2010 – Lower Production Scenario, except the magnitude would increase in approximate proportion to the 0.2 percent increase in unreclaimed acreage.

Wilderness and Roadless Areas

The effects on Wilderness and roadless areas under this scenario essentially would be the same as described under the 2010 – Lower Production Scenario. (See the Task 3A Report for the PRB Coal Review, Air Quality Effects [ENSR 2005g] relative to potential visibility impacts in Wilderness areas.)

2.7.2.6 Year 2020 – Upper Production Scenario

Land Use, Access, and Easements

Under this scenario, RFD activities in the study area are projected to disturb a total of approximately 514,732 acres (approximately 11.5 percent of the study area) by 2020. A projected 149,089 acres (29 percent of the disturbance) would result from coal mining activities.

Potential impacts to land use as a result of RFD activities would be similar those described under the 2010 – Lower Production Scenario, except approximately 174,820 additional acres would be

disturbed. Approximately 73 percent of the total disturbance (374,732 acres) would be reclaimed by 2020, and the unreclaimed acreage would be 139,998 acres, or approximately 3.8 percent greater than the unreclaimed acreage under the 2010 – Lower Production Scenario. The unreclaimed acreage is the area most likely to conflict with existing land uses in the study area.

It is projected that approximately 86,196 acres of the coal mining-related disturbance (58 percent) would be reclaimed by 2020. Of the remaining 62,890 acres of coal mine-related disturbance, it is estimated that approximately 28,345 acres would be unavailable for concurrent reclamation due to the presence of long-term facilities which would be reclaimed near the end of each mine's life. Reclamation of the remaining 34,545 acres of disturbance would proceed concurrently with mining operations.

Under this scenario, the expected effects on land use in the study area would be of the same type as described under the 2010 – Lower Production Scenario, except the cumulative disturbance area would 51 percent larger, and the unreclaimed disturbance area would be 3.8 percent larger, leading to a substantially greater potential for conflict with existing uses. The increases in total disturbance and, especially, unreclaimed disturbance areas would result in proportionately greater conflicts with existing land uses, which would be primarily grazing and agricultural uses. The projected population would be approximately 19 percent greater than under the 2010 – Lower Production Scenario, which would result in a proportionate increase in the urban development area.

Recreation

Under this scenario, the effects on recreation resources and activities as a result of RFD activities in the study area essentially would be the same as described under the 2010 – Lower Production Scenario, except the magnitude would increase in approximate proportion to the 3.8 percent increase in unreclaimed acreage.

Wilderness and Roadless Areas

The effects on Wilderness and roadless areas under this scenario essentially would be the same as described under the 2010 – Lower Production Scenario. (See the Task 3A Report for the PRB Coal Review, Air Quality Effects [ENSR 2005g] relative to potential visibility impacts in Wilderness areas.)

2.8 Transportation and Utilities

2.8.1 Study Area

The cumulative effects study area for transportation and utilities includes the following six subwatersheds in portions of Sheridan, Johnson, Campbell, and Converse counties: Antelope Creek, Dry Fork Cheyenne River, Little Powder River, Upper Belle Fourche River, Upper Cheyenne River, and Upper Powder River (**Figure 1-1**). It includes portions of the area administered by he BLM Buffalo and Casper field offices and a portion of the TBNG, which is administered by the FS (**Figure 1-2**).

2.8.2 Cumulative Impacts

Generally, the amount of disturbance and the relative amount of unreclaimed disturbance associated with RFD activities are not likely to directly affect transportation systems in the cumulative effects study area. 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. Regardless, construction of alternative routing would be required prior to closing existing links so any disruptive effects on transportation systems would be minimal.

The coal mines in Subregion 1 (North Gillette) currently ship most of their coal via the east-west Burlington Northern and Santa Fe Railroad (BNSF) rail line through Gillette. The subregion produced 55 mmtpy in 2003, which was just 22 percent of the estimated 250 mmtpy capacity of the BNSF rail line (ENSR 2005c). The coal mines in Subregions 2 and 3 (South Gillette and Wright, respectively) produced approximately 308 mmtpy in 2003, which was 88 percent of the estimated 350 mmtpy capacity of the joint Union Pacific (UP)/BNSF line serving those areas.

Potential effects of RFD activities on transportation and utilities may be either short- or long-term in nature, varying with the type of development. The effects of coal production and the related demand for rail capacity could vary with market changes, although the trend in recent years has been upward, and it is expected that the trend would continue (ENSR 2005c). 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. In contrast, 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.

Potential direct effects to roads and highways would include increased vehicular traffic and risk of traffic accidents on existing roadways in the cumulative effects study area from daily travel by workers and their families. Indirect effects would include increased wear and tear on existing roads, additional air emissions, 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.

Based on existing information, the discrete site-specific locations for non-coal RFD activities currently are unknown. Consequently, site-specific impacts are not quantifiable at this time. As a

result, they have been addressed qualitatively for this study. The potential effects of projected RFD activities on transportation and utilities in the study area under two (lower and upper) coal production scenarios are discussed below for the years 2010, 2015, and 2020.

2.8.2.1 Year 2010 – Lower Production Scenario

Transportation

Under this scenario, population is projected to increase by approximately 25 percent in Campbell County, which accounts for most of the population in the cumulative effects study area (ENSR 2005f). Based on traffic studies and estimates elsewhere, vehicle miles traveled (VMT) tend to increase at or above the rate of population growth. Consequently, highway traffic would be expected to increase by at least 25 percent by 2010. 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 significant constraints.

Rail lines would be expected to accommodate approximately 650 mmtpy by 2010, including the existing 250 mmtpy on the BNSF northern route and 400 mmtpy on the joint UP/BNSF southern route, up from the existing 350 mmtpy on that line as a result of upgrades. Projected production under the 2010 – Lower Production Scenario would be 62 mmtpy from Subregion 1 (north) and 349 mmtpy from Subregions 2 and 3 (south). Anticipated rail capacity would be sufficient to carry the projected production. Assuming the subregional production would be shipped by the nearest rail lines, the Subregion 1 coal would use 25 percent of the northern BNSF capacity, and Subregions 2 and 3 coal would use 87 percent of the joint UP/BNSF southern line capacity.

Utilities

Current gas pipeline capacity out of the PRB is approximately 1.9 BCF per day; total conventional natural gas and CBNG production is slightly below 1.1 BCF per day (ENSR 2005c). Based on the information in Appendix D of the Task 2 Report for the PRB Coal Review, Past and Present and Reasonably Foreseeable Development Activities (ENSR 2005c), potential production of CBNG has been projected at 1.3 BCF per day by 2010. This potential is pipeline capacity limited, suggesting additional pipelines could be built. There are no specific projects under way; however, one potential additional pipeline (Bison Project) has been identified for completion by 2010 (ENSR 2005c).

An estimate 1,000 megawatts (MW) of new power production capacity is anticipated in the cumulative effects area by 2010. 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.

2.8.2.2 Year 2010 – Upper Production Scenario

Transportation

Under this scenario, population is projected to increase by approximately 31 percent in Campbell County, which accounts for most of the population in the cumulative effects study area (ENSR 2005f). The VMT would be expected to increase at or above the rate of population growth. Consequently, highway traffic would be expected to increase by at least 31 percent. Effects on traffic and highways would be similar to, but slightly greater than, the effects described under the 2010 – Lower Production Scenario.

Existing rail lines, together with upgrades currently under way on the joint UP/BNSF line, would be expected to accommodate approximately 650 mmtpy by 2010, as noted under the 2010 – Lower Production Scenario. Projected production under the 2010 – Upper Production Scenario would be 78 mmtpy from Subregion 1 (north) and 401 mmtpy from Subregions 2 and 3 (south). Assuming the subregional production would be shipped by the nearest rail lines, the Subregion 1 coal would use 31 percent of the northern BNSF capacity, and Subregions 2 and 3 coal would use slightly over 100 percent of the joint UP/BNSF south line capacity. At this time, it is uncertain how this excess demand (for the additional 1 mmtpy) would be accommodated.

Utilities

Pipeline and transmission line constraints and opportunities would be the same as described under the 2010 – Lower Production Scenario.

2.8.2.3 Year 2015 – Lower Production Scenario

Transportation

Under this scenario, population is projected to increase by approximately 33 percent in Campbell County, which accounts for most of the population in the cumulative effects study area (ENSR 2005f). The VMT would be expected to increase at or above the rate of population growth. Consequently, highway traffic would be expected to increase by at least 33 percent. Effects on traffic and highways would be similar to, but approximately one-third greater than, the effects described under the 2010 – Lower Production Scenario.

Under this scenario, approximately 1.5 miles of U.S. Highway 14/16 may be affected by expansion of the Subregion 1 mines. In accordance with the requirements of SMCRA, surface coal mining operations may not be conducted on lands within 100 feet of the outside right-of-way line of any public road unless the appropriate public road authority allows the public road to be relocated or closed. The authorization for relocation or closure only would be granted after providing public notice and opportunity for a public hearing and issuance of a written finding that the interests of the affected public and landowners would be protected.

It is projected that the proposed Dakota, Minnesota, & Eastern (DM&E) line would be built and operational by 2015 (pending completion of additional environmental analysis), adding 100 mmtpy in shipping capacity for Subregions 2 and 3 (ENSR 2005c). Existing rail lines, together with upgrades currently under way on the joint UP/BNSF line and the DM&E line, would be expected to

accommodate approximately 750 mmtpy by 2015, including 250 mmtpy on the north BNSF line and 500 mmtpy on the two south lines. Projected production under the 2015 – Lower Production Scenario would be 74 mmtpy from Subregion 1 (north) and 393 mmtpy from Subregions 2 and 3 (south). Assuming the subregional production would be shipped by the nearest rail lines, the Subregion 1 coal would use 30 percent of the northern BNSF capacity and Subregions 2 and 3 coal would use 79 percent of the combined DM&E and joint UP/BNSF south line capacity. Rail shipment capacity would not be a constraining factor under this scenario.

Utilities

Pipeline and transmission line constraints and opportunities would be the same as described under the 2010 – Lower Production Scenario.

2.8.2.4 Year 2015 – Upper Production Scenario

Transportation

Under this scenario, population is projected to increase by approximately 41 percent in Campbell County, which accounts for most of the population in the cumulative effects study area (ENSR 2005f). The VMT would be expected to increase at or above the rate of population growth. Consequently, highway traffic would be expected to increase by at least 41 percent. Effects on traffic and highways would be similar to, but almost two-thirds greater than, the effects described under the 2010 – Lower Production Scenario. Additional street and highway improvements in the Gillette area almost certainly would be required over a period of years as the population gradually increased. (Additional information relative to projected growth rates is presented in the Task 2 Report for the PRB Coal Review, Past and Present and Reasonably Foreseeable Future Development [ENSR 2005c]).

Under this scenario, approximately 1.5 miles of U.S. Highway 14/16 may be affected by expansion of the Subregion 1 mines. In accordance with the requirements of SMCRA, surface coal mining operations may not be conducted on lands within 100 feet of the outside right-of-way line of any public road unless the appropriate public road authority allows the public road to be relocated or closed. The authorization for relocation or closure only would be granted after providing public notice and opportunity for a public hearing and issuance of a written finding that the interests of the affected public and landowners would be protected.

Existing rail lines, together with upgrades currently under way on the joint UP/BNSF line and construction of the proposed DM&E line, would be expected to accommodate approximately 750 mmtpy by 2015. Projected production under this scenario would be 104 mmtpy from Subregion 1 (north) and 439 mmtpy from Subregions 2 and 3 (south) by 2015. Assuming the subregional production would be shipped by the nearest rail lines, the Subregion 1 coal would use 42 percent of the northern BNSF capacity and Subregions 2 and 3 coal would use 88 percent of the combined DM&E and joint UP/BNSF south line capacity. Rail shipment capacity would not be a constraining factor under this scenario, although the usage factor on the south lines would suggest the need for expansion planning if continued growth should be projected.

Utilities

Pipeline and transmission line constraints and opportunities would be the same as described under the 2010 – Lower Production Scenario.

2.8.2.5 Year 2020 – Lower Production Scenario

Transportation

Under this scenario, population is projected to increase by approximately 41 percent in Campbell County, which accounts for most of the population in the cumulative effects study area (ENSR 2005f). The VMT would be expected to increase at or above the rate of population growth. Consequently, highway traffic would be expected to increase by at least 41 percent. Effects on traffic and highways would be similar to, but almost two-thirds greater than, the effects described under the 2010 – Lower Production Scenario. Additional street and highway improvements in the Gillette area almost certainly would be required over a period of years as the population gradually increased. (Additional information relative to projected growth rates is presented in the Task 2 Report for the PRB Coal Review, Past and Present and Reasonably Foreseeable Future Development [ENSR 2005c]).

In 2020, rail lines would be expected to accommodate approximately 750 mmtpy of coal. Projected production under this scenario would be 78 mmtpy from Subregion 1 (north) and 417 mmtpy from Subregions 2 and 3 (south). Assuming the subregional production would be shipped by the nearest rail lines, the Subregion 1 coal would use 31 percent of the northern BNSF capacity and Subregions 2 and 3 coal would use 83 percent of the combined DM&E and joint UP/BNSF south line capacity. Rail shipment capacity would not be a constraining factor under this scenario.

Utilities

Pipeline and transmission line constraints and opportunities would be the same as described under the 2010 – Lower Production Scenario.

2.8.2.6 Year 2020 – Upper Production Scenario

Transportation

Under the 2020 – Upper Production Scenario, population is projected to increase by approximately 48 percent in Campbell County, which accounts for most of the population in the cumulative effects study area (ENSR 2005f). The VMT would be expected to increase at or above the rate of population growth. Consequently, highway traffic would be expected to increase by at least 48 percent under the 2020 – Upper Production Scenario. Effects on traffic and highways would be similar to, but over 90 percent greater than, the effects described above for the 2010 – Lower Production Scenario. Additional street and highway improvements in the Gillette area would almost certainly be required over a period of years as the population gradually increased. (Additional information relative to projected growth rates is presented in the Task 2 Report for the PRB Coal Review, Past and Present and Reasonably Foreseeable Future Development [ENSR 2005c]).

Under this scenario, approximately 1.5 miles of State Route 59 potentially could be affected by mining at the Subregion 2 mines, depending on future leasing. In accordance with the requirements of SMCRA, surface coal mining operations may not be conducted on lands within 100 feet of the outside right-of-way line of any public road unless the appropriate public road authority allows the public road to be relocated or closed. The authorization for relocation or closure only would be granted after providing public notice and opportunity for a public hearing and issuance of a written finding that the interests of the affected public and landowners would be protected.

In 2020, rail lines would be expected to accommodate approximately 750 mmtpy of coal. Projected production under this scenario would be 121 mmtpy from Subregion 1 (north) and 455 mmtpy from Subregions 2 and 3 (south). Assuming the subregional production would be shipped by the nearest rail lines, the Subregion 1 coal would use 48 percent of the northern BNSF capacity, and Subregions 2 and 3 coal would use 91 percent of the combined DM&E and joint UP/BNSF south line capacity. Rail shipment capacity, would not be a constraining factor under this scenario, although the usage factor on the south lines would suggest the need for expansion planning if continued growth should be projected.

Utilities

Pipeline and transmission line constraints and opportunities would be the same as described under the 2010 – Lower Production Scenario.

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