United States Department of the Interior

Bureau of Land Management

Miles City Field Office

Billings Field Office

State of Montana

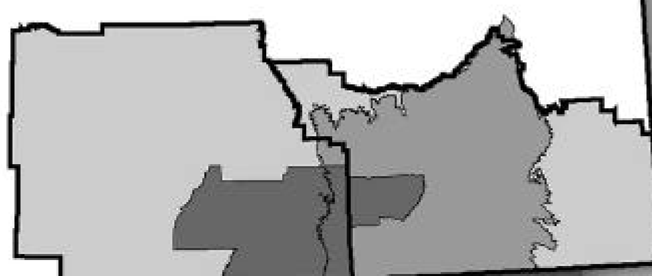
Montana Board of Oil and Gas Conservation

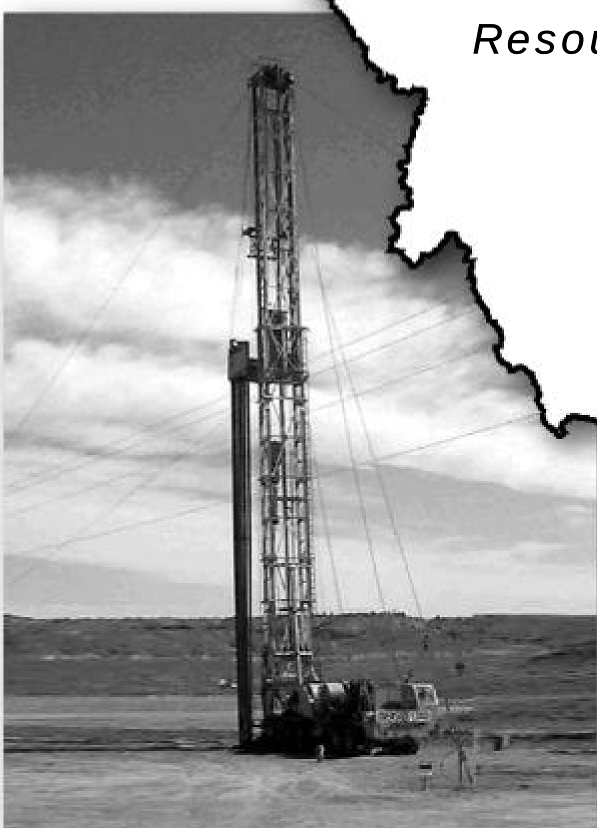
Montana Department of Environmental Quality

January, 2002

MONTANA

Statewide Draft Oil and Gas Environmental Impact Statement and Amendment of the Powder River and Billings Resource Management Plans





The Bureau of Land Management is responsible for the stewardship of our public lands. It is committed to manage, protect, and improve these lands in a manner to serve the needs of the American people for all times. Management is based on the principles of multiple use and sustained yield of our nation's resources within a framework of environmental responsibility and scientific technology. These resources include recreation; rangelands; timber; minerals; watershed; fish and wildlife; wilderness; air; and scenic, scientific, and cultural values.

BLM/MT/PL-02/003

U.S. Department of the Interior

Bureau of Land Management
Miles City Field Office
111 Garryowen Road
Miles City, Montana 59301

January 17, 2002

Dear Reader:

Enclosed for your review is the *Montana Statewide Draft Oil and Gas Environmental Impact Statement (EIS) and Amendment of the Powder River and Billings Resource Management Plans (RMPs)*. The document was prepared jointly by the Bureau of Land Management (BLM), and the State of Montana, Board of Oil and Gas Conservation and the Department of Environmental Quality (DEQ). The Bureau of Indian Affairs, Crow Tribe, Department of Energy and the Environmental Protection Agency are designated Cooperators in the EIS.

In the document, the word "State" refers to the appropriate State of Montana agency(s). State agencies have different jurisdictions, so the term "State" is used generically. For example, "State" can mean the Department of Natural Resources and Conservation, or Fish, Wildlife and Parks.

We anticipate the Final EIS being available to the public in the Summer of 2002. Studies to gather resource information are ongoing and planned to continue for the next three years. Several studies will be finalized during the EIS process.

- A 3D groundwater model of the Hanging Woman Area. The Draft EIS includes a 2D groundwater model for the planning area. The 3D model will demonstrate how such modeling falls within the parameters of the 2D Model.

- Air modeling for Montana is underway and will be available for the Final EIS.

- An Ethnographic Study to help determine areas or sites the tribes consider sacred was initiated in 2001 and will be available for the Final EIS.

- The Northern Cheyenne and Crow tribes have been asked to provide BLM "Narrative Reports" that describe their resources. If they agree and the information is available in the Spring of 2002, it will be incorporated into the Final EIS.

Other studies, upon becoming available, will be used to monitor and maintain the decisions made in the document. Ongoing studies not yet included in the EIS are:

- A Hyperspectral Assessment to determine potential for natural gas will be available the Fall of 2002.

- A Fluvial Geomorphology Study to help determine impacts to stream channels from water erosion will be available the Fall of 2002.

- A Soils Study being conducted with the BLM Wyoming office will be available the Spring of 2003.

- A Wetland Filtration Study being done by the Montana State University, Bozeman, is anticipated to be completed in the year 2004.

- And finally, a Flora/Fauna Study will begin this year with no schedule as of this writing.

The Draft was prepared by developing alternative management strategies to help resolve issues identified during Scoping. The EIS analyzes the environmental consequences of five alternatives, including the BLM/State Preferred Alterative (Alternative E).

The Summary found in front of the document briefly describes the issues and alternatives found later in detail.

Chapter 1 contains the legal authority mandating the writing of this document, the purpose and need for the analysis and its application. The planning area is defined, a general location map provided, lands not analyzed are described, and the plan's conformance to the BLM RMPs is discussed. There is a brief discussion on concerns raised during scoping. The "Planning Criteria" that helped guide the preparation of the Draft are provided in Chapter 1.

Chapter 2 discusses the five alternatives and the rationale for alternatives considered but not analyzed in detail. Management Common to All Alternatives is discussed first, then the management actions specific to each alternative are given. Table 2-2 in Chapter 2 compares the five alternative specific management actions.

Chapter 3 describes the existing environment. Each resource or topic is listed alphabetically.

Chapter 4 analyzes the impacts predicted to occur from each of the alternatives described in Chapter 2. The chapter includes Assumptions for the Analysis. Assumptions are predictions made by specialists based on their knowledge, education and experience. The Reasonable Foreseeable Development Scenario makes predictions for development, including for areas outside the planning area, so that cumulative impacts may be analyzed. For example, although the Indian Reservations are not part of the planning area, the number of wells that could possibly occur there are analyzed as part of the cumulative analysis. Chapter 4 describes the impacts from management common to all alternatives and impacts from each alternative by resource. The conclusion describes cumulative impacts, unavoidable adverse impacts, irreversible or irretrievable impacts, and short-term impacts vs long-term productivity. A comparative Summary of Impacts table is included at the end of Chapter 4.

The Draft EIS does not set water quality standards. The Montana DEQ held public meetings in December to begin the process of setting standards. If standards are set in a timely manner, they will be incorporated into the Final EIS.

Chapter 5 contains a listing of the personnel involved in preparing the document, and the public who participated through scoping meetings and letters.

The appendixes are in alphabetical order by resource. They contain material too detailed and analytical for the general discussion in the chapters. The appendixes were used to help develop the analysis described in the body of the document. The Monitoring Appendix gives general oil and gas monitoring guidance for resources or programs. More specific guidance, for example, a more detailed monitoring plan for wildlife, will be included in the Final EIS. The Montana Department of Natural Resources and Conservation Technical Advisory Committee also included a draft monitoring plan that can be found at the end of the Monitoring Appendix.

The Glossary is a list of definitions of technical terms used in the document; the Bibliography cites the references in the document; and the Index is a listing of words and topics and their location within the Draft EIS.

You are encouraged to comment on the entire document. A 90-day comment period will begin the day the Draft document is filed by EPA in the *Federal Register* (anticipated February 15, 2001). Written comments will be accepted and responded to in the Final EIS if received within the 90-day comment period. Please direct your comments to one of the following and the comment will be shared with the other parties.

Tom Richmond
Project Leader, Board of Oil and Gas Conservation
2535 St. Johns Avenue
Billings, Montana 59102

Greg Hallsten
Project Leader, Department of Environmental Quality
P. O. Box 200901
Helena, Montana 59620-0901

Mary Bloom
Project Leader, Bureau of Land Management
111 Garryowen Road
Miles City, Montana 59301

The public hearings to answer questions and gather comments concerning this document will be held at the following locations:

Helena	Billings
Crow Agency	Lame Deer
Broadus	

The comments received on the Draft will be given equal consideration in the preparation of the Final EIS and Proposed RMP Amendment (Final). In the Final, you will be able to evaluate the Agencies' responses to comments regarding the Draft EIS. The State will hold a public hearing to discuss the State's proposed decisions in the Final. A 30-day protest period will be held for the BLM proposed decisions in the Final.

Sincerely,

Jan P. Sensibaugh
Montana Department of Environmental Quality

Tom Richmond
Montana Board of Oil and Gas Conservation

Aden L. Seidlitz
Bureau of Land Management

DRAFT
STATEWIDE OIL & GAS
ENVIRONMENTAL IMPACT STATEMENT
AND
AMENDMENT OF THE POWDER RIVER AND BILLINGS RESOURCE MANAGEMENT PLANS

U.S. Department of the Interior
and
State of Montana

2002

Recommended by:	Sandra S. Brooks	1/17/02
	Sandra S. Brooks, Billings Field Manager	Date
Recommended by:	David McIlnay	1/16/02
	David McIlnay, Miles City Field Manager	Date
Recommended by:	Jan P. Sensibaugh	1/10/02
	Jan P. Sensibaugh, Director, MT DEQ	Date
Recommended by:		1/15/02
	Thomas P. Richmond, Administrator, BOGC	Date
Approved by:	Dave Ballard	1-15-02
	Dave Ballard, Chairman, BOGC	Date
Approved by:	Mat Millenbach	1/17/02
	Mat Millenbach, State Director, Montana BLM	Date

Draft
Statewide Oil and Gas Environmental Impact Statement and Amendment of the Powder River and Billings Resources Management Plans

Lead Agencies: U.S. Department of the Interior, Bureau of Land Management; and the State of Montana: Board of Oil and Gas Conservation and Department of Environmental Quality.

Type of Action: Administrative

Jurisdiction: State: Statewide.

BLM: Powder River RMP Area—Powder River, Carter, and Treasure counties and portions of Big Horn, Custer and Rosebud counties. Billings RMP Area—Carbon, Golden Valley, Musselshell, Stillwater, Sweet Grass, Wheatland, and Yellowstone counties and the remaining portion of Big Horn County.

Abstract: This document addresses alternatives for managing federal and state oil and gas administered by the Miles City and Billings Field Offices, Bureau of Land Management, and the State of Montana. The BLM planning area comprises approximately 1,506,011 acres of federally managed surface and 5,009,784 acres of federal mineral estate.

Five alternatives have been developed to evaluate the impacts related to the various development scenarios associated with CBM exploration and production. Alternative A, the No Action Alternative, would continue existing management. Alternative B would allow CBM development while emphasizing the resource protection. Alternative C would emphasize CBM development with minimal environmental restrictions. Alternative D would encourage CBM exploration and development while maintaining existing land uses. Alternative E is the Preferred Alternative and would allow for CBM exploration and development while minimizing the impacts to environmental resources.

The five alternative plans presented in Chapter 2 focus on allocating resource uses and prescribing general management actions. The impacts expected from implementing each of the alternatives are analyzed in Chapter 4.

When this document is published in final form, it will provide a comprehensive framework for managing oil and gas resources on public lands in the Powder River and Billings RMP areas of the Miles City and Billings Field Offices and state-administered land in Montana. Further information regarding this draft environmental impact statement and resource management plan amendment can be obtained from the address below. Comments will be accepted for 90 days following the date the Environmental Protection Agency publishes the notice of filing of this draft in the *Federal Register*. Comments received by that date will be considered in the final environmental impact statement and resource management plan amendment. When commenting, please type or print your name and complete mailing address and send to:

Mary Bloom, Team Leader
Bureau of Land Management
Miles City Field Office
111 Garryowen Road
Miles City, MT 59301
Telephone: (406) 233-3649

SUMMARY

Introduction

Background

This proposed amendment of the resource management plans and environmental impact statement addresses future exploration for and development of Bureau of Land Management (BLM) and State of Montana (state) managed coal bed methane gas (CBM) resources and conventional oil and gas. When completed, this document will provide a comprehensive framework for management of the CBM resource.

The planning area encompassed by this document includes the oil and gas estate administered by the BLM within the Powder River and Billings Resource Management Plan (RMP) Areas, and for the state, it is statewide with emphasis on the state-administered oil and gas within the BLM planning area and in Blaine, Park, and Gallatin counties. The planning area excludes those lands administered by other federal agencies, such as Forest Service and Park Service, and the Crow, Northern Cheyenne, and other Indian lands. This 16-county area, referred to as the "CBM emphasis area," is the area of CBM development interest.

Planning Issues

A variety of planning issues were identified through a process involving input from the public, other agencies, and BLM personnel. A brief synopsis of each major planning issue category is presented in this summary, but refer to Chapter 1 of this document for a complete listing of all the planning issues within each major planning issue category.

Air Quality

Planning issues for air quality revolve around the variety of emissions emanating from CBM activities and their effects on the natural and human environments. Of particular interest is the effect on the Northern Cheyenne Indian Reservation's Class I airshed.

Cultural Resources

Disturbance of cultural resource sites, effects on the eligibility of cultural resource sites for placement on the National Register of Historical Places, and identification of cultural areas where CBM development may be incompatible were identified as major planning issues.

Geology and Minerals

Planning issues associated with geology and minerals include effects on the coal resource and the ability to recover it, drainage of adjacent methane resources, and the effect of water production on methane recovery.

Hazardous Materials and Waste Management

Use and potential misuse of hazardous materials as part of CBM development was the only planning issue identified for this category.

Groundwater

Issues associated with groundwater include the quality of produced water and its beneficial uses, potential impacts to domestic water wells from groundwater drawdown by CBM wells, natural springs drying up, water rights, groundwater recharge, and opportunities to inject produced water.

Surface Water

High sodium adsorption ratio and flow rate effects, water quality, and aquatic resource organisms and habitat were planning issues associated with surface water resources.

Indian Trust Resources and Native American Concerns

Native American planning issues included effects of discharged water to Indian resources and land uses, traditional values, protection of Indian trust assets, water quality, Class I area, impacts on culturally important sites, increased use of Reservation resources, socio-economic impacts, and tribal members.

Lands and Realty

Construction effects and infrastructure needs and distribution to current land uses were identified as planning issues.

Livestock Grazing

Livestock grazing and ranching impacts from high salinity water and from increased water quantities, grazing land displacement, and vegetation changes to non-palatable plants were planning issue concerns.

Paleontological Resources

Planning issues are impacts to paleontological localities, vandalism, and unauthorized collecting.

Recreation

Effects on recreational activities and huntable wildlife were identified issues.

Social and Economic Values

Noise, depressed land values, real estate price escalation, agricultural job loss, social services impacts, tax and other revenue, local economy effects, and agricultural productivity are a few of the many socio-economic planning issues.

Environmental Justice

Distributive justice, and the Northern Cheyenne's reliance on operator lease fees, were listed as planning issues.

Soils

Soil planning issues include high sodium effects, erosion from water discharge, irrigated soil impacts, and land subsidence.

Vegetation

High sodium water effects on salt intolerant plants, vegetation community changes, exotic plant and noxious weed infestations, loss of plant productivity, grassland protection, and agricultural land withdrawal are vegetation planning issues.

Special Status Species

Planning issues are loss of threatened and endangered species and mitigation/avoidance measures to protect these species.

Visual Resource Management

Visual degradation and visual pollution are the planning issues associated with visual resources.

Wilderness Study Areas

Effects on wilderness study areas was the only planning issue associated with wilderness.

Wildlife

Fragmentation of habitat, impacts on habitat, effects of water availability, quality, and quantity, vehicle hazards, and migration interruption are wildlife planning issues.

Management Actions

This document presents management common to all alternatives, existing management, and management actions specific to each alternative. For a complete understanding of management actions that would be implemented under a specific alternative, existing management and management common to all alternatives must be considered in conjunction with each alternative.

Alternatives

Alternatives are fully described in Chapter 2 of this document.

Alternative A, the "no action" alternative, would continue existing management direction. Only CBM exploration and development authorized under existing BLM and state management directives would be implemented.

Alternative B, which emphasizes protection of soil, water, air, vegetation, wildlife, and cultural resources, allows for CBM development with special protection of resources.

Alternative C places management emphasis on full development of the CBM resource. It is less protective of natural resources, but still provides for a minimum level of resource protection to avoid loss or degradation of those resources.

Alternative D encourages CBM exploration and development while maintaining existing land uses. Protection of downstream water consumers is also emphasized.

Alternative E is the Preferred Alternative, which combines features of Alternatives B through D. It manages development of CBM in an environmentally sound manner.

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Acronyms and Abbreviations

ACEC	Area of Critical Environmental Concern
ACHP	Advisory Council on Historic Preservation
ADT	average daily traffic
AOU	American Ornithologist's Union
APD	Application for Permit to Drill
APLIC	Avian Power Line Interaction Committee
ARCO	Atlantic-Richfield Company
ARM	Administrative Rules of Montana
ARS	Agricultural Research Service
AUMs	animal unit-months
AWM	Air and Waste Management Bureau
BACT	Best Available Control Technology
BCF	billion cubic feet
BER	Board of Environmental Review
bgs	below ground surface
BIA	Bureau of Indian Affairs
BLM	U.S. Bureau of Land Management
BMP	Best Management Practice
BTU	British thermal unit
CAA	Clean Air Act
CBM	coal bed methane
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CFS	cubic feet per second
CO	carbon monoxide
COE	U.S. Army Corps of Engineers
CWA	Clean Water Act
DEIS	Draft Environmental Impact Statement
DOE	U.S. Department of Energy
DNRC	Department of Natural Resources and Conservation (Montana)

EA	Environmental Assessment
EC	electrical conductivity
EIS	Environmental Impact Statement
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FLPMA	Federal Land Policy and Management Act
FR	Federal Register
FWS	Fish and Wildlife Service (USDI)
FY	fiscal year
gpm	gallons per minute
GPO	Government Printing Office
GTI	Gas Technology Institute
HAP	hazardous air pollutants
HCP	Habitat Conservation Plan
HUD	U.S. Department of Housing and Urban Development
H_2S	hydrogen sulfide
ICC	Interstate Commerce Commission
ITA	Indian Trust Assets
kW	kilowatt
LGST	local government severance taxes
MBMG	Montana Bureau of Mines & Geology
MBOGC	Montana Board of Oil & Gas Conservation
MBTA	Migratory Bird Treaty Act
MCA	Montana Code Annotated
MCF	thousand cubic feet
MDA	Montana Department of Agriculture
MDEQ	Montana Department of Environmental Quality
MDT	Montana Department of Transportation
MEPA	Montana Environmental Policy Act

MFWP	Montana Fish, Wildlife, and Parks
mg/l	milligrams per liter
MGWPCS	Montana Groundwater Pollution Control System
MMB	Minerals Management Bureau
MNHP	Montana Natural Heritage Program
MPDES	Montana Pollutant Discharge Elimination System
MOA	Memorandum of Agreement
MSO IM	Montana State Office Instruction Memorandum
MT-GAP	Montana Gap Analysis Project
MOU	Memorandum of Understanding
MYBP	Millions of Years Before Present
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NO_2	nitrogen dioxide
NO_X	oxides of nitrogen
NOA	Notice of Availability
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service (USDI)
NRCS	Natural Resources Conservation Service (USDA)
NRHP	National Register of Historic Places
NRIS	Natural Resource Information System (Montana)
NSO	no surface occupancy
NWR	National Wildlife Refuge
OSHA	Occupational Safety and Health Administration
PM_{10}	particulate matter less than 10 microns in diameter
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
ppm	parts per million
PSD	Prevention of Significant Deterioration
psi	pounds per square inch
psig	pounds per square inch gauge
RCRA	Resource Conservation and Recovery Act of 1976

RFD	Reasonable Foreseeable Development Scenario
RMP	Resource Management Plan
ROD	Record of Decision
ROW	right-of-way
SAR	Sodium Adsorption Ratio
SDWA	Safe Drinking Water Act
SHPO	State Historic Preservation Office
SMA	Special Management Area
SOC	Species of Concern
SN	Sundary Notice
SO_2	sulfer dioxide
SR	State Road (when followed immediately by the State Road number)
T&E	Threatened and Endangered
TCF	trillion cubic feet
TDS	total dissolved solids
TLMD	Trust Land Management Division
TMDL	total maximum daily load
TOC	total organic carbon
TRR	Tounge River Railroad
$\mu g/m^3$	micrograms per cubic meter
$\mu S/cm$	micro-Siemens per centimeter
UIC	underground injection control
U.S.	United States
USBR	Bureau of Reclamation (USDI)
U.S.C.	United States Code
USDA	U.S. Department of Agriculture
USDC	U.S. Department of Commerce
USDI	U.S. Department of the Interior
USFS	U.S. Forest Service (USDA)
USGS	U.S. Geological Survey (USDI)
VOC	volatile organic compounds
VRM	visual resource management
WET	whole effluent toxicity

WMA	Wildlife Management Area
WMPP	Wildlife Monitoring and Protection Plan
WQS	water quality standards
WSA	Wilderness Study Area
WYDEQ-ADQ	Wyoming Department of Environmental Quality—Air Quality Division

CHAPTER 1

PURPOSE AND NEED

MONTANA

CHAPTER 1: PURPOSE AND NEED

Introduction

This Draft Environmental Impact Statement (DEIS) was prepared jointly by the Bureau of Land Management (BLM) and the State of Montana (state). The Environmental Protection Agency (EPA), Bureau of Indian Affairs (BIA), Department of Energy (DOE), and Crow Tribe are designated Cooperators for the EIS. The EIS is prepared in accordance with the National Environmental Policy Act (NEPA) of 1969 and the Montana Environmental Policy Act (MEPA) of 1971. The EIS analyzes the impacts from future exploration and development of State managed oil and gas resources statewide, with emphasis on the BLM planning area of the Billings and Powder River RMP areas, and Blaine, Gallatin, and Park counties.

BLM proposes to amend the Billings and Powder River Resource Management Plans (RMPs). The Powder River and Billings RMPs, as amended by BLM's 1994 *Oil and Gas Amendment of the Billings, Powder River, and South Dakota RMPs,* support conventional oil and gas development and limited coal bed methane (CBM) exploration and development. Current projections by industry indicate heightened interest in the exploration and development of CBM. Considering both conventional oil and gas and expanded CBM development would result in a major federal action with potential significant effects to the human environment. An EIS is needed to consider the impacts from existing management and its alternatives. An RMP Amendment is needed in order to allow BLM to change any existing land use decisions regarding oil and gas operations.

The state has placed a moratorium on state-permitted CBM wells in Montana until the EIS is completed. The EIS will be used by the state to supplement its EIS for permitting oil and gas activities, particularly large-scale CBM development.

Future oil and gas NEPA analysis by BLM or BIA or MEPA analysis by the State of Montana could tier off of this EIS. BLM's approval of potential oil and gas activities in the planning area would be consistent with the decisions and mitigation requirements developed in this amendment. Similarly, the state's rules and regulations governing CBM activities may be revised in this plan and used in tiering, so that their future decisions are consistent with the decisions made during this process. If a Native American tribe proposes to develop their CBM resource, the BIA will need to comply with NEPA for its approval actions under the Indian Mineral Development Act and other laws. The BIA could adopt this EIS, or tier off of the analysis in the EIS, to help meet its NEPA responsibilities in future proposed actions.

Conformance With the BLM Land Use Plan

The Billings RMP was approved through a Record of Decision issued by BLM September 28, 1984. The Powder River RMP was approved through a Record of Decision issued by BLM on March 15, 1985. BLM's 1994 Oil and Gas Amendment of the Billings, Powder River, and South Dakota RMPs amended both of these RMPs. The decisions made in the RMPs allow for a certain level of conventional oil and gas development on federal leases, support limited CBM exploration and development and do not include analysis for full-scale CBM development.

"The Reasonable Foreseeable Development projections can accommodate the drilling of test wells and initial small-scale development of CBM. The extension of the nonconventional fuels tax credit for wells drilled before December 31, 1993, should generate some activity in the planning area. This amendment does not contain either a hydrologic analysis of the RFD area or an environmental study of the impacts of building major pipeline systems. In order for development to occur on federal oil and gas lands, an additional environmental document tied to this amendment would be required" (BLM, 1992).

The Planning Area

The planning area shown in Map 1-1 is defined as the area where oil and gas decisions will be made by BLM and the State of Montana. The BLM's planning area is the oil and gas estate administered by the BLM in the Powder River and Billings RMP areas. The State of Montana's planning area is statewide, with emphasis on the state-administered oil and gas within the BLM planning area and in Blaine, Park, and Gallatin counties. The planning area excludes those lands administered by the Forest Service, the Crow, Northern Cheyenne and other Indian lands.

For ease of reference, the Billings and Powder River RMP areas, and Blaine, Park, and Gallatin counties, are referred to in the document as the BLM and state "CBM emphasis area." This is the 16-county area within the BLM and state planning area where there is CBM development interest.

The Powder River RMP area encompasses the southeastern corner of Montana, including Powder River, Carter, and Treasure counties, and portions of Big Horn, Custer, and Rosebud counties. The Powder River RMP area comprises approximately 1,080,675 acres of federally managed surface and 4,103,700 acres of federal mineral estate.

The Billings RMP Area comprises the south-central portion of Montana consisting of Carbon, Golden Valley, Musselshell, Stillwater, Sweet Grass, Wheatland, and Yellowstone counties and the remaining portion of Big Horn County. The Billings RMP Area comprises approximately 425,336 acres of federally managed surface and 906,084 acres of federal mineral estate.

Adjacent to the planning areas, other major land holdings include the Crow, Northern Cheyenne, and Fort Belknap Indian Reservations, the Custer National Forest, the Big Horn Canyon National Recreational Area, the Burlington Northern and Santa Fe Railroad, and the Fort Keogh Agricultural Experiment Station. The total surface area of the CBM emphasis area (all owners) exceeds 25 million acres.

Purpose and Need

The BLM is responsible for managing federally owned oil and gas resources. During the October 18, 2000, meeting of the Coal Bed Methane Coordination Group, oil and gas industry representatives presented their predictions for the number of CBM wells that might be drilled within the planning area. The oil and gas analysis in current BLM planning documents did not predict as many wells. In order to analyze the effects from full-field oil and gas development, an EIS and RMP amendment is needed.

BLM's purpose for the EIS is to analyze impacts from oil and gas activity, particularly from CBM exploration, production, development, and reclamation in the Billings and Powder River RMP areas. A BLM plan amendment is needed because of the anticipated change in intensity of the development of the oil and gas resources. BLM may need to change its decisions by considering oil and gas management options including mitigation measures that will help minimize the environmental and social impacts related to oil and gas activities. The EIS will focus the analysis on the oil and gas development issues not covered in the current RMPs, such as water management from CBM production.

The State of Montana's purpose is to develop a program to address CBM exploration, development, production, reclamation, and cleanup in Montana. The EIS, in part, responds to the stipulation and settlement agreement, dated June 19, 2000, resulting from a lawsuit brought by the Northern Plains Resource Council against the MBOGC in the Montana First Judicial District Court, Lewis and Clark County.

Planning Criteria

Introduction

Planning criteria are the constraints or ground rules used by the BLM to guide and direct the development of a resource management plan. Planning criteria guide the resource specialists in the collection and use of inventory information, in analyzing the management situation, defining and analyzing the alternatives, and selecting the Preferred Alternative.

Overall Considerations

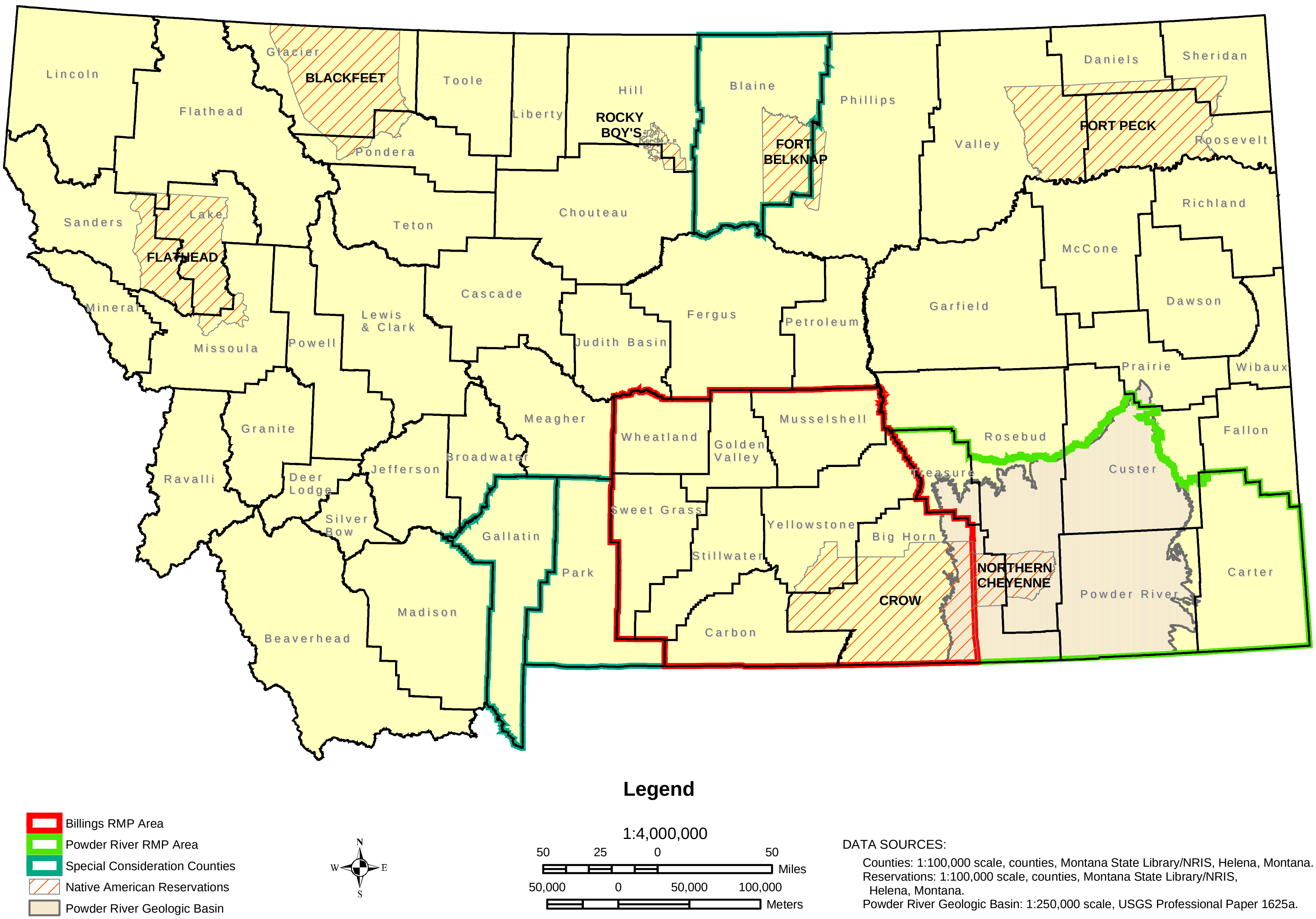
1. The EIS/RMP will stand alone, but may tier off, or incorporate by reference, other documents as previously mentioned (*Oil and Gas Final EIS and Proposed Amendment of the Billings, Powder River and South Dakota RMPs; Wyodak Coal Bed Methane Project Final EIS*; and *Board of Oil and Gas Conservation Oil and Gas Drilling and Production in Montana EIS).*

2. The planning area for BLM is the BLM-administered oil and gas estate in Wheatland, Golden Valley, Musselshell, Sweet Grass, Stillwater, Yellowstone, Carbon, Big Horn, Treasure, Powder River, and portions of Custer, Rosebud, and Carter counties. The state planning area is statewide with emphasis on the BLM planning area and three isolated areas in Blaine, Park, and Gallatin counties. The planning area excludes those lands administered by other agencies (for example, Forest Service or Indian trust acreage).

3. The analysis area is any land that may be affected, regardless of ownership.

4. Alternatives will address the identified issues and management concerns. All other guidance

Map 1-1: Planning Areas



DATA SOURCES:

Counties: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana.
Reservations: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana.
Powder River Geologic Basin: 1:250,000 scale, USGS Professional Paper 1625a.

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will be presented in the Management Common to All Alternatives section of the Amendment/EIS.

5. The alternatives chosen will be economically and technically feasible. Those alternatives, or components of those alternatives, found not to be economically or technically feasible or viable will be dropped from or modified for consideration in the range of alternatives.

6. Any decision or mitigation measure required by the Amendment/EIS will be enforceable and will lend itself to monitoring.

7. The Record of Decision (ROD) for BLM-administered lands will be prepared in accordance with NEPA and will contain the final BLM decisions of the Amendment and EIS.

8. Data acquisition will consist primarily of extrapolation and compilation of existing data and appropriate literature search.

9. Existing geological and fluid minerals data will be used to develop occurrence potentials and foreseeable development scenarios.

10. Geographic Information Systems will be used by the state in accordance with BLM data standards.

11. Current management guidance will be expanded to reflect recent resource regulations and guidelines pertaining to oil and gas operations.

12. A list of sensitive species will be identified and addressed in the document.

13. To the extent practicable, this document will be consistent with adjoining Forest Service lands and leases.

14. Decisions will comply with Rangeland Health Standards.

Agency Responsibilities

Bureau of Land Management

Drilling oil and gas exploration and production wells on lands where mineral rights are owned and controlled by the federal government must be conducted under an approved application for permit to drill (APD) issued by the BLM. In considering whether to approve applications for permit to drill and other lease activities, the BLM must consider the possible impacts from typical exploration and development activities, and cumulative environmental effects, to ensure compliance with NEPA. This DEIS was prepared to meet those requirements.

The BLM's authority and decisions related to oil and gas development in the planning area is limited to the agency's stewardship, resource conservation, and surface protection responsibilities for federal lands and minerals. As conservator of the federal surface and mineral estate, the BLM has responsibility for ensuring that the federal mineral resource is conserved (not wasted) and is developed in a safe and environmentally sound manner.

Much of the planning area contains lands known as "split estate." These are lands where the surface ownership is different from the mineral ownership. Management of federal oil and gas on these lands is somewhat different from management on lands where both surface and mineral ownership is federal. On split estate lands where surface ownership is private, and BLM administers the minerals, the BLM places necessary restrictions and requirements on permitted activities and works in cooperation with the surface owner. The BLM has established policies for the management of federal oil and gas resources under the following statutes: Federal Land Policy and Management Act (FLPMA), NEPA, National Historic Preservation Act (NHPA), and Endangered Species Act (ESA) (see BLM 1992, under "Split Estate" for more information).

Regulatory areas where the BLM has shared responsibilities with other federal or state agencies include the following:

- Oil and gas drilling—FLPMA of 1976, 43 U.S.C. 1701 et. seq. as amended (PL 94-579), and the Mineral Leasing Act of 1920, as amended, (PL 93-153). This is a shared responsibility with the Montana Board of Oil and Gas.
- Activities that would impact waters of the U.S. from the discharge of produced waters—BLM must comply with the Clean Water Act (CWA) as provided by Section 313 of the CWA, Section 313, 33 U.S.C. 1323. NPDES permits are issued by the State of Montana for actions involving the discharge of water from point sources on non-Indian lands and are issued by EPA for such actions on Indian lands. For actions involving the discharge of water from point sources, BLM works with Montana Department of Environmental Quality (MDEQ) on private and public lands, and with the U.S. Environmental Protection Agency (EPA) on

Indian lands. BLM issues its approval after State or EPA approval has been given.

- Activities that would impact waters of the U.S. from the placement of fill materials—The U.S. Army Corps of Engineers and BLM have shared responsibility in Montana for dredge and fill permits associated with CBM activities under Section 404, General Permit No. 404. This covers activities that impact waters of the U.S. as a result of placing fill in either waters of the U.S. or jurisdictional wetlands. See 33 CFR Part 320 and 40 CFR Part 230–Section 404(b)(1) Guidelines for the Specification or Disposal Sites for Dredged and Fill Materials.

- Special status species of plants or animals—ESA, U.S.C. 1531 et seq. This is a shared responsibility with the U.S. Fish and Wildlife Service and Montana Fish, Wildlife, and Parks (MFWP).

- Cultural, historical, or paleontological resources—NHPA, 16 U.S.C. 470. This is a shared responsibility with the Montana State Historic Preservation Office (SHPO) and the Advisory Council on Historic Preservation.

- Surface water diversions, stream channel modifications, construction of new reservoirs, reservoir supply, or dam modifications to existing reservoirs, except on federal surface—Montana Dam Safety Act, 85-15-207. This is a shared responsibility with the MDEQ Water Resources.

- Oil and gas well spacing—Memorandum of Understanding (MOU) between the BLM and the Montana Board of Oil and Gas Conservation (MBOGC) concerning Oil and Gas Well Spacing/Well Location Jurisdiction, and the Montana Oil and Gas Conservation Act, Statue 82-11-201, Establishment of Well Spacing Units. This is a shared responsibility with the MBOGC.

- Consultation with Tribal Governments—Under Executive Order 13175, BLM will provide a meaningful opportunity for input by tribal officials where the EIS would have tribal implications. The Executive Order reflects the federal government's trust responsibility to federally-recognized Indian tribes. Pursuant to this trust responsibility, the federal government establishes regular and meaningful consultation and collaboration with tribes on a government-to-government basis when federal activities may affect Indian tribes.

Protecting the United States Government and Indian lessors from loss of royalty as a result of conventional oil and gas drainage is a prime responsibility of the Bureau of Land Management (BLM). Under the terms of both federal and Indian leases, the lessee has the obligation to protect the leased land from drainage by drilling and producing any well(s) that is necessary to protect the lease from drainage, or in lieu thereof and with the consent of the authorized officer, by paying compensatory royalty. Drainage analysis, on the basis of a production screen or other criteria, is required by BLM's Drainage Protection Guidelines. Federal leases determined to be in danger of drainage will be subject to geologic, engineering, and economic analyses in order to define the presence and magnitude of resource drainage.

The geologic analysis is a comprehensive examination of the lithologic, structural, and stratigraphic components of the subject reservoir to determine whether drainage is geologically possible. The subject reservoir is mapped to define its limits and physical characteristics using all available data. Differences between the BLM's independent geologic analysis and the lessee's geologic analysis, if submitted, are discussed and reconciled in the final report. The report describes in detail how the geology affects drainage in the subject area.

The reservoir engineering/economic analysis is the final examination of the reservoir performance, production history, and economic determinants to determine whether drainage is occurring or has occurred and whether an economic protection well could have been drilled. The BLM would evaluate any data submitted by the lessee and resolve or explain any significant differences. The BLM analyses will determine the measures necessary to mitigate drainage of hydrocarbons ranging from a mineral owner's demand to drill a protection well to holding the lessee liable for the value of drained resource.

Exploration and production wastes include produced water, oilfield production fluids (including drilling muds and fracture fluid flowback), crude oil and condensate, and contaminated soils. Produced water, drilling muds, and fracture fluids are generally authorized for disposal by underground injection in Class II Underground Injection Control (UIC) wells under regulations of the MBOGC, and of the EPA on tribal lands. Small, uneconomical quantities of crude oil and/or condensate, when wasted, are typically collected and sold to a waste oil recycler. Soils contaminated with exploration and production wastes can be disposed in a Subtitle D (nonhazardous) landfill, or may be treated onsite with the approval of the appropriate regulatory authority and surface lessee. Drilling mud is exempt from both the Hazardous Waste Program (ARM 16.44.304(2)(c), and the Montana Hazardous Waste Act. Drilling mud that contains less than 15,000 total dissolved solids (TDS) can be disposed of onsite with the landowner's permission.

State of Montana

State agencies that have authority over oil and gas activities include the DNRC and MDEQ. The DNRC has two divisions involved in oil and gas development. These divisions are the Oil and Gas Conservation Division—also known as the MBOGC, and the Trust Land Management Division (TLMD). The MBOGC is the lead agency for regulating oil and gas development in Montana. The Board's responsibilities include issuing drilling permits; classifying wells; establishing well spacing units and land pooling orders; inspecting drilling, production, and seismic operations; investigating complaints; conducting engineering studies; and collecting and maintaining well data and production information. It also administers the federal Underground Injection Control Program for Class II injection or disposal wells in Montana to protect underground sources of drinking water.

Additional regulatory areas where the State of Montana has responsibility are managed by state agencies that have jurisdiction over some aspects of the oil and gas drilling and production. These agencies are the DNRC and MDEQ. The MFWP and the SHPO serve in advisory roles for they have no regulatory authority. Each of these agency's roles and responsibilities are discussed below.

Department of Natural Resources and Conservation

As a result of the 1995 legislative Natural Resource Agency reorganization, the "new" DNRC was formed. It combined the majority of programs from the old Departments of State Lands and Natural Resources and Conservation. Programs of the reorganized DNRC include: the MBOGC, TLMD, Reserved Water Rights Compact Commission, Forestry Division, Conservation and Resource Development Division, and Water Resources Division.

The DNRC is responsible for sustaining and improving the benefits derived from water, soil, and rangeland; managing the State of Montana's trust land resources; protecting Montana's natural resources through regulation and partnerships with federal, state, and local agencies; promoting conservation of oil and gas and preventing their waste through the regulation of exploration and production; and managing and assisting in the management of several grant and loan programs. Sections addressing the responsibilities of the MBOGC, TLMD, and Water Resources Division as they pertain to oil and gas development follow this discussion.

Montana Board of Oil and Gas Conservation

The MBOGC was established in 1953 with the passage of the Montana Oil and Gas Conservation Act (82-11-101, et seq., Montana Code Annotated [MCA]). Under Montana law, no oil or gas exploration, development, production, or disposal well may be drilled until MBOGC issues a drilling permit. This requirement applies to all private, state, and most federal lands, but excludes proposals on allotted or tribal minerals. In November 1987, MBOGC and the BLM signed a cooperative agreement to coordinate their decisions regarding permits to drill. Under this agreement, MBOGC accepts for the record all permits to drill for federal oil and gas minerals in Montana.

The powers and duties of MBOGC in regulating oil and gas activities are defined in 82-11-111, MCA. MBOGC is charged with determining whether a waste of resources is existing or imminent. Based on their determination, MBOGC can take measures to prevent contamination of or damage to surrounding land and underground strata caused by drilling operations and production. These measures include, but are not limited to, regulating the disposal of produced salt water and the disposal of oil field wastes. The MBOGC regulations are located in Title 36, Chapter 22, of the *Administrative Rules of Montana* (ARM).

In 1989, the MBOGC prepared a programmatic EIS to assist in determining how to incorporate any necessary environmental review into its rules and permitting process in an effort to come into compliance with MEPA. The programmatic EIS under MEPA presented various alternatives for addressing environmental reviews during the permitting process. From these alternatives, MBOGC has adopted an environmental review process for permitting wells.

In conducting environmental reviews for new permits, MBOGC works with other state agencies that may become involved in the process. This EIS was prepared to assist in the review process and to meet the requirements of MEPA and NEPA for CBM development.

The MBOGC is the lead state agency for regulating oil and gas development in Montana. It is a quasi-judicial body that is attached to the DNRC for administrative purposes. The law is quite specific regarding some of the MBGOC's makeup:

> *The board consists of seven members, three of whom shall be from the oil & gas industry and have had at least 3 years experience in the production of oil and gas, and two of whom shall be landowners residing in oil- or gas-producing counties of the state but not actively associated with the oil & gas industry, but one of the two landowners shall be one who owns the mineral rights with the surface and the other shall be one who does not own the mineral rights. (MCA Section 2-15-3303)*

Additionally, one must be an attorney. All members are appointed to 4-year terms by the governor—four members (the majority) when he or she takes office; the others, 2 years later.

MBOGC's regulatory action serves three primary purposes: (1) to prevent waste of oil and gas resources, (2) to conserve oil and gas by encouraging maximum efficient recovery of the resource, and (3) to protect the correlative rights of the mineral owners, that is, the right of each owner to recover its fair share of the oil and gas underlying its lands. MBOGC also seeks to prevent oil and gas operations from harming nearby land or underground resources. Since 1993, MBOGC has performed the certification required for companies to receive tax incentives available for horizontal wells and enhanced recovery projects.

Trust Land Management Division

The TLMD is responsible for managing the surface and mineral resources of forest, grazing, agricultural, and other classified state trust lands to produce revenue for the benefit of Montana's public schools and other endowed institutions. The TLMD manages more than 5.1 million acres of surface acreage and in excess of 6.3 million acres of mineral acreage.

The TLMD is divided into four bureaus: the Minerals Management Bureau, Agriculture and Grazing Management Bureau, Forest Management Bureau, and Special Uses Management Bureau.

The TLMD administers mineral leases on its school trust land mineral estate and, as a courtesy, other state agency's mineral estate. Leasing procedures will not change because of management alternatives. It should be noted that the TLMD is responsible for management of surface and mineral acreage, while some other agencies perform in more of a regulatory role. The TLMD must comply with MEPA. MEPA is required for state proposed actions. The process is implemented both at the leasing stage and for proposed plans of operation. For plans of operation, it is conducted by the area offices. Information, management restrictions, and environmental documents are then forwarded to the Minerals Management Bureau for approval. The Minerals Management Bureau then notifies operators of their decision to approve or disapprove.

Water Resources Division

The Water Resources Division is responsible for various programs coupled with the development, uses, and protection of Montana's water. It oversees the state-owned water resource projects, water rights, and water reservoirs. Its activities include centralized water rights record keeping, state water planning, floodplain management, dam safety, drought planning, and interstate coordination of water issues. The division provides administrative support to the Board of Water Well Contractors, a board that licenses well drillers and establishes minimum well construction standards.

Through the state water planning process, the division also guides the development of the state water plan and statewide water policies and laws. The state water plan is a progressive, collaborative, and citizen-based process for improving the management of the state's water resources. Other responsibilities include staffing the Drought Advisory Committee and coordinating drought responses; assisting in the planning and developing of water storage projects; analyzing the effects of proposed new water uses on existing water rights; protecting Montana's water from interstate, regional, and international threats; responding to federal laws and actions that potentially affect Montana's water; and providing water resource education to Montanans through the Montana Watercourse.

The division recently helped draft the *Powder River Basin Controlled Groundwater Area Final Order* that was signed by the DNRC director on December 15, 1999. A copy of the order is contained in Appendix A of the Water Resources Technical Report (ALL 2001b) prepared for this EIS. The order is intended to protect existing water users from impacts of CBM development. The order recommends monitoring and reporting standards, establishes a Technical Advisory Committee, and calls for the implementation of mitigation agreements between surface owners and CBM operators. The Technical Advisory Committee makes recommendations to the MBOGC regarding specific site monitoring and reporting requirements. The MBOGC has enforcement authority over monitoring and reporting requirements for continuing CBM operations as established in the Boards' Order 99-99, *Establishing CBM Operating Standards*.

Montana Department of Environmental Quality

MDEQ administers MEPA along with Montana's Hazardous Waste Management Act, Clean Air Act, the Solid Waste Management Act, Water Quality Act, Water Quality Discharge Permits, Major Facility Siting Act, and the Montana Pollutant Discharge Elimination System. MDEQ is responsible for investigating the environmental impacts associated with continued oil and gas activities in accordance with MEPA and the EIS process.

MDEQ has delegated responsibility under the Federal Clean Water Act (P.L. 92-500) and Montana Water Quality Act (75-5-101, et seq.) to monitor and assess the quality of Montana surface waters for toxic and conventional pollutants, to prepare plans to control pollution, to assess water quality conditions and trends, to report them to the EPA and Congress, and to identify impaired or threatened stream segments and lakes. Furthermore the state must provide a program for the prevention, abatement, and control of water pollution. Recent amendments to the Montana Water Quality Act (MCA 75-5-702, effective May 1997) require the Department to consider all currently available data when making water quality assessments, including information or data obtained from federal, state, and local agencies, private entities, or individuals with an interest in water quality protection.

MDEQ also has delegated responsibilities under the Federal Clean Air Act (42 U.S.C. 7401, et seq.) that requires the state to operate an approved ambient air quality monitoring network for the purpose of evaluating compliance with the National Ambient Air Quality Standards (NAAQS), to report air quality monitoring information to the EPA, and to prepare plans for controlling air pollution. Additionally, the state is required under the Clean Air Act of Montana (75-2-101, et seq.) to provide a coordinated statewide program of air pollution prevention, abatement and control. When actual locations and operational requirements for gas compression facilities (CBM development) are determined, permit applications would be submitted to MDEQ. At that time, additional site-specific, air quality analyses, such as the Best Available Control Technology (BACT) analysis or Prevention of Significant Deterioration (PSD) increment analysis, may be performed.

MDEQ has two divisions directly or indirectly involved with oil and gas development: Permitting and Compliance; and Planning, Prevention, and Assistance. The following are brief descriptions of the role of each division:

- The Permitting and Compliance Division is in charge of permit issuance and compliance monitoring for projects relating to air; water; public water supplies; solid and hazardous waste; subdivisions; motor vehicle recycling; open cut, hard rock, and coal and uranium mines; and applicable facilities under the Major Facility Siting Act. Nearly all permits and authorizations issued by MDEQ are handled through this division.
- The Planning, Prevention, and Assistance Division is involved with planning, policy, and standards development relating to air quality State Implementation Plans, water quality, non-point source management, groundwater protection, and solid waste management.

Montana Fish, Wildlife and Parks

MFWP is responsible for the conservation and management of the fish, wildlife, parks, and recreational resources of Montana. This department advises other agencies of wildlife concerns.

State Historic Preservation Office

Under the National Historic Preservation Act of 1966, states were given certain responsibilities. These responsibilities have been assigned to the SHPO, which is a program within the Montana Historical Society. The SHPO provides assistance in the following areas: the National Register of Historic Places; historic building maintenance and rehabilitation; archaeological sites and research; tax incentives for preservation; community surveys; the PLACES program (Peoples, Lands, and Cultural Environments); National Register Signs; local government and grant assistance; preservation education; and state and federal agency responsibilities. The SHPO provides information regarding the procedures that state and federal agencies must follow to consider historic and archaeological resources in their activities and programs.

Other Federal Agencies

Environmental Protection Agency

Under Section 402 of the Clean Water Act (CWA), 33 U.S.C. Section 1342, and 40 CFR Parts 122-125, EPA has authorized the states of Montana and Wyoming to issue National Pollutant Discharge Elimination System (NPDES) permits for discharges of pollutants from point sources into waters of the United States located in Montana and Wyoming, excluding Indian country as defined at 18 U.S.C. 1151. EPA retains an oversight and partnership role in state NPDES programs. As described in 40 CFR Part 123, Subpart C, EPA reviews proposed state NPDES permits for compliance with CWA requirements. For discharges in Indian country (a term that is defined in 40 CFR Section 122), EPA has direct implementation authority for issuing NPDES permits. Under Section 402 of the CWA, EPA is preparing a technical and economic analysis to assess disposal options for water that is produced as part of the CBM extraction process. The analysis will support the determination of effluent limitations that represent Best Available Technology Economically Achievable (BACT) for CBM produced waters. The following sections of the CWA also apply:

- **CWA Section 401, 33 U.S.C. Section 1341, and 40 CFR Part 121.** These provisions describe EPA's role in addressing certain discharges in one state that may affect the quality of water within any other state. The Northern Cheyenne Tribe has obtained "treatment as a state" designation under Section 518 of the CWA.

- **CWA Section 518, 33 U.S.C. Section 1377, and 40 CFR Part 131.8.** In June of 1999, the Crow Tribe submitted a draft application to EPA to administer a water quality standards program. The Northern Cheyenne Tribe submitted a draft application to EPA to administer water quality standards in January of 2001 and anticipates submitting a final application to EPA later this year.

- **CWA Section 303(d), 33 U.S.C. Section 1313(d) and 40 CFR Part 130.** These provisions require states to identify waters that need Total Maximum Daily Loads (TMDLs) standards and to establish TMDLs for them, with an oversight and partnership role for EPA. Currently, EPA and the State of Montana are subject to a court order that prohibits NPDES permits for new or increased discharges into any water body that has been listed as needing any TMDLs standards until all necessary TMDLs standards are established for a particular water quality limited segment (U.S. District Court 2000). The Tongue River, the Powder River and the Little Powder River have been included on the list of streams that need TMDLs and that are covered by the court's order.

The Safe Drinking Water Act (SDWA) also applies to this EIS; specifically, 42 U.S.C. Section 300f, et seq., particularly 42 U.S.C. Sections 1421 et. seq., and 40 CFR Parts 144-147 regarding underground injection control (UIC). Should produced water from CBM operations be injected into the ground, UIC permits may be necessary. EPA and the states administer UIC programs to protect underground sources of drinking water. EPA administers the programs for Class V UIC wells in the State of Montana and for all classes of UIC wells on Indian country lands in Montana and Wyoming. EPA has approved Wyoming's program for administering the UIC program for all five classes of UIC wells and Montana's program for administering the UIC program for Class II wells, and EPA retains an oversight and partnership role with these states for these programs. EPA's approvals of the states' authorities to administer these programs do not extend to Indian country.

EPA also administers Section 309 of the Clean Air Act, 42 U.S.C. Section 7609. This provision calls for EPA review and comment on the environmental impact of major federal actions to which the NEPA, 42 U.S.C. Section 4332(2)(C), applies.

Bureau of Indian Affairs

BIA is responsible for the approval of any lease, agreement, permit or document that could encumber lands and minerals owned by either tribes or allottees. Title to these resources is held by the U.S. Government in trust. As such, agreements or arrangements, involving the trust assets, that tribes or allottees make are not binding until they have been approved by the trustee. The agency that has been authorized to act as the trustee to keep the resources from being harmed or alienated is the BIA.

Within the Crow Reservation, there are approximately 1,497,000 acres of trust land out of the 2,282,000 total acres within the boundary. The Northern Cheyenne Reservation is composed of 444,000 acres within the external boundary. Of that amount, 442,000 acres are held in trust. (Land Titles and Records Office, BIA, Rocky Mountain Regional Office, 1994).

The BIA intends to adopt the EIS for future decisions the BIA may have to make associated with hydrocarbon exploration and production (with an emphasis on CBM on trust acreage or involving trust minerals. Such decisions relate to approval of leases, agreements, easements and/or rights of way associated with exploration and production. There will be a reliance, by the BIA, on the reasonably foreseeable development estimates and cumulative impact analysis anticipated for the region. The science and analysis components of the document may be incorporated in future BIA NEPA compliance documents.

U.S. Department of Energy

Fossil Energy

The Office of Fossil Energy is charged with enhancing the United States' economic and energy security through the following actions:

- Managing and performing energy-related research that promotes the efficient and environmentally sound production and use of fossil fuels.
- Partnering with industry and others to advance clean and efficient fossil energy technologies toward commercialization.
- Managing the Strategic Petroleum Reserve to reduce vulnerability to economic, national security, and foreign policy consequences of supply interruptions.
- Supporting the development of information and policy options that benefit the public by ensuring access to adequate supplies of affordable and clean energy.

Office of Fossil Energy—Oil and Gas Program

The primary mission is to assure that fossil energy resources can meet increasing demand for affordable energy without compromising the quality of life for future generations. This program has been at the forefront of research to advance fossil energy exploration, supply, and end-use technologies.

The Oil and Gas programs include the following:

- **Natural Gas Technologies.** Pursuing advances in exploration and production, infrastructure reliability, and technologies including fuel cells and gas turbines systems.
- **Oil Technology.** Enhancing the efficiency of oil exploration, recovery, and processing while improving environmental quality.
- **Gas Energy Systems Dynamics.** Activities will lead to the development of the next generation of gas turbines, fuel cells, coupled turbine-fuel cell systems, and reciprocating engines, and lay the foundation for new gas utilization technologies.
- **Ultra Clean Fuels.** Developing enabling science for the production of ultra-clean and affordable fuels from fossil resources for high-efficiency transportation systems.

Issues

This section presents planning issues identified through the public scoping process and the BLM and state planning activities. The issues raised were in relation to CBM development. These issues are addressed in the analysis of impacts in Chapter 4.

Air Quality and Climate

- Reduction in visibility occurring to the Northern Cheyenne Indian Reservation Class I airshed from emissions
- Air quality impacts from oil and gas related activities
- Dust and emissions associated with road and drill pad construction, drilling operations, production, and compression
- Creation or release of harmful gases (hydrogen sulfide) and venting
- Consistency with the air quality model currently being developed for the Powder River EIS through the BLM Buffalo Field Office, Wyoming
- Release of greenhouse gases and effect on global warming
- Changes in ambient air quality and how this relates to objectives for minimizing regional haze based on the "Regional Haze Rule"

- Changes in climate associated with CBM development

Cultural Resources

- Avoidance of direct and indirect disturbances to archaeological sites may precipitate the development of targeted area-wide mitigation strategies in the planning stages of field development
- Impacts on the qualities of a cultural resource site affecting its eligibility for the National Register of Historical Places
- Increased access for oil and gas exploration and development may result in inadvertent, indirect, and cumulative effects to cultural resources
- Identification of specific districts or localities in which oil and gas development may be incompatible with existing cultural values
- Identification of areas of critical environmental concern

Geology and Minerals

- Re-establish hydrologic balance and functionality after CBM development so adjacent or nearby coal companies can recover their bonds and determine effects on aquifer reconstruction in coal mine areas
- Discharge of CBM produced waters could affect new coal mines if entering the mine permit boundaries
- Effects on oil and gas development from other resource protection measures
- Loss of methane resource because of venting from coal mines
- Drainage of methane from federal minerals from offsetting state and private wells
- Quantity of methane recovered
- Effect of over-pumping CBM water on gas recovery
- Subsurface coal fires
- Potential loss of coal production from CBM development

Hazardous Materials and Waste Management

- Use of hazardous materials and potential for misuse as a part of CBM development

Hydrology

Groundwater

- Produced water quality and appropriate beneficial reuses
- Drawdown of aquifers and drying up of natural springs from CBM production
- Appropriate water management alternatives
- Water quality impacts
- Water right conflicts
- Changes in pumping rate and cumulative drawdown from CBM development
- Impacts on down- and up-gradient water resources in both confined and unconfined aquifers
- Long-term effects of CBM pumping on aquifer recharge and groundwater resources
- Effects on DNRC established Powder River Basin Controlled Groundwater Area
- Shallow (Class V) and deep (Class II) injection of produced water opportunities

Surface Water

- Effect of high SAR and increased flow rates on eroding stream channels
- Impacts on water quality from produced water
- Impacts on biota from water quality changes
- MPDES discharge analysis for CBM produced waters
- Cumulative impacts to water quality and quantity
- Impacts to irrigated cropland

Indian Trust Resources and Native American Concerns

- Unique Native American concerns and social impact on Native Americans
- The effects of discharged water on agriculture, fishing, hunting, and gathering of native and sacred plants as they relate to traditional values held by the tribes
- Protection of Indian trust assets with regard to resource drainage and reduction of usable assets
- Water quality preservation agreement with the Northern Cheyenne
- Effects to reservation Class I area classification and nonattainment area
- Impacts on sites with traditional cultural importance to Native Americans in areas on and adjoining the reservations
- Increased use of public facilities and services on reservations
- Cultural and socio-economic impacts to tribal members associated with CBM development

Lands and Realty

- Construction effects from drilling, roads, and pipelines
- Infrastructure needed to accommodate CBM development would require numerous road, powerline, and pipeline rights-of-way

Livestock Grazing

- Impacts on grazing lands from discharge of high salinity water
- Effects on livestock and ranching operations from the increased availability of water
- Displacement of grazing lands from the development of CBM well pads and loss of natural forage
- Change in vegetative communities to more salt-tolerant species that are generally not preferred by livestock

Paleontological Resources

- Impacts from vandalism and amateur fossil collectors as a result of increased access to remote areas
- Impacts to paleontological localities from oil and gas development

Recreation

- Effects on hiking, hunting, and other recreational activities from CBM development
- Displacement and disturbance of wildlife and habitat will affect hunting, hiking, and other recreational activities

Social and Economic Values

- Increased levels of background noise and what noise mitigation would be conducted
- Impacts on social service agencies and local economics from increased population
- Decreased land values
- Real estate price escalate
- Agricultural job loss
- Economic effect on local communities, including potential increased wage income, lower unemployment, increased local business, and potential costs of a “boom and bust” scenario
- Cost to residents from potential CBM production affect to springs, livestock watering, and domestic water
- Social structure impacts through direct impacts to the local economy
- Revenue associated with the amount of methane recovered
- Tax revenue to local, state, and federal entities
- Effects on local economies and lifestyle from royalties to the state and federal government
- Royalties to local landowners who own mineral rights and surface disturbance payments to landowners who do not own mineral rights
- Benefits from more abundant clean energy

- Effect from Wyoming CBM development (cumulative)
- Economics of mitigation strategies
- Socioeconomic effect from lowering the water table
- Quantity of economical oil and gas resources and market implications
- Effect to agricultural productivity from sodium adsorption ratio (SAR) values
- Effects to agriculture from air, soil, and water contamination
- Private surface owner notification prior to work
- Mechanism needed for land owner input on drilling, and leasing and mineral estate issues

Environmental Justice

- Make distributive justice analysis part of the public comment and decision process
- Northern Cheyenne Tribal Governments' reliance on operator lease fees from tribal ranchers and irrigators operating on private and reservation lands

Soils

- High sodium effects: dispersion of soil colloids; reduced water infiltration; vegetative composition and population changes; mud pits, bogs; change in crop production yields; and changes in crops grown because of salinity tolerance levels
- Effects on soils from surface discharge flow changes: erosion on stream banks, and erosion in ephemeral drainages if these are the discharge points (increased erosion where dispersion occurs)
- Effects on irrigated soils: changes salt content in soil profile; changes in salt composition; saline seeps downgradient from irrigated soils; dispersion of soil colloids (reduction of soil permeability and increased erosion); and changes to micro-organism populations and composition
- Development effects: disturbance during drilling at pads (exposure to wind and water erosion); and road development (loss of soil to develop road beds, and packing soil in undeveloped roads, leading to wind erosion)
- Effects on irrigation and crop management practices: addition of additional water for leaching fraction; potential for water logging soils; modification of irrigation systems; change in cropping equipment; and effects on crops
- Effects from land subsidence and disturbance

Vegetation

- Effect of surface discharge of high sodium or SAR water on native vegetation species that are salt intolerant, as well as on streamside vegetation
- Change in vegetative communities to more salt-tolerant species
- Loss of surface vegetation from construction
- Invasion of exotic and noxious plant species in disturbed areas
- Loss of plant productivity from development
- Protection of grasslands within the Powder River Basin
- Agricultural land withdrawal for CBM production

Special Status Species

- Mitigation measures or avoidance needed to manage and protect candidate and sensitive species
- Loss of threatened and endangered species from development

Visual Resource Management

- Visual degradation from construction of production facilities, roads, powerlines, and pipelines
- Visual pollution

Wilderness Study Areas

- Effects on wilderness study areas from CBM exploration and development

Wildlife

- Impacts from infrastructure development and increased human disturbance on wildlife habitat availability, quality and integrity, escape habitat, and management plans of MFWP
- Fragmentation of wildlife habitat
- Effects from water availability, quality, and quantity
- Loss of animals because of the addition of hazards to the habitat, such as vehicles, equipment, and increased human access
- Effects on major waterways, such as the Tongue and Powder rivers, and to aquatic ecosystems, including fisheries
- Effect on migration patterns
- Change in vegetative communities to species that are generally not preferred by wildlife
- Effects from increased noise levels
- Effects from powerlines

CHAPTER 2

ALTERNATIVES

MONTANA

CHAPTER 2: ALTERNATIVES

Introduction

The regulations of the Council on Environmental Quality Section 1502.14, Title 40 of the Code of Federal Regulations, require that an EIS "rigorously explore and objectively evaluate all reasonable alternatives. . . ." In this respect, this chapter presents the No Action Alternative (Existing Management) and four other action alternatives in detail for managing oil and gas resources—specifically coal bed methane (CBM) exploration and production—throughout the planning area state-wide, with emphasis in the BLM's Powder River and Billings RMP areas. The BLM and state lands affected by this EIS are those lands open to oil and gas development. Other alternatives were considered but eliminated without detailed analysis; their descriptions and reasons for elimination are provided in the *Alternatives Considered But Not Analyzed in Detail* section.

This chapter is presented in four sections: Alternatives Considered But Not Analyzed in Detail; Alternatives Analyzed in Detail; Management Common to All Alternatives; and, Management Actions Specific to Each Alternative.

Alternatives Considered But Not Analyzed in Detail

The following alternatives were considered for resolving planning questions or issues, but were not analyzed in detail because of technical, legal, or other constraints.

Leasing

BLM oil and gas leasing decisions and lease stipulations, including for CBM, were previously analyzed in the BLM 1992 *Final Oil and Gas RMP/EIS Amendment* (BLM 1992). Those decisions were approved in the project's *Record of Decision* (ROD) published in February 1994. The purpose of this document is to analyze levels of conventional oil and gas development that are greater than those analyzed in the BLM 1992 Final Oil and Gas RMP/EIS Amendment and full scale CBM development. Analyzing new federal lease stipulations as well as decisions such as closing federal areas of oil and gas estate in the Powder River and Billings RMP areas are therefore beyond the scope of this plan.

This plan will analyze the impacts from CBM exploration and development, and identify necessary mitigation measures that would be applied during the permitting process. CBM is part of the oil and gas estate. Existing oil and gas leases include the right to explore and develop CBM. Issuing separate leases for conventional oil and gas and separate leases for CBM would require a regulatory change. The environmental analysis conducted for federal permits can influence where and what level of CBM development can occur.

Bonding

Establishment of bond amounts specifically for CBM development activities that cover the full cost of coal bed methane development. This alternative is not analyzed in detail because the State of Montana and BLM regulations set minimum amounts of bonding required before approving drilling permits. The regulations allow agencies to raise the bond amount required depending upon such factors as the number and type of wells, type and amount of reclamation necessary, and operator history. Bond increases can't exceed the total of estimated costs of plugging and reclamation, the amount of uncollected royalties due and monies owed because of outstanding violations.

Omega Alternative

The Omega alternative to drill a large-diameter well through the coals and from the base of that shaft to directionally drill upwards into the various coal seams in a circular pattern is an experimental technology not yet proven for CBM. If this technology becomes viable for CBM extraction in the future, further consideration would be given to it.

Alternate Sources of Energy

The purpose of this EIS is to analyze CBM and conventional oil and gas development. Considering alternate sources of energy such as wind power and fuel cells is therefore beyond the scope of the EIS.

Re-Injection of Produced Water into the Same Aquifer Alternative

Re-injection of produced formation water is an accepted practice in conventional oil fields but its use in CBM fields would be counter productive. In conventional oilfields, operators have re-injected produced water since the 1920s to help maintain reservoir energy and to increase ultimate production efficiency, or to move oil preferentially to producing wells. When produced water is re-injected, original reservoir pressures are maintained; this can significantly increase the percentage of original oil in place that is produced before the field's economic limit is reached (Thomas et al. 1987). Re-injection can also sweep oil out of the reservoir toward producing wells in a waterflood, also increasing production efficiency. In these scenarios, water production is neither desired nor absolutely necessary; it's a nuisance that can be minimized with standard engineering practice. In the history of many oilfields, oil is produced water-free for months or even years before water is seen in producing wells.

In CBM production, formation water must be produced before reservoir pressures are sufficiently reduced for the adsorbed methane to be liberated. Water production is unavoidable and pre-requisite to CBM production. As water is produced from the coal seam, the pressure in the seam is reduced. Research by the BLM's Buffalo, Wyoming, Field Office suggests that methane production begins after 20 percent of the virgin reservoir pressure is depleted; significant production does not begin until 40 percent of the pressure is depleted (Crockett and Meyer 2001). Work by Jones et al. (1992) corroborates this relationship. If methane production is directly related to depletion of reservoir pressure, then re-injection of produced water within the confines of the CBM field will directly result in the decrease of methane production. Re-injection of CBM-produced water into the same aquifer cannot, therefore, be considered as a reasonable option for water disposal.

It would be reasonable to inject produced water into non-productive coal seams that were geologically separated from the CBM field. Separation could be the result of faulting or erosion, isolating coals in the injection area even from stratigraphically equivalent productive coal seams in the CBM field. Injection like this would result in preservation of the produced water resource, whether of high or low quality. The permit process could mitigate impact to groundwater so that quality of the injected water is matched to the quality of the formation water in the prospective injection zone. When and if this technology becomes viable, a more detailed analysis would be conducted for further consideration.

Alternatives Analyzed in Detail

Five alternatives have been developed to evaluate the impacts related to the various development scenarios associated with CBM exploration and production. Each alternative represents a different approach for resolving the issues identified during scoping. Alternative A, the No Action Alternative, would continue existing management. Alternative B would allow CBM development while emphasizing the resource protection. Alternative C would emphasize CBM development with minimal environmental restrictions. Alternative D would encourage CBM exploration and development while maintaining existing land uses. Alternative E is the Preferred Alternative and would allow for CBM exploration and development while minimizing the impacts to environmental resources.

The alternatives were formulated in response to the Purpose and Need section as outlined in Chapter 1, which is to amend the BLM's Resource Management Plans for the Powder River and Billings RMP areas in order to address fluid mineral development issues not covered in the current plans. The State of Montana's intention is to comply with the stipulation and settlement agreement for preparing a statewide programmatic supplemental EIS addressing CBM exploration, development, production, reclamation, and closure.

Management Common to All Alternatives

Management common to all alternatives are the management practices for conventional oil and gas operations that will remain the same in each alternative that is analyzed, including the Preferred Alternative.

Bureau of Land Management

The BLM has primary responsibility for managing the federally owned oil and gas estate. After lease issuance, operations may be conducted with an approved permit. Proposed drilling and associated activities must be approved before beginning operations. The operator must file an Application for Permit to Drill (APD) or Sundry Notice (SN) that must be approved according to (1) lease stipulations; (2) onshore oil and gas orders; and (3) regulations and laws. The steps required to obtain approval to drill and conduct surface operations are summarized in Appendix A of the *1992 Final Oil and Gas RMP/EIS Amendment* and in the *Minerals Appendix* of the *BLM's Big Dry Resource Management Plan/Environmental Impact Statement for the Big Dry Resource Area of the Miles City District (Big Dry RMP/EIS) (1995)*. The process described therein is common to all alternatives.

In addition, under requirements of the Clean Air Act and the Federal Land Policy and Management Act, any activity the BLM authorizes (including oil and gas development) must comply with all applicable air quality laws, regulations, standards, increments and implementation plans. Therefore, land use authorizations will specify that operating conditions (i.e., air pollutant emissions limits, control measures, effective stack heights, etc.) are consistent with the applicable air regulatory agency's requirements.

State of Montana

State agencies that have authority over oil and gas activities include the Department of Natural Resources and Conservation (DNRC), which includes the Montana Board of Oil and Gas Conservation (MBOGC) and the Trust Land Management Division (TLMD); and the Montana Department of Environmental Quality (MDEQ). Each of these agency's roles and responsibilities were discussed in Chapter 1. Current oil and gas development is managed under the guidelines developed in the MBOGC's *Oil and Gas Drilling and Production in Montana: Final Programmatic Environmental Impact Statement* (1989). This document outlines how to incorporate any necessary environmental review into its rules and permitting process in an effort to comply with the Montana Environmental Policy Act (MEPA). In conducting environmental reviews for new permits, MBOGC works with other state agencies that may become involved in the process.

Agency Permits

Table 2-1 shows the agencies involved with issuing permits for oil and gas operations on federal, state, and private leases.

TABLE 2-1
APPLICABLE PERMITS FOR OIL AND GAS DEVELOPMENT ACTIVITIES

Agency	Responsibility/Permit/Approval
Bureau of Land Management (BLM)	Approval of APDs and SNs on federal leases. Approval or issuance of rights-of-way on federal surface.
	Communitization Agreements and Federal Unit Agreements
U.S. Army Corps of Engineers (COE)	Section 404 of the Clean Water Act—regulates the discharge of dredged or fill material into waters of the United States; Section 404 permit.
U.S. Fish & Wildlife Service (FWS)	Review under the Endangered Species Act (ESA)/Biological Opinion.

TABLE 2-1
APPLICABLE PERMITS FOR OIL AND GAS DEVELOPMENT ACTIVITIES

Agency	Responsibility/Permit/Approval
U.S. Environmental Protection Agency (EPA)	Regulates Underground Injection Control (UIC) Class V injection program/UIC Permit.
	Regulates all classes of underground injection wells and all point source discharge to streams for any source located in Indian Country.
	ESA review for National Pollutant Discharge Elimination System (NPDES) permits, Total Maximum Daily Loads (TMDL's) and Water Quality Standards (WQS) on state and tribal lands
	Clean Air Act (CAA)—Air quality permitting for major emitting sources on tribal lands
	404 enforcement under the CWA for dredge and fill activities
	401 Discharge certification under the CWA on tribal lands and certain discharges in one state that may affect the quality of water within any other state
	518 under the CWA for approval or disapproval of Tribal Water Quality Standards
	Section 303(d) of the CWA regarding EPA's oversight and partnership role with states to identify streams that do not meet the CWA objectives by establishing TMDLs for such streams
Montana Department of Environmental Quality (MDEQ)	Administers MEPA (75-1-101, MCA).
	Air Quality Permitting—Clean Air Act of Montana (75-2-101 *et seq.*, MCA)(ARM 17.8).
	Resource Conservation and Recovery Act (RCRA) Waste Disposal—Hazardous Waste Management Act (75-10-401, Montana Codes Annotated [MCA]) (Administrative Rules of Montana [ARM] 17.53.101).
	Solid Waste Management Act (75-10-201, MCA) (ARM 17.50.501).
	Water Quality Act (75-5-401 through 405, MCA).
	Montana Surface WQS (ARM 17.30.601 *et seq.*).
	401 Discharge Certification under the CWA.
	Montana Nondegradation Rules (ARM 17.30.701 *et seq.*).
	Montana Pollutant Discharge Elimination System (MPDES) (ARM 17.30.1301 – 1426).
	Certificate of environmental compatibility—Major Facility Siting Act (75-20-101, MCA).
	Montana Groundwater Pollution Control System (MGWPCS) (ARM 17.30.100 *et seq.*)

TABLE 2-1
APPLICABLE PERMITS FOR OIL AND GAS DEVELOPMENT ACTIVITIES

Agency	Responsibility/Permit/Approval
State Historic Preservation Office (SHPO)	Review under the National Historic Preservation Act (NHPA) regarding protection of cultural/historic resources.
County Weed Districts	Review for control and prevention of noxious weed infestations under the Noxious Weed Control Law (7-22-2101, MCA)
Local Conservation District	Montana Natural Streambed and Land Preservation Act (310 Permit)
Montana Department of Natural Resources and Conservation (DNRC)	
Trust Land Management Division (TLMD)	Approval of activities on state trust surface and mineral estate (subsurface) lands; issuing land use licenses, easements, and mineral leases; conducting land exchanges; manages grazing permits.
Minerals Management Bureau (MMB)	Responsible for leasing, permitting, and managing mineral leasing program.
Water Resources Division, Water Rights Bureau	Permit to allow beneficial use of groundwater and surface water. (85-2-310 to 312, MCA)
Montana Board of Oil and Gas Commission (MBOGC)	Approval of state drilling permits on state and private leases (APDs). (ARM 36.22) (82-11-111, MCA)
	Oversee UIC program for Class II wells (ARM 36.22.1401)(82-11-101, MCA)
	RCRA-exempt Solid Waste Disposal (ARM 36.22.1105)
	Surface Restoration (ARM 36.22.1307)

Management Actions Specific to Each Alternative

Each alternative was structured within the varying theme circumstances to stress different development emphasis, such as resource protection, CBM development, and existing land uses.

Alternative A—No Action (Existing Management)

This section describes the current management practices used by the BLM and the state to manage the exploration, development, and operation of CBM wells in Montana.

BLM

The BLM issues oil and gas leases that include the right to explore for and develop CBM. The *Final Oil and Gas RMP/EIS Amendment* allowed for the drilling of test wells and initial small-scale development of CBM. Under Alternative A, the BLM would approve the drilling and testing of CBM wells on federal leases, but would not authorize production of CBM from federal minerals or the installation of production facilities.

The permitting procedures for CBM wells and associated activities would be the same as described in the *Management Common to All Alternatives* section for conventional oil and gas operations, which are detailed in the *Final Oil and Gas RMP/EIS Amendment* and in the *Minerals Appendix* of the *Big Dry RMP/EIS*.

Water produced during the testing phase would remain untreated and be contained at the well site in either a pit or a steel tank, and would not be discharged into state or federal waters. The water would be available for beneficial use by industry (for example, pipelines, dust abatement) and landowners. Wells drilled on federal minerals would be shut-in or plugged after completion of the testing phase.

Coal seams targeted for exploration would be determined by industry and not by the government. Vertical wells producing from a single coal seam would be allowed. Vertical wells producing from multiple coal seams would not be required. Operators would be required, when technologically and economically feasible, to drill several wells from a well pad which may require directional drilling. The placement of wells would not be restricted through the use of buffer zones around active coal mines or Indian reservations. The placement of wells would not be restricted through the use of buffer zones around active coal mines or Indian reservations.

Transportation corridors for vehicles would not be required; however, operators would be encouraged to use existing routes, corridors or previously disturbed areas when feasible or as required by the surface owner. Power lines would be either above ground or buried according to operator plans. Placement of roads and powerlines or other utilities requiring right-of-way (ROW) are subject to environmental review and agency approval. Diesel, electric, or gas-fired engines would power generators used during the testing phase of CBM wells. The number of wells connected to each compressor would be dependent on the operator's development circumstances. Equipment would have to be removed at the end of the testing phase or at the time of abandonment. Areas of surface disturbance associated with lease operations would have to be reclaimed at the completion of activities in accordance with surface owner requirements. Upon abandonment, roads providing legal access to BLM-administered surface would be open to the public.

State

For Alternative A, the state would manage CBM based on the Stipulation and Settlement Agreement reached in the First Judicial District Court, Lewis and Clark County, between the MBOGC and the Northern Plains Resource Council, Inc., on June 19, 2000. In this agreement, the MBOGC may, upon proper application by the operator, issue 200 CBM exploration permits for water quality, quantity and/or perform suitability tests on coals. An additional restriction limits the number of wells per pod to nine and pods per township to one, and prohibits the discharge of any water into the waters of Montana or the United States. In addition to these exploration wells, the agreement specifies that Redstone Gas Partners could apply to the MBOGC for up to 90 additional wells for its CX Field Pilot Project in southeastern Big Horn County. The total producing wells in the CX Pilot Field cannot exceed 250. In addition to these, Redstone can drill another 75 exploration wells for a total of 325 wells. Discharge of production water would be arranged through the state DEQ, via a MPDES permit. The MPDES permit would allow for 1,600 gallons per minute discharge into the Upper Tongue River from up to 11 discharge points.

Testing of CBM wells that have been previously drilled under previously issued permits would continue provided no water is discharged to the waters of Montana or the United States. No commercial production of methane would occur from any of the wells. For each landowner where tests wells are drilled, the operator conducting the drilling would enter into a water well mitigation agreement. All wells drilled under the terms of the settlement agreement would be required to comply with the MBOGC's regulations. After test wells are completed, such wells would be abandoned or plugged according to the MBOGC's regulations.

The development of CBM wells also would be subject to the same regulatory requirements outlined in the *Management Common to All Alternatives* section for conventional oil and gas. The exception to these rules that pertain to CBM would be the Stipulation and Settlement Agreement that would govern the number of well permits and require the completion of a statewide, programmatic, supplemental EIS. The stipulation and settlement agreement would remain in effect until a Record of Decision (ROD) is formulated and signed for this EIS.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

This alternative would allow CBM development while emphasizing the protection of natural and cultural resources.

All generators and compressors would be required to be powered by natural gas-fired engines. The number of wells connected to each compressor would be maximized to reduce the overall number of field compressors.

To the extent agency authority allows, buffer zones would be established around Indian lands and active coal mines. Until a reservation approves production of CBM on their lands, a 2-mile buffer would be enforced around reservations in Montana. A 1-mile buffer would be enforced around active coal mines where no CBM production would be permitted.

Water from exploration wells would be stored in tanks, or other approved non-discharging storage facilities. Water from producing wells would be injected into a different aquifer with the same or lesser quality water. Class V permits for injection of produced water with less than 3,000 milligrams per liter (mg/l) total dissolved solids (TDS) would need to be obtained from the EPA Region VIII. If the produced water has dissolved solids in excess of 10,000 mg/l, it would need to be disposed of via the Class II UIC program maintained by the MBOGC. Produced water between 3,000 and 10,000 ppm TDS can be disposed of in a Class II well permitted by MBOGC with concurrence from EPA. Regardless of the water quality or class of well, the produced water would not be injected into the same coal seam that the methane was being extracted from unless there was some form of geological separation to prevent migration of the injected water into the area of methane production.

Co-location of single-seam development wells on the same well pad would be required. Multiple seam completions in a single well bore would be encouraged to the extent technology permits. CBM production could occur simultaneously from multiple seams or staggered over time from separate seams. Directional drilling would be required for deeper coal seams to avoid excess surface use or disturbance.

Roads to wells and compressor sites would be limited to single lane width with turnouts. Exploration wells would not have permanent gravel access roads. Utilities would be placed along the road routes, using the transportation network as utility corridors. Power lines would be buried in the utility corridors; no overhead lines would be permitted. Produced water flowlines and gas flowlines would be buried in the same trench when feasible. When the well had reached the end of its useful life, new access roads on BLM and state surface would be rehabilitated and closed.

Alternative C—Emphasize CBM Development

This alternative would emphasize CBM exploration and development with minimal restrictions.

Operators could use diesel engines with Best Available Control Technology (BACT) to reduce emissions. Agencies would not require a minimum number of CBM wells be connected to a field compressor nor limit the number of field compressors delivering gas to a sales compressor.

Roads and utility corridors would be positioned to use existing disturbances as much as possible. Corridors would not be required. Power lines would be aboveground or buried per operator's plans. Gas and water lines would be buried. Upon abandonment, new BLM and state surface oil and gas roads would be rehabilitated and closed.

Operators would not be required to drill directional or horizontal CBM wells. Wells would be located by the operator and agencies would not require multiple wells to be located on the same well pad.

Water management would be based on a combination of beneficial use and surface discharge. Beneficial uses would include stock water, industrial needs, dust control, and agricultural reuse. Surface discharge would be subject to MDEQ permit requirements Montana Pollutant Discharge Elimination System (MPDES) and limitations established for discharge into identified watersheds. Water discharge via a transportation pipeline into a drainage system would not be required. The operator must obtain 401 Certification from the State if the disposal action needs BLM approval. Injection of produced CBM water would not be required.

A CBM production buffer zone would not be imposed around Indian reservations or coal mines.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

This alternative would encourage CBM development while maintaining existing land uses and protecting downstream water consumers.

The number of wells connected to each compressor would be maximized to reduce the overall number of field compressors required. Natural gas engines with electric booster would be required for all compression operations.

Operators would be required, when technologically and economically feasible, to drill several wells from a well pad which may require directional drilling. Multiple seam completions in a single well bore would be encouraged. The transportation network also would serve as a utility corridor. Roads and utilities would be constructed with one way in and out. All power lines and water and gas flowlines would be buried. Upon abandonment, new oil and gas roads on BLM and state surface would be rehabilitated if closed. Roads would remain open or closed at the surface owner's discretion.

If agency jurisdiction permits, buffer zones for production would be established around Indian lands (2 miles) and active coal mines (1 mile). The buffer zone around Indian lands would remain in effect until the Tribe approves production on its own lands.

All produced water (depending upon water quality) would be treated prior to surface discharge or pumping into holding facilities such as impoundments, pits, and ponds. Transportation of treated water for discharge would be via a constructed drainage system or pipeline to the nearest perennial watercourse if possible. The method of treatment is unrestricted, provided the effluent meets standards established by the MDEQ for down-stream use. Beneficial use of produced water would be allowed and treatment would vary based on industrial, municipal, or agricultural uses such as power plant cooling water, coal slurry pipeline, field irrigation, livestock or wildlife watering, or municipal power turbines. The operator must obtain 401 Certification from the State if the disposal action needs BLM approval. Surface storage of produced waters would also require an MPDES permit issued by MDEQ.

Alternative E—Preferred Alternative

Alternative E would provide management options to facilitate CBM exploration and development while sustaining resource and social values, and existing land uses.

Exploration and development of CBM resources on BLM, state and/or fee minerals are allowed subject to agency decisions, lease stipulations, permit requirements and surface owner agreements. Under this alternative, operators would be required to submit a Project Plan outlining the proposed development of an area when requesting CBM well densities greater than 1 well per 640 acres. The project plan would be developed in consultation with the affected surface owner(s) and other involved permitting agencies. All shallow coal seams would have vertical wells installed; for deeper coal seams, the operator would drill directionally or demonstrate in the project plan for agency consideration why directional drilling is not needed or feasible. Operators would develop single or multiple coal seams per their plans, however, there would be only one well bore per coal seam per designated spacing restriction. Operators would also be required to demonstrate in their project plan how impacts to surface resources, such as wildlife, would be minimized or mitigated.

The Preferred Alternative combines management options so that there would be no unnecessary or undue degradation of water quality allowed in any watershed. The preferred water management options of water produced with CBM is for beneficial use. Other produced water management options include, but are not limited to, injection, treatment, impoundment, and discharge. The operator must obtain 401 Certification from the State if the disposal action needs BLM approval. A Water Management Plan would be required for exploratory wells and for each Project Plan. Produced water management plans or permits would be approved by the appropriate agency in consultation with affected surface owners. Surface storage of produced waters would also require an MPDES permit issued by MDEQ. Impoundments proposed as part of the Water Management Plan would be designed and located to minimize or mitigate impacts to soil, water, vegetation, and channel stability. There would be no discharge of produced water (treated or untreated) into the watershed unless the operator has an approved MPDES permit and can demonstrate in the Water Management Plan how discharge could occur in accordance with water quality laws without damaging the watershed.

With regards to air quality, the objectives of this alternative are the same as Alternative B (the number of wells connected to each compressor would be maximized and natural gas-fired engines for compressors and generators would be required), except in areas with sensitive resources, including people, where noise is an issue. In those areas, the decibel level would be required to be no greater than 50 decibels measured at a distance of one-quarter mile from the compressor. This may require the installation of an electrical booster at these locations.

Transportation corridors would not be required; however, proposed roads, flowline routes and utility line routes would be located to follow existing routes or areas of previous surface disturbance when possible. The operator will also address in the Project Plan how the surface owner was consulted for input into the location of roads, pipeline and utility line routes. Concerning powerlines, the operator will demonstrate in the Project Plan how the proposal for power distribution would mitigate or minimize impacts to affected wildlife. For example, the operator may propose that all or a portion of the powerlines be buried and any above-ground lines be designed following raptor-safe specifications or designed to safely eliminate use by raptors in sage grouse habitat. When wells are abandoned, the associated oil and gas roads would remain open or be closed at the surface owner's discretion. If the roads were requested to be closed they would be rehabilitated. This includes leaving BLM and State surface roads open if access is desirable.

As with current management, there would be no buffer zone for CBM production around active coal mines (MSO IM 2000).

To determine potential impacts to groundwater on the Crow and Northern Cheyenne reservations, monitoring wells would be required to be installed during the exploration phase on all BLM-administered oil and gas leases that are within two miles of reservation boundaries in Montana. Any development projects that propose CBM well densities greater than 1 well per 640 acres would need monitoring wells when the closest edge of the field is within 5 miles of reservation boundaries. If monitoring indicates drawdown would occur on the reservation, mitigation such as the operator providing a hydrologic barrier, communitization agreement, or spacing that would protect the Indian minerals from drainage, would be required.

Comparison of Alternatives

The differences between alternatives by development theme are depicted in Table 2-2. The variations for development by theme are compared for the five alternatives carried forward for detail analysis.

A range of potential issues affecting development has been analyzed in the context of the themes described for each alternative. The comparison focuses on the various techniques typically used to develop CBM fields. The variations between alternatives reflect the different potential drilling technologies, water disposal methods, transportation corridor construction, compressor engines, socioeconomic issues, etc. These alternatives represent the majority of development techniques commonly used with CBM operations. There are general and specific assumptions as to percentages of use per theme within each alternative. These assumptions are presented in Chapter 4, *Environmental Consequences*.

TABLE 2-2

ALTERNATIVE MANAGEMENT FOR CBM

Theme	Alternative A—No Action (Existing Management)	Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C—Emphasize CBM Development	Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses	Alternative E—Preferred Alternative
Air	The number of wells connected to each compressor would be per the operator's plans.	The number of wells connected to each compressor would be maximized.	Same as Alternative A.	Same as Alternative B.	Same as Alternative B.
	Compressors and generators would be powered by diesel, electric, or gas-fired engines.	Gas-fired engines for compressors and generators would be required.	Same as Alternative A.	Gas engines for compressors and generators with electric boosters would be required.	Same as Alternative B, except in areas with sensitive resources, including people, where noise is an issue. In those areas, the decibel level would be required to be no greater than 50 decibels measured at a distance of 0.25 miles from the compressor. This may require an electrical booster.
Coal	There would be no buffer zone for CBM production around active coal mines.	There would be a 1 mile buffer area around active coal mines where no CBM production would be allowed.	Same as Alternative A.	Same as Alternative B.	Same as Alternative A.
CBM	Limited CBM exploration would be allowed on BLM-administered minerals. No CBM production wells would be permitted on BLM-administered minerals.	CBM exploration and production would be allowed by BLM and the state.	Same as Alternative B.	Same as Alternative B.	Same as Alternative B, except the operator would be required to submit a Project Plan outlining the proposed development for an area when requesting a different spacing from the State.
	The state would permit up to 200 CBM exploration wells. The CX Ranch Field would be allowed to have up to 250 production wells and 75 exploration wells.				The Project Plan would be developed in consultation with the surface owner.

TABLE 2-2

ALTERNATIVE MANAGEMENT FOR CBM

Theme	Alternative A—No Action (Existing Management)	Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C—Emphasize CBM Development	Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses	Alternative E—Preferred Alternative
	Operators would drill vertical CBM wells. Directional drilling for deeper coal seams would not be required.	Directional drilling for deeper coal seams would be required.	Same as Alternative A.	Same as Alternative B.	Operators would drill vertical wells for shallow coal seams. For deeper coal seams, the operator would demonstrate in the Project Plan for agency consideration why directional drilling is not needed or feasible.
	There would be one well bore per coal seam developed.	There would be multiple completions in a single well bore.	Same as Alternative A.	Same as Alternative B.	Same as Alternative A.
	Operators would develop coal seams per their plans.	Company would be required to develop all coal seams at the same time.	Same as Alternative A.	Same as Alternative B.	Same as Alternative A, except operator would need to demonstrate in project plan how impacts to wildlife and other surface resources would be minimized or mitigated.
Hydrology	Untreated water from CBM exploration would be placed in holding facilities such as pits, and tanks. The water would be available for beneficial use by industry (pipelines, dust abatement, etc.) and landowners. No discharge to waters of the U.S. would be allowed for BLM-authorized wells. The state would permit discharge for the CX Ranch field up to 1,600 gallons per minute (gpm).	Untreated water from CBM exploration would be placed in tanks.	Discharge of untreated water onto the surface would be allowed by BLM and the state in the planning area. General dispersal adjacent to the well pad and/or into ephemeral drainage's would be allowable. The water would be available for beneficial use by industry and landowners.	Water would be treated prior to discharge onto the surface. All discharge water would be transported to the nearest perennial body of water via a pipeline or constructed drainage system. Treated water would be used for industrial (power plants, hydro, coal slurry pipeline, municipal, power turbines) and landowner's beneficial use.	No degradation of a watershed would be allowed. A Water Management Plan would be required for every exploration Application for Permit to Drill. First priority for discharged water would be for beneficial use.

TABLE 2-2

ALTERNATIVE MANAGEMENT FOR CBM

Theme	Alternative A—No Action (Existing Management)	Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C—Emphasize CBM Development	Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses	Alternative E—Preferred Alternative
	Injection of produced CBM water would not be required.	Water from CBM production would be injected into a different aquifer with water of same/lesser quality.	Same as Alternative A.	Same as Alternative A.	Water from production would be managed per a site-specific Water Management Plan submitted by the operator as part of the Project Plan. First priority for discharged water would be for beneficial use. Impoundments proposed as part of the Water Management Plan would be designed and located to minimize or mitigate impacts to soil, water and vegetation. There would be no discharge of produced water into the watershed unless the operator can demonstrate in the Water Management Plan how discharge could occur without damaging the watershed in accordance with water quality laws. Injection of produced CBM water would be an option.
Realty	There would be no transportation corridors required. Existing disturbances would be used where possible.	Transportation corridors would be required. Roads would be designed to have one way in and out.	Same as Alternative A.	Same as Alternative B.	Same as Alternative A, except the operator will also address in the project plan how the surface owner was consulted for input into the location of ROWs.

TABLE 2-2

ALTERNATIVE MANAGEMENT FOR CBM

Theme	Alternative A—No Action (Existing Management)	Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C—Emphasize CBM Development	Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses	Alternative E—Preferred Alternative
	Powerlines would be aboveground or buried.	All powerlines would be buried.	Same as Alternative A.	Same as Alternative B.	In the Project Plan, the operator would demonstrate how their proposal for powerlines would mitigate or minimize impacts to affected wildlife, for example, propose that the powerlines be buried. All above-ground proposals would have raptor-safe specifications.
	Upon abandonment, roads providing legal access to BLM-administered surface would be open to the public.	Upon abandonment, new oil and gas roads would be rehabilitated and closed.	Same as Alternative B.	Upon abandonment, new oil and gas roads would be rehabilitated if closed. Roads would remain open or closed at surface owner's discretion.	Same as Alternative D.
Indian Trust Resources	There would be no CBM production buffer around the reservations	A 2-mile CBM development buffer would be established around reservation borders in Montana. The buffer zone would remain in effect until the Tribe approves production on its own lands.	Same as Alternative A.	Same as Alternative B.	There would be no CBM production buffer around the reservations. Monitoring wells would be required on BLM-administered oil and gas that abuts the reservation boundaries during the exploration phase. If monitoring indicates drawdown would occur on the reservation, mitigation such as the operator providing a hydrologic barrier, communitization agreement, or spacing which would protect the Indian minerals from drainage would be required.

CHAPTER 3

AFFECTED ENVIRONMENT

MONTANA

CHAPTER 3: AFFECTED ENVIRONMENT

Introduction

This chapter contains a description of the natural resources, economic, and social conditions found in the planning area and within the two Indian reservations adjacent to the planning area.

Air Quality

The air quality of any region is controlled primarily by the magnitude and distribution of pollutant emissions and the regional climate. The transport of pollutants from specific source areas is affected by local topography and meteorology. In the mountainous western United States, topography is particularly important in channeling pollutants along valleys, creating up slope and downslope circulations which may entrain airborne pollutants, and blocking the flow of pollutants toward certain areas. In general, local effects are superimposed on the general synoptic weather regime and are most important when the large-scale wind flow is weak.

Although site-specific quality monitoring is not conducted throughout most of the CBM emphasis area, air quality conditions are likely to be very good, as characterized by limited air pollution emission sources (few industrial facilities and residential emissions in the relatively small communities and isolated ranches) and good atmospheric dispersion conditions, resulting in relatively low air pollutant concentrations.

Air quality monitoring data collected throughout the southeastern Montana and northeastern Wyoming are presented in Table 3-1. Although monitoring is primarily conducted in urban or industrial areas, the data are considered to be the best available representation of background air pollutant concentrations through out the CBM emphasis area.

Regulated air pollutants include: carbon monoxide (CO), nitrogen dioxide (NO_2; a portion of oxides of nitrogen, or NO_x), inhalable particulate matter less than 10 microns in effective diameter (PM-10), fine particulate matter less than 2.5 microns in effective diameter (PM-2.5), sulfur dioxide (SO_2), and volatile organic compounds (VOC).

The assumed background pollutant concentrations are below applicable National Ambient Air Quality Standards (NAAQS) and applicable Montana Ambient Air Quality Standards for most pollutants and averaging times, although hourly background concentrations of nitrogen dioxide, ozone and sulfur dioxide are not available.

TABLE 3-1
BACKGROUND CONCENTRATIONS, APPLICABLE AMBIENT AIR QUALITY STANDARDS, AND PSD INCREMENT VALUES (IN Φg/m^3)

Pollutant	Averaging Time[1]	Background Concentration	National Standards	Montana Standards	PSD Class I Increments	PSD Class II Increments
carbon monoxide[2]	1-hour	15,000	40,000	26,286	—	—
	8-hour	6,600	10,000	10,000	—	—
nitrogen dioxide[3]	1-hour	n/a	—	566	—	—
	Annual	11.3	100	94	2.5	25
ozone[4]	1-hour	n/a	235	196	—	—
	8-hour	100	157	—	—	—
PM_{10}[3]	24-hour	105	150	150	8	30
	Annual	29.9	50	50	4	17
$PM_{2.5}$[3]	24-hour	20	65	—	—	—
	Annual	8.1	15	—	—	—

TABLE 3-1
BACKGROUND CONCENTRATIONS, APPLICABLE AMBIENT AIR QUALITY STANDARDS, AND PSD INCREMENT VALUES (IN Φg/m^3)

Pollutant	Averaging Time[1]	Background Concentration	National Standards	Montana Standards	PSD Class I Increments	PSD Class II Increments
sulfur dioxide[2]	1-hour	n/a	—	1,300	—	—
	3-hour	291	1,300	—	25	512
	24-hour	73	365	260	5	91
	Annual	15.7	80	52	2	20

Footnotes:
Φg/m3 micrograms per cubic meter
n/a not available
[1]Annual standards are not to be exceeded; short-term standards are not to be exceeded more than once per year.
[2]Data collected in Billings, MT (1998-2000)
[3]Data collected in Rosebud County, MT (1998-2000)
[4]Data collected in Flathead County, MT (1998-2000)

Cultural and Historical

Cultural resources consist of the material remains of or the locations of past human activities, including sites of traditional cultural importance to both past and contemporary Native American communities. Cultural resources within the planning area represent human occupation throughout two broad periods: the prehistoric and the historic. The prehistoric period is separated into the Paleo-indian Period (circa 10,000 B.C. to 5,500 B.C.), the Archaic Period (circa 5,500 B.C. to A.D. 500), the Late Prehistoric Period (circa A.D. 500 to 1750), and the Proto-historic Period (circa 1750 to 1805+). The prehistoric period began with the arrival of humans to the area around 12,000 years ago, and is generally considered to have ended in 1805 when the Lewis and Clark Expedition passed through the area. Cultural resources relating to the prehistoric period may consist of scatters of flaked and ground stone tools and debris, stone quarry locations, hearths and other camp debris, stone circles, wooden lodges and other evidence of domestic structures, occupied or utilized rock shelters and caves, game traps and kill sites, and petroglyphs, pictographs, stone cairns and alignments, and other features associated with past human activities. Some of these sites contain cultural resource features that are in buried deposits.

The historic period is characterized by the arrival of fur traders and explorers to the area and is the start of the period for which written records exist. Cultural resources within the planning area that are associated with the historic period consist of fur trading posts, homesteads, settlements, historic emigrant and stage trails, Indian war period battle sites, ranch development, railroad installations, mining operations, oil and gas fields, and Native American sites from the extensive continuing occupation throughout historic times.

The following areas are designated cultural Areas of Critical Environmental Concern (ACECs):

- Powder River Resource Management Plan (RMP) area—Battle Butte ACEC is a 120-acre site in Rosebud County. Reynolds Battlefield ACEC is a 336-acre site in Powder River County.
- Billings RMP area—Pompeys Pillar is a 470-acre site in Yellowstone County. Castle Butte ACEC is a 185-acre site in Yellowstone County. Petroglyph Canyon is a 240-acre in Carbon County. The Stark Site is an 800-acre site in western Musselshell County. Weatherman Draw is a 4,268-acre site in Carbon County.

Each of these ACECs have their own management plans that include restrictions on activities and development (BLM 1999a). Two additional cultural resource sites, the Mill Iron and Powers-Yonkee sites in the Powder River RMP area, have been designated Special Management Areas (SMAs) that also have their own management plans that include restrictions on activities and development.

The existence of cultural resources within a specific location is determined through examination of existing records, on-the-ground surveys, and subsurface testing of areas that are proposed for disturbance on federal and state lands. Cultural resources are further suspected if federal or state minerals are involved and, for traditional cultural properties, consultation with appointed tribal government representatives who have knowledge of and can address issues of traditional cultural significance. Section 106 of the National Historic Preservation Act (NHPA) requires an inventory of cultural resources if federal involvement is present either in terms of surface or mineral estate, federal funds, federal grant, or federal license. The Montana State Historical Preservation Officer (SHPO) maintains a register of all identified sites within each of Montana's counties as well as all sites that are listed or eligible for listing on the National Register of Historic Places (NRHP). Table 3-2 contains information about the number of cultural resource sites that have been identified to date by SHPO for each of the counties within the planning area. Also included in this exhibit is information about the number and density of sites that are known to be located within the current area of CBM production.

TABLE 3-2
CULTURAL RESOURCE SITES IDENTIFIED BY SHPO WITHIN EACH COUNTY OF THE PLANNING AREA

RMP Area County	Number of Cultural Resource Sites Identified	Number of Acres Surveyed	Number of Sites Per Surveyed 1,000 Acres	Number of Acres Within the County	Extrapolated Number of Sites In the County
Powder River RMP Area					
Carter	444	122,652	3.62	2,141,781	7,753
Powder River	1460	91,500	15.96	2,109,764	33,664
Custer	700	42,211	16.58	2,425,137	40,217
Rosebud	1465	196,576	7.45	3,213,997	23,953
Treasure	101	17,051	5.92	629,181	3,727
Billings RMP Area					
Wheatland	137	5,694	24.06	913,056	21,969
Sweet Grass	209	24,866	8.41	1,190,775	10,009
Stillwater	257	9,417	27.29	1,154,183	31,499
Carbon	919	34,326	26.77	1,319,462	35,326
Golden Valley	97	9,309	10.42	752,063	7,837
Musselshell	482	33,267	14.49	1,196,012	17,329
Yellowstone	801	36,700	21.83	1,693,917	36,971
Big Horn	1819	278,802	6.52	3,207,937	20,930
Additional Counties					
Blaine	1111	89,285	12.44	2,711,308	33,738
Gallatin	810	95,682	8.47	1,683,524	14,252
Park	614	43,570	14.09	1,799,751	25,363
CBM Production Area*	3,297	525,427	6.27	2,699,992	16,942

*CBM Production Area includes portions of Big Horn, Rosebud, and Powder River counties where active coal mining is currently conducted and where non-federal CBM production wells currently exist.

Approximately 4 percent of the planning area has been surveyed for cultural resources resulting in a total of 11,426 cultural resource properties or sites being identified. This represents an average density of 10.10 sites per 1,000 surveyed acres or, assuming an equal distribution of sites, one site per 98.97 surveyed acres. Assuming this data across the total acreage contained within the counties of the planning area yields a total of 364,535 cultural resource properties or sites that might be expected. A total of 3,297 sites have been identified in those portions of Big Horn, Rosebud, and Powder River counties that represent the area with the greatest potential for CBM production, with an average density of 6.27 sites per 1000 surveyed acres or, assuming an equal distribution of sites, one site per 159.49 acres. Extrapolated data yields a total of 16,942 sites that might be expected within the CBM production area.

The site densities estimated above are, of course, extrapolated assuming a consistent distribution within each county. This is not necessarily valid since some sites can be clustered around geographical features such as broad, heavily vegetated river floodplains. Certain types of cultural resource sites will be more densely located in such riparian areas than atop barren ridgelines. Nonetheless, easily accessible geographical classification data does not exist for these sites and the above estimates are the best that can be made at the present time.

Two typical field compressors. These four-stage, 6.0 million cubic feet per day, reciprocal compressors operate at 380 horsepower and use natural gas as a fuel.

Geology and Minerals

Stratigraphy

The sedimentary strata of the planning area extend backward in time from recent age alluvium found in stream valleys, to strata at the surface that is largely Tertiary and Cretaceous (ALL 2001b). These older sediments correspond to the Laramide tectonism that gave rise to most of the uplifted areas in Montana. Though the area contains significant regional thicknesses of older stratigraphic units, the Tertiary basin fills are of particular interest for coal, CBM, and groundwater production (Ellis et al. 1999). Conventional oil and natural gas occur in the older, pre-Laramide section but coals in the Powder River Basin are confined to the Early Tertiary units.

A number of regional stratigraphic units occur beneath the major basin fill units within the Powder River Basin. These formations are broadly present across Montana including the Powder River Basin. Penetrations of these formations by conventional oil and gas wells have been few and hydrocarbon production is scattered. The Cretaceous age Judith River, Shannon, Eagle, and Dakota/Lakota Formations are present in the subsurface between approximately 2,200 feet below ground surface (bgs) and 9,000 feet bgs. These four sandy formations are encased and overlain by thick Cretaceous shales of the Colorado and Pierre Formations (Noble et al. 1982). Reservoir quality sands are not present everywhere within each of these formations but each could locally be a suitable disposal zone for produced CBM water. In addition, the shales of the Colorado and Pierre Formations could perhaps accept produced water under injection pressures higher than fracture pressure. Only the Shannon Formation produces gas within the Powder River Basin.

The Upper Cretaceous Eagle Formation carries coals in Blaine, Park, and Gallatin counties (Noble et al. 1982). These coals are prospective for CBM resources but currently do not produce.

The Hell Creek and Fox Hills Formation are Late Cretaceous in age and underlay the Fort Union in the Montana portion of the Powder River Basin. The sands are difficult to separate in outcrop, very difficult to separate in the subsurface, and appear to be in hydrologic continuity. Together, the Hell Creek and Fox Hills total approximately 500 feet of non-marine coastal plain sediments that have been shed from the mountains to the east and west (Perry 1962). They are made up of variable, shaley sands that contain some of the youngest dinosaur fossils in the world. The sands are scattered over most of Eastern Montana but are not present everywhere in the Powder River Basin; the sands outcrop at the edges of the basin and are found as deep as 3,700 feet bgs near the axis of the basin in Montana (Miller 1981). The Fox Hills Formation lies conformably upon approximately 2,000 feet of Upper Cretaceous Pierre Shale. The Hell Creek is overlain by the thick Tertiary Fort Union Formation.

The Fort Union forms most of the sedimentary fill within the Montana Powder River Basin. It consists of approximately 3,500 feet of non-marine silty and shaley clastics and coal beds whose individual thicknesses can be as much as 37 feet near the Decker mine (Roberts et al, 1999a). The Fort Union also contains clinker deposits, formed by the natural burning of coal beds and the resultant baking or fusing of clayey strata overlying the burning coal, which are present throughout much of the area and can be more than 125 feet thick (Tudor 1975). Stratigraphically the clinker bodies are part of the Fort Union but the clinker is a lithological unit composed of baked and fused siltstone, clay, and sandstone units that have undergone diagenetic changes during the combustion of the coal within the past 3.0 million years (Heffern et al. 1983).

The Fort Union is split into three stratigraphic members: the lowest being the Tullock Member, overlain by the Lebo Shale Member, overlain by the Tongue River Member (McLellan et al. 1990). In the Montana portion of the Powder River Basin, the bulk of the coals are confined to the Tongue River Member, while the Lebo and Tullock Members are predominantly shale and shaley sand (McLellan et al. 1990). The Members are discussed in detail below:

The Tullock Member

This is the stratigraphically lowest part of the Fort Union, consisting of approximately 300 feet to more than 500 feet of interbedded sands and shales with minor coals near the base (Tudor 1975). The Tullock rests unconformably upon the Upper Cretaceous Hell Creek Formation throughout the Powder River Basin. While generally sandier, the Tullock is difficult to separate in outcrop and in the subsurface from the overlying Lebo Member.

The Lebo Member

This middle member ranges from 75 feet to more than 200 feet of claystones, limestones, and mudstones with the Big Dirty coal (3 to 13 feet of thickness) at the very base (Tudor 1975). The Lebo is, in part, stratigraphically equivalent with the overlying Tongue River (McLellan et al. 1990).

The Tongue River Member

The thickness of the Tongue River varies from 750 feet at the outcrop edge near the fringe of the basin to 3,000 feet near the axis of the basin (Williams 2001). Total coal isopach ranges up to approximately 150 feet (Ellis et al. 1999). The Tongue River Member is divided into three units. The lower unit includes that portion below the Sawyer coal seam. The Middle unit includes the Sawyer through the Wall coal seam. The Upper unit includes that portion above the Wall coal seam (Ellis et al. 1999).

The Lower Tongue River unit is present across most of the Montana portion of the basin. It includes, from the base up, the Stag, Terret, Witham, Robinson, Rosebud-McKay, Flowers-Goodale, Nance, Calvert, and Knobloch coals. In the Ashland coalfield, the Lower Tongue River unit is up to 1,660 feet in thickness, and individual coals can be up to 71 feet thick (Roberts et al. 1999b).

The Middle Tongue River unit is present over a large part of the Montana portion of the Powder River Basin. It includes, from the base up, the Sawyer, Mackin-Walker, Cache, Odell, Brewster-Arnold, Pawnee, and Wall coals.

The Upper Tongue River unit is present only in the southern part of the Montana portion of the Powder River Basin. It includes, from the base up, the Otter, Cook, Carney, Canyon, Dietz, Anderson, and Smith coals. At the Decker mine, the Upper Tongue River is up to 1,500 feet thick; coals can attain an individual thickness of 57 feet and an aggregate thickness up to 111 feet (Roberts et al.1999a).

The Eocene Wasatch Formation is present in the Montana portion of the Powder River Basin as fine-to medium-grained sandstone lenses and channel-fill interbedded with siltstones, shales, and minor coal. The thickness of the Wasatch Formation ranges from near zero at the outcrop edge to 400 feet near the southern state boundary (Roberts et al. 1999a). It is present in outcrop in the extreme southwest corner of the basin where it overlies the Fort Union.

Quaternary age sediments are those that are Pleistocene (the latest glacial episode) and Recent (post-glacial episode) in age; the sequence is dominated by events and effects associated with continental glaciation, including glacial till and exaggerated peri-glacial valley fill. Quaternary sediments in the Powder River Basin and most of the state are present as variable fill in stream and river valleys. Quaternary alluvium consists of unconsolidated sand, silt, and gravel that make up the floodplains and stream terraces of creek valleys in the Powder River Basin (BLM 1999b). Thickness is highly variable, but maximum thickness is not expected to exceed 90 feet. Lithology is somewhat dependent on bedrock outcrop; alluvium overlying the Tertiary strata are mostly fine-grained to medium-grained sands and silts. Coarser-grained alluvium may be associated with some of the larger rivers where provenance has been outside the Powder River Basin (Hodson et al. 1973). Alluvium aquifers are largely unconfined and connected to active river flow. Because alluvial aquifers can deliver large quantities of water to water supply wells, they are important stratigraphic features. They are also important to this report because they are vulnerable to impact and are often connected to surface water resources. Alluvial aquifers can be impacted by surface activity and can act as a conduit to carry those impacts to valuable surface water resources.

Powder River RMP Area

The Powder River RMP area is centered over the broad, flat-lying Powder River Basin, with basin margins rising up to the Black Hills (South Dakota) on the southeast and the Big Horn Mountains to the west. The Powder River Basin has seen oil production since 1954, including Belle Creek field in Powder River County. During 2000, eight conventional oil and natural gas fields were active in the RMP area (MBOGC 2001a). Production, summarized in Figure GMA-2 (ALL 2001b), shows a sharp decline of oil production during the past 15 years caused by the aging of the several Muddy Formation fields on the edge of the basin. During the same time, conventional natural gas production from shallow Cretaceous reservoirs has increased, although it has remained at minor levels.

Billings RMP Area

The Billings RMP area centers on the Montana portion of the Big Horn Basin, the largest structural element in the area. The RMP area also includes the Big and Little Snowy and Little Belt Mountains to the north that combine to make up the Central Montana Uplift. Oil and gas is produced from the Big Horn Basin and oil is also produced from the Central Montana Uplift. Natural gas and oil were produced from 68 fields in the year 2000. Production statistics for 2000 show a 50 percent decline of both natural gas and oil production in the past 15 years, although significant quantities of both commodities are still being produced in the area (ALL 2001b).

Map 3-1 shows location and type of geological outcrops in the area.

Conventional Oil and Gas

Conventional oil and gas resources are scattered across Tertiary and older basins of the state, as well as in faulted and thrusted sedimentary rocks at the edges of some of the basins. The type of hydrocarbon fluids that are produced (oil, natural gas, or both) varies with the local geology and position in the field. Natural gas can be produced along with oil in some reservoirs or it can be produced "dry"—without associated oil. Most oil and gas reservoirs will also produce associated water. Produced water is mostly reinjected into the producing formations to maintain reservoir energy or into non-productive, salt-water bearing reservoirs although there are currently 24 surface water discharge permits that have been issued for producing conventional oil and gas fields.

- The Williston Basin produces the majority of the oil for the State of Montana and small amounts of natural gas associated with the oil; except for shallow gas fields along the Cedar Creek Anticline, little dry gas is produced.
- North-central Montana produces mainly dry natural gas from shallow fields.
- Northwestern Montana produces shallow oil with little associated natural gas.
- Central Montana produces oil with virtually no natural gas.
- The Big Horn Basin produces small amounts of both oil and natural gas.
- The Powder River Basin produces small amounts of oil at the eastern edge of the basin and very small amounts of conventional natural gas from shallow reservoirs (MBOGC 2000).

Conventional oil and gas production for the RMP areas is summarized in the Geology and Minerals Appendix.

Coal

Coal occurs in all of the RMP areas discussed in this EIS. Coal mining has also historically occurred in Park and Gallatin Counties (Roberts 1966, and Calvert 1912a, and Calvert 1912b). Coal mining is underway at five mines in the Powder River RMP area, but has historically been accomplished in the Billings RMP area and Blaine County (USDL 1999). A more detailed description is included in the *Final Environmental Impact Statement, Resource Management Plan, Powder River Resource Area* (BLM 1984).

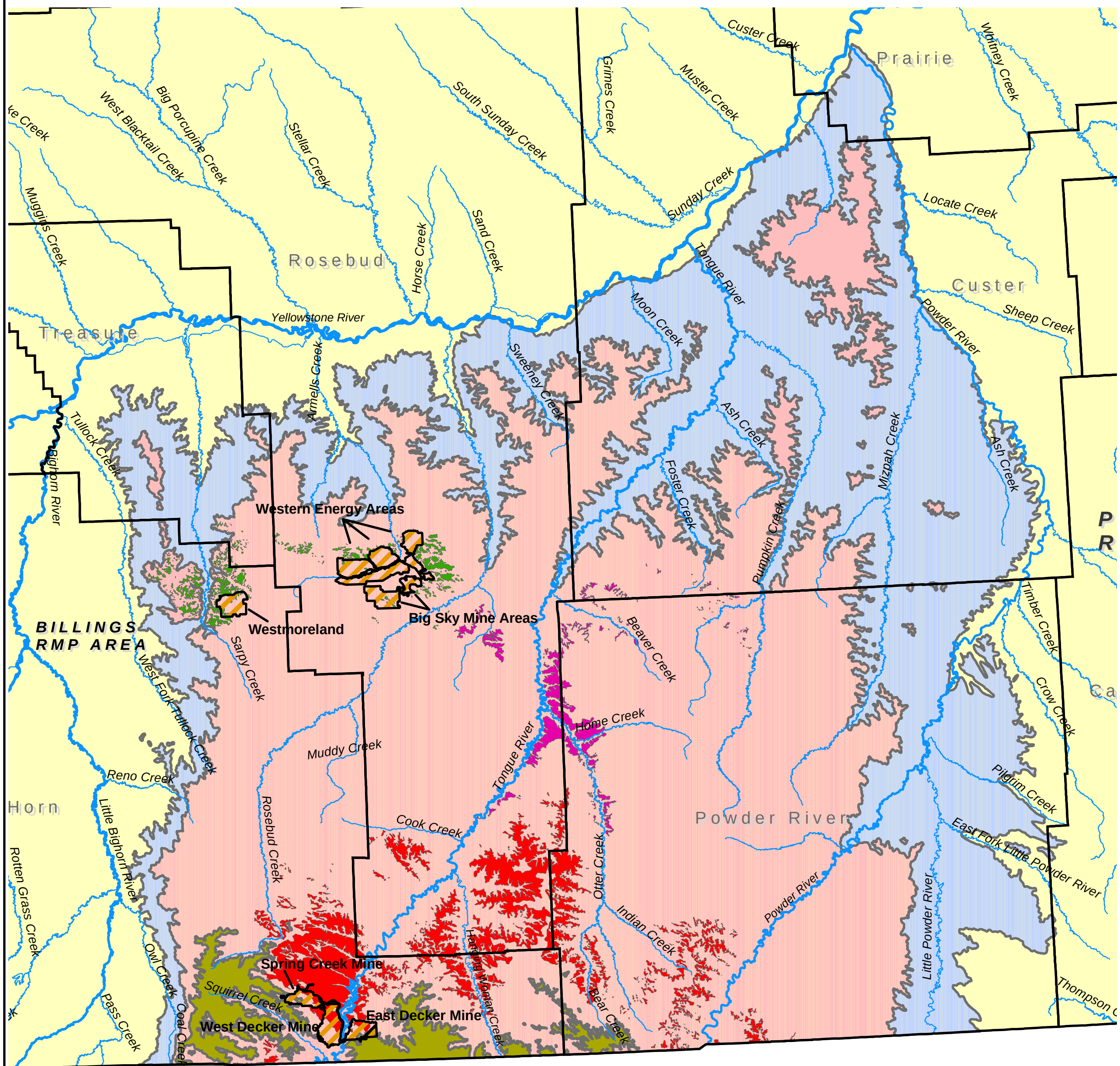
Mineral Materials

Construction materials that are classified as saleable minerals are found in the RMP areas. These include sand and gravel, scoria, common clay, and crushed common stone not subject to regulation under the 1872 Mining Law. Descriptions of these materials are given under Mineral Materials and Locatable Minerals in *the Final Oil and Gas RMP/EIS Amendment* (BLM 1992) and in the *Final Environmental Impact Statement, Resource Management Plan, Billings Resource Area* (BLM 1983) as well as the Final EIS Amendment for the Billings, Powder River, and South Dakota Resource Areas of the Miles City District (BLM 1992).

Locatable Minerals

Locatable minerals are subject to provisions of the 1872 Mining Law. Minerals such as vanadium, uranium, gold, silver, gypsum, and uncommon varieties of bentonite are found in the various planning areas. Detailed descriptions of management practices for locatable minerals on federally managed lands are given in the *Final RMP/EIS* for the Billings and Powder River Resource Areas of the Miles City District (BLM, 1983, 1984).

Map 3-1: Map of Coal and Clinker Deposits Montana Portion of Powder River Basin



Legend

1:1,300,000

20 10 0 20 Miles

20,000 10,000 0 20,000 40,000 Meters

Coal Mines

Wyodak - Anderson Coal Clinker

Knoblock Coal Clinker

Colstrip Coalfield Clinker

GEOLOGY

Wasatch Fm.

Tongue River Mbr.

Lebo Mbr.

N W E S

DATA SOURCES

Counties: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana
Rivers: 1:100,000 scale, rivers, Montana State Library/NRIS, Helena, Montana
RMP Areas: BLM Miles City Field Office.
Geology and Coal: 1:250,000 scale, 1999, USGS Professional Paper 1625a.
Coal Mine Boundaries: Montana Bureau of Mines & Geology

FIGURE 3-1

ERA	Period	Principal Aquifers	Age:
CENOZOIC	Quaternary	Alluvium & Fluvial-Glacial Gravels	10,000 Years
	Tertiary	Alluvium Fluvial-Glacial Gravels (and equivalents) Terraces Fort Union Formation	1.6 MYBP
MESOZOIC	Cretaceous	Lower Hell Creek-Fox Hills Formation Judith River Formation Eagle Formation	66.4 MYBP
	Jurassic	Kootenai Formation	
	Triassic	Ellis Group	
PALEOZOIC	Permian	No Principal Aquifers	245 MYBP
	Pennsylvanian	No Principal Aquifers	
	Mississippian	Madison Group	
	Devorian Silurian Ordovician Cambrian	No Principal Aquifers	570 MYBP

MYBP – Millions of Years Before Present

Hydrological Resources

Hydrology within the planning area consists of surface water flow from several rivers and their associated tributaries, and the production of groundwater from a variety of geological formations—the combination of which comprises the aquifer systems within any specific portion of the planning area. Of particular importance to residents is the protection of surface water and groundwater in the vicinity of CBM development. CBM development typically involves the necessary and unavoidable production of large volumes of water from coal aquifers and the appropriate use or disposal of this produced water. Continuous

CBM water production and disposal has the ability to impact both groundwater and surface water. As such, it is the subject of the Montana Department of Natural Resources and Conservation (DNRC) Final Order: In the Matter of the Designation of the Powder River Basin Controlled Groundwater Area. This order describes the authorities that pertain to CBM development. A copy of the order is included as an appendix to the Water Resources Technical Report (ALL 2001b). The order outlines water rights issues, mitigation, monitoring plans, and jurisdiction. Jurisdiction is summed up by this paragraph of the Order:

> "With this designation of a controlled groundwater area the withdrawal of groundwater associated with coal bed methane production will be under the prior jurisdiction of the Montana Board of Oil and Gas. However, water rights matters and hydrogeologic issues are not within the ordinary technical expertise and area of concern to the Board. These are matters ordinarily dealt with by the Montana Department of Natural Resources and Conservation and the Montana Bureau of Mines and Geology.
>
> The Montana Department of Natural Resources may petition the Board for hearings in regard to the production, use, and disposal of water from coal bed methane development wells that could effect existing water rights in the area based upon information gathered concerning water withdrawals."

Protection of groundwater will focus on maintaining beneficial uses. The coal seams are the primary aquifers for the agricultural community in southeastern Montana. In many areas the coal aquifer supplies water for livestock and wildlife. In the Bull Mountain coal field, the coal seams are also used as aquifers, though to a lesser degree than in southeastern Montana. In other coal bearing areas of the State, coal seams are not used as aquifers, or that use is limited and not well known.

Surface Water

Surface water is the primary source of water for all uses in Montana, representing 97 percent of the water used throughout the State (Solley et al. 1995). The quality of groundwater from surficial aquifers within the west half of the Billings RMP area, as well as in Park and Gallatin Counties, is usually very good. Maps 3-2 and 3-3 show the occurrence of surficial aquifers as well as the quality of the groundwater produced from these aquifers. Map 3-4 shows that portion of the planning area with the greatest potential for CBM development. The map outlines those areas of continuous surface drainage termed watersheds; each watershed is drained by a single main stream element. The map emphasizes those watersheds vulnerable to impact from CBM water. The volume and quality of surface water can best be interpreted on a watershed basis. Table 3-3 lists basic data on volume and quality. Volume is summarized by two values—an average high-flow figure and a base-flow figure. High-flow conditions typically occur during times of significant melt-water runoff or significant rainfall events. Base-flow conditions occur during dry periods when water input is restricted to inflow of groundwater.

Generally, water quality in a certain watershed varies inversely with volume. High-flow periods correspond to the seasonal influx of relatively high-quality, low-SAR surface water typically during spring snow-melt and early summer rains. Base-flow periods correspond to periods of scarce surface water typically during the winter when streams are fed only by the influx of lower quality, high-SAR groundwater from shallow aquifers. Surface water varies with season; during times of high flow, streams receive runoff water while during times of base-flow, streams receive little runoff and are fed primarily by groundwater. Table 3-3 lists basic flow and Sodium Adsorption Ratio (SAR) data for the major streams in the watersheds of primary CBM potential. The Upper Tongue River near Decker illustrates the variation with rate of 1467 cfs and high quality water (SAR=0.4) during high-flow periods and rate averaging 175 cfs of lower quality water (SAR=1.1) during base-flow periods.

TABLE 3-3
SURFACE WATER QUALITY BY WATERSHEDS

TABULATION OF SURFACE WATER QUALITY IN SELECTED WATERSHEDS OF MONTANA WITH HIGH CBM POTENTIAL

Watershed	USGS Gaging Station #	Average Base-Flow			Average High-Flow	
		7Q10[1] (cfs)	Rate (cfs[2])	SAR[3]	Rate (cfs)	SAR
Little Big Horn (near Wyola)	06290500	36	61.8	1.2	526	0.2
Little Big Horn (near Crow Agency)	06293900	7.6*	123	N/A	782	N/A
Little Big Horn (near Hardin)	06294000	83.17*	138	2.0	851	0.5
Lower Yellowstone (Myers)	06294840	1530*	4200	1.7	42,000	0.7
Lower Yellowstone (Hysham)	06294940	N/A	0.01	8.5	280	1.5
Lower Yellowstone (Colstrip)	06294930	N/A	0.6	4.5	65	1.5
Little Powder (near Broadus)	06325500	0.0*	0.35	N/A	69	N/A
Lower Bighorn (near St. Xavier)	06287000	633	1750	2.5	10,300	1.7
Lower Bighorn (near Big Horn)	06294500	841	640	3.7	21,500	1.2
Mizpah (near Mizpah)	06326300	0.0*	26	21.0	60.1	6.5
Middle Powder (near Moorhead)	06324500	0.89	153	5.2	1433	2.5
Middle Powder (near Broadus)	06324710	1.27*	198	N/A	1077	N/A
Rosebud (at Reservation Boundary near Kirby)	06295113	0.07	1.78	0.8	15.7	0.6
Rosebud (near Colstrip)	06295250	0.0	7.5	1.5	56.5	1.1
Rosebud (at mouth near Rosebud)	06296003	0.0	9.02	3.7	77.0	1.6
Upper Tongue (at state line)	06306300	39	181	N/A	1724	N/A
Upper Tongue (at Tongue R. Dam near Decker)	06307500	20	175	1.1	1467	0.4
Lower Tongue (near Birney Day School)	06307616	39	185	1.4	1202	0.4
Lower Tongue (near Ashland)	06307830	43.49	206	N/A	2073	N/A
Lower Tongue (at Miles City)	06308500	4.5	194	2.4	1305	0.6

Gathered from USGS stream gauging points

[1]7Q10—seven day, ten year low stream flow (calculated by USGS)
[2]CFS—Cubic Feet per Second
[3]SAR—Sodium Adsorption Ratio (unitless)
*Estimated Values
N/A—Data Not Available

TABLE 3-4
STREAM FLOW STATISTICS FOR SELECTED WATERSHEDS IN THE POWDER RIVER BASIN

Watershed	Period of Record	Low Mean Monthly Flow (cfs)[1]	Irrigation Season Low Mean Monthly Flow (cfs)	Median Mean Monthly Flow (cfs)
Little Powder River at Dry Creek near Weston	1972-2000	3	4	12
Little Powder River near Broadus	1978-2000	4	7	21
Powder River at Moorhead	1929-2000	149	149	260
Powder River at Broadus	1975-1992	173	173	256
Tongue River at State Line near Decker	1960-2000	180	182	246
Tongue River at Birney Day School near Birney	1979-2000	185	236	272
Tongue River by Brandenberg Bridge near Ashland	1974-2000	207	321	330
Tongue River at Miles City	1938-2000	188	188	274
Rosebud Creek at Reservation Boundary near Kirby	1979-2000	2	2	4
Rosebud Creek near Colstrip	1974-2000	8	8	18
Rosebud Creek at Mouth near Rosebud	1974-2000	9	9	20
Little Bighorn River by Pass Creek near Wyola	1939-2000	105	111	121
Little Bighorn River near Hardin	1953-2000	123	123	183
Lower Bighorn River near ST. Xavier	1934-2000	2612	2759	2936
Lower Bighorn River at Tullock Creek near Bighorn	1945-2000	2884	2884	3325
Mizpah Creek near Mizpah	1974-1986	0.3	2	11

[1]cfs—cubic feet per second

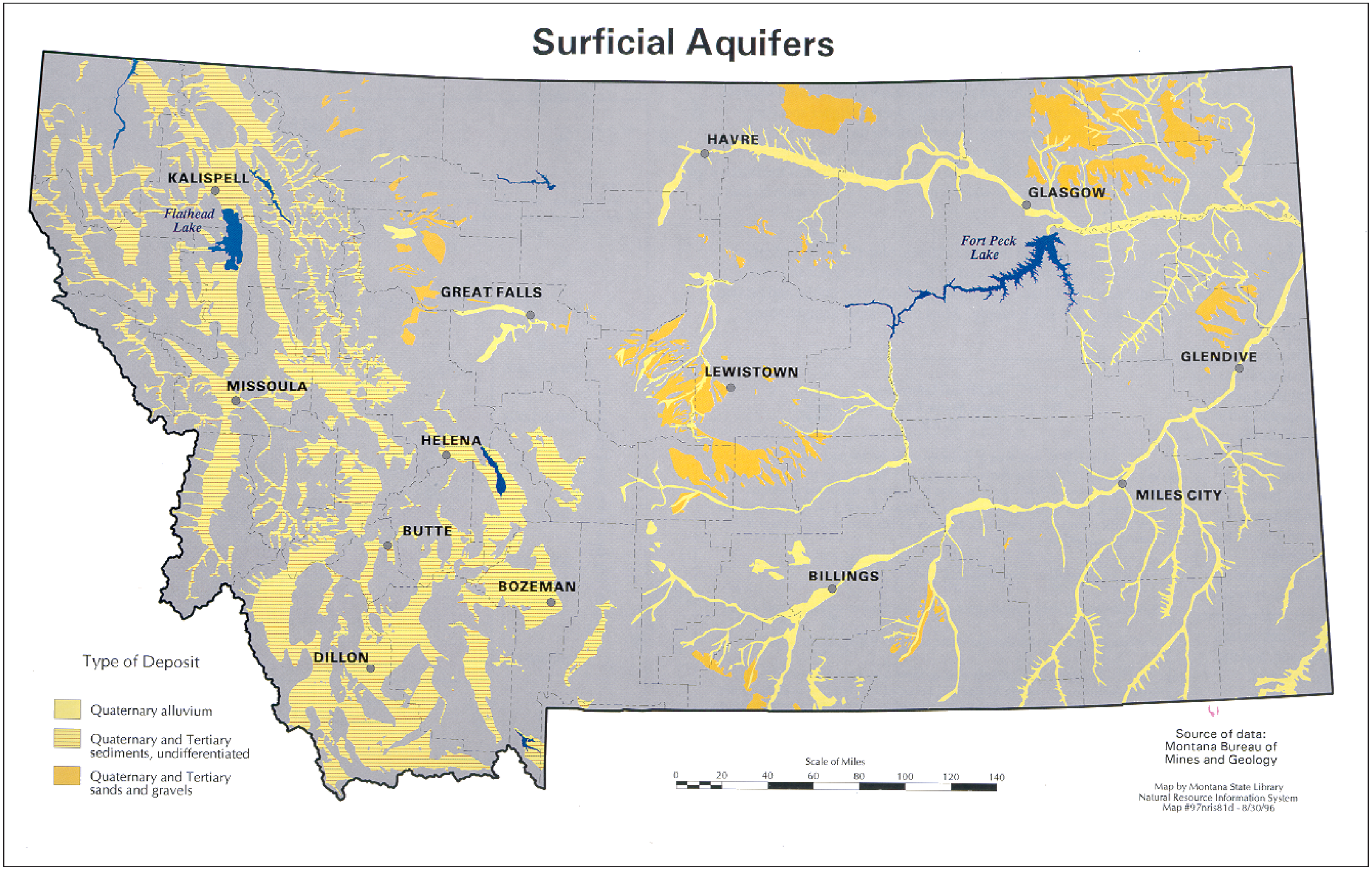
TABLE 3-5
ELECTRIC CONDUCTIVITY (EC) AND SODIUM ADSORPTION RATIO (SAR) FOR SELECTED WATERSHEDS IN THE POWDER RIVER BASIN

Watershed	Period of Record	Median EC (μS[1]/cm)	Average EC (μS/cm)	N[2]	Median SAR	Average SAR	N
Little Powder River at Dry Creek near Weston	1979-1999	2890	2890	178	5.5	5.5	197
Little Powder River near Broadus	1978-2001	2110	2110	16	9.4	9.4	16
Powder River at Moorhead	1969-1999	1950	1950	264	4.5	4.5	154
Powder River at Broadus	1978-1989	2025	2052	62	4.7	4.7	13
Mizpah Creek near Mizpah	1975	1980	1980	104	11	13	73
Tongue River at State Line near Decker	1985-1999	610	673	115	0.56	0.67	25
Tongue River at Birney Day School near Birney	1979-1999	670	719	153	0.87	0.94	93
Tongue River by Brandenberg Bridge near Ashland	1974-2001	818	871	113	1.6	1.8	87
Tongue River at Miles City	1959-1999	840	840	548	1.5	1.5	408
Rosebud Creek at Reservation Boundary near Kirby	1979-1999	950	942	149	0.7	0.7	41
Rosebud Creek near Colstrip	1974-1999	1380	1376	190	1.5	1.4	95
Rosebud Creek at mouth near Rosebud	1974-1999	1590	1720	223	3.1	3.1	16
Little Bighorn River by Pass Creek near Wyola	1993-1999	452	453	44	0.2	0.2	16
Little Bighorn River near Hardin	1969-1999	712	723	368	1.22	1.1	212
Lower Bighorn River near ST. Xavier	1966-1999	847	837	388	2.0	2.0	223
Lower Bighorn River at Tullock Creek near Bighorn	1959-1999	935	953	525	2.1	2.2	73

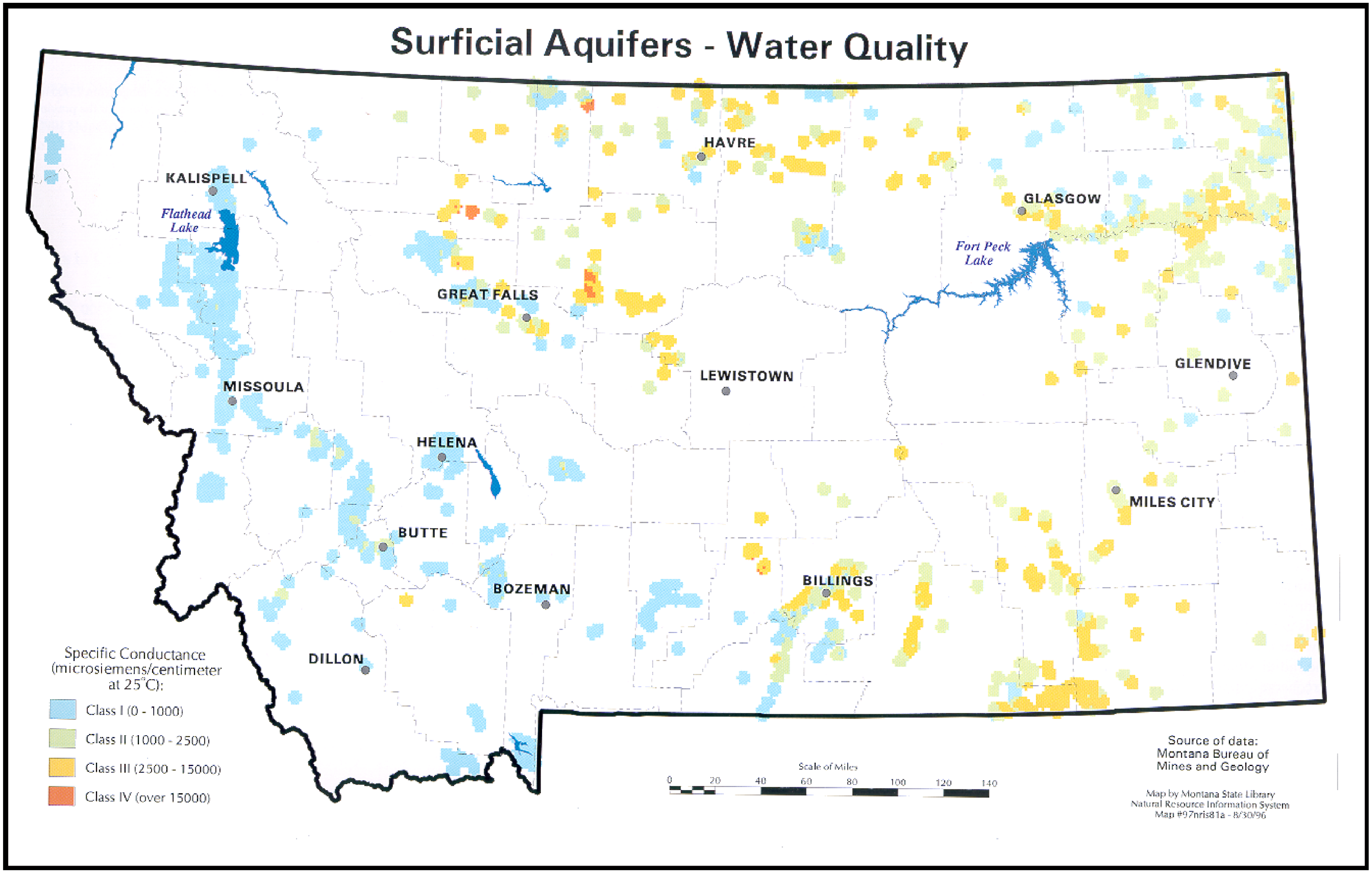
[1]μS—micro Seimens

[2]N—Number of Samples

Map 3-2


Surficial Aquifers
HAVRE
GLASGOW
KALISPELL
Flathead Lake
Fort Peck Lake
GREAT FALLS
GLENDIVE
LEWISTOWN
MISSOULA
HELENA
MILES CITY
BUTTE
BILLINGS
BOZEMAN
DILLON
Type of Deposit
Quaternary alluvium
Quaternary and Tertiary sediments, undifferentiated
Quaternary and Tertiary sands and gravels
Scale of Miles
0 20 40 60 80 100 120 140
Source of data: Montana Bureau of Mines and Geology
Map by Montana State Library
Natural Resource Information System
Map #97nris81d - 8/30/96

Map 3-3


Surficial Aquifers - Water Quality
KALISPELL
Flathead Lake
HAVRE
GLASGOW
Fort Peck Lake
GREAT FALLS
LEWISTOWN
GLENDIVE
MISSOULA
HELENA
MILES CITY
BUTTE
BILLINGS
BOZEMAN
DILLON
Specific Conductance (microsiemens/centimeter at 25°C):
Class I (0 - 1000)
Class II (1000 - 2500)
Class III (2500 - 15000)
Class IV (over 15000)
Scale of Miles
0 20 40 60 80 100 120 140
Source of data: Montana Bureau of Mines and Geology
Map by Montana State Library Natural Resource Information System Map #97nris81a - 8/30/96

Surface water within the planning area is supplied by runoff from precipitation and snowmelt to a network of streams and tributaries that flow into larger rivers. Drainage within the Powder River Basin RMP area is to the Tongue River and Powder River, which both flow north-northeast into the Yellowstone River. The central and southern portions of the Billings RMP area are drained by a series of tributaries that also flow north-northeast into the Yellowstone River; these tributaries are the Boulder, Stillwater, Rock/Red Lodge Creeks, Clarks Fork, Bighorn, and Little Bighorn. Drainage within the northern portion of the Billings RMP area is to the Musselshell River, which flows eastward until it meets the boundary between Musselshell and Rosebud Counties—at which point it turns northward and flows into the Missouri River. The three additional counties of Park, Gallatin, and Blaine each have separate watersheds. Park County is drained by the Yellowstone River, which flows to the northeast. Much of the drainage in Gallatin County is to the Gallatin River, which flows northerly to the Missouri River. However, the eastern portion of Gallatin County is drained by streams that flow into the Yellowstone River. Blaine County is drained by the Milk River, which flows to the east and into the Missouri River. Groundwater flowing into the streams and rivers within the planning area also contributes to the supply of available surface water.

Surface water can be impacted by cultural activity such as agriculture and industry. When groundcover is broken it exposes soil to wind and water erosion, leading to suspended sediment being brought to bodies of surface water. Artificial impoundments can cause infiltration into the soil and migration into surface water. Accidental releases of wastes can migrate into water bodies.

Watershed water-use statistics in Table 3-4 apply to those watersheds shown in Map 3-3. Table 3-4 presents data about the quantity of surface water and groundwater used in each water-use category. These data cover the area projected to have maximum CBM potential but similar data is available for other areas of the state (USGS 1995). Surface water in these watersheds is the dominant source of water, locally, however, groundwater use is important for public and domestic drinking water.

TABLE 3-6
WATER USE (IN MILLIONS OF GALLONS PER DAY [gpd]) STATISTICS IN 1995 BY WATERSHED SURFACE AND/OR GROUNDWATER USE

Watershed	Public Supply	Domes-tic	Indus-trial	Thermo-Electric	Mining	Livestock	Irrigation	Total Ground-water	Total Surface Water
Little Bighorn	0.01/0.15	0.0/0.12	0.0/0.0	0.0/0.0	0.0/0.0	0.9/0.37	84.01/1.46	2.1	84.24
Lower Bighorn	0.61/0.02	0.0/0.25	0.0/0.01	0.0/0.0	0.0/0.44	0.3/0.73	221.6/3.67	5.12	222.51
Lower Yellowstone	2.37/0.19	0.0/0.17	0.0/0.12	16.1/0.0	0.45/0.0	1.48/0.4	250/2.56	3.44	270.4
Rosebud	0.01/0.43	0.0/0.08	0.0/0.0	0.0/0.0	0.0/1.04	0.2/0.25	8.04/0.1	1.90	8.25
Upper Tongue	0.0/0.06	0.0/0.09	0.0/0.0	0.0/0.0	0.0/0.0	0.11/0.27	23.75/0.34	0.76	23.86
Lower Tongue	0.01/0.11	0.0/0.17	0.0/0.0	0.0/0.0	0.0/1.18	0.45/0.61	36.29/0.36	2.43	39.75
Middle Powder	0.01/0.12	0.0/0.04	0.0/0.0	0.0/0.0	0.0/0.0	0.02/0.24	3.18/0.04	0.44	3.21
Mizpah	0.0/0.0	0.0/0.03	0.0/0.0	0.0/0.0	0.0/0.0	0.1/0.19	6.41/0.06	0.28	6.51
Little Powder	0.0/0.12	0.0/0.04	0.0/0.0	0.0/0.0	0.0/0.0	0.05/0.24	2.18/0.03	0.43	2.23
Lower Powder	0.0/0.0	0.0/0.06	0.0/0.0	0.0/0.0	0.0/0.0	0.5/0.24	9.65/0.09	0.39	10.15

USGS 1995

The Clean Water Act of 1972 and amendments require states to adopt standards for the protection of surface water quality. These standards are designed to maintain water quality sufficient to support the waterbody's beneficial uses. Montana waterbodies are classified according to the present and future beneficial uses that they normally would be capable of supporting (75-5-301 MCA). The state Water-Use Classification System (ARM 17.30.604-629) identifies the following beneficial uses:

- Drinking, culinary use, and food processing
- Aquatic life support for fishes and associated aquatic life, waterfowl, and furbearers
- Bathing, swimming, recreation and aesthetics
- Agriculture (crop irrigation, stock watering, etc.) water supply
- Industrial (coal mining, electrical power generation, etc.) water supply

The current use classification of each waterbody in Montana was assigned on the basis of its actual or anticipated uses in the early 1970s. Waterbodies are classified primarily by: 1) the level of protection that they require; 2) the type of fisheries that they support (warm water or cold water) or; 3) their natural ability to support use for drinking water, agriculture etc. The water quality standards employed to maintain these uses address changes from natural conditions for such parameters as coliform bacteria, dissolved oxygen, pH, turbidity, temperature, color, toxics, and other harmful substances.

When streams and other waterbodies are impacted by outside agents, their support of beneficial uses can become impaired. In Montana, surface water quality is tracked by the MDEQ. Table 3-7 is a compilation of impaired and threatened waterbodies in need of water quality restoration. Waterbodies included in this list do not currently support their original beneficial uses. This list is commonly referred to as the "303(d) List" because it is prepared in accordance with the requirements of Section 303(d) of the Federal Clean Water Act.

TABLE 3-7
IMPAIRED WATERBODIES IN AREA OF MAXIMUM CBM POTENTIAL

Watershed	Impaired Waterbody	Probable Causes of Impairment	Probable Sources of Impairment
Lower Yellowstone	Yellowstone River (MT42K001-1) from the Forsyth to the mouth of the Powder River	Metals Nutrients Other Habitat Alterations Pathogens Salinity/TDS/Chlorides Suspended Solids pH	Agriculture Irrigated Crop Production Municipal Point Sources Natural Sources Range Land Streambank Modification/Destabilization
Lower Yellowstone	East Fork of the Armells Ck. (MT42KJ002-3) from Colstrip to the mouth of the West Fork of the Amells Ck.	Nutrients Salinity/TDS/Chlorides Suspended Solids	Agriculture Natural Sources Range Land
Lower Yellowstone	East Fork of the Armells Ck (MT42KJ002-9) above Colstrip	Nutrients Suspended Solids	Agriculture Range Land
Lower Yellowstone	West Fork of the Armells Ck (MT42KJ002-4)	Flow Alteration Nutrients Salinity/TDS/Chlorides Suspended Solids	Agriculture Natural Sources Range Land
Lower Yellowstone	East Fork of the Sarpy Ck (MT42KJ002-2)	Salinity/TDS/Chlorides Suspended Solids	Natural Sources Resource Extraction Silviculture Surface Mining

TABLE 3-7
IMPAIRED WATERBODIES IN AREA OF MAXIMUM CBM POTENTIAL

Watershed	Impaired Waterbody	Probable Causes of Impairment	Probable Sources of Impairment
Little Bighorn	None		
Lower Bighorn	Bighorn R. (MT43P003-1) Excludes Tribal reservation Waters	Metals Salinity/TDS/Chlorides Suspended Solids Thermal Modifications pH Other Inorganics Siltation	Agriculture Flow Regulation/Modification Natural Sources Upstream Impoundments
	Bighorn R. (MT43P005-1)	Metals Salinity/TDS/Chlorides Suspended Solids Thermal Modifications pH Flow Alteration Nutrients Other Inorganics	Agriculture Flow Regulation/Modification Natural Sources Upstream Impoundments
Lower Big Horn	Tullock Creek (MT43P006-1)	Metals Salinity/TDS/Chlorides Suspended Solids Nutrients Other Inorganics	Agriculture Irrigated Crop Production Natural Sources
Upper Tongue	Hanging Woman Creek (MT43B002)	Flow Alteration Metals Salinity/TDS/Chlorides	Agriculture Irrigated Crop Production Natural Sources
Upper Tongue	Hanging Woman Creek from Stroud Creek to the mouth	Siltation	Grazing and Agriculture
Upper Tongue	Tongue River Reservoir	Nutrients Organic Enrichment/DO Suspended Solids	Agriculture Municipal Point Sources
Upper Tongue	Upper Tongue River (MT43B001-1) above reservoir	Flow Alteration	Agriculture Irrigated Crop Production Natural Sources
Upper Tongue	Tongue River (MT43B001-2) from the Reservoir to mouth of Hanging Woman Ck.	Flow Alteration	Agriculture Flow Regulation/Modification Irrigated Crop Production
Lower Tongue	Tongue River (MT42C001) from reservoir to the mouth	Flow alteration Metals Other Organics Salinity/TDS/Chlorides Suspended Solids	Agriculture Flow Regulation/Modification Irrigated Crop Production Natural Sources

TABLE 3-7
IMPAIRED WATERBODIES IN AREA OF MAXIMUM CBM POTENTIAL

Watershed	Impaired Waterbody	Probable Causes of Impairment	Probable Sources of Impairment
Lower Tongue	Otter Creek (MT42C002-2)	Metals Other Habitat Alterations Salinity/TDS/Chlorides Suspended Solids	Agriculture Highway/Road/Bridge Construction Land Development Natural Sources
Lower Tongue	Pumpkin Creek (MT43C002-6)	Flow Alteration Salinity/TDS/Chlorides Thermal Modifications	Agriculture Irrigated Crop Production
Rosebud	Rosebud Creek (MT42A001)	Flow Alteration Metals Nutrients Other Organics Salinity/TDS/Chlorides Suspended Solids	Agriculture Irrigated Crop Production Natural Sources
Mizpah	Mizpah Creek (MT42J005-1)	Organic Enrichment/DO Other Inorganics Suspended Solids	Irrigated Crop production Natural Sources Range Land
Little Powder	Little Powder River (MT42I001)	Flow Alteration Other Organics Salinity/TDS/Chlorides Suspended Solids Siltation	Irrigated Crop Production Natural Sources Streambank Modification/Destabilization
Lower Powder	Stump Creek (MT42J004-2)	Suspended Solids	Agriculture Range Land
Lower Powder	Lower Powder River (MT42J003-1) from mouth of Little Powder to the mouth	Flow Alteration Metals Nutrients Other Organics Pathogens Salinity/TDS/Chlorides Suspended Solids	Agriculture Irrigated Crop Production Natural Sources Petroleum Activities Resource Extraction Range Land Streambank Modification/Destabilization

Final Year 1996 Montana 303(d) List. A Compilation of Impaired and Threatened Waterbodies in Need of Water Quality Restoration, Part A, Water Quality Assessment Results.

Several of the above watersheds and impaired waterbodies are shared jurisdictionally between the State and Tribes. Segment MT42C001, the Tongue River from the reservoir to the mouth, for instance is shared between the State of Montana and the Northern Cheyenne Tribe, with the boundary lying in the middle of the river. The Lower Tongue Watershed intersects with the Northern Cheyenne Reservation. The Rosebud watershed includes most of the Northern Cheyenne Reservation and a part of the Crow Reservation; the Northern Cheyenne Reservation contacts the impaired portion of the Rosebud Creek. The Lower Bighorn watershed includes a large part of the Crow Reservation, which contacts both impaired portions of the Bighorn River. The Little Bighorn watershed includes a large part of the Crow Reservation but no waterbodies are determined to be impaired on the 1996 list.

In accordance with Section 303(d) of the Federal Clean Water Act, the Montana Department of Environmental Quality (MDEQ) has prepared a list of impaired and threatened waters every 2 years since 1992. This so called "303(d) list" identifies lakes, rivers and streams that are not meeting water quality standards and establishes priorities for TMDL development. However, Montana, like the rest of the nation, was slow to develop TMDLs. On June 21, 2000, the United States District Court of Montana ordered EPA to work with the State of Montana to develop and adopt a schedule that would result in developing all necessary Total Maximum Daily Loads (TMDLs) for waterbodies on Montana's 1996 Section 303(d) list (Table 3-7) by May 5, 2007. On November 1, 2000, MDEQ and EPA published a schedule that divided the state into 91 TMDL Planning Areas each with a deadline for completing all necessary TMDLs. The surface waters likely to be affected by CBM development are located in the Tongue and Powder TMDL Planning Areas. The TMDL completion dates for these planning areas are 2005 and 2006, respectively. Impacted waterbodies and TMDL issues are discussed in detail in the Hydrology Appendix.

Groundwater

Groundwater within the planning area is found within a variety of aquifers, ranging from shallow unconsolidated alluvial aquifers associated with modern rivers to deep bedrock aquifers consisting of consolidated sandstone, limestone, or coal. The occurrence of specific bedrock aquifers and the quality of groundwater produced from these aquifers vary throughout the planning area. Maps 3-4 and 3-5 are maps that show the occurrence of bedrock aquifers and the quality of groundwater produced from these aquifers. In general, the quality of groundwater produced from bedrock aquifers is best near their recharge or outcrop areas. Water enters the aquifers or reservoirs during deposition of the sedimentary unit as formation water that can be salty or fresh. Later, meteoric water can enter the aquifer through outcropping recharge zones where runoff water infiltrates and is conducted into the subsurface. Groundwater comes to the surface by way of natural springs that conduct groundwater onto the surface or into bodies of surface water. Aquifer pressure can be measured in pounds per square inch (psi) or in feet of head and can vary from a low-pressure reservoir where water stands below the top of the reservoir, to an artesian aquifer where water stands above the top of the reservoir, sometimes being above ground surface and flowing from wells. Aquifer pressure can be measured in a monitoring well where water is not normally produced except for testing and sampling. Groundwater can be produced through water wells that pump or convey water from aquifers to the surface.

Water quality and quantity are variable with the primary water quality issue being salinity. Groundwater represents less than 3 percent of the total water use in the State (Solley et al. 1995). Table 3-6 presents data about the quantity of groundwater used in each water-use category on a watershed basis. Although the use of groundwater only represents 3% of the total water use it is extremely critical because it provides almost 100% of the domestic water farmsteads and constitutes the largest percentage of dependable stock water, because it is not seasonal or drought affected.

The principal aquifers within the planning area are listed in Figure 3-1 according to their geologic Era and Period. Table 3-8 contains information about the general depth of particular aquifers, their yield, geologic materials, and water quality.

Surficial aquifers within the planning area consist of Quaternary and Tertiary alluvium, Tertiary fluvial-glacial sand and gravel deposits, and Tertiary terrace deposits. These surficial aquifers are located within the floodplains and along the channels of larger streams, tributaries, and rivers, and are among the most productive sources of groundwater within the planning area. The quality of groundwater from surficial aquifers is generally good, but within the Powder River RMP area and Blaine County it can be highly variable (approximately 1500 mg/l to 2,800 mg/l and 5.0 to 10 SAR). The quality of groundwater from surficial aquifers within the west half of the Billings RMP area, as well as in Park and Gallatin Counties, is usually very good. Wells completed in coarse sand and gravel alluvial aquifers can yield as much as 100 gallons per minute (gpm), although yields of 15 gpm are the average. Alluvial deposits associated with old river beds as detached terraces will usually only yield as much as 20 gpm because they are isolated topographically and have limited saturation (Zelt et al. 1999).

The occurrence of specific bedrock aquifers and the quality of groundwater produced from these aquifers vary throughout the planning area. In general, the quality of groundwater produced from bedrock aquifers is best near their recharge or outcrop areas. Groundwater produced near an aquifer's recharge zone has only been in contact with the rocks and minerals in the aquifer material for a relatively short period of time. As a result, the water has not had time to dissolve substantial amounts of soluble salts and minerals and so it remains fresh. The longer the water is in the aquifer, the more time it will have to dissolve salts and minerals. In general, the concentration of total dissolved solids increases with distance from an aquifer's recharge or outcrop zone.

Within the Powder River RMP area, the primary bedrock aquifers are the sandstones and coal beds of the Tertiary Fort Union Formation and the sandstones of the Cretaceous Hell Creek–Fox Hills Formation. Wells within the Fort Union Formation may produce as much as 40 gpm, but yields of 15 gpm are more typical. Where confined and artesian conditions exist, wells in the Fort Union Formation will generally flow less than 10 gpm. Groundwater yields from the Hell Creek–Fox Hills Formation may be as much as 200 gpm, but are generally less than 100 gpm. Artesian wells within the Hell Creek–Fox Hills Formation may flow as much as 20 gpm (Zelt et al. 1999). The primary aquifer within Blaine County is the Judith River Formation.

Primary bedrock aquifers within the Billings RMP area and also Park and Gallatin counties are the Jurassic Kootenai Formation in the northern part of the area and the Mississippian Madison Formation. The Kootenai aquifer consists primarily of sandstone beds, while the Madison aquifer is composed of limestone. The Eagle Sandstone is a primary bedrock aquifer in Park and Gallatin counties. The Lower Hell Creek–Fox Hills Formation and the Tongue River and Tullock Members of the Fort Union Formation also produce significant groundwater within the area of the Bull Mountains in the northeast portion of the Billings RMP area. Groundwater yields from the Hell Creek–Fox Hills Formation can be as much as 200 gpm, but yields of 70 gpm are more common. Artesian wells within the Hell Creek–Fox Hills Formation can flow up to 20 gpm. Wells within the Tullock Member of the Fort Union Formation may produce as much as 40 gpm with yields of 15 gpm being the average and artesian wells flowing less than 10 gpm. Wells within the Tongue River Member of the Fort Union Formation may produce up to 160 gpm, with 20 gpm being more common (Zelt et al. 1999). Wells within the Kootenai Formation generally yield between 10 to 30 gpm, but may be as much as 100 gpm. Groundwater production from the Madison Formation can be highly variable because of the karst and fractured nature of this limestone, which can have yields ranging from 20 to 6,000 gpm or higher in karst areas (MBMG 1982).

Of particular importance is the water quality of groundwater within the primary aquifers of the area of main CBM potential; it is these aquifers that may be impacted by CBM development. Table 3-9 lists two of the most important aspects of water quality—TDS and SAR. Water quality is detailed in the Water Resources Technical Report (ALL 2001b).

Groundwater is variable in terms of both stratigraphic depth and geography but alluvium can be seen as higher quality in terms of SAR and lower quality in terms of TDS, suggesting that these aquifers contain water higher in other ions besides sodium and chloride.

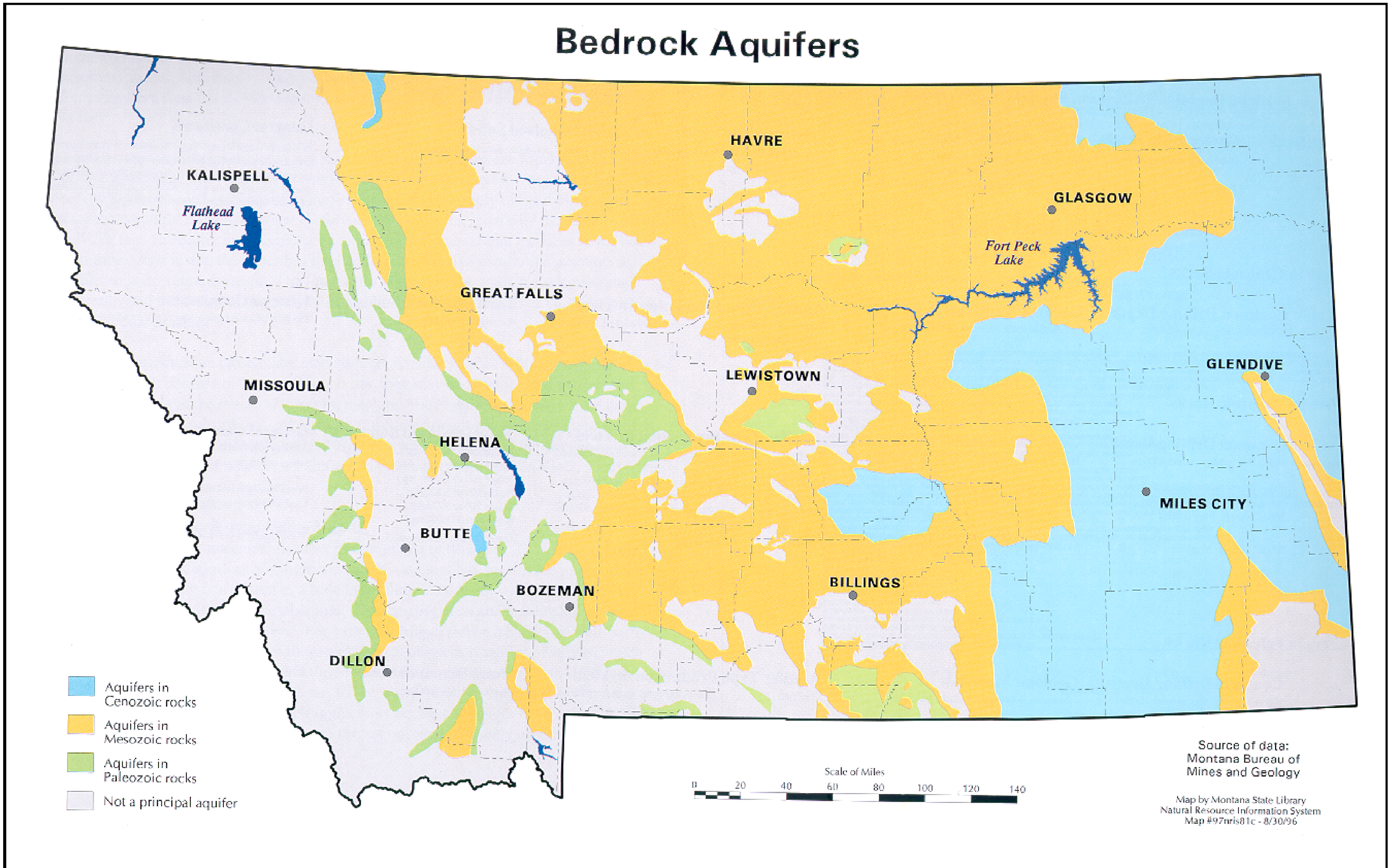
Water Rights

Water rights in Montana are the subject of The Montana Water Use Act (Title 85, Chapter 2, MCA) of 1973, which became effective July 1, 1973. Water rights existing prior to that date are to be finalized by state courts. Water rights applications since that date will be secured through a MDNRC permit system. In addition, some water rights are protected under federal and state statutes.

Water rights on some BLM lands are protected by the Federally Reserved Water Rights for Public Springs and Water Holes, Public Water Reserve 107, pursuant to Executive Order dated April 17, 1926. Compacts between the State of Montana and Northern Cheyenne Tribe have placed moratoria on new water use developments on Tribal Lands within the Rosebud, Lower Bighorn, and Pryor watersheds.

Water rights are being adjudicated on a watershed basis. The Tongue River and Little Bighorn have not yet been fully adjudicated, Rosebud is 78 percent examined prior to being adjudicated, Lower Yellowstone is 90 percent examined. Table 3-10 lists water rights developments by watershed in the area of main potential for CBM production.

Map 3-4



Bedrock Aquifers
HAVRE
KALISPELL
Flathead Lake
GLASGOW
Fort Peck Lake
GREAT FALLS
LEWISTOWN
GLENDIVE
MISSOULA
HELENA
MILES CITY
BUTTE
BOZEMAN
BILLINGS
DILLON
Aquifers in Cenozoic rocks
Aquifers in Mesozoic rocks
Aquifers in Paleozoic rocks
Not a principal aquifer
Scale of Miles
0 20 40 60 80 100 120 140
Source of data: Montana Bureau of Mines and Geology
Map by Montana State Library
Natural Resource Information System
Map #97nris81c - 8/30/96

Map 3-5

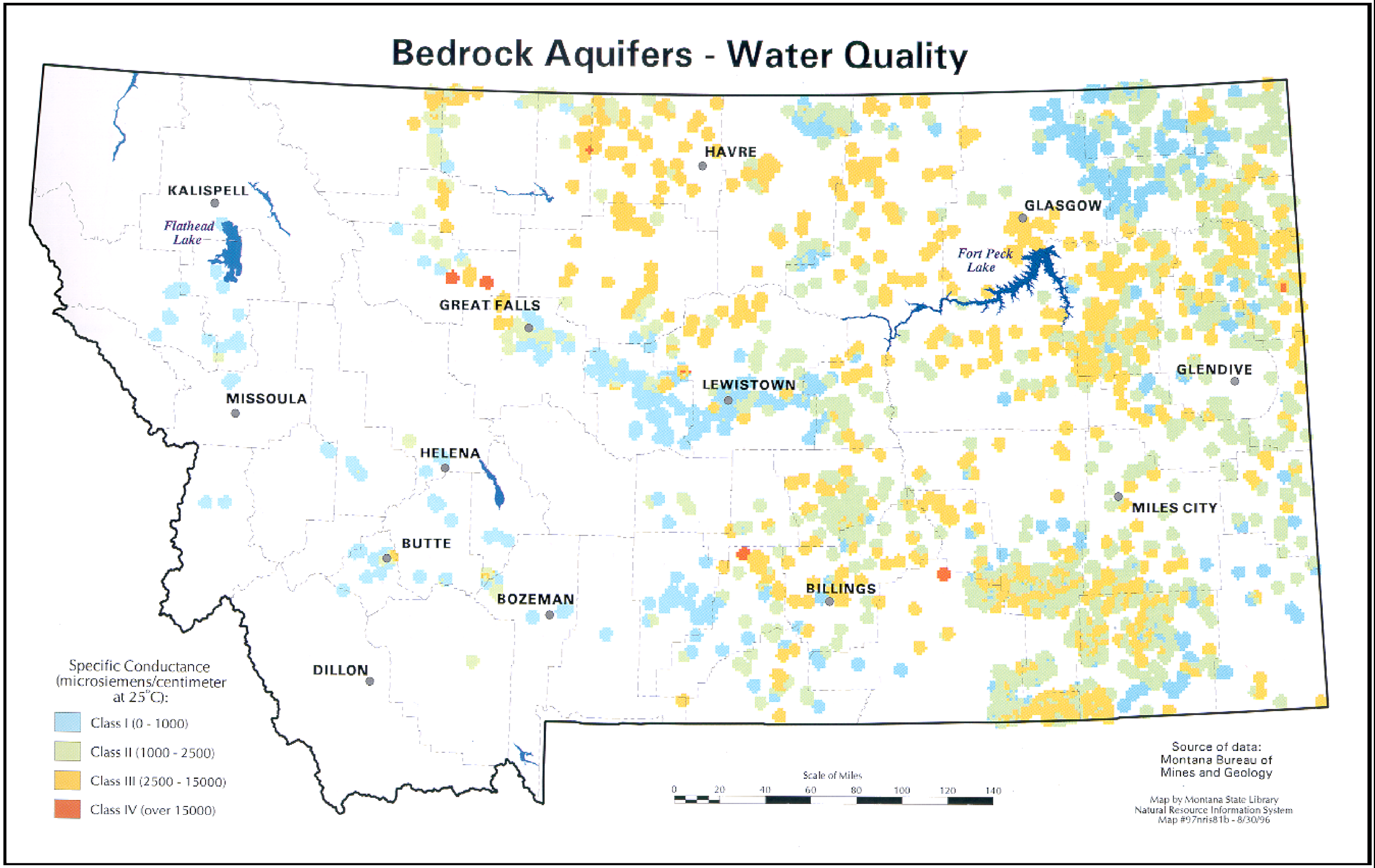

Bedrock Aquifers - Water Quality
KALISPELL
Flathead Lake
HAVRE
GLASGOW
Fort Peck Lake
GREAT FALLS
LEWISTOWN
GLENDIVE
MISSOULA
HELENA
MILES CITY
BUTTE
BILLINGS
BOZEMAN
DILLON
Specific Conductance (microsiemens/centimeter at 25°C):
Class I (0 - 1000)
Class II (1000 - 2500)
Class III (2500 - 15000)
Class IV (over 15000)
Scale of Miles
0 20 40 60 80 100 120 140
Source of data: Montana Bureau of Mines and Geology
Map by Montana State Library
Natural Resource Information System
Map #97nris81b - 8/30/96

TABLE 3-8
PLANNING AREA AQUIFERS AND THEIR GENERAL CHARACTERISTICS

AQUIFERS IN SURFICIAL DEPOSITS						
Aquifer	**Common Drilling Depth**	**Geologic Materials**	**Aquifer Type**	**Production or Yield**	**Total Dissolved Solids**	**General Comments**
Alluvium, Fluvial-Glacial Gravels, Terrace gravels, and Flaxville Formation Gravels and equivalents.	20 to 40 ft. May exceed 250 ft.	Unconsoli-dated clay, silt, sand, gravel	Commonly unconfined	Typically 5 to 50 gpm.	Range 300 to 2,200 milligrams/ liter (mg/l).	Widely used aquifer systems. Alluvial aquifers are most often used because they lie near the surface and are accessible via shallow wells and water yield is routinely quite good. They can be partially confined to completely confined with yields that may exceed 1,500 gpm in some areas. Yields from gravel deposits are more variable but water quality is usually quite good. Alluvial aquifers are vulnerable to human caused contamination in a variety of settings.
AQUIFERS IN CENOZOIC ROCKS						
Aquifer	**Common Drilling Depth**	**Geologic Materials**	**Aquifer Type**	**Production or Yield**	**Total Dissolved Solids**	**General Comments**
Fort Union Formation	50 to 300 ft. May exceed 1000 ft.	Interbedded shale, siltstone, sandstone, and coal.	Commonly confined, except near surface.	Typically 5 to 50 gpm.	Range 500 to 5,000 mg/l.	The Fort Union is a major source of ground water for eastern Montana. Water is suitable for watering stock but may not be suitable for irrigation.

TABLE 3-8
PLANNING AREA AQUIFERS AND THEIR GENERAL CHARACTERISTICS

AQUIFERS IN MESOZOIC ROCKS

Aquifer	Common Drilling Depth	Geologic Materials	Aquifer Type	Production or Yield	Total Dissolved Solids	General Comments
Lower Hell Creek-Fox Hills Formations	150 to 500 ft. May exceed 1,000 ft.	Mainly sandstone with some siltstone and shale.	Confined	5 to 20 gpm. May exceed 200 gpm.	Range 500 to 1,800 mg/l.	Although the Fort Union overlies the Hell Creek-Fox Hills, the latter is often the target for water well drilling as a result of its higher quality of water.
Judith River Formation	200 to 600 ft. May exceed 1,000 ft.	Sandstone, siltstone, with some coal.	Confined	5 to 15 gpm. May exceed 100 gpm.	Range 160 to 27,000 mg/l.	
Eagle Formation	100 to 800 ft. May exceed 2,000 ft.	Interbedded sandstone and shale.	Confined	10 to 20 gpm. May exceed 200 gpm.	Range 800 to 1,500 mg/l.	Water quality is best in central Montana, poorer in eastern Montana.
Kootenai Formation	100 to 1000 ft. May exceed 3,000 ft.	Interbedded sandstone, siltstone, and shale.	Confined	10 to 30 gpm. may exceed 100 gpm.	Range 200 to 500 mg/l. May exceed 14,000 mg/l.	Used heavily near the Belt Mountains where water quality is good.
Ellis Group	300 to 2,000 ft. May exceed 5000 ft.	Sandstone, shale, limestone, and dolomite.	Confined	No Data.	Generally less than 600 mg/l.	Water quality is best near outcrop areas.

TABLE 3-8
PLANNING AREA AQUIFERS AND THEIR GENERAL CHARACTERISTICS

AQUIFERS IN PALEOZOIC ROCKS

Aquifer	Common Drilling Depth	Geologic Materials	Aquifer Type	Production or Yield	Total Dissolved Solids	General Comments
Madison Group	500 to 3,000 ft. May exceed 7,000 ft.	Limestone, dolomite, anhydrite, and halite	Confined	20 to 6,000 gpm. Higher in karst areas.	Range 500 to 300,000 mg/l.	Very extensive aquifer, it underlies a large portion of the Great Plains. Water quality can be very high near recharge areas and is poorest in northeastern Montana.

TABLE 3-9
GROUNDWATER QUALITY FOR THE MONTANA PORTION OF THE POWDER RIVER BASIN SELECTED GROUNDWATER QUALITY DATA COLLECTED FROM WATER SUPPLY WELLS LOCATED THROUGHOUT MONTANA POWDER RIVER BASIN

	Judith River Formation		Hell Creek /Fox Hills Formation		Fort Union Formation		Quaternary Alluvium	
County	Avg. TDS (mg/l)	Avg. SAR	Avg. TDS (mg/l)	Avg. SAR	Avg. TDS (mg/l)	Avg. SAR	Avg. TDS (mg/l)	Avg. SAR
Big Horn	936	54	1440	14	1658	8	2118	5
Rosebud	2465	31	1376	35	1595	16	1516	9
Powder River	No data	No data	890	35	1882	15	2783	5
Custer	No data	No data	896	37	1810	31	1665	8
Treasure	2312	64	1985	56	1782	32	2437	10
Weighted Average	2100	42	1148	37	1892	18	2014	7

Note:
Avg. TDS = Average Total Dissolved Solids
Avg. SAR = Average Sodium Adsorption Ratio
Source: MBMG 2001a

TABLE 3-10
WATER RIGHTS DEVELOPMENT SUMMARY BY WATERSHED

	Number of Pre-1973 Developments		Number of Post-1973 Developments		
Watershed	Surface	Ground-water	Surface	Ground-water	Number of Pending Water Rights Permits
Rosebud	765	408	27	210	1
Upper Tongue River	820	504	35	136	3
Lower Tongue River	2407	2278	98	662	1
Little Powder	1320	741	66	166	3
Lower and Middle Powder and Mizpah	5204	2816	314	4	7
Lower Yellowstone	3398	1330	278	804	4
Little Bighorn	786	387	35	96	0
Lower Bighorn	1522	596	105	419	3

DNRC 2001

Indian Trust Assets

Indian Trust Assets (ITAs) are official interests in assets held in trust by the federal government for Indian tribes or individuals. The U.S. Department of the Interior (DOI) Departmental Manual 303 DM 2 defines ITAs as lands, natural resources, money, or other assets held by the federal government in trust or that are restricted against alienation for Indian tribes and individual Indians. Furthermore, DOI Departmental Manual 512 DM 2 requires all of its bureaus and offices to explicitly address anticipated effects on ITAs in planning, decision, and operating documents.

Beyond the maintenance of tangible assets, the federal government also has a trust responsibility to be considerate of the general well being of the tribes. This responsibility includes recognizing the Indian culture as an important value and to carefully consider Indian cultural values when conducting planning efforts. Indian cultural values include their unique way of life, ceremonial practices, spiritual beliefs, family values, and worldview. The DOI Department Manual 512 DM 2 also asserts an affirmative responsibility to ensure the tribal health and safety, to consult on a government to government basis with tribes who may be affected by proposed actions, to disclose all applicable information and to fully incorporate tribal views in its decision-making processes.

Background

Land associated with a reservation or public domain allotments are examples of ITAs. Natural resources that exist within Indian reservations such as standing timber, minerals, and oil and gas are ITAs. Treaty rights, water rights, and hunting and fishing rights may also be ITAs. Other ITAs may consist of financial assets held in trust accounts or intangible items such as Indian cultural values, ITAs are a product of the unique history and relationship of the U.S. government with various American Indian tribes and remain within the purview of federal process. There is no similar relationship between the Montana State government agencies and sovereign dependent Indian tribal nations (like the Northern Cheyenne and Crow Tribes).

Identification Methods

The BIA is mandated by the DOI to develop inventories of ITAs for all Indian tribes. The only ITAs in the EIS planning area are the actual Indian reservation lands belonging to the Northern Cheyenne, Crow, and Fort Belknap tribes.

Applicable Laws

Federal

The DOI Department Manual 512 DM 2 requires all DOI Bureaus and offices to explicitly address anticipated effects on ITAs in planning, decision, and operating documents. This order also requires descriptions of how decisions will conform to the DOI’s trust responsibilities. Furthermore, DOI Department Manual 303 DM 2 outlines the principals for managing ITAs.

State

ITAs are not considered under any State standards or regulations.

The Crow

The Crow Reservation is located in south-central Montana, and comprises nearly 2,296,000 acres. Access is via Interstate 90 or U.S. Highway 87. The reservation is bordered on the south by the State of Wyoming, on the east by the Northern Cheyenne Reservation, and on the northwest by the city of Billings, which is Montana's largest metropolitan area. The reservation encompasses the Little Big Horn Battlefield and approximately 3,600 square miles of rolling prairie and rugged foothills drained by the Bighorn River. The BIA Realty Office indicated that the tribe has some 455,719 surface acres and 405,888 acres of mineral rights. There are another 1,035,850 acres that have been individually allotted, and 824,427 acres of allotted mineral rights.

There are about 10,083 Crow tribal members, the majority of which live on the reservation. The Crow language is spoken by more than 80 percent of the tribe. Headquarters are at Crow Agency, Montana, just south of Hardin, Montana. The total labor force on the Crow Reservation is 3,902. The unemployment rate is 61 percent. The average per capita income is $4,243.

Water Rights

The Crow have existing water rights held in trust, similar to the Northern Cheyenne. The Crow Tribe has not negotiated a water rights compact with the State of Montana.

Mineral Rights

The BIA Realty Office has stated that the Crow have mineral right assets totaling some 405,888 subsurface acres and another 824,427 allotted mineral acres.

Air Quality

The Crow Reservation is classified as a PSD Class II area.

Cultural Resources

The Crow also considers cultural and prehistoric resources located within their reservation to be ITAs. At present, an unknown number of archaeological resources are on the reservation. Sites are known to exist on the reservation, but the tribe reserves the information. These sites can consist of burials, trails, rock features, lithic scatters, house pits/rings, rock-shelters, caves, bison kills, and petroglyphs.

The Northern Cheyenne Tribe

The Northern Cheyenne Indian Reservation occupies about 445,000 acres in eastern Big Horn and southern Rosebud Counties, Montana. Access is provided by U.S. Highway 212. The reservation covers nearly 695 square miles and is bordered on the east by the Tongue River and on the west by the Crow Reservation. According to the BIA Realty Office, the tribe has 442,193 trust acres and 444,000 of surface and mineral estate lands. There are 138,211 individual allotted acres on the reservation.

The total tribal population is 7,473, of which approximately 4,212 Northern Cheyenne live on or near the reservation. The tribal headquarters are in the town of Lame Deer. The total work force of the tribe is approximately 2,437 and the unemployment rate is 71 percent according to the BIA Indian Labor Force Report 1999. The per capita income is estimated at $4,479.

Water Rights

The Northern Cheyenne Tribe has existing water rights held in trust by the U.S. The 1908 U.S. Supreme Court ruling in *Winters v. United States* (207 US 564) ruled that water rights needed to develop Indian reservations were reserved and this includes both groundwater and surface water rights. The Northern Cheyenne Tribe has developed draft water quality standards and is currently discussing an agreement with the State of Montana and the BLM regarding preservation. The draft water quality standards have not been submitted to the EPA for approval. The Northern Cheyenne have successfully negotiated a water rights compact with the State of Montana and owns a significant amount of water in the Tongue River Basin, including a principal portion of the Tongue River Reservoir.

Mineral Rights

The Indian Minerals Development Act (PL 97-382, 25 USC 2101) and the Federal Oil and Gas Royalty Management Act of 1982 (PL 97-451) provide that information about mineral development of Indian Trust lands are proprietary to the individual tribe and may not be disclosed without consent. The BIA Realty Office has stated that the Northern Cheyenne have mineral right assets totaling some 444,000 subsurface acres.

Air Quality

The Northern Cheyenne Reservation is classified as a PSD Class I area. Additionally, the community of Lame Deer, Montana, is classified as a moderate PM_{10} nonattainment area. Furthermore, the tribe maintains and operates three PSD monitoring sites on the reservation. Class I areas have the highest quality of air and allow for only a small degree of air quality deterioration.

Cultural Resources

The Northern Cheyenne Tribe considers cultural resources located within their reservation to be ITAs. At present, an unknown number of archaeological resources are on the reservation. Sites are known to exist on the reservation, but the information is reserved by the tribe. These sites can consist of burials, trails, rock features, lithic scatters, house pits/rings, rock-shelters, caves, bison kills, and petroglyphs.

Fort Belknap Community Council

The Fort Belknap Indian Reservation is positioned in north-central Montana near the Canadian border between the Milk River and the Little Rocky Mountains. The reservation is in Blaine and Phillips counties. The trust acreage of the reservation is roughly 618,228 acres (Madison

2001). The land is predominately rolling prairie with good grass and brush cover. There are 232,799 tribal-owned surface acres and an additional 385,429 individually allotted surface acres. The mineral rights include 54,351 tribal acres and 369,044 allotted acres.

The reservation houses two tribes that operate under one central government. The two tribes are the Gros Ventre and the Assiniboine. The combined enrollment of the two tribes is approximately 5,133. (Fort Belknap Indian Community 2001) The tribal headquarters are located at the Fort Belknap Agency, 3 miles southeast of Harlem, Montana, on U.S. Highway 2. The total labor force on the Fort Belknap Reservation is 721 and the per capita income is $4,536. The unemployment rate is 29.5 percent.

The tribes' economy is based on agriculture, which includes farming, ranching, and land leasing, including grazing permits. Crops include wheat, hay, and barley. The reservation's climate, as with most of north-central Montana, is subject to severe weather extremes, with hot, dry summers and harsh winters. Both fishing and hunting are popular, and trout, deer, antelope, and some migratory waterfowl are plentiful.

Water Rights

Fort Belknap is the site where the 1908 U.S. Supreme Court decision in *Winters v. United States* (207 US 564) was originally contested regarding Indian water rights. As noted previously, the waters are a federally reserved trust asset.

Mineral Rights

The BIA Realty Office has stated that the Assiniboine and Gros Ventre have mineral right assets totaling about 54,351 subsurface acres and another 369,044 allotted mineral acres.

Air Quality

The Fort Belknap Reservation is classified as a PSD Class II area.

Cultural Resources

The Assiniboine and Gros Ventre also consider cultural and prehistoric resources located within their reservation to be ITAs. At present, an unknown number of archaeological resources are on the reservation. Sites are known to exist on the reservation, but the tribe reserves the information. These sites can consist of burials, trails, rock features, lithic scatters, house pits/rings, rock-shelters, caves, bison kills, and petroglyphs.

The Turtle Mountain Public Domain Allotments

There are approximately 61,520 acres (Madison 2001) of federal trust lands allotted to the members of the North Dakota Turtle Mountain Tribe scattered throughout 2,000 square miles of Montana.

In 1906, the Burke Act provided that individual tribe members could receive allotments of reservation land. At that time, parcels of 160 acres each were allotted to individuals of the Turtle Mountain Tribe in Montana. These allotments, although not grouped as a reservation, are considered existing environmental lands within the planning area. These lands are Trust lands and will follow the same leasing and development procedures as for the reservations.

Lands and Realty

A variety of land uses exist throughout the planning area, including agricultural (crops and grazing); roads and highways; railroads; utility rights-of-way (ROW) for electrical power lines and telephone; communication sites; oil and gas production and pipelines; residential; commercial and light industrial uses; mining; municipalities; and recreation.

Table 3-11, *Land Ownership*, shows surface ownership in acres by county for federal, state, tribal, and private lands. It also shows that approximately 65 percent of the land is private land. The majority of the private land is agriculturally based (grazing and crops). The next largest ownership is federal lands at 20 percent. Federal lands include lands managed by the BLM, U.S. Forest Service (USFS), National Park Service, U.S. Bureau of Reclamation (USBR), and U.S. Fish and Wildlife Service (FWS). BLM and USFS lands are used for grazing, timber production, mineral production (except for the Custer National forest, which is excluded from surface coal mining by Section 522 of the SMCA of 1977), and year-round recreation activities; USBR lands are used for water storage and recreation; National Park Service lands are used for recreation; and FWS lands are used for wildlife refuges and human recreation.

Tribal lands comprise 10 percent of the land in the planning area. They are used for cattle production, mining, logging and lumber production, residential, and recreation on the Northern Cheyenne Reservation. The Crow Reservation's major land uses include agriculture, mining, and recreation (Madison 2001).

State lands comprise the least amount of land in the planning area at 5 percent. This land is used for grazing, mining, timber production, oil and gas production, state parks, and recreation activities. State lands are composed of school trust land administered by DNRC Trust Land Management Division, land owned by DNRC Water Resources Division, and land owned by other state agencies. Uses vary by agency. School trust land uses include agriculture, grazing, mineral exploration and mining, aggregate production, recreational activities, oil and gas exploration and production, timber production, and special uses, for example, wind turbines for energy production. School trust lands also have pipelines, power lines, telephone lines, roads and highways, home site leases, and cabin site leases, depending on the situation.

Roads and highways include interstate, United States, state, and off-system roads open to the public—county, local, and private roads open to public use. Table 3-12 lists the number of miles of each type within the planning area.

Railroad rights-of-way crisscross the counties in the planning area. Railroads in the planning area transport goods such as grains, intermodal containers, and coal. Table 3-13 indicates the approximate miles of railroad ROW within the planning area for each county, by railroad.

There are existing gas pipelines in all the counties being studied. Some existing roads, utilities, and gas lines could be used as part of the network for new CBM installations.

TABLE 3-11
LAND OWNERSHIP

		Federal					Managed by State			Managed by Tribal			
County	**Total Acres**	**BLM**	**Forest Service**	**National Park Service**	**Bureau of Reclamation**	**U.S. Fish & Wildlife Service**	**Lands**	**Water**	**State Park**	**Federal Government Holdings**	**Tribal Land**	**Private**	**Unknown**
Big Horn	3,208,115	61,617	12	762			97,483	16,535	3,733	1,996	1,565,898	1,459,556	523
Blaine	2,711,111	465,021		204		2,700	173,811	12,138		19	498,968	1,558,250	
Carbon	1,319,367	222,309	323,729		6		42,463	9,099	382		121	700,233	21,025
Carter	2,132,128	505,614	90,246				141,754	5,736	372			1,388,406	
Custer	1,556,352	188,226	46,332				89,787	3,245				1,228,762	
Gallatin	1,682,769	9,026	607,719	62,927			52,793	16,549	7,825			925,930	
Golden Valley	752,094	8,182	23,570			303	48,898	1,523				669,618	
Musselshell	1,196,032	102,932				13,586	75,742	3,642				1,000,130	
Park	1,799,785	13,459	752,830	93,555		1,113	33,172	6,587				899,069	
Powder River	2,109,880	258,817	340,424				141,034	560				1,369,045	
Rosebud	1,502,305	83,857	95,575				64,807	3,031			242,132	1,012,903	
Stillwater	1,154,243	5,986	191,973		12	3,800	45,600	11,531				895,341	
Sweetgrass	1,190,833	16,116	281,586				47,836	4,502	135			840,658	
Treasure	629,224	12,252	1,323				36,955	3,635			1,600	573,459	
Wheatland	913,079	1,415	65,397				74,379	3,446	1,329			767,113	
Yellowstone	1,693,991	86,924			1,487	284	80,042	9,034	41		134,010	1,382,169	
Total:	25,551,308	2,041,753	2,820,716	157,448	1,505	21,786	1,246,556	110,793	13,817	2,015	2,442,729	16,670,642	21,548

Data Sources: Land Ownership, Highways and Railroad ROW, Montana State Library/NRIS, Helena, Montana. Created from GIS intersection of 1:100,000 scale county boundaries with 1:100,000 scale Land Ownership, Highways and Railroad ROW.

TABLE 3-12
MILES OF ROAD/HIGHWAY

County	Interstate	US	State	Off-System
Big Horn	81.8	38.7	21.7	925.0
Blaine		54.5	39.3	1,359.0
Carbon		107.6	46.0	833.0
Carter		38.3	12.1	694.0
Custer	42.8	25.5	51.8	824.0
Gallatin	43.6	115.0	67.2	1,441.0
Golden Valley		29.2	12.4	483.0
Musselshell		99.5	1.6	554.0
Park	32.4	104.0	6.7	781.0
Powder River		64.6	55.1	718.0
Rosebud	41.9	26.2	51.3	1,052.0
Stillwater	38.1		23.0	858.0
Sweetgrass	37.1	31.8		516.0
Treasure	26.2			244.0
Wheatland		79.8		449.0
Yellowstone	95.2	29.8	41.7	1,826.0
Total	**439.1**	**844.4**	**430.0**	**13,557.0**

Data Sources: Land Ownership, Highways and Railroad ROW, Montana State Library/NRIS, Helena, Montana. Created from GIS intersection of 1:100,000 scale county boundaries with 1:100,000 scale Land Ownership, Highways and Railroad ROW.

TABLE 3-13
MILES OF RAILROAD ROW

	Railroad		
County	**BNSF[1]**	**Montana Rail Link**	**Tongue River Railroad (Proposed)**
Big Horn	119		19
Blaine	62		
Carbon	61		
Custer	32		44
Gallatin		72	
Golden Valley	70		
Musselshell Park		34	
Rosebud	39		64
Sweetgrass		32	
Treasure	36		
Yellowstone	32	50	
Totals	419	188	127 (proposed)

Data Sources: Land Ownership, Highways and Railroad ROW, Montana State Library/NRIS, Helena, Montana. Created from GIS intersection of 1:100,000 scale county boundaries with 1:100,000 scale Land Ownership, Highways and Railroad ROW.
[1]BNSF—Burlington, Northern, and Santa Fe Railroad.

Livestock Grazing

Most allotments involve only one permittee; however, there are several multi-permittee allotments. There are no other rights or control of public lands granted by issuance of a grazing permit. The length of grazing periods varies from seasonal to yearlong use. Most ranch operators using the allotments are cow-calf operations with sheep operations coming in second. Most allotments are predominantly private lands with scattered 40 to 80 acre tracts of federal lands. Occasionally a few larger blocks of 640 acres or more of federal lands are encountered. Most allotments have several range improvements such as fences, stock ponds, pipelines, springs, windmills, seedings, wells, and access roads for better control of livestock for management purposes (BLM 1992).

In the planning area, approximately 1,205 allotments cover 1.6 million acres of federal lands (Tribby 2001, Padden 2001, Haas 2001). These allotments are used to graze cattle, sheep, and horses. The main class of livestock using public lands is cattle (93 percent). Authorized livestock use on the grazing allotments totals about 288,000 animal unit months which include active-use, non-use, and exchange-of-use options (Tribby 2001, Padden 2001, Haas 2001). An animal unit month is the amount of forage necessary to support one cow and her calf, or five sheep, for one month.

The TLMD regulates the grazing rights for the trust land resources in the State. For the RMP areas and three additional counties, there is a total of 1,207,400 acres of classified grazing and forested lands, and 323,941 animal unit months. Grazing use of trust lands for the entire state includes approximately 8,500 agreements during the year 2000. The 4.3 million acres of classified grazing and forested lands have an estimated carrying capacity of 1,090,000 animal unit months (Chappell 2001).

Native Americans

There are eight federally recognized Indian tribal organizations in Montana. They are the Assiniboine and Sioux Tribes of Fort Peck (Sioux Division of Sisseton/Wahpetons, the Yantonias, the Teton Hunkpapa, and the Assiniboine bands of Canoe Paddler and Red Bottoms), the Blackfeet Tribe, the Metis, the Chippewa Cree Tribe, the Confederated Salish and Kootenai, the Crow Tribe of Montana, the Fort Belknap Indian Community (the Assiniboine and the Gros Ventre), and the Northern Cheyenne Tribe. A non-federally recognized tribe also resides in Montana: the Little Shell Band of Chippewas of Montana.

Tribal enrollment within these organizations is recorded as 61,203 individuals or nearly 6.6 percent of the states population. Within this population there is an average unemployment rate of 61 percent and a high level of poverty (BIA 1999).

The majority of these native people reside on seven Indian reservations throughout Montana. The reservations are the Crow, Northern Cheyenne, Fort Peck, Fort Belknap, Rocky Boys, Blackfeet, and the Flathead. Three reservations are within the planning areas of the State of Montana and the BLM: the Crow, Northern Cheyenne, and Fort Belknap. See Table 3-14 and Map 1-1 for the general location and boundaries of the reservations. Of particular interest are the Crow and Northern Cheyenne reservations that are located within the CBM emphasis area of the Powder River Basin.

Crow Reservation

The Crow Reservation is located in south-central Montana, and comprises nearly 2,296,000 acres. Access is via Interstate 90 or U.S. Highway 87. The reservation is bordered on the south by the State of Wyoming, on the east by the Northern Cheyenne Reservation, and on the northwest by the city of Billings, which is Montana's largest metropolitan area. The reservation encompasses the Little Big Horn Battlefield and approximately 3,600 square miles of rolling prairie and rugged foothills drained by the Bighorn River. The BIA Realty Office indicated that the tribe has some 455,719 surface acres and 405,888 acres of mineral rights. There are another 1,035,850 acres that have been individually allotted, and 824,427 acres of allotted mineral rights.

Mountains, residual uplands, and alluvial bottoms make up the topography of the Crow Reservation. The three principle mountain areas are the Wolf Mountains to the east and the Big Horn and Pryor Mountains to the south. Sloping downward to the north from the mountains are rolling upland plains. The plains constitute the bulk of the reservation and

TABLE 3-14
INDIAN TRUST ASSETS

Tribe	Acreage of Reservation	Trust Acres	Tribal Surface Acres	Individually Allotted Surface Acres	Tribal Mineral Acres	Individually Allotted Mineral Acres	Fee Acreage
The Northern Cheyenne	445,000	442,193	444,000	138,211	444,000	138,211	2,087
The Crow	2,296,000	1,491,569	455,719	1,035,850	405,888	824,427	804,431
Fort Belknap Community Council	623,000	618,228	232,799	385,429	54,351	369,044	4,772
Turtle Mountain Public Domain Allotments	N/A	61,520	N/A	61,520	N/A	61,520	N/A

Source: Madison 2001

vary in altitude from 3,000 to 4,500 feet. The alluvial bottomlands are located along the Big Horn River, Little Big Horn River, and Pryor Creek drainage systems.

Tribal Government

The United States signed treaties in 1825, 1851, and 1868 with the Crow Tribe. These legal documents define the tribes' relationship with the United States, recognized their rights as a sovereign government, and established reservation boundaries. The Treaty of 1851 established the Crow Reservation. The Tribal government has authority within the boundaries of the reservation for all rights-of-way, waterways, watercourses and streams, running through any part of the reservation.

The tribal government functions under a constitution ratified on June 24, 1948 by the tribal membership. Under this constitution, the Crow Tribe has a council form of government that is made up of all members of the Crow Tribe over 18 years old. One hundred or more adults comprise a quorum of the general council. The Council has the authority to represent, act and speak for the tribe and its members. The Council meets four times a year to debate tribal matters and pass motions. Headquarters are at Crow Agency, Montana, just south of Hardin, Montana. The daily operations of the tribal government are the responsibility of four elected administrators: the Chairman, Vice Chairman, Secretary and Vice Secretary. In addition, there are several committees that oversee and operate specific programs. Each committee derives it's authority from the Council through approval of a plan of operation. In the past there has been committees formed to address the technical aspects of energy development and its environmental effects.

Population and Employment

There are about 10,000 Crow tribal members, the majority of which live on the reservation (75 percent). The Crow language is spoken by more than 80 percent of the tribe. The total workforce is 3,902 with 1,531 members employed. Of the employed 582 (38 percent) are considered to be employed but below the poverty guidelines. The unemployment rate is 61 percent and the average per capita income is $4,243 (BIA 1999). Members of the tribe are employed in various occupations including ranching, farming, government services, coal mining, and tourism. The United States government is the largest single employer of Crow people. The BIA, with offices at Crow Agency, the Indian Health Service, and the National Park Service are the providers.

Economy

The tribe's economy is based on income from the reservations land that is used to directly support livestock operations. The tribe owns immense amounts of renewable and non-renewable resources on the reservation that include water, land, timber, sand and gravel, coal, oil and gas. These resources, largely under lease agreements, serve as the primary source of most of the tribal income. Less significant sources of income include timber, fisheries, and hunting. The tribe has discussed opportunities to create alternative sources of income from increased agriculture, expanded energy development, further tourism and recreation and commercial institutions. Agriculture remains the most important commercial activity on the reservation and with the quality of water and land available increased agricultural production would be complimentary.

Education

The reservation has eight elementary schools, three high schools and the Little Big Horn Community College. The three high schools are located in Lodge Grass, Pryor, and Hardin. From coal mining revenues, the schools at Hardin and Lodge Grass have become two of the wealthiest in the state. Public schools are also available in both Billings and Hardin. Approximately 70 percent of members have a high school diploma and over 6 percent have a Bachelor's Degree or higher.

Air Quality

The air quality and climate of the Crow Reservation is similar to that of the regions described earlier in Chapter 3. The Crow Reservation is classified as a PSD Class II area.

The reservation is located in a part of Montana that has a moderate climate relative to its latitude. Snow rarely accrues for long periods of time because of the warm Chinook winds, which originate from the mountains in the West. This portion of Montana is also known for its "Indian Summers" which frequently extend into November. The mean annual temperature is 45.5^{o}F with a summer high of 110^{o}F and a winter low of -48^{o}F. The bulk of the reservation varies from 12 to 18 inches annual precipitation, depending on the elevation.

Culture and History

The Crow Tribe's native name is the Apsalooke, literally translated, "children of the large beaked bird." Early explorers mistook the signing for Apsalooke, the flapping of one's hands like the wings of a bird in flight, and called them the Crow. The Crow people are generally recognized as a matrilateral society, meaning they lived with the wife's relatives. The tribes' structure was based on the clan system with marriage between clans. The clans of the Crow Tribe are the Acirari o (new lodges), Acitsi te (thick lodge), Aci oce (sore lip lodge), U watace (greasy mouths), U sawats ia (without shooting they bring game), Xu xkaraxtse (tied in a knot), Acpe nuce (filth eaters), E rarapio (kicked in the bellies), Ackya pkawia (bad war honors), Birikyo oce (whistling water), Acxatse (streaked lodge), and the Ackya mne (piegan lodge).

The Crow people were originally part of the Hidatsa. It is believed they came from eastern Kansas in a series of migrations in the 17th century. It is probable that the Mountain Crow made the first westward migration and the River Crow followed them much later. The Crows first moved to the area west of the Black Hills but were pushed further west by the Cheyenne and Sioux. The Mountain Crows settled in the upper reaches of the Yellowstone in what is now southern Montana and northern Wyoming. The River Crow continued to make a yearly visit to the Hidatsa and Mandan villages on the Missouri while the Mountain Crow traded across the Rockies with the Flatheads and Nez Perce. This trade route enabled them to became important middlemen in the regional transfer of goods amid east and west and resulted in the Crow becoming rich in horses.

Powerful enemies surrounded the relatively small tribe: the Lakota in the West and the Northern Cheyenne/Arapaho in the Southwest, the Blackfeet/ Gros Ventre in the North, and the Assiniboine in the northeast. These powerful tribes constantly warred on the Crow creating a struggle that honed their skills and produced confident and strong warriors. The first westerners to encounter the Crow reported a hospitable environment and one in which fur traders often wintered over in their camps. As the fur trade grew, many Crow bands found opportunities to trade for other western supplies and technology.

As the 19th century progressed, western migration pushed other tribes further West, creating conflicts between the Crow and the Sioux/Cheyenne alliance. During the Powder River War, the Crow were invited to join the Sioux, Cheyenne, and Arapaho but due to their earlier trading alliance with the white-man they remained loyal to the American Army and sent back the Sioux pipe. As the war progressed, the Crow fought with merit and honor alongside the U.S. Army at the Rosebud and supplied scouts for the Little Big Horn campaign. A Crow scout named Curly brought the news of Custer's defeat to the U.S. Army command headquarters on the Yellowstone (Free Indian News Web Page 2001).

Today the Reservation encompasses a portion of the original hunting grounds in southern Montana. Within this area there are many revered sites, hunting camps, vision quest locations and other sites of religious significance. Many similar sites are also located off the reservation and are discussed in general in the Cultural Resources section.

Geology and Minerals

The reservation contains a varied geology, as does the State of Montana (see earlier Geology and Minerals description). Of particular interest to this EIS are the deposits of sub-bituminous coal within the reservation. The known coal occurrences in the Powder River Basin are generally located in the Paleocene Fort Union Formation. The coals on the reservation are known to be on the eastside, beneath a 12 to 15 mile wide swathe extending from the Wyoming border to the northern border of the reservation. These deposits have been estimated to contain 17.1 billion tons of coal of which 16.1 billion tons may be prospective for CBM development. These coals may be as thick as 100 feet in places (Admin Report BIA-7, 1975). Geology and stratigraphy of the planning area are discussed at length in the *Minerals Appendix*.

The Absaloka coal mine produces coal from a strip of land the Crow Tribe ceded in 1904 to the United States for settlement by non-Indians. The United States holds rights to minerals underlying the ceded strip in trust for the tribe. In 1972, with the approval of the Department of the Interior and pursuant to the Indian Mineral Leasing Act of 1938, Westmoreland Resources, Inc., a non-Indian company, entered into a mining lease with the tribe for coal underlying the ceded strip (Supreme Court, May 1998). Today the Absaloka mine annually produces an average of 5,500,000 short tons of coal from its 5,400 acre permitted facility.

The reservation also includes the Soap Creek, Lodge Grass, Gray Blanket, and Ash Creek oil and gas fields. There have been 172 conventional wells drilled to date on the reservation. Production occurs from the Shannon, Tensleep, Amsden and Madison formations within the reservation.

Protecting the Indian lessors from loss of royalty as a result of conventional oil and gas drainage is a prime responsibility of the BLM. Under the terms of both federal and Indian leases, the lessee has the obligation to protect the leased land from drainage by drilling and producing any well(s) that are necessary to protect the lease from drainage, or in lieu thereof and with the consent of the authorized officer, by paying compensatory royalty. Drainage analysis, on the basis of a production screen or other criteria, is required by BLM document H-3160-2, Drainage Protection Guidelines Instruction Memorandum. Under this memorandum, federal or Indian mineral interests determined to be in danger of drainage will be subject to geologic, engineering, and economic analyses in order to define the presence and magnitude of resource drainage.

Hydrology

Hydrological resources on the reservation consists of surface water flow from several rivers and their associated tributaries, and the production of groundwater from a variety of geological formations. A detailed explanation of the regional hydrology including that of the reservations' is included in an earlier section of this chapter under *Hydrology*.

According to the 1996 303d list, several watersheds and impaired waterbodies are adjacent to the Crow Reservation. These include the Rosebud watershed which crosses a part of the Crow Reservation; The Lower Bighorn watershed includes a large part of the Crow Reservation, which contacts both impaired portions of the Bighorn River; and the Little Bighorn watershed that includes a large part of the Crow Reservation but no waterbodies are determined to be impaired on the 1996 303d list.

The groundwater resources for the reservation are similar to those described for the Powder River Basin in the previous hydrology section of this chapter.

Land Use and Realty

The Crow Reservation comprises approximately 9 percent of the land in the planning area. The Crow Reservation's major land uses include agriculture, mining, and recreation (Madison 2001). The Crow maintain almost 1.2 million acres of leased grazing lands, 150,000 acres leased dry-farming land, and the nearly 30,000 acres leased irrigated farming land. Most lands are leased to large non-Indian interests by Allottees (U.S. Department of Commerce 1996).

The principal communities located on the Crow Reservation are as follows:

- Crow Agency—The Crow Tribal Government administration, the BIA, and the Crow Hospital are located in the town of Crow Agency. There are approximately 3,245 Indian people residing in Crow Agency. A 16-bed hospital is located in Hardin, Montana, approximately 12 miles from Crow Agency. Two larger hospitals (250+ bed facilities) are located in Billings, Montana 65 miles from Crow Agency. Billings is recognized as the major medical referral center for east-central Montana and northern Wyoming.
- Lodge Grass—The Lodge Grass is located approximately 22 miles south of Crow Agency and houses the Lodge Grass Health Center. Approximately 2,125 Indian people live in Lodge Grass.
- Pryor—The Pryor Health Station is located here, approximately 69 miles northwest of Crow Agency. The Indian population of Pryor is estimated at 1,018.
- Wyola—This community is located approximately 13 miles from Lodge Grass and approximately 35 miles from Crow Agency. There are nearly 450 Indian people residing in Wyola.

Recreation

The Crow Indian Reservation is a large contiguous tract of land that provides dispersed outdoor recreation for tribal members. This includes hunting, fishing, picnicking, camping, hiking, horseback riding, snowmobiling, and off-road vehicle use. Yellowtail Dam at Big Horn Canyon provides some of the finest fishing, water sports and camping in the state of Montana. Non-tribal members are not allowed to hunt on the

Reservation except for spouses of tribal members. Crow Agency recreational facilities are provided at three city parks, the school gymnasium, at playground areas, and at the Crow Tribal Fairgrounds. Within the town of Lodge Grass on the Reservation, there is a city park with landscaped open space and picnic facilities. Outdoor sports and playground equipment are available on the school grounds in Lodge Grass.

The Crow Tribe hosts one of the largest powwows held in the United States, The Crow Fair, it takes place at the Crow Agency every August. There is spirited competition dancing, drumming and singing, as well as food and craft concessions. Crow Agency is also near the Battle of the Little Big Horn National Monument a popular tourist site. Once each year the tribe does a brilliant re-enactment of the battle.

Soils

Soils in the reservation, just like soils in the rest of the RMP area, are derived mainly from sedimentary bedrock and alluvium. The soils generally range from loams to clays, but are principally loams to silty clay loams. For more information on soil types, see the Soils Appendix.

Vegetation

The same types of vegetative communities as described in this chapter are anticipated to be found on the reservation. It is understood that the Crow Tribe considers certain plants to be sacred for their therapeutic and/or traditional values.

Wildlife

The reservation environment supports a variety of wildlife including large game animals, small mammals migratory birds, raptors, waterfowl, amphibians, and reptiles. The aquatic resources are just as diverse including some 32 different fish species. See Chapter 3 discussion for details regarding species and habitat.

Northern Cheyenne Reservation

The Northern Cheyenne Indian Reservation occupies about 445,000 acres in eastern Big Horn and southern Rosebud Counties, Montana. U.S. Highway 212 provides access. The reservation covers nearly 695 square miles and is bordered on the east by the Tongue River and on the west by the Crow Reservation. According to the BIA Realty Office, the tribe has 442,193 trust acres and 444,000 of surface and mineral estate lands. There are 138,211 individual allotted acres on the reservation.

President Arthur issued an Executive Order establishing the reservation in November of 1884 with a land trust of about 271,000 acres. In 1900, President McKinley issued a second Executive Order on behalf of the Northern Cheyenne that shifted the eastern boundary to the Tongue River, expanding the reservation to its current size. The topography deviates from low, grass-covered hills to high, steep outcroppings and narrow valleys. Elevations range from approximately 3,000 to 5,000 feet.

Tribal Government

The tribe ratified a constitution and bylaws in 1936 according to Indian Reorganization Act rules. The constitution was amended in 1960 and is the document on which the Tribal Council structure is based. The tribe elects the Tribal Council, which serves as the governing body. The Tribal Council consisting of the president and 24 council members elected in the proportion of one member per 200 tribal members. The president serves a 4-year term while the council members are elected every 2 years (on a staggered basis) from five separate districts. The tribal administrative headquarters are housed in Lame Deer.

Population and Employment

The tribal enrollment is approximately 7,500 with nearly 56 percent (4,210) Northern Cheyenne living on or near the reservation. The labor force of the reservation is estimated at 2,435 with 718 members employed. Of the employed 190 (26 percent) are considered to be employed but below the poverty guidelines (BIA 1999). The unemployment rate is 71 percent and the average per capita income is $4,479. Members of the tribe are employed in various occupations including ranching, farming, government services, construction, small businesses and light manufacturing. The tribe employs a total of about 300 of its members in various capacities, including social services, health care, forestry, and casino operations.

Economy

The current economy is primarily based on livestock; individual tribal members own an estimated 12 to 15 thousand head of cattle, which are presently worth about $12 million on the open market. The tribe has approximately 27,000 acres of reservation lands presently under cultivation, the vast majority of which is dryland farming. This primarily entails hay, wheat, barley, and small grains. Annual revenues generated by farming are estimated at about $2.5 million (U.S. Department of Commerce 1996).

In addition to this agricultural based income the tribe has developed several secondary routes of income including construction, timber sales, small business, light manufacturing and casino gaming.

There are several skilled construction contractors and subcontractors amongst the tribe, one of which is reported to have a contract for construction of the new Community Center (the old one having burned down in 1989). Additionally, new tribal housing units are planned; tribally based contractors are bidding for this project. In general, the construction industry generates sizable employment and revenues for the tribe.

One third of the reservation or approximately 147,000 acres is composed of forested land, the majority of which is comprised of Ponderosa Pine forests. The commercially available portion of the these forested lands is estimated at 70 percent. The Northern Cheyenne Pine Company is the lead forest product company using reservation timber resources.

There are currently 44 small businesses on the reservation, the majority Indian-owned. These businesses include laundromats, restaurants, gas stations, grocery stores, construction contractors, drilling companies, a lumber mill, a clothing designer, and Indian arts and crafts outlets. The reservation also hosts several light manufacturing facilities, including the Northern Cheyenne Industries, which produce teepees and other traditional articles, and the Cheyano Designs, which manufactures designer clothing.

Recently the tribe opened the Northern Cheyenne Bingo facility, a moderate-sized casino operation, offering bingo, pull tabs, and video poker. Although new, it generates nearly $11,000 a week in revenues and employs a number of tribal members.

Education

Public schools are available for pre-school grades, and K-12 in Lame Deer. Ashland houses the St. Labre Indian High School or students may decide to attend public high school in Colstrip, Montana. In Colstrip are three public elementary schools, a middle school and a transportation system, which serves all grade levels. For college, students may choose to attend the Dull Knife Community College in Lame Deer. The institution offers several associate degrees and certified programs. Dull Knife Community College also offers courses on the Cheyenne language. Approximately 62 percent of the tribal members have a high school diploma and 5.6 percent have a Bachelor's Degree or higher.

Air Quality

The air quality and climate of the Northern Cheyenne Reservation is similar to that of the regions described earlier in Chapter 3. The Northern Cheyenne Reservation is classified as a PSD Class I area. Additionally, the community of Lame Deer, Montana, is classified as a moderate PM-10 nonattainment area. Furthermore, the tribe maintains and operates three Prevention of Significant Deterioration monitoring sites on the reservation. Class I areas allow for only a small degree of air quality deterioration.

The reservation is located in a part of Montana that has a moderate climate relative to its latitude. Snow rarely accrues for long periods of time because of the warm Chinook winds, which originate from the mountains in the West. This portion of Montana is also known for its "Indian Summers" which frequently extend into November. The mean annual temperature is 45.5°F with a summer high of 110°F and a winter low of -48°F. The bulk of the reservation varies from 12 to 18 inches annual precipitation, depending on the elevation.

Culture and History

Cheyenne descend from the Algonquian language family. It is believed that they originated from the upper Great Lakes region, south of Hudson Bay and James Bay. During the 15th century, there was a southerly migration toward what is now northern Minnesota. This migration gave rise to a shift away from reliance on fishing and toward the practice of farming. At about the time of the first Thanksgiving, the Cheyenne (along with other Plains Indians) started moving into what is now the Dakotas. About halfway through the 18th century, the Cheyenne acquired and mastered the art of horsemanship; this provoked another extraordinary cultural shift from farming to the sole reliance on buffalo.

The first treaty the Cheyenne participated in was in 1825 near present-day Ft. Pierre, South Dakota (the Friendship Treaty). About a decade later, the tribe separated into two groups with a large segment of the tribe moving southward and settling along the Arkansas River in Colorado. The remaining members continued to roam the plains in the region of the North Platte and Yellowstone Rivers. These bands of free roaming Cheyenne eventually formed the Northern Cheyenne and joined forces in 1876 with the Sioux in the Sitting Bull War and the Battle of Little Big Horn. Although they won the battle, the Northern Cheyenne were finally subdued and taken as prisoners of war to Ft. Reno, Oklahoma, where the Southern Cheyenne and Arapaho joined them in captivity.

A band of Northern Cheyenne lead by Dull Knife fled Oklahoma and headed for their homelands in Montana. The dangerous escape attempt resulted in fewer than 100 of the group reaching the north. After several years of wandering the north the tribe was placed on what is more or less the site of their current reservation.

Two years after the issuing of the 1934 Indian Reorganization Act, the Northern Cheyenne structured themselves into a council form of government and sought sovereign recognition. The council administered the reservation through the Second World War but found a constitution amendment necessary in 1960. In the late 1960s, development of the tribe's coal reserves had become a major issue. In 1972, an off-reservation company made a proposal to the tribe that would have placed over 70 percent of the reservation in the hands of outside energy companies. This prompted a ground swell in activism by tribal members to reassert the tribe's political, economic, and environmental sovereignty. Arguing against the BIA and a few tribal leaders, the activists prevailed when in 1978 Congress intervened and canceled the disputed coal leases. Since that time, the Northern Cheyenne have overseen their energy development with a cautious demeanor toward economic development while preserving their cultural integrity and land.

Geology and Minerals

The reservation contains a varied geology, as does the State of Montana (see earlier Geology and Minerals description). Of particular interest to this EIS are the deposits of sub-bituminous coal within the Reservation. The known coal occurrences in the Powder River Basin are generally located in the Paleocene Fort Union Formation. The coals on the reservation are known to be beneath the entire reservation and are estimated to contain 23 billion tons of coal of which 16.3 billion tons may be prospective for CBM development (Admin Report BIA-3, 1975). Geology and stratigraphy of the planning area are discussed at length in the Geology and Minerals Appendix.

The reservation does not have any known oil or gas fields. Twenty conventional wells have been drilled to date. Additionally, Atlantic Richfield (ARCO) has explored for oil and gas reserves on tribal lands, this data has not been released to state or federal agencies.

Protecting the Indian lessors from loss of royalty as a result of conventional oil and gas drainage is a prime responsibility of the BLM. Under the terms of both federal and Indian leases, the lessee has the obligation to protect the leased land from drainage by drilling and producing any well(s) that is necessary to protect the lease from drainage, or in lieu thereof and with the consent of the authorized officer, by paying compensatory royalty. Drainage analysis, on the basis of a production screen or other criteria, is required by BLM document H-3160-2, Drainage Protection Guidelines Instruction Memorandum. Under this memorandum, federal or Indian mineral interests determined to be in danger of drainage will be subject to geologic, engineering, and economic analyses in order to define the presence and magnitude of resource drainage.

Hydrology

Hydrological resources on the reservation consist of surface water flow from several rivers and their associated tributaries, and the production of groundwater from a variety of geological formations. A detailed explanation of the regional hydrology including that of the reservations' is included in an earlier section of this chapter under *Hydrology*.

According to the 1996 State of Montana 303d, list several watersheds and impaired waterbodies are adjacent to the Northern Cheyenne Reservation. The probable cause of the impairment is nutrients and the probable source is dam construction and hydro-modification. The Lower Tongue Watershed intersects with the Northern Cheyenne Reservation, which extends up to the Tongue River itself although the Reservation does not touch the impaired Tongue River segment. The Rosebud watershed includes most of the Northern Cheyenne Reservation and a part of the Crow Reservation; the Northern Cheyenne Reservation contacts the impaired portion of the Rosebud Creek.

The groundwater resources for the Reservation are similar to those described for the Powder River Basin in the previous hydrology section of this chapter.

Land Use and Realty

The Northern Cheyenne Reservation comprises approximately 2 percent of the land in the planning area. The Northern Cheyenne lands are used for cattle production, mining, logging and lumber production, residential, and recreation (Madison 2001). About 27,000 acres of reservation lands are presently under cultivation; the vast majority of this is dry-land farming, an additional 105,000 acres is composed of forested land that is considered commercially harvestable (U.S. Dept. of Commerce 1996).

The principal communities located on the Northern Cheyenne Reservation are as follows:

- Lame Deer—Lame Deer is located in Rosebud County approximately 21 miles West of Ashland between Busby and Custer National Forest along Highway 212/39. Lame Deer is the tribal headquarters and home of the Northern Cheyenne Powwow. There are approximately 1,925 Indian people residing in Lame Deer.
- Ashland—Ashland is located in Rosebud County 70 miles South of Miles City between Birney and Brandenburg along Highway 212 on the banks of the Tongue River near the Custer National Forest. Approximately 500 Indian people live in Ashland.

Recreation

The Northern Cheyenne Indian Reservation provides dispersed outdoor recreation including hunting, fishing, hiking, horseback riding, and plant and berry gathering. Hunting by non-members is not permitted. Lame Deer has the tribal gymnasium, two baseball diamonds, and a hand game building. Developed recreation sites include Crazy Head Springs and Lost Leg Lake (fishing, camping, picnicking); Green Leaf, Red Nose, Parker, and LaFerre ponds (fishing); and Morning Star Lookout. Undeveloped sites include Buffalo Jump and Badger Peak.

Camping facilities exist at the Northern Cheyenne Craft Center in Lame Deer and at the Morning Star View Campgrounds. Tribal elk and buffalo herds are pastured near Lame Deer Ice Well Campgrounds. A museum/curio shop is under development; this will serve, in part, as an outlet for the work of numerous tribal artists and craftspeople. The tribe holds a 4th of July powwow each year, which is widely attended. Finally, many visitors on their way to Glacier and Yellowstone parks, the Little Big Horn Battlefield, and other regional attractions find it convenient to stop by the reservation.

Soils

Soils in the reservation, just like soils in the rest of the RMP area, are derived mainly from sedimentary bedrock and alluvium. The soils generally range from loams to clays, but are principally loams to silty clay loams. For more information on soil types, see the Soils Appendix.

Vegetation

The same types of vegetative communities as described in this chapter are anticipated to be found on the reservation. It is understood that the Northern Cheyenne Tribe considers certain plants to be sacred for their medicinal or traditional values.

Wildlife

The reservation environment supports a variety of wildlife including large game animals, small mammals migratory birds, raptors, waterfowl, amphibians, and reptiles. The aquatic resources are just as diverse including some 32 different fish species. See Chapter 3 discussion for details regarding species and habitat.

Paleontological Resources

Paleontologic resources consist of fossil-bearing rock formations containing information that can be interpreted to provide a further understanding about Montana's past. Fossil-bearing rock units underlie the entire planning area. While fossils are relatively rare in most rock layers, there are seven geologic rock units within the planning area that do contain significant fossil material. Rock units that are known to contain fossils are the Tullock and Ludlow Members of the Fort Union Formation, the Judith River, Hell Creek, Morrison, and Cloverly Formations, the Lakota Sandstone Formation, and the White River Group. Figure 3-1 is a stratigraphic section showing the age and relative position of each of these fossil-bearing units.

The Morrison, Hell Creek, Cloverly, and Lakota Sandstone formations are noted for the occurrence of dinosaur fossils. The Bridger Fossil ACEC, a 575-acre site located in Carbon county within the Billings RMP area, contains outcrops of both the Cretaceous Period Cloverly Formation and the Jurassic Period Morrison Formation. Outcrops of the Morrison Formation within the Bridger Fossil area have yielded the fossil remains of numerous juvenile and subadult sauropods. The Bridger Fossil Area is one of two listed National Natural Landmarks within the Billings RMP area, the other is the Cloverly Formation site in Bighorn County (Federal Register 48(41):8693, 1983). There are other areas within the EIS study areas that have been nominated for National Natural Landmarks for paleontological resources.

The Judith River Formation preserves the fossil record from ancient environments including shallow oceans, deltas, rivers, freshwater swamps, and lakes. The Judith River Formation contains the fossil remains of plants as well as many animal species including mollusks, fish, amphibians, lizards, small mammals, dinosaurs, and other reptiles.

The Cretaceous Period Hell Creek Formation preserves the fossil record of a subtropical to tropical environment that was characterized by low plains interrupted by broad swampy bottoms and deltaic areas. Fossil remains from the Hell Creek Formation include a wide variety of plants, mollusks, fish, amphibians, reptiles, birds, small mammals, and dinosaurs. Fossil dinosaur remains include *Triceratops, Anatosaurus,* and *Tyrannosaurus.* The fossil record of plant and animal communities found within the Hell Creek Formation varies between low moist areas and the drier, upland plains environments that were present in the past. The Castle Butte ACEC, located in Yellowstone County within the Billings RMP area, contains outcrops of the Hell Creek Formation, which are noted for their paleontologic resources.

The contact between the Cretaceous Period Hell Creek Formation and the Paleocene Tullock/ Ludlow Member of the Fort Union Formation marks an important event in time. This contact represents a time of worldwide extinction for many animals, most notably the dinosaurs, and the beginning of the rapid evolution of mammals. The fossil record from the Fort Union Formation contains evidence of ancient environments that include streamside swamps, bottomlands, and well-established river courses. Fill within ancient river channels contains fossils of fresh water clams and snails. The Tullock/Ludlow Member is the primary fossil bearing unit of the Fort Union Formation and contains fossils of turtles, fish, reptiles, and mammals.

The Tertiary Period White River Group is considered an important source of fossil mammals. Although the White River Group outcrops in the planning areas, the majority of the fossil bearing areas are in the Dakotas.

Recreation

Montana's natural features, coupled with the large amount of state and federal lands, offer residents and vacationers a variety of year-round recreational opportunities. Montana has thousands of miles of streams, hundreds of lakes, reservoirs, mountainous areas, rolling hills, and grassland prairies—many of which are available for recreational purposes.

The planning area, which includes the Billings and Powder River RMP areas and the counties of Blaine, Gallatin, and Park, are replete with recreational opportunities that vary with seasonal changes. Spring and summer provide opportunities for fishing, hiking, photography, wildlife viewing, spring turkey hunting, water sports (powered and non-powered), off-road vehicle activities, camping, picnicking, touring (vehicle and bicycle), and caving. Early to late fall is hunting season. Winter brings the winter sports of skiing, snowshoeing, and snowmobiling. The planning area provides vast areas for people to enjoy.

Federal

There are three national forests in the planning area: Custer, Gallatin, and Lewis and Clark. These forests provide a variety of year-long, outdoor recreation. The Absaroka Beartooth Wilderness and the Lee Metcalf Wilderness (Spanish Peak Unit) in the Gallatin National Forest provide unique wilderness opportunities for hiking, horseback riding, camping, fishing, hunting, wildlife viewing, and photography. The Bridger Mountains National Recreational Trail (also in the Gallatin Forest), the Lewis and Clark Historic Trail, and the Nez Perce National Historic Trail provide opportunities for hiking, photography, wildlife viewing, and historic touring.

The Upper Missouri National Wild and Scenic River (North Side–Blaine County) provides fishing, hiking, non-powered water sports, camping, picnicking, wildlife viewing, and photography opportunities.

The Bighorn Canyon National Recreation Area is a popular area for camping, fishing, boating, hiking, wildlife viewing, and photography. West of and adjacent to the Bighorn Canyon National Recreation Area is the Pryor Mountain Wild Horse Range where off-road vehicles are not allowed, and skiing, caving, hiking, and wildlife viewing occur.

The BLM has land holdings throughout the state. The majority of this land is not contiguous; it is fragmented and many times isolated by private holdings. Most of this land is managed for multiple use. Recreational opportunities include hiking, horseback riding, off-road vehicle travel, fishing, hunting, wildlife viewing, camping, picnicking, caving, skiing, and showshoeing. The off-road vehicle plan is currently under protest. If approved, off-road vehicle use would be limited. Included in this land is the Pryor Mountain Wild Horse Range and the Pompey's Pillar National Monument.

There are nine National Wildlife Refuges in the planning area—two in Blaine County, one in Golden Valley County, four in Musselshell County, and two in Stillwater County. They provide opportunities for wildlife viewing, hiking, and photography.

According to 33 CFR Part 329, navigable waters of the United States are those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. A determination of navigability, once made, applies laterally over the entire surface of the waterbody, and is not extinguished by later actions or events which impede or destroy navigable capacity. A determination whether a waterbody in the project area is a navigable water of the United States is made by the U.S. Army Corps of Engineers Omaha District's Division Engineer, and is based on a report of findings prepared at the district level in accordance with the criteria set out in regulations. Tabulated lists of final determinations of navigability are maintained in the District office, and are updated as necessitated by court decisions, jurisdictional inquiries, or other changed conditions.

State

There are 12 state parks within the emphasis area that offer outdoor activities, Native American history and geological sites, wildlife preserves, water sports, photography, hiking, camping, and fishing. These parks are Chief Plenty Coups, Cooney Reservoir, Greycliff Prairie Dog Town, Lake Elmo, Madison Buffalo Jump, Medicine Rocks, Missouri Headwaters, Natural Bridge, Pictograph Cave, Rosebud Battlefield, and Tongue River Reservoir.

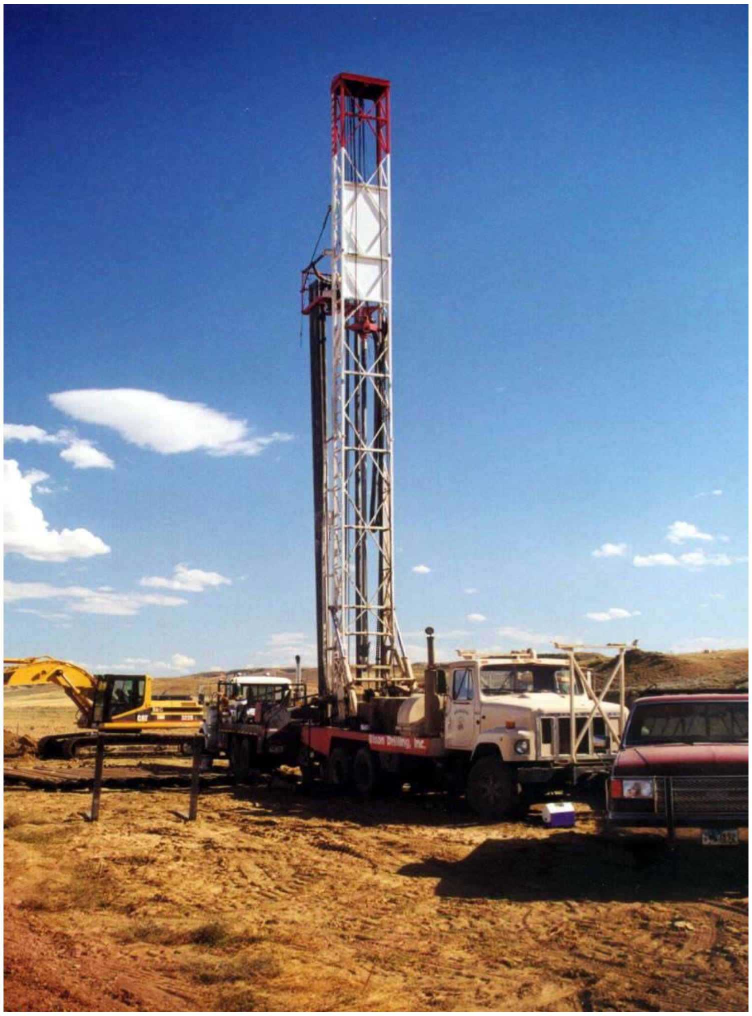
In addition, state-owned lands checkerboard the planning areas. Much of this land is surrounded by private or federal land. Recreational opportunities include hunting, fishing, wildlife viewing, hiking, snowmobiling, and skiing. Navigable waterways and islands owned by the state also provide additional recreational opportunities.

Local/City Recreation

The larger municipalities of Billings, Bozeman, Laurel, Miles City, Livingston, and Three Forks offer museums, parks, baseball fields, rodeo grounds/fairgrounds, walking/hiking/bike trails, water sports, and other opportunities. The other municipalities in the planning area offer a city park, outdoor sports activities at the schools, and, depending on the municipality, possibly a museum or rodeo grounds.

Private Lands

In addition to public lands, recreational opportunities also exist on privately owned lands, including private campgrounds, resorts, and dude ranches. Activities such as hunting and back-country trips also may be permitted on privately owned land with landowner consent. Recreational opportunities also arise on private lands as a result of MFWP actions, such as hunting opportunities through the block management program and conservation easements.



Typical rig used to drill a CBM well.

Socio-Economics

Demographics

Population data for Montana and the 16-county CBM emphasis area is presented in Table 3-15. Between 1990 and 2000, the population in Montana increased at an average annual rate of 1.2 percent to 902,195 persons. The 16-county planning area grew at a slightly greater rate of 1.5 percent over the same period. Three counties—Gallatin, Stillwater, and Carbon—grew faster than the average for the planning area, with average annual rates of 3.0 percent, 2.3 percent and 1.7 percent, respectively. Four counties—Carter, Powder River, Rosebud, and Treasure—had negative growth rates and lost population.

The forecasted population for the year 2020 is also shown in Table 3-15. For both the state and the CBM emphasis area, the forecasts show faster growth over the next 20 years compared to the last

TABLE 3-15
HISTORICAL POPULATION AND POPULATION FORECASTS

	1990 (Census)	2000 (Census)	Percent Annual Average Growth 1990-2000	2020 (Forecast)	Percent Average Annual Growth 2000-2020
Big Horn County	11,337	12,671	1.1%	14,880	1.6%
Blaine County	6,728	7,009	0.4%	7,310	0.4%
Carbon County	8,080	9,552	1.7%	11,390	1.8%
Carter County	1,503	1,360	-1.0%	1,470	0.8%
Custer County	11,697	11,696	0.0%	13,060	1.1%
Gallatin County	50,463	67,831	3.0%	82,460	2.0%
Golden Valley County	912	1,042	1.3%	1,180	1.3%
Musselshell County	4,106	4,497	0.9%	5,390	1.8%
Park County	14,484	15,694	0.8%	20,170	2.5%
Powder River County	2,090	1,858	-1.2%	1,770	-0.5%
Rosebud County	10,505	9,383	-1.1%	13,720	3.9%
Stillwater County	6,536	8,195	2.3%	10,590	2.6%
Sweetgrass County	3,154	3,609	1.4%	3,870	0.7%
Treasure County	874	861	-0.1%	800	-0.7%
Wheatland County	2,246	2,259	0.1%	2,330	0.3%
Yellowstone County	113,419	129,352	1.3%	158,310	2.0%
Total Emphasis Area	**248,134**	**286,869**	**1.5%**	**348,700**	**2.0%**
State of Montana	**799,065**	**902,195**	**1.2%**	**1,082,260**	**1.8%**

Source: Montana Department of Commerce, Census and Economic Information Center. Projections by NPA Data Services, Inc.

10 years. State population is forecast to grow by 1.8 percent and the planning area is forecast to grow by 2.0 percent. Four counties—Gallatin, Park, Rosebud, and Stillwater—are projected to grow at equal or greater rates than the average for the emphasis area, with rates of 2.0 percent, 2.5 percent, 3.9 percent and 2.6 percent, respectively. Population in Treasure County is forecast to fall, with a rate of –0.7 percent. However, personal communication with the Montana Department of Labor and Industry indicates that the projected population of 13,720 for Rosebud County in the year 2020 is an overestimate and that a more likely future population is 12,200 or 12,500 (Montana Department of Labor and Industry 2001b). These numbers correspond to annual growth rates of 1.3 percent and 1.4 percent, respectively, which are more consistent with the average for the emphasis area and the state.

Data on race and ethnicity from the 2000 U.S. Census are shown in Table 3-16. The data indicate that the Montana population is 90.6 percent white, similar to the 16-county planning area, which is 90.1 percent white. Statewide and in the planning area, Native Americans make up the largest non-white group, totaling 6.2 percent and 6.6 percent, respectively. Persons identified as Hispanic or Latino (of any race) comprise 2.0 percent of the State population and 2.6 percent of the 16-county area population.

TABLE 3-16
RACE/ETHNICITY AS PERCENT OF TOTAL POPULATION

Geographic Area	Total Population	Percent White	Percent Black or African American	Percent American Indian and Alaska Native	Percent Asian	Percent Native Hawaiian and Other Pacific Islander	Percent Some Other Race	Two or More Races	Percent Hispanic or Latino (of any race)[1]
Big Horn County	12,671	36.6%	0.0%	59.7%	0.2%	0.0%	0.7%	2.8%	3.7%
Blaine County	7,009	52.6%	0.2%	45.4%	0.1%	0.0%	0.2%	1.5%	1.0%
Carbon County	9,552	97.1%	0.3%	0.7%	0.4%	0.0%	0.6%	1.0%	1.8%
Carter County	1,360	98.6%	0.1%	0.4%	0.1%	0.0%	0.3%	0.5%	0.6%
Custer County	11,696	97.0%	0.1%	1.3%	0.3%	0.1%	0.3%	1.0%	1.5%
Gallatin County	67,831	96.2%	0.2%	0.9%	0.9%	0.1%	0.5%	1.2%	1.5%
Golden Valley County	1,042	99.1%	0.0%	0.6%	0.1%	0.0%	0.0%	0.2%	1.2%
Musselshell County	4,497	96.9%	0.1%	1.3%	0.2%	0.0%	0.4%	1.2%	1.6%
Park County	15,694	96.6%	0.4%	0.9%	0.4%	0.0%	0.5%	1.2%	1.8%
Powder River County	1,858	97.4%	0.0%	1.8%	0.1%	0.0%	0.2%	0.5%	0.6%

TABLE 3-16
RACE/ETHNICITY AS PERCENT OF TOTAL POPULATION

Geographic Area	Total Population	Percent White	Percent Black or African American	Percent American Indian and Alaska Native	Percent Asian	Percent Native Hawaiian and Other Pacific Islander	Percent Some Other Race	Two or More Races	Percent Hispanic or Latino (of any race)[1]
Rosebud County	9,383	64.4%	0.2%	32.4%	0.3%	0.0%	0.7%	2.0%	2.3%
Stillwater County	8,195	96.8%	0.1%	0.7%	0.2%	0.0%	0.9%	1.2%	2.0%
Sweet Grass County	3,609	97.0%	0.1%	0.6%	0.3%	0.0%	0.7%	1.3%	1.5%
Treasure County	861	96.4%	0.1%	1.6%	0.3%	0.0%	0.9%	0.6%	1.5%
Wheatland County	2,259	97.0%	0.1%	0.6%	0.2%	0.2%	0.3%	1.6%	1.1%
Yellowstone County	129,352	92.8%	0.4%	3.1%	0.5%	0.0%	1.3%	1.9%	3.7%
Planning Area Total	286,869	90.1%	0.3%	6.6%	0.5%	0.0%	0.9%	1.6%	2.6%
MONTANA	902,195	90.6%	0.3%	6.2%	0.5%	0.1%	0.6%	1.7%	2.0%

Source: U.S. Census Bureau, Census 2000 Redistricting Data (Public Law 94-171) Summary File, Matrices PL1 and PL2.
[1]Percent numbers in this column are a subset of one or more of the other race/ethnicity designation percentages.

While 13 of the 16 counties are between 92.8 percent and 99.1 percent white, three of the counties—Big Horn, Blaine, and Rosebud—include Indian Reservations with substantial Native American populations. Big Horn County, which includes most of the Crow Reservation and part of the Northern Cheyenne Reservation, has a population that is 59.7 percent Native American. Rosebud County also includes part of the Northern Cheyenne Reservation and is 32.4 percent Native American. Blaine County includes most of the Fort Belknap Reservation and is 45.4 percent Native American.

Table 3-17 shows the percentage of people below the poverty level (as defined by the U.S. Census Bureau) for Montana and each of the 16 study-area counties (1997 data). The Census Bureau uses a set of money income thresholds that vary by family size and composition to determine who is poor. Compared to the state as a whole, the 16-county planning area has a somewhat greater percentage of people below the poverty level; some counties within the planning area have poverty rates that are much higher than average for the state.

TABLE 3-17
POVERTY STATUS BY COUNTY (AS DEFINED BY U.S. CENSUS BUREAU)
(1997)

	Number of Persons Below Poverty Level	Percent of Population Below Poverty
Big Horn County	3,768	29.6%
Blaine County	1,904	26.8%
Carbon County	1,230	12.9%
Carter County	294	19.3%
Custer County	2,022	17.0%
Gallatin County	7,059	11.6%
Golden Valley County	216	21.2%
Musselshell County	893	19.4%
Park County	2,196	13.8%
Powder River County	277	15.3%
Rosebud County	1,999	19.9%
Stillwater County	860	10.6%
Sweetgrass County	418	12.3%
Treasure County	141	15.8%
Wheatland County	453	19.8%
Yellowstone County	15,363	12.1%
Planning Area Total	**39,093**	**17.3%**
Montana	**135,691**	**15.5%**

Source: U.S. Census Bureau Small Area Income and Poverty Estimates Program 2001.

In 1997, the percentage of the population of Montana below the U.S. Census Bureau poverty threshold was 15.5 percent; the average in the 16-county emphasis area was 17.3 percent. Nine of the 16 counties in the planning area have poverty rates greater than the state average. The two counties with the highest rate are Big Horn and Blaine, where more than one quarter of the population had an income below the poverty level in 1997. The total number of persons in the planning area below the poverty level was about 39,093. This represents about 28.8 percent of the state's total population below the poverty level.

Table 3-17A shows the percent of tribal members who are employed but below U.S. Health and Human Services poverty guidelines (similar to U.S. Census guidelines). These data indicate that the percent of tribal members who are employed but below the poverty guideline is greater than the total percent of persons below poverty for the respective counties where the tribes are located. It can be inferred that the total poverty rate for all tribal members (employed and unemployed) would be even greater than just for those who are employed, suggesting relatively large numbers of persons on the reservations living in poverty.

TABLE 3-17A
TRIBAL POVERTY RATES AMONG THOSE EMPLOYED (1999)

Tribe	County	Total Tribal Enrollment	Percent Employed but Below Poverty Guideline
Crow Tribe of Montana	Big Horn County, Yellowstone County	10,083	38%
Northern Cheyenne Tribe	Big Horn County, Rosebud County	7,473	26%
Fort Belknap Indian Community	Blaine County	5,223	40%
Montana (all tribes)		61,203	33%

Source: BIA 1999.

Social Organization

Housing Units and Vacancy

Housing units and vacancy rates for Montana and the 16-county planning area are shown in Table 3-18. The latest available county-specific data on housing units is from the 1990 Census.

In 1990, Montana had 361,155 housing units; 109,719 or 30 percent of these were in the 16-county planning area. A U.S. Census estimate indicates there were about 328,881 housing units in Montana in 1998, which is an increase of 6 percent since 1990.

Homeowner vacancy rates indicate the percent of total owner-occupied housing that is vacant. In Montana, the homeowner vacancy rate for 1990 was 2.9 percent, compared to 3.4 percent for the planning area. Six counties had home ownership vacancy rates higher than the planning area average, suggesting a surplus of vacant houses on the market. This is possibly because of a poor economic climate.

The rental vacancy rate in 1990 was 9.6 percent for the state and 13.3 percent for the planning area. Generally, rental vacancy rates between 5 percent and 10 percent are considered adequate. Rental vacancy rates below 5 percent can indicate potential rental shortages and above 10 percent can indicate potential surplus. The relatively high rental vacancy rate in the planning area (13.3 percent) indicates a potential surplus, which is possibly because of a poor economic climate.

Temporary Housing

Temporary housing units are typically defined to include hotels and motels, and recreational vehicle or camping sites. An inventory of temporary housing units is typically included in an environmental impacts analysis to use in determining potential impacts on the local housing supply from an influx of temporary population (such as construction workers or other employees). This data is typically gathered for a city, county, or small region. Because of the broad scope of this study, however, an inventory of accommodations by specific location was not attempted. A large number of hotels/motels and recreational vehicle and camping areas are available throughout the State and the 16-county planning area. These sites tend to be concentrated in and around the large cities, such as Billings or Bozeman, as well as major tourist or recreation areas, such as Yellowstone National Park.

TABLE 3-18
HOUSING UNITS

	1990 Housing Units	1990 Homeowner Vacancy Rate (%)	1990 Rental Vacancy Rate (%)
Big Horn County	4,304	3.7	10.4
Blaine County	2,930	2.5	8.9
Carbon County	4,828	4.1	13.7
Carter County	816	3.6	20.8
Custer County	5,405	4.0	14.3
Gallatin County	21,350	1.5	4.5
Golden Valley County	432	3.3	14.8
Musselshell County	2,183	5.7	20.0
Park County	6,926	2.5	9.8
Powder River County	1,096	2.2	20.4
Rosebud County	4,251	2.7	13.3
Stillwater County	3,201	2.6	9.5
Sweetgrass County	1,639	2.7	12.9
Treasure County	448	8.0	12.4
Wheatland County	1,129	2.1	17.3
Yellowstone County	48,781	2.9	10.2
Planning Area Total	**109,719**	**3.4%**	**13.3%**
Montana	**361,155**	**2.9%**	**9.6%**

Source: US Census Bureau (1990)

Public Services and Utilities

Public services, typically provided by local governments (cities, counties and special service districts), include police and fire protection, emergency medical services, schools, public housing, parks and recreation facilities, water supply, sewage and solid waste disposal, libraries, and roads and other transportation infrastructure. Other important community services include electric and communications utilities. The provision of public services and the ability of service providers to adapt to change over time, or resulting from specific development activities, depend on a number of factors, including financial ability and community leadership.

Attitudes, Beliefs, Lifestyles, and Values

Information on general attitudes, beliefs, lifestyles, and values in Montana and the general planning area as they relate to CBM development has been gathered from public comment letters received during the scoping process for this project and also from past summaries in several related documents. While the generalized characterizations are not likely to apply to all individuals, the intention is to provide an idea of the range of the attitudes and lifestyles of the population subgroups present in the study area. See the Socioeconomics Appendix for detailed information.

The study area population is largely rural, with strong ties to the land and to the many small towns. Residents generally value the rural character of their lifestyle. Specific aspects of this lifestyle might include appreciation of wide-open spaces, natural landscape, fresh air and solitude. The lifestyle of rural communities often offers the desirable qualities of neighbors knowing each other, lack of urban problems, relaxed pace, personal freedom, and being a good place to raise children. Longtime residents often want to see continued control of the land at the local level without interference from outside agencies or groups.

A portion of the population in the study area are Native Americans, who generally desire to preserve many elements of their heritage, express strong connections with the natural environment, and often do not wish to become homogenized into the non-Indian culture. At the same time, some tribal members or subgroups are pursuing the development of energy resources for the long-term social and economic betterment of tribal members.

The vast majority of public comments received during the scoping process in early 2001 relayed concerns about potential impacts on water quality and quantity. Those who commented were most concerned with the discharge of water of poor quality (e.g., saline) and the drawdown of groundwater aquifers.

The comments reflect a difference in attitudes toward CBM development among those individuals and organizations that might profit directly from CBM and those that would not. The comments reflect a tension between the desire for new development to support the often stagnant rural economies and the concern that such development could harm the environment and the lifestyle qualities for which Montana is known, including natural beauty, wide-open spaces, and solitude. Concerns were also expressed about potential adverse affects on the lifestyles of Native Americans, particularly those on the reservations. The comments reflect the traditional high value placed on natural resources by these groups, the importance of existing water and other natural resources in tribal economies and cultures, and the opinion that tribal members will be unduly burdened with the costs of development while not receiving many or any benefits.

Economics

Employment

Table 3-19 displays state employment by sector for the years 1990 and 1998. In 1998, an estimated 543,333 people were employed in Montana, with 184,525 in the 16-county planning area. In 1998, employment in the planning area represented about 34 percent of the jobs in the state. Between 1990 and 1998, total employment in the state grew by 106,759, an increase of 24.5 percent. Employment in the 16 study-area counties grew by a total of 39,008, or 26.8 percent, during the same period.

Montana’s largest employment sectors in 1998 were services, retail trade, and government; the smallest sector was mining. By far the fastest-growing sector between 1990 and 1998 was construction, which increased by 74.3 percent during the period. Other fast-growing sectors were agriculture, forestry and fishing services, and retail trade.

Some sectors of state employment decreased between 1990 and 1998. Mining jobs decreased by 14 percent in the state, from 7,824 to 6,730. Overall, government jobs increased by only 3.4 percent; within that sector, military jobs decreased by 19.4 percent and federal civilian jobs decreased by 8.2 percent.

Tables 3-20 and 3-21 present state and planning area employment by sector. Table 3-20 shows that the economic base of the planning area by sector is very similar to the state as a whole. However, as indicated in Table 3-21, there is substantial variation among the sizes and strengths of the various economic sectors in the 16 study-area counties.

TABLE 3-19
MONTANA EMPLOYMENT TRENDS BY SECTOR

	1990	1998	Change, 1990-1998	Percentage Point Change, 1990-1998
Farm Employment	30,576	32,071	1,495	4.9%
Non-Farm Employment				
Agriculture, Forestry, Fishing, and other	6,154	8,739	2,585	42.0%
Mining	7,824	6,730	-1,094	-14.0%
Construction	19,070	33,245	14,175	74.3%
Manufacturing	26,342	29,504	3,162	12.0%
Transportation and Public Utilities	23,858	26,759	2,901	12.2%
Wholesale Trade	17,449	20,693	3,244	18.6%
Retail Trade	78,715	106,202	27,487	34.9%
Finance, Insurance, and Real Estate	27,693	34,673	6,980	25.2%
Services	118,623	161,740	43,117	36.3%
Government				
Federal, civilian	13,771	12,647	-1,124	-8.2%
Military	10,516	8,474	-2,042	-19.4%
State	21,561	22,972	1,411	6.5%
Local	34,422	38,884	4,462	13.0%
Montana Total	**436,574**	**543,333**	**106,759**	**24.5%**

Source: U.S. Department of Commerce, BEA, 2001.

TABLE 3-20
STATE EMPLOYMENT VERSUS PLANNING AREA EMPLOYMENT BY SECTOR (1998)

	Planning Area Employment by Sector	% of Planning Area Total by Sector	State Employment by Sector	% of State Total by Sector
Farm Employment	9,459	5.2%	32,071	5.9%
Non-Farm Employment				
Agriculture, Forestry, Fishing, and other	2,347	1.3%	8,739	1.6%
Mining	2,193	1.2%	6,730	1.2%
Construction	11,590	6.3%	33,245	6.1%
Manufacturing	8,583	4.7%	29,504	5.4%
Transportation and Public Utilities	8,450	4.6%	26,759	4.9%
Wholesale Trade	9,287	5.1%	20,693	3.8%
Retail Trade	36,475	20.0%	106,202	19.5%
Finance, Insurance, and Real Estate	11,789	6.5%	34,673	6.4%
Services	54,915	30.1%	161,740	29.8%
Government				
Federal, civilian	3,730	2.0%	12,647	2.3%
Military	1,596	0.9%	8,474	1.6%
State	7,390	4.0%	22,972	4.2%
Local	12,137	6.6%	38,884	7.2%
Undisclosed or under 10 jobs	2,586	1.4%	N/A	N/A
Montana Total	182,527	100.0%	543,333	100.0%

Source: U.S. Department of Commerce, BEA, 2001.

TABLE 3-21
PLANNING AREA EMPLOYMENT BY COUNTY AND SECTOR (1998)

Industry	Big Horn	Blaine	Carbon	Carter	Custer	Gallatin	Golden Valley	Mussel -shell	Park	Powder River	Rosebud	Stillwater	Sweet Grass	Treasure	Wheatland	Yellowstone
Farm Employment	13.2%	21.8%	17.9%	44.4%	6.9%	2.5%	41.7%	15.8%	6.8%	33.8%	9.7%	14.3%	22.4%	40.6%	22.1%	1.6%
Non-Farm Employment																
Ag. Services, forestry, fishing, and other	3.0%	a	3.1%	a	1.5%	1.6%	a	a	1.7%	a	1.4%	2.5%	a	a	a	0.9%
Mining	8.7%	a	1.2%	a	b	0.4%	0.0%	3.6%	0.4%	1.7%	9.2%	a	b	0.0%	b	0.9%
Construction	3.3%	3.6%	6.8%	a	a	8.6%	a	6.5%	7.3%	a	1.5%	5.1%	9.0%	a	a	6.4%
Manufacturing	1.2%	1.2%	3.4%	1.9%	2.6%	6.4%	a	5.8%	6.3%	a	2.5%	8.9%	4.2%	0.0%	3.3%	4.3%
Transportation and public utilities	1.8%	2.2%	2.2%	3.6%	a	3.3%	b	4.3%	4.2%	5.0%	12.0%	a	a	5.7%	2.7%	6.1%
Wholesale trade	1.5%	3.6%	2.0%	0.0%	3.0%	4.0%	a	a	1.8%	1.0%	0.1%	1.6%	2.1%	a	a	7.6%
Retail trade	12.6%	14.6%	18.6%	8.0%	22.6%	21.0%	a	17.6%	21.4%	13.1%	12.3%	14.5%	20.5%	12.2%	20.5%	21.1%
Finance, insurance, and real estate	3.7%	4.7%	5.9%	2.2%	5.9%	6.3%	0.0%	4.4%	5.8%	1.7%	3.3%	3.8%	5.4%	a	3.9%	7.5%
Services	30.3%	20.0%	27.0%	a	29.5%	28.5%	a	23.9%	34.7%	15.4%	34.0%	17.8%	16.3%	11.7%	22.5%	32.8%
Government																
Federal, civilian	7.3%	6.4%	1.4%	2.0%	4.7%	1.1%	b	0.8%	0.9%	1.4%	3.2%	0.8%	1.5%	1.1%	3.6%	2.0%
Military	1.2%	1.3%	1.1%	1.0%	1.0%	0.8%	b	1.3%	1.0%	0.8%	1.0%	1.0%	0.9%	0.9%	1.1%	0.8%
State	0.8%	0.8%	0.5%	0.3%	4.1%	11.0%	b	0.8%	0.6%	1.7%	0.6%	0.5%	0.8%	1.4%	0.7%	1.9%
Local	11.4%	15.2%	8.9%	12.6%	7.7%	4.6%	16.3%	10.8%	7.0%	16.5%	9.3%	8.4%	12.2%	17.0%	12.7%	6.0%
Undisclosed or under 10 jobs	0	4.4%	0	24.0%	10.4%	0	41.9%	4.2%	0	7.8%	0	20.9%	4.6%	9.4%	6.8%	0
Total	100.0 %	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0 %	100.0%	100.0%	100.0%

Source: U.S. Department of Commerce, BEA, 2001.
a = Not shown to avoid disclosure of confidential information but the estimates for these items are included in the totals.
b = Less than 10 jobs but the estimates for these items are included in the totals.

Unemployment

Table 3-22 presents the unemployment rate for Montana and each of the planning area counties in 1995 and 2000. In 1995, the average unemployment rates in Montana and in the planning area were essentially the same; 5.9 percent for the state and 5.8 percent for the planning area. In 2000, the average State unemployment rate had dropped to 4.9 percent while the average rate in the planning area remained at 5.8 percent.

In 2000, unemployment rates in four of the planning area counties were higher than the 16-county average: Big Horn (14.4 percent); Blaine (6.7 percent); Musselshell (7.4 percent); and Rosebud (7.5 percent). Unemployment rates in each of the counties but Musselshell are explained in part by the high unemployment rates on the Indian Reservations contained wholly or partly within these counties. As indicated in Table 3-23, unemployment on the Crow, Northern Cheyenne, and Fort Belknap Indian reservations in 1999 ranged between 14.9 percent and 22.9 percent. Consistent with trends in the rest of the state, the unemployment rate on each reservation fell between 1996 and 1999.

TABLE 3-22
AVERAGE ANNUAL UNEMPLOYMENT RATES BY COUNTY

	1995 Rate (%)	2000 Rate (%)	Percentage Point Change, 1995-2000
Big Horn County	12.7	14.4	1.7
Blaine County	9.8	6.7	-3.1
Carbon County	6.0	5.1	-0.9
Carter County	1.8	2.1	0.3
Custer County	4.6	4.3	-0.3
Gallatin County	2.7	2.7	0.0
Golden Valley County	7.6	5.7	-1.9
Musselshell County	8.6	7.4	-1.2
Park County	4.7	5.3	0.6
Powder River County	2.4	3.0	0.6
Rosebud County	9.2	7.5	-1.7
Stillwater County	5.0	4.9	-0.1
Sweetgrass County	3.7	2.5	-1.2
Treasure County	3.5	5.0	1.5
Wheatland County	5.1	4.6	-0.5
Yellowstone County	4.8	3.8	-1.0
Planning Area Total	**5.8**	**5.8**	**0.0**
Montana	**5.9**	**4.9**	**-1.0**

Source: Montana Department of Labor & Industry, Research & Analysis Bureau, Local Area Unemployment Statistics (2001a).

TABLE 3-23
AVERAGE ANNUAL UNEMPLOYMENT RATES BY RESERVATION

	1996 Rate (%)	1999 Rate (%)	Change 1996-1999
Crow Reservation	15.5	14.9	0.6
Northern Cheyenne Reservation	26.0	18.7	7.3
Fort Belknap Reservation	27.2	22.9	4.3

Source: Montana Department of Labor & Industry, Research & Analysis Bureau, Local Area Unemployment Statistics (2001a)

Unemployment rates on the reservations as measured by the Bureau of Indian Affairs are reported in Table 3-23A. These rates are based on self-reported information from tribal leaders; 1999 is the latest year available. The rates calculated in this manner are substantially greater than those reported by the Montana Department of Labor and Industry (Table 3-23). They indicate unemployment at 61 percent for the Crow tribe, 71 percent for the Northern Cheyenne tribe, and 76 percent for the Fort Belknap tribe. For all tribal members in Montana, the unemployment rate was 61 percent.

TABLE 3-23A
TRIBAL WORKFORCE AND UNEMPLOYMENT (1999)

Tribe	County	Total Tribal Enrollment	Available for Work of Total Work Force	Unemployed as % of Labor Force	Percent Employed but Below Poverty Guideline
Crow Tribe of Montana	Big Horn County	10,083	3,902	61%	38%
Northern Cheyenne Tribe	Big Horn County, Rosebud County	7,473	2,437	71%	26%
Fort Belknap Indian Community	Blaine County	5,223	2,780	76%	40%
Montana (all tribes)		61,203	26,348	61%	33%

Source: BIA 1999

Per Capita Income

Per capita income for the State of Montana and the counties in the planning area is shown in Table 3-24. In 1998, the average U.S. per capita income was $27,203, and the State average was $21,229. The average per capita income in the planning area was $17,715, only 83.4 percent of the state average. In 1998, per capita income in Gallatin and Yellowstone counties was higher than the State average, and incomes in Carbon, Custer, and Stillwater Counties were more than 90 percent of the state average. On the other hand, per capita income in three counties was substantially lower: Big Horn County (62.4 percent); Carter County (61.9 percent), and Musselshell County (67.6 percent).

TABLE 3-24
PER CAPITA INCOME, 1996-1998

	Dollars per Year			% Average Annual Increase (1996-1998)	% of State Average (1998)
	1996	1997	1998		
Big Horn County	11,987	12,418	13,239	5.1%	62.4%
Blaine County	13,357	13,764	15,358	7.2%	72.3%
Carbon County	17,798	18,901	19,745	5.3%	93.0%
Carter County	11,793	12,480	13,139	5.6%	61.9%
Custer County	18,879	19,792	20,487	4.2%	96.5%
Gallatin County	21,019	21,889	22,820	4.2%	107.5%
Golden Valley County	14,471	15,115	16,095	5.5%	75.8%
Musselshell County	13,087	14,047	14,351	4.7%	67.6%
Park County	17,578	17,756	18,708	3.2%	88.1%
Powder River County	13,593	15,061	16,314	9.6%	76.8%
Rosebud County	16,395	17,423	18,066	5.0%	85.1%
Stillwater County	18,114	18,726	19,736	4.4%	93.0%
Sweet Grass County	16,871	18,591	19,032	6.2%	89.7%
Treasure County	15,208	14,744	15,707	1.6%	74.0%
Wheatland County	14,784	16,695	16,217	4.7%	76.4%
Yellowstone County	22,173	23,168	24,425	5.0%	115.1%
Planning Area	**16,069**	**16,911**	**17,715**	**5.0%**	**83.4%**
Montana	**19,383**	**20,130**	**21,229**	**4.7%**	**100.0%**
United States	**24,651**	**25,924**	**27,203**	**5.0%**	

Source: Bureau of Economic Analysis

Between 1996 and 1998, per capita income in the planning area increased by an average of 5 percent annually, slightly greater than in the State as a whole, in which per capita income increased by 4.7 percent. Per capita income increased in all of the planning area counties between 1996 and 1998.

Government Revenue Sources

Government revenues include taxes, royalties, fees, and several other income sources. Please see the Socioeconomics Appendix for more information.

Taxes

Public finance mechanisms include taxes, royalties, and other fees paid to local, state, and federal governments. Taxes in Montana consist of property taxes, income taxes, natural resource taxes (coal, oil, and natural gas), and selective sales taxes (cigarette and alcoholic beverages). There is no general sales tax in Montana. Table 3-25 shows total taxes collected in Montana. In 2000, more than $789 million was collected in property taxes, accounting for 51.2 percent of the total state tax revenues collected. Income taxes were the second largest portion at 37.3 percent, followed by natural resources (6.5 percent) and sales taxes (5 percent).

TABLE 3-25
TOTAL TAXES COLLECTED IN MONTANA (2000)

	2000 Tax Revenues Collected in Montana	Percent of Total
Property Taxes	$789,786,040	51.2%
Income Taxes	$575,094,186	37.3%
Natural Resource Taxes	$100,063,319	6.5%
Selected Sales Taxes	$77,860,652	5.0%
Montana Total	**$1,542,804,197**	**100.0%**

Source: Montana Department of Revenue (2000)

The taxes and royalties assessed on oil and gas development and production are an important source of revenue for local governments and the State of Montana. The oil and gas industry pays rents, royalties, and bonuses on federal leases; production taxes on working and non-working interests in the State of Montana; and local property taxes on drilling and production equipment. See the Socioeconomics Appendix for more information on taxes.

State Oil and Gas Lease Income

DNRC leases oil and gas, metalliferous and non-metalliferous, coal, sand, and gravel mineral rights agreements on 6.3 million acres of school trust lands, and more than 100,000 acres of other state-owned land throughout Montana. School trust lands are lands historically granted to the State of Montana to be used to support common schools and other educational and state institutions.

State mineral lease royalties are collected from production facilities located on state lands. Royalty payments are based on the volume of oil and gas produced and the price of the commodity. Rental and royalty revenues are either deposited into the appropriate permanent or distributable school trust or the state general fund. Table 3-26 presents the revenues received by the state in fiscal year (FY) 2000 from minerals management, including leases (rents) and mineral production royalties on state trust lands. Oil and gas revenues in FY 2000 were $6.6 million, or 57.2 percent of total state mineral management revenues. Oil and gas revenues comprised the largest share, with coal revenues the second largest, at 40.3 percent of the total.

TABLE 3-26
REVENUES RECEIVED FROM MINERALS MANAGEMENT ON STATE LANDS IN FY 2000

	FY 2000 Revenue (Dollars)
Oil and Gas	
Rentals/Bonuses/Penalties	2,966,285
Royalties	3,684,595
Seismic Exploration	11,075
Subtotal	6,661,955
Percent	57.2%

TABLE 3-26
REVENUES RECEIVED FROM MINERALS MANAGEMENT ON STATE LANDS IN FY 2000

	FY 2000 Revenue (Dollars)
Aggregate Minerals	
Rentals	250
Royalties	245,693
Subtotal	245,943
Percent	2.1%
Coal	
Rentals	44,371
Royalties	4,649,634
Subtotal	4,694,005
Percent	40.3%
Other Minerals	
Subtotal	41,124
Percent	0.4%
Rentals/Penalties	32,246
Royalties	8,878
TOTAL	11,643,027

Source: MDNRC 2000 (www.dnrc.state.mt.us/trust/mmb.htm)

The state mineral leasing program includes 2,433 oil and gas leases, 534 of which are currently productive. From FY 1999 and FY 2000, the number of oil and gas leases increased by 8.1 percent and the number of productive leases increased by 14.3 percent. In FY 2000, state lands yielded 923,777 barrels of oil, 5,050,552 million cubic feet of gas, and 375,113 gallons of condensate. Oil production declined 6.5 percent from FY 1999. However, the increase in average price from $10.50 per barrel in FY 1999 to $20.21 per barrel in FY 2000 accounted for the large increase in oil royalty revenue. Gas production in FY 2000 increased 19.6 percent, while price increased 36.0 percent compared to FY 1999, also resulting in a substantial increase in royalty revenue.

Federal Mineral Revenues

Oil and gas royalties are earned from production facilities on federal leases, units, or communication agreements. Federal mineral lease royalties are collected on oil and gas produced based on the volume of product. Table 3-27 presents federal mineral revenue disbursements by county of origin for the 16 planning area counties and the state as a whole. Coal, gas, and oil are the main mineral products. The totals reported do not include royalties and rents from leases on Native American tribal and allotted lands.

TABLE 3-27
ONSHORE FEDERAL MINERAL REVENUE DISBURSEMENTS IDENTIFIED BY COUNTY OF ORIGIN, FISCAL YEAR 2000, MONTANA[1]

	Product	Sales Volume ($)	Royalty Value ($)	Disbursed to State ($)
Big Horn	Bonus		185,076	92,538
	Coal	20,416,210	20,912,616	10,456,308
	Gas	44,411	4,028	2,014
	Other Revenues		16,562	8,281
	Rent		335,127	167,564
	Subtotal		21,453,409	10,726,705
Blaine	Bonus		251,411	125,705
	Gas	1,559,733	460,736	230,368
	Oil	35,238	69,797	34,898
	Other Revenues		64,995	32,497
	Rent		105,524	52,762
	Subtotal		952,462	476,231
Carbon	Gas	166,547	45,722	22,861
	Gas Plant Products	2,789,164	89,617	44,809
	Oil	386,161	1,042,440	521,220
	Other Revenues		2,616,601	1,308,301
	Rent		76,892	38,446
	Sulfur	1,023	524	262
	Subtotal		3,871,797	1,935,899
Carter	Bonus		47,366	23,683
	Oil	865	1,888	944
	Other Revenues		22,294	11,147
	Rent		90,429	45,214
	Subtotal		161,976	80,988
Custer	Bonus		51,904	25,952
	Gas	56,563	11,875	5,938
	Other Revenues		1,135	568
	Rent		44,205	22,103
	Subtotal		109,119	54,560

TABLE 3-27
ONSHORE FEDERAL MINERAL REVENUE DISBURSEMENTS IDENTIFIED BY COUNTY OF ORIGIN, FISCAL YEAR 2000, MONTANA[1]

	Product	Sales Volume ($)	Royalty Value ($)	Disbursed to State ($)
Gallatin	Rent		5,127	2,564
	Subtotal		5,127	2,564
Golden Valley			0	0
Musselshell	Bonus		594	297
	Oil	5,378	2,394	1,197
	Other Revenues		1,077	539
	Rent		19,030	9,515
	Subtotal		23,095	11,547
Park			0	0
Powder River	Bonus		39,028	19,514
	Gas	14,352	4,076	2,038
	Oil	74,079	172,508	86,254
	Other Revenues		6,796	3,398
	Rent		482,732	241,366
	Subtotal		705,139	352,569
Rosebud	Bonus		517,040	258,520
	Coal	1,612,516	1,852,468	926,234
	Oil	21,613	42,355	21,178
	Other Revenues		690,601	345,301
	Rent		220,533	110,266
	Subtotal		3,322,997	1,661,499
Stillwater	Bonus		6,766	3,383
	Oil	3,499	5,222	2,611
	Rent		26,077	13,039
	Subtotal		38,066	19,033
Sweet Grass	Bonus		8,928	4,464
	Rent		25,854	12,927
	Subtotal		34,782	17,391

TABLE 3-27
ONSHORE FEDERAL MINERAL REVENUE DISBURSEMENTS IDENTIFIED BY COUNTY OF ORIGIN, FISCAL YEAR 2000, MONTANA[1]

	Product	Sales Volume ($)	Royalty Value ($)	Disbursed to State ($)
Treasure	Coal	97,143	118,745	59,372
	Rent		2,760	1,380
	Subtotal		121,505	60,752
Wheatland	Other Revenues		480	240
	Subtotal		480	240
Yellowstone	Oil	1,648	2,494	1,247
	Other Revenues		516	258
	Rent		131	65
	Subtotal		3,140	1,570
Planning Area Total			30,768,312	15,384,156
% of State Total			71.8%	75.4%
Montana Total[2]			42,881,292	20,401,472

Source: U.S Department of Interior, Minerals Management Service 2001.
[1]Does not include revenues collected from American Indian lands or offshore operations.
[2]Adjusted for net receipts sharing (less $1,039,174 disbursed to state).

Mineral royalties from the 16 planning area counties totaled $30.7 million—approximately 71.8 percent of the $42.8 million collected in the state. Big Horn County accounted for a large share of the planning area revenues, with total royalties of $21.4 million, which were mostly from coal. Coal and oil revenues are far greater than gas revenues.

Formulas for disbursement of revenues from federal mineral leases are governed by legislation and regulations. Nationally, in fiscal year 2000, federal mineral lease revenues were disbursed as follows: 66.0 percent to the U.S. Treasury; 20.2 percent to special purpose funds, such as historic preservation, land and water conservation, and reclamation; 10.8 percent to states; and 3.0 percent to Native American tribes. This corresponds to $5.1 billion to the U.S. Treasury, $1.6 billion to special purpose funds, $843 million to states, and $235 million to tribes.

The percentage of royalties disbursed in Montana is much greater than the national average. Of the $42.8 million in royalties collected on federal lands in Montana counties in 2000, nearly half, or $20.4 million, was disbursed to the state.

Private Landowner Revenue

Some landowners in Montana own the mineral rights to their land and lease those rights for natural gas development and other uses. Landowners who do not own mineral rights may be subject to the development of natural gas or other energy or mineral resources on their land. Both of these categories of landowners receive income for use of their land, in the form of natural gas royalties or one-time compensation for land disturbance and use, respectively. This income is included in the total per capita incomes presented in Table 3-24.

Water Resource Values

Water plays an important role in the state and local economies of Montana. Water is a scarce resource in Montana—particularly in eastern Montana. Many of the state's surface water basins are over-appropriated and have been closed to future appropriations. In these locations, water users are turning more and more to groundwater to meet their water needs.

Most of the water in the planning area originates as groundwater. Livestock watering and domestic water wells are the primary uses of groundwater in the area. Surface water and ground water are also used for agricultural irrigation and surface water is used for recreation in some areas. Continued availability of adequate quantity and quality for these major uses is essential to maintaining the health of these sectors of the local and state economies.

The economic value of water resources for human uses varies greatly by location and by use and user. As an example, it has been estimated that the value of irrigation water to agricultural producers, based on the increase in production attributable to the use of the water for irrigation, is between $25 and $50 per acre-foot in eastern Montana (Schaefer 2001). Costs for domestic water would generally be more. The values are inherent components of the values of the various sectors of the economy, such as income from grazing and agriculture or costs of providing public water service. Changes in the supply or cost of water would contribute to changes in the costs and revenues for these activities.

Environmental Justice

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority and Low-Income Populations" (1994) requires the non-discriminatory treatment of minority populations and low-income populations for projects that occur on federal lands, require federal permits, use federal funds, or are otherwise under the jurisdiction of a federal agency. Disproportionately high or adverse health or environmental effects on such populations must be identified and addressed as appropriate.

Low-Income and Minority Populations

This section describes locations of concentrations of minority populations and low-income populations at the county level, in accordance with the scope of this study. Potential sub-county concentrations of minority populations and low-income populations are also possible but could only be identified on a project-specific basis. The occurrences of minority populations and low-income populations are discussed in detail in the *Demographics* section of this report, and are presented in Tables 3-16 and 3-17, respectively.

The Montana population is 92.2 percent white, similar to the 16-county study area, which is 91.5 percent white. While thirteen of the 16 study-area counties are between 94.5 percent and 99.1 percent white, three of the counties—Big Horn, Blaine, and Rosebud—include Indian Reservations with substantial Native American populations. Big Horn County, where the population is 59.7 percent Native American, includes most of the Crow Reservation and part of the Northern Cheyenne Reservation. Rosebud County also includes part of the Northern Cheyenne Reservation and is 32.4 percent Native American. Blaine County includes most of the Fort Belknap Reservation and is 45.4 percent Native American.

The percentage of the Montana population living in poverty is 15.5 percent; the average in the 16-county study area is 17.3 percent. The study area contains 39,093 persons below the poverty level, or about 28.8 percent of the State's total below the poverty level. Nine of the 16 study-area counties have poverty rates greater than the State average. The two counties with the highest rate are Big Horn and Blaine, where more than one quarter of the population had an income below the poverty level in 1997.

Soils

Montana, with its wide mix of geologic parent material, has a vast array of different soil types. Differences in climate, parent material, topography, and erosional conditions result in soils with diverse physical and chemical properties. The distribution and occurrence of soils can be highly variable and is dependent on a number of factors including slope, geology, vegetation, climate, and age. For more information on soil types, see the Soils Appendix.

The five major soil forming factors are as follows (Brady 1990):

1. Climate—particularly temperature and precipitation.
2. Living Organisms—especially native vegetation, microbes, soil animals, and human beings.
3. Nature of parent material.
4. Topography of the site.
5. Time that parent materials are subject to soil formation.

Soils in the RMP areas are derived mainly from sedimentary bedrock and alluvium. The soils generally range from loams to clays, but are principally loams to silty clay loams.

Soil salinity affects the suitability of a soil for crop production and the stability of the soil. The SAR is the measure of sodium relative to calcium and magnesium, and affects the soil structure and infiltration rate of water. The *Soils Technical Report* presents a more detailed discussion pertaining to the salinity and SAR of the soils in the Billings RMP and Powder River RMP areas. A summary of this report is presented in the Soils Appendix.

Solid and Hazardous Wastes

The hazardous materials program priorities are to protect the public health and safety; protect natural and environmental resources; comply with applicable federal and state laws and regulations; and minimize future hazardous substance risks, costs, and liabilities on public lands. BLM is responsible for all releases of hazardous materials on public lands and requires notification of all hazardous materials to be used or transported on public land.

Solid and hazardous wastes can be generated during oil and gas and CBM activity. These wastes are under the jurisdiction of the MDEQ for Resource Conservation and Recovery Act (RCRA) wastes; the MBOGC for RCRA-exempt wastes such as drilling wastes; and the EPA on tribal lands. At the present time, wastes generated from the wellhead through the production stream to and through the gas plant are exempt from regulation as a hazardous waste under RCRA's exploration and production exemption, but are covered by mineral leasing regulations. The exemption does not apply to natural gas as it leaves the gas plant for transportation to market. Releases must be reported in a timely manner to the National Response Center the same as any release covered under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Prior to a gas plant, releases are reported to the BLM via a Report of Undesirable Event (NTL-3A; 43 CFR 3162.5-1(c)). The BLM requires immediate reporting of all Class I events, which involve the release of more than 100 barrels of fluid/500 MCF of gas, or fatalities. The MDEQ's Solid and Hazardous Waste Bureau is responsible for administering both the Montana Solid Waste Management Act (75-10-201 *et. seq.*, Montana Code Annotated [MCA]) and the Montana Hazardous Waste Act (75-10-401 *et seq.* MCA).

It has been established by CERCLA that the owner of the land is ultimately responsible for hazardous materials or substances placed or released on their lands. Under CERCLA, the term "hazardous substance" is typically any toxic, corrosive, ignitable, explosive, or chemically reactive substance, but does not include petroleum, crude oil, natural gas, natural gas liquids, liquefied natural gas, or synthetic gas usable for fuel, or mixtures of natural gas and synthetic gas. The oil and gas industry transports hazardous materials on the highways, stores and uses the materials at the sites, and produces some hazardous wastes, such as paint waste from the painting of facilities, and unused acid or chemicals that were not used in well treatments. This presents a potential for spills, leaks, and illegal disposal. Reserve pits may be required to be lined, which reduces but does not eliminate leaks. Produced water is the predominant fluid, but some hazardous substances also are released. The content of the releases or spills will be varied and unpredictable.

The transportation of hazardous materials is regulated by Montana's Department of Transportation (MDT) under CFR Parts 171-180. These regulations pertain to packing, container handling, labeling, vehicle placarding, and other safety aspects. The transportation of all hazardous waste materials in Montana must comply with the Federal Motor Carrier Safety Regulations, part 390 through part 397.

The EPA requires manufacturers to report releases of more than 600 designated toxic chemicals into the environment. EPA compiles this data in an annual Toxics Release Inventory. Toxics Release Inventory facilities are required to report on releases of toxic chemicals into the air, water, and land. In addition, they report on off-site, pollution prevention activities and chemical recycling. The Toxics Release Inventory also provides information about potentially hazardous chemicals and their use; however, the law does not cover toxic chemicals that reach the environment from non-industrial sources, such as dry cleaners or auto service stations. In 1998, EPA added seven new industries to the Toxics Release Inventory: metal mining, coal mining, electrical utilities that combust coal or oil, RCRA Subtitle C hazardous waste treatment and disposal facilities, chemicals and allied products wholesale distributors, petroleum bulk plants and terminals, and solvent recovery services. There are currently 19 facilities in the RMP areas that report Toxics Release Inventory information to the EPA, with most of them being related to the energy and mining industries. The Solid and Hazardous Waste Appendix contains *the Toxics Release Inventory for Montana*.

Vegetation

The land classification system developed by the University of Montana for the Montana Gap Analysis (MT-GAP) is used for this discussion because it has a large amount of detailed information about vegetation and wildlife distribution. All classification descriptions are from the MT-GAP project, and acreage estimates and calculations are based on their data results (Fisher et al. 1998).

The planning area includes six general land classes or vegetative communities: Agriculture/Urban Areas, Grassland, Shrubland, Forests, Riparian Areas, and Barren Lands. The five general land classification descriptions and their subdivisions will be explained in more detail below. All of these habitats are important to a wide variety of wildlife species.

Plant Communities

Grasslands

Grasslands are among the most biologically productive of all vegetative communities because of soil nutrient retention and fast biological recycling. They are also very valuable because the vegetation is nutritious and used by livestock and by a large constituent of wildlife (Williams and Diebel 1996; Estes et al. 1982). Grassland sites are dominated by herbaceous canopy cover at greater than 15 percent, shrub cover at less than 15 percent, and forest cover at less than 10 percent (Fisher et al. 1998).

Grasslands cover an estimated 10.4 million acres of the 16 counties that make up the CBM emphasis area. This is almost twice as much land as any other vegetation type in the planning area. Those grasslands with underlying subbituminous or bituminous coal deposits cover 1.5 million acres of the Powder River RMP area and 1 million acres of the Billings RMP area. Together, the counties of Park, Blaine, and Gallatin have almost a million acres of grasslands underlain by coal within their boundaries. For grassland types, see the Biological Appendix.

Shrublands

Shrublands are characterized by shrub covers greater than 15 percent and forest cover less than 10 percent (Fisher et al. 1998). This vegetation type is dominant on approximately 5 million acres of the CBM emphasis area. Of this, 1.8 million acres are underlain by bituminous coal deposits. Important shrubs include several species of sagebrush (*Artemisia nova*, *A. tridentata*, *A. vaseyana*, and *A. wyomingensis*). Other important shrub species in this category are bitterbrush (*Purshia tridentata*), creeping juniper (*Juniperus horizontalis*), greasewood (*Sarcobatus* spp.), mountain mahogany (*Cercocarpus* spp.), rabbitbrush (*Chrysothamnus* spp.), and shadscale (*Atriplex canescens*). These shrublands are often associated with a complex of understory grasses such as bluebunch wheatgrass (*Agropyron spicatum*), blue grama (*Bouteloua gracilis*), Idaho fescue (*Festuca idahoensis*), needle and thread (*Stipa comata*), and western wheatgrass (*Agropyron smithii*).

Forests

Land is classified as forest if it has more than 10 percent tree cover. Montana has 19 categories of forests under this classification. Within the emphasis area, 4.5 million acres are classified as forest. Of that, almost 1.4 million acres are underlain by subbituminous or bituminous coal deposits. Two forest types account for the majority of the forested areas within the emphasis area: Ponderosa Pine Forests and Low-Density Xeric Forests. Ponderosa Pine sites are dominated by ponderosa pine (*Pinus ponderosa*) at 20 to 80 percent cover. They are associated with big sagebrush, ninebark, snowberry, bluebunch wheatgrass, blue grama, and Idaho fescue. Low-density xeric forests have tree cover at 5 to 20 percent with a grass understory. Dominant tree species are Douglas-fir, limber pine, ponderosa pine, Rocky Mountain juniper, or Utah juniper (Fisher et al. 1998).

Riparian Areas

These are sites that are associated with intermittent and perennial water sources or with woody draws. Riparian areas are classified as Conifer, Broadleaf, Mixed Broadleaf and Conifer, Graminoid and Forb, Shrub, and Mixed (Fisher et al. 1998). All riparian types have high species richness, which reaffirms why riparian sites are considered to be some of the most biologically diverse habitats anywhere.

Barren Lands

These are sites with less than 10 percent forest cover, less than 10 percent shrub cover, and less than 10 percent herbaceous cover (Fisher et al. 1998). The category name may imply that these areas have no biological value, but this would be misleading.

Noxious Weeds

Although the word "noxious" means harmful or deleterious, in this context it is a legal term for species of plants that have been designated "noxious" by law. Noxious weeds are non-native species with the potential to spread rapidly—usually through superior reproductive capacity, competitive advantage mechanisms, and lack of natural enemies.

Fourteen species have been defined as Category 1 noxious weeds for Montana; these weeds are currently known to be established within the state. Approximately 87,365 acres within the CBM emphasis area that are underlain by subbituminous or bituminous coal beds are considered to be altered by exotic or introduced plant species (defined by 30 percent or more of vegetative cover coming from non-native species). Not all of these are in the "noxious " weed category, but this switch from native plants is an indication of the potential scope of the issue.

- **Spotted Knapweed** (*Centaurea maculosa*): Since the 1920s, this perennial has spread from western Montana to every county in Montana. It covers an estimated five million acres of Montana land. This species readily establishes itself on disturbed sites and has the competitive advantage over many native species because it starts growth early in spring.

- **Diffuse Knapweed** (*Centaurea diffusa*): This aster invades roadsides, waste areas and dry rangelands. It is highly competitive and able to exclude many native species.

- **Hoary Cress (Whitetop)** (*Cardaria chalepensis*): This invader is well adapted to moist habitats such as sub-irrigated pasture, hay fields, rangelands, and roadsides. In unshaded areas that have been disturbed, it can form dense monocultures.

- **Dyer's Woad** (*Isatis tinctoria*): This species was first reported in Montana in the 1950s. It tends to invade dry, rocky soils in rugged terrain. A chemical in the seed pods can inhibit the germination of seeds from other plants. It has been confirmed to be in two counties within the planning area: Musselshell and Park.

- **Oxeye Daisy** (*Chrysanthemum leucanthemum*): This perennial invades by both prolific seed production and by branching rhizomes and adventitious roots. It prefers upland pastures and meadows, but also grows along waste areas in western and southern Montana.

- **Dalmatian Toadflax** (*Linaria dalmatica*): This species grows in a wide range of habitats, especially if soils are well-drained and coarse-textured. Wet conditions seem to limit the success of this species.

- **St. Johns's Wort** (*Hypericum perforatum*): This perennial covers about 500,000 acres in Montana. It is particularly adapted to sandy or gravelly soils. It reproduces by both seeds and short runners.

- **Leafy Spurge** (*Euphorbia esula*): Leafy spurge began to invade eastern Montana as early as 1925 and now is known to be in every county. It is most aggressive in dry areas where competition from native plants is less robust.

- **Purple Loosestrife** (*Lythrum salicaria*): This species' fast growth and enormous reproductive ability allow it to choke native vegetation out of wetlands.

- **Saltcedar** *(Tamarix ramosissima):* Saltceder is an aggressive woody invader. It prefers waterways and ponds and can transpire up to 200 gallons of water per day. It forms dense monocultures that provide little or no habitat for wildlife. It exudes salts onto the surrounding surface rendering the inter-spaces uninhabitable to other vegetation.

See the *Biological Appendix* for a complete list of noxious weeds for Montana.

Species of Concern

Many federally listed threatened, endangered, or candidate species of special concern exist in the planning area that are given special consideration under Section 7(c) of the Endangered Species Act of 1973 (ESA). As required by the ESA, the FWS has provided a list of endangered, threatened, and proposed species that may be present in the planning area (see Table 3-28). This section reviews its habitat requirements, as well as the likelihood of this species being found in the 16 counties that may be potentially affected.

TABLE 3-28
ENDANGERED, THREATENED, AND PROPOSED PLANT SPECIES PRESENT IN THE CBM EMPHASIS AREA

Common Name	Scientific Name	Habitat in Montana	Federal Status*
Ute ladies'-tresses orchid	*Spiranthes diluvialis*	River meander wetlands in Jefferson, Madison, Beaverhead, and Gallatin counties	T

*T=Threatened

Ute Ladies'-Tresses Orchid

This plant was listed as Threatened January 17, 1992 (57 Federal Register [FR] 2053). Ute ladies'-tresses orchid (*Spiranthes diluvialis*) is endemic to moist soils in mesic or wet meadows near springs, lakes, or perennial streams. It occurs primarily on sites subject to intermittent and unpredictable inundation, and the plants often emerge from shallow water (Sheviak 1984; FWS 1996).

The species occurs primarily in areas where the vegetation is relatively open and not overly dense, overgrown, or overgrazed (Coyner 1989, 1990; Jennings 1989, 1990). In Montana, it is found in meandered wetlands and swales in broad, open valleys, at margins with calcareous carbonate accumulation (Montana NRIS 2001). It is known to occur only in southwestern Montana in Beaverhead, Gallatin, Jefferson, and Madison counties.

State Species of Concern

In addition to species that are federally protected under the ESA, the State of Montana has designated additional species of concern within its jurisdictional boundaries. There are five rankings for State Species of Special Concern. This document focuses only on the highest ranking (S1). This ranking is defined as critically imperiled because of extreme rarity (five or fewer occurrences, or very few remaining individuals), or because some factor of its biology make it especially vulnerable to extinction.

State-listed species (with BLM and Forest Service rankings) that have potential distributions within the 16-county emphasis area of this EIS or that have undefined distributions in the state are listed in the *Biological Appendix* (see *Plant Species of Concern in the 16 County Planning Area*). Species that are federally listed under the ESA have been omitted from these tables because they have already been considered. The *Biological Appendix* also includes the type of habitat where they are likely to be found. (Montana NRIS 2001). Table VEG-6 links wildlife species to habitat requirements.

Plant species are listed by county where each state species of concern is known to occur (*Biological Appendix*). Sensitive species for the BLM and USFS are also listed in this appendix. Historic maps for most species of concern show much wider distributions than present distributions.

Visual Resource Management

Visual resources are visual features in the Montana landscape that include landform, water, vegetation, color, adjacent scenery, uniqueness or rarity, structures, and other man-made features. The 16 counties in the emphasis area portray a variety of landscapes and habitats, all with different visual qualities. Current visual resource management is in accordance with the two RMPs. The four classes are as follows:

- Class I—preserve the existing character of the landscape
- Class II—retain the existing character of the landscape
- Class III—partially retain the existing character of the landscape
- Class IV—provide for management activities that require major modifications to the existing character of the landscape

Non-federal land is not under any visual resource management system although there are often visual quality concerns. Federally authorized projects, however, undergo a visual assessment to comply with aesthetic requirements. Typically, sensitive areas include residential areas, recreation sites, historical sites, significant landmarks or topographic features, or any areas where existing visual quality is valued.

Three CBM well heads forming a field pod near Decker, Montana.
Each well is drilled to a different depth and into a different layer of coal.

Wilderness Study Areas

Ten wilderness study areas are within the planning area:

- Carbon County
  - Burnt Timber Canyon WSA
  - Pryor Mountain WSA
  - Big Horn Tack-On WSA
- Golden Valley County
  - Twin Coulee WSA
- Park County
  - Yellowstone River Island WSA
- Blaine County
  - Stafford WSA
  - Ervin Ridge WSA
  - Cow Creek WSA
- Rosebud County
  - Zook Creek WSA
- Powder River County
  - Buffalo Creek WSA

Monitoring reports for these WSAs list little or no activity with the exception of some minor vehicle tracks found in the Cow Creek WSA, Stafford WSA, Pryor Mountain WSA, Big Horn Tack-On WSA, and Burnt Timber Canyon WSA.

Wildlife

The EIS planning area covers very large portions of southeast, south central, and north central Montana, and includes substantial geographic and topographic variation and a wide variety of plant communities and wildlife habitat types. This combination of factors results in very diverse wildlife communities, with some species having widespread occurrence throughout the planning area and others being restricted to one or a few specialized habitats and locations.

The *Vegetation* section described the predominant native plant communities that provide habitat for wildlife in the planning area. These include a variety of grassland, shrubland, forest, and riparian habitat types. Drier grasslands and shrublands are dominant with breaks, badlands, coulees, wooded draws, open conifer forests, and riparian shrub and forest communities along perennial and intermittent drainages. Two other cover types present in the planning area include open water and a variety of agricultural land uses, both of which provide important habitat value to certain species during some seasons. Additionally, special habitat features such as cliffs, snags, springs, natural potholes, reservoirs, lakes, and islands are present in the planning area.

Mammals

The variety of locations, topography, and cover types in the planning area support many mammal species. The Montana Gap Analysis atlas of terrestrial vertebrates (MT-GAP 1998) shows the known distribution of vertebrates in Montana. It indicates that the planning area supports 10 species of bats; 8 species of shrews; 34 other species of small mammals and lagomorphs; 17 omnivores or predators ranging in size from the least weasel (*Mustela nivalis*) to the black bear (*Ursus americanus*) and mountain lion (*Felis concolor*); and 5 to perhaps 7 big game species. Several of these species have suffered substantial habitat loss and population decline and are considered to be rare or are protected by federal statutes. These species are addressed in the *Species of Concern* (SOC) section.

Some of the more common predators include the coyote (*Canis latrans*), red fox *(Vulpes vulpes*), raccoon (*Procyon lotor*), badger (*Taxidea taxus*), and striped skunk (*Mephitis mehpitis*). Local occurrence of several of these and other predators varies by habitat type present.

Big game species common within parts or all of the planning area include elk (*Cervus elaphus*), mule deer (*Odocoileus hemionus*), white-tailed deer (*O. virginianus*), and pronghorn (*Antilocapra americana*). The MT-GAP (1998) provides the following summary of habitat preferences for these species.

Elk habitat preference is described as including moist sites during the summer. Elk use open areas such as alpine pastures, marshy meadows, river flats, and aspen parkland as well as coniferous forests, brushy clearcuts, and forest edges. High quality winter range is critical to long term elk survival.

Mule deer are the most widely distributed big game species in Montana and occupy a wide range of habitat types during the year. Breaks, badlands, and brushy draws are preferred in open prairie country. McCracken and Uresk (1984) reported that both hardwood and pine forests were important to mule deer in southeastern Montana, with hardwood forests preferred. The Billings RMP (BLM 1983) indicates that although mule deer occur throughout the planning area, they are more abundant in the open shrub-grassland habitats adjacent to timbered or broken terrain. Habitat such as riparian bottoms, agricultural areas, and forests are used as well, either year long or seasonally. Winter ranges are typically at lower elevation than summer ranges, and are often dominated by shrub species that provide crucial browse.

White-tailed deer also occur throughout Montana but are more restricted by habitat preference than are mule deer. Preferred habitats include forest types, agricultural fields and prairie areas adjacent to cover. Mesic areas such as riparian areas and montane forests are preferred in the drier portions of central and eastern Montana. McCracken and Uresk (1984) reported a strong preference for hardwood forests in southeastern Montana. During the winter, white-tailed deer using forested areas prefer dense canopy classes, moist habitat types, uncut areas, and low snow depths. Winter concentration areas occur almost exclusively in riparian-wetland habitats and in dense pine (Youmans and Swenson 1982). White-tailed deer tend to remain in one particular area and do not migrate in the winter (Hamlin 1978).

Pronghorn are relatively common throughout eastern and central Montana and occupy a variety of grassland and shrubland habitats on prairies, semi-desert areas, and foothills. Summer habitat preferences are reported to include mixed shrub communities, perennial grasslands, silver sagebrush stands, annual forblands, and croplands (Armstrup

1978; Wentland 1968). McCracken and Uresk (1984) reported a strong preference to sagebrush-grassland cover types in southeastern Montana. Sagebrush-grasslands with shrubs 12 to 24 inches tall are preferred in the winter when sagebrush comprises a significant portion of the pronghorn diet (Bayless 1967).

The range of moose (*Alces alces*) overlaps with coal bearing lands in Carbon County. Moose habitat generally consists of a mosaic of second-growth forest, openings, swamps, lakes, and wetlands. Water bodies are required for foraging and hardwood-conifer forests provide winter cover. Willow flats may provide year-long habitat in some areas (Stone 1971) and closed canopy stands may be important in late winter (Mattson and Despain 1985).

The other two big game species that may occur in the planning area include the mountain goat (*Oreamnos americanus*) and mountain bighorn sheep (*Ovis canadensis*). Mountain goats typically occupy alpine and subalpine habitats, steep grassy talus slopes, grassy ledges and cliffs, or alpine meadows. Both mountain goats and mountain sheep may overlap with coal-bearing lands in southwestern and southern Carbon County, respectively. The Pryor Mountain bighorn herd, which occurs south of Billings, is estimated at 100 individuals (BLM 1983). Grasses and forbs provide the major portion of their yearlong diet, which is supplemented with browse types such as curlleaf mountain mahogany and sagebrush (FWS 1978). Little information is currently available on the migratory routes of this herd.

In eastern Montana, most mule deer and elk winter range is located on relatively large areas of land with a diversity of slopes, aspects, and topographic features (MBOGC 1989). Winter range is often part of year-round habitat.

Prairie dog towns provide habitat for more than 163 vertebrate species, including several rare or endangered species such as the burrowing owl (*Athene cunicularia*), swift fox (*Vulpes velox*), mountain plover (*Charadrius montanus*), and black-footed ferret (*Mustela nigripes*)—which is an endangered species (Reading et al. 1989; Koford 1958; Tyler 1968; Campbell and Clark 1981; Clark et al. 1982; and Agnew 1983). Black-tailed prairie dogs *(Cynomys ludivicianus*) formerly occupied most of the planning area along with thousands of acres of adjacent short grass prairie lands. White-tailed prairie dogs (*C. leucurus*) are found only along the Clarks Fork of the Yellowstone River in Carbon County, which is at the northern limit of its range.

As noted above, at least 10 species of bats probably occur in the planning area. Additional species migrate through central and eastern Montana. These sites vary by species and include caves, large diameter hollow trees, old buildings, abandoned mines, rock crevices, and under the loose bark on large trees.

As noted above, at least 42 species of shrews and other small mammals and lagomorphs occur in the planning area. MFWP has expressed particular concern about the Preble's shrew (*Sorex preblei*) and Merriam's shrew (*S merriami*). Preble's shrew has a spotty distribution associated with dry sagebrush and sagebrush grasslands (Hoffman and Pattie 1968) and riparian shrubs (Allen et al. 1994; Ports and George 1990). Merriam's shrew is apparently somewhat more widely distributed in the planning area. It occupies the same general habitat types as the Preble's shrew plus grasslands and open ponderosa pine stands (MT-GAP 1998).

Birds

As noted for mammals, the variety of locations, topography, and cover types in the planning area also support many bird species. The MT-GAP (1998) indicates that more than 250 species of birds occur in the emphasis area. Some are year-long residents, a few migrate south into the emphasis area during the winter, and most breed in the emphasis area and winter to the south. Approximate numbers of species include 32 waterfowl and related species; 33 shore and wading birds; 18 diurnal and 11 nocturnal raptors; 8 species of gallinaceous birds; 8 woodpeckers; and 137 songbirds, including many neotropical migrants. Species richness and breeding bird densities are highest in riparian woodlands and wetland habitats.

Waterfowl

The Billings RMP planning area is within the Central Flyway, which has important migration corridors. Lands in the planning area also fall within the Prairie Pothole Joint Venture established through the North American Waterfowl Management Plan. The Prairie Pothole Joint Venture is thought to contain the most important duck breeding habitat in North America. Many spring runoff ponds in the planning area provide important habitat for nesting waterfowl. The major rivers and stockponds provide important habitat for resident ducks and nesting areas for migrants. A large variety of ducks, geese, and shorebirds use riparian-wetland habitats within the planning area for both nesting and migration stopovers. Common species include the mallard (*Anas platyrhynchos*), pintail (*A. acuta*), gadwall (*A. strepera*), blue-winged teal (*A. discors*), common merganser (*Mergus merganser*), Canada goose (*Branta canadensis*), killdeer (*Charadrius vociferus*), and avocet (*Recurvirostra americana*). The Yellowstone and Clarks Fork drainages are used heavily for nesting by Canada geese and some species of ducks. Nesting occurs mostly on established islands and brushy riparian-wetland areas where abundant cover provides protection from predators.

Hansen (2001) identified several specific areas that are important to waterfowl and shorebirds. One critical habitat (for waterfowl and shorebird nesting and migration) is the Lake Mason National Wildlife Refuge (NWR), its entire watershed, and some associated shallow lakes located in Mussellshell County. Another is the Spidel Waterfowl Production Area, another FWS area for waterfowl and shorebirds located at the edge of one of the coal areas about 3 miles northeast of Broadview. A group of major waterfowl and shorebird areas located in Stillwater County between Molt and Rapelje includes Big Lake, Halfbreed NWR, and Hailstone NWR.

The Yellowstone River through Yellowstone, Big Horn, Treasure, Rosebud, and Custer counties is a major habitat for nesting, migrating, and wintering waterfowl. Also, the Howrey Island ACEC is a large island in the Yellowstone River in Treasure County that provides valuable habitat for waterfowl and many other species.

In Blaine County there are a number of large and small wetlands within the coal area that are important to waterfowl and shorebirds. These include North Chinook Reservoir and the Holm Waterfowl Production Area about 20 miles north-northwest of Chinook, and Tule Lake and BR12, about 10 miles north of Zurich. Smaller wetlands in this area are collectively extremely important. This is an important nesting area for northern pintails, a species of duck that has declined in numbers.

Raptors

Many of the raptors occurring in the Billings RMP planning area and the rest of the planning area have been identified by the State of Montana, the USFS, or BLM as sensitive species or species of special interest or concern (Flath 1991; Houtcooper et al. 1985). Those listed by the state include the ferruginous hawk (*Buteo regalis*), osprey (*Pandion haliaetus*), Cooper's hawk (*Accipiter cooperii*), northern goshawk (*Accipiter gentilis*), golden eagle (*Aquila chrysaetos*), merlin (*Falco columbarius*), prairie falcon (*Falco mexicanus*), burrowing owl, flammulated owl (*Otus flammeolus*), great gray owl (*Strix nebulosa*), and Boreal owl (*Aegolius funereus*). The endangered bald eagle (Haliaeetus leucocephalus) is discussed in the *Species of Concern* section.

Burrowing owls are of particular interest because of the rapid decline in their numbers (MT-GAP 1998). They occur in a variety of open habitat types, nesting and roosting in burrows dug by mammals (AOU 1983). They appear to be totally dependent on these mammal burrows with prairie dog towns providing prime habitat (MT-GAP 1998).

Ferruginous hawks occupy relatively undisturbed prairie and shrub steppe regions with scattered trees, rock outcrops, and wooded stream bottoms (Evans 1982; Clark et al. 1989). MFWP notes that there are a few pairs that apparently nest along tributaries in both the Powder River and Tongue River watersheds. Ferruginous hawks have declined throughout their range over the last 30 years. Merlins have also suffered substantial population declines. They occur in sparsely treed prairie, prairie parkland, along stream bottoms, and in grassland habitats. MFWP notes that merlin were present in the Powder River watershed, but that little current information is available.

Upland Game Birds

The following section from the Billings and Big Dry RMPs describes habitat preferences and important natural history information for the prairie sharp-tailed grouse *(Tympanuchus phasianellus jamesi*) and greater sage grouse (*Centrocercus urophasianus*) that applies to the entire planning area. Sharp-tails are widely distributed and are generally found in the grassland, shrub-grassland, and woodland vegetation areas. Sharp-tail habitat includes hills, benchlands, and other areas of rolling topography that have good stands of residual cover composed chiefly of grasses for roosting, feeding, and nesting. Dancing grounds, or leks, are usually flat areas on elevated knolls or benches. The dancing or mating sites are nearly bare of vegetation, although brushy cover is located nearby for feeding and escape. The breeding and nesting period from March to June is the most critical period in the life cycle. Females nest and raise their broods in the grassy uplands, usually within 1 mile of mating grounds.

Studies in southwestern North Dakota have shown that more than 90 percent of the nest sites were in residual vegetation over 6 inches high, and 70 percent of brood locations were in vegetation over 9 inches high (Kohn 1976). Habitat preferences in this planning area are similar.

Sage grouse are discussed under *Species of Concern* later in this *Wildlife* section.

Neotropical Migrants

A wide variety of neotropical migrants pass through or breed in the planning area. Habitat types that would be expected to support the highest species richness and highest breeding densities include cottonwood and ash riparian communities (Hopkins 1984) and emergent wetland communities. Hansen (2001) indicated that large blocks of native grasslands in Blaine County are very important to several species of birds that are declining in numbers, including Baird's sparrow (*Ammodramus bairdii*), Sprague's pipit *(Anthus spragueii*), chestnut-collared longspur (*Calcarius lapponicus*), and McCown's longspur (*Calcarius mccownii*). A number of other bird species, including the Brewer's sparrow (*Spizella breweri*), and loggerhead shrike (*Lanius ludovicianus*), are also declining throughout their range.

Reptiles and Amphibians

The MT-GAP (1998) indicates that the emphasis area supports 9 species of amphibians and 14 species of reptiles. These include 1 salamander, 4 frogs, 4 toads, 3 turtles, 2 lizards, and 9 snakes. MFWP has expressed particular concern about 5 of these species including the northern leopard frog (*Rana pipiens*), tiger salamander (*Ambystoma tigrinum*), hognose snake (*Heterdon nasicus*), milk snake (*Lampropeltis triangulum*), and the spiny softshell (*Trionyx spiniferus*).

Leopard frogs have declined substantially in western, and to a somewhat lesser extent, central Montana (MT-GAP 1998). They are locally abundant in southeastern Montana (Reichel and Flath 1995). They are associated with permanent slow moving water bodies with considerable vegetation, but may also range into moist meadows and grassy woodlands and occasionally agricultural areas (Nussbaum et al. 1983). They are most often associated with riparian habitats and on prairies near permanent water. Tiger salamanders occur throughout the planning area wherever there is terrestrial substrate suitable for burrowing and a nearby body of water for breeding (MT-GAP 1998). All amphibians are particularly susceptible to adverse effects of water quality degradation because larval stages are spent in water and they absorb water through their skin during all life stages.

The western hognose snake occurs in a variety of habitats throughout central and eastern Montana. They are especially associated with arid areas, prairie grasslands and shrublands, and floodplains with gravely or sandy soils (Reichel and Flath 1995). Milk snakes occur in suitable habitats throughout south central and southeastern Montana. Preferred habitats include sandstone bluffs, rock outcrops, grasslands, and open ponderosa pine and juniper stands (Hendricks and Reichel 1996). The spiny softshell is a riverine species that occurs primarily in the larger rivers of southeastern Montana. It is found in well-oxygenated, slower moving water with nearby mud flats and sandbars, and occasionally in back water sloughs (MT-GAP 1998).

Species of Concern

This section discusses wildlife species of concern that occur in the planning area. These include species listed or proposed for protection under the ESA, species classified as sensitive by the BLM or Forest Service, and species considered to be critically imperiled in the state of Montana. Table 3-29 and the following discussion present information about the species protected under ESA.

Birds

Sage Grouse

Sage grouse are widely distributed in suitable habitat, but because their numbers have declined significantly throughout their range over the last 20 years they are a possible candidate for listing under the ESA. Sage grouse are primarily associated with big and silver sagebrush communities in grassland-shrub and shrub vegetation types. The importance of mature sagebrush with a good under story of grasses and forbs to sage grouse is well documented.

Sage grouse males appear to form leks opportunistically at sites within or adjacent to potential nesting habitat. Although the lek may be an approximate center of annual ranges for non-migratory populations (Eng and Schladweiler 1972, Wallestad and Pyrah 1974, Wallestad and Schladweiler 1975), this may not be the case for migratory populations (Connelly et al. 1988, Wakkinen et al. 1992). Average distances between

TABLE 3-29
ENDANGERED, THREATENED, AND PROPOSED ANIMAL SPECIES PRESENT IN THE CBM EMPHASIS AREA

Common Name	Scientific Name	Habitat in Montana	Federal Status*
Birds			
mountain plover	*Charadrius montanus*	Arid, shortgrass prairieland in eastern Montana	PT
bald eagle	*Haliaeetus leucocephalus*	Forested riparian areas throughout the State	T
interior least tern	*Sterna antillarum athalassos*	Sandbars and beaches in eastern Montana and along the Yellowstone and Missouri rivers	E
Mammals			
gray wolf	*Canis lupus*	Adapted to many habitats, need large ungulate prey base and freedom from human influence	E/10(j)
black-tailed prairie dog	*Cynomys ludovicianus*	Short-grass and mixed-grass prairie in the east of the 110th Meridian; concentrations are in southern Philips County, Custer County, Blaine County, Fort Belknap Reservation, and Crow Reservation	C
Canada lynx	*Felis lynx canadensis*	Montana spruce/fir forest in western Montana	T
black-footed ferret	*Mustela nigripes*	Prairie dog complexes in Eastern Montana	E
grizzly bear	*Ursus arctos horribilis*	Alpine/subalpine coniferous forest in Western Montana	T

*T=Threatened; E=Endangered; C=Candidate; PT=Proposed Threatened;
E/10(j)= Endangered/Experimental Populations.

nests and nearest leks vary from 0.66 to 3.75 miles but documented distances from leks with which females were associated to their nests have exceeded 12 miles. (Autenrieth 1981 Wakkinen et al. 1992, Fischer 1994, Hanf et al. 1994, Lyon 2000). Nests are placed independent of lek location (Bradbury et al. 1989, Wakkinen et al. 1992). Nesting habitat is usually located under sagebrush, and with about 50 percent of nests located within 2 miles of leks (Wallestad and Pyrah 1974; Martin 1970). Sagebrush provides 80 to 100 percent of their winter diet (Wallestad and Schladweiler 1975; Martin 1970; Eng and Schladweiler 1972). For winter, sage grouse prefer an area where sagebrush shrubs are at least 12 inches high (BLM 1995). Forbs, especially dandelion and salsify, are an important dietary component for the juveniles and adults in the spring and summer and wet meadows and other riparian areas are heavily used in the summer as sagebrush areas dry out.

Mountain Plover

This species has been proposed for listing as threatened. It was once widely distributed across short-grass prairies on the western Great Plains, occupying a range extending from Montana to New Mexico and Texas. Conversion of native prairies to agriculture has significantly reduced suitable breeding habitats for this species. It prefers level sites with very short grass and scattered cactus. Intensive grazing is beneficial for mountain plovers, and they also regularly occupy prairie dog towns. High, arid plains and shortgrass prairie with blue grama-buffalo grass communities are the primary habitat. The mountain plover does not winter in Montana, but may breed within the planning area, particularly in black-tailed prairie dog towns. It currently breeds in central, north-central, and southwest Montana and is transitory in other parts of Montana, such as the Greater Yellowstone Ecosystem. Blaine and Phillips counties currently support the bulk of mountain plovers that nest in Montana.

Bald Eagle

This species was reclassified from endangered to threatened, because of recovery status, on July 12, 1995. Bald eagles concentrate in and around areas of open water where waterfowl and fish are available. They prefer solitude, late-successional forests, shorelines adjacent to open water, a large prey base for successful brood rearing, and large, mature trees for nesting and resting.

Bald eagle recovery zones include the Powder and Missouri rivers. Bald eagles commonly nest along the Yellowstone River in Rosebud and Custer counties. The Yellowstone River is used during spring and fall migration. Peak occurrence is November through April. The Missouri, Yellowstone, Musselshell, and Powder rivers provide habitat during migration as well as during the winter months. Bald eagles currently are expanding their nesting territories down the Yellowstone River (Flath 1991).

Interior Least Tern

The historic distribution of the interior least tern is the major river systems of the plains states and midwestern United States. The occurrence of breeding least terns is localized and is highly dependent on the presence of dry, exposed sandbars and favorable river flows that support a forage fish supply and isolate the sandbars from the riverbanks. Characteristic riverine nesting sites are dry, flat, sparsely vegetated sand and gravel bars within a wide, unobstructed, water-filled river channel. In the upper Missouri River Basin, it often nests with piping plovers. During spring and fall migrations, the least tern uses stockwater reservoirs (Flath 1991).

The least tern is known to nest in the planning area. Its habitat includes graveled islands in the lower Yellowstone River and the Missouri River below Fort Peck dam.

Peregrine Falcon

The peregrine falcon was delisted on August 25, 1999, and protection from take and commerce for the peregrine falcon is no longer provided under the ESA. However, peregrine falcons are still protected by the Migratory Bird Treaty Act (MBTA). The MBTA and its implementing regulations (50 CFR parts 20 and 21) prohibit take, possession, import, export, transport, selling, purchase, barter, or offering for sale, purchase, or barter any migratory bird, their eggs, parts, and nests, except as authorized under a valid permit (50 CFR 21.11). With limited exceptions, take will not be permitted under MBTA until a management plan is developed in cooperation with state wildlife agencies, undergoes public review, is approved, finalized, and published in the FR.

Peregrine falcons migrate through the planning area during spring and fall, especially along rivers and other water bodies that support waterfowl and shorebirds. Peregrines are believed to nest northeast of Great Falls, possibly within the planning area.

Mammals

Gray Wolf

This species was listed as endangered on March 11, 1967. On November 18, 1994, the FWS announced that experimental populations of this species would be reintroduced in central Idaho and southwestern Montana. Populations classified as experimental are exempt from full endangered status. Historically, the gray wolf ranged throughout Montana. It appears to have been common throughout the State, inhabiting both short and tall grass prairie as well as forested regions. It has no particular habitat preference, but requires areas with low human population, low road density, and high prey density, which are ideally large, wild ungulates.

Most confirmed wolf sightings and pack accounts are for western Montana, along the Bitterroot divide, and in the areas around Yellowstone National Park, where it has been reintroduced (Fisher et al. 1998).

Black-tailed Prairie Dog

This species was proposed for listing as threatened on March 25, 1999. On February 3, 2000, the FWS determined that the black-tailed prairie dog warrants listing under the ESA. However, because there are other species also awaiting listing that are in greater need of protection, the FWS is not proposing to list the species at this time, but it still remains a candidate for listing.

Although the original abundance of prairie dogs in Montana is unknown, early accounts indicate they were abundant and widely distributed east of the Continental Divide in grasslands and sagebrush-grasslands. This species is capable of colonizing a variety of shrub-grassland and grassland habitats. Generally, the most frequently used habitats in Montana are dominated by western wheatgrass, blue grama, and big sagebrush and located in relatively level areas in wide valley bottoms, rolling prairies, and the tops of broad ridges. The black-footed ferret is an obligate predator of prairie dogs. Other species with close associations to prairie dogs are burrowing owls, mountain plovers, and ferruginous hawks. These are all species of concern.

Canada Lynx

This species was listed as threatened on March 24, 2000. It is dependent on snowshoe hares and found in the same habitats, which include dense, mature old-growth lodgepole pine, Douglas-fir, Engelmann spruce, and subalpine fir forest. Distribution and primary potential habitats for Montana are in the western portion of the State in mature coniferous forests with a well-developed understory. Dens are primarily located in mature lodgepole pine and spruce-fir forests.

Black-footed Ferret

This species was listed as endangered on March 11, 1967. Black-footed ferrets depend almost exclusively on prairie dogs for food and shelter. They primarily prey on prairie dogs and use their burrows for shelter and dens. Ferret range is coincident with that of prairie dogs. There is no documentation of black-footed ferrets breeding outside of prairie dog colonies. There are specimen records of black-footed ferrets from ranges of three species of prairie dogs: the black-tailed prairie dog (*Cynomys ludovicianus*), white-tailed prairie dog (*Cynomys leucurus*), and Gunnison's prairie dog (*Cynomys gunnisoni*).

The Montana Black-footed Ferret Working Group has studied prairie dog towns capable of supporting black-footed ferrets. They are assessing the possibility of black-footed ferret reintroduction, and have released a paper suggesting eight possible reintroduction sites in Montana (Clark et al. 1982). One of these sites is located in Custer and Prairie counties.

Grizzly Bear

This species was listed as threatened on March 11,1967. On November 11, 2000, the FWS listed some populations in Montana and Idaho as experimental in order to facilitate restoration to designated recovery areas. The grizzly (or brown) bear was once found in a wide variety of habitats including open prairie, brushlands, riparian woodlands, and semidesert scrub. Its distribution in Montana is now limited to the Northern Continental Divide Ecosystem and the Yellowstone Ecosystem with a few in the Cabinet-Yaak Ecosystem. Scattered individuals may occur in the mountainous areas of western Montana. It no longer exists in the wild in eastern Montana. Most populations require vast areas of suitable habitat to prosper. This species is common only in habitats where food is abundant and concentrated, including white-bark pine, berries, and salmon or cutthroat runs, and where conflicts with humans are minimal.

State Species of Special Concern

In addition to species that are federally protected under the ESA, the State of Montana has designated additional species of concern within its jurisdictional boundaries. There are five rankings for State Species of Special Concern. This document focuses only on the highest ranking (S1). This ranking is defined as critically imperiled because of extreme rarity (five or fewer occurrences, or very few remaining individuals), or because some factor of its biology makes it especially vulnerable to extinction.

State-listed species (with BLM and USFS rankings) that have potential distributions within the 16-county emphasis area of this EIS or that have undefined distributions in the state are listed in the Wildlife Appendix, *Wildlife Species of Concern* (see Table WIL-1 for Special Status Species of State of Montana, BLM and USFS). Species that are federally listed under the ESA have been omitted from these tables because they have been considered. Table WIL-1 also lists vertebrate species that are species of concern for the state, BLM, or the USFS.

Aquatic Resources

Aquatic habitat in the CBM emphasis area that supports, or could potentially support, fisheries and other aquatic resources briefly described in the following paragraph includes rivers, streams, lakes, and stock ponds. Extensive information on aquatic habitat and fisheries resources in the Billings and Powder River RMP areas and in Gallatin, Park, and

Blaine counties is contained in the Montana NRIS on the Internet at http://nris.state.mt.us/wis/mris1.html (Montana NRIS 2001). Tables WIL-2 through WIL-5 in the *Biological Appendix* summarize representative planning area information from the Montana NRIS (2001) Internet database. Table WIL-2 summarizes aquatic resources characteristics of major drainages and representative tributaries within the boundaries of each RMP area and county. These characteristics include drainage length, aesthetics, fisheries management, fisheries resource value, number of fish species present, and whether a dewatering problem has been identified. The relative abundances of fish species present in major drainages and representative tributaries are summarized in Table WIL-3 (Billings RMP area), Table WIL-4 (Powder River RMP area), and Table WIL-5 (Park, Gallatin, and Blaine counties). The scientific names of fish species discussed in the following text are given in Tables WIL-3, WIL-4, and WIL-5.

Numerous other aquatic resources besides fish are present in emphasis area water bodies. These resources often are important in the diet of various species of fish, or they comprise part of the food web that fish ultimately depend on in their diet. Examples of other aquatic resources include benthic macroinvertebrates and microinvertebrates, zooplankton, phytoplankton, periphyton (attached algae), snails, clams, and worms. Numerous taxa of aquatic insects whose distribution and abundance vary with geographic location, habitat type, and habitat condition occur in planning area drainages. Immature and adult forms of Plecoptera (stoneflies), Ephemeroptera (mayflies), Trichoptera (caddisflies), and Diptera (true flies) are particularly important in the diets of juvenile and adult trout, whitefish, and other native fish species.

Fish and other aquatic species that have been listed, proposed, or are candidates for listing as federally endangered or threatened species, or have otherwise been designated as federal or state sensitive species or species of concern, are discussed under *Special Status Species* in this Aquatic Resources section.

Billings RMP Area

Major rivers and streams in the Billings RMP area are the Yellowstone River and its tributaries in the southern two-thirds of the area, and the Musselshell River and its tributaries in the northern one-third of the area. Both of these rivers eventually drain to the Missouri River outside of the RMP area. Major tributaries to the Yellowstone River are the Boulder, Stillwater, Clarks Fork of the Yellowstone, and Bighorn rivers. Careless Creek is a major tributary to the Musselshell River. Each of the referenced drainages is characterized by a dendritic pattern of tributaries, with flows ranging from perennial to ephemeral (MBOGC 1989). Examples of other water bodies that provide important habitat for aquatic resources in this resource area are Bighorn Lake, Cooney Reservoir, Big Lake, Lebo Lake, numerous mountain lakes at higher elevations, and miscellaneous water bodies such as storage reservoirs and stock ponds.

The Billings RMP area drainages listed in Table WIL-2 have been characterized as ranging from "national renown" in the more upstream reaches to "stream and area fair" in some of the downstream reaches (Montana NRIS 2001). Designated fisheries management in these drainages is for trout, except in the Yellowstone River east of Billings (managed for warm/cool water and non-trout species) and in the downstream section of the Clarks Fork of the Yellowstone (managed for non-trout species) (see Table WIL-2). The fisheries resource value in these drainages is either outstanding, high, or substantial, except in the Little Bighorn River (moderate value) and Careless Creek (moderate or limited value in some reaches). The greatest numbers of fish species are generally found in the more downstream reaches of larger drainages, with comparatively fewer species present in the more upstream, or upstream reaches of, tributaries. Numbers of fish species present vary from 32 in the Musselshell River, 28 in the Yellowstone River east of Billings, 20 in the Yellowstone River west of Billings, 9 in the Boulder and Stillwater rivers, and 8 in the Little Bighorn River (see Table WIL-2).

Table WIL-3 provides detail about the relative abundance of fish species collected from each of the Billings RMP area drainages listed in Table WIL-2. Many of the same fish species are abundant or common in many of these drainages, although there is a pattern, proceeding downstream, of increased species diversity and the replacement of predominantly cold water species by cool and warm water species. Examples of abundant or commonly occurring game fish in the Yellowstone River west of Billings are rainbow trout, brown trout, mountain whitefish, and burbot (ling); abundant or common non-game fish species in this reach of the Yellowstone River include, among others, goldeye, longnose sucker, white sucker, mountain sucker, shorthead redhorse, and mottled sculpin (see Table WIL-3). The same species of trout and whitefish, as well as Yellowstone cutthroat trout and brook trout, also are abundant or common in the Boulder and

Stillwater rivers. By comparison, these same species of salmonids are either uncommon in occurrence or absent from the mainstem Yellowstone River east of Billings. Instead, game fish typically associated with cool or warm water regimes—such as channel catfish, northern pike, smallmouth and largemouth bass, yellow perch, sauger, and walleye—first appear in river collections or are more abundant than farther upstream (see Table WIL-3).

Fish species present in the Clarks Fork of the Yellowstone and in the Bighorn River generally represent a subset of fish species present in nearby reaches of the Yellowstone River. There are more fish species present in the downstream sections of the Clarks Fork (19 species) and the Bighorn (30 species) than in their upstream sections (12 species in the Clarks Fork and 17 species in the Bighorn) (see Table WIL-2). Rainbow trout, brown trout, and mountain whitefish are present in both sections of the Clarks Fork and Bighorn rivers, but these species are more abundant in the upstream than downstream sections (see Table WIL-3). Yellowstone cutthroat trout also are present in the Clarks Fork, and Arctic grayling are present in the upstream section of the Clarks Fork. Other game species present in these two drainages include channel catfish, burbot, and sauger in the downstream section of the Clarks Fork, and channel catfish, northern pike, burbot, smallmouth bass, sauger, and walleye in both sections of the Bighorn River. The Little Bighorn River, which is tributary to the downstream section of the Bighorn River, supports five commonly occurring game fish species, including rainbow trout, brown trout, mountain whitefish, channel catfish, and smallmouth bass (see Table WIL-3).

A variety of 32 fish species are present in the Musselshell River within the Billings RMP area (Table WIL-2). More than half of these species have been rated as abundant or common in occurrence in various fisheries studies conducted on this drainage (see Table WIL-3) (Montana NRIS 2001). Examples of game species present in the Musselshell, which is managed as a trout fishery within the RMP area, include brown trout, mountain whitefish, channel catfish, black bullhead, northern pike, smallmouth bass, sauger, and walleye. Examples of dominant non-game species present in the Musselshell are goldeye, common carp, sand shiner, flathead chub, longnose dace, longnose sucker, white sucker, mountain sucker, shorthead redhorse, and mottled sculpin. The ten species of fish present in Careless Creek, a tributary to the Musselshell, are dominated by non-game fish, such as lake chub, flathead chub, longnose dace, and white sucker. The only game fish reported from Careless Creek is brook trout, which is common in occurrence (see Table WIL-3).

Some of the storage reservoirs and stockponds in the Billings RMP area, and in other planning area reservoirs and stockponds, have been stocked with various game fish species. Examples include northern pike, largemouth bass, yellow perch, walleye, bluegill, crappie, and rainbow trout (MBOGC 1989, BLM 1995). Rainbow trout must be restocked regularly because they will not reproduce in ponds, but other species such as bass, perch, bluegill, and crappie may establish self-sustaining populations in ponds.

Water quality in perennial rivers and streams within the Billings RMP area is generally good. Water quality in the Yellowstone River has been rated as good for wildlife uses, while water quality in the Musselshell River has been rated as satisfactory for wildlife uses (BLM 1995). The BLM (1995) also reported that the area's semiarid climate is not conducive to maintaining fish habitat and populations in most intermittent streams. However, Regele and Stark (2000), citing the Montana Fish, Wildlife, and Parks (MFWP), stated that perennial as well as intermittent prairie streams in southeastern Montana are important in the life histories of native fish species and often provide spawning and rearing habitat for mainstem fish species.

Powder River RMP Area

Major rivers and streams that comprise important aquatic habitat in the Powder River RMP area are the Yellowstone River and its tributaries in the western two-thirds of the area, and the Little Missouri River and its tributaries in the eastern one-third of the area. All of these rivers eventually drain to the Missouri River outside of the RMP area. Major tributaries to the Yellowstone River are the Tongue (and Tongue River Reservoir), Little Powder, and Powder rivers, and Rosebud, Pumpkin, Otter, Armells, Hanging Woman, and Mizpah creeks. Box Elder Creek is a tributary to the Little Missouri River. The referenced drainages are characterized by a dendritic pattern of perennial and ephemeral tributaries (MBOGC 1989). Examples of other water bodies that provide habitat for aquatic resources in this RMP area are lakes, storage reservoirs, and stock ponds.

The Powder River RMP area drainages listed in Table WIL-2 have been characterized as typically ranging from "clean stream and natural setting" to "stream and area fair," although the Powder River varies from "natural and pristine beauty" in the upstream section to "low" in the downstream section

(Montana NRIS 2001). Fisheries management in these drainages is for non-trout species, warm/cool water species, or has not been designated, except in the upstream section of the Tongue River where designated fisheries management is for trout. The fisheries resource value in most of these drainages is either high, substantial, or moderate, except in some reaches of Pumpkin and Mizpah Creeks that have limited fisheries resource value. The greatest numbers of fish species are generally found in the more downstream or downstream reaches of larger drainages, with fewer species present in the more upstream or upstream reaches of smaller tributaries. Numbers of fish species present vary from 40 in the Yellowstone River and 33 in the downstream section of the Tongue River to 13 in the Little Powder River and 18 in the Little Missouri River (see Table WIL-2).

Table WIL-4 provides detail on the relative abundance of fish species collected from many of the Powder River RMP area drainages listed in Table WIL-2. The number of fish species in this reach of the Yellowstone River (40 species) is considerably greater than in the Yellowstone within the Billings RMP area east of Billings (28 species) and west of Billings (20 species). The most abundant game fish in the Yellowstone River in the Powder River RMP area are shovelnose sturgeon, paddlefish, channel catfish, burbot, sauger, and walleye. Lesser numbers of a wide variety of other game species also are present, such as northern pike, various sunfishes, smallmouth and largemouth bass, white and black crappie, and rainbow and brown trout. Examples of some of the more abundant non-game species in the Yellowstone are goldeye, common carp, emerald shiner, flathead chub, river carpsucker, white sucker, shorthead redhorse, and stonecat. The federally-listed endangered pallid sturgeon occurs rarely in the Yellowstone River within this RMP area (see Table WIL-4).

Species present in tributaries to the Yellowstone River within the Powder River RMP area generally overlap with those species present in the mainstem Yellowstone. However, species composition in the tributaries is less diverse overall, particularly in the smaller drainages and in the upstream sections of drainages (see Table WIL-4). Some of the fish species dominant in the Yellowstone also are prominent in sections of the Tongue and Powder rivers. Examples include shovelnose sturgeon, channel catfish, sauger, goldeye, common carp, flathead chub, white sucker, and shorthead redhorse. Other game species present in the Tongue and Powder rivers include northern pike, walleye, several species each of bullheads, sunfishes, and crappies in the Tongue River; burbot, green sunfish, and walleye in the Powder River; and rainbow and brown trout, which are uncommon in occurrence, in the upstream sections of the Tongue and Powder rivers (see Table WIL-4).

Considerably fewer game species are present in the smaller Powder River RMP area tributaries listed in Table WIL-2. For the following tributaries, the only game species reported as common in occurrence are channel catfish, northern pike, burbot, and sauger in Rosebud Creek, which drains directly to the Yellowstone; channel catfish in Pumpkin Creek, which is tributary to the downstream section of the Tongue River; and channel catfish in the Little Powder River, which is tributary to the downstream section of the Powder River (Montana NRIS 2001) (see Table WIL-4). The Little Missouri River, which empties into the Missouri River and contains 18 fish species, supports four game species, including channel catfish, black bullhead, green sunfish, and sauger (see Table WIL-4).

Water quality conditions and concerns in perennial, intermittent, and ephemeral drainages in the Powder River RMP area are generally similar to those described for drainages in the Billings RMP area. Water quality in the Yellowstone and Powder rivers has been rated as good for wildlife uses (MBOGC 1989).

Elser et al. (1980) reported the results of extensive fisheries investigations conducted on numerous large and small drainages in southeastern Montana. The authors found that the lower Yellowstone River in this part of the State supports a diverse, productive fishery that is dependent on adequate flows and good water quality. Elser et al. (1980) reported that in the Tongue River, fish populations range from a cold water-mixed population downstream of the dam at Tongue River Reservoir to an assemblage of slow-water species downstream near the river’s mouth. They added that migrant fish species from the Yellowstone River depend on high spring flows to allow good passage into the Tongue River. Elser et al. (1980) noted that fish populations in the Powder River are limited in diversity and abundance because of water quality and water quantity conditions. Fish populations are probably limited for similar reasons in the Little Missouri River, which Elser et al. (1980) described as having highly erratic flows, fair to poor water quality, very hard water, and moderate to high turbidities.

Park, Gallatin, and Blaine Counties

Various water bodies provide important aquatic habitat and sustain valuable fisheries in Park, Gallatin, and Blaine counties. Important habitat in Park County includes the Yellowstone River as it flows north from Yellowstone National Park, tributaries to the Yellowstone such as Shields River, and numerous mountain lakes. The Yellowstone River in Park County is of "national renown," is managed for its trout fishery, and has an outstanding fisheries resource value (see Table WIL-2). Shields River has been characterized as a "clean stream in a natural setting," is managed for its trout fishery, has a high to substantial fisheries resource value, but also is periodically dewatered (Montana NRIS 2001).

The Yellowstone River in Park County supports 12 species of fish. Yellowstone cutthroat trout, rainbow trout, brown trout, and mountain whitefish are the dominant game species, with longnose sucker, white sucker, longnose dace, and mottled sculpin among the dominant non-game species (see Table WIL-5). Shields River, with 10 fish species, generally supports the same assemblage of dominant cold water game and non-game fish as the Yellowstone River. Water quality in the referenced Park County drainages, and in drainages in Gallatin and Blaine counties discussed in the following text, generally tends to be good to excellent, primarily because of the proximity to headwaters or the often undeveloped or remote nature of the surrounding areas.

Major drainages in Gallatin County include the Gallatin, Madison, and Jefferson rivers and their tributaries, which combine to form the Missouri River. These rivers and streams are managed for, and support, nationally renowned trout fisheries that have either an outstanding, high, or substantial fisheries resource value (see Table WIL-2). The Gallatin County drainages vary from "national renown" to "clean stream and natural setting." However, periodic dewatering problems have been identified for portions of the Missouri and Gallatin rivers, and chronic dewatering problems have been identified for portions of the Jefferson and Gallatin rivers (Montana NRIS 2001).

The relative abundance and kinds of fish species present in the referenced Gallatin County drainages are similar, varying from 13 species in the Missouri and Madison rivers to 12 species in the Jefferson and Gallatin rivers. Dominant game fish include brown trout, rainbow trout, and mountain whitefish, with dominant non-game fish consisting of longnose sucker, white sucker, longnose dace, and mottled sculpin. Other less abundant cold water game species present in some of these drainages include Yellowstone cutthroat trout, westslope cutthroat trout, brook trout, and Arctic grayling. Table WIL-5 provides further information on fish species present and their relative abundance in these drainages.

Important aquatic habitat in Blaine County includes the Missouri River and its tributaries, such as Cow Creek, in the southern half of the county, as well as the Milk River and its tributaries, such as Lodge and Peoples creeks, in the northern half of the county. The Milk River empties into the Missouri River east of Blaine Country. Examples of other water bodies that provide important aquatic habitat in Blaine County are North Chinook Reservoir and Putnam Lake. The Missouri River in Blaine County is of "national renown," is managed as a non-trout fishery, and has an outstanding fisheries resource value (see Table WIL-2). Its tributaries in Blaine County have been characterized as of "clean stream and natural setting" or "stream and area fair," and have a fisheries resource value of high, substantial, or moderate. Cow Creek and part of Peoples Creek are managed as trout fisheries, while the Milk River, Lodge Creek, and part of Peoples Creek are managed for non-trout species (Montana NRIS 2001).

The numbers of fish species present in Blaine County drainages listed in Table WIL-2 vary from 31 in the Milk River and 26 in the Missouri River to eight in Cow Creek (see Table WIL-5). Many of the same fish species are abundant or common in the Missouri and Milk rivers and are dominated by species with warm or cool water preferences. Examples include goldeye, common carp, emerald shiner, flathead chub, longnose dace, and stonecat. Examples of other commonly occurring species in these drainages include shovelnose sturgeon, western silvery/plains minnow, longnose sucker, channel catfish, and sauger in the Missouri River, and lake chub, northern redbelly/finescale dace, white sucker, burbot, yellow perch, sauger, and walleye in the Milk River. Of the eight species present in Cow Creek, which is managed as a trout fishery, only brook trout occur in abundance. Examples of commonly occurring species in Lodge and Peoples creeks include: lake chub, common carp, fathead minnow, black bullhead, northern pike, and yellow perch in Lodge Creek; longnose dace, redside shiner, brook trout, and mottled sculpin in Peoples Creek; and white sucker and western silvery/plains minnow in both creeks. The federally listed endangered pallid sturgeon occurs rarely in the Missouri River within Blaine County (see Table WIL-5).

Special Status Species

Many federally listed threatened, endangered, or candidate species of special concern exist in the planning area that are given special consideration under Section 7(c) of the ESA of 1973. As required by the ESA, the FWS has provided a list of endangered, threatened, and proposed species that may be present in the planning area. This section reviews the habitat requirements of the three special status aquatic species identified by the FWS (see Table 3-30), as well as the likelihood of them being found in the 16 counties that may be potentially affected by this project.

Montana Arctic Grayling

This species is a candidate for listing under the ESA. On October 2, 1991, a petition requested that the "fluvial Arctic grayling" be listed as an endangered species throughout its historic range in the lower 48 states. The petitioners stated that the decline of the fluvial Arctic grayling was a result of many factors, including habitat degradation as a result of the effects of domestic livestock grazing and stream diversions for irrigation, competition with nonnative trout species, and past overharvesting by anglers. Additionally, the petition stated that much of the annual recruitment is lost in irrigation ditches. Historically, this species was widely, but irregularly, distributed and locally abundant above Great Falls in the upper Missouri River drainage in Montana. (FWS 1994c).

Pallid Sturgeon

This species was listed as endangered on September 6, 1990 (55 FR 36641). They evolved in large rivers with high turbidity and a natural hydrograph consisting of spring flooding and other natural highwater events. Historically in Montana, they occupied reaches of the Missouri River from Fort Benton downstream and in the Yellowstone River from Miles City to the Missouri River (FWS 1993). There are three priority recovery management areas in Montana, two on reaches of the Missouri and one on the Yellowstone River.

Warm Spring Zaitzevian Riffle Beetle

This species is a candidate for listing. This species is only known to inhabit a single warm springs in Gallatin County near the city of Bozeman.

TABLE 3-30
SPECIAL STATUS AQUATIC SPECIES PRESENT IN THE CBM EMPHASIS AREA

Common Name	Scientific Name	Habitat in Montana	Federal Status*
Fish			
Montana Arctic grayling	*Thymallus arcticus*	Fluvial populations in the cold-water, mountain reaches of the Upper Missouri River	C
Pallid sturgeon	*Scaphirhynchus albus*	Bottom dwelling fish of the Missouri and Yellowstone rivers	E
Invertebrates			
Warm spring zaitzevian riffle beetle	*Zaitzevia thermae*	Warm springs in Gallatin County	C

*E=Endangered; C=Candidate.

CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

Introduction

This chapter presents the environmental impacts from management actions described in Chapter 2. The descriptions of predicted effects that would result from the exploration, construction, operation and maintenance, and abandonment activities associated with coal bed methane (CBM) for each alternative is compared to the pre-project environment. The method of recognizing impacts and accomplishing a systematic impact analysis are in accordance with the Council of Environmental Quality (CEQ) guidelines, which address procedures on applying the National Environmental Policy Act (NEPA). The duration of the impacts are analyzed and described as either short-term (up to 5 years) or long-term (greater than 5 years).

Chapter 4 contains an *Introduction, Analysis Assumptions, and Guidelines* section, individual Resource Topic discussions and a *Comparison Table for Alternative Impacts*. The *Introduction* outlines the chapter and provides an explanation of the organization and creation of assumptions. The *Analysis Assumptions and Guidelines* section presents the Reasonable Foreseeable Development scenario (RFD) used to predict the level of CBM development and addresses the analysis assumptions common to all alternatives. The Resource Topic discussions are organized alphabetically. Under each resource topic, the following are addressed: assumptions, impacts from management common to all alternatives, and impacts from management specific to each alternative.

Impacts from management of conventional oil and gas are found in the *Impacts From Management Common to All Alternatives* sections. Impacts from management of CBM are found in the *Impacts From Management Specific to Each Alternative* sections.

The narrative describing the impacts from management specific to each alternative includes subsections summarizing the impacts to the Crow and Northern Cheyenne Tribes, mitigation measures and a conclusions summary. The conclusion summarizes the cumulative impacts from other regional ongoing and foreseen projects.

Cumulative impacts consider the alternative in combination with other substantial existing and future developments in and near the CBM emphasis area, including oil and gas development projects, existing and future coal mines, the Tongue River Railroad project, new power plants, and effects from Wyoming's CBM development. Project descriptions for activities considered in the cumulative impacts analysis are presented in the *Minerals Appendix* under Oil and Gas. Mitigation measures that are not already included as part of the alternative or alternatives are described and evaluated, and the residual impacts are determined.

The resource discussions also address the differences between U.S. Bureau of Land Management (BLM) and State of Montana (state) impacts where divisions are meaningful. Physical impacts on landscapes from development disturbances can easily be quantified for BLM and state regulated wells; however, effects on watersheds or wildlife from both BLM and state development cannot easily be distinguished and therefore are discussed in conjunction.

Analysis Assumptions and Guidelines

Analysis assumptions and guidelines provide common data to EIS team members to use when conducting the environmental assessments for each resource. The assumptions and guidelines are based on previous events, experience of personnel, and their knowledge of the resources in the planning area. The assumptions include the demand for various resources, the ability of the resources to meet the demand, and how the actions will be carried out. An RFD was developed for this purpose and is discussed in the following sections.

Potential for Development—Reasonable Foreseeable Development Scenario

The RFD addresses potential development of all owners, including the Crow and Northern Cheyenne Indian reservations and the Ashland Ranger District of the U.S. Forest Service (USFS). The RFD is in no way stating that the BLM or the State of Montana are making decisions for Indian lands or the USFS administered lands. For example, the decision to develop CBM on Indian lands will be made by the Indian allottees, and the tribes with concurrence of the Bureau of Indian Affairs (BIA), not by BLM or the state.

The presumption of possible impacts to the environment is based on BLM guidance (BLM H-1624-1) provided for estimating the potential for oil and gas resources and for extrapolating the degree of development that is reasonably foreseeable over a given period of time. In the case of Montana's Powder River Basin and additional areas of emphasis, it is the level of CBM development most likely to occur over the next 20-year period. The RFD is located in the *Minerals Appendix*, under "Oil and Gas." The following sections contain explanations of 1) the potential for CBM resources within the emphasis area boundaries, and 2) RFD for the different detailed development scenarios that are addressed by the various alternatives in this EIS.

Potential for CBM Resources

An estimate of CBM and conventional oil and gas resources was accomplished using many sources of information, including established files and databases, the BLM resource management plans (RMPs) for the areas, coal information from the U.S. Geological Survey (USGS), professional and academic literature, available oil and gas maps, previous mineral assessments and expressions of interest, and projections from the oil and gas industry. To project CBM exploration and development, the areal extent of certain coals and the rank of coals in the CBM emphasis area were considered. Areas of subbituminous to bituminous coals were considered as the most likely to be explored and developed in Montana, although exploration and development has occurred mainly in subbituminous coal in the Wyoming portion of the Powder River Basin. The USGS produced a Open File Report (OF 96-92) showing the areas of coal, by rank, for the United States. This information indicates subbituminous and bituminous coals in many parts of the emphasis area. See Map MIN-1 in the *Minerals Appendix* for an illustration of this data and Map 4-1 for a geographical presentation of potential CBM development within Montana. Powder River, Rosebud, Custer, and Big Horn counties contain the northern part of the basin, which extends from Wyoming. Blaine and Musselshell counties have mostly subbituminous coal. Carbon County has an extension of the Big Horn Basin coal, which is ranked as bituminous coal. Gallatin and Park counties have scattered areas of bituminous to subbituminous coals. The amount of methane gas that could be produced from the coal beds in Montana has been projected to range from a low of 1 trillion cubic feet (TCF) (Crockett and Meyer 2001) to a high of 17.7 TCF (Nelson 2000). This and other information for Montana is used to predict where CBM exploration is most likely to occur in the emphasis area. The RFD predicts the number of CBM wells that would be drilled and completed during the next 20 years per alternative. By making these predictions, cumulative impacts can be assessed.

Reasonable Foreseeable Development Scenario

Projections of future CBM development and production are difficult to make. Several variables complicate such forecasts, including new exploration, development or production techniques; increases or decreases in demand for natural gas; and price increases or decreases that may prompt larger or smaller development and production programs. For this EIS, a combination of historical trends, present activity, government and industry estimates, and professional judgments were used in establishing the estimate of RFD. The RFD is discussed under two scenarios: restricted development and expanded development.

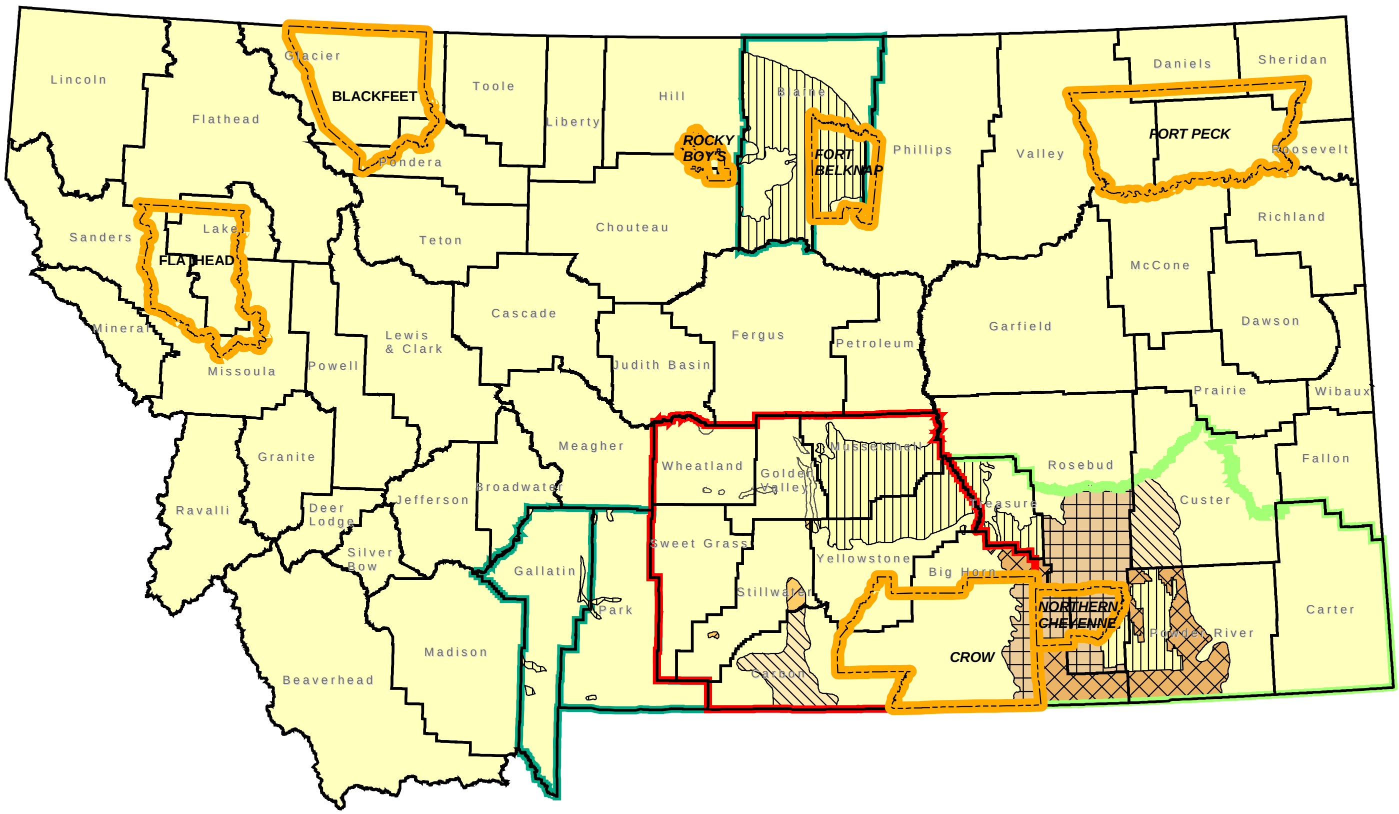
Restricted Development

Restricted development is applied to Alternative A. Under this scenario, the BLM would only approve exploration well permits and the state would only proceed with the development identified in the Stipulation and Settlement Agreement as presented in Chapter 2. With regards to the BLM exploration wells, an RFD of 200 wells per RMP area was assigned to provide a level of quantification for analysis; however, the BLM has no actual upper cap on issuing exploration well permits. The RFD number in no way represents a regulatory number for exploration wells that could be issued by the BLM. The 400 BLM exploration wells, combined with the state's limited development, results in a total of 675 exploration wells and 250 production wells assumed under Alternative A.

Expanded Development

Expanded development is considered for Alternatives B, C, D, and E. Expanded refers to the number of potential wells based on known coal volumes that would be drilled in the CBM emphasis area during the next 20 years, regardless of mineral ownership. Given the current oil and gas stipulations, the restricted development areas, and the unknown geographical distribution of coal bed methane, it is unlikely that the maximum well density of 1 well per producing coal seam per 80 acres would be achieved. Map 4-1 indicates the predicted number of wells per county overlying known coal occurrences. The estimate for expanded development ranges from 10,000 to 26,000 wells drilled, which includes a potential 4,000 wells for each of the Crow and Northern Cheyenne reservations. The Powder River RMP area could host as many as 7,500 to 14,000 producing CBM

Map 4-1: CBM Development Based on Reasonable Foreseeable Development Scenario



Legend

POTENTIAL CBM WELLS

- Minimal
- 1 - 150
- 151 - 400
- 401 - 700
- 701 - 4000
- 4001 - 7000

- Powder River RMP Area
- Billings RMP Area
- Special Consideration Counties
- Native American Reservations

1:5,000,000

64,000 0 64,000 128,000 192,000 Meters

30 15 0 30 60 90 Miles

N W E S

This map shows the maximum number of CBM wells as described in the Reasonable Foreseeable Development Scenario. NOTE: Development on this map has been confined to the regions with known sub-bituminous coal occurences.

DATA SOURCES:

Counties: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana.
Reservations: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana.
Development Data: BLM Reasonable Foreseeable Development Scenario.

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wells during the next 20 years. The RFD also estimated that between 200 to 800 new conventional oil and gas wells could be drilled in the Powder River RMP area during the same time period. In the Billings RMP area, an estimated 1,000 to 2,400 producing CBM wells could be installed. Conventional oil and gas wells are estimated to increase by 250 to 975 during this same time. The expanded estimate for the three counties outside the RMP areas suggested that from 18 to 50 CBM wells could be drilled (Blaine 3 to 10, Gallatin 5 to 15, and Park 10 to 25), along with 150 to 500 conventional oil and gas wells.

The expanded development estimate also predicted the number of potential field and sales compressors needed to export the gas. This level of development would require from 400 to 1,000 field compressors and from 50 to 100 sales compressors. Estimates for the gathering and sales lines are also included in the RFD.

Assumptions Common to All Alternatives

Assumptions common to all alternatives address issues such as level of disturbance associated with various development scenarios, implementation of best management practices (BMPs), general assumptions for percentages of alternative themes and numbers for various field equipment utilized, well spacing for production of CBM, and water discharge and drawdown rates for expanded development.

Assumptions represent the best professional judgment of the specialists based on past experience, similar studies reviewed, and on the known circumstances for the given situation. These assumptions are used to ground the analysis so that similar comparisons can be conducted across the various resource topics and throughout the alternatives.

Levels of Disturbance

In evaluating environmental impacts, criteria for determining quantitative impacts are required. Further, to facilitate some uniformity with respect to impact analyses, the following synopsis was prepared to give a general understanding of the resources necessary for the installation and production of a single CBM well.

These values were determined from a variety of sources, including previous CBM Environmental Assessments, discussions with BLM and state personnel, discussions with CBM operators, and information derived from the review of numerous applicable documents. However, actual references are not provided as these numbers were ultimately derived through internal analysis based on understanding of current and proposed CBM activities in Montana and other areas (including Wyoming, Colorado, New Mexico, Arkansas, Alabama, and Oklahoma).

The values presented in Table 4-1 can be scaled to accommodate the various scenarios being proposed for exploration, construction and operation phases.

The following descriptions outline the assumptions used to develop Table 4-1:

Well Sites

Construction = 0.25 acres based on a 105-foot by 105-foot pad for exploration, construction and drilling operations

Operations = 0.058 acres based on a 50-foot by 50-foot pad for operations, well pad size may increase if multiple wells are drilled on the same pad, but total acres of disturbance would be less than separate well pads for single wells

Access Roads

Two-track = 0.30 acres based on 12-foot-wide roads by 0.21 miles/well (this applies to both construction and operation)

Graveled Roads = 0.11 acres based on 12-foot-wide roads by 0.075 miles/well (this applies to both construction and operation)

Bladed Roads = 0.075 acres based on 12-foot-wide roads by 0.05 miles/well (this is for construction phase only)

Bladed Roads = 0.090 acres based on 12-foot-wide roads by 0.06 miles/well (this is for operation phase only)

Bladed Roads = 0.75 acres based on 12-foot-wide roads by 0.5 miles/well (this is for exploration only)

Utility Lines

Water = 0.35 acres based on 15-foot by 0.20 miles/well (construction only)

Elec. Utility Overhead = 0.20 acres based on 10-foot by 0.15 miles/well (construction and operation)

Elec. Utility Underground = 0.35 acres based on 15-foot by 0.20 miles/well (construction only)

Transportation Lines

Low Pressure Gas = 0.90 acres based on 15-foot by 0.5 miles/well (construction only)

Intermediate Pressure Gas = 0.25 acres based on 25-foot by 0.08 miles/well (construction only)

Battery Site

Construction and Operation = 0.5 acre per battery site. Assume one battery site per field compressor. Disturbance per well = (0.5/24) = 0.020

Access Roads = 0.15 acres based on 25-foot by 0.050 miles/well during construction and operations

Field Compressors = 1 compressor/24 producing wells

Sales Compressors = 1 compressor/240 producing wells or 10 field compressors

Plastic line = 0.5 miles/well pad. Assume 3 wells per pad, 25-foot width

Gathering line = 2.0 miles/field compressor at 25-foot width or (5280*2*25/24/43,560) = 0.25 acres/well

Sales line = 6.0 miles/sales compressor at 25-foot wide. (6*5280*25/240/43,560) = 0.075 acres/well

Produced Water Management

Assume 1 discharge point for every 20 wells

Discharge points construction = 0.01 acres/point based on 20-foot by 20-foot area during construction

Discharge points operations = 0.002 acres/ point based on 10-foot by 10-foot area during operations

Storage impoundments = 6 acres/impoundment during construction per well pod of 20 wells, assume one acre reclaimed from construction so 5 acres/impoundment during operation per pod of 20 wells

Total Area of Disturbance

Exploration = 1.0 acres/well

Construction = 3.25 acres/well

Operation = 2.0 acres/well

Field Rules and Leasing Stipulations

The discussion of impacts assumes that the leasing stipulations described for each resource would be successfully implemented in each of the alternatives regardless of land ownership or management classes to which they apply. Existing Lease Stipulations and mitigation measures (see *Minerals Appendix*) are considered to be standard operating procedures by BLM. The MBOGC implements restrictions analogous to stipulations through the issuance of field rules. Field rules are applied on a case-by-case basis to protect resources on state land and private land. The Montana Board of Oil and Gas Conservation (MBOGC) reviews each operator's development plan and then issues field rules. The MBOGC will provide guidance to private landowners if requested on how and what to include in their leases to protect resources, but it is up to the individual lessor as to what they request from the operator in terms of reclamation, mitigation, and other measures. The Montana Trust Land Management Division (TLMD) of the Montana Department of Natural Resources and Conservation (DNRC) also has lease stipulations for their minerals as listed in the *Minerals Appendix*. The TLMD utilizes a set of standard stipulations on all oil and gas leases that is different from those used by BLM. Additional stipulations are placed on the leases on a case-by-case basis prior to their being leased. In addition, the TLMD undertakes a site-specific review process for exploration and operating plan proposals. This review process generates site-specific stipulations for issues such as steep topography, wildlife, streams, wooded areas, rivers/lakes. It was assumed that only requirements contained in existing federal and state law that apply to private land ownership will be enforced on private land.

Stipulations and field rules are intended to avoid potential effects on resource values and land uses from oil and gas activities and include actions such as site clearances and occupancy and timing restrictions. Lease stipulations would be implemented before conducting exploration, production, and abandonment activities. The following discussion of project impacts assumes that applicable stipulations and field rules would be fully implemented and followed. The success of these stipulations or field rules in avoiding covered impacts, in some instances, will require collection of site specific information regarding the resources to be protected relative to exploration, production, and abandonment plans followed by strict adherence to the terms of the stipulations and field rules. Planned monitoring activities for all resources have been outlined in a table attached in the *Monitoring Appendix*. Impacts described include those that would occur in spite of the successful implementation of stipulations or field rules, or where stipulations or field rules are not expected to avoid all impacts.

TABLE 4-1
LEVEL OF DISTURBANCE

Facilities		Exploratory Well Disturbance (acres/well)	Construction Disturbance (acres/well)	Operation/Production Disturbance (acres/well)
Well Sites		0.25	0.25	0.05
Access Roads/ Routes to Well Sites	Two-track	N/A	0.30	0.30
	Graveled	N/A	0.10	0.10
	Bladed	0.75	0.075	0.10
Utility Lines	Water	N/A	0.35	----[1]
	Overhead Elec.	N/A	0.20	0.20
	Underground Elec.	N/A	0.35	----
Transportation Lines	Low Pres. Gas	N/A	0.90	----
	Intermediate Pres. Gas	N/A	0.25	----
Processing Area	Battery Site	N/A	0.020	0.020
	Access Roads	N/A	0.15	0.15
	Field Compressor	N/A	----	(0.5/24) = 0.02
	1/24 producing wells			
	Sales Compressor	N/A	----	(1.0/240) = 0.005
	1/10 Field Compressors			
	[2]Plastic Line	N/A	----	0.5
	Gathering Line	N/A	----	0.25
	Sales Line	N/A	----	0.075
Produced Water Management	Discharge Point	N/A	0.01	0.002
	Storage Impoundment	N/A	0.3	0.25
Total Disturbance		1.0	3.25	2.0

Note: This table shows levels of disturbance associated with exploration and development of CBM wells and field transfer equipment. All values represent acres per well unless otherwise noted.

[1]All utilities are completed underground and the land above is reclaimed so the acres of disturbance are removed from the operation column. **Note:** The intent of reclamation is to stabilize the area of disturbance and establish a vegetative cover similar to the native plant community that existed prior to disturbance. Reclamation success will vary as described in the Vegetation section.

[2]Lines within processing area are assumed to disturb an average width of 25 feet.

Proposed mitigation measures are intended to minimize the impacts that cannot be avoided. Mitigation measures also apply to all alternatives on BLM and state lands. Residual impacts are those expected to remain after the implementation of mitigation measures.

General Assumptions

General assumptions address the various alternative themes and apply numerical interpretations to the theme explanations. The following assumptions apply to each alternative:

- The spacing for CBM wells would be similar to CBM well spacing in Wyoming with one well per 80 acres per coal seam. Up to three coal seams have been identified for possible methane extraction in the Powder River Basin. This would result in three wells drilled per 80 acre spacing unit.
- The life of a typical CBM production well is assumed to be 20 years.
- It is assumed that a single CBM well will drain the methane from a single coal seam over an 80-acre unit. Research by the BLM in the Wyoming portion of the Powder River Basin suggests that drainage may be across a broader radius (Crockett and Meyer 2001). Drainage issues will need to be assessed on a case-by-case basis to determine the drainage radius, which will depend upon local reservoir parameters.
- The level of disturbance associated with a production well is the same regardless of the method of completion, whether a single well bore per coal seam or multiple seam completions in a well bore.
- Typical drilling operations for each CBM well, regardless of whether it was a CBM exploration or production well, would require 3 to 5 days with an additional 2 to 3 days for completion work. A maximum of 7 to 8 people would be present on a well at any one time during this construction phase.
- Approximately 8,000 gallons of water would be needed to drill each well. The water will be obtained from the local river, streams, wells, or reservoirs trucked into remote sites as needed.
- Equipment present at each well site during construction would consist of the following: one or two truck-mounted drill rig(s), with three men per rig; one backhoe; one blade; three crew pick-up trucks; one well logging truck; one pipe truck; two to four water trucks; one cement truck; one electrical generator trailer; one frac tank for waste water; and two large flat bed trailers. Not all vehicles would be at the well site at the same time or for the entire duration of drilling and completion operations.
- Portable toilets would be available at the drill sites. Garbage would be stored in closed containers. Sewage and solid waste would be hauled offsite to permitted disposal facilities.
- Each CBM well would be equipped with a submersible pump ranging from 3 to 20 horsepower, depending on well depth and other site conditions.
- Exploration wells would be visited once a day during testing and pumping operations. Pump tests could last as long as 6 months depending on the time required for measuring cumulative methane production estimates. Methane would be flared (burned off) continuously during the testing phase.
- Fuel for generators during exploration testing would be either gas (propane) or diesel and require at least one trip to the well site weekly. Small generators used during testing would be mobile, enclosed, and between 15 to 20 kW.
- A larger generator used during production would serve several wells (three to four) and be in the range of 75 to 125 kW.
- Under Alternatives B, C, and D, the number of exploration/dry holes would be approximately 10 percent of the total estimated wells drilled. Furthermore, all exploration/dry holes would be drilled in the first 5 years of development.
- Under Alternatives A and C, the number of wells connected to each compressor would be per operators plans; it is assumed that this is consistent with the RFD of 24 wells per compressor. This estimate is based on an average well production rate of 250,000 cubic feet per day methane being sent to a 6 million cubic feet per day, four-stage reciprocal compressor operating at 380 horsepower and using natural gas.
- Under Alternatives B and D, the number of wells connected to each compressor would be maximized; this is assumed to be approximately 35 wells at average production going to a 9 million cubic feet per day, four-stage reciprocal compressor. The maximization of well

connections would reduce the number of field compressor sites and air emissions.

- No hydraulic fracturing or cavitation would be required to stimulate wells; however, low-pressure, low-volume water enhancement may be used. This would involve flushing the well with a few hundred gallons of water to clean the face of coal surface in the exposed seam. This process does not fracture the coal; it simply cleans out the existing fractures.

- Under Alternatives B and D in the theme of CBM, multiple completions in a single borehole would be required. It is assumed that a small reduction in surface disturbance would be experienced, but that the levels of disturbance previously described are acceptable for these alternatives without alteration.

- Under *Lands and Realty*, when no transportation corridors are required, it is assumed that the utility lines (power, water, and gas) would be placed along separate routes, or in existing disturbances to and from the well site locations or compressor batteries, whichever is more suitable to the operator. When transportation corridors are required, it is assumed that they would be placed adjacent to access roads and along existing disturbances, resulting in a 35 percent reduction of disturbed surface areas.

- Concerning *Socioeconomics* it is assumed that the state would not enforce buffer zones on their minerals or on private minerals since they do not have a trust responsibility.

- The potential development on the reservations would be considered under the cumulative effects analysis based on the development outline in the RFD for the reservations.

- Under the *Hydrology* theme for Alternative B, untreated CBM water from exploration wells would be placed in tanks and disposed of at a permitted injection well. It is assumed that the use of pits, impoundments, and other holding facilities as permitted under Alternative A would be allowed. In addition, it is assumed produced water would be injected into a deeper aquifer of lesser quality with no communication to aquifers used as sources of drinking water or into coal seam aquifers.

- Under the *Hydrology* theme for Alternatives C and D, produced water would be available for beneficial use. It is assumed that industries and landowners would use approximately 20 percent of the produced water. The estimate of 20 percent is based on the observed beneficial uses at the CX Ranch, and in Wyoming and on the perceived potential for similar uses throughout the emphasis area.

Resource Topics

Air Quality and Climate

Assumptions

Fugitive dust and exhaust from construction activities, along with air pollutants emitted during operation (i.e., well operations, injection well and pipeline compressor engines, etc.), are potential causes of air quality impacts. These issues are more likely to generate public concern where natural gas development activities occur near residential areas. The Federal Land Managers (FLM), including the U.S. Department of Agriculture (USDA)—Forest Service (FS), the U.S. Department of the Interior (USDI)—National Park Service (NPS), and the USDI—U.S. Fish & Wildlife Service (FWS), have also expressed concerns regarding potential visibility and atmospheric deposition (acid rain) impacts within distant downwind Prevention of Significant Deterioration (PSD) Class I and PSD Class II areas under their administration, located throughout Montana, Wyoming, southwestern North Dakota, western South Dakota, northwestern Nebraska, and northeastern Utah.

Air pollution impacts are limited by state, tribal and Federal regulations, standards, and implementation plans established under the Clean Air Act and administered by the applicable air quality regulatory agency (including the Montana Department of Environmental Quality—Air and Waste Management Bureau (MTDEQ-AWM) and the U.S. Environmental Protection Agency [EPA]). Although not applicable to the development alternatives, the Wyoming Department of Environmental Quality—Air Quality Division (WYDEQ-AQD) has similar jurisdiction over potential air pollutant emission sources in Wyoming, which may have a cumulative impact with MTDEQ-AWM approved sources. Air quality regulations require proposed new, or modified existing air pollutant emission sources (including gas compression facilities) to undergo a permitting review prior to construction. Therefore, the applicable air quality regulatory agencies have the primary authority and responsibility to review permit applications and to require emission permits, fees and control devices, prior to construction and/or operation.

In addition, the U.S. Congress (through the Clean Air Act Section 116) authorized local, state, and tribal air quality regulatory agencies to establish air pollution control requirements more (but not less) stringent than Federal requirements. Additional site-specific air quality analysis would be performed, and additional emission control measures (including a BACT analysis and determination) may be required by the applicable air quality regulatory agencies to ensure protection of air quality.

In addition, under the Federal Land Policy and Management Act (FLPMA) and the Clean Air Act, BLM cannot authorize any activity which does not conform to all applicable local, state, tribal, and Federal air quality laws, statutes, regulations, standards, and implementation plans. Therefore, land use authorizations will specify that operating conditions (i.e., air pollutant emissions limits, control measures, effective stack heights, etc.) are consistent with the applicable air regulatory agency's requirements.

The significance criteria for potential air quality impacts include state, tribal, and federally enforced legal requirements to ensure air pollutant concentrations will remain within specific allowable levels. These requirements include the National and Montana Ambient Air Quality Standards which set maximum limits for several air pollutants, and PSD increments which limit the incremental increase of certain air pollutants (including $N0_2$, PM-10 and $S0_2$) above baseline concentration levels. These ambient air quality limits were presented in Chapter 3—Affected Environment.

Impacts from Management Common to All Alternatives

Impacts to air quality would be localized and short-term in duration, lasting from hours to days. A more detailed discussion of potential air quality impacts from conventional oil and gas development is presented in the *Final Oil and Gas Amendment, Billings—Powder River—South Dakota RMPIEIS, Miles City District Appendix D—Air Quality* (BLM 1992).

There would be no measurable impacts to climate under any of the proposed Alternatives.

Impacts from Management Specific to Each Alternative

Alternative A

Given the lower level of anticipated CBM development, potential air quality impacts are anticipated to be within applicable air quality standards, and would be less than those described for Alternative C below.

Crow Reservation

The Crow reservation would experience air quality changes less than those discussed under Alternative C. Potential air quality impacts to Tribal Lands are anticipated to be within applicable air quality standards.

Northern Cheyenne Reservation

The Northern Cheyenne reservation would experience air quality changes less then those discussed under Alternative C. Potential air quality impacts to Tribal Lands are anticipated to be within applicable air quality standards.

Mitigation

Roads and well locations constructed on soils susceptible to wind erosion could be appropriately surfaced to reduce the amount of fugitive dust generated by traffic or other activities, and dust inhibitors (i.e., surfacing materials, nonsaline dust suppressants, water, etc.) could be used as necessary on unpaved collector, local, and resource roads which present a fugitive dust problem. To further reduce fugitive dust, operators could establish and enforce speed limits on all project-required roads in and adjacent to the Project Area.

Conclusion

Future development activities must comply with applicable state, tribal, and Federal air quality laws, statutes, regulations, standards, and implementation plans. Some increase in air pollutant emissions would occur as a result of this development alternative. However, based on the "reasonable, but conservative" assumptions, direct and cumulative impacts are assumed to be within applicable air quality standards.

Alternative B

Employing directional drilling techniques and requiring natural gas-fired compressors, potential air quality impacts are anticipated to be within applicable air quality standards, and would be less than those described for Alternative C below.

Crow Reservation

The Crow reservation would experience air quality changes less than those discussed under Alternative C. Potential air quality impacts to Tribal Lands are anticipated to be within applicable air quality standards.

Northern Cheyenne Reservation

The Northern Cheyenne reservation would experience air quality changes less then those discussed under Alternative C. Potential air quality impacts to Tribal Lands are anticipated to be within applicable air quality standards.

Mitigation

Roads and well locations constructed on soils susceptible to wind erosion could be appropriately surfaced to reduce the amount of fugitive dust generated by traffic or other activities, and dust inhibitors (i.e., surfacing materials, nonsaline dust suppressants, water, etc.) could be used as necessary on unpaved collector, local, and resource roads which present a fugitive dust problem. To further reduce fugitive dust, operators could establish and enforce speed limits (15 mph) on all project-required roads in and adjacent to the Project Area.

Conclusion

Future development activities must comply with applicable state, tribal, and Federal air quality laws, statutes, regulations, standards, and implementation plans. Some increase in air pollutant emissions would occur as a result of this development alternative. However, based on the "reasonable, but conservative" assumptions, direct and cumulative impacts are assumed to be within applicable air quality standards.

Alternative C

Air quality impacts would occur during construction (due to surface disturbance by earth-moving equipment, vehicle traffic fugitive dust, well testing, and drilling rig and vehicle engine exhaust) and production (including well production equipment, nitrogen injection, and pipeline compression engine exhausts). Applying water or chemical surfactants to disturbed soils would control the amount of air pollutant emissions during construction. Air pollutant emission limitations imposed by applicable air quality regulatory agencies would influence the amount and frequency of water or chemical surfactant applied. Actual air quality impacts depend on the amount, duration, location and emission characteristics of potential emissions sources, as well as meteorological conditions (wind speed and direction, precipitation, relative humidity, etc.).

Construction emissions would occur during limited road building, well drilling, and completion testing. During well completion testing, natural gas could be burned (flared) for a limited time. Hydrogen sulfide

(H_2S) is not anticipated to be a concern since the gas fields are typically "sweet" (containing negligible concentration of sulfur compounds). However, should H_2S be encountered during drilling, operators must comply with Oil and Gas Order Number 6, which requires special precautions to protect worker and public safety. Maximum air pollutant emissions from each well would be temporary (i.e., occurring during a limited construction period) and would occur in isolation, without appreciably interacting with adjacent well locations. Where needed, particulate matter emissions from well pad and resource road construction would be minimized by application of water and/or chemical dust suppressants. The control efficiency of these dust suppressants would be 50 percent during construction. In addition, particulate matter concentrations would decrease rapidly from the emission source. The maximum short-term (3- and 24-hour) $S0_2$ emissions would be generated by drilling rigs and other diesel engines used during the drilling and completion operations (sulfur is a trace element in diesel fuel). Since these PM-10 and $S0_2$ construction emissions would be temporary, PSD increments are not applicable.

Operation emissions (primarily CO and NO_x) would occur due to increased compression requirements. Since produced coal bed natural gas is nearly pure methane and ethane, with little or no liquid hydrocarbons, no substantial direct volatile organic compound (VOC) emissions would occur due to well operations. The maximum direct annual $N0_2$ impact would be below the applicable annual PSD Class II increment. All NEPA analysis comparisons to the PSD Class II increments are intended to evaluate a threshold of concern, and do not represent a regulatory PSD Increment Consumption Analysis.

Potential formaldehyde (a listed Hazardous Air Pollutant, or HAP) impacts could occur very close to pipeline compressor engines. However, neither the MTDEQ-AWM nor EPA has established HAP standards. It is assumed potential 8-hour HAP concentrations would be below a range of maximum Acceptable Ambient Concentration Levels identified in other states. Maximum formaldehyde concentrations would occur adjacent to a compressor station; as the distance from the emission source increases, the potential concentrations would decrease rapidly.

Although well development would cause short-term (less than five years) impacts to air quality during construction, drilling and completing oil or gas wells, long-term (over five years) operational impacts would occur throughout the life of a typical oil or gas well, until plugging and abandonment.

It is important to note that before actual development could occur, the applicable air quality regulatory agencies (including the state, tribe, or EPA) would review specific air pollutant emissions preconstruction permit applications, which examine potential project-wide air quality impacts. As part of these permits (depending on source size), the air quality regulatory agencies could require additional detailed air quality impacts analyses or mitigation measures. Thus, before development occurs, additional site-specific air quality analyses would be performed to ensure protection of air quality.

Since the direct Alternative C and cumulative air pollutant emission sources constitute many minor sources spread out over a very large area, it is unlikely the maximum potential air quality impacts at downwind PSD Class I areas (including Northern Cheyenne Tribal Lands), or other "sensitive receptors," would: 1) exceed the PSD Class I $N0_2$ increment; 2) cause noticeable nitrate and sulfate atmospheric deposition (and their related impacts) in sensitive lakes; or 3) cause perceptible visibility impacts (regional haze).

Crow Reservation

The Crow reservation would experience air quality changes similar to those discussed above. As noted, no major changes in air quality or violation of applicable Federal, state, or tribal air quality standards would occur.

Northern Cheyenne Reservation

The Northern Cheyenne reservation would experience air quality changes similar to those discussed above. As noted, no major changes in air quality or violation of applicable federal, state, or tribal air quality standards would occur.

Mitigation

Roads and well locations constructed on soils susceptible to wind erosion could be appropriately surfaced to reduce the amount of fugitive dust generated by traffic or other activities, and dust inhibitors (i.e., surfacing materials, nonsaline dust suppressants, water, etc.) could be used as necessary on unpaved collector, local and resource roads which present a fugitive dust problem. To further reduce fugitive dust, operators could establish and enforce speed limits (15 mph) on all project-required roads in and adjacent to the Project Area.

Conclusion

Future development activities must comply with applicable state, tribal, and Federal air quality laws, statutes, regulations, standards, and implementation plans. Some increase in air pollutant emissions would occur as a result of this development alternative. However, based on the "reasonable, but conservative" assumptions, direct and cumulative impacts are assumed to be within applicable air quality standards.

Alternative D

Requiring a combination of natural gas-fired and electric compressors, potential air quality impacts are anticipated to be within applicable air quality standards, and would be less than those described for Alternative C above.

Crow Reservation

The Crow reservation would experience air quality changes less than those discussed under Alternative C. Potential air quality impacts to Tribal Lands are anticipated to be within applicable air quality standards.

Northern Cheyenne Reservation

The Northern Cheyenne reservation would experience air quality changes less than those discussed under Alternative C. Potential air quality impacts to Tribal Lands are anticipated to be within applicable air quality standards.

Mitigation

Roads and well locations constructed on soils susceptible to wind erosion could be appropriately surfaced to reduce the amount of fugitive dust generated by traffic or other activities, and dust inhibitors (i.e., surfacing materials, nonsaline dust suppressants, water, etc.) could be used as necessary on unpaved collector, local, and resource roads which present a fugitive dust problem. To further reduce fugitive dust, operators could establish and enforce speed limits (15 mph) on all project-required roads in and adjacent to the Project Area.

Conclusion

Future development activities must comply with applicable state, tribal, and Federal air quality laws, statutes, regulations, standards, and implementation plans. Some increase in air pollutant emissions would occur as a result of this development alternative. However, based on the "reasonable, but conservative" assumptions, direct and cumulative impacts are assumed to be within applicable air quality standards.

Alternative E (Preferred Alternative)

By encouraging multiple-well directional drilling at a site and optimizing the number of wells connected to a compressor, potential air quality impacts are anticipated to be within applicable air quality standards, and would be less than those described for Alternative C above.

Crow Reservation

The Crow reservation would experience air quality changes less than those discussed under Alternative C. Potential air quality impacts to Tribal Lands are anticipated to be within applicable air quality standards.

Northern Cheyenne Reservation

The Northern Cheyenne reservation would experience air quality changes less than those discussed under Alternative C. Potential air quality impacts to Tribal Lands are anticipated to be within applicable air quality standards.

Mitigation

Roads and well locations constructed on soils susceptible to wind erosion could be appropriately surfaced to reduce the amount of fugitive dust generated by traffic or other activities, and dust inhibitors (i.e., surfacing materials, nonsaline dust suppressants, water, etc.) could be used as necessary on unpaved collector, local, and resource roads which present a fugitive dust problem. To further reduce fugitive dust, operators could establish and enforce speed limits (15 mph) on all project-required roads in and adjacent to the Project Area.

Conclusion

Future development activities must comply with applicable state, tribal, and Federal air quality laws, statutes, regulations, standards, and implementation plans. Some increase in air pollutant emissions would occur as a result of this development alternative. However, based on the "reasonable, but conservative" assumptions, direct and cumulative impacts are assumed to be within applicable air quality standards.

Cultural Resources

Assumptions

Cultural resources would be treated similarly and equally in terms of type, composition, and significance; their distributions and densities are detailed in Table 3-2 in Chapter 3. Surface disturbance assumptions are detailed in the *Analysis Assumptions and Guidelines* section of this chapter. There would be 1 site for every 100 acres surveyed for cultural resources. This assumption was made by averaging the number of sites vs. acres surveyed in the planning area.

Impacts From Management Common To All Alternatives

Cultural resources would be impacted by surface and subsurface disturbing activities. Activities that involve the use of heavy equipment (road construction, well drilling, pad construction, pipeline and utility placement, etc.) that result in changes to the natural landscape cause the most disturbance and have the greatest effect on cultural resources. Other activities, such as increased travel and vandalism resulting from access improvements, and increased erosion resulting from surface disturbances, would also impact cultural resources. These activities can also produce indirect impacts to cultural resources from fires; and to rock art sites from gas emissions, abrasive dust, and vibrations from drilling equipment. Noise, activity, traffic and smells can affect the quality and continued use of traditional cultural sites.

Impacts would occur at an estimated 318 cultural resource sites. Thirty-two to forty-six of these sites are projected to be National Register of Historic Places eligible. The estimated number of sites include 176 cultural resource sites from disturbance by conventional oil and gas development, and 142 sites as a result of impacts caused by the proposed Tongue River Railroad and surface coal mining activities.

Mitigation

The laws and regulations established for cultural resources were established to minimize and mitigate impacts to cultural resources. Cultural resource inventories prior to development attempt to discover properties before they can be impacted, so that appropriate plan changes are implemented. These inventories may not find all sites prone to impact during surface and subsurface activities. Unavoidable impacts may occur to cultural resources that are not identified by surveys. To minimize impact to cultural resources surface and subsurface disturbance may need to be monitored. Cultural resources may also be damaged or destroyed by unauthorized disturbances (pot hunting) and vandalism particularly once access to previously inaccessible areas is opened as a result of CBM development. The cultural resources survey should extend outside the area of direct CBM development in order to evaluate, and mitigate if necessary, the potential impact to cultural resources by unauthorized disturbance, vandalism, and secondary and indirect impacts. A lease notice tells the lessee that cultural resources may be present, also that the surface management agency would have to examine the site and may specify mitigation measures. Lease Stipulations (BLM 1994), which require inventory and mitigation measures, can benefit cultural resources by delineating and minimizing impacts to these resources. Noteworthy cultural sites that could not be avoided through project relocation would be mitigated through data recovery or excavation. Although mitigation by excavation recovers valuable data, the process of archeological excavation using the most current methods and technology still results in the destruction of sites and loss of some data. Sites that have religious or sacred values cannot be mitigated through standard mechanical or archival means, and some sites exist that cannot be mitigated at all. Despite these efforts some cultural resources will be lost but the recording of these resources will enrich local and state knowledge of past cultures.

Impacts from Management Specific to Each Alternative

Alternative A

Alternative A has the least impact to cultural resources of all alternatives since this alternative has the least amount of surface and subsurface disturbance. Approximately 17 cultural resource sites would be disturbed by all projected CBM activities in state and BLM planning areas. An estimated four sites would be impacted from exploration activities in state planning areas; six sites would be impacted from production activities at CX Ranch; and seven would be impacted from exploration activities in BLM planning areas. One or two of these disturbed sites could be found eligible for the National Register of Historic Places. There would be no production activities in BLM planning areas under this alternative and therefore no impacts from production.

Crow Reservation

Impacts to the Crow Reservation are not expected because no exploration wells are planned for installation on the Reservation at this time. However if exploration wells were to be drilled on the Reservation the likelihood of site impacts would occur at a similar frequency as described for Cultural Resources in general.

Northern Cheyenne Reservation

Impacts to the Northern Cheyenne Reservation also are not expected at this time because the Northern Cheyenne have not indicated that exploration wells would be drilled. As with the Crow Reservation, it is anticipated that when and if the Northern Cheyenne explore their Reservation for CBM resources cultural sites would be encountered on the same regularity as described for Cultural Resources in general. It is conceivable though that the density of cultural sites would be increased on the Reservation resulting in an increase in cultural site disturbance during exploration activities.

Conclusion

Over the next 20 years, disturbances from CBM development, conventional oil and gas development, and other cumulative effect analysis project activities could identify 4,285 cultural resource sites of which 430 to 612 would be eligible for the National Register requiring mitigation. Impacts from surface disturbance would be minimized by using existing disturbances where possible, and by allowing aboveground utility lines. The impacts from erosion as a result of surface discharge of produced water at CX Ranch would be negligible because of the conveyance systems used to transport the relatively small amount of discharged water. The mitigation measures would be the same as those discussed in the *Impacts From Management Common to All Alternatives* section above. However, given the number of acres likely to be disturbed by all anticipated CBM development, it is unlikely that it would be necessary to mitigate sites or cultural properties through data recovery. In almost all situations, direct impacts to cultural properties would be avoided by relocating well sites or pipelines. Monitoring may indicate sites adjacent to the development fields are being indirectly affected by vandalism in which case data recovery would be the preferred mitigation.

These are the best estimates of cultural resources that can be derived at this level of study. It is understood that sites occur in clusters based on a host of various criteria (location to water, slope, view, predominate wind, etc) and that some sites are more important than others. A cultural resource location and significance model would be an important and useful tool to help identify areas of critical concern.

Alternative B

Under this alternative, an estimated 629 cultural resource sites would be disturbed by all projected CBM activities in state and BLM planning areas. Of these sites, 119 to 170 could be found eligible for the National Register of Historic Places. An estimated 16 sites would be impacted by exploration activities in state planning areas, 335 sites from production activities in state planning areas, 10 sites from exploration activities in BLM planning areas, and 269 sites from production activities on BLM planning areas.

Crow Reservation

Impacts to the Crow Reservation would be the same as described for Cultural Resources in general. Disturbance totals include sacred Native American sites that would be identified and impacted from the above mentioned activities.

Northern Cheyenne Reservation

Impacts to the Northern Cheyenne Reservation would be the same as described for Cultural Resources in general. Disturbance totals include sacred Native American sites that would be identified and impacted from the above mentioned activities.

Conclusion

Over the next 20 years, disturbances from CBM development in state, BLM, Native American, and U.S. Forest Service planning areas; conventional oil and gas development; the proposed TRR; and surface coal mining activities would impact approximately 5,135 cultural resource sites. Of those sites 515 to 735 would be eligible for the National Register, and may require mitigation. These totals include sacred Native American sites that would be identified and impacted from the above mentioned activities. The requirement of transportation corridors, one-way in-and-out roads, and the prevention of surface discharge of produced water would help to minimize the number of cultural resource sites impacted. The mitigation measures would be the same as those discussed in the *Impacts From Management Common to All Alternatives* section above.

Alternative C

Under this alternative, impacts to cultural resources would be similar to Alternative B with the following exceptions: transportation corridors are not required, thereby increasing the number of disturbed acres and hence disturbed sites; discharge of produced water directly to the ground surface would increase erosion and site disturbance; power lines may be aboveground or buried, which would decrease the number of disturbed acres. The estimated number of cultural resources disturbed under Alternative C would total 629 with 119 to 170 of these sites being found eligible for the National Register of Historic Places.

Crow Reservation

Impacts to the Crow Reservation would be the same as described for Cultural Resources in general.

Northern Cheyenne Reservation

Impacts to the Northern Cheyenne Reservation would be the same as described for Cultural Resources in general.

Conclusion

Cumulative impacts would be similar to Alternative B with some exceptions. The surface disturbance from roads and utilities would be greater because one-way in-and-out roads and transportation corridors would not be required. Cultural resource inventories would be conducted along the surface watercourses. Surface discharge of produced water would result in increased erosion. The discharge of produced water to the surface would increase erosion and cause increased surface disturbance. The increased surface disturbance would be in the area near the production area, and in the downstream segments of perennial streams and valleys leading to the major surface waters. Further discussion of erosion and the disturbances to soils can be found in the *Soils* section of this chapter. Mitigation measures would be similar to Alternative B with some exceptions. Mitigation measures would include the use of piping instead of discharging waters into drainage ditches in order to minimize erosion.

Alternative D

Under this alternative, impacts to cultural resources would be similar to Alternative B.

Crow Reservation

Impacts to the Crow Reservation would be the same as described for Cultural Resources in general.

Northern Cheyenne Reservation

Impacts to the Northern Cheyenne Reservation would be the same as described for Cultural Resources in general.

Conclusion

Cumulative impacts would be similar to Alternative B. Mitigation measures would be the same as for Alternative B.

Alternative E (Preferred Alternative)

Under this alternative the impact to cultural resources would be similar to Alternative B with the following exceptions: the removal of an inactive buffer zone around active coal mines and reservations would increase the potential acreage for CBM development and hence increase the number of impacted cultural resources; there might be a decrease in the number of well pads since operators might be able to use vertical wells for deep coal seams decreasing the impact to cultural resources; transportation corridors are not required, thereby increasing the number of disturbed acres and hence disturbed sites; power lines may be aboveground or buried, which would decrease the number of disturbed acres. The operator’s project plan would help develop a survey identification strategy and increase the likelihood of site identification and implementation of mitigation measures. The estimated number of cultural resources disturbed under Alternative E would total 629 with 119 to 170 of these sites being found eligible for the National Register of Historic Places.

Conclusion

Cumulative impacts would be similar to Alternative B. Mitigation measures would be the same as for Alternative B.

Environmental Justice

Assumptions

The purpose of this analysis is to report whether high and adverse human health or environmental effects of the proposed alternatives are likely to fall disproportionately on minority or low-income populations. This analysis focuses on the populations that are located within the areas potentially affected by the alternatives. It examines where expected high and adverse impacts, if any, fall relative to minority and low-income populations. In order to make a finding that a proposed project is inconsistent with the Environmental Justice policy established in Executive Order (EO) 12898 and described in Section 4.10.1.7, two situations must occur at the same time: 1) there must be a minority or low-income population; and 2) that population must receive a disproportionately high and adverse environmental or human health impact.

Two options are considered depending on what the impacts are:

- If adverse impacts are identified in the resource analyses, the individual occurrence potential, where relevant, is analyzed for disproportionate effects on minority and/or low-income populations.
- If no adverse impacts are reported in the resource analyses, then no NEPA environmental justice issues would be expected as a result of any of the alternatives. Therefore, it is concluded that no adverse human health or environmental effects would be expected to fall disproportionately on minority or low-income populations. Consequently, none of the impacts of the proposed action can be described as having a high and adverse impact in the context of EO 12898. The proposed alternatives are therefore consistent with the policy established in EO 12898.

Impacts from Management Common to All Alternatives

Current management of conventional oil and gas resources does not appear to disproportionately impact minority populations.

Mitigation

Under management common to all alternatives, the EO and guidance are expected to bolster minority participation in future BLM management decisions. This participation will assist in these under-represented groups achieving greater political efficacy.

Impacts From Management Specific to Each Alternative

Alternative A

A review of the resources analyses prepared for the management objectives described under the existing management alternative revealed that no adverse impacts of concern warrant further analysis for disproportionate effects to minorities or low-income populations, with the exception of CBM-produced waters being discharged into the Little Bighorn River and the Tongue River Reservoir from Wyoming CBM activities. See reservation discussions below.

Crow Reservation

The Little Bighorn River, which originates in Wyoming and flows onto the Crow Reservation, would experience impacts to its water quality. The changes in water quality would be dependent upon the Final Water Quality Agreement signed between Montana and Wyoming. Impacts could range from a negligible effect to a modest increase in Sodium Adsorption Ratio (SAR), Total Dissolved Solids (TDS), electrical conductivity (EC), and bicarbonate. If the agreement allows for some CBM-produced water to be discharged into the Little Bighorn River, the resulting downstream water would increase SAR, EC, TDS, and bicarbonate, thus the tribe's beneficial use of that water may be diminished. No health effects are foreseen from the change in water quality or the consumption of downstream fish present in the Little Bighorn River. No other impacts are anticipated from the other resource topics analyzed.

Northern Cheyenne Reservation

Impacts to the Northern Cheyenne's Water Right in the Tongue River Reservoir would be the result of Wyoming allowing CBM-produced waters to be discharged into the Tongue River, altering the water quality of the reservoir. The range of water quality changes would be dependent upon the Final Water Quality Agreement between Montana and Wyoming. The scenarios for possible impact ranges are described in detail in the *Hydrology* section of this chapter. Worth mentioning though, is that even a slight change in water quality to the reservoir would impact the Northern Cheyenne's ability to market their water as a commodity and reduce their own beneficial uses. Other resource topics do not indicate any other impacts would be felt on the reservation from this alternative.

Mitigation

Mitigation for the potential impacts to the surface water concerns of both tribes could be somewhat alleviated by their participation in the state-to-state discussions regarding the Water Quality Agreement. Furthermore, if either tribe were to obtain self-governance over their water quality, they could act as a state and set their own water quality or non-degradation standards and negotiate with Wyoming for an altered agreement more in line with their specific needs and concerns.

Conclusion

No adverse impacts, with the exception of the undetermined Wyoming discharge influence, are reported in the resource analyses. It is concluded that no adverse human health or environmental effects would be expected to fall disproportionately on minority or low-income populations from this alternative.

Alternative B

A review of the resource analyses conducted for Alternative B indicates that the following impacts would have effects, which warrant further review for occurrence potential, and relevance to disproportionate effects on minority or low-income populations. The impacts included in this evaluation are the drawdown of groundwater; air quality changes; and changes to vegetation and soils.

Groundwater Drawdown

CBM production in Montana would result in the depletion of an estimated 21 percent (ALL 2001b) of the groundwater resources in Montana's Powder River Basin watersheds. This drawdown would be basinwide and correspond to the geographical distribution of production wells. The occurrence potential is not localized and would not impact segregated portions of the population, the impact would be felt evenly across the region. Furthermore, the drawdown has the potential to reduce surface water flows in some drainages depending on specific site conditions. The availability of groundwater is important, as many rural families depend on the supply of groundwater for their household and ranch/agricultural (irrigation) applications.

Air Quality Changes

CBM development in the Powder River Basin would necessitate the construction of many minor emission sources spread out over a very large area. It is unlikely the maximum potential air quality impacts at downwind mandatory Federal PSD Class I areas, or at other "sensitive receptors" would exceed the PSD Class I NO_2 increment; cause substantial nitrate and sulfate atmospheric deposition (and their related impacts) in sensitive lakes; or cause perceptible visibility impacts (regional haze).

The negligible changes in air quality from development would be widespread and distributed across the region. The impacts associated with the dispersion of air pollutants across the region would not be disproportionately distributed upon any minority or low-income groups.

Crow Reservation

Under this alternative, a 2-mile buffer zone would be enforced on federal minerals around the reservation to restrict development of minerals adjacent to these boundaries. This buffer zone would delay some of the groundwater drawdown impact associated with federal pumping but would not prevent state and private mineral estates from being developed adjacent to the reservation. Therefore, drawdown will affect Indian populations within the Crow Reservation adjacent to off-reservation development.

The Crow tribal government derives some of its income from operator lease fees: ranchers and irrigators operating both on private and reservation lands. If these operators were to experience a reduction in available groundwater that impacted their operations and the Crow Tribe subsequently changed the fees the tribe would be able to collect. Trust agencies might be needed to resolve conflicts. Ideally, the form of resolution most desirable would be the replacement of water resources and the according adjustment in fees. However, if the replacement of water resources could not be achieved because of site-specific conditions or other variables, the loss in potential income generation from reduced fees and limited new fee opportunities could be viewed as environmental justice impairment.

Northern Cheyenne Reservation

The Northern Cheyenne Tribe would experience similar groundwater drawdown and potential operator lease fee issues as discussed under the Crow Reservation section above.

As described under the above Air Quality Changes section, no adverse impacts are anticipated from CBM infrastructure development to PSD Class I areas, including the Northern Cheyenne's PSD Class I area.

Mitigation

Mitigation measures for groundwater drawdown and air emission sources would be consistent with the previously mentioned measures discussed under these two resource topics.

Conclusions

If the Northern Cheyenne and Crow tribes elected to develop their CBM resources the federal buffer zone would be eliminated and drawdown impacts from adjacent federal mineral developments would increase the effect on the reservation. An additional 11 percent of drawdown would be experienced across the basin watersheds from the Northern Cheyenne and Crow tribal developments (see *Hydrology* section for details). If the tribe's CBM resources were drilled to the levels estimated in the RFD (4,000 wells for each reservation), the depletion of the groundwater resource would increase to 32 percent across the region and cause a hardship on numerous low-income and minority populations, which are prevalent throughout the area. However, water well and spring mitigation agreements are required by the MBOGC, BLM, and TLMD and would facilitate the replacement of groundwater lost to the drawdown of resources within the coal seam aquifers. Drawdown in deeper aquifers is not anticipated. Replacement may not be possible in some areas with concentrated CBM production, this represents a possible environmental justice issue if the non-replacement areas are adjacent to reservation boundaries and no suitable water is available for mitigation.

No adverse human health impacts are foreseen from these environmental changes. The influence of Wyoming's discharge on Montana rivers would constitute a potential environmental justice issue if unresolved. It is concluded that no adverse human health or environmental effects would be expected to fall disproportionately on minority or low-income populations from this alternative.

Alternative C

The resource analyses performed for Alternative C indicate that groundwater drawdown, and changes to the surface water quality and the subsequent impacts on vegetation, wildlife, and aquatic resources would have effects that warrant further review for occurrence potential, and relevance to disproportionate effects on minority or low-income populations.

Groundwater Drawdown

The drawdown of groundwater within the Powder River Basin watersheds would have the same effects as described under Alternative B; however, with the elimination of the federal development buffer zone around Indian reservations, these effects could be amplified and appear sooner on reservation properties.

Surface Water Quality

Under Alternative C, the quality and quantity of surface waters in the Powder River Basin watersheds will be altered depending on the outcome of the statewide water quality standards. The MDEQ is in the process of setting statewide water quality standards that would likely include the framework for managing surface discharge of CBM-produced water throughout the state. The watersheds would most likely experience increases in SAR values, sedimentation, TDS, and a marginal increase in base flow as described in the *Hydrological Resources* section of this chapter. Based on SAR values, the addition of untreated CBM-produced waters with high SAR values under the least restrictive extreme criteria would not exceed an SAR value of 12. High-quality watersheds in the CBM emphasis area would have adequate assimilative capacity to accept expected discharges from full-scale development of CBM. All other watersheds should only experience a slight increase in SAR, which would remain below the suggested not to exceed a value of 3 for some soils and possibly as high as 12 for others.

It is assumed that the sodium content of produced CBM water is the target contaminant that determines the usefulness of the water for crop irrigation. Irrigation uses the majority of water resources in those watersheds thought to have the greatest potential for CBM development. Sodium causes osmotic stress to plants and destroys the texture of clayey soils; these combined effects make sodium content, and especially SAR, a point of emphasis when gauging impacts to water resources from CBM water. Other parameters such as TDS, nitrogen, and barium concentration may be locally important in determining restrictions to beneficial use. It is assumed that discharge to high-quality watersheds would be limited during the irrigation season and managed on a flow-based discharge scenario. Under these circumstances, high-quality watersheds in the CBM emphasis area would have sufficient capacity to meet the current irrigation needs. Flow-based discharge would however, require additional storage of produced water during the irrigation season for later discharge when stream flows are less sensitive to being impacted by produced water discharges.

The trickle-down effects of increased SAR and base flow would result in the erosion of riparian areas along rivers, the reduction of both vegetation and wildlife habitat, and the impairment of fish populations. These trickle-down effects are mentioned because of the large number of Native Americans who have a traditional reliance on the natural agriculture for sacred plants used in medicines and for their hunting and fishing way of life. If these combined water quality impacts are realized, there could be a disproportionate effect felt by the Native Americans as it reduces their ability to gather sacred plants and limit their hunting and fishing opportunities. A large percentage of the population in Big Horn (61 percent) and Rosebud (33 percent) counties are Native Americans and constitutes a sizeable minority population within the CBM emphasis area.

Crow Reservation

Impacts on the Crow Reservation are expected to be similar to impacts projected for the CBM emphasis area. The reservation can expect impacts to surface water such as increased flow volume, changes to quality of various water parameters, including SAR, EC, and bicarbonate. The Crow Tribe would experience drawdown of groundwater from coal seam aquifers from Wyoming and Montana CBM production. The traditional pattern of natural resource consumption would be altered and therefore impacts to sacred plants and hunting and fishing are expected.

Northern Cheyenne

Impacts on the Northern Cheyenne Reservation are expected to be similar to impacts projected for the CBM emphasis area. The Northern Cheyenne Reservation will experience impacts to surface water in the form of increased flow volume and changes to water quality for various water parameters, including SAR, EC, and bicarbonate. The reservation will also experience drawdown of coal seam aquifers from CBM production in the area surrounding the reservation. The traditional pattern of natural resource consumption would be altered and therefore impacts to sacred plants and hunting and fishing are expected.

Mitigation

Mitigation measures for groundwater drawdown and air emission sources would be consistent with the previous measures discussed under these two resource topics.

Conclusions

These surface water quality and quantity effects, when combined with the increases projected from similar current and planned CBM development activities in Wyoming, will further increase the SAR value, base flow, and other potential constituents of concern in the Tongue, Powder, and Little Powder rivers. The combined decrease in water quality will necessitate the use of flow-based discharge to avoid limiting the resource for use as a source of irrigation. The resulting impacts may still impair tribal government leasing activities, rendering an environmental justice impact to tribes as described under Alternative B with regards to drawdown of groundwater and subsequent availability.

If the Northern Cheyenne and Crow tribes elected to develop their CBM resources, impacts as described under Alternative B above would be experienced.

No adverse human health impacts are foreseen from these environmental changes. The influence of Wyoming's discharge on Montana rivers would constitute a potential environmental justice issue if unresolved. It is concluded that adverse environmental effects would be expected from downstream water quality changes, resulting in limitations to subsistence living styles. These limitations would fall disproportionately on minority or low-income populations from this alternative.

Alternative D

A review of the resource analyses for Alternative D revealed that similar potential effects would be felt as described under Alternative B for groundwater drawdown and air quality changes and under Alternative C for surface water quality but at a reduced impact because of water treatment and discharge conveyance. The same trickle-down effects would be experienced under Alternative D as described in Alternative C but, again, at a reduced level because of water treatment.

Crow Reservation

Impacts on the Crow Reservation are expected to be similar to impacts described above under this Alternative.

Northern Cheyenne

Impacts on the Northern Cheyenne Reservation are expected to be similar to impacts described above under this Alternative.

Mitigation

Mitigation measures for groundwater drawdown and air emission sources would be consistent with the previous measures discussed under these two resource topics.

Conclusions

These surface water quality and quantity effects, when combined with the increases projected from similar current and planned CBM development activities in Wyoming, would be less than those described in Alternative C because of the treatment of discharge water. Water would be available for irrigators and tribal government leasing activities would not be impaired. The drawdown of groundwater and subsequent availability would be as described in Alternative B. If the Northern Cheyenne and Crow tribes elected to develop their CBM resources, impacts as described under Alternative B above would be experienced. No adverse human health impacts or environmental effects are foreseen from these management objectives.

Alternative E (Preferred Alternative)

A review of the resource analyses for Alternative E indicates that impacts to hydrology would be similar to those described in Alternative C and dependent upon the water quality criteria being developed. Alternative E stresses the beneficial uses of produced water from CBM wells and requires a Water Management Plan be developed explaining how an operator can discharge without degrading the surface water quality before any discharge can occur. Similar potential effects would be felt as described under Alternative B for groundwater drawdown and air quality changes. The trickle-down effects of surface water quality changes would be reduced considerably.

Crow Reservation

Impacts on the Crow Reservation are expected to be similar to impacts projected for the region under Alternative E.

Northern Cheyenne

Impacts on the Northern Cheyenne Reservation are expected to be similar to impacts projected under Alternative E.

Mitigation

Mitigation measures for groundwater drawdown and air emission sources would be consistent with the previous measures discussed under these two resource topics.

Conclusions

These surface water quality and quantity effects, when combined with the increases projected from similar current and planned CBM development activities in Wyoming, would be less then those described in Alternative C. Water would be available for irrigators and tribal government leasing activities would not be impaired. The drawdown of groundwater and subsequent availability would be as described in Alternative B. If the Northern Cheyenne and Crow tribes elected to develop their CBM resources, impacts as described under Alternative B above would be experienced. No adverse human health or environmental effects are anticipated from this alternative.

Geology and Minerals

Assumptions

- Federal oil and gas leases would continue to be issued with standard lease terms and stipulations as identified by BLM. No Surface Occupancy (NSO), Controlled Surface Use (CSU) and Timing Restriction (Timing) stipulations provide protection to other resources from oil and gas lease activities. A detailed listing and description of stipulations are found in the Final Oil & Gas EIS/Amendment (BLM 1992).
- Federal APDs and Sundry Notices would continue to be issued with Conditions of Approval (COAs) as identified by BLM. COAs provide mitigation to minimize or eliminate impacts to other resources or land uses from oil and gas lease activities. COAs must conform to lease rights and land use decisions.
- BLM would continue to consult with private surface owners before approving oil and gas lease activities on private surface. Surface owner requirements can be incorporated as COAs.
- BLM would continue to require a copy of a signed agreement between the private surface owner and the CBM operator before approving drilling operations on private surface.
- Other related Assumptions regarding typical CBM operations are found at the beginning of this Chapter.

Impacts From Management Common to All Alternatives

The production or drainage of oil and gas results in the irreversible and irretrievable loss of these resources. Oil and gas resources within a lease area can be directly removed by wells located on the lease area or drained by wells located adjacent to the lease when geologic conditions allow. Gas resources can be irreversibly and irretrievably lost during venting or flaring operations. The cumulative impact to oil and gas resources would be a reduction in the known amount of these resources.

The cumulative impacts to lease development from stipulations, field rules, permit requirements, and regulations would be a reduction in the number of wells drilled on leases with more or more restrictive stipulations, an increase in the number of wells drilled on less restrictive leases, relocation of proposed well sites, interference with orderly field development, possible loss of revenues, and loss of oil or gas resources from drainage by off-lease wells.

CBM development in Wyoming would result in drainage to Montana lands by wells just across the state boundary. The 80-mile-wide belt of the Powder River Basin that is prospective for CBM would represent approximately 320 1/4-by-1/2-mile (80-acre) spacing units draining resources (gas) from the adjacent state.

Another drainage issue results from produced water associated with oil and gas production that may or may not be an irreversible or irretrievable loss of resources depending on the water quality and aquifer from which it is drawn. A more detailed discussion about impacts to water resources is included later in this chapter in the *Hydrology* section.

Oil and gas development would impact strippable coal resources in areas adjacent to existing coal mines or in new areas of coal mine interest. Oil and gas well bores and the production infrastructure would prevent the mining of coal in areas of oil and gas production.

Conventional oil and gas lease operations would not impact CBM resources because of the geology and well bore requirements. Migration of conventional oil and gas from source reservoirs to coal seams usually does not occur because the geology includes an impermeable layer(s) between the hydrocarbon bearing formations and the coal seams. The BLM and State require well bores to be completed with steel casing and cement in key locations of the well annulus to prevent the migration of fluids and drastically reduce the migration of gas from one formation to another formation.

Conventional oil and gas wells and the associated infrastructure could be located on a lease area with CBM wells and associated infrastructure.

Sand, gravel, or scoria needed for lease operations can be removed from BLM land by the operator from areas disturbed by lease operations under authority of the lease. Removal of sand, gravel, or scoria from BLM surface by the operator outside of the area of disturbance for lease operations or removal by a third party would require a separate permit approved by BLM.

Mitigation

Existing BLM and State regulations allow for the production of oil and gas in a manner that conserves those resources so they are not wasted. Oil and gas production is guided by well spacing rules, field rules, lease development requirements, and protective agreements such as Communitization and Unit Agreements. Flaring and venting operations must be conducted in accordance with agency approval which also seeks to limit the wasting of gas resources as well as minimizing air quality and safety impacts.

The policy of both the BLM and State is to use the least restrictive method to provide protection for other resources and land uses from oil and gas activities while allowing for lease development and production. Regulations, lease stipulations, and permit requirements allow for lease exploration and development while sustaining other resource values and land uses.

Water produced with oil and gas operations is required to be put to beneficial use unless the quality of the water would prevent beneficial use. Produced water of poor quality may be treated so the water can be put to beneficial use or with agency approval can be disposed of into a subsurface formation designated by the State with the same or poorer quality water.

BLM issued oil and gas leases are issued with an NSO stipulation in an area with an approved mine plan. The NSO stipulation prohibits surface occupancy and use for oil and gas lease operations. In areas outside of approved mine plans, BLM may issue both coal and oil and gas leases on the same parcel of land. BLM regulations support approval of applications from the first lessee, but also require lessees to resolve conflicts. Resolution of conflicts is further guided by BLM Instruction Memorandum WO-IM-2000-081 (BLM 2000c).

Well spacing and field rules would be established to help maintain the integrity of subsurface formations and help reduce the migration of hydrocarbons. The BLM and State would continue to require certain well drilling and completion practices, such as steel casing and cementing, to stabilize the well bore and dramatically reduce the opportunity for hydrocarbon migration.

Operators would be required to minimize surface disturbance by sharing access roads, flowline routes, and utility line routes. When feasible, multiple wells would be drilled on the same well pad. Reclamation would be required on areas of surface disturbance during the production and abandonment phases of development. operators, along with surface owners, would be invited to discuss development plans to reach a common agreement.

Impacts From Management Specific To Each Alternative

Alternative A

Under this alternative, CBM production would be limited by the number of wells that can be permitted for CBM production by BLM and the State. The total number of producing CBM wells is limited to 250 by the terms of the Settlement Agreement affecting the State. The constraint is in place until the State has completed an EIS addressing the impacts from CBM field development throughout the state. BLM is not approving the production of CBM from federal wells until completion of the EIS which addresses the impacts from CBM field development in the Powder River and Billings RMP areas.

The production and venting of CBM during the testing phase represent an irretrievable loss of that resource. Under the existing situation, CBM may be drained from federal lands by producing CBM wells on private and state leases. This drainage of federal CBM represents an irretrievable loss of that resource and loss of royalties to the federal and state governments. The vending of CBM during coal mining represents the irretrievable loss of the resource. The location of CBM wells and associated infrastructure on private and state lands could influence the location of future CBM wells and associated infrastructure on federal lands.

Expansion of the Decker coal mine to the west and south, and expansion of the Spring Creek coal mine to the south would be constrained by CBM wells and the associated infrastructure of the CX Field. Mine expansion could occur after abandonment of the CX Field and removal of facilities and equipment.

Removal of groundwater by CBM wells in coal seams that are being mined by Decker and Spring Creek could reduce the amount of groundwater flowing into the mine areas. Reduction in the amount of groundwater or degradation of groundwater quality by CBM production would reduce the amount of groundwater available for domestic water wells from a particular coal seam. CBM could migrate to domestic wells or escape at the surface from the removal of groundwater for CBM production.

The presence of CBM wells and the associated infrastructure could prevent certain types of seismic operations from being conducted in the area of CBM production. The use of explosives could damage well bores or surface equipment, and could damage the upper coal seam used for CBM production.

Crow Reservation

Producing CBM wells located within 1 mile of the Crow Reservation boundary could drain CBM resources from the Reservation. This drainage of Indian owned or privately owned CBM would represent an irretrievable loss of the resource and a loss of royalties to the mineral owner. The location of CBM wells and associated infrastructure on private and state lands could influence the location of future CBM wells and associated infrastructure on lands within the Crow Reservation.

Producing CBM wells located within 1 mile of the Crow Reservation boundary could drain groundwater from the Reservation. This drainage of groundwater could represent an irretrievable loss of the resource unless the aquifer is recharged to pre-production level. Reduction in the amount of groundwater or degradation of groundwater quality by CBM production would reduce the amount of groundwater available for domestic water wells from a particular coal seam. CBM could migrate to domestic wells or escape at the surface from the removal of groundwater for CBM production.

A detailed description of potential drainage impacts to Crow resources is found in the Environmental Justice section, and a detailed description of potential impacts to groundwater from drawdown by CBM wells is found in the hydrology section.

Northern Cheyenne Reservation

Producing CBM wells located within 1 mile of the Northern Cheyenne Reservation boundary could drain CBM resources from the Reservation. This drainage of Indian owned or privately owned CBM would represent an irretrievable loss of the resource and a loss of royalties to the mineral owner. The location of CBM wells and associated infrastructure on private and state lands could influence the location of future CBM wells and associated infrastructure on lands within the Reservation.

Producing CBM wells located within 1 mile of the Northern Cheyenne Reservation boundary could drain groundwater from the Reservation. This drainage of groundwater could represent an irretrievable loss of the resource unless the aquifer is recharged to pre-production level. Reduction in the amount of groundwater or degradation of groundwater quality by CBM production would reduce the amount of groundwater available for domestic water wells from a particular coal seam. CBM could migrate to domestic wells or escape at the surface from the removal of groundwater for CBM production.

A detailed description of potential drainage impacts to Northern Cheyenne resources is found in the Environmental Justice section, and a detailed description of potential impacts to groundwater from drawdown by CBM wells is found in the hydrology section.

Conclusion

The production of CBM by state and private wells, and the venting of CBM represents the irreversible and irretrievable loss of the resource. Drainage by off-lease CBM wells represents the irreversible and irretrievable loss of the resource and royalties to the lessee of the lease being drained. The restrictions on the total number of CBM wells approved for production reduces and delays associated revenues to lessees and government. The venting of CBM during coal mining represents the irreversible and irretrievable loss of the resource.

Production of CBM should not impact the geology of the production area or any conventional oil and gas in the area of CBM production. CBM wells and the associated infrastructure would hinder the expansion of the Decker and Spring Creek coal mines toward the CX Field. The production of CBM would not prohibit the production of conventional oil and gas resources from the area of CBM production. The production of conventional oil and gas in or around the CX Field would increase and intensify the impacts to other resources and on land uses.

The mitigation measures for this alternative would be similar to those described in the Impacts From Management Common to All Alternatives section.

Alternative B

Under this alternative, impacts would be similar to Alternative A, but increased because of expanded CBM production on state, fee, and BLM oil and gas lease areas. The increased development as part of this alternative would result in more CBM production and the irretrievable commitment of more resources. Increased CBM production would amplify the opportunity for methane drainage from adjacent leases. Under this alternative, multiple coal seams would be developed from a single well bore. All coal seams would be developed at the same time and directional drilling for deeper coal seams would be required.

This alternative also includes a 1-mile buffer zone around active coal mines that would minimize the water drawdown impact from nearby CBM production. Production of CBM would not be authorized on federal leases within a 2-mile buffer zone in Montana along the Reservation boundary. The state may allow production of CBM from state leases within the buffer zone. The prohibition on the production of CBM within the buffer zone would not apply to fee leases within the buffer zone. The drawdown of groundwater from coal seams would not damage the coal resource present through compaction, nor would the likelihood of coal seam fires be greater than before. The circumstances for self-ignition of coal would not be present in the direct vicinity of CBM wells in the emphasis area. During the production stage of CBM activity, conditions essential to cultivate spontaneous combustion of coal such as oxidation, heat of wetting, airflow rate, coal particle size, pyrite content and temperature are not present. In fact, the design and construction of CBM wells efficiently vents heat out of the coal so that temperatures needed for coal ignition are neither present nor anticipated. After the coal seam is exhausted of inexpensive methane resources, wells must be plugged and sealed. Unlike abandoned mines, CBM wells leave no underground voids vulnerable to further subsidence and associated spontaneous coal ignition. The probability of completely dewatering a coal bed and revealing large areas of fine coal particles to oxygen seem exceedingly remote (Lyman and Volkmer 2001). Further discussion regarding groundwater issues is contained in the *Hydrology* section of this chapter.

The presence of CBM wells and the associated infrastructure could prevent certain types of seismic operations from being conducted in the area of CBM production. The use of explosives could damage well bores or surface equipment and could damage the upper coal seam used for CBM production.

The drawdown of groundwater from CBM activities has been identified as the cause of surface subsidence in Wyoming (Case et al. 2000). The subsidence was recorded as 1/2 inch and therefore, does not represent an immediate impact to surface lands. In Montana where coal seams are thinner, subsidence would be less than what has been observed in Wyoming where coal seams are thicker.

Crow Reservation

Impacts to mineral resources on the Crow Reservation would be the same as described above in this alternative. Expanded CBM development activities may increase the impacts and extraction of CBM resources described in Alternative A if there is development and production near tribal lands or on fee lands within the external boundaries of the Reservation.

Northern Cheyenne Reservation

Impacts to mineral resources on the Northern Cheyenne reservation would be the same as described above in this alternative. Expanded CBM development activities may increase the impacts and extraction of CBM resources described in Alternative A if CBM production occurs near the external boundaries of the reservation.

Conclusion

One of the cumulative impacts from this alternative would be increased production of CBM from an increased number of producing wells and from multiple coal seam development simultaneously. Multiple coal seam development simultaneously would result in the production of CBM occurring more quickly than single seam development. Along with venting of CBM during well testing, this would represent an irreversible and irretrievable loss of the resource.

A second cumulative impact from this alternative would be the potential for a greater amount and extend of groundwater because of the increased number of producing CBM wells. Groundwater drawdown would be increased where CBM production wells are located in an area affected by drawdown occurring from coal mining. The volume of groundwater produced would increase with the increased number of producing CBM wells, especially during the first two production years of the well's life cycle.

The increased number of producing CBM wells and the associated infrastructure could inhibit the expansion of existing coal mines, even with the 1-mile buffer zone. This would delay or possibly preclude the mining of coal in certain areas. Areas of new coal mine interest would be excluded from opening new coal mines by the existence of producing CBM wells and infrastructure.

The mitigation measures for this alternative would be similar to those described in the Impacts From Management Common to All Alternatives section. Additional mitigation measures include buffer zones around existing coal mines and the Crow and Northern Cheyenne Reservations, requiring simultaneous production of multiple coal seams through single well bores, subsurface injection of untreated water produced with CBM, and maximizing the number of producing CBM wells connected to field compressors.

Alternative C

Under this alternative, CBM production could occur on state, fee, and BLM lease areas. Operators would not be required to produce CBM simultaneously from multiple coal seams through a single well bore. CBM production from multiple coal seams could occur simultaneously through single well bores or simultaneously through separate well bores or different coal seams could be developed separately (staggered over time) or a combination of production methods. Allowing CBM production from state, fee, and BLM leases would increase the amount of CBM produced. Producing CBM from multiple coal seams simultaneously would have impacts similar to those described in Alternative B. Producing CBM from single coal seams would have similar impacts, but would extend the length of time for production. The potential for drainage of CBM resources by producing CBM wells would increase with the increase in the number of producing wells. Directional drilling would not be required. Without directionally drilled wells, the impacts from vertical wells would be the same as Alternative A.

CBM production will impact adjacent coal mines by increasing coal bed aquifer drawdown. The added dewatering from CBM operations would affect the coal mines by hindering the aquifer restoration efforts the mine must perform once mining activities cease. In addition, the removal of coal seam water may create a situation where some coal mines would need to purchase water for dust control.

The drawdown of groundwater does not represent an immediate impact to surface lands resulting from subsidence. The thinness of the coal seam aquifers and their shallow depth should prevent them from being substantially impacted by groundwater withdrawal and subsequent aquifer compaction.

Crow Reservation

Impacts on the Crow Reservation would be the same as described in general for Alternative C.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this Alternative.

Conclusion

The cumulative impacts for this alternative would be similar to Alternative B with some exceptions. The removal of the buffer zone around coal mines would result in increased drawdown within the mines from CBM production. After mining has ceased, the added dewatering will need to be remediated by the mine operators. Remediation bonds executed by the mine operators prior to operations will need to be honored. Unless the impact of the CBM production can be separated from impacts by the coal mine, the remediation bond will force the mine operator to spend more money to remediate the aquifer. Coal mine operators may develop aquifer mitigation agreements with CBM operators prior to CBM production. The mitigation measures for this alternative would be similar to Alternative A.

Alternative D

Impacts from management objectives outlined in Alternative D would be similar to the impacts described under Alternative B.

Crow Reservation

Impacts to the Crow Reservation would be similar to impacts described in Alternative B.

Northern Cheyenne Reservation

Impacts to the Northern Cheyenne Reservation would be similar to impacts described in Alternative B.

Alternative E (Preferred Alternative)

Impacts to coal and existing coal mines would be the same as Alternative A because a buffer zone would not be required around existing coal mines.

Impacts to CBM resources would be the same as Alternative B if all coal seams are produced simultaneously or to Alternative C if coal seams are produced separately. Impacts to CBM production and wells would be the same as Alternative A because multiple seam production through a single well bore would not be required.

Impacts on conventional oil and gas resources would be the same as in Management Common section.

The production of CBM by state and private wells, and the venting of CBM represents the irreversible and irretrievable loss of the resource. Drainage by off-lease CBM wells represents the irreversible and irretrievable loss of the resource and royalties to the lessee of the lease being drained.

This alternative allows the operator to use best engineering practices to demonstrate in the Project Plan how they will develop their coal leases. The use of best engineering practices does not prevent the irretrievable commitment of this resource but may reduce the amount of resource loss during development and production.

Crow Reservation

Impacts to the Crow Reservation would be the same as described in Alternative C. A buffer zone would not be established around the borders of the Reservation which could allow the drainage of CBM resources on the Reservation by adjacent wells. These impacts would be mitigated by a hydrologic barrier, communitization agreement, or spacing to protect reservation CBM resources from drainage.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to impacts described in Alternative C. These impacts would be mitigated by a hydrologic barrier, communitization agreement, or spacing to protect reservation CBM resources from drainage.

Conclusion

The cumulative impacts for this alternative would be similar to Alternative B. The major difference would be impacts to other resources and land uses from the disposal of produced water. Produced water could be injected, disposed of onto the surface, disposed of into water bodies, or used for beneficial uses. Disposal of water produced with CBM should not impact mineral resources.

Under this alternative, impacts would be similar to Alternative B with the exception that injection of produced water would not be required. Injection of produced water into a subsurface formation approved by the state would be one water management option available to operators under this alternative. Other produced water management options would be making produced water available for beneficial uses and treating, as needed, produced water before being discharged onto the surface or into bodies of water. Impacts from produced water management options are described in other resource sections, such as hydrology and soils.

Weathered landscape with exposed Fort Union Coal Formation

Hydrological Resources

Assumptions

CBM development has the potential to impact surface water and groundwater resources in the planning and CBM emphasis area. The following assumptions form the framework for analyzing the impacts:

- The productive life of a CBM well is estimated to be 20 years.

- The average groundwater production rate, over the estimated 20-year life of a CBM well in Montana, is expected to be 2.5 gpm (ALL 2001b). This average rate accounts for initial, short-term CBM groundwater production rates that can be as high as 20 to 25 gpm per well, followed by steady declines in the rate of groundwater production over the life of an individual CBM well as groundwater levels within the producing area are stabilized. The average estimated producing rate was calculated based on data from CBM wells that have been producing at the CX Ranch site near Decker, Montana. Water production data from these wells were obtained from the MBOGC, normalized to the age of each well and averaged to determine a decline trend. The decline rate was extrapolated for a total production period of 20 years. Water production rates were then estimated based on the extrapolated trend line over the entire 20-year period and averaged to determine the estimated 20-year average rate of 2.5 gpm. The maximum total field discharge would occur in years 6 and 7 of the RFD, when production rates per well would be 7.1 and 6.1 gpm, respectively.

  In addition to performing trend analysis, water production rates were compared to water production rates for CBM wells in Wyoming. It is reasonable to consider CBM water production rates in Wyoming while determining an average rate for CBM development in Montana because of hydrogeologic similarities. In 1997, the average water production rate in the Wyoming portion of the Powder River Basin was approximately 11.9 gpm (WOGCC 2001). Through the first eight months of 2001, the average water production rate for a total of 5,762 CBM wells had decreased to approximately 7 gpm (WOGCC, 2001). This trend of decreasing average water production rates supports the average values used for purposes of impact analysis in Montana, especially considering that many of the wells included in the Wyoming analysis are still in early stages of production.

  It is important to understand that the estimated 20-year average production rate was determined from a relatively small number of wells in a discrete area in the Powder River Basin of Montana. Actual rates could vary by area as a result of variations in coal thickness, aquifer recharge, aquifer characteristics, and other geologic and hydrologic circumstances. This is especially important when considering potentially productive areas outside the current producing area and potentially productive areas in Blaine, Park, and Gallatin Counties.

  It is also important to recognize that the 20-year average rate is very different than the rate used in the Wyoming CBM EIS (BLM 1999b). For Wyoming, the BLM used a snapshot derived from 1997 production data that represented water production rates in the initial production stages of a CBM well. Had the BLM in Wyoming chosen to use an average rate over the entire life of a CBM well, that average would align more closely with the 20-year average assumed for impact analysis in Montana.

- The quality of CBM-produced groundwater throughout the planning area is assumed to be the same as the quality of CBM-produced groundwater from the CX Ranch field near Decker in the Powder River Basin (ALL 2001b).

- It is assumed that the sodium content of water produced from CBM wells is the target contaminant that determines the usefulness of the water for crop irrigation. Irrigation is the primary beneficial use for the majority of water resources in watersheds expected to have the greatest potential for CBM development, especially with respect to the Montana portion of the Powder River Basin. Sodium causes osmotic stress to plants and destroys texture of clayey soils; these combined effects make sodium content, and especially SAR, a point of emphasis when gauging impacts to water resources from CBM water. Other parameters such as TDS, bicarbonate, nitrogen, and barium concentration may be locally important in determining restrictions to beneficial use. Ammonia and fluoride were limiting factors for the permit at the CX Ranch.

- MDEQ regulates surface discharge of water produced with oil and gas in the state of Montana, except on Indian lands where EPA regulates surface discharge of produced water. The state of

Montana does have numeric water quality standards for some, but not all, water constituents. To facilitate analysis, a range of water quality criteria is assumed based on discussions with representatives of the MDEQ and representatives of other state and federal cooperating agencies. Watersheds in the CBM emphasis area, which essentially includes the Montana portion of the Powder River Basin, can generally be categorized as either high-quality or low-quality. High-quality streams include the Tongue River, Little Bighorn River, and others that may be similarly characterized. Streams that would be categorized as low-quality include the Powder River, Little Powder River, Bighorn River, and other streams that are relatively low in quality. Numeric water quality criteria for SAR, EC, and bicarbonate were developed for these watersheds (MDEQ 2001c). These particular parameters were chosen because of their significance with respect to CBM development and environmental impacts. SAR is the most restrictive criterion as it represents a potential threat to soil condition and crop vigor. EC is an important measure for monitoring productivity of soils. Bicarbonate is a criterion that affects aquatic biota; bicarbonate shows a range of toxicities as measured by researchers (Mount et al. 1997, Ranney 2001). Numeric criteria for high-quality watersheds include a range of SAR from 2 to 12, EC of 1,000 micro-siemens per centimeter (μS/cm), and bicarbonate from 1,000 to 1750 milligrams per liter (mg/l). For the low-quality watersheds, a range for SAR from 9 to 12, EC of 1,600 μS/cm, and bicarbonate from 1,000 mg/l to 1750 mg/l were assumed. CBM development within the Powder River Basin of Wyoming and Montana has the potential to impact surface water quality within the watersheds of the entire basin. The states of Wyoming and Montana recognize this concern and, in an effort to protect the water quality within the Powder River Basin, have entered into an 18-month interim memorandum of cooperation. The two states will cooperate to protect water quality in the Powder River Basin while allowing for CBM development. A copy of the interim memorandum of cooperation can be found in the Hydrology Appendix. The interim memorandum of cooperation is intended to specifically protect the downstream quality of the Powder and Little Powder watersheds that enter Montana from Wyoming. The agreement establishes interim thresholds only for EC in the Powder River at the state line based on monitoring data from the Moorehead, Montana, gauging station. The criteria for EC are expressed in monthly maximum values that are not to be exceeded. The two states are also concerned with SAR and bicarbonate, but lack sufficient data. For the Little Powder River, monitoring of the EC, SAR, and TDS will be performed by the state of Montana to determine if these levels change appreciably. If considerable changes are detected, the state of Wyoming will be notified, at which time Wyoming will perform investigations to determine if CBM activities are responsible and adjust its regulatory position to ensure the compliance with the spirit of the agreement. Further, Montana has accepted Wyoming's anti-degradation policy to be protective of Montana's water quality.

For Alternative C, all CBM production water is discharged continuously, and there is no storage or treatment. Because the thresholds to protect irrigation apply only during the irrigation season, this assumption results in an underestimate of the number of wells that could discharge without exceeding the thresholds.

- CBM Discharge Rate: 2.5 gpm/well (single well 20-year average)
- Beneficial Use: 20%
- Conveyance Loss: 70%
- Effective Discharge to Rivers: 24%
- CBM Water Quality: EC of 2207 μS/cm (mean of CX ranch CBM produced water); SAR of 47; same values were used for all drainages
- Stream Flow Rates: low mean monthly flow rates as shown in Table 3-4
- Stream Water Quality: low flow EC and SAR as shown in Table 3-5
- EC and SAR Limits: based on no reduction in infiltration EC-SAR relationship further limited by suggested MTDEQ thresholds (high level): SAR <= 12 for the Powder, Little Powder, and Mizpah Rivers, SAR <= 2 or 12 for all other streams
- Cumulative Impacts from Upstream Development: All upstream development including development in Wyoming is evaluated for each watershed. If multiple stream gauge locations occur in a watershed, the projected number of wells is divided equally among the reaches represented by the stations
- Allocation Factors: 50/50 between Wyoming and Montana

Impacts From Management Common to All Alternatives

Conventional Oil and Gas Production

Conventional oil and gas production can produce large volumes of water that could impact surface and groundwater resources because of the quality of the produced water. Since 1953, the MBOGC has regulated the use and disposal of water produced in association with the production of oil and natural gas in order to mitigate the potential for impacts to the environment. The use of surface impoundments is controlled by BLM and the state. BLM permits water disposal pits (surface impoundments) on federal leases. The permitted surface impoundments are those designed primarily for evaporation. Any impoundments constructed in the state, including those involving federal land or minerals, would require approval from the MBOGC. Further, the MDEQ permits any point source discharges to surface waters (e.g., streams), including those that could result from surface impoundments. Conventional oil and gas is typically produced from depths below usable aquifers and below coal seams. Regulations require the isolation of oil and gas producing zones from other reservoirs containing possible hydrocarbons or from aquifers that contain usable water. Underground Injection Control (UIC) regulations also require safeguards to isolate injection zones from other zones that contain hydrocarbons and from aquifers that contain usable, or potentially usable quality water (i.e., groundwater containing less than 10,000 mg/l of total dissolved solids). Produced water that has a TDS concentration of less than 15,000 mg/l can be discharged to permitted surface impoundments. As a result of the existing regulations, the impact on surface water and groundwater resources from conventional oil and gas production is minimal.

Impacts from Management Specific to Each Alternative

Alternative A

Alternative A consists of the existing CBM management scenarios. The following are the impacts expected from CBM exploration, production, and abandonment.

Exploration

CBM exploration activities on state, fee or BLM-administered mineral estates would not result in additional impacts to surface water or groundwater. Exploration wells would be tested but not commercially produced. Testing of CBM exploration wells involves pumping the wells for several weeks; however, the volume of groundwater removed is moderate and is not expected to impact nearby water wells or springs. Recovered produced water and drilling wastes would be contained in impoundments or tanks and would be disposed of in accordance with regulations for conventional oil and gas wastes.

Production

CBM water production would continue to be allowed within the CX Ranch CBM field, but at a level approximately 20 percent above current conditions; this would constitute a total of 250 producing wells. The majority of produced waters would continue to be discharged to the Tongue River with small amounts being diverted to surface impoundments, used for stock watering, and for use by coal mines to control dust.

The projected level of CBM production at CX Ranch would have an impact on the quality and quantity of surface water within the area. The discharge of CBM-produced waters to surface water would be in accordance with the provisions of the existing MPDES Discharge Permit that allows for the discharge of up to 1600 gpm (3.3 cfs) into the Tongue River. The maximum discharge would result in a river flow volume of approximately 178 cfs of water with an average SAR value of 2.0 (up from 1.1) during base flow, and 1,470 cfs of water and an average SAR value of 0.5 (up from 0.4) during times of high flow. Water would continue to be delivered to the discharge points by pipeline to avoid soil erosion along the pipeline route. The change in water quality noted above would not affect current water use and would be within assumed water quality criteria. The increase in flow volume would not be sufficient to cause added erosion to stream banks or streambeds. An increase in soil erosion resulting from the construction of additional well pads and lease roads could occur adding to the suspended sediment load of area surface waters.

The 250 producing CBM wells at the CX Ranch field would also have an impact on groundwater resources within the area. Production at this level would result in increases to groundwater drawdown levels within the three coal seam aquifers being produced. Groundwater drawdown currently extends at least 1.8 miles beyond the edge of CBM production at the CX Ranch field. Increasing the size of the field by approximately 20 percent would add to the drawdown, which, with the increased production, is estimated via computer modeling to eventually extend up to 14 miles from the edge of production (Wheaton and Metesh 2001). Groundwater impacts could also take the form of dry springs caused by coalseam aquifer drawdown This phenomenon could be expected to take place also up to 14 miles from production. Water released to unlined surface impoundments has the opportunity to infiltrate into shallow aquifers, causing measured impacts to the depth to water in the alluvial aquifers and alluvial wells.

Abandonment

Abandoned well pads would be restored to their original condition with the only impact having been the short-term increase in suspended sediments in area surface waters resulting from the increased erosion of disturbed soil. CBM wells that are not produced would be abandoned in accordance with existing regulations and with procedures for the abandonment of oil and gas wells to protect groundwater resources, or converted to monitoring wells as directed by the BLM.

Crow Reservation

The Crow Reservation can expect few impacts from CBM development within Montana under this alternative. Continued development is expected in the CX Ranch field near Decker. Computer modeling has shown that coal aquifers could be impacted approximately 14 miles from production and this could impact water wells and springs on tribal land. Scattered exploration CBM drilling and testing could impact reservation groundwater.

CBM development in Montana and Wyoming could drain groundwater and methane from coal seams under the Reservation. If Wyoming CBM operators are able to discharge CBM water to either the Little Bighorn or Bighorn watersheds, there could be impacts to surface waters on the Reservation.

Northern Cheyenne Reservation

The Northern Cheyenne Reservation can expect continued impact by CBM development outside the reservation under this alternative. The CX Ranch has a permit to discharge CBM water to the Tongue River and this will continue under this alternative. Computer modeling has shown that CX Ranch production could impact coal seam aquifers 14 miles distant. This groundwater drawdown impact should not reach the Northern Cheyenne Reservation.

CBM development in Wyoming is not expected to impact groundwater under the reservation. If operators are able to discharge water into the Tongue River, the impact could be expected to reach surface waters in the reservation with attendant loss of water quality.

Conclusion

Montana-based CBM development, conventional oil and gas development, and surface coal mining would have the potential for impacts to surface water and groundwater resources in Montana. Under Alternative A, few CBM wells would be drilled and impacts would be limited in both magnitude and geographic extent. CBM development at the CX Ranch field would expand, although surface discharge volume to the Tongue River would be controlled by an existing permit. Groundwater impacts to coal seam aquifers from the CX Ranch would extend out as far as 14 miles from development. Scattered CBM exploration and testing would impact coal seam aquifers to a limited extent, but would not be expected to impact surface waters.

Coal seams that are the targets of surface coal mining operations typically contain groundwater. As a result of the presence of this water, coal mine operators must remove this water as it collects in the bottom of the pits in order to mine the coal. Map 4-2 shows coal mines in the planning area. These mines cover approximately 50,000 acres where coal seam aquifers have been impacted either by the removal, partial depletion, or total depletion of groundwater. In the mining areas around Colstrip and Decker, coal seam aquifers have been drawn down by as much as 75 feet near the coal mines, with a radius of impact of up to four miles from the mines (Wheaton and Metesh 2001). The discharge of groundwater pumped from mine pits would also affect surface water depending on the quality of groundwater within the mine vicinity and the quantity of groundwater discharged. In instances where the mines do not discharge because all of the recovered groundwater is used, there would be no direct impacts to surface water quality. Much of the groundwater pumped from the mine pits would be stored and used to control dust on roads, truck and train car loading areas, and the mine face.

During periods of precipitation, stockpiled soil cover and mine spoils can be eroded and transported to surface waters. Surface water quality within the vicinity of the coal mines would be impacted by increased sediment load resulting from the increased erosion associated with mining activities. This would be mitigated by the use of sediment settling ponds and the vegetation of overburden and topsoil storage areas. In some instances, mining activities require the diversion of streams or drainage areas that are within the area to be mined. Original topography, including stream channels and drainage areas, would be restored during mine reclamation activities.

CBM development in Wyoming would have the potential to cause substantial impacts in Montana to surface water quality and groundwater resources. The large number of CBM wells forecast for the Wyoming portion of the Powder River Basin would manage produced water in some manner. The Wyodak EIS (BLM 1999b) projected that 6,000 CBM wells would be developed in the Wyoming portion of the Powder River Basin. To estimate impacts of this development scenario, the BLM estimated an average production rate of 12 gpm per CBM well for a discrete producing period (BLM 1999b). The level of development, combined with the assumed water production rate, would result in an approximately 1.1 percent increase (452 cfs to 457 cfs) in the average flow volume of the Powder River at Moorhead, Montana (BLM 1999b), and an increase of approximately 50 percent (22 cfs to 33 cfs) in the average flow volume in the Little Powder River at the Weston station, which is located approximately 20 miles south of the Wyoming/Montana border. Although these estimated increases are based on yearly averages, the Powder River flow volume could be increased by CBM related discharges more than 800 percent during low-flow periods. Flow volumes into the Little Powder River during times of extreme low-flow could consist almost entirely of discharged CBM produced waters due to the ephemeral nature of this and other watersheds in the Powder River Basin (BLM 2001b).

Surface water quality would be similarly affected by CBM water discharge with yearly average SAR values increasing from 4.0 to 4.1 in the Powder River and from 6.0 to 7.5 in the Little Powder River. Water quality parameters other than SAR would be impacted similarly to SAR, including chloride and barium, which can also result in both direct and indirect environmental impacts. Impact to the quality of water within the Powder River during low-flow periods is expected to increase water quality concentrations for compounds common to CBM produced water, including increases in the SAR from values that could be as low as 1 up to approximately 17. During low-flow periods in the Little Powder River, SAR is expected to increase from approximately 6.5 to an estimated value of approximately 9. The Wyoming EIS (BLM 1999b) did not address potential impacts to the Tongue River from discharge of CBM-produced waters within Wyoming. However, it is expected that impacts of similar magnitude to those predicted for the Powder and Little Powder could occur.

Following the release of the Wyodak EIS (BLM 1999b), the BLM reassessed the RFD for the Wyoming portion of the Powder River Basin and issued a new RFD (BLM 2001a). This more recent study indicates that the total number of CBM wells in the Wyoming portion of the Powder River Basin may approach 50,000 (BLM 2001a). An EIS using this level of development is in progress, but some extrapolations can be made from the existing EIS.

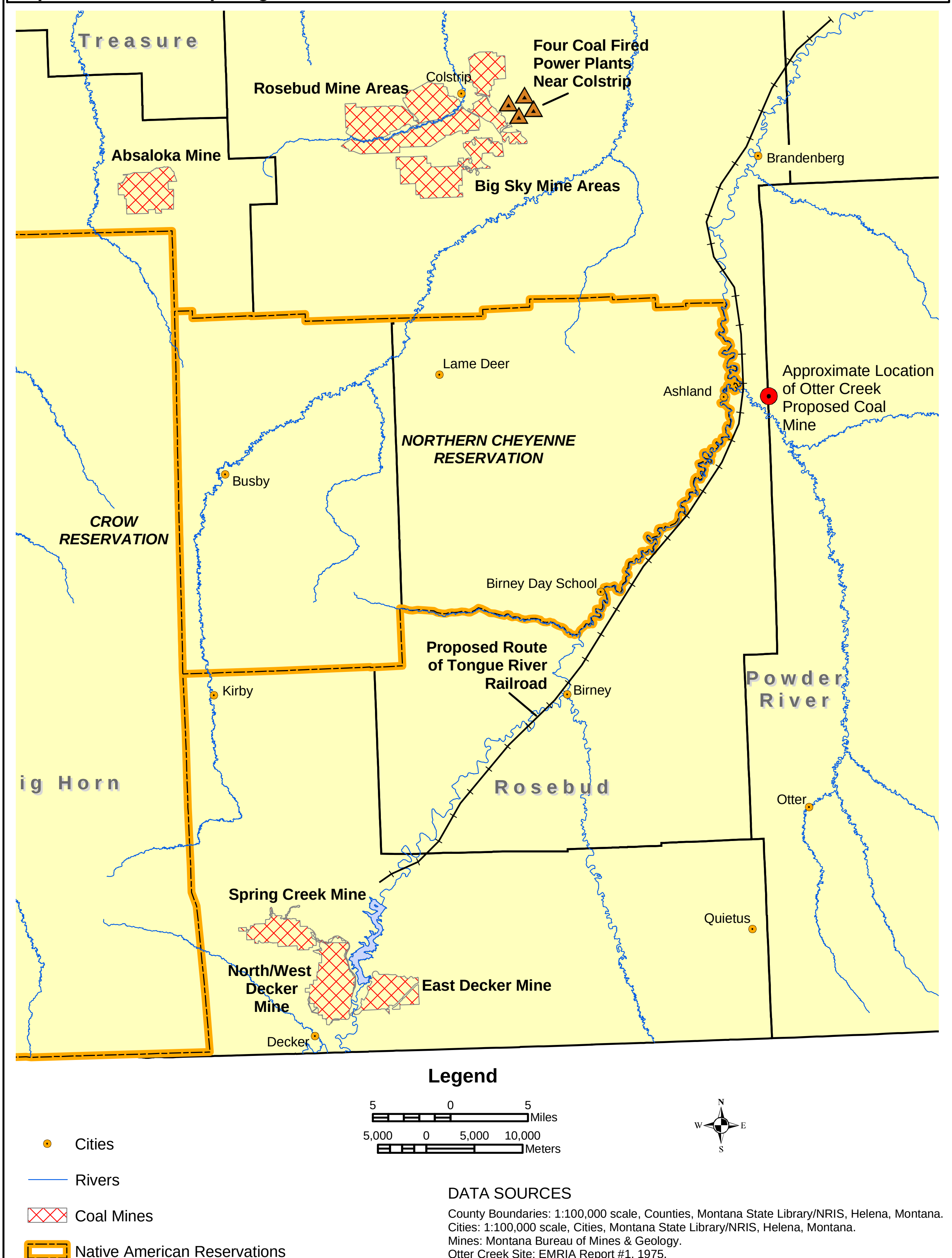
Rivers within the Wyoming portion of the Powder River Basin show considerable seasonal variation in terms of flow volume and water quality. The flow volume in the Powder River ranges from a maximum of 1,400 cfs to a minimum of 0.5 cfs. Water quality also varies because flow volume contains varying amounts of meteoric water added to the base-flow contributed by groundwater. If CBM water discharge rates are essentially constant throughout the year, resultant flows in the river would vary depending upon the ratio of CBM discharge to natural river flow. Impacts to the Powder River would include a 9 percent increase in the annual average flow volume (450 cfs to 500 cfs), as well as an increase in the annual average SAR value from 4.0 to 5.2. Impacts during natural low-flow periods, however, would cause the river to flow at rates 70 times normal with SAR values in excess of 17.

Annual average flow within the Little Powder River with the impact of CBM discharge water is extrapolated to increase from 22 cfs to 92 cfs and a resultant SAR up from 6 to 9. Depending on how CBM-discharges are managed in Wyoming, these flow rates and water qualities could be maintained during traditionally low-flow periods when the river is normally often dry, resulting in SAR and TDS values comparable to undiluted CBM water.

Impacts to surface water quantity and quality resulting from the increase in the number of CBM wells and the resultant increase in the volume of CBM water discharged in Wyoming would be possible. The Upper Tongue River watershed is currently the site of CBM production and it is expected that more development would occur. Impacts to the Tongue River in Montana would be commensurate with impacts to the Powder and Little Powder Rivers by Wyoming CBM production. These impacts would result in increases in surface water quantity and decreases in quality. This could result in 3 to 5 times more water entering Montana and an increase in SAR from 0.7 to 5. This is important because Tongue River water quality is the highest in the Powder River Basin and the river feeds the Tongue River Reservoir.

Groundwater resources in Montana could also be impacted by CBM production in Wyoming. CBM-producing wells in northern Wyoming would cause a

Map 4-2: Location Map, Regional Coal Mines



DATA SOURCES
County Boundaries: 1:100,000 scale, Counties, Montana State Library/NRIS, Helena, Montana.
Cities: 1:100,000 scale, Cities, Montana State Library/NRIS, Helena, Montana.
Mines: Montana Bureau of Mines & Geology.
Otter Creek Site: EMRIA Report #1, 1975.

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drawdown of coal aquifers on adjacent land, with groundwater drawdown possibly extending northward into Montana. Groundwater computer modeling for the Wyodak EIS, which used the estimate of 6,000 CBM wells in Wyoming, indicates that the 5-foot drawdown level could extend up to 14 miles from the edge of production, given a 12-gpm per well rate of water withdrawal (BLM 1999b). The modeling values are based on assumptions made regarding the known geology of the Wyoming portion of the basin, which field data has shown to differ from the Montana portion of the basin. The Wyoming coal seams that have been developed are deeper and thicker than the seams in Montana. In addition, the 12-gpm water production value for the state was a "snap-shot" derived from current production data at a single point (1997) early in the life of the CBM play. The 20-year average rate of 2.5 gpm for Montana was derived from carefully organized data from a single CBM field considering production trends with time. Nonetheless, both the 12 gpm and the 2.5 gpm rates are projections that will be monitored and refined over time as CBM development proceeds. Given these groundwater modeling results and related assumptions, if CBM fields were located in Wyoming adjacent to the border with Montana, this could affect groundwater levels for a distance of up to 14 miles into Montana, assuming the parameters used in the Wyoming computer model are applicable to this area of Montana. Drawdown impacts of this magnitude would result in impacts on private lands, the Crow Indian Reservation, state-owned lands, and federal lands controlled by BLM.

Cumulative surface water impacts from Wyoming and Montana CBM development under Alternative A could be severe and could prevent the surface discharge of any Montana CBM water. If Wyoming CBM development reaches expected levels and if large quantities of water are discharged, Montana watersheds could be degraded to the point where water quality criteria (MDEQ 2001c) could prohibit any discharge. If, however, interstate agreements or Montana Water Quality Standards limit Wyoming discharges, the cumulative effects to surface water in Montana would not impact water uses in Montana. Cumulative groundwater impacts would be largest near CX Ranch and close to the Wyoming border.

Surface water discharge permits that limit the quantity or quality of discharged CBM water would mitigate the impacts from Wyoming CBM production and from expanded CX Ranch production. Mitigation agreements would be needed to replace water lost from drawdown of groundwater within aquifers and springs impacted by Wyoming CBM production, Montana CBM production, and Montana coal mines. If no replacement water is available for mitigation, there may be a need to restrict the volume of water produced if alternate sources, potentially from off-site locations, cannot be provided in lieu of local sources.

Alternative B

Alternative B consists of full-scale development of CBM with water produced from CBM exploration wells stored in tanks or impoundments, and water produced from CBM production wells injected into approved subsurface zones other than the seam it was produced from. The estimated 16,500 producing CBM wells would draw down groundwater levels within coal seam aquifers over several areas of the state, impacting water wells and springs within the area of drawdown. The construction of well pads and lease roads would result in surface disturbances that would increase the potential for soil erosion. No CBM water would be discharged to the surface.

Exploration

Full-scale CBM exploration would require water generated from the testing of CBM exploration wells be stored in tanks or impoundments on state and federal lands. Construction permits would require suitable mitigation measures to reduce leakage from impoundments. The estimated 2,000 dry CBM exploration wells would result in the short-term disturbance of approximately 2,000 acres of land at the well sites. These disturbed acres would be vulnerable to soil erosion that would cause run-off water impacted by suspended sediment. BMPs to curtail soil erosion such as water bars across lease roads, relieving and mulching cut-banks, and restoration of the surface would serve to mitigate erosion related impacts to surface water resources. Short-term testing of CBM exploration wells would not substantially impact area groundwater resources. However, groundwater modeling has suggested that substantial local drawdown may occur within the first year of production.

Production

Under Alternative B, CBM production is expected to be concentrated in the Powder River Basin, but could also develop locally in other portions of the state. This full-scale level of CBM development would result in the potential for impacts to surface water resources from increased soil erosion and the accidental releases of produced water. Full-scale development of 16,500 producing CBM wells would disturb an estimated 54,000 acres, which would increase the potential for soil erosion and the corresponding impact to surface water. However, the implementation of BMPs described in the preceding paragraph would reduce the potential for impacts from soil erosion. The projected 16,500 production wells would generate an estimated average of 2.9 billion cubic feet of produced water per year over 20 years. This produced water would have an average TDS of 1,400 mg/L, and an average SAR value of 47. However, using the assumptions in the RFD, the extrapolated discharge trend line, it is calculated that the maximum discharge would occur in years 6 and 7 of the plan. During year six, 7,710 wells would be producing with an average discharge of 7.1 gpm per well, for a total discharge of 3.85 billion cubic feet of produced water in that year. 3.85 billion cubic feet of produced water would also be discharged in year 7 of the RFD; however, in that year there would be 8,970 producing wells with an average discharge of 6.1 gpm per well. Water management options under this alternative would consist of the injection of CBM-produced waters into approved subsurface zones; the surface discharge of CBM waters from production wells would not be allowed. Some of the produced water would be temporarily stored in tanks or impoundments prior to injection - storage would not be long-term, but these facilities could nonetheless fail, causing localized impacts to surface water and shallow groundwater. The implementation of BMPs concerning the location and construction of these impoundments would mitigate the potential for impacts to surface water from the stored produced waters. Berms around tank batteries would reduce the potential for impacts from leaks and catastrophic failures.

Groundwater resources would be vulnerable to impact from groundwater drawdown levels resulting from full-scale CBM production. The same volume of water produced would be removed from coal seam aquifers, resulting in impacts to water wells and springs. Surface water bodies and springs should not be impacted directly from groundwater withdrawal due to the depth and confined nature of the individual coal seam aquifers. Groundwater resources up to 14 miles from producing CBM fields would potentially be impacted by coal aquifer drawdown (Wheaton and Metesh 2001). During the 20-year planning period for CBM production, groundwater levels within coal seam aquifers could be drawn down over large, contiguous areas of the state. For example, the Upper Tongue watershed covers 590,000 acres and could hold 5,800 CBM wells as projected in the *Water Resources Technical Report* (ALL 2001b). These wells would produce an estimated combined total of 1.02 billion cubic feet of CBM-produced water per year. Over the life of the project, 60 percent of the groundwater could be lost to CBM production in this watershed. Following methodology detailed in the *Water Resources Technical Report* (ALL 2001b), total groundwater resources per watershed and groundwater depletion estimates after 20 years for other watersheds are listed in Table 4-2.

TABLE 4-2
GROUNDWATER DEPLETION BY CBM DEVELOPMENT IN THE MONTANA POWDER RIVER BASIN

Watershed	Potential CBM Producing Wells	Potential Produced CBM Water in 20 years (billion cubic feet)
Little Big Horn	675	2.5
Little Powder	200	0.7
Lower Bighorn	800	2.8
Lower Tongue	3,450	12.0
Lower Yellowstone	1,700	6.0
Middle Powder	2,100	7.4
Mizpah	125	0.5
Rosebud	3,600	12.6
Upper Tongue	3,850	13.5
Total	**16,500**	**58.0**

Note: Calculated maximum potential groundwater production by watershed and resulting depletion (billion cubic feet) after 20 years of CBM production. Details on the method used to calculate these numbers can be obtained from the *Water Resources Technical Report* (ALL 2001b).

The nature of the Fort Union Formation coal seam aquifers that contain the methane gas (i.e., layers of coal interbedded with shale layers having low vertical hydraulic conductivity) should minimize impacts to aquifers above these seams. Shale layers above the coal seam aquifers should provide some degree of protection from drawdown associated with CBM production from the coal seams. Shale layers are confining units that isolate aquifers, such as coal seams and/or sandstone units. The shale layers limit vertical migration of groundwater, thereby reducing leakage and loss of resource from overlying aquifers. Although production of CBM water will enhance cleat within the coal seams, it should not propagate vertical fracturing into the adjacent shale confining units. The impacts to shallow aquifers would more likely result from the disposal of CBM produced water by discharge to land or surface water bodies, re-injection, or one of many beneficial use options (e.g., controlled irrigation, dust control, storage impoundments, etc.).

Impacts on groundwater resources would occur but are difficult to quantify with the available data. As more of the groundwater is depleted, more area water wells and springs would be impacted and it would become more difficult to mitigate water well impacts by transporting water to residents. Depending on the distribution of the CBM development, aquifer drawdown could be concentrated in scattered producing areas. Mitigation agreements are expected to facilitate replacement of water lost to the drawdown of groundwater levels within area aquifers, but in areas of concentrated depletion (such as predicted for the Little Big Horn watershed), water supplies may not support water replacement. In such cases, agriculture that depends upon groundwater may be limited.

Recovery of the coal seam aquifers after production ends is a slow process involving recharge from undrained areas of the aquifer, infiltration from aquifers above the coal seams, and infiltration of precipitation from the surface. Modelers that assisted the Wyoming BLM determined that coal seams that have experienced substantial drawdown see recovery as a two-part process (BLM 2000). "After CBM development (and water removal) ends, within three to four years water levels in the coal aquifers are expected to partially recover to within 20 to 30 feet of pre-operational conditions. Complete water level recovery will be a long-term process, likely requiring hundreds of years for the removed groundwater to be replaced through the infiltration of precipitation." A similar recovery process is expected to occur in the Montana area of CBM interest with most of the recovery happening in a short time but full aquifer recovery not happening within the lifetimes of any of the state's residents. Local groundwater recovery conditions may be different but landowners, CBM operators, and land managers need to be aware of the possible impacts to coal seam aquifers in the vicinity of CBM production.

Deep injection of an estimated 2.9 billion cubic feet of produced water annually throughout the state would not impact coal seam aquifers. The injection of CBM-produced water has not been conducted in Montana, but is commonplace for waters produced from conventional oil and gas activities. In the year 2000, the state of Montana averaged 847 injection/disposal wells that disposed of 0.6 billion cubic feet of water every year (average injection of 128,000 bbl of water per well per year). Injection of CBM water is estimated to increase the number of injection wells to nearly 3,000. These new CBM injection wells would have an average injection rate of 265,000 barrels of water per well per year. This water would be injected into deep aquifers, whose water is not fit for use. Given the effectiveness of current injection regulations, the increase in injected volume resulting from CBM production is anticipated to have only a minimal impact on surface water or groundwater resources.

In those portions of Montana where CBM is developed outside of the Powder River Basin, CBM production is not expected to be as concentrated and hydrological impacts would be less. Limited CBM production in these areas would result in the localized drawdown of groundwater levels within coal seam aquifers with the extent of the drawdown estimated at less than 10 miles from the edge of production (Wheaton and Metesh 2001).

Abandonment

When the estimated 16,500 production wells are abandoned throughout the life of the resource in the planning area, 33,000 acres of soil would be disturbed for a short time period. This disturbed soil would be vulnerable to erosion and the resulting suspended material could be washed into adjacent surface waters unless mitigating measures are employed. The implementation of BMPs would mitigate the potential for impacts to surface water resources resulting from soil erosion until groundcover and original site conditions are restored.

Crow Reservation

Surface water impacts on Crow Tribal Lands under Alternative B are expected to include those impacts noted in Alternative A with the added impacts of suspended sediment due to soil erosion and runoff from the disturbed acreage resulting from increased

CBM development in the vicinity of the Crow Reservation. Groundwater impacts will include those detailed in Alternative A as well as additional impacts from nearby wells in the RFD. The tribe can expect drawdown of coal seam aquifers from CBM wells within 14 miles of the reservation boundaries. This drawdown would impact water wells and springs within the reservation. In addition, because of the large presence of fee land within the exterior boundaries of the Crow Reservation, CBM development on those non-reservation lands would also cause impacts to surface water and groundwater in a manner consistent with other areas of the Powder River Basin.

Northern Cheyenne

Surface water impacts on Northern Cheyenne Tribal Lands under Alternative B would include those impacts noted in Alternative A with the added impacts of suspended sediment as a result of soil erosion and runoff resulting from increased CBM development in the area surrounding the Northern Cheyenne Reservation. Groundwater impacts on the reservation would be similar to impacts in other areas of the Powder River Basin. The tribe can expect drawdown of coal seam aquifers from CBM wells within 14 miles of the reservation boundaries, and this drawdown would impact water wells and springs within the reservation.

Conclusion

Impacts on surface water and groundwater as a result of Wyoming CBM development would be same as discussed under Alternative A. Impacts on surface water under this alternative will include those impacts listed under Alternative A plus the impact of suspended sediment generated by soil erosion taking place in the vicinity of CBM development as projected in the RFD.

CBM production in Montana under Alternative B would result in the withdrawal of approximately 23 percent of the groundwater resources in Montana's Powder River Basin watersheds. This production coupled to a similar level of development on the Crow and Northern Cheyenne reservations would cause the depletion of groundwater to increase to 35 percent. In water wells near CBM fields, the drawdown of coal seam aquifers could be in excess of 100 feet. Water well and spring mitigation agreements would facilitate replacement of groundwater lost to the drawdown of groundwater levels within these coal seam aquifers. Replacement of groundwater supplies may be difficult in some areas and may require supply from off-site sources.

Alternative C

Alternative C consists of the direct discharge of CBM-produced waters to the land surface. Impacts to water resources resulting from this alternative would be a combination of drawdown-related effects similar to Alternative B, and effects due to the large volume of CBM water being discharged to the ground, and allowed to flow into drainages and water bodies. Discharge to the ground would cause increased soil erosion between the discharge point and the nearest drainage. There would be a corresponding increase in the suspended sediment load in surface waters adjacent to CBM development. As CBM water slows along drainages, infiltration of the water would occur, resulting in rises in groundwater elevations, and shifts in the chemistry of the groundwater. In the long term, this would result in diffuse discharge of low-quality water into waterways as the CBM water flows downgradient in the alluvial aquifers until a perennial waterway is reached. That CBM water which is not infiltrated or evaporated en route would reach perennial waterways as point discharges. The addition of CBM water to drainages and surface water bodies, through both point and diffuse discharges, would increase erosion of the stream banks. The increased flow volume, changes in water chemistry, and loss of soil structure would result in increased suspended sediment loads. The chemistry of the surface waters would also be impacted, rendering it unsuitable for some uses by humans and wildlife.

Exploration

Similar to Alternative B above, the moderate volume of water generated by the testing of CBM exploration wells would be stored in tanks or impoundments to be discharged under the appropriate permits.

Production

Alternative C assumes that 80 percent of the volume of CBM water produced would be discharged directly to the land surface adjacent to the wellhead. Impacts to water resources would consist of those effects of drawdown described in Alternative B, soil erosion and the increase in suspended sediments in area rivers and streams, changes in the elevation of groundwater in alluvial aquifers, changes in alluvial aquifer water chemistry, and changes in the chemistry of perennial water bodies. Each CBM well would discharge at an estimated average rate of 2.5 gpm over 20 years. The maximum discharge would be achieved in years 6 and 7 of the RFD. The total discharge in years 6 and 7 would be approximately 58,500 gpm, from 7,710 and 8,970 wells respectively. The discharge at the CBM wellhead would result in the erosion of soils creating gullies that would lead to natural runoff areas where the water would join natural drainage. These natural drainages or ephemeral portions of the water-course would also be impacted by increased erosion and would likely become more nearly perennial as result of receiving CBM discharge water. Before the CBM water reaches surface water, some portion would evaporate or infiltrate into the soil. The portion lost would depend upon season of the year, permeability of the soil, and the presence of a shallow, unconfined aquifer connected to surface water.

Produced water discharged to the surface would be released in several ways: directly to surface water or drainages, into on-drainage impoundments, and into off-drainage impoundments. These three methods would impact surface and groundwater in different ways. Water lost to infiltration or evaporation would depend upon the distance of transport to the surface water body, the amount of CBM water discharged, the physical characteristics of the drainage, and climatic conditions. Discharge to an impoundment constructed by damming an ephemeral drainage (on-drainage pond) would result in losses to both evaporation and infiltration. The infiltration would lead to groundwater doming under the pond that could rise far enough to intersect the ephemeral stream causing discharge to the stream during part or all of the year. Drainage impoundments would also prevent natural meteoric runoff from flowing down drainage and into perennial surface water bodies. Discharge to an impoundment constructed near the ridge-line separating drainages (off-drainage pond) would also result in losses to evaporation and infiltration, but the infiltration and groundwater doming associated with infiltration would have less tendency to intersect ephemeral drainages. In addition, saline seep may form below both off-drainage and on-drainage discharge reservoirs as salt laden waters seep out and intersect a confining layer and rise to the surface. All surficial discharges would have to be in compliance with a NPDES permit. A copy of the Montana general discharge permit for coal bed methane produced water is attached at the end of the *Hydrology Appendix*. The NPDES fact sheet can be obtained from the MDEQ.

Losses associated with evaporation would reduce water volume, but not reduce salt load, and would increase the salinity of the water remaining in the impoundment. How much evaporation takes place would depend upon residence time in the pond and climatic conditions of humidity, temperature, wind, and rainfall. Increased salinity in the stored water would act upon the pond's soil liner by causing dispersal of the clay particles in the soil. Increased salinity would tend to reduce the pond's permeability, reduce subsequent infiltration, and increase residence time in the pond.

It is likely that water that infiltrates into shallow, unconfined alluvial aquifers would be delayed in reaching surface water and not be completely lost to the system. BLM water modelers (BLM 2001b) estimate conveyance losses through evaporation and infiltration in the Wyoming portion of the Powder River Basin at 70 percent. The modelers did not estimate time delays associated with water that comes into contact with shallow, unconfined groundwater. The modelers also did not consider soil and shallow bedrock transmissivity values for Montana when they estimated conveyance losses. Given that only 80 percent of the total 2.9 billion cubic feet (BCF) of CBM produced waters would be discharged under this alternative, and given the 70 percent conveyance loss projection, approximately 0.7 billion cubic feet of CBM-produced water would directly enter area streams and rivers each year. An unknown percentage of the projected conveyance loss would enter shallow groundwater flow systems and eventually reach streams and rivers.

Discharged CBM water would have the ability to impact surface water in many watersheds. The *Water Resources Technical Report* (ALL 2001b) summarizes the water quality in watersheds of the CBM emphasis area. Existing water quality varies between the watersheds and between the seasons within one watershed. Water in the mainstream and tributaries is a combination of base-flow, originating from groundwater and run-off originating as precipitation. In the Montana CBM emphasis area, precipitation is of higher quality than groundwater. Therefore, surface water quality in the watershed would depend on the season. In the Montana CBM emphasis area, it is assumed that CBM water would be of lower quality than either meteoric water or local groundwater. When CBM produced water is discharged to the watershed, water quality would be reduced. The amount of reduction would depend on the constituent, the volume of CBM water, the quality of the CBM water, and the water quality of the receiving body. There would be three primary chemical constituents of concern when analyzing impacts related to CBM production. These include SAR, TDS as measured by EC, and bicarbonate. The MDEQ is in the process of setting statewide numeric water quality standards that would likely include these parameters. When the standards have been approved, they will serve as a framework for managing surface discharge of CBM produced water throughout the state. At issue is the fundamental bimodality of water quality in the CBM emphasis area.

Some streams and tributaries such as the Tongue River carry water of relatively high quality throughout the year (although the Tongue River also shows some decrease in quality when in base-flow) and support such uses as irrigation and various fisheries. Other streams such as the Powder and Little Powder have a lower quality and do not support a full range of uses throughout the year. Water quality in both the high- and low-quality streams seems to be a function of natural circumstances and pre-date CBM and conventional oil and gas development. CBM discharge permits would be based upon the uses designated in State water quality standards and existing water quality data.

Excess assimilative capacities would provide a broader range of options with respect to coordinating water management with CBM discharges in Wyoming and the Crow and Northern Cheyenne Reservations. Excess capacity would allow CBM operators to transport CBM produced water from one watershed where capacity is very low to another watershed where there exists excess capacity.

Surface waters would be further impacted by infiltrated water that contacts shallow groundwater sources and eventually discharge into surface water bodies. Infiltrated water that was stored in an impoundment would have elevated concentrations of some constituents as a result of evaporation. As this water infiltrates through the soil and bedrock, changes to its quality would occur from interactions with the soil, rock, and connate water. The impacts from this water would be difficult to quantify as the distance and residence time within shallow aquitards and shallow aquifers affect the quality of the water that might subsequently be discharged into the surface waters.

Under this alternative, produced water would also be placed into impoundments for use by livestock and wildlife. Water placed in impoundments can be lost to evaporation and seepage/infiltration into the soil below the impoundment. Impoundments are usually constructed of native soil present on site, however, local soils vary widely in their permeabilities as described in the *Soils Technical Report* (ALL 2001a). Impoundments constructed of sandy soils would allow more infiltration of produced water than those built from clay. Water stored in sandy impoundments would be more liable to seep into deeper soil horizons where the water would be able to increase the salinity of the soils. Produced water would also be able to seep into unconfined aquifers if these were present, modifying the quality of the native groundwater. The specific soil types and impoundment locations are unknown with regards to future CBM developments in Montana. The degree of produced water infiltration cannot be estimated without site-specific data.

Impacts on groundwater under this alternative would be the same as in Alternative B except that discharged water could infiltrate into soils and underlying aquifers. The produced water from the only Montana CBM field (CX Ranch) has an SAR value in excess of the water contained in most shallow aquifers, including the alluvial aquifers (ALL 2001b). If infiltration of CBM-produced water occurred, the water quality of the alluvium would be impacted.

Abandonment

Impacts on water resources caused by abandonment operations would be similar to impacts by produced water discharged to the surface. The two activities-soil disturbance at abandonment and 20 years of surface discharge-would combine to increase the suspended sediment load within area surface water streams and rivers.

Crow Reservation

Impacts on the Crow Reservation are expected to be similar to impacts projected for the CBM emphasis area. The reservation can expect impacts to surface water in the form of increased flow volume and quality of various water quality parameters, including SAR, EC, and bicarbonate. The tribe can expect drawdown of coal seam aquifers from Wyoming and Montana CBM production for a distance of approximately 14 miles outside the reservation boundaries. In addition, potential CBM development on fee land within the external boundaries of the reservation could cause more direct impacts that would also be similar to those impacts described for the CBM emphasis area.

Northern Cheyenne

Impacts on the Northern Cheyenne Reservation are expected to be similar to impacts projected for the CBM emphasis area. The reservation can expect impact to surface water in the form of increases in flow volume and quality of various water quality parameters, including SAR, EC, and bicarbonate. The tribe can expect drawdown of coal seam aquifers from CBM production in the area surrounding the reservation for distances of approximately 14 miles from the reservation boundaries.

Conclusion

Impacts from CBM development in Wyoming would be the same under this alternative as under Alternative A. Montana CBM impacts to surface water as well as cumulative impacts would be more extensive under this alternative.

Impacts on groundwater would include those listed under Alternative B, as well as impacts from infiltration of surface water into shallow aquifers from impoundments and drainages. BMPs for surface impoundment construction, however, would mitigate impacts by incorporating clay into sandy soil impoundments, by the use of impermeable geomembrane liners, by not building impoundments where sandy soil occurs, by not building impoundments over alluvial areas, and by not building impoundments in natural drainage ways.

In terms of surface water, CBM development in Montana under this alternative would have impacts on most watersheds in the CBM emphasis area and elsewhere in the state where CBM development occurs. The impact of untreated CBM discharge on surface water quality in Powder River Basin streams in Montana was analyzed using the assumptions described at the beginning of this section and the expanded development scenario for the RFD excluding any dry holes or nonproductive wells. This impact analysis, summarized in Table 4-3 and Figure 4-1, is based on the assumption that CBM wells produce water at an average rate of 2.5 gpm/well with discharge reduced by 20 percent due to beneficial use and that 70 percent of the remaining discharge (80 percent) is lost during conveyance. The effective discharge to streams is 24 percent of the amount of water produced. An SAR value of 47 and EC value of 2207 μS/cm were used for all streams. Base stream flow rates—equal to the low mean monthly flows—were input, along with average values of EC and SAR for baseline stream water quality. All upstream development, including development in Wyoming, was evaluated for each watershed (MDEQ 2001c). Map 4-3 graphically depicts the expanded development potential including dry holes for each watershed in the Powder River Basin regardless of ownership.

Figure 4-1 shows that the discharge of untreated CBM produced water to streams would render all rivers, except the Bighorn and Little Bighorn Rivers, unusable for irrigation based on the EC-SAR relationship that represents no reduction in infiltration. The Bighorn and Little Bighorn Rivers also meet the additional limitation on SAR (<=12). The SAR values in these rivers after mixing with the RFD CBM discharge are less than 12. If the SAR criterion is 2 instead of 12, then only the Little Bighorn River would maintain acceptable water quality after mixing with the RFD CBM discharge (SAR <=2).

The following analysis uses the EC-SAR relationship and a cap of 12 on SAR to calculate the maximum number of CBM wells that could discharge before meeting an irrigation threshold. The assimilative capacity at the stateline stations was split equally between Wyoming and Montana. The calculated volume for CBM discharge and the corresponding number of average CBM wells are listed in Table 4-4. The discharge range for preserving downstream beneficial use would be 20 percent to 60 percent of the RFD projected amount for the Tongue, 8 percent to 46 percent in Rosebud, and less than 33 percent in the Little Powder River in Montana. On the Wyoming side, discharge would be less than 4 percent in the Little Powder, 40 percent in the Powder, and less than 70 percent in the Tongue. The ranges would vary due to differences in baseline water quality in the reaches of the streams, which results in differences in the assimilative capacity of each reach. These results are based on the assumption that the quality of CBM produced water is the same throughout the Powder River Basin and is represented by the water quality of the CBM wells at the CX Ranch on the Tongue River. If water quality parameters representative of the CBM water produced in the Little Powder and Powder Rivers are used as input to the model rather than the CX Ranch values, the amount of CBM produced water that could be released to the Little Powder and Powder Rivers would be greatly increased. If SAR is limited to 2 instead of 12 for all rivers except the Little Powder and Powder, very little CBM discharge would be accommodated in the rivers (Table 4-5). The discharge in the Tongue River would decrease to one fifth; with a SAR cap of 12 and no discharge of untreated CBM produced water would occur in either the Rosebud or Lower Bighorn drainages.

Surface water in high-quality watersheds would show increases in SAR from less than 1 to between 4 and 6. Surface water in low-quality watersheds would show a generalized increase in SAR from approximately 4 to 7. A few low- and high-quality watersheds would not have sufficient assimilative capacity to accept potential discharge predicted for full-scale development without using flow-based discharge permits or transporting produced water to watersheds having excess capacity. All discharges would need to be in compliance with a NPDES permit.

Cumulative impacts to surface water combines Wyoming CBM development occurring upstream of Montana's development. Wyoming impacts to Montana surface water are currently uncertain. One possibility is that the two states will maintain cooperation and management of discharges in a manner whereby surface water quality impacts from

Wyoming are minimal and do not drastically reduce assimilative capacity in Montana. If, however, the interim memorandum of cooperation between the two states expires or is replaced by a less restrictive agreement, Wyoming discharges to shared watersheds could increase, surface water quality could be reduced, and watersheds would have little or no additional assimilative capacity to accommodate produced water discharges from CBM development in Montana. This could proceed far enough that surface water in the Tongue, Powder, and Little Powder is at or above the assumed water quality criteria, and no Montana CBM water could be discharged to those watersheds.

In addition, suspended sediment impacts by way of direct discharge to land would affect all drainages in the Montana portion of the Powder River Basin and could affect other drainages where CBM development is sufficiently concentrated.

Area surface waters would be impacted by an increase in suspended sediments contained in the discharged CBM water. This increase in suspended sediment load would result from the increased erosion of soils due to surficial disturbances, CBM water runoff from the point of discharge to drainages, and from the increased erosion of stream banks resulting from increased water volume and increased salinity (which will cause clays to lose their cohesiveness and erode more easily).

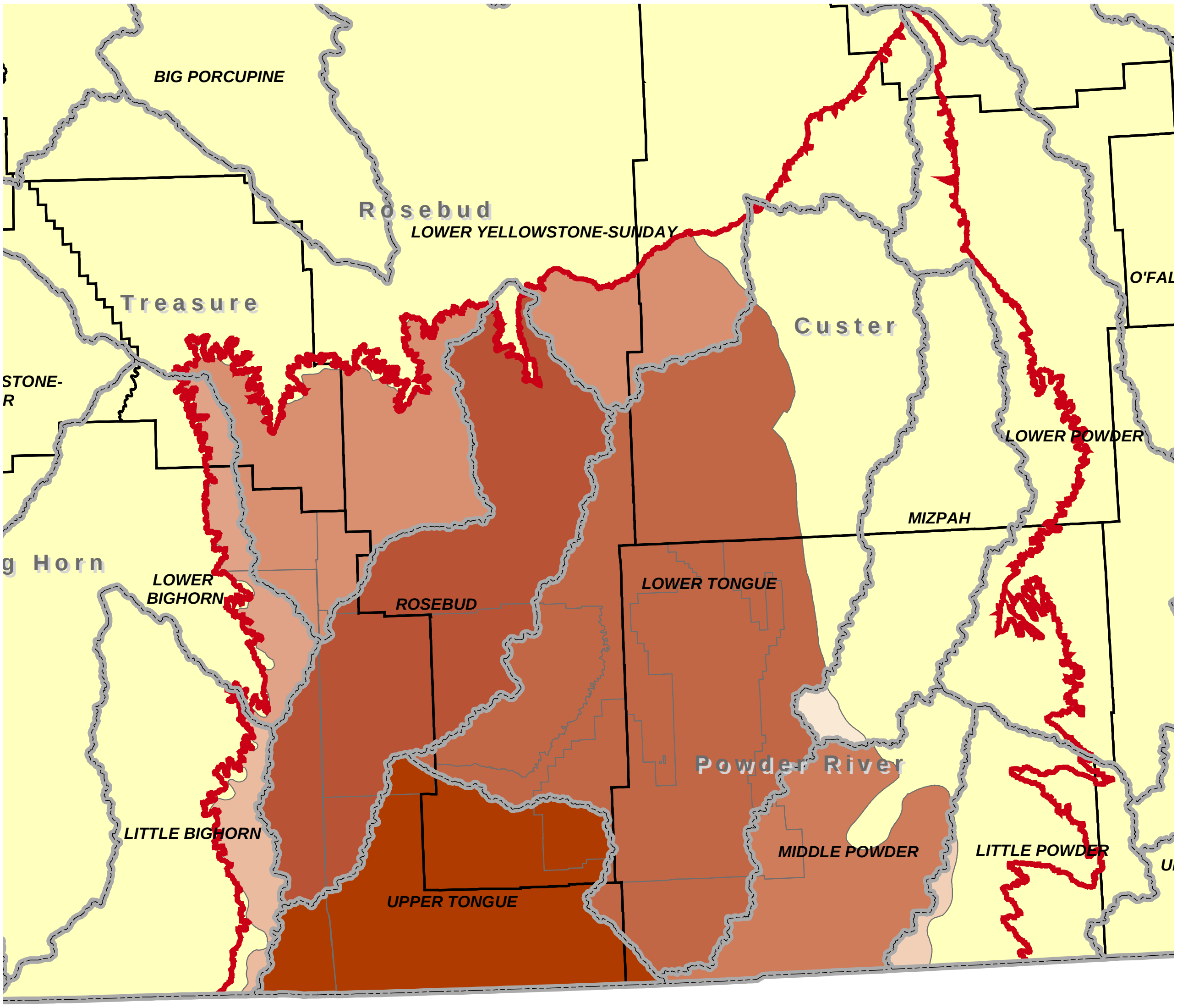
Table 4-6 summarizes the surface water SAR values that would be expected to result from implementation of Alternative C. The increase in suspended sediment content of surface water could affect its beneficial use, making the water unsuitable for drinking except after treatment. All of the watersheds in the CBM emphasis area would be vulnerable to impacts from an increase in suspended sediment. Discharge to ephemeral channels will also degrade the channel form causing increased deepening and widening.

TABLE 4-3
SUMMARY OF IMPACTS FOR IRRIGATION IN MONTANA

Location	Impact to Irrigation (EC and SAR Exceed Threshold)
Little Powder River at Dry Creek near Weston	Yes
Little Powder River near Broadus	Yes
Powder River at Moorhead	Yes
Powder River at Broadus	Yes
Mizpah Creek near Mizpah	Yes
Tongue River at State Line near Decker	Yes
Tongue River at Birney Day School Bridge near Birney	Yes
Tongue River by Brandenberg Bridge near Ashland	Yes
Tongue River at Miles City	Yes
Rosebud Creek at Reservation Boundary near Kirby	Yes
Rosebud Creek near Colstrip	Yes
Rosebud Creek at Mouth near Rosebud	Yes
Little Bighorn River by Pass Creek near Wyola	No
Little Bighorn River near Hardin	No
Lower Bighorn River near ST. Xavier	No
Lower Bighorn River at Tullock Creek near Bighorn	No

[1]Based on SAR threshold of 12

Map 4-3: Predicted Number of CBM Wells by Watershed for Expanded Development Scenarios Regardless of Ownership



Legend

1:1,400,000

0 3.75 7.5 15 22.5 30 Miles

0 12,000 24,000 48,000 Meters

Watershed Boundaries

Powder River Geologic Basin Bnd.

Predicted # of CBM Wells Per Watershed

- 225 - MIZPAH
- 280 - LITTLE POWDER
- 1050 - LITTLE BIGHORN
- 1200 - LOWER BIGHORN
- 2570 - LOWER YELLOWSTONE - SUNDAY
- 3170 - MIDDLE POWDER
- 5180 - LOWER TONGUE
- 5400 - ROSEBUD
- 5810 - UPPER TONGUE

N W E S

This figure represents the predicted number of Coal Bed Methane Wells in the Montana Portion of the Powder River Basin by watershed based on the Reasonable Foreseeable Development Scenario for expanded development regardless of ownership. These wells represent the potential wells drilled including dry holes.

DATA SOURCES:
Counties: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, MT.
Reservations: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, MT.
National Forests: 1:100,000 scale, national forests, Montana State Library/NRIS, Helena, MT.
Parks: 1:100,000 scale, parks, Montana State Library/NRIS, Helena, MT
Development Data: BLM Reasonable Foreseeable Development Scenario
Coal Occurence: Tully, 1996.

NOTE: To be used as a reference graphic only. Some data represented are at scales greater than it's source.

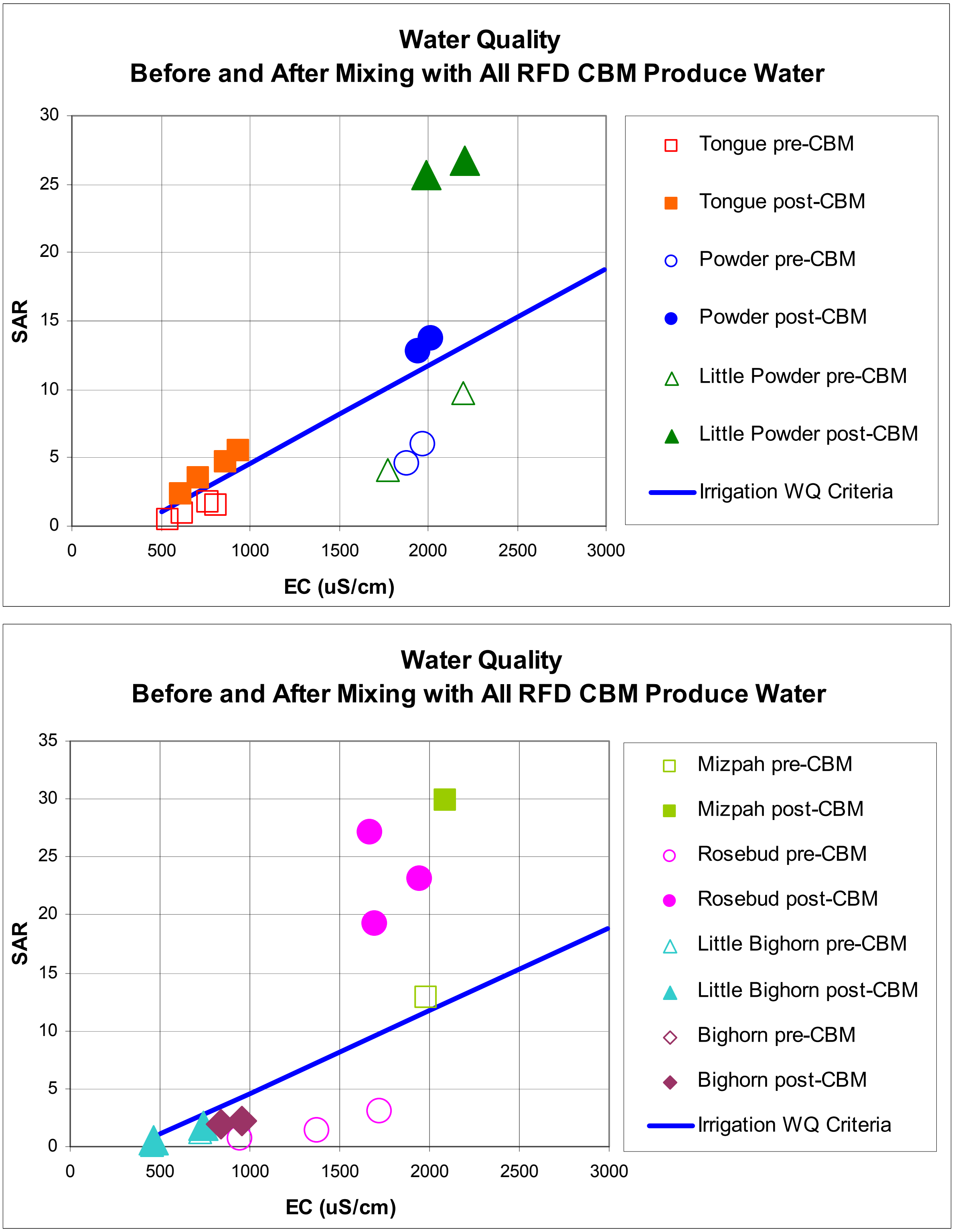


Figure 4-1. Water quality of Powder River Basin streams before and after mixing with the expanded development level of potential RFD CBM well discharge. This analysis used the maximum number of RFD potential producing wells regardless of ownership and assumed none would be dry holes or nonproductive.

TABLE 4-4
LIMITS ON CBM DISCHARGE AND NUMBER OF DISCHARGING CBM WELLS TO AVOID EXCEEDING IRRIGATION THRESHOLDS[1] FOR IRRIGATION IN MONTANA WITH SAR CAP OF 12

Location	Discharge Limit (cfs)	Number of CBM Wells	Fraction of RFD CBM Wells (%)
Wyoming			
Little Powder River at Dry Creek near Weston	0.1	91	4
Powder River at Moorhead	13.9	10356	39
Tongue River at State Line near Decker	2.4	1793	69
Montana			
Little Powder River near Broadus	0.1	91	33
Powder River at Broadus	14.5	RFD (3167)	100
Mizpah Creek near Mizpah	0	0	0
Tongue River at State Line near Decker	2.4	1793	62
Tongue River at Birney Day School Bridge near Birney	0.8	598	21
Tongue River by Brandenberg Bridge near Ashland	2.1	1588	61
Tongue River at Miles City	2.1	1602	62
Rosebud Creek at Reservation Boundary near Kirby	0.2	141	8
Rosebud Creek near Colstrip	1.1	834	46
Rosebud Creek at Mouth near Rosebud	0.4	285	16
Little Bighorn River by Pass Creek near Wyola	1.5	RFD (525)	100
Little Bighorn River near Hardin	3.4	RFD (525)	100
Lower Bighorn River near ST. Xavier	106.1	RFD (600)	100
Lower Bighorn River at Tullock Creek near Bighorn	63.2	RFD (600)	100

[1] Based on SAR threshold of 12.

TABLE 4-5
LIMITS ON CBM DISCHARGE AND NUMBER OF DISCHARGING CBM WELLS TO AVOID EXCEEDING IRRIGATION THRESHOLDS[1] FOR IRRIGATION IN MONTANA WITH SAR CAP OF 2.

Location	Discharge Limit (cfs)	Number of CBM Wells	Fraction of RFD CBM Wells
Wyoming			
Little Powder River at Dry Creek near Weston	0.1	91	4
Powder River at Moorhead	13.9	10356	39
Tongue River at State Line near Decker	2.4	1793	69
Montana			
Little Powder River near Broadus	0.1	91	33
Powder River at Broadus	RFD	RFD (3167)	100
Mizpah Creek near Mizpah	0	0	0
Tongue River at State Line near Decker	0.7	516	18
Tongue River at Birney Day School Bridge near Birney	0.0	0	0
Tongue River by Brandenberg Bridge near Ashland	0.0	0	0
Tongue River at Miles City	0.7	530	20
Rosebud Creek at Reservation Boundary near Kirby	0.0	0	0
Rosebud Creek near Colstrip	0.0	0	0
Rosebud Creek at Mouth near Rosebud	0.0	0	0
Little Bighorn River by Pass Creek near Wyola	RFD	RFD (525)	100
Little Bighorn River near Hardin	RFD	RFD (525)	100
Lower Bighorn River near ST. Xavier	0.0	0	0
Lower Bighorn River at Tullock Creek near Bighorn	0.0	0	0

[1] Based on a SAR threshold of 2.

Alternative D

Under this alternative, 80 percent of produced water would be treated prior to discharge and discharge would be accomplished by pipeline or constructed watercourse to the nearest body of water to eliminate soil erosion, the generation of suspended sediments, and the infiltration of treated CBM water. The treatment of CBM-produced waters would eliminate or greatly reduce SAR, EC, bicarbonate, and suspended sediment impacts to surface waters. Treatment would increase the beneficial uses of CBM water, but the volume of produced water that would be beneficially used is expected to stay the same, at 20 percent of the total water produced. All discharges would need to be in compliance with a NPDES permit.

Exploration

Any water generated by drilling and testing would be treated with 80 percent of the treated water discharged via pipeline and 20 percent used for beneficial purposes. Treatment would eliminate potential impacts to water quality and water quantity impacts would be minor because of the moderate volume produced from the testing of CBM exploration wells.

Production

Approximately 80 percent of CBM-produced water would be treated and discharged under this alternative. Because the water is piped to the receiving body of water, no conveyance losses are deducted. Table 4-7 presents the Montana Powder River Basin CBM development utilizing a tabulated average production rate of 2.5 gpm, the maximum discharges expected in years 6 and 7, and an assumed discharge rate of 80 percent via pipeline.

On average, over 20 years, discharged water would add about 1% to the total water discharged into the Yellowstone from the affected watersheds. Peak total discharge during years 6 and 7 would add about 1.35% to the total water discharged to the Yellowstone. In detail, every watershed except the Little Yellowstone-Sunday, the Lower Bighorn, and the Mizpah, experience at least a 10 percent increase in baseflow in at least one portion of the watershed. Rosebud Creek and the Little Powder would experience the greatest percentage change in baseflow during years 6 and 7, with 1,145 percent and 275 percent increases in baseflow respectively. These increases in flow volume would result in increased erosion in impacted watersheds. Since discharge water would be treated, the water quality of the streams would not be impacted. The treatment of CBM-produced waters could result in the generation of residues that would contain concentrated salts extracted from the CBM water. This waste would need to be analyzed on a case-by-case basis to determine its character and would need to be disposed of in an appropriate manner that could involve deep injection (i.e., Class II injection wells). Base-flow values listed in Table 4-7 may have already been impacted by CBM development in Wyoming. Cumulative impacts of CBM development in both Montana and Wyoming are listed below in the *Conclusions* section. The temperature of the receiving water bodies may also be affected by the increased groundwater discharge associated with this alternative. The temperature change that would result would depend on the water management practices employed for treating the CBM water. Given the high degree of natural variation in water temperature in this region, it seems unlikely that the resultant temperature shift would impact wildlife.

Impacts on groundwater from CBM production would be similar to Alternative B.

Abandonment

Impacts on water resources caused by abandonment operations would be similar to impacts under Alternative B. When the estimated 16,500 CBM production wells are abandoned over the 20-year life of the resource, 33,000 acres of soil would be disturbed for a short time period. This disturbed soil would be vulnerable to erosion and the resulting suspended material would be washed into adjacent surface waters unless mitigating measures are employed. The implementation of BMPs would control soil erosion until groundcover and original conditions are restored.

Crow Reservation Impacts

Surface water impacts on Crow Tribal Lands under Alternative D are expected to include those impacts noted in Alternative B with the added impacts from the surface discharge of 80 percent of the produced water from all of the Montana CBM wells forecast in the RFD. Because the produced water would be treated prior to discharge, the reservation can expect impacts to surface water only in the form of increased flow volume. Groundwater impacts will include those detailed in Alternative B. The tribe can expect drawdown of coal seam aquifers from Wyoming and Montana CBM wells within 14 miles of the reservation boundaries.

TABLE 4-6
ALTERNATIVE C DISCHARGE SCENARIO, BY WATERSHED

Watershed	Average CBM Discharge (CBM_A) (bcf/yr)	Maximum CBM Discharge (CBM_M) (bcf/yr)	Average Stream Baseflow (bcf/yr)	7Q10 Stream Discharge (bcf/yr)	SAR of Receiving Water body at low flow	Resultant Discharges: Baseflow CBM_A+BF (bcf/yr)	Resultant Discharges: Baseflow CBM_M+BF (bcf/yr)	Resultant Discharges: 7Q10 CBM_A+7Q10 (bcf/yr)	Resultant Discharges: 7Q10 CBM_M+7Q10 (bcf/yr)	Resultant SARs: Baseflow CBM_A+BF (bcf/yr)	Resultant SARs: Baseflow CBM_M+BF (bcf/yr)	Resultant SARs: 7Q10 CBM_A+7Q10 (bcf/yr)	Resultant SARs: 7Q10 CBM_M+7Q10 (bcf/yr)
Little Bighorn (Wyola)	0.06	0.13	1.90	1.48	0.04	1.96	2.03	1.54	1.61	0.80	1.64	1.01	2.07
Little Bighorn (Crow Agency)	0.06	0.13	0.41	NA	0.04	0.47	0.54	NA	NA	3.31	6.51	NA	NA
Little Bighorn (Hardin)	0.06	0.13	4.40	0.66	1.06	4.46	4.53	0.72	0.79	1.32	1.62	2.73	4.49
Yellowstone-Sunday (Myers)	0.19	0.38	133.00	NA	1.35	133.19	133.38	NA	NA	1.38	2.52	NA	NA
Little Powder (Broadus)	0.02	0.03	0.01	0.00	NA	0.03	0.04	0.02	0.03	NA	NA	47.21	47.21
Lower Bighorn (St. Xavier)	0.09	0.18	55.00	20.79	0.70	55.09	55.18	20.88	20.97	0.71	0.72	0.73	0.76
Lower Bighorn (Big Horn)	0.09	0.18	91.48	27.41	1.72	91.56	91.65	27.50	27.59	1.74	1.76	1.78	1.85
Mizpah (Mizpah)	0.02	0.03	0.82	0.00	6.31	0.84	0.85	0.02	0.03	6.47	6.54	47.21	47.21
Middle Powder (Moorhead)	0.22	0.45	4.80	0.03	4.02	5.02	5.25	0.26	0.48	4.51	5.00	27.84	0.76
Middle Powder (Broadus)	0.22	0.45	6.30	0.28	4.02	6.52	6.75	0.51	0.73	4.39	4.78	10.45	1.85
Rosebud (Kirby)	0.40	0.80	0.06	0.0032	8.88	0.46	0.86	0.40	0.80	27.11	32.96	44.70	45.90
Rosebud (Colstrip)	0.40	0.80	0.24	0.00	8.88	0.64	1.04	0.40	0.80	16.98	21.53	47.21	47.21
Rosebud (Rosebud)	0.40	0.80	0.28	0.00	8.88	0.68	1.08	0.40	0.80	16.14	20.41	47.21	47.21
Upper Tongue (state line)	0.42	0.83	5.70	1.32	0.96	6.12	6.53	1.74	2.15	2.14	3.22	5.51	8.90
Upper Tongue (TR Dam)	0.42	0.83	5.50	0.69	0.96	5.92	6.33	1.11	1.52	2.19	3.29	8.70	13.59
Lower Tongue (Birney DS)*	0.79	1.58	5.80	1.42	0.96	6.59	7.38	2.21	2.99	3.08	4.93	8.17	12.95
Lower Tongue (Ashland)*	0.79	1.58	6.50	2.21	0.77	7.29	8.08	3.00	3.78	3.23	5.39	7.20	11.83
Lower Tongue (Miles City)*	0.79	1.58	6.10	0.25	1.36	6.89	7.68	1.04	1.83	3.49	5.36	23.99	31.06
Total	**1.79**	**3.57**											

*CBM Discharge into the Lower Tongue is the sum of the amount anticipated to be discharged into the Upper Tongue plus the amount anticipated to be discharged into the Lower Tongue, as all water in the Upper Tongue will flow into the Lower Tongue.

CBM_A = Average Projected Coal Bed Methane Related Discharge (20 Year Average)

CBM_M = Maximum Projected Coal Bed Methane Related Discharge (Years 6 and 7 of the RFD)

BF = Average Stream Baseflow

7Q10 = Ten Year Seven Day Minimum Flow (Calculated by USGS)

Assumes SAR of CBM water is 47.21

Assumes 20% beneficial use and a 70% conveyance loss

Precipitation of calcite is not calculated although the resulting waters are saturated with respect to calcite for many locations.

NA = Date is not available for these values.

TABLE 4-7
ALTERNATIVE D DISCHARGE SCENARIO, BY WATERSHED

Watershed	Average CBM Discharge (CBM_A) (bcf/yr)	Maximum CBM Discharge (CBM_M) (bcf/yr)	Average Stream Baseflow (bcf/yr)	7Q10 Stream Discharge (bcf/yr)	Resultant Discharges: Baseflow CBM_A+BF (bcf/yr)	Resultant Discharges: Baseflow CBM_M+BF (bcf/yr)	Resultant Discharges: 7Q10 CBM_A+7Q10 (bcf/yr)	Resultant Discharges: 7Q10 CBM_M+7Q10 (bcf/yr)
Little Bighorn (Wyola)	0.08	0.16	1.90	1.48	1.98	2.06	1.56	1.64
Little Bighorn (Crow Agency)	0.08	0.16	0.41	NA	0.49	0.57	NA	NA
Little Bighorn (Hardin)	0.08	0.16	4.40	0.66	4.48	4.56	0.74	0.82
Yellowstone-Sunday (Myers)	0.24	0.48	133.00	NA	133.24	133.48	NA	NA
Little Powder (Broadus)	0.02	0.04	0.01	0.00	0.03	0.05	0.02	0.04
Lower Bighorn (St. Xavier)	0.11	0.22	55.00	20.79	55.11	55.22	20.90	21.01
Lower Bighorn (Big Horn)	0.11	0.22	91.48	27.41	91.59	91.70	27.52	27.63
Mizpah (Mizpah)	0.02	0.04	0.82	0.00	0.84	0.86	0.02	0.04
Middle Powder (Moorhead)	0.28	0.56	4.80	0.03	5.08	5.36	0.31	0.59
Middle Powder (Broadus)	0.28	0.56	6.30	0.28	6.58	6.86	0.56	0.84
Rosebud (Kirby)	0.50	1.00	0.06	0.0032	0.56	1.06	0.50	1.00
Rosebud (Colstrip)	0.50	1.00	0.24	0.00	0.74	1.24	0.50	1.00
Rosebud (Rosebud)	0.50	1.00	0.28	0.00	0.78	1.28	0.50	1.00
Upper Tongue (state line)	0.52	1.04	5.70	1.32	6.22	6.74	1.84	2.36
Upper Tongue (TR Dam)	0.52	1.04	5.50	0.69	6.02	6.54	1.21	1.73
Lower Tongue (Birney DS)*	0.99	1.97	5.80	1.42	6.79	7.77	2.41	3.39
Lower Tongue (Ashland)*	0.99	1.97	6.50	2.21	7.49	8.47	3.20	4.18
Lower Tongue (Miles City)*	0.99	1.97	6.10	0.25	7.09	8.07	1.24	2.22
TOTAL	**2.24**	**4.46**						

*CBM Discharge into the Lower Tongue is the sum of the amount anticipated to be discharged into the Upper Tongue plus the amount anticipated to be discharged into the Lower Tongue, as all water in the Upper Tongue will flow into the Lower Tongue.
CBM_A = Average Projected Coal Bed Methane Related Discharge (20 year average)
CBM_M = Maximum Projected Coal Bed Methane Related Discharge (Years 6 and 7 of the RFD)
BF = Average Stream Baseflow
7Q10 = Ten Year Seven Day Minimum Flow (Calculated by USGS)
Assumes that 20% of the water is put to beneficial use, and that there is no conveyance loss.
As the CBM water would be treated prior to discharge, there would not be an appreciable effect on the chemistry of the receiving water body.
NA = Data is not available for these values.

Northern Cheyenne Impacts

Surface water impacts on Northern Cheyenne Tribal Lands under Alternative D are expected to include those impacts noted in Alternative B with the added impacts from the surface discharge of 80 percent of the produced water from all of the Montana CBM wells forecast in the RFD. Because produced water would be treated prior to discharge, the Reservation can expect impact to surface water in the form of increased flow volume. Groundwater impacts will include those detailed in Alternative B. The Tribe can expect drawdown of coal seam aquifers from Montana CBM wells within 14 miles of the reservation boundaries.

Conclusion

Treatment and discharge of produced water from Montana would result in impacts through increased river flow volume. Since this water is treated, the impacts to water quality would depend on the level of treatment. The level of treatment will determine the resultant quality of the receiving stream, if CBM produced water is treated to higher quality it would improve the quality of the receiving stream when discharged. Flow volumes in some watersheds would change only slightly, but some watersheds would see flow increase, especially during times of traditionally low-flow. The impacts could include bank erosion, riparian area alteration, and loss of indigenous habitat. All discharges would need to be in compliance with a NPDES permit.

These increased flow volumes could be overshadowed by impacts due to Wyoming CBM produced water discharge. Impacts on Montana watersheds from Wyoming CBM discharge would be the same under this alternative as under Alternative C. Depending upon the fate of the interim memorandum of cooperation between the states of Montana and Wyoming, discharges of Wyoming CBM water into watersheds shared by Wyoming and Montana could be minimal or several times larger than the Montana discharges. Cumulative impacts to surface water could include localized erosion and stream alteration. These impacts would be similar to those caused by major rain events, but would be concentrated into small producing areas rather than spread over the entire watershed.

Impacts from surface impoundments would be similar to impacts under Alternative C except that produced water would be treated prior to storage, lessening the chances for increasing the salinity of sub-soils and shallow, unconfined aquifers.

Drawdown impacts to groundwater would be the same as under Alternative B.

Alternative E (Preferred Alternative)

Impacts under Alternative E (Preferred Alternative) would be similar to impacts described in Alternative C. However, Alternative E emphasizes the beneficial uses of produced water from CBM wells. Further, Alternative E does not set limits that surface discharges would be limited to treated water as in Alternative D, or untreated water as is the case with Alternative C. Alternative E could include produced water discharges that involve both treated and untreated water, so long as NPDES requirements are met. Furthermore, water produced from CBM wells could be managed in a much broader fashion than has been analyzed in any of the previous alternatives by emphasizing beneficial use of CBM water. A Water Management Plan would be required prior to exploration or production. Water management options would include injection, treatment and discharge, impoundment, direct discharge, or any other operator proposed methods, provided that they are addressed in the Water Management Plan, and the plan is approved by the appropriate agency. The Water Management Plan must address both site-specific conditions and regional cumulative effects of CBM development. The plan would address the proposed water management practices and their effects on soil, water, vegetation, wildlife, stream channel stability, and any other resources reasonably expected to be impacted by the actions.

Exploration

Similar to Alternative C above, the moderate volume of water generated by the testing of CBM exploration wells would be stored in tanks or lined (clay or geotextile) impoundments to be discharged under the appropriate permits.

Production

Similar to Alternative C above, an average of 2.5 gpm of water will be produced by each of the 16,500 CBM wells expected to be developed in the CBM emphasis area. But unlike Alternative C, the Preferred Alternative allows wide latitude in produced water management. In addition to surface discharge, injection can be used, with the proper permits, to dispose of water into shallow coal aquifers or deep aquifers that contain water either above or below 10,000 mg/l TDS. CBM water could also be used for new beneficial uses. The combination of emphasizing beneficial use and increased flexibility for managing produced water should increase water used for beneficial purposes, such as stock watering, irrigation, dust control, etc. Increases in beneficial use would also result in decreased impacts resulting from surface discharge as compared to Alternative C. But because actual management practices are yet to be defined as far as the level of beneficial use and alternate water management practices (e.g., surface discharge), Alternative E assumes the same level of beneficial use as Alternative C. Therefore, impacts from Alternative E would be the same or less as those for Alternative C.

Abandonment

Impacts on water resources caused by abandonment operations would be similar to impacts under Alternative B. When the estimated 16,500 CBM production wells are abandoned over the 20-year life of the resource, 33,000 acres of soil would be disturbed for a short time period. This disturbed soil would be vulnerable to erosion and the resulting suspended material would be washed into adjacent surface waters unless mitigating measures are employed. The implementation of BMPs would reduce soil erosion until groundcover and original conditions are restored.

Crow Reservation

Surface water impacts on Crow Tribal Lands under Alternative E (Preferred Alternative) are assumed to include those impacts noted in Alternative C. Because of the latitude in produced water management, however, impacts would be much less. Groundwater impacts will include those detailed in Alternative B. The Tribe can expect drawdown of coal seam aquifers from Wyoming and Montana CBM wells within 14 miles of the reservation boundaries.

Northern Cheyenne

Surface water impacts on Northern Cheyenne Tribal Lands under Alternative E (Preferred Alternative) are assumed to include those impacts noted in Alternative C. Because of the latitude in wastewater management, however, impacts could be much less. Groundwater impacts will include those detailed in Alternative B. The tribe can expect drawdown of coal seam aquifers from Montana CBM wells within 14 miles of the reservation boundaries.

Conclusion

Impacts under Alternative E (Preferred Alternative) on the important hydrological resources-surface water and groundwater as seen in springs as well as water wells are assumed to be the same as Alternative C. Operators may choose other options when managing their CBM water, however, with concomitant reductions in the volume of surface discharge. Cumulative impacts are similar to Alternative C in that impacts from the Wyoming portion of the Powder River Basin are difficult to predict. The existing interim agreement may be expanded to involve other constituents and other watersheds. However, future agreements may be more or less restrictive, or the agreement may expire with no replacement. These different scenarios will have an effect on Wyoming's impact on the hydrological resources of Montana.

Indian Trust and Native American Concerns

Assumptions

The state does not have an ITA responsibility; therefore, it is assumed that the state would not be able to enforce but would encourage the 2-mile buffer zone around the reservations as called for in the management objectives for Alternatives B and D. Furthermore, it is assumed that the BLM's trust responsibility includes being responsible for identifying and mitigating impacts from U.S. government and BLM-sponsored developments on or adjacent to the reservations.

Impacts From Management Common to All Alternatives

While the BLM would not have jurisdiction over Indian lands located on or off the reservation, the BLM would have a trust responsibility that encompasses oil and gas exploration. ITAs would be managed following the DOI Secretarial Order 3215, Principles for the Discharge of the Secretary's Trust Responsibility.

The conventional wells expected to be drilled within BLM-administered RMP areas would impact adjacent reservation lands by draining tribal hydrocarbons or groundwater, or even by allowing produced water to impact surface water resources or soil. Drainage by adjacent wells is addressed by 43 CFR Part 3162.2-2, which instructs the BLM on steps to be taken to protect Indian landowners from drainage.

The potential wells estimated for reservation development (12) coupled with the predicted wells (<25) adjacent to reservation lands, do not appear to represent a measurable increase in development on or near the reservation for the next 20 years. This level of development is not expected to impact tribal hydrocarbons or effect groundwater resources. Quantitatively, the direct land impacts from this small number of wells on reservation lands would be minor (less than 75 total acres permanently impacted) with regard to grazing lands, vegetation, biological resource etc.

Impacts From Management Specific to Each Alternative

Alternative A

Based on the limited development scenario presented under this alternative, the known locations of production wells (CX Ranch), the number of exploration wells, and the assessment of impacts on the other resource topics, no measurable ITAs are expected from the CBM activities planned under this alternative in Montana.

Conclusion

Impacts on ITAs from management decisions included in Alternative A, management practices common to all alternatives, and from projects evaluated under the cumulative effects analysis would be of no consequence to the physical resources with the exception of the Absaloka Coal Mine and the production and discharge of CBM production waters from Wyoming.

Mining activities at the 5,400-acre Absaloka Coal Mine facility located just north of the northeastern corner of the Crow Reservation has resulted in the irretrievable loss of the coal mined at approximately 5 million tons per year, and has removed or disturbed approximately 3,150 acres of topsoil. Additional impacts have been felt from the dewatering of the coal and the lowering of the surrounding groundwater by an estimated 75 feet (Wheaton and Van Voast 1998). Finally, the surface water within the adjacent vicinity of the mine has undergone a reduction in quality, resulting in impacts on the local watercourses and subsequent fields using these waters as sources of irrigation.

Development of CBM in Wyoming during the next 20 years has the potential to impact the surface water, groundwater, and methane resources of the Crow and Northern Cheyenne tribes. Drawdown of groundwater levels is an unavoidable impact from CBM development. Increased groundwater drawdown would be experienced along the southeastern boarder of the Crow Reservation adjacent to and up to 14 miles north of the Wyoming state line (Wheaton and Metesh 2001). The magnitude of impact to water wells and springs would depend on the location and number of CBM producing wells south of the state boundary. Depending upon their locations, natural springs and water wells on tribal lands could go dry.

Wyoming CBM production could also drain methane from tribal mineral resources. As groundwater is drawndown and reservoir pressures decrease, methane is liberated from the coal matrix and becomes free to be produced or migrate. Modeling (Crockett and Meyer 2001) suggests that drainage of methane could occur at distances more than 5 miles from a producing CBM field. The Crow Reservation is adjacent to the Wyoming boundary and is close enough to be drained by CBM wells that may be drilled in Wyoming.

Full-scale CBM production in the Wyoming portion of the Powder River Basin would result in either widespread surface discharge of produced water to streams that flow north into Montana or be the impetus behind a state-to-state agreement limiting the discharge and preserving the water quality within these rivers and streams. Expected levels of development, if unregulated, could result in volumes of discharged water causing a notable increase in annual flow rates of the Powder, Little Powder, Little Bighorn and Tongue Rivers. A corresponding decrease in the quality of surface water would also be felt downstream from these Wyoming discharges. The percent increase in flow volume would be greater during periods of low-flow. These increases in flow volume could cause changes in river courses and result in erosion and impact to riparian areas as well as increased sediment load to the rivers and decrease in water quality due to increased suspended sediment. The resulting water quality may lose its usefulness for irrigation. Impacts to the Little Bighorn and the Tongue Rivers would be felt by the Northern Cheyenne and Crow members who use river water for irrigation.

The Northern Cheyenne have a large reserved water right in the Tongue River Reservoir. That stored water represents a marketable commodity and if it were to experience even a slight decrease in quality, it would affect the tribes' ability to market or use the water. Under this full-scale Wyoming discharge scenario, it is conceivable that the reservoir water quality would be diminished.

On the other end of the spectrum of possibilities, Montana and Wyoming may come to terms on a water quality agreement that would have the intention of preserving the current water quality. If this state-to-state agreement were to be ratified between Montana and Wyoming, it is likely that the water quality in the rivers that flow from Wyoming to Montana would experience little to no degradation, thus nullifying the previous full-scale scenario discussion.

Alternative B

Based on the development scenario presented in Alternative B and on the management objectives described under this alternative, potential impacts on ITAs include the drawdown of groundwater, reduction in surface water quality, and drainage of CBM.

The drawdown or depletion of the groundwater table within the vicinity of a producing Montana CBM field has been modeled by the MBMG at up to 14 miles from the edge of production (Wheaton and Metesh 2001). Without site-specific information, it is impossible to predict the degree of drawdown to a neighboring aquifer. In the case of the Crow and Northern Cheyenne, it is conceivable that the reservations' groundwater would be drawn down to some extent along the boundaries by both state and BLM-leased development. The drawdown of groundwater within the reservation would result in impacts on shallow stock and domestic wells and some surface springs. These impacts would reduce water pressure and in some cases render the complete loss of water from a well or spring.

The recognition of a 2-mile buffer zone around the reservations would effectively reduce and delay the drawdown that would be experienced by the tribes in these areas from BLM leased mineral development. In the case of development on either private or state fee lands, the state would not be subject to the same buffer zone restrictions, and therefore, the drawdown would be generated earlier and be to a greater horizontal and vertical extent. The effect of these combined drawdowns would create a long-term impact to the groundwater level.

The reduction of surface water quality from the management objectives in this alternative is almost negligible because the alternative calls for the injection of all produced water and the storage of all waters generated during exploration well tests. However, the potential exists for localized, short-term (less than 1 year) impacts from spills and ruptures associated with these water disposal methods. Undetected ruptures along water conduits feeding injection wells also would impact soils and create erosion problems within the immediate vicinity. These impacts are not expected to reach reservation lands under this management objective. Only the spilled or released waters entering associated watersheds near the reservations would be affected.

Drainage of CBM resources from Native American minerals is dependent upon local reservoir parameters. It is assumed that a single CBM well would drain the methane from a single coal seam over an 80-acre unit. Research by the BLM in the Wyoming portion of the Powder River Basin, however, suggests that drainage may be across a broader radius (Crockett and Meyer 2001) from BLM, private, or state lands. The Wyoming BLM estimates that considerable methane drainage happens when 40 percent of the hydrostatic head is removed from the coal aquifer. Modeling by the Montana Bureau of Mines and Geology (MBMG) (Wheaton and Metesh 2001) suggests that the hydrostatic head of a producing coal seam could be reduced sufficiently to cause methane liberation at distances more than 5 miles from a producing CBM field. The reduction of hydrostatic pressure achieved by lowering the water table within a specific coal seam is necessary for CBM production. This reduction liberates the methane held in the coal matrix; however, the complex, site-specific aquifer conditions dictate the actual radius of methane drainage. Therefore, conclusions regarding methane drainage from tribal minerals need to be made on a case-by-case basis during development. CBM development would threaten to drain methane resources under tribal lands in the planning area.

The reduction of the hydrostatic pressure in a coal seam and the resulting liberation of CBM could also cause the methane to migrate along the path of least resistance and appear as an unchecked seepage at the surface. This scenario would be unlikely in view of the depths of the coal seams being explored (greater than 500 feet below the ground surface), the distance of foreseeable producing fields to the reservations and the relatively shallow groundwater wells used on the reservations for water production.

This alternative calls for the directional drilling of deeper coal seams, multiple completions in a single well bore, and the simultaneous development of all coal seams within a field. These techniques would increase the likelihood that CBM would be drawn from adjacent Indian mineral resources.

Mitigation

Mitigation agreements would be needed to replace water lost from the drawdown of groundwater within aquifers impacted by CBM production. These agreements would call for the replacement of the groundwater wells at the operator's expense. Surface water discharge permits that limit the quantity of CBM-produced water that is discharged would mitigate the impacts from Wyoming CBM production, as well as from expanded CX Ranch production. Potential hydrocarbon migration would be the subject of detailed monitoring and periodic drainage analysis conducted by the BLM as part of their trust responsibility (See *Monitoring Appendix* for details and frequency of monitoring). Monitoring and conducting drainage analysis would reduce the chances of correlative rights violations being brought to court. Native American development of reservation CBM resources is another potential mitigation measure that would ensure the Tribes receive their fair share of the CBM revenues.

Conclusion

Impacts on ITAs from management decisions included in Alternative B, from management practices common to all alternatives, and from projects evaluated under the cumulative effects analysis, would result in impacts to surface water quality, groundwater availability, and the irreversible loss of fluid and solid minerals.

The impacts on surface water quality and groundwater availability would be similar to those explained above and in the *Impacts From Management Common to All Alternatives* section. The surface water quality impacts would be similar to those described under Alternative A and range from the full-scale Wyoming discharge scenario to the no or very little degradation expected from the Montana-Wyoming Water Quality Agreement. The water drawdown from Montana CBM development under Alternative B, coupled with the development of CBM on the reservations, would result in a more widespread effect than just adjacent to the reservation boundaries. Considering the location of known coal occurrences, the groundwater drawdown would be experienced generally along the eastern portion of the Crow Reservation and across the entire Northern Cheyenne Reservation. The water drawdown would be contingent on the continuity of the coals, many of which are fractured, crop out, pinch out or have shale stringers. Impacts could not be detailed until the fields are developed.

The cumulative effect would also include the development of CBM on the reservations and the previously described impacts from the Absaloka Coal Mine. The timely development of CBM on reservations would reduce the potential for adjacent fluid mineral drainage, but increase the likelihood of proximity related impacts to the Absaloka Coal Mine. Impacts related to encroachment of the Absaloka Coal Mine would be similar to those previously discussed in the *Geology and Minerals* section of this chapter.

Alternative C

The differences in management objectives for Alternative C that would affect ITAs are the elimination of the buffer zone, direct discharge of a portion of untreated production water, and to some extent, the removal of the directional drilling and multiple completion requirements. Important to note is that, depending on the ranges of water quality criteria developed by the MDEQ to preserve current beneficial use of surface waters throughout the state and in particular in the CBM emphasis area, various levels of impacts on surface water would occur. If the criteria imposed were to be relatively conservative, the discharge of CBM produced water would be limited into watersheds of both low and high water quality, resulting in minimal surface water quality impacts and increased treatment and use of alternative disposal methods. On the other hand, if the criteria were to be somewhat liberal and allow untreated discharge of produced CBM water into watersheds of higher quality, then impacts such as the following would be experienced: increased soil erosion and a corresponding increase in the addition of suspended sediment to surface waters adjacent to CBM development; the elevation of existing SAR, EC, and bicarbonate values for streams and rivers used by the tribes for irrigation; and the increase in flow that would result in riparian erosion and river course changes. These impacts are discussed in further detail in the *Hydrology* section of this chapter.

Impacts on groundwater would consist of the same drawdown effects as described in Alternative B, although the horizontal and vertical effect would be increased because of the lack of BLM buffer zone. The development of federal minerals near the reservations would increase the rate at which the groundwater is removed and discharged to the surface. Additionally, impacts on shallow aquifers from the infiltration of untreated produced water is expected where the soils have a coarser texture (sandy to loamy) and good internal drainage (ALL 2001a). Produced water less than 15,000 mg/l TDS can be discharged into permitted surface impoundments, which would allow infiltration of produced water into subsoil-thereby impacting shallow aquifers. Some of the shallow aquifers adjacent to reservation boundaries would be affected by this type of short-term infiltration.

The discharge of untreated produced water into drainages and ephemeral watercourses adjacent to well sites would cause an overall increase in erosion leading to gullying. Based on the *Soils Technical Report* (ALL 2001a), much of the soil would likely be susceptible to increasing sodicity when irrigated or land applied with water having a high SAR (generally greater than 12). The long-term consequence is an anaerobic, waterlogged, saline/sodic soil that can be reclaimed, but would be very difficult to mitigate.

Impacts on Native American hydrocarbons via adjacent production drainage would be similar to those described for Alternative B but the chances increase because of the lack of the BLM buffer zone. As previously mentioned, site-specific conditions control methane liberation and collection and therefore, to evaluate potential drainage, a case-by-case study is necessary. The removal of the directional drilling and multiple completion requirements from this alternative's management objectives would reduce the likelihood of added potential drainage from adjacent CBM operations.

With the removal of the buffer zones, encroachment on the Absaloka Coal Mine would be increased and impacts associated with the groundwater drawdown and inhibition of future coal resources—as discussed in the *Geology and Minerals* section of this chapter—would be felt.

Mitigation

Mitigation measures similar to those described under Alternative B would be helpful in delaying and reducing impacts expected from the Alternative C management objectives. Additional mitigation measures, such as the repair and lining of impoundments, would reduce untreated water infiltration and the effects to shallow aquifer quality. The loss of groundwater resources from the reservations could be mitigated through an agreement to increase the tribes' portion of water ownership in the Tongue River Reservoir. Other beneficial uses of produced water could be assigned to the tribes depending on water quality and quantity.

Conclusion

Impacts to ITAs from management decisions included in Alternative C, management practices common to all alternatives, and projects evaluated under the cumulative effects analysis would result in increased impacts to surface water quality, the increased reduction of groundwater availability, and the irreversible loss of liquid minerals.

The impacts to surface water quality would be increased over the degree of impact described in Alternative B, but the biggest factors influencing water quality would be the creation of a Water Quality Agreement between Montana and Wyoming, and the implementation of water quality criteria regarding degradation of Montana watersheds by the DEQ. CBM development on reservations would further increase the SAR value of available surface waters, adding to the chain reaction of impacts associated with erosion, sedimentation, riparian damage, and land use applications.

Impacts on the Northern Cheyenne's water right in the Tongue River Reservoir would be as described under Alternative A.

Impacts on groundwater drawdown and availability would be similar to those explained under

Alternative B, but without the buffer zone drawdown adjacent to the reservations, they would be increased both horizontally and vertically.

Without the buffer zone, additional monitoring and drainage analysis would be necessary to evaluate the case-by-case mineral drainage of adjacent fields. A detailed description of the planned monitoring to be administered by the BLM is included as the *Monitoring Appendix* to this EIS. As stated under Alternative B, the timely development of CBM on reservations would reduce the potential for adjacent liquid mineral drainage, but would increase the likelihood of proximity-related impacts to the Absaloka Coal Mine.

The impacts on lands irrigated by streams and rivers receiving untreated CBM discharge would be as described in the *Soils Technical Report* (ALL 2001a), and would be greatly dependent on the altered quality of the particular watershed being used. Increased soil erosion leading to gullying would be a result of development on the reservations along with the previously described erosion outside reservation boundaries.

Alternative D

The only differences in management objectives for Alternative D that would have an effect on ITAs is the treatment and piped conveyance of production water. This difference would reduce the impacts to erosion along ephemeral drainages, lower the sediment load in watercourses, and reduce the water quality impact to both surface water and groundwater. There would be an increase in available surface water for beneficial reuse because of the required treatment and lack of conveyance losses from the piped system of discharge. The lack of conveyance losses would increase the flow in receiving watercourses resulting in course changes and riparian alterations, as identified in Alternative A. Groundwater drawdown would be as described in Alternative B because of the use of the buffer zone by the BLM. Mineral drainage also would be the same as discussed under Alternative B, with the use of monitoring required to evaluate the case-by-case field conditions. Irrigated lands would be less affected by the use of treated waters, as described in the Soils section of this chapter. The Absaloka Coal Mine would experience the same groundwater drawdown impacts as described under Alternative B.

Mitigation

Mitigation measures similar to those described under Alternatives B and C would be helpful in delaying and reducing impacts expected from the Alternative D management objectives. The loss of groundwater resources from the reservations could be mitigated through an agreement to receive treated production waters for beneficial uses in prescribed amounts.

Conclusion

Impacts on ITAs from management decisions included in Alternative D, management practices common to all alternatives, and from projects evaluated under the cumulative effects analysis would result in increased surface water flow, reduction of groundwater availability, and the irreversible loss of liquid minerals.

Impacts on surface water quality would be similar to those discussed under Alternative B with regard to the influence of Wyoming's CBM production waters entering Montana and effecting the Northern Cheyenne water right in the Tongue River Reservoir. With the increase in flow from the treated waters in Montana, the overall SAR values would be expected to be adjusted downward, but only slightly. CBM development on reservations would further add to available surface waters once treatment is administered; groundwater drawdown would be the same as discussed in Alternative B. Soil erosion would be decreased because of the use of conveyance systems, which would result in the reduction of suspended solids in watercourses and the elimination of gullying. The impacts on lands irrigated by streams and rivers receiving treated CBM discharge would be reduced.

As stated under Alternative B, the timely development of CBM on reservations would reduce the potential for adjacent liquid mineral drainage, but would increase the likelihood of proximity-related impacts to the Absaloka Coal Mine.

Alternative E (Preferred Alternative)

The management objectives for Alternative E would result in surface water, groundwater and potential methane drainage impacts similar to those described in Alternative C. Noteworthy is the fact that the DEQ will set numerical criteria for their current non-degradation of surface water quality narrative resulting in either restricted discharge to most rivers and streams in the CBM emphasis area or flow based discharge with increased impoundment or discharge with some increase to the surface waters SAR, EC, and bicarbonate values. Regardless of what choice is made, impacts would resemble those described in the ranges analyzed under Alternative C in the *Hydrology* section of this chapter. There would be no discharge of produced water (treated or untreated) into the watershed unless the operator has an approved

National Pollutant Discharge Elimination System (NPDES) permit and can demonstrate in the Water Management Plan how discharge could occur in accordance with water quality laws without damaging the watershed.

Impacts on groundwater would consist of the same drawdown effects as described in Alternative C; however, water quality impacts from infiltration would be minimized as a result of the design and placement of impoundments. Impoundments proposed as part of the Water Management Plan would be designed and located to minimize or mitigate impacts to soil, water, vegetation, and channel stability reducing infiltration impacts to groundwater quality.

Impacts on Native American hydrocarbons via adjacent production drainage would be similar to those described for Alternative C because of the lack of a BLM buffer zone. As previously mentioned, site-specific conditions control methane liberation and collection and therefore, to evaluate potential drainage, a case-by-case study is necessary.

As discussed earlier under Alternative C, the Absaloka Coal Mine would be encroached on by CBM development but wells could not be drilled within permitted coal mining acres.

Mitigation

Mitigation measures similar to those described under the previous alternatives would be helpful in mitigating some of the impacts expected from the Alternative E management objectives, such as injection wells around the Reservation to maintain the hydrostatic balance, protecting Reservation water sources, and preventing methane migration.

Conclusion

Impacts on ITAs from management decisions included in Alternative E, management practices common to all alternatives, and projects evaluated under the cumulative effects analysis would result in a minimal decrease to surface water quality, the increased reduction of groundwater availability, and the irreversible loss of liquid minerals.

The impacts on surface water quality would be within the ranges analyzed under Alternative C of the *Hydrology* section.

Impacts to the Northern Cheyenne's water right in the Tongue River Reservoir would be as described under Alternative A.

Impacts on groundwater drawdown and availability would be similar to those explained under Alternative C. Monitoring and drainage analysis would be conducted by the BLM and MBOGC to evaluate the case-by-case mineral drainage of adjacent fields.

The impacts to lands irrigated by streams and rivers receiving CBM discharge would be as described in the *Soils Technical Report* (ALL 2001a), and would be dependent on the DEQ non-degradation numerical criteria being developed.

Lands and Realty

Assumptions

Gas from CBM wells is normally measured at the well site or on a collection line before mixing at field compression stations, making it possible for flow lines and compression stations to be shared by different operators to reduce development cost and surface land disturbance.

Split estate surface owners have the right to maintain control of non-CBM related access. Non-agreement between the surface owner and operator allows surface condemnation for access by the operator under the domain provisions of Montana's mining laws.

Operators are responsible for communicating requirements and stipulations to independent contractors working on behalf of the operator when performing various phases of CBM exploration and production development.

There are no expected disruptions to existing fiber optic, phone, gas, electric, or water lines as a result of the construction, production, or abandonment of project alternatives. It is the responsibility of the operator to identify whether buried lines exist within the pathway of new land-disturbing activities.

According to the Farmland Protection Policy Act, federal agencies involved in proposed projects that may convert farmland to non-agricultural uses must complete a USDA Farmland Conversion Impact Rating Form AD-1006. The form focuses on two farmland designations: prime farmland and agricultural lands of statewide importance. Prime farmland and agricultural lands designations are based on soil type and productivity and are not based on present use. The AD-1006 form would be completed for each APD application or as part of an Environmental Assessment (EA) checklist to assess impacts to agriculture on federal lands.

No physical displacements of residences or commercial property are predicted to result from project alternatives.

CBM-related, human activity increases fire hazards in the project area. The loss of vegetation by fire would impact all land uses including ranching, recreation, and agriculture, and would limit access to public lands because reclamation will be sensitive to soil disturbance.

The required reclamation plan by the operator would be reviewed and approved by BLM on federal lands, by the state on state lands, and by the landowner on private lands.

Impacts From Management Common to All Alternatives

Potential land use impacts would primarily consist of conflicts between conventional oil and gas activities and other uses of property, such as agriculture, residences, and coal mines. New realty authorizations for major gathering lines, major transportation lines, and power lines, for example, would impact rights-of-way (ROWs) and land segmenting. The development of oil and gas resources impacts agricultural production by taking land out of production and by soil contamination from drilling and production activities.

Surface disturbance associated with oil and gas activities, such as roads, well pads, and battery sites would remove those areas of agricultural production during the life of the road, well pad, or tank battery site. Removal of vegetation would reduce the acreage available for livestock grazing or crop production. Buried flowline and utility line routes would be seeded so the acreage would be temporarily removed from use for grazing or crop production. The infrastructure associated with oil and gas production could affect the movement or area available for livestock and could hinder irrigation systems.

Most existing roads would be lightly traveled by local residents, ranchers, and oil and gas workers. Use of unimproved roads would increase because of daily operations for a month at each site during development and testing of exploration wells. This road activity would be increased in general areas targeted for well development. Unimproved roads would be vulnerable to damage in adverse weather conditions. Public and private lands could be impacted by driving on soft or unstable road surfaces.

Residents and public visitors would be impacted by the sights, sounds, and delays caused by the construction and testing of exploratory and production wells. An increase in slow-moving vehicles would be an impact in areas not currently experiencing these activities. Creation of a temporary, unimproved, unrestricted access road to an area would allow public access and exposure of the property in a new way, and would expand the road system requiring maintenance by federal or state agencies and private landowners.

Public access to most wells would likely be limited because 65 percent of the land area is private; however, there would be conflicts with recreation (see the *Recreation* section of this chapter). Short-term impacts would occur during road building, pad development, drilling, and production-related activities. Access for recreation on legally accessible public lands would increase as a result of the increase in unimproved roads. These impacts would be viewed as a benefit to sportsmen, who generally support increased vehicle access. Road densities on private lands would likely increase in the areas targeted for oil and gas wells, but property owners would be responsible for access control.

Produced water of quality suitable for livestock could be placed in impoundments in areas currently without such impoundments for livestock. This would enhance or expand livestock grazing. Construction disturbance would also force cattle onto previously unused range, further changing land use (see discussion on Livestock Grazing). Similar displacement would occur for wildlife, disrupting hunting on land designated for controlled or general hunts.

There may be a trespass impact to private landowners from the conversion of unroaded federal lands with a right-of-way that now allows access to private lands.

On private and public lands, road maintenance would be specified in the lease agreement as the responsibility of either the contractor or landowner.

Complete removal of the indication of vehicle passage and revegetation of two-track exploration on public lands would be important to prevent these temporary roads from becoming an established access through consistent misuse by four-wheel-drive and all-terrain vehicles, especially in areas historically not accessed by vehicles. The mitigation portion of the *Vegetation* section describes the seeding policy for reclaiming surface disturbances.

Impacts From Management Specific To Each Alternative

Alternative A

Impacts on multiple land use on public lands would be minimal because there would be no CBM production development on federal lands. State and private lands would have limited CBM production activities.

Exploration

The amount of new roads to be built with this alternative would be minimal relative to other alternatives. The primary land use impacts on federal and state lands are from short-term direct land use displacement by exploratory well pads and the creation of two-track trails across prairie or other lands from exploratory equipment. Impacts on private lands would be largely addressed in the contractual agreement with the private owners of the CX ranch.

Production

Newly created roads for CBM production would increase access across the CX Ranch that may displace or change the land use patterns on the land.

Abandonment

Two-track trails and associated motorized access created by CBM exploration on federal and state lands would be reclaimed after abandonment, unless otherwise authorized. New access created under a ROW may be reclaimed depending on the situation and the BLM and surface owner's desires. New motorized access in watersheds targeted for water quality restoration by MDEQ may require road reclamation as part of abandonment. Restoration based on water quality will be on a case-by-case basis with involvement from MDEQ. Abandonment and reclamation of roads on the CX Ranch could be highly variable according to the agreement with the surface owner. Abandonment impacts on private land cannot be determined because of this variability. Unwanted roads on the CX Ranch would be obliterated and revegetated according to the agreement with the lease operator.

Crow Reservation

Impacts on the Crow Reservation would be the same as described in general for Alternative A. If there were no CBM development on Tribal Lands, then there are expected to be minimal, if any, impacts to the reservation. Trespassing from CBM related vehicles might increase because of activities adjacent to the reservation.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under Alternative A.

Mitigation

BLM guidelines for road reclamation described in the seeding policy (BLM 1999c) would be used to mitigate federal land disturbances and presented as a reclamation alternative for state and private lands.

Road and utility impacts experienced prior to reclamation are mitigated by requirements for repair or replacement in the site-specific review, or through compensation for actual damages with damage payments. This mitigation is common to all alternatives.

The operator shall conduct all activities associated with the construction, operation, maintenance, and termination of the road and utility ROWs within the authorized limits of the federal ROW or state lease, land use license, or state ROW easement.

Conclusion

Alternative A would have the least land use impact among alternatives because of the limited number of exploratory and production wells within the project area. The greatest potential land use impact would be the ranching disturbance and displacement on the CX Ranch (see the *Livestock Grazing* section of this chapter).

Cumulative impacts for Alternative A include the increased road network to the CX Ranch, which may lead to increased public use and new development opportunities near the ranch. This increased road network may create future conflicts with current livestock grazing.

Alternative B

Exploration And Production

Short-term impacts of land uses during construction would consist of the physical intrusion by CBM crews and equipment, the local generation of dust and noise, and the limited obstruction of traffic. Long-term impacts include loss of existing land use, increased access from roads, and loss of land value.

Some surface landowners are unaware of the severed mineral rights, and even though compensated, would be displeased with the possibility of having well facilities located near dwellings. There are no legally required buffer distances between CBM facilities and residential, community, or government dwellings. Placement of roads and well pads near residential, business, and community dwellings may cause direct reduction of property values.

Although there may be no statute that covers buffer distances, State of Montana oil and gas leases include a minimum buffer distance of 200 feet. Reasonable additional buffers can be added as needed through stipulations on the lease or at the time of site-specific operating plan review.

Impacts from placement of roads, utility lines, pipelines, and well pads around communities may cause loss of future community development opportunities. These uses displace other surface uses like residential development and location of public parks and schools. There are safety and liability concerns.

Although private landowners and state land managing agencies would help decide road routes on their lands, as described in the *Mitigation* section, they would likely want to maintain some roads that benefit existing or future uses.

The increase in average daily traffic (ADT) of U.S., interstate, and state highways by action alternatives would be minor and is not expected to decrease their designed level of service within the CBM project area. Increased highway ADT over the 20-year life of the project would be largely from increases in demographics.

County roads in some portions of the project area will receive substantial CBM exploration and development traffic volumes. This large influx of CBM-related traffic on some isolated county and local roads will increase their associated road maintenance cost.

Short-term exploration impacts to farming include seasonal loss of crops during construction, interference with irrigation patterns, and increased introduction of noxious weeds.

Cropland area converted to production well pads and roads would be lost for the 20-year life of the project. Based on estimates in the *Vegetation* section, 20 percent of wells on state-permitted land in Blaine, Gallatin, and Park counties would occur in cropland soils. Four percent of wells in the Powder River RMP area and 8 percent of the wells in the Billings RMP area would occur in cropland soils. Specific long-term impacts include land displacement; alteration of existing flood and center pivot irrigation systems; modification of farming operations near and around well pads and access roads; potential for proliferation of noxious weeds; surface and groundwater quality losses; farming operations that are no longer commercially viable at certain locations; economic losses associated with all of the above; and lower land values.

Direct impacts on commercial woodlands would be caused by the immediate harvest of timber in ROWs and well pad sites and the loss of timber growth in these areas during the life of production and time of regrowth to merchantable trees. The income loss for the tree growth loss is reflective of time to grow merchantable trees, which is 50 to 100 years after reclamation of ROWs and pad sites. New roads on public forest lands may become part of the existing road system and their ROWs would be a permanent loss of timber production. The increased use of four-wheel-drive and all-terrain vehicles would allow other vehicles to have extensive access once a route is established.

Roads from CBM development and CBM-related motorized activity may create conflict with timber cruising, logging, and hauling activities of an active timber sale. CBM-related traffic could increase traffic hazards with log-hauling trucks unless road use coordination occurs.

Indirect impacts from land clearing include wood fuel loading, introduction of noxious weeds; increases in insect population from slash buildup; and increased access for forest and fire management. CBM-constructed roads may not always be located in the best area for managing forest resources.

Abandonment

On federal and state lands, the access plan would create fewer two-track trails and roads than other development alternatives. Utility reclamation would occur with road reclamation because they are located in the same corridor. Public access would need enforcement to prevent the 20-year life of the CBM production road network from becoming part of the permanent public access network. On private lands, road abandonment would be highly variable as with the other alternatives because each landowner agreement would be different.

Regeneration time of timber to commercial size after CBM activities or other related land use would likely be 50 to 100 years. Road obliteration would include re-contouring the landscape and planting tree seedlings appropriate to the forest site.

A fire related to CBM activities or other land use disturbance will be a liability of the operator. Liability of fire is detailed in Statute 50-63-103 Montana Code Annotated (MCA).

Crow Reservation

Impacts on the Crow Reservation would be the same as described in general for Alternative B. If there were no CBM development on Tribal Lands, then impacts on the reservation, other than CBM related traffic discussed above, would be minimal.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under Alternative B.

Mitigation

Some road locations would be mutually beneficial to the present and future land uses of private surface owners and should be considered in negotiations. The operator would present to surface owners an environmentally preferred road construction plan and a road construction plan that compliments their economic preference. The use of a single corridor for transportation and utilities would be a preferred voluntary BMP for private lands.

Federal, state, and private lands will have all CBM-related roads reclaimed unless there is an alternative beneficial use for the road. The beneficiary user of the road will be responsible for its maintenance.

Dust abatement with the use of water or by rocking road surfaces would be used near residential and commercial dwellings to reduce indirect dust impacts to these land uses.

Lease operators would discuss compensation with county and local road and bridge departments when CBM-related traffic has caused increased road maintenance cost. There may be times when an operator or a group of operators may choose to provide maintenance for a particular road.

Trees would be commercially harvested from pipelines, utility, and road ROWs. Long-term loss of commercial timber production on these lands would be negotiated with the state and private landowners. Wood slash would be burned or "lopped and scattered" in an effort to control forest pests. If an outbreak occurs, insect spraying would occur as recommended by a forest specialist. The ROW holder must pay the BLM for merchantable timber cut in the ROW. The cut timber becomes the holder's responsibility.

CBM-related personnel will receive basic training and have fire safety and emergency phone numbers in all vehicles. Fire extinguishers will be carried and maintained in all vehicles. Under high fire warnings of summer, CBM employees may have fire-related restrictions directed by the land management agency. State trust lands requirements may also include additional equipment to be carried, such as shovels, pulaskis, etc. Various restrictions can apply to an area due to various levels of fire danger. These can include timing restrictions for work, avoidance of vegetation, having a backpack pump on equipment not capable of constructing a fire line, to total restriction of work or admittance to an area for Level 5 fire danger. Spark arrestors can be a requirement on equipment and vehicles.

There would be a need to increase enforcement of unauthorized use of roads and motorized trespass in an effort to educate the public that CBM-related roads are not part of the public road network. Funds from CBM proceeds may help support additional enforcement personnel.

CBM facilities, including roads, would be located away from or at the edges of agricultural lands to the maximum extent practical to reduce direct and indirect effects on agricultural resources and operations.

Disruption to irrigation facilities, including water canals, ditches, and pipelines; and other water conveyance systems would be minimized to the extent practical to allow irrigation to operate as designed.

If facilities such as fences or gates are damaged or displaced, they would need to be repaired or replaced according to landowner agreements.

Project traffic, such as truck convoys or heavy wide loads, would be scheduled to avoid disturbance to agriculture and other land.

Where possible, access roads would be placed on parcel boundaries to reduce impacts to residential property.

CBM-related traffic would maintain a safe speed that also controls dust when approaching adjacent residential dwellings. CBM-related roads, pipelines, and well pads would be placed away from residences and out of view from residences as much as possible. Displaced farmland, whether in crop production or not, should be reclaimed to original soil productivity in 1 to 3 years through adoption of standard reclamation procedures. Farmers would likely negotiate an agreement that requires the salvage, storage, and replacement of agricultural topsoil for reclamation.

Conclusion

Alternative B would have the least impact to present land use of the four development alternatives (B, C, D, and E). The types of displacement would be the same, but the amount of displacement would be less. For example, the required use of a transportation corridor for both road and utility lines in a one-way pattern reduces the direct surface disturbance by an estimated one-third compared to a grid pattern, multiple corridor approach.

Common land use impacts from roads, pads, pipelines, and utility lines include direct loss of agriculture, timber, grazing, recreation, and wildlife habitat and increased potential of wildfire. Indirect impacts include limited road access; dust, noise, and reduced property values; and increased local road maintenance cost, production, water storage, and ground injection, which reduces the potential direct and indirect impacts to other surface land uses.

Most direct and indirect impacts are mitigated through reclamation and financial compensation. Unmitigated impacts include displaced, non-monetary uses like public access, fire hazards, noise disturbance to livestock, and noise and dust to residents and communities.

Cumulative impacts for Alternative B include increased fire hazards from CBM exploration and development, which are the largest potential cumulative economic and environmental impacts to future land uses. The loss of range, timber, habitat, dwellings, access, and other impacts would not be recovered for a long time.

Road networks created for CBM development would increase access for fighting fires and create fuel breaks.

Alternative C

The less stringent access plan, separate placement of pipelines, utility lines, lack of buffers, and use of production water, would lead to an increase in surface land disturbance when compared to the other alternatives.

Exploration And Production

On federal and state lands, two-track roads created by exploration need to have access restrictions enforced to prevent them from becoming part of the permanent trail system or road network. New production roads may be placed along existing trails or be placed in the more traditional road grid system, which allows multiple routes from any production intersection. The traditional road grid system used for CBM production will create the highest density of roads and increase maintenance cost to land management agencies. On private lands, road placement would be a contractual agreement with the surface owner as described in the *Assumptions* section.

Surface disturbance from roads, pipelines, and utility lines is estimated to be approximately 30 percent greater than Alternatives B and D (see Table 2-2 in Chapter 2) because there are not the same road and utility restrictions to this alternative. Surface disturbance and its impact to agriculture is similar to Alternative B because most agriculture is on private lands. The potential impacts from production water discharges are also similar for the same reason.

CBM production water may have high levels of salinity or sodicity, which can cause negative impacts to agriculture with continued use. The saline level of the average CBM production water is near the threshold for causing yield reduction. Reduction in yields would be expected in salinity-sensitive crops like alfalfa, corn, and clover hay. High SAR production water would reduce water infiltration, especially in clay soils, and would increase erosion. CBM water with combined high SAR and low EC can cause notable reductions in the water infiltration rate of irrigated crops (ALL 2001b). Repeated sprinkler-applied CBM water high in saline can cause salt accumulation near the soil surface and cause foliar damage to certain crops. Dewatering coal seams may lead to release of methane gas that can contaminate neighboring agricultural and residential wells (ALL 2001b). The contamination of wells is a possibility that cannot be estimated in either amount of methane per well or by proximity of a well to a CBM field. Any contaminated well could be rendered unusable, and if the well is within a closed structure, increased ventilation is required to reduce buildup to explosive quantities.

It must be assumed that the historic road grid system used for CBM development is a worst-case scenario allowed under this alternative when there are no existing disturbances. The road grid system would create the densest road network and largest surface disturbance by providing multiple access to all the wells in the 80-acre well spacing proposal.

Abandonment

Land use displacement from road disturbances would be an assumed 20-year loss on federal, state, and private lands as in Alternative B, except there is more displacement on federal and state lands with this alternative. Land use displacement on private lands would have varying degrees of reclamation based on whether road placements benefit long-term private operations.

Reclamation of roads and utility lines on federal and state lands would need to receive strict access enforcement to prevent off-road recreationists from converting reclaimed roads, pipelines, and utility ROWs into unimproved road and all-terrain vehicle trails. This appears almost insurmountable, considering the linear miles of roads and utility corridors that would be created under Alternative C.

There is limited access to many small federal land parcels within the project area. CBM lease operators would create roads to these parcels and increase access and potential public use of the federal parcels. Neighboring private owners who have contributed access to the federal and state parcels may incur increased trespass problems similar to Alternatives B and D.

Crow Reservation

Impacts on the Crow Reservation would be the same as described in general for Alternative C. If there were no CBM development on Tribal Lands, then impacts on the reservation, other than increased CBM related trespass problems discussed above, would be minimal.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under Alternative C.

Mitigation

The mitigation measures described in Alternative B would be used with the addition of the following.

The increased road network on federal and state lands with this alternative will likely increase road maintenance costs. In those high-impact areas on public lands, the operator may need to negotiate maintenance support either by financial assistance or by maintaining certain roads themselves. New CBM production-related roads on public lands would be obliterated and revegetated after the 20-year term of the lease. Revegetation would follow BLM protocol (BLM 1999c). There would be a need to increase enforcement to prevent unauthorized public use as described in Alternative B. Private landowners should have opportunity to comment on road placement.

High levels of salinity and sodicity can be diluted with surface irrigation water to negate EC-related crop reductions or SAR-related infiltration problems. Subsurface water levels should be tracked to identify whether methane gas could potentially contaminate adjacent wells.

Conclusion

The management objectives of Alternative C would result in the most impacts to present land uses among the four development alternatives (B, C, and D). The type of surface disturbances are no different than other alternatives except that the displacement is estimated to be one-third greater than Alternatives B and D. The two main causes for the increased surface disturbance and land use displacement are from not having transportation corridors and use of a traditional road grid system where there are no existing disturbances.

Cumulative impacts would be the same as described in Alternative B, with the exception of additional impacts to surface coal mining, the Tongue River Railroad project, and the improvement to county roads, etc.

Alternative D

Short-term transportation impacts on federal and state land uses would be the same as Alternative B. However, the long-term transportation impacts would be greatest because road obliteration and reclamation might not occur under this alternative and would permanently displace present and future land uses. The roads would become part of the public transportation system and would increase vehicle access on federal lands. The existing public road network may receive substantial traffic during production, requiring increased maintenance cost by public agencies. The new roads on federal lands that are not reclaimed would become the maintenance responsibility of the corresponding public agency.

Crow Reservation

Impacts on the Crow Reservation would be the same as described in general for Alternative D, with an emphasis on CBM vehicle trespassing.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under Alternative D.

Mitigation

Public land management agencies would want more decision-making responsibility with CBM-related road placement to prevent conflict with the long-range management goals of the public resource area. After the 20-year oil and gas lease, the cost of road maintenance would convert to the agencies and future road maintenance expense needs would need to be negotiated with the lease operator.

Other mitigation relative to transportation impacts on public and private lands is the same as that described in Alternative B.

Conclusion

Alternative D has the same short-term transportation impacts as Alternative B but has the greatest long-term land use displacement impacts from the created permanent roads. The types of land use displacement with this alternative are the same as other development alternatives.

Most direct and indirect impacts are mitigated through reclamation and financial compensation. Unmitigated impacts include public access, fire hazards, disturbance to livestock, noise, and dust.

Alternative E—Preferred Alternative Impacts and Mitigation

Exploration and Production

The type of impacts from roads, pipeline and utility line in Alternative E are the same as those described in Alternative B except the extent of impacts from these disturbances are the same as described in Alternative C. This alternative, like Alternative C, will not require transportation corridors for the placement of roads, utility lines, and pipelines. Existing disturbances will be used as much as possible.

Land use displacement from road disturbances would be an assumed 20-year loss on federal, state, and private lands as with Alternatives B and C. CBM lease operators would create roads to small federal and state parcels never before road accessible to the public. Motorized trespass will be enhanced as a result of the increased road network on federal, state, and private lands from CBM-related exploration and development.

Agricultural-related impacts will be the same as those described in Alternative B.

CBM activities increases the likelihood of fire. Road networks created for CBM development would increase access for fighting fires.

The risk to surface water quality is the same as described in Alternative C.

Abandonment

Abandonment of roads, utility lines, and powerlines will be the same as described in Alternative C.

On private lands, road abandonment would be highly variable as with the other alternatives because each landowner agreement would be different.

Fire liability does not end at the time of abandonment but continues as long as fire can occur from CBM development-related activities. Liability of fire does not end at abandonment and is detailed in Statute 50-63-103 Montana Code Annotated.

Mitigation

Road mitigation described in Alternatives B and C would be largely used here with the exception of the following:

Operators will be required to submit a project plan when well densities are greater than one well per 640 acres. The operator must consult with surface owner for development of Project plan relative to location of roads and utility lines. This consultation must be presented in the plan.

A water management plan will be submitted as part of the Project plan. The water management plan will be required for every exploration Application for Permit to Drill and on a site-specific basis for management of production water. The plan will allow various disposal and discharge options if water beneficial uses are not harmed or degraded in accordance with water quality laws.

Conclusion

CBM operators will be required to submit a Project Plan when the proposed development for an area will exceed one well per 640 acres.

The type of impacts from roads, pipeline, and utility line in Alternative E are the same as those described in Alternative B, except the amount of impacts from these disturbances are the same as described in Alternative C. This alternative, like Alternative C, will not require transportation corridors for the placement or roads, utility lines, and pipelines. Existing disturbances will be used as much as possible.

New roads would remain open or closed at the surface owner's discretion. Ones to be closed will be rehabilitated upon abandonment.

There will be no degradation of a watershed from water releases. A Water Management Plan would be required for every exploration Permit to Drill. First priority for discharged water would be for beneficial uses.

The potential for fire hazard is the same as Alternatives B, C, and D.

Livestock Grazing

Livestock forage and petroleum development would be generally compatible because exploration activity would be temporary and operational activities require a small area for equipment. Livestock grazing on rangeland would continue during CBM and conventional oil and gas development.

Assumptions

Affected acres and animal unit months (AUMs) were calculated assuming all CBM activity would be located on grazing lands. AUM losses were predicted separately for the two BLM RMPs and the state because of differences in permits and land grazing capacities. Surface disturbance assumptions are detailed elsewhere in this chapter. This analysis is focused on the CBM emphasis area, but can be used for inference to similar areas throughout Montana. It is assumed that existing roads and fence crossings would be used for oil and gas operations as much as possible.

Impacts From Management Common to All Alternatives

Impacts on rangeland would occur from the loss of vegetation for livestock grazing; the disruption to livestock management practices; and loss of grazing capacity from construction of well pads and roads. Each well would present its own set of unique circumstances that would be mitigated to minimize impacts. With the exception of minimal short-term forage loss, these impacts would only last as long as construction activities were ongoing. Controlling livestock movement by maintaining fence line integrity would be essential for efficient livestock and range management. The construction of roads and pipelines would bisect fences, which would require placement and maintenance of cattle guards and gates. The current development of oil and gas and CBM on state land would require installation of cattle guards on fence lines to prevent livestock escape. The impacts of oil and gas development would result in the loss of about 833 AUMs in the Billings RMP, 830 AUMs in the Powder River RMP, and 359 AUMs on state-permitted rangelands. These losses would be reduced to a total of 735 AUMs during the production phase of oil and gas activities.

While roads, trails, and well pads would block traditional cattle trails, this network of new roads would provide livestock producers with improved access to remote livestock facilities and grazing areas. However, road systems would interfere with livestock dispersal and cause decreased forage efficiency because cattle tend to congregate and travel along roads. The relatively high volumes of exploration vehicle traffic would present a hazard to livestock. Heavy traffic on temporary access roads would increase the risk of collision with stock, resulting in injury or death of the animals. Airborne dust stirred up by heavy exploration vehicles would settle on forage along the road. The dust would affect the palatability of grass and forbs up to 1/4 mile from the road. Livestock forage would be killed by accidental spills of crude oil, high saline-produced water, or drilling fluid.

Areas of soil disturbance, such as results from construction, may experience an influx of noxious weeds. Noxious weeds reduce rangeland value to livestock by displacing preferred forage species. Severe infestations would result if weeds are not controlled, decreasing rangeland capacity for grazing. Additionally, some weed species are poisonous to livestock, causing illness, internal injury, or death when ingested.

Mitigation

The following mitigation measures would minimize grazing impacts associated with CBM and conventional oil and gas development:

- Repair or replace damaged or displaced facilities such as fences or gates according to landowner requirements.
- Minimize project-related construction equipment and vehicle movement except on specific access roads to avoid disturbance of grazing land.
- Clearly define responsibility for fence, gate, and cattle guard maintenance and for noxious weed control in APDs and right-of-way grants, and require both as conditions of granting a new APD or right-of-way grant.
- Develop a reclamation plan for all areas that have been disturbed during production, and specify techniques for reclamation of well pads, pipeline rights-of-way, and roads.
- Site facilities to avoid or minimize impacts on livestock waters.

Impacts From Management Specific to Each Alternative

Alternative A

Under Alternative A, exploration wells located on BLM-permitted rangelands would result in the temporary loss of 30 AUMs for the Billings RMP rangeland and 39 AUMs for the Powder River RMP rangeland. There would be no production activities in BLM planning areas under this alternative and, therefore, no impacts from production. State-permitted exploration and production wells located at CX Ranch would result in a loss of 272 AUMs. Revegetating parts of the well pads during production would reduce the losses to 194 AUMs. The mitigation measures would be the same as those discussed in the *Impacts From Management Common To All Alternatives* section above.

Crow Reservation

Impacts on the Crow Reservation would be the same as described in general for Alternative A. If there were no CBM development on Tribal Lands, then there are expected to be minimal, if any, impacts on livestock grazing on the reservation. If there is CBM development on the reservation, then reductions in AUMs from BLM, state and private lands could be inferred to the reservation.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under Alternative A.

Conclusion

During the next 20 years, disturbances from CBM development, conventional oil and gas development, and other projects considered under the cumulative effects analysis would result in the loss of about 863 AUMs in the Billings RMP, 869 AUMs in the Powder River RMP, and 955 AUMs on state-permitted and private rangelands. These losses would be reduced to a total of 929 AUMs during the production phase of CBM and conventional oil and gas activities. After production ceases and lands used for production and mining are abandoned, most land can be returned to production (excluding permanent roads and facilities).

Alternative B

Alternative B considers expanded development of CBM resources. Table 4-8 presents the predicted AUMs that will be lost from exploration, construction, and production on both BLM and state grazing lands. Losses from exploration would be mostly temporary (less than 5 years) and would be reclaimed after exploration activities cease. Revegetating parts of the well pads during production would reduce construction losses to those shown below under operation losses.

Impacts on livestock grazing would be reduced under this alternative through the requirement of transportation corridors, using multiple completions per well bore and directional drilling, injecting produced water instead of storing on-site in impoundments, and rehabilitating new roads at the end of the well lifetime. All of these would help to minimize the area of surface disturbances shown in Table 4-8 by up to 35 percent during construction and 40 percent during production, thus reducing the number of AUMs lost. The mitigation measures would be the same as those discussed in *Impacts From Management Common To All Alternatives* section above.

Crow Reservation

Impacts on the Crow Reservation would be the same as described in general for Alternative B. If there were no CBM development on Tribal Lands, then there are expected to be minimal, if any, impacts on livestock grazing on the reservation. If there is CBM development on the reservation, then reductions in AUMs from BLM, state and private lands could be inferred to the reservation.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under Alternative B.

Conclusion

During the next 20 years, disturbances from CBM development in state, BLM, Native American, and USFS planning areas; conventional oil and gas development; and other projects considered in the cumulative effects analysis would result in the loss of about 18,500 AUMs. These AUM losses would be partially recovered during the production phase of CBM and oil and gas activities, and after production ceases and lands used for production and mining are abandoned. The requirement of transportation corridors, injection of produced water (less land needed for impoundments), and multiple use of drilling pads would help to minimize livestock grazing losses up to 35 or 40 percent.

TABLE 4-8
NUMBER OF PREDICTED ANIMAL UNIT MONTHS (AUMS) LOST TO EXPLORATION, CONSTRUCTION, AND PRODUCTION

	AUMs Lost to Exploration	AUMs Lost to Construction	AUMs Lost to Operation
Billings RMP	11	340	209
Powder River RMP	152	4,430	2,275
BLM Sub-total	163	4,770	2,484
State/Private Lands	250	7,190	4,420
Total	**413**	**11,960**	**6,904**

Alternative C

Under this alternative, impacts to livestock grazing would be similar to Alternative B with the following exceptions: transportation corridors and collocation of wells would not be required, thereby increasing the number of disturbed acres and AUMs lost compared to Alternative B (see Table 4-8); suitable CBM discharge water could be used for livestock watering reducing the amount discharged; and the discharge of produced water to the surface would increase erosion and cause increased surface disturbance to livestock. Other impacts would include the possibility of an increase of noxious weeds and a decrease in forage material if produced water that is too high in saline content is discharged on the land surface, and possible health effects if livestock consume produced water that is unacceptable (ALL 2001a). Generally, water is acceptable for livestock if the TDS is lower than 10,000 mg/l and the EC is less than 16,000 μS/cm. Some CBM water has also been found to exceed standards for fluoride (2 mg/l) and aluminum (0.2 mg/l) (ALL 2001b). Discharging untreated CBM-produced water on the ground surface at the well pad would lead to increased localized soil erosion and gullying, which could also lead to disrupted grazing patterns, undermined fencing, and reduced forage. Mitigation measures would be similar to Alternative B.

Crow Reservation

Impacts on the Crow Reservation would be the same as described in general for Alternative C.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under Alternative C.

Conclusion

Cumulative impacts would be similar to Alternative B with some exceptions. The surface disturbance could be greater since transportation corridors and collocated wells are not required. Surface discharge of untreated produced water could result in increased forage loss, erosion, gullying, grazing pattern disruptions, and fencing undermining. Forage losses could be permanent because of soil sterilization by saline water applications. This amount would vary depending on the quality and quantity of water discharged. Watering livestock represents only a small portion of the estimated 20 percent beneficial reuse assumed under this alternative, but would still result in a small amount of impacts reduction to the other resources.

Alternative D

Under this alternative, impacts on livestock grazing would be similar to Alternative C with the following exceptions: impacts from drilling and collocation of wells would be the same as Alternative B; transportation corridor and road impacts would be similar to Alternative B; discharged CBM-produced water would be treated and not discharged directly at the well site; and there would be a reduction to forage losses from increased land application of produced water through irrigation applications. This would be a favorable impact from having more treated water available in the winter and arid months available for livestock watering and irrigation of grazing lands.

Crow Reservation

Impacts on the Crow Reservation would be the same as described in general for Alternative D.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under Alternative D.

Conclusion

Cumulative impacts would be similar to Alternative C with some exceptions: impacts from drilling and collocation of wells would be the same as Alternative B; transportation corridor and road impacts would be similar to Alternative B; there would be a reduction to forage losses from increased land application of produced water; and there would be less soil and forage loss from erosion of soils.

Alternative E (Preferred Alternative)

Under this alternative, impacts on livestock grazing would be similar to Alternative B with the following exceptions: transportation corridors and collocation of wells would not be required, thereby increasing the number of disturbed acres and AUMs lost compared to Alternative B (see Table 4-8); suitable CBM discharge water could be used for livestock watering reducing the amount discharged; Water Management Plans would be designed on a site-specific basis to allow for no degradation to the quality of the watershed and have a priority for beneficial use, which could include livestock watering and irrigation (benefits for livestock); and surface owners would be more involved in planning and decision making processes.

Crow Reservation

Impacts on the Crow Reservation would be the same as described in general for Alternative E.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under Alternative E.

Conclusion

Cumulative impacts would be similar to Alternative B with some exceptions. The surface disturbance could be greater since transportation corridors and collocated wells are not required. There would be less soil and forage loss from erosion of soils. Beneficial use of produced water by watering livestock would reduce, by a small amount, the impacts to other resources. The surface owners will also have more input into Project Plan, which may affect livestock grazing.

Paleontological Resources

Assumptions

Surface occupancy is prohibited within paleontological sites on BLM minerals in the planning area. As an exception, modification or a waiver may be applied for under similar circumstances as mentioned in the *Cultural Resource* section, provided it can be demonstrated that the paleontological resource values can be protected or undesirable impacts can be mitigated.

Impacts From Management Common to All Alternatives

Within the planning area, several localities have been found to contain noteworthy paleontological resources. The Bridger Fossil and East Pryor Mountains are classified as Areas of Critical Environmental Concern (ACEC) because of their paleontological resources.

Mitigation

The BLM APD contains guidance for registering and mitigating damage to paleontological resources discovered while constructing well pad sites. Other mitigation activities would include oil and gas leasing, which will not be allowed on the 575 acre Bridger Fossil Area ACEC site. Underground explosives for geophysical exploration for oil and gas will not be allowed. Other geophysical exploration methods for oil and gas will be allowed if the method will not damage the paleontological resource. If monitoring indicates damage to fossils as a result of the geophysical activity, it will no longer be allowed.

Impacts From Management Specific to Each Alternative

Alternative A

Impacts from this alternative would be similar to those described in the *Impacts From Management Common to All Alternatives* section above, with some exceptions. In CBM development there would be no geophysical exploration that could result in the destruction of paleontological resources. Other impacts would include vandalism and removal of fossils by amateur fossil collectors resulting from increased accessibility to remote areas.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative A. If there were no CBM development on Tribal Lands, then there are expected to be minimal, if any, impacts to paleontological resources on the reservation. Impacts on Tribal Lands are discussed in more detail under the *Cultural Resources* section.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this Alternative.

Conclusion

Cumulative impacts under this alternative would include the effects from CBM development, conventional oil and gas development, the proposed Tongue River railroad, and surface coalmining activities. Known paleontological resources within the planning area would be protected by Section 6 of the lease terms. NSO stipulations applied to known paleontological resources would help protect those sites.

Alternative B

Impacts from this alternative would be similar to Alternative A with some exceptions. Under this alternative, development would result in increased access to remote areas. The impacts of increased access would include increased vandalism and removal of fossils by amateur fossil hunters.

Crow Reservation

Impacts to the Crow Reservation would be similar to those described in general for Alternative B.

Northern Cheyenne Reservation

Impacts to the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this Alternative.

Conclusion

Cumulative impacts under this alternative would be similar to Alternative A with the exception of increased CBM development resulting in increased vandalism and removal of fossils from increased access to remote areas. Mitigation measures would be similar to Alternative A.

Alternative C

Impacts from this alternative would similar to Alternative B with some exceptions. Under this alternative, increased surface disturbances from not using ROW corridors would result in increased impacts to unknown paleontological resources and increased access to remote areas. The impacts of increased access would include increased vandalism and removal of fossils by amateur fossil hunters.

Crow Reservation

Impacts to the Crow Reservation would be similar to those described in general described above for Alternative C.

Northern Cheyenne Reservation

Impacts to the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Conclusion

Cumulative impacts under this alternative would be similar to Alternative B with the exception of increased surface disturbance resulting from the lack of ROW corridors, vandalism and removal of fossils from increased access to remote areas. Mitigation measures would be similar to Alternative A.

Alternative D

Impacts would be the same as described under Alternative B.

Alternative E (Preferred Alternative)

Impacts under this alternative would be similar to Alternative C with some exceptions. Under this alternative, the potential for project plan stipulations could affect the amount of surface disturbances. Directional drilling may be performed on deeper coal seams and would decrease surface disturbances. The potential for impacts from surface disturbances resulting from the placement of underground utilities would increase impacts to paleontological resources.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described above for Alternative E.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described above for Alternative E.

Conclusion

Cumulative impacts under this alternative would be similar to Alternative C with the exception of the potential changes to surface disturbances resulting from the Project Plan stipulations. Efforts would be taken to minimize the impacts to paleontological resources by minimizing the total surface disturbance. Mitigation measures would be similar to Alternative A.

Recreation

Assumptions

Recreation areas were detailed in Chapter 3. Most of the recreation resources in the study area consist of dispersed activities such as hunting and fishing. BLM has stipulations to protect recreation areas receiving concentrated public use and reservoirs used for recreational fishing. Surface disturbance assumptions are detailed in the *Analysis Assumptions and Guidelines* section of this chapter. In general, the demand for recreational activities will increase proportionately with the increase or decline of regional populations.

Impacts From Management Common to All Alternatives

Recreation areas are potentially impacted by surface-disturbing activities. The activities that involve the use of heavy equipment (road construction, well drilling, pad construction, pipeline and utility placement, etc.) would result in changes to the natural landscape, which would cause the most surface disturbance and have the greatest impact on recreation areas. Other activities, such as increased travel and vandalism resulting from access improvements, and increased erosion resulting from surface disturbances, can also impact recreation areas. These activities can produce indirect impacts to recreation areas such as fires, hazardous waste spills and cleanups, changes in livestock grazing patterns, and wildlife habitats.

BLM has stipulations to protect recreation areas receiving concentrated public use and reservoirs with fishes. The state also has stipulations for protection of recreation areas including prohibiting activity within 100 feet of streams, ponds, lakes, or other water facilities. Additional state stipulations include a 1/8-mile buffer for rivers, lakes, or reservoirs, and a sensitive areas stipulation that may be used when field staff receive comments regarding recreation areas. Most of the recreation resources in the study area are dispersed activities, such as hunting and fishing, and are not developed recreation sites. Exploratory activities such as drilling and testing would temporarily displace game species locally. Installation of oil and gas production facilities in areas used for hunting, hiking, and other dispersed recreational activities would infringe on the solitude and rural characteristics of the area. The oil and gas infrastructure and activities would reduce the number of game animals in the area or force some game animals to leave the area which would reduce or eliminate certain hunting activities. Hunters would be concerned about shooting around facilities and equipment.

Exploration and production would create new roads, which would provide easier motorized access to areas that may not have been accessible before. Motorized recreation user groups would see this as a benefit to their sports, and would appreciate increased access to streams, lakes, and hunting areas. Non-motorized recreational enthusiasts who seek solitude and quiet, including backpackers, hikers, and some hunters and anglers, would not benefit from road development. As formerly remote areas become more accessible and competition for limited resource escalates, conflicts among these user groups would occur.

Increased human access and increased human activity associated with exploration and development would result in increased legal and possibly illegal harvest of fish from nearby drainages. Increased legal harvest would be a recreation benefit as fishing opportunities are more accessible to a wider range of people and game regulations are adapted to accommodate the increased fishing pressure. However, if increased illegal harvest causes fish populations to drop below a sustainable level, fishing as a recreational resource would be affected.

Increased access typically causes an increase in vandalism and the need for law enforcement. As recreation in public lands becomes more popular, undeveloped recreation sites would generally require more time and attention and have the potential to become developed sites, if use becomes concentrated to that level. Exploration and production activities may cause some ranches to be closed to hunting access via surface agreements.

Mitigation

Mitigation activities include avoiding location of oil and gas facilities in established recreation sites or undeveloped sites having concentrated use, and coordinating timing of exploration activities to minimize conflicts during peak periods of use.

Impacts From Management Specific to Each Alternative

Alternative A

Impacts on recreation areas would include the loss of land for recreation purposes, and the disruption to recreation activities. Each well would present its own set of unique circumstances that would need to be mitigated to minimize impacts. Exploratory activities such as drilling and testing would temporarily displace game species locally. There would be no production activities in BLM planning areas under this alternative and therefore no impacts from production on BLM land.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described above for recreation in general. If there were no CBM development on Tribal Lands, then there are expected to be minimal impacts on recreation on the reservation. Impacts on hunting and fishing from trespassing described above should be emphasized because of Native Americans' reliance on these resources.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Mitigation

Impacts from surface disturbance would be minimized by using existing disturbances where possible, and by allowing aboveground utility lines. The mitigation measures would be the same as those discussed in the *Impacts from Management Common to All Alternatives* section above.

Conclusion

Cumulative impacts under this alternative would include the effects of Alternative A combined with conventional oil and gas development and other projects discussed under the *Cumulative Impacts and Projects Evaluated* section above. These would include impacts from nearby activities such as mining or power generation facilities, which can result in increased use due to increases in population associated with additional available jobs. In addition, the construction of the Tongue River Railroad would result in the loss of 264 acres of BLM land that could provide hunting opportunities for the public. (Note: surface mining is getting ready to expand by 4,000 acres under permit request now. See this chapter's *Introduction* section.)

Alternative B

Alternative B would allow development with single-lane roads and turnouts. Upon abandonment, new roads would be rehabilitated and closed. Impacts from this alternative would be similar to Alternative A with the addition of increased CBM development resulting in increased access, resulting in increased impacts on dispersed recreation activities such as hunting and fishing.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described above for Alternative B.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Mitigation

The mitigation measures would be the same as those discussed in the management common to all alternatives section above.

Conclusion

The residual impact of this alternative is increased CBM development, which would result in increased access to remote areas and increased vandalism.

Cumulative impacts under this alternative would be similar to those described under Alternative A, but on a large scale because of CBM development.

Alternative C

Under this alternative, impacts on recreation areas would be similar to Alternative B with the following exceptions: transportation corridors are not required, thereby increasing the number of disturbed acres and opportunities for access; and discharge of produced water may be directly to the ground, which would increase erosion. Increased erosion could lead to a reduced amount of land available for recreation activities and could disrupt habitat for game species.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described above for Alternative C. If there were no CBM development on Tribal Lands, then the additional impact exceptions mentioned above would be minimal, if any, to recreation on the reservation.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Mitigation

The mitigation measures would be the same as those discussed in the management common to all alternatives section above.

Conclusion

The residual impacts of this alternative are similar to Alternative B. The exception would be that surface disturbance from roads would be greater, increasing the opportunity for access to remote areas and the discharge of water, which would increase erosion and potentially damage lands used for recreation.

Cumulative impacts would be similar to those described under Alternative A, but on a large scale because of CBM development.

Alternative D

Under this alternative, impacts to recreation resources would be similar to Alternative B, however water management would include measures to eliminate soil erosion by piping discharged water to the nearest body of water. Also, under this alternative, new oil and gas roads would remain open or closed at the surface owner's discretion. Without a firm commitment to close new roads, impacts and benefits from additional roads as discussed above would occur.

Crow Reservation

Impacts to the Crow Reservation would be similar to those described above for Alternative D.

Northern Cheyenne Reservation

Impacts to the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this Alternative.

Mitigation

The mitigation measures would be the same as those discussed in the management common to all alternatives section above.

Conclusion

The residual impacts of this alternative would be similar to those described under Alternative B.

Cumulative impacts would be similar to those described under Alternative A but on a larger scale due to the expanded CBM development.

Alternative E (Preferred Alternative)

Alternative E, the Preferred Alternative, would allow CBM development subject to existing planning restrictions and balances CBM development and the protection of the natural environment. Impacts on recreation areas would include the loss of land for recreation purposes, and the disruption to recreation activities. Each well would present its own set of unique circumstances that would need to be mitigated to minimize impacts. Exploratory activities such as drilling and testing would temporarily displace game species locally. Impacts from surface disturbance would be minimized by using existing disturbances where possible however, transportation corridors are not required, thereby increasing the number of disturbed acres and opportunities for access.

Crow Reservation

Impacts to the Crow Reservation would be similar to those described above for Alternative E.

Northern Cheyenne Reservation

Impacts to the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this Alternative.

Mitigation

The mitigation measures would be the same as those discussed in the management common to all alternatives.

Conclusion

The residual impacts of this alternative are similar to Alternative B. The exception would be that surface disturbance from roads would be greater, increasing the opportunity for access to remote areas.

Cumulative impacts under this alternative would be similar to those described under Alternative B.

Social and Economic Values

Assumptions

It is assumed that the average CBM production well in Montana produces about 125,000 cubic feet per day (MBOGC 2001b). Using a gas price of about $4.00 per thousand cubic feet, the average well would generate about $182,500 per year in total income. Income-producing wells on average are expected to last between 10 and 20 years, with an average production life of 15 years. Exploration wells do not produce income.

The social and economic analysis in this chapter is based on the RFD rate of development over a 20-year period. During this 20-year period, all CBM wells would be drilled and production would peak. However, because CBM wells typically produce for 10 to 20 years, a well drilled in year 20 would continue to produce until year 40. Thus, social and economic consequences of production and abandonment would continue for up to 20 more years beyond the period assessed here.

The number and type of jobs related to CBM development would vary with the project phase, exploration, development, production, or abandonment. During exploration and development, the majority of jobs created would be for well drillers and pipeline installers along with specialty positions such as land surveyors, supervisors, and geologists. A number of related support personnel (e.g., truck drivers and material handlers) would also be required during these activities. During production, most new jobs would be for maintenance and repair workers and their supervisors. During abandonment, field workers, support workers, and their supervisors would be in demand.

To simplify this analysis, all dollar amounts (e.g., wages and other project-related income) are reported in current dollars with no adjustment for inflation over time.

Impacts From Management Common to All Alternatives

Impacts on social conditions would include changes in employment and population; changes in the services provided by governments; the effects of drilling and related activities on rural lifestyles in the project area; the effects of changes in employment opportunities on communities; changes in levels of traffic, noise, visual resource impacts, and psychological stress levels; and the effects of population change on local housing, schools, and services.

Direct economic impacts of the project would include changes in personal income resulting from new employment of oil and gas workers; purchases of services from local area vendors; lease, royalty, and production payments; taxes and other government levies; impacts resulting from changes in environmental quality; and related changes in the fiscal health of county, state, and federal governments. Indirect impacts would include induced economic activity from local purchases of equipment, supplies, and services; induced economic activity from purchases of goods and services by project workers; and changes in the sources of income for local governments. The largest economic benefit from CBM development is the methane itself, measured by the revenues obtained by the companies involved in developing the resource. It is assumed that most of these revenues will go to out-of-state companies. Montana's share of that benefit will come mostly in the form of natural gas taxes and royalties, discussed below.

Conventional oil and gas development would have economic impacts on landowners, communities, county governments, reservations, and the state and Federal governments. When hydrocarbons are produced and sold, the operator is responsible for paying the mineral owner and governmental entities in the form of taxes and royalties. New employees generally would be needed as wells are added; for example, drilling contractors and other contractors would be required to service and supply the wells to maintain production. At the same time, an increase in wells would impact the community through an influx in population which, in turn, would result in increased pressure on community services such as schools, roads, medical facilities, and other public services.

Property values would be affected by full field development. Small ranchettes located within the area would increase in value because of the demand for additional housing. Full-size ranches would be impacted by the increase in activity accompanying development. This could include such factors as the change in rural character of the land. Ranchers choosing to sell their ranches would receive less monetarily if the ranch sells without mineral rights attached. Outfitting would be impacted from increased road development, causing a decline in outfitting income.

Oil and gas development would impact social and economic resources through influence on area employment, taxes, Payments in Lieu of Taxes, royalties to mineral owners, and county, state, and federal services. It might also affect local environmental resources, from which many residents make their living. Conventional well development is projected at between 595 to 2,325 additional oil and gas wells over the next 20 years. This level of industrial activity (average 116 wells per year) would have negligible impact on the social economic resources of the area.

Impacts From Management Specific to Each Alternative

Alternative A

Employment and Unemployment

The location and distribution of the exploratory wells by county is not known, and therefore, this analysis assumes that the wells in the two RMPs are distributed across those areas and the wells to be drilled statewide are also distributed geographically in proportion to the RFD estimates for development. The production wells are assumed to be confined to the CX Ranch in Big Horn County.

Average numbers and types of jobs and their associated wages are estimated based on a recent report on the economic impacts of CBM development in the Powder River Basin (ZurMuehlen 2001), which assumes the following ratios: 49 jobs per 160 wells for exploration/development; 9 jobs per 160 wells for production; and 12 jobs per 160 wells for abandonment. As shown in Table 4-9, the estimated number of jobs created under Alternative A would range between 175 (Year 1) and 14 (Years 8 through 19), for an average of about 32 jobs per year over the period. This change would be small compared to the total employment in the CBM emphasis area (183,000 in 1998). For Alternative A, it is assumed that all wells would be abandoned by year 20 of the project.

Measurable indirect changes to local employment would not be anticipated for Alternative A. The purchase of equipment, supplies, and services related to the proposed wells would have some impact but likely would not be distinguishable from the existing economic activity in the CBM emphasis area and in the state.

Thus, few or no new jobs would be created indirectly. New employment created directly and indirectly for Alternative A would be small in relation to total employment in the CBM emphasis area (183,000 in 1998), and therefore, it would not be expected to result in changes to current county or state unemployment rates.

Demographics

Employees who would fill the CBM jobs would likely be a mixture of current residents from the surrounding areas and those who would be drawn to the project and its employment opportunities from around the region. It is assumed that local labor (i.e., those within commuting distance of the CBM well locations) would be used to the extent available; however, many of the new jobs would likely be filled by new migrants to the region. The degree to which the jobs would be filled by current residents would depend on a number of factors, including job skills (including Native Americans living on and off the reservations). The extent to which workers who move to the region for new jobs would bring families with them would depend on a number of factors, most notably the duration of the job in a given location. Assuming a mixture of single employees and those with families, it is estimated that, on average, each new employee would bring one additional person to the region. Even if all the jobs (175 during Year 1) were filled by new migrants to the region and resulted in new persons moving to the area, the total new population (perhaps 350 persons) would be small compared to the total regional population (287,000 in 2000). There would likely be some concentration of new residents associated with jobs in Big Horn County related to the CX Ranch. Given that any new population would be spread over both time and geographic area, no impact on demographics would be anticipated from Alternative A.

Social Organization

Housing Units and Vacancy

Only small changes in the supply or demand of permanent or temporary housing are anticipated as part of Alternative A. This follows from the small changes in employment and population discussed above.

Public Services and Utilities

The relatively small scale of CBM well development proposed for Alternative A would not result in any substantial changes in the ability of county, state, or Federal governments to provide public services or utilities. The basis for this conclusion is the lack of additional temporary or permanent population and the associated lack of demand for additional public services.

TABLE 4-9
ALTERNATIVE A: ESTIMATED WAGES AND JOBS FOR WELL DEVELOPMENT, PRODUCTION, AND ABANDONMENT (WAGES REPORTED IN CONSTANT DOLLARS)[1]

Year	Wells Drilled per Year	Initial Development Jobs	Initial Development Wages[2]	Wells Producing per Year	Production Jobs	Production Wages	Wells Abandoned per Year	Abandonment Jobs	Abandonment Wages	Estimated Total Jobs	Estimated Total Wages
1	525	161	$4,662,656	250	14	$539,063				175	$5,201,719
2	150	46	$1,332,188	250	14	$539,063				60	$1,871,250
3	150	46	$1,332,188	250	14	$539,063				60	$1,871,250
4	100	31	$888,125	250	14	$539,063	375	28	$972,656	73	$2,399,844
5				250	14	$539,063	100	8	$259,375	22	$798,438
6				250	14	$539,063	100	8	$259,375	22	$798,438
7				250	14	$539,063	100	8	$259,375	22	$798,438
8				250	14	$539,063				14	$539,063
9				250	14	$539,063				14	$539,063
10				250	14	$539,063				14	$539,063
11				250	14	$539,063				14	$539,063
12				250	14	$539,063				14	$539,063
13				250	14	$539,063				14	$539,063
14				250	14	$539,063				14	$539,063
15				250	14	$539,063				14	$539,063
16				250	14	$539,063				14	$539,063
17				250	14	$539,063				14	$539,063
18				250	14	$539,063				14	$539,063
19				250	14	$539,063				14	$539,063
20				250	14	$539,063	250	19	$648,438	33	$1,187,500
20-Year Total	**925**	**283**	**$8,215,156**	**250**	**281**	**$10,781,250**	**925**	**69**	**$2,399,219**	**634**	**$21,395,625**

NOTES:

[1]Data for jobs per well and wages (ZurMuehlen 2001).

[2]Wages paid for initial development phase for well drillers and pipeline installers was estimated at $6,600 per well (Langhus 2001)

Attitudes, Beliefs, Lifestyles, and Values

The information reflected in the public comments and newspaper reports summarized in Chapter 3 indicate a range of attitudes and beliefs with respect to the development of CBM and its relationship to the lifestyles and values of area residents.

As discussed in Chapter 3, the majority of public comments received during scoping related to concerns about impacts on the environment, and water quality and quantity in particular. The possibility of unfavorable economic impacts resulting from environmental impacts is also a concern. Other concerns include possible increases in traffic levels, noise, visual resource impacts, and psychological stress associated with changes to the surrounding built and natural environment.

The limited development of CBM proposed for Alternative A likely would be experienced by the communities in the CBM emphasis area as a continuation of existing oil and gas development practices in the region and in the state. As a result, these actions by themselves would likely be perceived as generally consistent with the attitudes, beliefs, lifestyles, and values of most population groups (e.g., ranchers, Native Americans, small town residents).

Personal Income

Wages paid to project employees would contribute to the total personal and per capita income of every county where employees reside. As shown in Table 4-9, total direct wages from Alternative A over 20 years are estimated at about $21 million, and would range from a high of $5.2 million (Year 1) to a low of $539,000 (Years 8 through 19).

Any of the producing wells proposed for operation on the CX Ranch would generate new personal income, depending on ownership. Individuals who own the mineral rights to their land and lease those rights to developers as part of the existing management scenario would receive additional income from rents or royalties. Although only a small percentage of landowners own mineral rights, the royalty income to any one individual would still be substantial over many years if a given well is highly productive. Individuals on whose land CBM is developed but who do not own the mineral rights to their land would receive one-time payments as compensation for land disturbance. However, given the small scale of production anticipated, these changes to personal income likely would have only a small effect on the per capita income of the CBM emphasis area or the state as a whole.

Additional personal income for residents of the counties and the state would be generated by circulation and re-circulation of dollars paid out as business expenditures and as state and local taxes.

Government Revenues

The primary source of government revenues generated by the project would be from taxes levied on property, equipment, income, and natural gas output generated by production wells. Exploratory wells would generate government income only to the extent the associated temporary facilities are subject to local property taxes.

Oil and Gas Income

Royalties of 12.5 percent are typically earned for oil and gas production on state and federal lands. About 50 percent of royalties paid to the federal government are generally returned to the state from which they originate. Assuming the 250 production wells on the CX Ranch proposed for Alternative A each generate about $182,500 in gross production income per year (assuming production of 125,000 cubic feet per day and a price of $4.00 per thousand cubic feet), the total annual gross income would be about $45.6 million per year for an average of 15 years. About 12.5 percent, or $5.7 million, of this new income would accrue to the state, federal, or private mineral owner annually.

Rents on state and federal lands leased for oil and gas development are bid competitively, with the lowest bid being $1.50 per acre. Resulting government income would depend on the specifics of leases on the CX Ranch; however, it is assumed that additional income would accrue to the state and federal government.

Taxes

Income Taxes

A portion of the taxable income (wages, rent or royalty income, and land disturbance payments) generated by Alternative A would accrue to the state as income tax revenue. Income taxes would be paid on the annual wages paid for the average 32 jobs per year discussed under *Employment*. Dividing the estimated total wages over 20 years by the estimated total jobs for the same period (Table 4-9), the average annual salary per job would be about $34,000. Income in Montana is taxed according to a graduated rate structure with rates ranging from 2 percent to 11 percent of taxable income; the average rate in 2000 was about 3 percent (Montana Department of Revenue 2001). It is important to note that these sums are already included in the estimates of personal income (income taxes are a transfer of personal income to the state). Thus, estimated income tax revenues from an annual average of 32 jobs at $34,000 would range from $21,800 (2 percent tax rate) to $119,700 (11 percent tax rate), with a likely amount closer to $32,600 (3 percent tax rate) based on recent history. The project would result in an increase in state tax revenues to the extent that new income is created that didn't previously exist in the state.

Property Taxes

Both real and personal property are subject to property taxes. Personal property would consist of structures, equipment, and materials used for the proposed exploration and production of CBM. Taxes on real property would be based on changes in the assessed value that result from improvements to the property. Each county in which facilities were located would assess tax levies and apply them to the taxable value of the relevant facilities. The levy would be based on the total value of property multiplied by a tax rate or rates specific to the property location (i.e., county and special service districts). Any such additional property taxes would contribute new income directly to both the county tax base and the local economy. It should be noted that property taxes on business equipment (e.g., drilling equipment) will likely be phased out by 2006, reducing the total taxes that would be collected.

Given the limited nature of CBM exploration and development proposed in Alternative A, changes in taxes are not expected to be substantial for any given county. The exception is Big Horn County, where the new production wells are proposed. Additional county tax revenues would be anticipated. Property tax revenues would be a cost to CBM development companies and landowners and a benefit to the counties and the state.

Natural Resources Taxes

The products of natural resource extraction in Montana, including natural gas, are subject to state natural resource taxes, including local government severance taxes (LGST). Any new production of natural gas generated by the 250 production wells in Big Horn County would be subject to such taxes. Severance taxes are distributed to a variety of state and local funds and would contribute positively to the state and local economies.

Other Taxes

In general, the local and state economies would benefit from sales of goods and services by local businesses to oil and gas operators associated with the project. However, because there is no sales tax in Montana, local sales of goods and services associated with CBM development would not generate increases in tax revenues.

Water Resource Values

The purpose of a discussion of water resource values in the economics section of this report is to acknowledge that the existing surface and groundwater resources in the CBM emphasis area have an economic value that is part of the overall economy of the area and that alterations to these resources, if not mitigated, would have economic impacts to water users or to the regional economy. Affected users would include those who depend on surface water or groundwater for irrigation, ranching, municipal water needs, home water needs, landscape needs, and any other business and household need of water from a surface water body or well.

Given the relatively limited scale of CBM development proposed for Alternative A, effects on water resources and water resources economics would be relatively limited (see the analysis in the *Hydrological Resources* section). For Alternative A, untreated water from exploration would be placed in holding facilities for beneficial re-use, which would provide an economic benefit to affected water users. No discharge to waters of the United States would be allowed for BLM-authorized exploration wells; the state would permit discharge for the CX Ranch field of up to 1,600 gpm. Because of the small scale, no economic impacts to downstream surface water users would be anticipated.

Localized groundwater depletion would result over time (more than 5 years) from the CBM wells proposed for Alternative A.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described above for social and economic values in general. It is assumed that no CBM wells would be developed on the Native American reservations initially, and therefore social impacts would be more likely to affect those individuals living off the reservations or whose activities are conducted off the reservations. Native American development is considered as part of the cumulative effects potential. Few, if any, tax revenues would accrue to Tribal governments as a result of off-reservation CBM development. It is likely that a smaller number of Native Americans who are interested in the development of energy resources for the long-term social and economic betterment of tribal members would perceive or experience fewer impacts from CBM development.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Mitigation

It is assumed that any such impacts would be addressed by mitigation agreements between developers and groundwater users, thus avoiding economic impacts to groundwater users.

Conclusions

The existing management scenario is essentially a continuation of existing oil and gas industry practices in the CBM emphasis area and would not result in social impacts (e.g., only small changes in employment, population, demand for services, etc.), and would have only a small effect on economic conditions in the CBM emphasis area, as well as environmental and social conditions.

As described above, the new jobs and related social and economic impacts from Alternative A would be small, with the exception of the proposed production wells in Big Horn County, which would result in positive economic impacts in that county. Future development in the area, such as the Tongue River Railroad and further expansion of existing surface coal mines, would likely have a number of larger social and economic impacts (e.g., creation of more jobs and income), which would be additive to the impacts from Alternative A described above.

Alternative B

Employment and Unemployment

Estimated direct employment from CBM under the development scenario for the 20-year project life is presented in Table 4-10. (Wage information is discussed under *Economics*.) The number and type of jobs involved would vary with the project phase. The types of jobs would be the same as those described for Alternative A.

As shown in Table 4-10, development (drilling of about 18,300 wells over 20 years) would result in an estimated average of 851 jobs per year, with a range from 334 (Year 1) to 943 (Year 18) for all project phases combined. The actual number of jobs in a given year would depend on the actual number of wells drilled, in production, or abandoned in that year. Abandonment of wells during years 21-40 would result in an estimated 1,054 additional jobs, for an average of about 53 jobs per year during that period.

The additional jobs created would be small compared to the total employment in the CBM emphasis area (183,000 in 1998). However, given that most of the CBM wells would be located in three counties (Big Horn, Powder River, and Rosebud), a large number of the jobs would be concentrated in those counties. Because some of these jobs would go to non-local residents, the actual number of new jobs in the study area would be less.

The water management conditions included in Alternative B would require injection wells, the installation and operation of which would be associated with additional jobs. Water injection wells would be required at a rate of about 1 per 10 CBM wells. This would result in an increase in jobs and wages of about 10 percent over those reported in Table 4-10 for all phases of the project combined.

In addition to the direct jobs created by the project, some additional jobs would be created indirectly through additional work for persons in related support industries such as truckers, material suppliers, inspectors, and various other specialists. One estimate is that one indirect job would be created for every four direct jobs created (ZurMuehlen 2001).

The effect of the new jobs on current unemployment rates in the area would be moderate. Although the new direct jobs would help boost total employment in the emphasis area, the increases would be limited to those sectors and individuals with the appropriate skills for the jobs and to those geographic locations where the jobs are located. For example, the relatively high unemployment rates (about 9 percent) in the mining sector in Big Horn and Rosebud counties would be decreased if unemployed persons gain employment from the new CBM development.

Any new jobs filled by new residents (see the *Demographics* section) would increase the number of employed persons in a given county but would not decrease the number of unemployed persons. To the extent that indirect jobs are created by the project, some increased employment in other service industries also would occur.

Demographics

As with Alternative A, employees who would fill the CBM jobs would likely be a mixture of current residents from the surrounding areas and those who would be drawn to the project and its employment

TABLE 4-10
ALTERNATIVES B, C, D, and E: ESTIMATED WAGES AND JOBS FOR WELL DEVELOPMENT, PRODUCTION, AND ABANDONMENT (WAGES REPORTED IN CONSTANT DOLLARS)[1, 2]

Year	Wells Drilled per Year	Initial Development Jobs	Initial Development Wages[3]	Wells Producing per Year	Production Jobs	Production Wages	Wells Abandoned per Year	Abandonment Jobs	Abandonment Wages	Estimated Total Jobs	Estimated Total Wages
1	900	276	$7,993,125	510	29	$1,099,688	390	29	$1,011,563	334	$10,104,375
2	1,100	337	$9,769,375	1,220	69	$2,630,625	390	29	$1,011,563	435	$13,411,563
3	2,000	613	$17,762,500	2,830	159	$6,102,188	390	29	$1,011,563	801	$24,876,250
4	2,200	674	$19,538,750	4,640	261	$10,005,000	390	29	$1,011,563	964	$30,555,313
5	2,000	613	$17,762,500	6,250	352	$13,476,563	390	29	$1,011,563	993	$32,250,625
6	1,500	459	$13,321,875	7,750	436	$16,710,938	0	0	$0	895	$30,032,813
7	1,300	398	$11,545,625	9,050	509	$19,514,063	0	0	$0	907	$31,059,688
8	900	276	$7,993,125	9,950	560	$21,454,688	0	0	$0	835	$29,447,813
9	900	276	$7,993,125	10,850	610	$23,395,313	0	0	$0	886	$31,388,438
10	700	214	$6,216,875	11,550	650	$24,904,688	0	0	$0	864	$31,121,563
11	550	168	$4,884,688	11,900	669	$25,659,375	200	15	$518,750	853	$31,062,813
12	550	168	$4,884,688	12,250	689	$26,414,063	200	15	$518,750	873	$31,817,500
13	550	168	$4,884,688	12,600	709	$27,168,750	200	15	$518,750	892	$32,572,188
14	550	168	$4,884,688	12,950	728	$27,923,438	200	15	$518,750	912	$33,326,875
15	550	168	$4,884,688	13,300	748	$28,678,125	200	15	$518,750	932	$34,081,563
16	450	138	$3,996,563	13,550	762	$29,217,188	200	15	$518,750	915	$33,732,500
17	450	138	$3,996,563	13,800	776	$29,756,250	200	15	$518,750	929	$34,271,563
18	450	138	$3,996,563	14,050	790	$30,295,313	200	15	$518,750	943	$34,810,625
19	400	123	$3,552,500	14,100	793	$30,403,125	350	26	$907,813	942	$34,863,438
20	300	92	$2,664,375	14,050	790	$30,295,313	350	26	$907,813	908	$33,867,500
20-Year Total	18,300	5,604	$162,526,875		11,090	$425,104,688		319	$11,023,438	17,013	$598,655,000
Annual Average	915	280	$8,126,343.75		554	$21,255,234.38		16	$551,171.88	851	$29,932,750

NOTES:

[1]Data for jobs per well and wages (ZurMuehlen 2001).

[2]The water management conditions included in Alternative B would require injection wells, the installation and operation of which would be associated with additional jobs. Water injection wells would be required at a rate of about 1 per 10 CBM wells. This would result in an increase in jobs and wages of about 10% over those reported in Table 4-26 for all phases of the project combined.

[3]Wages paid for initial development phase for well drillers and pipeline installers was estimated at $6,600 per well (Langhus 2001).

opportunities from around the region. It is assumed that local labor would be used to the extent it is available; however, for Alternative B it is likely that many additional workers (e.g., drill rig crews) from outside the area would be needed, especially during the peak employment years of the project. It is assumed that drill rigs from a variety of locations-both Montana and Wyoming-would be used, depending on supply and demand at any given time. The potential for new population is greatest in the counties where the number of CBM wells to be drilled is greatest: Big Horn, Powder River, and Rosebud counties (about 90 percent of proposed CBM wells would be drilled in these three counties; see Table 4-11). As with Alternative A, it is estimated that, on average, each new employee would bring one additional person to the region. Assuming, as a worst-case scenario, that all of the jobs were filled by new migrants to the area, as many as 1,986 people (993 x 2) might be added to the region during the peak employment year (Year 5). The new population would be spread over a relatively large geographic area and likely would be concentrated in larger populated areas. An increase of this magnitude would be small compared to the total regional population (287,000 in 2000). However, the new population could be concentrated in the three counties with the most CBM wells (see Table 4-11). Because these three counties have a relatively small combined population (about 24,000), population change within these counties could be substantial. Of the approximately 24,000 persons in the three counties, about 10,400 or 44 percent are Native American (see Table 3-16).

TABLE 4-11
TOTAL PROPOSED WELLS AND PERCENT BY COUNTY
(ALTERNATIVES B, C, D, AND E)

County	Wells to be Drilled	% of Total
Big Horn	7,000	38.3%
Blaine	10	0.1%
Carbon	400	2.2%
Carter	0	0.0%
Custer	300	1.6%
Gallatin	15	0.1%
Golden Valley	0	0.0%
Musselshell	150	0.8%
Park	25	0.1%
Powder River	6,700	36.6%
Rosebud	2,800	15.3%
Stillwater	700	3.8%
Sweetgrass	25	0.1%
Treasure	25	0.1%
Wheatland	0	0.0%
Yellowstone	150	0.8%
Subtotal	18,300	100.0%
Combined Total: Big Horn, Powder River, and Rosebud counties	16,500	90.2%

Social Organization

Housing Units and Vacancy

Depending on the type and duration of the jobs (e.g., long-term production supervisor versus drill rig crew member), new employees in the area would seek either temporary housing (hotels, apartments, trailer parking) or permanent housing (homes to purchase or to rent long-term). Individual choices about where to live are hard to predict and vary with personal preference, in addition to the supply of housing and availability of services in a given location and the mobility demands of a given job. The relatively limited supply of temporary and permanent housing in the smaller communities in the CBM emphasis area would limit the number of new employees (and families, if applicable) who would be able to live there without additional housing and related services. The larger communities, such as Billings or Gillette, Wyoming, have a greater supply of temporary and permanent housing and would be likely settlement locations for people employed by the CBM industry. In part because of the general trend of migration within Montana from the east to the west during recent years, vacant housing is available in a number of communities. As discussed in Chapter 3, vacancy rates for both temporary and permanent housing are adequate to high in the CBM emphasis area. This information, combined with the large size of the geographic area and the dispersed nature of the new job opportunities and associated new population, suggest that adequate housing opportunities would be available in the larger communities and might not be available in some of the smaller communities.

Public Services and Utilities

Impacts on the ability of local governments to provide public services and utilities would be related to the ability of the service providers to adapt to relevant fiscal or physical changes from CBM development. Affected services typically include police and fire protection, emergency medical services, schools, public housing, park and recreation facilities, water supply, sewage and solid waste disposal, libraries, roads, and other transportation infrastructure. Given the large geographic scale of the CBM development scenario, it is infeasible to quantitatively assess the relationship of the project to these individual services. However, because the changes in population discussed above would be moderate and dispersed throughout the CBM emphasis area, any resulting increases in demand on public services and utilities are anticipated to be within the capacity of the providers. For example, the three counties (Big Horn, Powder River, and Rosebud) in which most of the CBM wells are proposed to be drilled would also receive the greatest amounts of property tax and other government revenue (see the *Economics* section) that would fund improvements or other changes to services.

The alternatives being considered include varying management objectives with respect to the construction of roads and utilities. Although the construction and maintenance of utilities would be funded by the users, the majority of new roads created to access CBM wells would subsequently become county roads. To the extent local governments opt to maintain these roads after this time, additional revenue would be required to balance the additional costs required to do so.

Attitudes, Beliefs, Lifestyles, and Values

The large scale development of a large number of CBM wells in the planning area would likely conflict with the attitudes, beliefs, lifestyles, and values of many individuals and population subgroups in the area (e.g., farmers, ranchers, small town residents, Native Americans, retirees, etc.). Drilling, testing, and operation of CBM wells would result in increased traffic from trucks and other vehicles; noise from traffic and the operation of generators and drilling and other equipment; visual resource impacts from the construction of the wells themselves as well as power lines and related electrical infrastructure; and psychological stress associated with unwanted change, division in the community, or other impacts. The population subgroups would be affected to the degree to which their lifestyles and values are inconsistent with such impacts.

The majority of individuals in the planning area are understood to have traditional rural lifestyles in which the relatively quiet and pristine surroundings are an important value. They would likely find this level of CBM development inconsistent with the desired balance between environmental stewardship and economic development expressed in many of the scoping comments and newspaper reports. This would be particularly true for Big Horn, Powder River, and Rosebud Counties in which the majority of the wells would be developed. Large-scale CBM development could be viewed as part of a gradual transition away from traditional rural and agricultural lifestyles. A smaller group of people in the area who are more interested in the potential economic benefits of CBM development would likely perceive or experience fewer impacts with respect to lifestyles and values.

Large-scale CBM development is likely to conflict to some degree with traditional Native American values which emphasize preservation of cultural heritage and a reverence for the natural environment. Native American groups could be affected by increases in noise, impacts on visual resources and plant populations, etc., in particular as they affect locations and resources used for spiritual or religious purposes. It is assumed that no CBM wells would be developed on the Native American reservations initially, and therefore impacts would be more likely to affect those individuals living off the reservations or whose activities are conducted off the reservations. Native American development is considered as part of the cumulative effects impact potential. It is likely that a smaller number of Native Americans who are interested in the development of energy resources for the long-term social and economic betterment of tribal members would perceive or experience fewer harmful impacts from CBM development.

Impacts on recreation areas would include the loss of land for recreation purposes, and the disruption to recreation activities. Each well would present its own set of unique circumstances that would need to be mitigated to minimize impacts. Exploratory activities such as drilling and testing would temporarily displace game species locally.

The subsurface discharge of produced water would likely be seen as consistent or somewhat inconsistent with the desired balance between environmental stewardship and economic development expressed in many of the scoping comments and newspaper reports. Impacts on groundwater would be the same for Alternatives B, C, D, and E, with the primary impact being the drawdown of groundwater.

Personal Income

Wages paid to CBM workers would contribute to the total personal income in the county where the employees reside. As shown in Table 4-10, wages would be generated from all three project phases. Over the first 20 years of the project, total wages paid for all phases of the project would be an estimated $598 million. Estimated annual wages would range from $10 million in Year 1 to almost $35 million in Years 18 and 19. Although this much estimated personal income would be generated by the project, it would not all be experienced as "new" income within a given county or the state. New income would be the difference between the income of workers before CBM development and the income after CBM development.

A number of the producing wells in the development scenario would generate new personal income for those who own the land or the mineral rights, as stated under Alternative A. The circulation and re-circulation of direct income (including royalties to private owners) generated by the project would generate additional (indirect) personal income throughout the region.

Government Revenues

Oil and Gas Income

Assuming each of the approximately 16,500 production wells anticipated for Alternative B generate about $182,500 in gross production income per year of operation, the total annual gross income would vary depending on the number of wells in production in a given year. As shown in Table 4-10, the estimated number of producing wells ranges from 510 in Year 1 to 14,100 in Year 19. It follows that the estimated annual gross income would range from $93 million (Year 1) to $2.5 billion (Year 19). Most of this revenue would go to methane companies located out of state. The 12.5 percent royalty collected on this annual income would range from about $12 million (Year 1) to $322 million per year. It is estimated that about one-half the well sites would be permitted on minerals administered by the federal government (BLM) about 5 to 10 percent on state (fee) minerals, and the remaining 40 to 50 percent on private minerals. As a result, about half of the royalty income would initially go to the federal government, with about half of the federal half being returned to the state. Thus, an estimated 30 to 35 percent of royalty income, between $4 million and $113 million in a given year, ultimately would accrue to the state. Given that total state revenues received from minerals management on state lands in FY 2000 was $11.6 million and total federal mineral revenues collected on Montana lands and disbursed to the state were $20.4 million in FY 2000 (see Chapter 3), new state revenues from CBM would be substantial, especially during the peak years of the project.

Rents on state and federal lands leased for oil and gas development are bid competitively, with the lowest bid being $1.50 per acre. Resulting government income would depend on the specifics of the leases. It is assumed that additional income would accrue to the state and federal government from these rents.

Net government revenues would be reduced by costs incurred for monitoring and regulating CBM activity. These costs would be relatively small compared to the revenues generated.

Water treatment costs for Alternative B would be greater than for Alternative D and much greater than for Alternative C.

Taxes

Income Taxes

A portion of the taxable income (wages, rent or royalty income, and land disturbance payments) generated by Alternative B would accrue to the state as income tax revenue. Income taxes would be paid on the annual wages paid for the average 851 jobs per year discussed above under *Employment*. Dividing the estimated total wages over 20 years by the estimated total jobs for the same period (Table 4-10), the average annual salary per job would be about $35,000 (does not account for inflation over time). Income in Montana is taxed according to a graduated rate structure with rates ranging from 2 percent to 11 percent of taxable income; the average rate in 2000 was about 3 percent (Montana Department of Revenue 2001). It is important to note that these sums are already included in the estimates of personal income (income taxes are a transfer of personal income to the state). Thus, estimated income tax revenues from an annual average of 851 jobs at $35,000 would range from $596,000 (2 percent tax rate) to $3.3 million (11 percent tax rate), with a likely amount closer to 894,000 (3 percent tax rate) based on recent history. As discussed above, the project would generate new income tax revenue for the state to the extent that revenue generated by new jobs, for example, exceeds existing tax revenues. The income tax sums are already included in the estimates of personal income.

Property Taxes

See general discussion of property taxes for Alternative A. Only at the time when a given property is improved (i.e., a CBM well or other facilities are developed there) would estimated new property tax revenues be calculated. However, property taxes would accrue to counties roughly in proportion to the number of new wells. Big Horn, Powder River, and Rosebud counties would have the vast majority of new wells; therefore, they would be anticipated to experience the greatest increases in assessed values and the greatest increase in new county property tax revenues. These new revenues could help improve schools, roads, community services, and other county assets, after any new costs associated with CBM are accounted for.

Natural Resources Taxes

Natural resources taxes would be the same as described under Alternative A except based on 18,000 wells.

Other Taxes

Other taxes would be the same as described under Alternative A.

Water Resource Values

See introductory discussion to water resource values under Alternative A. Surface discharge of produced water would be prohibited, and therefore surface water impacts such as erosion and water quality would be avoided. In the absence of surface water impacts, no associated economic impacts to surface water users would occur. Water stored from exploration would provide a benefit to some water users.

The primary impact to groundwater resources is depletion of groundwater in the Powder River Basin watersheds affecting wells and springs.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described above for social and economic values in general for Alternative B. As shown in the RFD, 4,000 wells could be developed on the Crow Reservation. If this entire number of wells were developed, additional economic impacts would occur. Such impacts would generally be in the form of new jobs and employment opportunities, a drawdown in groundwater, and additional personal income and revenues from CBM development and production.

Access, damage payments, royalties, and taxes would be received by Indian allottees, and the Crow Tribe.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this Alternative. The additional wells that could be developed on the Northern Cheyenne Reservation would also total 4,000.

Mitigation

As stated in the *Hydrological Resources* analysis, water well and spring mitigation agreements would facilitate replacement of lost groundwater in most cases. Such agreements and mitigation would reduce potential economic impacts for groundwater users. Despite mitigation, increased electricity costs to users could result from deeper pumping of groundwater. Economic impacts to landowners could occur from coal bed methane, even with mitigation agreements. These include the legal fees borne by landowners, the time and hassle to landowners in reaching the agreement, any litigation from excess damage, monitoring by landowners of development impacts, the degradation of their land beyond compensation, the aesthetic scars left by development in the local area, additional electricity to pump groundwater, and unknown risks of long-term damage to land during and after development.

Conclusion

The primary social impacts identified from Alternative B would be the new jobs created in the emphasis area as a result of development and change from a predominantly rural and agricultural based lifestyle. These new jobs would result in some demographic shifts as a result of people moving to the area. It is anticipated that the impact of added employment and population on social conditions would be small overall but that impacts in the three counties with the most CBM activity could be greater. Impacts would be both positive and negative. Alternative B would result in the generation of new personal and government income. New personal income would include the wages from both direct and indirect jobs created by the project, as well as income from land disturbance payments and mineral leases. Similarly, new local, state, and federal government income would be generated through the variety of means discussed. Over the long term, there is the possibility of a "boom and bust" cycle as CBM activity rises and falls.

As shown in the RFD scenario presented elsewhere in this document, in addition to the 18,300 CBM wells considered for Alternative B, an additional 8,050 CBM wells would be developed in this area in the future: 4,000 on the Northern Cheyenne Reservation, 4,000 on the Crow Reservation, and about 50 wells on USFS land. This number is about 44 percent of those proposed for Alternative B. If this entire number of wells was developed over the same 20-year period as the other 18,300 wells, additional economic impacts would occur. Such impacts would generally be in the form of new jobs and employment opportunities, additional population, additional demands on public services, a drawdown in groundwater, and additional personal income and government revenues from CBM development and production. Potentially large social and economic impacts also would result from other developments proposed for the area, including the Tongue River Railroad and expansion of existing surface coal mines. Economic impacts for the railroad have been addressed previously and are expected to be considerable. The impacts from these other developments would be additive to those identified above for Alternative B.

Alternative C

Employment And Unemployment

Employment and unemployment would be the same as described under Alternative B, except that there would be no additional jobs created from installation of injection wells, which would not be required for this alternative.

Demographics

Demographics would be the same as described under Alternative B.

Social Organization

Housing Units and Vacancy

Housing units and vacancy would be the same as described under Alternative B.

Public Services and Utilities

Public services and utilities would be the same as described under Alternative B.

Attitudes, Beliefs, Lifestyles, and Values

General impacts on population subgroups are the same as for Alternative B.

Impacts on recreation areas would include the loss of land for recreation purposes, and the disruption to recreation activities. Each well would present its own set of unique circumstances that would need to be mitigated to minimize impacts. Exploratory activities such as drilling and testing would temporarily displace game species locally.

Alternative C would allow discharge of untreated water to the land surface. As indicated in the *Hydrology Resources* section, this discharge would result in erosion and water quality impacts. Such impacts would be inconsistent with the desired balance between environmental stewardship and economic development expressed in many of the scoping comments and newspaper reports. The primary reasons for this conclusion include the potentially large scale of this discharge, the potential for degraded water to negatively affect farming and ranching operations (e.g., reduce economic viability), increased noise, loss of natural scenery, and the inconsistency of this approach with the rural lifestyles and values discussed in Chapter 3.

Personal Income

Personal income would be the same as described under Alternative B, with the possible exception of decreases in farming or ranching income as a result of water quality and erosion impacts.

Government Revenues

Government revenues would be the same as described under Alternative B.

Oil and Gas Income

Oil and gas income would be about the same as described under Alternative B. Water treatment costs would be less than for Alternative B due to the allowance of discharge to the land surface (see Water Resource Values below).

Taxes

Income Taxes

Income taxes would be the same as described under Alternative B.

Property Taxes

Property taxes would be the same as described under Alternative B.

Natural Resources Taxes

Natural resources taxes would be the same as described under Alternative B.

Other Taxes

Other taxes would be the same as described under Alternative B.

Water Resource Values

See the discussions for Alternatives A and B. Alternative C would allow discharge of untreated water to the land surface. As indicated in the *Hydrological Resources* section elsewhere in this document, this discharge would result in erosion and water quality impacts. In turn, some downstream surface water users who depend on surface water resources for their livelihood would be affected (for example, if suitable irrigation water were no longer available or if ranch land were lost to erosion). See further discussion under Attitudes, Beliefs, Lifestyles and Values, above. Groundwater impacts would be similar to Alternative B. A difference is that no groundwater would be reinjected as it would for Alternative B, possibly increasing the risk of groundwater drawdown in some locations.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described above for Alternative C.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Mitigation

No mitigation is proposed.

Conclusions

Residual impacts would be similar to those for Alternative B, except for impacts to lifestyles and water resource values, which would be greater for Alternative C than for Alternative B.

Cumulative impacts would be greater than for Alternative B, given the discussion regarding water resource impacts.

Alternative D

Employment and Unemployment

Employment and unemployment would be the same as described for Alternative B.

Demographics

Demographics would be the same as described under Alternative B.

Social Organization

Housing Units and Vacancy

Housing units and vacancy would be the same as described under Alternative B.

Public Services and Utilities

Public services and utilities would be the same as described under Alternative B.

Attitudes, Beliefs, Lifestyles, and Values

General impacts on population subgroups are the same as for Alternative B.

Impacts on recreation areas would include the loss of land for recreation purposes, and the disruption to recreation activities. Each well would present its own set of unique circumstances that would need to be mitigated to minimize impacts. Exploratory activities such as drilling and testing would temporarily displace game species locally.

Treatment of most produced water and discharge via pipeline or other constructed water courses would eliminate most of the erosion and water quality impacts.

Personal Income

Personal income would be the same as described under Alternative B, with the possible exception of decreases in farming area ranching income as a result of water quality and erosion impacts.

Government Revenues

Government revenues would be the same as described under Alternative B.

Oil and Gas Income

Oil and gas income would be the same as described under Alternative B. Water treatment costs would be greater than for Alternative C and much less than for Alternative B.

Taxes

Income Taxes

Income taxes would be the same as described under Alternative B.

Property Taxes

Property taxes would be the same as described under Alternative B.

Natural Resources Taxes

Natural resources taxes would be the same as described under Alternative B.

Other Taxes

Other taxes would be the same as described under Alternative B.

Water Resource Values

See discussion for Alternatives A, B, and C. Most discharge would be treated and carried over land in pipes. Surface water impacts and the potential for resulting economic impacts to surface water users would be less than for Alternative C and greater than for Alternative B. Groundwater impacts would be the same as Alternative D.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described above for Alternative D.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Mitigation

No mitigation is proposed.

Conclusions

Residual impacts would be similar to those for Alternative B, except with respect to impacts on water resource economics and related lifestyle impacts, which would be less than Alternative C but greater than Alternative B.

Cumulative impacts would be less than Alternative C and somewhat greater than Alternative B, given the differences in water resource impacts.

Alternative E (Preferred Alternative)

Employment and Unemployment

Employment and unemployment would be the same as described under Alternative B. It is assumed that the approximate number of additional jobs created from installation of injection wells required for Alternative B would also occur for Alternative E, except that the jobs would be associated with the variety of site-specific produced water management options allowed with that alternative.

Demographics

Demographics would be the same as described under Alternative B.

Social Organization

Housing Units and Vacancy

Housing units and vacancy would be the same as described under Alternative B.

Public Services and Utilities

Public services and utilities would the same as described under Alternative B, except that the oil and gas roads would remain open or be closed at the surface owner's discretion, potentially increasing or decreasing the burden on public jurisdictions to maintain these roads.

Attitudes, Beliefs, Lifestyles, and Values

General impacts on population subgroups would be the same as for Alternative B.

Of the all the alternatives being considered for protection of water resources, Alternative E would likely be seen as the most consistent with the desired balance between environmental stewardship and economic development expressed in the scoping comments.

Personal Income

Personal income would be the same as described under Alternative B.

Government Revenues

Government revenues would be the same as described under Alternative B.

Oil and Gas Income

Oil and gas income would be about the same as described for Alternative B, although water treatment costs could be greater, thus potentially decreasing the net income to producers.

Taxes

Income Taxes

Income taxes would the same as described under Alternative B.

Property Taxes

Property taxes would be the same as described under Alternative B.

Natural Resource Taxes

Natural resource taxes would be the same as described under Alternative B.

Other Taxes

Other taxes would be the same as described under Alternative B.

Water Resource Values

Alternative E would be the most protective of water resources and water resource values of all the alternatives being considered. The activities proposed to prevent the degradation of surface and groundwater resources would substantially prevent erosion and water quality impacts.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described above for Alternative E.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this Alternative.

Mitigation

No mitigation is proposed.

Conclusions

Residual impacts would be similar to those for Alternative B, with the exception of the reduced impacts on lifestyles and values and water resource values that would result from the proposed measures to prevent the degradation of water resources.

Cumulative impacts would be somewhat less than for Alternative B, given the greater degree of prevention and control of unfavorable water resource impacts.

Soils

Assumptions

Surface disturbance assumptions are detailed in the *Analysis Assumptions and Guidelines* section of this chapter. This analysis is focused on the CBM emphasis area, but can be used by inference on similar areas in Montana. A more detailed discussion of soils is presented in the *Soils Technical Report* (ALL 2001a).

Impacts From Management Common to All Alternatives

Impacts on soils would occur from various activities during the exploration, construction, operation, and abandonment of conventional oil and gas wells developed resulting in a loss of either soil resources or soil productivity. These impacts would include soil compaction under disturbed areas such as well sites and lease access roads, soil erosion in disturbed areas, and chemical impacts from spills of liquids. Some impacts would be unavoidable, such as those resulting from the construction of well sites. Other impacts would be mitigated by standard oil field practices, such as the use of berms around production facilities. Short-term impacts would occur typically during construction phases, including reclamation of construction sites.

Soils disturbed by the building of access roads, drill pads, and pipelines would be prone to accelerated erosion because of the removal of protective vegetation and litter cover during construction activities. This protective cover would bind the soil, provide desirable surface texture for infiltration of water and air, and protect the surface from water and wind erosion. Accelerated soil erosion would occur during the production phase in high traffic areas of the well pad or along access roads or in portions of the well pad that have not been properly graded. In areas where soils have high to severe erosion potential and are unstabilized, disturbance would result in accelerated erosion to the extent that damage to facilities and roadways may occur. Wind and water erosion on bare soil surfaces would cause more sedimentation in streams from runoff following rainfall or snowmelt. Impacts would be greatest on shallow soils of low productivity and on soils on moderately sloping to steep landscapes. Project activities would have minimal effect on slope stability because surface disturbance on slopes in excess of 30 percent would be avoided where possible. Where such disturbances cannot be avoided, mitigative measures required by MBOGC and BLM through the APD authorization process would be implemented to reduce erosion and protect watershed resources. Eastern Montana suffers from excessive wind erosion primarily from dry soil, sparse vegetative cover, and erodible soils.

Drilling activity-especially equipment transport-would cause soil compaction. The degree of compaction would be influenced by soil texture, moisture content, organic matter, and soil structure. Soils with a mixture of sand, silt, and clay compacts more than a soil with more uniform particle size. Coarse-textured sandy soils generally would be more compactable than fine-grained soils. Soil moisture would be the most critical factor in compaction. At field capacity, which is the amount of soil moisture remaining after a soil mass is saturated and allowed to drain freely for 24 hours, sufficient water remains in the pores to provide particle-to-particle lubrication and maximum compaction potential under load. Thus, moist but not wet soils would be most susceptible to compaction. Organic matter such as roots and humus would help reduce soil compaction. In general, the greater the organic matter content, the less compaction. Compaction would severely affect plant growth by inhibiting root penetration, limiting oxygen and carbon dioxide exchange between the root zone and the atmosphere, and severely limiting the rate of water infiltration into the soil. Compaction of soils would inhibit reclamation and natural revegetation of disturbed areas. Loss of topsoil and a decrease in soil productivity from soil layer mixing and compaction would impact the natural vegetation supported in the area, which in turn may affect forage and habitat for wildlife and livestock. The use of off-road vehicles and heavy equipment would cause soil compaction, which will lead to increased surface runoff and subsequent erosion. Effects will be most severe when off-road vehicles and heavy equipment are used during moist and wet soils conditions.

With development, the potential for impacts to soil from drilling and produced fluids would increase. Soil contamination from conventional oil and gas development in Montana would result mainly from leaking and improperly reclaimed reserve/brine pits. Produced hydrocarbons and fuel spills would occasionally cause impacts. Spills generally would not be large and the materials would be relatively immobile. Toxic and saline concentrations from the spilled fluids would be capable of sterilizing the soil.

Construction disturbances from conventional oil and gas production would lead to the disturbance of approximately 12,650 acres (9,817.5 acres of BLM lands and 2,832.5 acres of state lands) during the next 20 years. Revegetating parts of the well pads during production would reduce the area of disturbance to

4,600 acres. Most of these acres would be remediated after the hydrocarbons have been produced.

The area would be reclaimed as prescribed by an approved reclamation plan that includes revegetation to reduce soil erosion. Most soil disturbances and related erosion would be mitigated within 20 to 25 years after drilling the well. Exceptions would be sites with severe characteristics (slope and physical and chemical nature of the soils) or sites where saline water spills have occurred. Saline water would have a more persistent and detrimental effect on soil productivity. There would be some loss of soil through erosion as a result of surface disturbance, but this would be minimized with an approved surface use plan.

Additional disturbances would occur from coal mining in the CBM emphasis area, which is estimated at a total of 49,500 acres.

Prime Farmland

If prime farmland exists on federal or state surface where CBM development is proposed, the same type of reclamation plan is developed for it as with all such proposals. A difference would be that more topsoil probably would be available for reclamation purposes on a prime farmland site and would be identified in the reclamation plan prior to development.

If the site proposed for development were private surface, then the reclamation plan would be developed in consultation with and according to the wishes of the private land owner. Most likely, the reclamation plan on Federal versus state and private surface would be very similar.

No prime farmlands are known to exist on the federal surface. Privately-owned prime farmlands over federal and state leases that are impacted by roads or site development would be reclaimed in accordance with consultation with the private surface owner. This situation would be same for all alternatives.

Mitigation

The BLM *Gold Book* (USDI and USDA 1989) describes mitigation measures for well sites constructed over areas of steep topography to protect easily eroded soils. The existing BLM RMP provides for approval of surface occupancy on oil and gas leases on slopes in excess of 30 percent based upon mitigation of soil erosion, surface productivity after remediation, and mitigation of impacts to surface water quality. The *Gold Book* and APD Section A describe mitigation measures to protect riparian zones from exploration and production activity and lease access roads. The *Surface Use Program* section of the APD describes guidance for limiting lease roads and construction to mitigate erosion. 43 CFR Part 3162.5-1, *Environmental Obligations*, describes the requirements for stockpiling surface soil and the remediation of drill sites after well completion. Produced water can be released on the surface or to surface waters with the appropriate permits. The BLM *Seeding Policy* of October 27, 1999, lists guidelines for seeding practices in typical Montana soil types (BLM 1999c). These species are recommended for quick coverage of disturbed and impacted soils to discourage invasion of noxious weeds and attenuate soil erosion. During the leasing process and the site-specific operating plan review for oil and gas operations, TLMD specifies requirements to prevent erosion and destruction of the surface soils. TLMD requires that the surface lessee or surface owner be consulted regarding surface facilities and roads to minimize surface impacts.

Additional mitigating measures applied to federal leases reduce soil erosion and compaction impacts would be as follows:

- Incorporate federal legislation that addresses the protection of soils, including the Clean Water Act of 1972 and the Soil and Water Resources Conservation Act of 1977.
- Separate topsoil from subsurface soil and use the topsoil for reclamation purposes.
- During the production phase, the unused portion of the drill location would have topsoil spread evenly over the surface and reseeded at the recommended ratio per BLM recommended seed mixture.
- Limit construction activities to dry conditions to reduce soil compaction and rutting.
- Use BMPs and design construction to control erosion and sedimentation.
- If porous materials (subsurface) are encountered during the construction of any pit designed to contain fluids, a pit liner would be installed. This liner would prohibit the migration of fluids from the pit.
- Surface soil material should be stockpiled to the side of the routes where cuts and fills or other surface disturbance occurs during pipeline and road construction.
- Minimize stream crossings.

- Promptly revegetate cut-and-fill slopes to control surface erosion by wind and water.
- Maintain and continue erosion control measures and/or features after construction until adequate vegetative cover is re-established.
- Avoid road and well pad construction on slopes greater than 30 percent.
- Remove vegetation only when necessary; any organic matter in the soil helps avoid compaction.
- Subsoil or deep rip when soil is driest (usually late summer or early fall) in order to best remedy compaction prior to reclamation. When compaction is shallow (the result of using large low-pressure tires or tracked vehicles), conventional tillage or scarifying equipment can be used.
- Recontour and revegetate disturbed areas upon completion of construction.
- Construct water bars on slopes of 3:1 or greater. Water bars would be constructed on the contour.

Impacts From Management Specific to Each Alternative

Alternative A

Impacts on soils may occur from various activities during the exploration, construction, operation, and abandonment of CBM wells developed for the project and may result in a loss of either soil resources or soil productivity. The primary concerns include increased soil erosion, loss of topsoil, mixing of soil horizons, compaction, and contamination of soils from various pollutants. These impacts may result in a loss of either soil resources or soil productivity.

Under this alternative, all CBM water on BLM-administered land would be contained or beneficially used at the well site, while all CBM water on private lands would be discharged under the existing MPDES permit into the Tongue River (up to 1,600 gpm), impounded, or used for dust control at on-site coal mines.

Exploration

Under Alternative A for BLM lands, approximately 400 acres would be disturbed for exploratory wells. On state and private lands, approximately 275 acres would be disturbed during exploration. All produced CBM water during exploration will be contained; therefore, there would be no impacts to soils caused by high saline/sodium water applications.

Production

Because there will be no CBM production on BLM lands, there will be no impacts from production. Only state and private lands will have CBM production. During the construction of the well sites, access roads, utilities, and other facilities, 812 acres of soils will be disturbed. Revegetating parts of the well pads during production would reduce the state and private soil disturbances to 500 acres. Production water may be discharged to surface waters in accordance with the existing MPDES Discharge Permit that allows discharge up to the rate of 1,600 gpm into the Tongue River. This small increase in flow volume is not considered sufficient to cause added erosion to stream banks or streambeds. Produced water may also be used beneficially by industry and landowners, or stored in impoundments onsite. If the quality of the water were acceptable (not too high in SAR or salinity), there would be little or no additional impacts to soils from land application. If the quality of land-applied water were detrimental, further mitigation measures would need to be implemented to reduce the impacts to soils (ALL 2001a).

Abandonment

After reclaiming the exploratory wells, there will be 500 acres of soil disturbed long-term-all on state and private lands. The area will be reclaimed as prescribed by an approved reclamation plan including revegetation to reduce soil erosion. Soils would be recovered and erosion eliminated within 20 to 25 years, helped in part by mitigation. Exceptions may be sites with severe characteristics (slope and physical and chemical nature of the soils) or sites where saline water spills have occurred. There may be some irretrievable loss of soil through erosion as a result of surface disturbance, but this can be minimized with a well-developed and approved surface use plan. Soil beneath unlined surface impoundments would also require extensive reclamation because of accumulation of sodium during infiltration of water. The soils structure could be damaged severely, plant growth would be minimal, and accumulation of salt in the soils would likely lead to the soil being removed and disposed.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative A.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described in general for Alternative A.

Mitigation

The mitigation measures would be the same as those discussed in the management common to all alternatives section above. Additional mitigation measures are included in the *Soils Technical Report* (ALL 2001a).

Conclusion

During the next 20 years, disturbances from limited CBM development and exploration, conventional oil and gas development, coal mining, and other projects considered under the cumulative effects analysis would result in the disturbance of about 62,150 acres of soil. These disturbances would be reduced to about 54,100 acres during the production phase of CBM, conventional oil and gas activities, and coal mining. After production ceases and lands used for production and mining are abandoned, most land can be returned to production (excluding permanent roads and facilities). There would be minimal unavoidable, irreversible, and irretrievable impacts to soils. There would be a temporary increase in soil erosion, runoff, and sedimentation, mostly during construction activities. If the qualities of land-applied or impounded waters were acceptable, there would be little or no impacts to soils; but if water quality is detrimental, additional mitigation measures would need to be implemented.

Alternative B

Alternative B considers development of CBM resources, but with an emphasis in protecting soils and other natural and cultural resources. Impacts to soils would be reduced under this alternative by requiring transportation corridors; using a single trench for utilities and piping; using multiple completions per well bore and directional drilling; using temporary tank storage and injection of all produced CBM water; and rehabilitating new roads at the end of the well lifetime. All of these would help to minimize the area of surface disturbances, which would be up to a 35 percent or higher reduction in soil disturbances.

Exploration

Under this alternative, approximately 850 acres of BLM lands would be disturbed for exploratory wells. On state and private lands, approximately 1,000 acres would be disturbed during exploration. All produced CBM water during exploration will be contained; therefore, there would be no impacts to soils caused by high saline/sodium water applications. Losses from exploration would be mostly temporary and would be reclaimed after exploration activities cease.

Production

During the construction of the well sites, access roads, utilities, and other facilities, 16,200 acres of BLM soils and 18,900 acres of state and private soils will be disturbed. Revegetating parts of the well pads during production would reduce the BLM soil disturbances to 8,600 acres and state and private soil disturbances to 8,850 acres. Production water will be injected; therefore, no impacts will be made to soils from CBM waters.

Abandonment

Reclaiming all of the exploratory wells would provide vegetation cover to 1,850 acres of disturbed soils. Additional reclamation activities at the production wells and utility ROWs would further establish vegetation cover to these previously disturbed soils. The disturbed areas would be reclaimed as prescribed by an approved reclamation plan including revegetation to reduce soil erosion. Soils would be recovered and erosion halted within 20 to 25 years, helped in part by mitigation. Exceptions may be sites with severe characteristics (slope and physical and chemical nature of the soils). There may be some irretrievable loss of soil through erosion as a result of surface disturbance, but this can be minimized with a well-developed and approved surface use plan.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative B. If there were no CBM development on Tribal Lands, then there are expected to be minimal, if any, impacts on soils on the reservation. If there is CBM development on the reservation, then disturbed soil areas could be inferred to the reservation using the same approach used in this section.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow reservation under this alternative.

Mitigation

The mitigation measures would be the same as those discussed in the *Impacts From Management Common To All Alternatives* section above. Additional mitigation measures are included in the *Soils Technical Report* (ALL 2001a).

Conclusion

During the next 20 years, disturbances from CBM development, conventional oil and gas development, coal mining, and other projects considered under the cumulative effects analysis would result in the disturbance of about 115,760 acres of soil. These disturbances would be reduced to about 87,090 acres during the production phase of CBM, conventional oil and gas activities, and coal mining. After production ceases and lands used for production and mining are abandoned, most land can be returned to production (excluding permanent roads and facilities). There would be minimal unavoidable, irreversible and irretrievable impacts to soils. There would be a temporary increase in soil erosion, runoff, and sedimentation, mostly during construction activities.

Alternative C

Under this alternative, impacts on soils would be similar to Alternative B with the following exceptions:

- Untreated CBM discharge water could be used for land application
- The discharge of produced water to the ground surface would increase erosion
- There would not be a 35 percent reduction in impacted soils due to specific management practices for transportation routes

The long-term impacts of using CBM water or diluted discharge water for agricultural purposes include crop effects, farming practice changes, irrigation management, and direct effects to soils. Based on the generally fine texture of the surface soils (clayey) in the emphasis area, much of the soil would likely be susceptible to increasing sodicity when irrigated or land applied with water having a high SAR (generally greater than 3 for some soils and greater than 12 for others). If sodic water is applied to these soils, the probability of soil dispersion (deflocculation) is high, causing infiltration and drainage decreases. The long-term consequence is an anaerobic, waterlogged, saline/sodic soil, which would be difficult to reclaim. Those soils with a coarser texture (sandy to loamy) and good internal drainage will be the least susceptible to increasing sodicity and salinity. Dispersed soil would also be subject to accelerated erosion leading to gullying, increased sedimentation, and harm to riparian vegetation and aquatic habitats. The native species composition in these effected areas also will change. CBM water discharge will have the cumulative effect of encouraging the establishment and proliferation of non-native and noxious weed species. As noted in the *Soils Technical Report* (ALL 2001a), there are fewer irrigated than non-irrigated acres along the Tongue and Powder Rivers, which, based on the RFD, is where a majority of the potential CBM activity would reside. However, if adequate water and suitable agricultural soils were available in areas adjacent to production, more irrigated land would be available for production and use. The use of high salinity/sodium CBM water may have long-term effects on crops, limiting crops to those that are more salt tolerant. Additional irrigation water would be required for leaching to ensure salts are moved out of the root zone. Increasing the frequency of irrigation may also need to be implemented to maintain soil water content and to decrease the effects of applying saline water (lower water-holding capacity and higher salinity levels). These increases in irrigation water amounts would lead to producers having to file for additional water rights or finding other sources of lower salinity water for leaching, as well as a potential for more saline seeps in areas irrigated with CBM water. The *Soils Technical Report* (ALL 2001a) discusses the impacts of discharging CBM waters to soils in more detail.

Exploration

Under this alternative, impacts on soils would be similar to Alternative B, except water generated by testing CBM wells could be discharged to surface waters and the land surface-with impacts as discussed above.

Production

Under this alternative, impacts on soils would be similar to Alternative B, except untreated water generated during production could be discharged to surface water with appropriate permits and to the land surface at the well pad. Impacts of land application of CBM waters are discussed above.

Abandonment

Under this alternative, impacts on soils would be similar to Alternative B. Roads would be rehabilitated and closed. The use of unlined impoundments would have impacts similar to those mentioned in Alternative A.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative C.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow reservation under this alternative.

Mitigation

The mitigation measures would be the same as those discussed in the *Impacts From Management Common To All Alternatives* section above. Additional mitigation measures for land applications of CBM waters are included in the *Soils Technical Report* (ALL 2001a), and include soil amendments for sodic soils, irrigation scheduling and leaching, and plant/crop selection.

Conclusion

Cumulative impacts would be similar to Alternative B, except that the surface disturbances would not be able to be decreased by up to 35 percent and surface discharge and irrigation of produced water would increase detrimental impacts to soils. Saline water has a more persistent and detrimental effect on soil productivity, especially when immediate mitigative measures are not followed for cleanup. One advantageous side effect would be that more water would be available for irrigation if acceptable agricultural land is available, but if acceptable qualities of water are not used, there could be an increased detrimental impact on additional soils.

Alternative D

Under this alternative, impacts on soils would be similar to Alternative B except that produced water would be treated prior to discharge onto the surface or for irrigation, and not injected, which would reduce the detrimental impacts caused by application of high-SAR water to soils.

Exploration

Under this alternative, impacts on soils would be similar to Alternative B, except that water generated by testing CBM wells would be treated prior to discharge to surface waters and the land surface (instead of injection), which lessens the impacts caused by application of high-SAR water to soils.

Production

Under this alternative, impacts on soils would be similar to Alternative B, except water generated during production would be treated prior to discharge to the land surface and to surface water-with appropriate permits. Impacts of the land application of CBM waters are discussed above.

Abandonment

Under this alternative, impacts on soils would be similar to Alternative B. Roads would remain open or closed at surface owner's discretion. The use of unlined impoundments would have impacts similar to those mentioned in Alternative A.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative D.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow reservation under this alternative.

Mitigation

The mitigation measures would be the same as those discussed in the Impacts From Management Common To All Alternatives section above. Additional mitigation measures for land applications of CBM waters are included in the *Soils Technical Report* (ALL 2001a).

Conclusion

Cumulative impacts would be similar to Alternative B with the exception that produced water would be treated prior to discharge onto the surface and not injected, which would reduce the detrimental impacts caused by application of high-SAR water to soils.

Alternative E (Preferred Alternative)

Under this alternative, impacts on soils would be similar to Alternative B except that produced water would be managed per a site-specific Water Management Plan with first priority being beneficial use of produced water; impoundments designed to minimize or mitigated impacts to soil, water and vegetation; an option for injection of CBM water; and no degradation of a watershed. All of these factors would reduce the detrimental impacts caused by application of high-SAR water to soils. There would also not be a 35 percent reduction in impacted soils because of specific management practices for transportation routes-this percent will vary depending on site-specific Project Plans for ROWs agreed upon with the surface owners.

Exploration

Under this alternative, impacts on soils would be similar to Alternative B, except that water generated by testing CBM wells would not be allowed to degrade the watershed, which lessens the impacts caused by application of high-SAR water to soils.

Production

Under this alternative, impacts on soils would be similar to Alternative B, except water generated during production would be beneficially used, stored in impoundments, or discharged without impacts to the watershed. Impacts of the land application of CBM waters are discussed above.

Abandonment

Under this alternative, impacts on soils would be similar to Alternative B. Roads would remain open or

closed at surface owner's discretion. The use of unlined impoundments would have impacts similar to those mentioned in Alternative A.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative E.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow reservation under this alternative.

Mitigation

The mitigation measures would be the same as those discussed in the *Impacts From Management Common To All Alternatives* section above. Additional mitigation measures for land applications of CBM waters are included in the *Soils Technical Report* (ALL 2001a).

Conclusion

Cumulative impacts would be similar to Alternative B with the exception that produced water would be managed per a site-specific Water Management Plan that would be geared toward minimizing impacts to soil, water and vegetation, and surface owners would have more input in the Project Plan for the transportation corridors.

Solid and Hazardous Waste

Assumptions

All wastes generated by oil and gas including CBM that are Resource Conservation and Recovery Act of 1976 (RCRA)-classified wastes, such as paint wastes or RCRA-exempt wastes such as drilling wastes, would be disposed of in accordance with regulations. Any release of a hazardous material would be reported in a timely manner to the relevant agency or to the BLM via a Report of Undesirable Event (NTL-3A). Any release of a CERCLA substance would be reported in accordance with regulations.

Impacts From Management Common to All Alternatives

Typical solid waste refuse would be generated by oil and gas drilling and can be disposed of in local landfills. The largest volume of waste generated from drilling activities would be from the drilling mud and cuttings generated. These drilling wastes would be exempt from RCRA and are considered non-hazardous. Drilling mud containing less than 15,000 mg/l TDS can be disposed of on-site with the landowner's permission. The amount of waste generated should not exasperate the landfills in the area. Other impacts would result from spills of waste during maintenance activities, including waste oil from generators, paint waste from construction activities and other solid wastes from construction activities. Impacts would also occur from the use of pesticides and herbicides during access and construction activities.

Mitigation

The mitigation of solid and hazardous waste includes the disposal of all wastes according to federal and state regulations. Other mitigation activities would include a leak detection or monitoring system for hydraulic and lubricating systems, and drilling mud retention ponds. The mitigation of accidental spills and releases would involve the clean up and reporting of all spills in accordance with an approved Spill Prevention Control and Countermeasures Plan.

Impacts From Management Specific to Each Alternative

Alternative A

Impacts from Alternative A would be similar to the impacts described in the *Impacts From Management Common to All Alternatives* section above. The solid and hazardous waste generated during CBM exploration, production, and abandonment would be similar to conventional oil and gas. The drilling muds would be of lesser quantity because of the shallow drilling depths for CBM wells compared to conventional oil and gas.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative A. If there were no CBM development on Tribal Lands, then there is expected to be minimal, if any, impacts from solid and hazardous waste on the reservation. However, regulations followed by the tribe would fall under the jurisdiction of the EPA and Tribal Laws.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Conclusion

The cumulative impacts of this alternative would include the solid and hazardous waste generated from conventional oil and gas, the proposed Tongue River Railroad, surface mining activities, and CBM development. These other activities would result in increased production of both solid and hazardous waste that occur as part of general operation activities. Mitigation would be the same as management common to all alternatives.

Alternative B

The impacts from this alternative would be similar to the impacts under Alternative A. However, CBM development would result in larger quantities of solid and hazardous waste production.

Conclusion

The cumulative impacts from this alternative would be similar to Alternative A. However, the development of CBM, including the potential development of CBM on Indian reservations and USFS lands, would increase the volume of solid and hazardous waste generated. The increased volume of solid and hazardous wastes would result in local landfills reaching capacity sooner, while additional trucks used for hauling waste would increase traffic and air emissions, and would generate the need for the construction of new landfills-which would further disturb lands.

Mitigation activities would be similar to those described in the *Impacts From Management Common to All Alternatives* section above.

Alternative C

The impacts under Alternative C would be the same as for Alternative B.

Alternative D

The impacts under Alternative D would be the same as for Alternative B.

Alternative E (Preferred Alternative)

The impacts under Alternative E would be the same as for Alternative B.

Ute ladies-tresses orchid, *Spiranthes diluvialis*

Vegetation

Assumptions

The Miles City BLM *Seeding* Policy, dated October 27, 1999(c), lists guidelines for seeding practices by typical Montana soil types; it is assumed this policy will be implemented where appropriate. Recommended species are identified for quick coverage of disturbed soils, to discourage invasion of noxious weeds, and to attenuate soil erosion. Reclamation work will be considered complete when the disturbed area is stabilized, soil erosion is controlled, and at least 60 percent of the disturbed surface is covered with the prescribed vegetation.

Under all alternatives, most riparian areas and certain wildlife habitats (see the *Wildlife* section) are protected from direct impact under current stipulations on BLM land that restrict surface occupancy but not road crossings (BLM 1994).

Surveys to determine the presence of federally listed species would occur on BLM-managed land or mineral estate. The APD requires that BLM determine if the proposed development plan would affect any species listed as threatened or endangered.

Formal consultation with the FWS would occur for site-specific federal CBM projects developed under this EIS if a federally listed threatened and endangered (T&E) species or candidate or proposed species may be affected. Section 7(a) of the ESA requires that federal actions "are not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or undesirable modification of its habitat." BLM policy for proposed and candidate species is to avoid actions that would jeopardize a species and require formal listing under the ESA.

Special management attention is given by state and federal agencies to state, BLM, and USFS Species of Concern. Agencies approve actions to avoid areas that would jeopardize a species and thereby require federal protection in the future.

The MBOGC environmental review includes an assessment of potential impacts to vegetation during construction and drilling operations. MBOGC policies require the operators to minimize the size of drilling pads and require complete restoration of the area once operations are complete (ARM 36.22). Mitigation plans are included with the environmental review to notify operators of requirements prior to construction.

For Federal actions, FWS is required to give Federal agencies consultation. They do not have this same requirement for state agencies. Even if a state agency requests a consultation, the FWS does not have the authority to do it. If a state or private CBM project triggers a federally related action, the FWS would need to be consulted for federally protected species, by the Federal agency.

The FWS would be consulted under Section 10 of the ESA if a federally related action is triggered.

On BLM lands, where specific stipulations do not exist or do not currently apply, there is a presumption that impacts on T&E plant species would be avoided through development and observation of specific conservation measures developed through consultation with FWS intended to avoid impacts on T & E species as required under the ESA.

Impacts on T&E plants on non-federal lands are less likely to be avoided through conservation measures because they are not protected.

Species of concern on all lands would likely receive a relatively high degree of protection at a metapopulation scale because federal and state agencies are committed to avoiding measures that would require listing protection under ESA. However, this would likely not protect all individuals or perhaps some populations within a metapopulation.

Field clearances and other required pre-exploration activities developed through this EIS process, and which are intended to identify site-specific occurrence of T&E species, would be conducted as specified, leading to knowledge of specific resources and implementation of appropriate avoidance actions and conservation measures discussed above.

Federal and state agency monitoring of exploration, development, and production activities are assumed to be adequate to ensure all lease conditions and ESA requirements are followed.

Preventing the spread of noxious weeds is easier, more successful, and less costly and time-consuming than reclamation or mitigation. Stipulations for current exploration authorizations within the Billings and Powder River RMP areas cover weed management and riparian/wetland management (BLM 1995). Under these stipulations, all categories of noxious weeds must be managed.

Policies for containment of noxious weeds on state lands are listed in the *Minerals Appendix*, Table MIN-5.

The BLM has co-developed an action plan for weed containment and eradication practices that will be implemented for all alternatives (BLM 1996). Pertinent sections of Appendix 3 from that document are reproduced in Table 4-12. The action plan applies to the State of Montana's list of weed species of concern (see Table VEG-7, *Vegetation Appendix*). This list includes species that are considered to be highly invasive and disruptive to natural systems. It is assumed that these weed-prevention activities will be required for CBM exploratory and production sites, roadways, pipelines, utility corridors, and other disturbed sites on BLM land except as specifically noted for some of the alternatives.

Impacts From Management Common to All Alternatives

Construction of facilities and roads would cause the primary effects on vegetation. For a developed well, a site about 40 percent of the original drill site would remain disturbed for the life of the well (20 years). However, unsuccessful exploratory sites would be reclaimed. Reclamation generally includes spreading topsoil and reseeding according to the landowner's request (private land) or the BLM *Seeding Policy*.

TABLE 4-12
EXAMPLE: PARTIAL DISTRICT-WIDE WEED PREVENTION SCHEDULE

Prevention Activity	When	Who Is Responsible
Clean off-road equipment with powerwash or high-pressure to remove all mud, dirt, and plant parts before moving into relatively weed-free areas.	All Year	Equipment Operators; Fire Crew
Re-establish vegetation on all disturbed soil from construction, reconstruction, and maintenance activities.	Spring/Fall	Project Proponent
Inspect gravel pits and fill sources to identify weed-free sources. Gravel and fill to be used in relatively weed-free areas must come from weed-free sources.	Spring/Summer	Surface Protection Specialist; Equipment Operator
Retain bonds (for mineral activity) for weed control until the site is returned to desired vegetative conditions.	All Year	Mineral Specialist
Include weed-risk considerations for environmental analysis for habitat improvement projects.	All Year	Wildlife Biologist
Provide weed identification training for field-going employees and managers.	Winter/Summer	Weed Coordinator
Distribute public information/brochures.	Spring/Summer	Public Affairs Officer
Include weed risk factors and weed prevention considerations in Resource Advisor (Environmental Specialist) duties on all Incident Overhead Teams and Fire Rehabilitation Teams.	Summer	Resource Advisor

Note: Revised from BLM 1996.

Small areas of vegetation would be lost to roads and drill sites for each well. Dust and vehicle emissions could reduce growth of vegetation adjacent to roads and drill sites. If disturbed areas are prepared and seeded properly, reclamation may further reduce the effects of dust. The effects of drilling on vegetation would be of particular concern under the following circumstances:

- When drill sites or roads are located within or cross riparian areas, wooded drainages, or wetlands
- Where drill sites or roads would cause sedimentation or channel down-cutting in riparian areas
- When drill sites or roads would be in areas that contain populations of special status plants
- Where operations could spread or encourage the growth of weeds
- In case of reserve pit leakage
- In the event of blowouts or wildfire

Drilling sometimes may occur in or near areas that support riparian vegetation or special status plants. If located in or at the head of drainages, drill sites and access roads can add sediment to streams and wetlands. Channel degradation can also occur. Heavy sediment loads or severe degradation would affect riparian vegetation. Roads and facilities are supposed to avoid sensitive areas "to the extent practicable." Therefore many, but not all, sensitive areas such as riparian areas and wetlands would be avoided.

Soil disturbance associated with drilling can cause weeds to spread. Of even greater concern is the long-distance transport of certain weed species by drilling equipment and vehicles. Weed spread is reduced if disturbed areas are re-vegetated during the season of disturbance or the next growing season as recommended (Table 4-12). All well drilling operations are covered by the County Noxious Weed Control Act, which holds landowners responsible for weed control. The contribution of oil and gas drilling to weed spread is comparable to other types of construction.

Because of the legal restrictions placed on the harm or take of federally listed species, direct impacts to these listed species would not occur on federal land. Indirect impacts to federally listed species such as habitat destruction will be addressed on a species-by-species basis. Federally listed plant species on non-federal land ownership may be impacted through conventional oil and gas activities because threatened and endangered plants on private lands are not covered by the ESA.

Mitigation

Site clearance surveys would be conducted prior to disturbance. Where necessary, operator plans would be adjusted as appropriate to avoid impacts to federally listed species or species of concern for the state.

During TLMD field reviews of site-specific oil and gas wells on TLMD lands, any species with special status are noted. The TLMD would coordinate with the Montana Fish, Wildlife and Parks (MFWP) to address management considerations.

Conclusions

There would be no impact on federal land to federally listed species. There may be impacts to federally listed plants on non-federal land and to other species of concern.

Impacts From Management Specific to Each Alternative

Alternative A

Previous authorizations have allowed selected CBM exploration in the Powder River and Billings RMP areas as well as selected well development and exploration on state lands.

Disturbance to vegetation is of concern because wildlife habitat and livestock production capabilities may be diminished or lost over the long-term through direct loss of vegetation (including direct loss of both plant communities and specific plant species). Indirect impacts, such as noxious weed invasion, erosion, reduced plant species diversity following reclamation, or lack of successful reclamation, could also cause vegetation loss. Under the No Action Alternative, only riparian habitat types and certain wildlife habitats (see *Wildlife* section) are protected under current stipulations (BLM 1995).

Direct impacts on vegetation would occur during land-disturbing activities associated with installation of exploratory or development CBM wells that remove vegetation to construct a facility (e.g., roads, drilling pads, mud pits, etc.). All direct impacts from exploratory wells are for the life of the well, then rehabilitated. Both temporary and permanent impacts would occur with installation of development wells.

DNRC uses buffer stipulations, and the no-surface-occupancy of navigable riverbeds and related acreage stipulation on its oil and gas leases for protection of riparian habitat. The remaining four habitat types (grassland, shrubland, forest land, and barren land) may be affected in varying amounts by the existing authorizations for exploration and development. Table 4-13 summarizes the acreage that could be potentially impacted in the two RMP areas and the three counties under state-permitting jurisdiction.

Vegetation types to be potentially impacted were determined based on the extent of each vegetation type overlying coal beds. Impacts to specific vegetation types were assigned in proportion to their total acreage within an ownership (see Table 4-13). For example, there are 1,537,000 acres of grassland in the Powder River RMP area or 40 percent of the total area. Assuming that 200 acres would be permanently disturbed in the Powder River RMP area, 80 acres (40 percent) of permanent, direct impacts would be expected to occur in grassland. If natural communities from Table 4-14 are considered, grasslands would be expected to experience the largest permanent loss (580 acres), based on occurrence. Shrubland would be the next most permanently impacted habitat (174 acres), followed by forest land (114 acres), barren land (46 acres), and riparian habitat (56 acres). Of the 56 permanently impacted riparian acres, 20 are on BLM land, and most are protected by stipulation during exploration.

Indirect impacts may be as important as direct impacts for plants and habitats. As noted earlier, indirect impacts would include the effects of erosion, changes in wildlife and livestock distribution, unsuccessful reclamation, riparian community changes, and the spread of noxious weeds.

Erosion from roads and drilling sites can indirectly affect vegetation from high runoff velocities scouring the plants from the site or by sediment burying the plants. The extent of this potential impact would be determined by the effectiveness of erosion-control measures and the level of enforcement of stormwater management plans. Plant community impacts would be in the same proportions as discussed under direct impacts. The basis of this analysis is formed from the assumption that installation of erosion-control procedures and effective enforcement of stormwater management plans would occur. Implementation of erosion-control measures and stormwater management plans would result in no long-term impacts from erosion. Short-term impacts are still likely to occur from thunderstorm during first year and roadbeds active for 20 years.

A total of 250 acres may be reclaimed following temporary disturbance at state-permitted wells. Failure to adequately restore these acres to pre-disturbance conditions would result in a loss of native habitat. Present seeding mixes do not adequately restore shrub or forest sites because they do not include species other than grass. When shrub and forest sites are impacted, there would be a loss of structure and diversity of vegetation using the current seeding mix. If reseeding is successful, it would potentially reduce noxious weed invasion, erosion, and dust through restoration of plant cover.

TABLE 4-13
AMOUNT OF ACREAGE WITH UNDERLYING COAL BEDS IN EACH HABITAT TYPE (BY RMP AREA AND STATE LAND)[1]

Area	Grassland	Shrubland	Forest Land	Barren Land	Riparian	Agricultural or Other Land Not Included as Native Vegetation
Powder River RMP area	1,537,000 (40%)	920,000 (24%)	897,000 (23%)	210,000 (5%)	180,0002 (5%)	136,685 (4%)
Billings RMP area	1,022,000 (40%)	735,000 (29%)	372,000 (15%)	87,000 (3%)	105,0002 (4%)	206,287 (8%)
State-permitted land in Blaine, Gallatin, and Park counties	990,000 (56%)	152,000 (9%)	89,000 (5%)	75,000 (4%)	93,000 (5%)	359,151 (20%)

[1]Figure in parentheses indicates percentage of total acreage within the RMP area and state-permitted land.

[2]These acres are exempt from CBM development as a result of stipulations that omit this type from consideration for CBM exploration and development; they may be affected by water pollution and increased salinity.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative A. If there were no CBM development on Tribal Lands, then there is expected to be minimal, impacts on vegetation for the reservation. The majority of impacts would be invasion of noxious weeds brought in by increased traffic on county and state roads leading to the scattered CBM exploration and development areas forecast under Alternative A.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Mitigation

The area of disturbance would be minimized to the extent practicable to reduce the area of direct impact to vegetation. All areas temporarily impacted would be reclaimed as soon as possible following disturbance (see Table 4-12). Abandoned well locations on BLM land or on the federal mineral estate would be reclaimed as per existing BLM permitting guidelines.

Mitigation measures are listed in Table MIN-5 of the *Minerals Appendix*. Erosion-control measures would be approved by BLM or the state to prevent impacts to native plant communities from erosion. Erosion-control measures would be inspected to ensure compliance.

Issuance of MPDES permits for discharge of produced water from state-permitted wells is required to protect riparian vegetation. Strict adherence to the BLM riparian protection stipulation would protect riparian areas from impacts during exploration and production.

The MBOGC environmental review includes an assessment of potential impacts on vegetation during construction and drilling operations. MBOGC policies require the operators to minimize the size of the drilling pads and require complete restoration of the area once operations are complete (Administrative Rules of Montana [ARM] 36.22). Mitigation plans are included with the environmental review to notify operators of requirements prior to construction. The Montana Department of Agriculture (MDA) regulates vegetative issues under all alternatives through the requirements in the County Noxious Weed Control Act (7-22-2201 to 2153, MCA). This act requires the re-vegetation of disturbed areas with a cover of beneficial plants. The revegetation plan must be approved by the local district weed board and must include weed-management procedures. The MBOGC requires operators to comply with the County Noxious Weed Control Act when reclaiming disturbed areas.

Under all alternatives, the TLMD requires the revegetation of any area of an oil and gas pad site not being used after drilling has been completed. Sites are typically seeded back to native grass species. Some areas on the pad and road may be devoid of vegetation and have gravel or scoria placed on the surface as long as the well is in production. The road and pad site would be re-claimed if the well is taken out of production.

The BLM has developed weed management guidelines that follow the Management Requirement Best Known Practices Prototype developed by the USFS (USDA 1991) for weed prevention during road building and mineral exploration. The BLM Integrated Weed Management Guidelines and the state regulations concerning control of noxious weeds would be implemented for noxious weed containment and suppression. Conservation measures would be implemented to ensure that as little native vegetation is disturbed as possible, as little recruitment of noxious weeds as possible occurs, and that all types of disturbance are revegetated as quickly as possible. Noxious weed control measures include removal of the plants by pulling, biological, or chemical means, or by destroying seed heads; by cleaning mud and plant debris from drilling and construction equipment before moving to a new site; or by revegetating disturbed sites quickly. In some instances, early successional plants that can hold the site for natural succession or until further restoration is put into place may be necessary to prevent the spread of noxious weeds.

Under all alternatives, operators on state land managed by TLMD are required to monitor mineral leases for noxious weeds and control any weeds that may be introduced. TLMD may place special restrictions on the lease in areas with serious noxious weed concerns or where introduction of noxious weeds would make control difficult. On state lands leased by the TLMD, they may require power-washing of all vehicles coming onto the site to prevent the introduction of noxious weeds.

User-created roads would result in additional loss of vegetation and increased potential spread of noxious weeds (USDI and USDA 2001).

State Species Of Concern

Where released production water increases flows in reaches dewatered from other activities, habitat for the orchid would be improved. Surveys will be conducted in riparian areas that would be affected by production water release. If a state or private CBM project triggers a federally related action, the FWS would need to be consulted for federally protected species, by the Federal agency.

Direct and indirect impacts on other species of concern would be expected to some degree.

Conclusions

Up to 1,105 acres of native vegetation (excluding up to 20 riparian acres on BLM land) would be lost through CBM exploration activities and an additional 250 acres would be temporarily disturbed. Unspecified grazing impacts to native vegetation would occur if displaced animals concentrate in certain areas. Shrub, forested, and barren lands would not be restored using existing recommended seed mixes and some reclamation efforts may fail. Strict adherence to reclamation policies would result in no impact to vegetation from noxious weed infestations. However, these guidelines and regulations have been in place for many years and weeds continue to spread across central and eastern Montana. Therefore, some further infestations of noxious weeds would be expected. User-created roads would result in additional loss of vegetation and increased potential spread of noxious weeds (USDI and USDA 2001). No impacts on the Ute ladies'-tress would be expected.

Cumulative impacts may occur from coal mining operations. Coal mining occurs within the same area covered by this EIS. Vegetation will be destroyed within the disturbed area of a coal mine. As the mine area is reclaimed, topsoil is redeposited and reseeded to reestablish vegetation. Reseeding during reclamation activities will generally result in an increase in grasslands with less plant diversity than was present under pre-mining conditions.

Construction of the Tongue River Railroad from Miles City to Decker, Montana, would cross 17 tracts of BLM land containing 4,357 total acres and would require 264 of these acres as easement, contributing to cumulative effects when combined with CBM development. A total of 910 acres would be used for construction purposes. This land would have vegetation removed or damaged, and this area is a potential source of noxious weed expansion.

About 92 percent of the coal volume located in the Powder River basin occurs within Wyoming (Ellis et al. 1999) and as many as 50,000 CBM wells may be developed in the Wyoming portion of the basin. The direct and indirect effects of Wyoming CBM development would far surpass the effects of CBM development in Montana under Alternative A because of so many wells. Rivers entering Montana from Wyoming would be expected to have substantially higher flows and degraded quality, resulting in potentially substantial erosion of wetland and riparian communities and habitat degradation from higher SAR levels.

ESA provisions applied to other projects should avoid cumulative impacts to T&E wildlife species when considered in conjunction with CBM exploration and development.

Alternative B

As listed under Alternative A, four habitat types (grassland, shrubland, forest land, and barren land) will be affected in varying amounts depending on the alternative and the amount of habitat with underlying coal beds. Well development is estimated at 18,300 wells in the RFD. If these wells are distributed evenly over habitats by the proportion of habitats with bituminous coal beds, a total of approximately 59,475 acres would be directly impacted. Approximately 26,962 acres of grassland vegetation, 12,292 acres of shrubland, 8,525 acres of forest land, and 2,379 acres of barren land could be potentially impacted, if wells were distributed in proportion to the amount of acres in each habitat type. Direct impacts to riparian areas are similar to Alternative A.

Table 4-15 estimates the acres of direct impact for each action alternative based on information in Chapter 2. Direct vegetation loss by habitat type is assumed to be proportional to the relative amount of each habitat type shown in Table 4-14.

As discussed in the *Wildlife* section, water production and roads can alter the distribution of wildlife and livestock. As wildlife or livestock use is concentrated due to those factors, plant communities can be altered through overgrazing. Overgrazing tends to favor establishment and reproduction of annual and invasive plant species. These species tend to displace native plant assemblages. To the extent grazing animals concentrate in smaller areas, plant communities would change to less diverse, introduced plant communities. Most county weed control efforts focus on herbicide spraying, which reduces plant diversity even more.

Indirect effects include changes in wildlife and livestock distribution patterns as a result of machinery disturbance or removal of habitat.

TABLE 4-14
ACREAGE POTENTIALLY IMPACTED IN EACH HABITAT TYPE
(BY RMP AREA AND STATE-PERMITTED LAND)

Area	Grassland		Shrubland		Forest Land		Barren Land		Riparian		Other Areas	
	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary
Powder River RMP	80	0	48	0	46	0	10	0	10	0	8	
Billings RMP	80	0	58	0	30	0	6	0	8	0	16	
State-permitted Lands	420	140	68	23	38	13	30	10	38	13	150	50
Total*	**580**	**140**	**174**	**23**	**114**	**13**	**46**	**10**	**56**	**13**	**174**	**50**

*These estimates were arrived at using GIS data. Sweet Grass and Carter counties did not have enough bituminous coal beds to show up on those layers, therefore CBM well data for those two counties are not included in these estimates. The total acres of impact using GIS data are 1,393 acres. Total real impacts for all counties are estimated to be 1,488 acres.

CBM exploration activities could result in the recruitment of noxious weeds by disturbing present vegetative cover, compacting soil, exposing mineral soil to seed fall, and aiding the migration of seeds through movement of vehicles and drilling equipment from site to site. Noxious weeds can indirectly impact native vegetation by out-competing native plants for scarce nutrient, light, and water resources, thereby displacing the native species. Sites with the greatest potential for noxious weed invasion, erosion, or difficulty in restoring to pre-disturbance vegetation are generally sites with pre-existing weed problems or drier sites, such as those designated as barren land. Noxious weeds introduced into a forest environment would be very difficult to control because of access restrictions when weeds spread into deep drainages and timbered hills where chemical control would be difficult. Control of noxious weeds is addressed under current BLM stipulations or state law. The increase in the number and potential for spread of noxious weeds with disturbance is an important consideration even at the current level of exploration and development. This concern is related to other indirect impacts, such as lack of successful reclamation and erosion.

Species of concern include federally listed T&E, and candidate species; Montana species of concern; BLM species of concern, USFS species of concern, and Montana Natural Heritage Program (MNHP) species of concern. For the state, this document addresses only those listed as category S1, which are species of extreme rarity or species for which some factor of its biology makes it especially vulnerable to extinction. The *Vegetation Appendix*, Table VEG-6 describes and lists all special-status species.

As discussed in the *Species of Concern* section of Chapter 3 in this EIS, there is one federally listed threatened plant species. In accordance with the ESA, this species and its habitat must be protected from possible impact by oil and gas and CBM development on federal land, but not on state or private land. Additionally, 69 species are classified as "species of special concern" by the Montana BLM, USFS, and MNHP. By policy, BLM management cannot impact these species in a way that may cause further declines in the species' population status. This section will address federally listed plant species protected under the ESA.

Species of Concern: Federally Protected

Ute Ladies'-Tresses Orchid

This species is only known to occur in the southwestern part of the state. No development is planned for that part of the state, therefore impacts are not expected to known populations of this orchid from CBM exploration or development.

TABLE 4-15
ACRES OF LAND AND LENGTH OF ROADS AND UTILITY CORRIDORS DIRECTLY IMPACTED BY CBM CONSTRUCTION

	Alternative			
	B	**C**	**D**	**E**
Area disturbed per well[1]	3.25 acres	4.14 acres	3.25 acres	4.14 acres
Length of roads per well	0.237 miles	0.365 miles	0.237 miles	0.365 miles
Length of utility corridor per well	0.734 miles	1.13 miles	0.734 miles	1.13 miles
Number of wells	18,300	18,300	18,300	18,300
Total area directly disturbed	59,475 acres	75,762 acres	59,475 acres	75,762 acres
Length of CBM roads per square mile[2]	2.9 to 8.8 miles	3.9 to 11.9 miles	2.9 to 8.8 miles	3.9 to 11.9 miles
Total length of CBM roads	6,680 miles	9,018 miles	6,680 miles	9,018 miles
Length of pipeline and utility corridors per square mile[2]	9.04 to 27.12 miles	12.2 to 36.61 miles	9.04 to 27.12 miles	12.2 to 36.61 miles
Total length of pipeline and utility corridors	20,679 miles	27,917 miles	20,679 miles	27,917 miles

[1]The land area disturbed and the length of roads and corridors would be 35 percent greater for Alternative C than for Alternatives B and D because transportation corridors and the use of existing disturbed lands would not be required for roads and utilities under Alternatives B and D.

[2]Length of roads, pipelines, and utility corridors per square mile covers the range of 8 to 24 wells per square mile of land overlying 1 to 3 coal seams, respectively. At an average of 8 wells per square mile, 2,287 square miles would be impacted by intensive CBM development. At 24 wells per square mile, 762 square miles would be impacted by intensive CBM development. Additional wildlife habitat surrounding well fields would be indirectly impacted by human activities and presence.

When disturbance removes vegetative cover from soil, it is open to erosion from wind and water. Erosion from roads and drilling sites can indirectly affect vegetation from high runoff velocities scouring plants from the site or by sediment burying the plants. The extent of this potential impact would be determined by the effectiveness of erosion-control measures and the stormwater management plans. Types of plant community impacts would be in the same proportions as discussed above but on a much greater scale than for Alternative A.

Existing hydrology and riparian vegetation would not be affected by build-up of salts with this alternative because of the use of injection and holding tanks for production water. The potential for spreading noxious weeds is substantially greater than under Alternative A because 20 times as much land would be disturbed.

Species of Concern-Federally Listed Species

Direct impacts to federally protected species are prohibited by law and are the same as under Alternative A.

The potential for direct and indirect impacts on other species of concern would be much greater under this alternative because of the much larger amount of habitat that will be disturbed or lost with the increased level of vegetation disturbance associated with the greater number of well pads, roads, pipelines, and utility lines. More roadways provide greater access and more potential for disturbance, poaching, or harassing of protected species.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative B. If there were no CBM development on Tribal Lands, then there is expected to be minimal, impacts on vegetation for the reservation. If there is CBM development on the reservation, then the acres of disturbed habitat could be inferred to the reservation using the same approach used in this section.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Mitigation

Mitigation would be the same as described for Alternative A, but applied to a larger area.

Conclusions

The impacts of CBM development under Alternative B would be substantially greater than under Alternative A because 20 times as many wells would be developed and 20 times as much area would be disturbed.

Reclamation after well abandonment on 44,000 acres may revegetate well sites and roads, but not necessarily restore the sites to previous vegetation or habitats, resulting in native habitat loss.

Cumulative impacts would be the same as described for Alternative A except that Montana CBM development impacts would be greater.

Alternative C

A total of approximately 75,762 acres would be directly impacted. Approximately 34,345 acres of grassland vegetation, 15,657 acres of shrubland, 10,859 acres of forest land, and 3,030 acres of barren land could be potentially impacted, if wells were distributed in proportion to the amount of acres in each habitat type. Direct impacts to riparian areas are similar to Alternative A. In addition, although no wells will be authorized in riparian areas under any alternative, the discharge of untreated water from exploration and production onto the surface could affect riparian vegetation, perhaps as much as 3,535 acres. This is the estimated average total acreage of habitat with riparian vegetation that is underlain by bituminous coal bed (BLM and state).

Indirect impacts would include the impacts noted earlier of noxious weed invasion, erosion, and changes in wildlife and livestock distribution. In addition, indirect impacts would include increased SAR and salinity levels, which would result in riparian community changes and increased erosion potential for wetland and riparian communities.

Alternative C has the greatest potential for erosion because of the increased disturbance area with no restrictions on corridors for pipelines, utilities and roadways and no requirements for directional drilling or multiple completions in a single well. The extent of erosion would be determined by the effectiveness of erosion-control measures and the stormwater management plans. This alternative will potentially increase the area of disturbance over Alternatives B or D by approximately 42,000 acres (Table 4-15). This acreage increase will increase the potential for erosion.

With discharge of the CBM water to surface drainages and streams, erosion could occur, which could damage or destroy instream and streambank riparian vegetation (Regele and Stark 2000). The erosion could result in increased sediment loads that, along with the potential high salinity and sodicity, could degrade the stream and impact riparian vegetation. Impacts of discharging CBM waters would likely be greatest in intermittent and smaller perennial drainages during low-flow periods. Releases during low-flow periods of late summer and fall would have the greatest potential to impact riparian vegetation. This is also the time when this vegetation is naturally stressed because of low water. The potential for impacts on riparian vegetation exists along drainages and streams throughout the CBM development area.

CBM groundwater discharge has an SAR capable of killing vegetation (Regele and Stark 2000). Plant growth is affected in sodic soils due to decreased soil permeability, increased pH (which lowers nutrient availability), and accumulation of certain elements (sodium, boron, and molybdenum) at a level toxic to plants. Because of the typically low flows of the CBM wells (approximately 5 to 10 gallons per minute), it is likely that these SAR impacts would be localized in the vicinity of the discharge, unless flow were collected from a large number of wells.

Species of concern have a higher potential for direct and indirect impacts compared to Alternative B because of more surface disturbance.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative C.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Mitigation

Mitigation measures would be same as described for Alternative A.

Conclusion

Reclamation of vegetation after well abandonment may revegetate well sites and roads, but not necessarily restore the sites to previous vegetation or habitats, resulting in native habitat loss.

Localized increases in salinity and SAR values may be the most important aspect of this alternative. Salinity can have long-term effects on vegetation, including death of riparian vegetation and concentrations of salt in riparian soils. Soil impacts may last long after a given project site has been abandoned. Increased SAR values may prevent nonhydrophytic reclamation vegetation from succeeding. Increased roads result in more land being disturbed, more wildlife and livestock forage will being removed, and more area for noxious weed invasion being present.

All species of concern that are not federally protected may be impacted by habitat changes caused by vegetation removal that are not fully recovered with reclamation after well abandonment, by increased access through increased roads, and/or by changing streambed hydrology and increased SAR and salinity values in water and soil.

Cumulative impacts are the same as discussed under Alternative A and B plus some additional losses as a result of CBM development in Montana under this alternative.

Alternative D

Impacts

Impacts on habitat types under this alternative would be the same as Alternative B except for the potential for riparian impacts. Although no wells will be authorized in riparian areas on BLM land under any alternative, the discharge of water from exploration and production onto the surface could create riparian areas that will be abandoned and could affect the hydrology of current riparian areas, perhaps as much as 2,776 acres.

Under this alternative, indirect impacts could include the impacts noted earlier of noxious weed invasion, erosion, and changes in wildlife and livestock distribution. In addition, indirect impacts would likely include increased water being added to riparian systems, which could affect riparian vegetation. Reservoirs that are used in this alternative for holding treated water could produce problems when they are abandoned. Riparian vegetation that developed during the operation dies after abandonment and the bed of the drying reservoir tends to become infested with noxious weeds (Lahti 2001).

Erosion potential may increase under this alternative because there are no reclamation requirements for roadbeds. This is offset somewhat by the stipulation that no slopes greater than 30 percent can be used for CBM construction.

Discharge of water from exploration and production onto the surface could affect the hydrology of as much as 2,776 acres of current riparian vegetation. Changes in hydrology could have both advantageous and undesirable effects on Ute ladies'-tresses through erosion and changed surface and ground water levels.

Other species of concern could be impacted as described for Alternative B and by discharge of CBM water.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative D.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Mitigation

Under this alternative, mitigation would be the same as Alternative A, except water would be treated prior to surface release.

Conclusions

There is no requirement for road abandonment so long-term impacts caused by removal of vegetation for roadways is not known, but would occur. Stipulations concerning slope of land for potential CBM sites are likely to protect such slopes from failure and mass wasting problems. A secondary effect is that such areas will remain in their existing habitat and plant communities. Reclaimed areas may revegetate adequately, but this will not restore the sites to previous native vegetation or habitats. There is potential for habitat loss because of the lack of requirements for roadbed reclamation or for abandoned reservoirs. Areas that are not reclaimed would represent a permanent loss of native vegetation and be subject to noxious weed infestations.

Release of production water, even when treated, under this alternative can potentially impact habitats preferred by the Ute ladies'-tresses orchid on state or private lands by changing streambed hydrology.

All species of concern that are not federally protected may be impacted by habitat changes caused by vegetation removal that are not fully recovered with reclamation after well abandonment, by increased access through user-created roads, or by changing streambed hydrology and increased SAR and salinity values in water and soil.

Cumulative impacts would be the same as Alternatives A and B.

Alternative E (Preferred Alternative)

Impacts

The same types of impacts to vegetation and species of concern described for Alternative C would occur under Alternative E because no additional specific mitigation measures will be required and because transportation corridors will not be required. This Alternative would require a Water Management Plan for every well exploration APD on a site-specific basis for management of production water. There would be no discharge of produced water, either treated or untreated, into the watershed under this alternative unless the operator can demonstrate in the Water Management Plan how discharge could occur without damaging the watershed in accordance with water quality laws. Water quality laws will not protect riparian vegetation from inundation and other changes in the water level as a result of production.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative E.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Mitigation

Mitigation would be the same as for Alternative A with the addition of preparation of a Water Management Plan.

Conclusions

Residual impacts would be the same as described for Alternative C. All species of concern that are not federally protected may be impacted by habitat changes caused by vegetation removal that are not fully recovered after well abandonment and by increased access through increased road densities, which may cause greater disturbance and noxious weed infestations.

The cumulative impacts from Alternative E would be the same as described for Alternatives A and C.

Visual Resource Management

Assumptions

Based on the Visual Resource Management (VRM) class, BLM stipulations would require special design, including location, painting, and camouflage, to blend with the natural surroundings and meet visual quality objectives for the area. A standard component typically includes painting facilities to camouflage them, and a standard color may be specified.

The TLMD has the ability through site-specific mitigation measures to address visual concerns on state lands.

Impacts From Management Common to All Alternatives

Visual resources would be impacted to varying degrees by oil and gas exploration and production activities. Exploration would involve minor visual impacts from clearing operations for access to exploratory sites. The majority of this impact would be expected to result from access road construction, site construction, drill rig operations, and on-site generator use. Short-term visual impacts would occur where construction and drilling equipment is visually evident to observers. Long-term impacts would occur from construction of roads and pads, installation of facilities and equipment, vegetation removal, and change in vegetation communities. These would produce changes in landscape line, form, color, and texture.

Impacts would occur locally on a case-by-case basis as the native vegetation is disturbed and small structures are erected. Landscape line, form, color, and texture would all be expected to change. The view to travelers throughout much of the Powder River area is a high plain with low-lying scrub-shrub vegetation and periodic rock outcrops. In the Castle Rock Project, there is rough terrain, high hills and buttes, and timber present. Much of the area is very scenic and quite a contrast to the landscape of open prairie you might find in other areas of the Powder River Basin. Visual impacts may include building roads in rough terrain or cutting timber. Introducing man-made structures into this landscape, although small and painted for camouflage, changes the overall nature of the visual resource.

Three thousand acres of surface mining expansion under permit consideration may be approved this year. This mining activity may affect some visual resources in those areas for the next 20 to 30 years. The construction of the Tongue River Railroad would impact the visual resources along the river. The decrease in air quality (see the Air Quality and Climate section) from all of the activities, for example, dust and compressor emissions would reduce overall visibility.

Impacts From Management Specific to Each Alternative

Alternative A

CBM production well activities would have visual impacts. CBM wells, typically covered in a box, or "housing" for protection from weather, are isolated structures approximately 4 feet high by 4 feet wide by 4 feet long. The wells are scattered across a wide area, and are connected to field compressors. The compressors are larger, and create more of a visual impact-although in a much smaller area because these structures are more widely distributed. Compressors range in size from field compressors at 8x12x8 (width, length, height; in feet) to sales compressors at 12x18x10. Visual impacts also would arise from construction activities related to developing access to the sites. Exploration well activities may have short-term visual impacts if the exploration wells are not converted to production wells. These short-term impacts (approximately 2 months) would be from the visual effects of the drill rig, portable generator, and access road.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative A. If there were no CBM development on Tribal Lands, then there is expected to be minimal, if any, impacts on visual resources for the reservation.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Mitigation

Because Alternative A is an amendment to the existing RMP, the mitigation measures would be the same as described in that document.

Conclusions

As determined in the existing RMP, mitigation measures offset the impacts.

Alternative B

Visual impacts would occur from the development of CBM wells in this alternative for lands in VRM Classes III and IV. VRM Class I and II lands would not be developed and the No Surface Occupancy stipulation applies. The Controlled Surface Use stipulation would be applied to Class III and IV lands providing for special design, painting, camouflage, to help the aboveground equipment blend in with the natural surroundings to meet visual quality objectives for the area. A Visual Resource Inventory would be accomplished to determine the VRM class and the visual quality objectives for the area of development. Impacts from utilities would be minimal as power lines are buried and other utilities are concentrated within roadway corridors.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative B

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Mitigation

A mitigation plan based on the objectives identified in the Visual Resource Inventory and VRM Class would be developed on a case-by-case basis. Typical measures include designing the compressor station to blend into the background, landscaping options, and painting to camouflage the aboveground equipment. Powerlines and pipelines would be placed underground and well heads camouflaged with landscaping or vegetation.

Conclusions

Implementation of the mitigation plan and visual impact reducing elements of the alternative would lessen the majority of visual impacts but would not eliminate them. Residual visual impacts would include the impact of the expanded road network when viewed from a distance or from higher elevations.

Cumulative impacts would include the visual impact of additional roads when combined with existing roads and new roads being constructed for other uses.

Alternative C

For Alternative C, visual impacts would occur from the development of CBM wells for lands in VRM Classes II, III, and IV. VRM Class I lands would not be developed and the No Surface Occupancy stipulation would apply. The Controlled Surface Use stipulation would be applied to Class II, III, and IV lands. A visual resource inventory would be accomplished to determine the VRM class and the visual quality objectives for the area of development.

Power lines would be aboveground in this alternative and roads would be allowed to be placed according to operator plans. This would result in power lines where none now exist, as well as a wider expanse of roads.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative C.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Mitigation

The results of the visual resource inventory would be incorporated into the project plan for VRM Classes II, III, and IV. Identified visual quality objectives would be evaluated and where feasible incorporated into the plans.

Conclusions

Residual visual impacts would include the impact of the expanded road network when viewed from a distance or from higher elevations. There also would be a network of power lines visible from many places.

Cumulative impacts would be the same as described for Alternative B.

Alternative D

Visual impacts would be the same as described for Alternative B.

Mitigation

Mitigation would be the same at described for Alternative B.

Conclusions

Residual and cumulative impacts are the same as described for Alternative B.

Alternative E (Preferred Alternative)

Visual impacts would occur from the development of CBM wells for lands in VRM Classes II, III, and IV. VRM Class I lands would not be developed and the No Surface Occupancy stipulation would apply. The Controlled Surface Use stipulation would be applied to Class II, III, and IV lands providing options for lessening the visual impact through design and landscape features. A Visual Resource Inventory would be accomplished to determine the VRM class and the visual quality objectives for the area of development.

This alternative does allow for installation of pipelines, power lines and roads where there are none now. But, it also requires that the operator minimize or mitigate impacts from these activities in the Project Plan and state how the surface owner was consulted for input on the location of roads, pipeline and utility line routes. It also allows, at the surface owners discretion, the closing and rehabilitation of roads or the option of leaving them open, after well abandonment.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative E.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Mitigation

A mitigation plan based on the results of the Visual Resource Inventory Visual Quality Objectives would be developed on a case-by-case basis. This plan would include measures to design the compressor stations and well heads to blend into the background through the use of landscape or painting options, burying pipelines and powerlines when necessary, and locating wells in locations that would mask the visual impact.

Conclusions

Use of the mitigation plan as part of the Project Plan would lessen many of the visual impacts but would not eliminate them. New roads and powerlines would be a residual visual impact from this alternative.

There would be cumulative visual impacts from the combination of new and existing roads and utilities.

Wilderness Study Areas

Assumptions

Wilderness Study Area (WSA) policy prohibits leasing of WSA lands for resource extraction subject to rights associated with valid claims and leases existing at the time of designation.

Impacts From Management Common to All Alternatives

BLM leasing restrictions are designed to protect WSAs from considerable impact. The WSA policy prohibits leasing of these lands for resource extraction. It is expected that WSAs will not be impacted through conventional oil and gas development under current management.

Mitigation

The laws and regulations established for WSAs were established to minimize and mitigate impacts to WSAs; these include prohibiting leasing of WSA designated lands for resource extraction.

Impacts From Management Specific to Each Alternative

Alternative A

State and fee lands would be impacted by CBM production activity. There would be no production activities in BLM planning areas under this alternative and therefore no impacts from CBM activities.

Conclusion

Impacts from this alternative would be similar to management common to all alternatives. Since stipulations for WSAs prevent leasing of these lands for resource extraction, there are expected to be no major impacts to WSAs.

There are no cumulative impacts from CBM development.

Alternative B

Alternative B would allow development while emphasizing the protection of natural and cultural resources. Under this alternative development would result in increased access to remote areas. The impacts from this alternative would be similar to those described under *Impacts From Management Common to All Alternatives*.

Conclusion

Impacts from this alternative would be similar to those described under Alternative A.

Alternative C

Alternative C would emphasize CBM exploration and development with minimal restrictions. The impacts from this alternative would be similar to management common to all alternatives.

Conclusion

Impacts from this alternative would be similar to those described under Alternative A.

Alternative D

Alternative D would encourage CBM development while maintaining existing land uses and protecting down stream water consumers. The impacts from this alternative would be similar to management common to all alternatives.

Conclusion

Impacts from this alternative would be similar to those described under Alternative A.

Alternative E (Preferred Alternative)

Alternative E, the Preferred Alternative, would allow CBM development subject to existing planning restrictions and balances CBM development and the protection of the natural environment. The impacts from this alternative would be similar to those described under *Impacts From Management Common to All Alternatives*.

Mitigation

The mitigation measures would be the same as those discussed in the management common to all alternatives.

Conclusion

There are no cumulative impacts from CBM development.

Wildlife

Assumptions

CBM exploration, production, and abandonment on BLM lands is subject to the stipulations summarized in Table 4-16, which are intended to offer some protection to wildlife as a result of development on BLM-administered minerals. These stipulations are recommended for, but do not necessarily apply to, CBM-related activities on non-BLM lands. Therefore, the stipulations would avoid some of the potential impacts on BLM lands, but may or may not avoid impacts on non-BLM lands. The success of these stipulations in avoiding covered impacts would require collection of site-specific information regarding the resources to be protected in relation to exploration, production, and abandonment plans, followed by strict adherence to the terms of the stipulations. For the purposes of this analysis it is assumed that the stipulations offer some protection to these wildlife species on BLM-administered lands.

The DNRC TLMD may apply the following stipulations on a case-by-case basis to school trust lands leased for oil and gas exploration, development, and production. The noxious weed stipulation is placed on all oil and gas leases issued by TLMD. Some of the stipulations indirectly relate to wildlife, while others are more specific. The dates on the timing restriction stipulation vary depending on the wildlife species to which it applies.

- **Notification:** Lessee shall notify and obtain approval from the Department's Trust Land Management Division (TLMD) prior to constructing well pads, roads, power lines, and related facilities that may require surface disturbance on the tract. Lessee shall comply with any mitigation measures stipulated in TLMD's approval.

- **Weeds:** The lessee shall be responsible for controlling any noxious weeds introduced by Lessee's activity on state-owned land and shall prevent or eradicate the spread of those noxious weeds onto land adjoining the lease premises.

- **Sensitive Areas:** This lease includes areas that may be environmentally sensitive. Therefore, if the lessee intends to conduct any activities on the lease premises, the lessee shall submit to TLMD one copy of an Operating Plan or Amendment to an existing Operating Plan, describing in detail the proposed activities. No activities shall occur on the tract until the Operating Plan or Amendments have been approved in writing by the Director of the Department. TLMD shall review the Operating Plan or Amendment and notify the lessee if the Plan or Amendment is approved or disapproved.

  After an opportunity for an informal hearing with the lessee, surface activity may be denied or restricted on all or portions of any tract if the Director determines in writing that the proposed surface activity will be detrimental to trust resources and therefore not in the best interests of the trust.

- **Wildlife Restrictions:**

  - To protect wildlife during periods important to their survival, surface occupancy or other activity shall be restricted from March 15 through July 15 of each year unless otherwise authorized in writing by the TLMD.

  - Potential wildlife conflicts have been identified for this tract. The TLMD will contact the Montana Department of Fish, Wildlife, and Parks office in the area for advice on alleviating any possible conflicts caused by lessee's proposed activities. Additional mitigation measures may be required.

  - Potential wildlife conflicts have been identified for this tract. The TLMD will contact the U.S. Fish and Wildlife Service office in the area for advice on alleviating any possible conflicts caused by lessee's proposed activities. Additional mitigation measures may be required.

  - Wildlife species of concern have been identified on or near this tract. A survey in areas of proposed activity may be required prior to disturbance. Identified species will be avoided, unless otherwise authorized by the TLMD. Additional mitigation measures may also be required.

TABLE 4-16
EXISTING WILDLIFE-RELATED STIPULATIONS COVERING CBM EXPLORATION AND DEVELOPMENT ON BLM LANDS

Resource	No Surface Use	No Surface Occupancy	No Surface Use or Occupancy
Riparian areas		X	
100-year floodplains of major rivers, streams, and water bodies		X	
Water bodies and streams		X	
Crucial big game winter range*	December 1 - March 31		
Elk calving areas*	April 1 - June 15		
Powder River Breaks bighorn sheep range		Within designated bighorn sheep range	
Grouse leks			Within ¼ mile of lek
Grouse nesting zones*	Within 2 miles of leks from March 1 - June 15		
Raptor nests*	Within ½ mile from March 1 to August 1, within ½ mile of raptor nest sites which have been active within the past 2 years.		Within ¼ mile of nest
Bald eagle nests and nesting habitat	Within ½ mile from March to August 1, within ½ mile of raptor nest sites which have been active within the past 2 years.		Within ½ mile of nests active in the last 7 years and within riparian area nesting habitat
Peregrine falcon			Within 1 mile of nests
Ferruginous hawk			Within ½ mile of nests active within 2 years
Piping plover			Within ¼ mile of wetlands identified as piping plover habitat
Interior least tern			Within ¼ mile of wetlands identified as Interior Least Tern habitat
Prairie dog colonies > 80 acres	Controlled surface use		

Note: These stipulations are attached to leases and can affect exploration and construction

*Stipulation does not apply to operation and maintenance of production facilities.

Please refer to Table MIN-5, *Minerals Appendix*, for a listing of resource mitigation.

- **Miscellaneous Restrictions:**
  - Plant species of concern have been identified on or near this tract. A vegetation survey in areas of proposed activity will be required prior to disturbance. Identified rare plant species will be avoided, unless otherwise authorized by the TLMD.
  - A critical weed problem exists on this tract. Additional mitigation measures will be required to prevent further spread of noxious weeds. The department may require such measures as power washing of vehicles, car pooling, timing restrictions for seismic, etc. to facilitate this prevention.
  - This tract contains biological weed-control sites which must be avoided unless otherwise authorized by TLMD.
- Other:
  - Any activity within 1/8 mile of the river or lake/reservoir on or adjacent to this tract must be approved in writing by the TLMD prior to commencement. No surface occupancy will be allowed within the bed of the river, abandoned channels, the bed of the lake/reservoir, or on islands and accretions associated with the river or lake/reservoir.
  - No activity shall be allowed within 100 feet of any perennial or seasonal stream, pond, lake, prairie pothole, wetland, spring, reservoir, well, aqueduct, irrigation ditch, canal, or related facilities without prior approval of the TLMD.
  - Wooded areas on this tract will be avoided unless otherwise authorized by the TLMD.

In addition to these stipulations, motorized vehicle use for recreationists on state trust lands is restricted by current policy to federal, state, and dedicated county roads or other roads regularly maintained by the county, or to other roads that have been designated open by DNRC. Off road use is prohibited. Increased posting efforts, i.e., Walk-In Only signs, may be implemented by the TLMD to prevent unauthorized use of two-track trails and roads by recreationists to alleviate increased pressure on wildlife.

Exploration for and development of CBM wells would cause a wide range of both direct and indirect impacts on wildlife. The extent and duration of effects on wildlife would depend on the animal species, the type and quantity of vegetation removed, the nature and period of disturbance, and the success of stipulations in avoiding some impacts. The impacts described below assume that the site-specific natural resource information and the stipulations discussed above are successfully used to avoid certain impacts on BLM and state lands.

As previously described, the No Action Alternative includes exploration for and development of a relatively small number of CBM wells (compared to the other alternatives) and the associated roads, pads, power lines, pipelines, utility corridors, facilities, and human activities and presence. Many of the direct and indirect impacts of CBM development on wildlife described for Alternative A would occur regardless of the number of CBM wells developed. These direct and indirect impacts are discussed below under the No Action Alternative and referenced as appropriate in the discussion of the impacts of Alternatives B, C, D, and E. Additional ecosystem-level impacts associated with the substantially larger number of CBM wells that would be developed under Alternatives B, C, D, and E are discussed under those alternatives.

Impacts From Management Common to All Alternatives

The responses of wildlife to facilities and activities associated with oil and gas development are complex but well documented (Wisdom et al. 2000; USDI and USDA 2000; Trombulak and Frissell 2000). Tolerance of various types of environmental disturbances varies among species and among individuals of the same species. The potential for impact is related to the timing and nature of the disturbance, severity of winter, location in the state, habitats and species present, physiological status of the animal, hunting pressure, and predictability of the disturbance. The scale of oil and gas development, number of associated roads and other facilities, and implementation of measures to avoid or reduce impacts also influence the probability and severity of impacts on wildlife.

Direct and indirect impacts of road construction and use on wildlife and wildlife habitat have been well documented for oil and gas projects and other natural resource developments. Impacts include a wide range of biological effects, such as habitat loss, displacement, noise, human disturbance, and stress. The types of impacts expected to result from oil and gas development would be similar to those described in detail under Alternative A for CBM development. The extent of the impacts would vary depending on the level of development.

A detailed discussion of impacts and mitigation measures for wildlife is included in the remainder of this section and in the *Wildlife Appendix*. This discussion addresses the direct and indirect quantitative and qualitative impacts that would likely result from CBM development in the Powder River and Billings RMP areas. The impacts from conventional oil and gas development would be similar to those anticipated for CBM but at a scale associated with conventional oil and gas development as identified in the Miles City District's *Oil and Gas Final EIS*, (BLM 1992). Conventional oil and gas development produces less water than comparable CBM production facilities, although at a higher salinity.

Impacts From Management Specific to Each Alternative

Alternative A

CBM exploration and production includes development of roads, pads, power lines, pipelines, utility corridors, and facilities as well as human activities and regular human presence. Much of this activity would occur in the relatively undisturbed native short grass prairie of eastern Montana, resulting in both direct and indirect impacts on wildlife. Those impacts would be localized around CBM exploration and production sites and proportional to the level of activity at a particular location. The following discussion documents the types of impacts that would be expected from CBM-related actions. These impacts would occur on BLM, state, and private lands.

While the types of impacts described below would occur under all of the alternatives, the extent of the impact would be roughly proportional to the extent of CBM development under each alternative. The number of CBM exploratory and development wells under the No Action Alternative is 1/20th the number that would be developed under the other alternatives. Therefore, the extent to which these impacts would occur under the No Action Alternative is relatively minor compared to the other alternatives.

With a few exceptions, the same types of impacts to wildlife would occur under all of the alternatives. Therefore, they are described under Alternative A below. Differences in the type or extent of impacts between alternatives and are noted for Alternatives B, C, D, and E.

Direct habitat loss and direct and indirect impacts because of habitat disruption and wildlife disturbance caused by roads, pipelines, and utility corridors would cause the bulk of the impacts on wildlife. Numerous studies have documented the direct and indirect impacts on wildlife from road development, human presence in formerly remote areas, and facilities construction (Trombulak and Frissell 2000, Wisdom et al. 2000). The nature of these impacts and how they relate to exploration, development, and maintenance of CBM wells is discussed in the text that follows. In most instances, the impacts would occur during all CBM phases. Exceptions are noted as appropriate.

Direct impacts would include loss of habitat to accommodate project features. They would persist for the duration of CBM activities and, in the case of loss of habitat value, beyond that time. Some degree of habitat loss and degradation would continue following CBM abandonment because of ecological differences between reclaimed sites and native vegetation.

The amount and types of habitat that would be directly lost from exploration and development are described in the Vegetation section. The species that would be affected by direct habitat loss would depend on the location of CBM exploration and development and the types of habitat affected. Based on the average area expected to be disturbed by exploration and development of each CBM well, about 675 acres would be lost during exploration, 310 acres would be impacted by well development, and an additional 500 acres would be impacted during operation under Alternative A. Additional lands would be impacted by the approximately 16 vehicles involved in exploration as they move across the landscape creating two-track trails in the arid short grass prairie lands of central and southeastern Montana.

Direct impacts on wildlife would also include mortality as relatively less mobile small mammals, reptiles, and amphibians are killed during road and other site construction during development of CBM facilities. Smaller mammals, reptiles, and amphibians are most likely to be directly killed by vehicles and are especially vulnerable when crossing roadways (USDI and USDA 2001). Amphibians are especially vulnerable to roadkill on all types of roads because their life histories often involve migration between wetland and upland habitats and individuals are often inconspicuous and slow-moving. Inexperienced juveniles of many raptor species experience high rates of mortality from collisions with vehicles (Trombulak and Frissell 2000). Grouse are particularly susceptible to collision mortality during the spring because they often fly to and from leks near the ground. Also, higher CBM-related traffic volumes on existing paved roads would result in higher mortality rates for reptiles that seek out roads for thermal cooling and heating (Vestjens 1973). Direct mortality from vehicle collisions would be expected to increase for all wildlife along both new and existing roads used for CBM exploration and well construction and maintenance (Groot et al. 1996). Collision mortality would be most injurious to small and declining populations with limited distribution. Direct impacts from collision and crushing would continue for the duration of the project along roads until they are successfully closed and reclaimed.

Additional direct impacts that may occur on private lands because BLM stipulations are recommended but not required. These impacts include greater potential loss of riparian vegetation and other floodplain habitats valuable for wildlife, abandonment of raptor nests because of direct habitat loss and disturbance, and habitat loss for a wide range of species that occupy prairie dog towns.

Most indirect impacts on wildlife would occur during all CBM phases on BLM, state, and private lands. The duration of effects would correspond with the duration of each phase and the intensity of activity during that phase. The relative magnitude of impacts would be directly related to the nature and relative extent of activities associated with each phase of CBM development. Some indirect effects would persist beyond abandonment because continued human use of some CBM and user-created roads that are not closed and reclaimed (USDI and USDA 2001).

Indirect impacts of road development and use as would occur during exploration, development, and production on wildlife and wildlife habitat have been well documented for a variety of natural resource extraction and development projects (Trombulak and Frissell 2000, USDI and USDA 2000, Wisdom et al. 2000). Indirect impacts of CBM exploration and development on certain species of wildlife that are more sensitive to development and human disturbance would occur over much larger areas than the direct impacts. The *Oil and Gas Development on the Southern UTE EIS* (USDI 2000) suggested that human presence associated with exploration and development of oil and gas wells disturbed wildlife at distances up to 1/2 mile, and that operation and maintenance activities caused disturbance within 1/4 mile of wells and roads. The disturbance results both from the presence of people and from the noise associated with exploration and development. There are numerous studies documenting wildlife avoidance of roads and facilities and wildlife disturbance at distances of 1,650 feet (Madsen 1985), 6,600 feet (Van der Zande et al. 1980), and as far as 2 miles or more for sage grouse (summarized in Connelly et al. 2000) and raptors (Fyfe and Olendorff 1976). Elk avoidance of roads has been documented in many studies throughout the West (Lyon 1979 and 1983, Perry and Overly 1976, Rost and Bailey 1979, Ward et al. 1973). Roads displace animals from otherwise useable habitat. Elk in Montana prefer spring feeding sites away from visible roads (Grover and Thompson 1986) and both elk and mule deer in Colorado prefer areas greater than 660 feet from roads during the winter (Rost and Bailey 1979). Lyon (1983) studied the effects of roads on elk distribution and habitat use. He reported that within blocks of available elk habitat, road densities of only 2 miles of primitive (undeveloped) road open to vehicle traffic per square mile resulted in elk displacement from over 50 percent of the available habitat in the areas with roads present. The avoidance was due to human disturbance and the resulting lack of security for the elk. This type of disturbance would be greatest in open country such as the EIS planning area where line-of-sight distances are relatively long and escape cover is often limited.

Table 4-17 displays the area of wildlife habitat that may be indirectly affected by CBM exploration and development under Alternative A using both 1/2- and 2-mile zones of disturbance and also lists the types of direct and indirect impacts on wildlife that would be expected to be associated with CBM exploration, development, and maintenance, and indicates the relative level of vulnerability of different representative types of wildlife to these impacts.

Displacement from habitat because of roads, CBM facilities, and human disturbance may result in any of a number of individual and population level impacts on wildlife (Trombulak and Frissell 2000, Wisdom et al. 2000). These include stress, disruption of normal foraging and reproductive habits, abandonment of unique habitat features, and increased energy expenditure. These factors contribute to reduced over winter survival for individuals, poor condition entering the breeding season, reduced reproductive success and recruitment, and eventually population declines. For sensitive species, displacement from important habitat features is effectively equal to loss of habitat and the individuals that occupied that habitat. Wildlife cannot generally just move to unoccupied habitat in response to disturbance and survive there because other suitable habitat is already occupied by other individuals of the same species or by other species using the available resources.

CBM-developed roads and two-track trails would provide public access into previously unroaded areas and will result in additional user-created roads and trails branching off from CBM roads (USDI and USDA 2001). This is most likely to occur on BLM and state lands where access is not easily controlled because of large land area and limited funding. Access

TABLE 4-17
VULNERABILITY OF WILDLIFE TO TYPES OF CBM IMPACTS, ALTERNATIVE A

(The relatively low impact probabilities in this table reflect the fact that the no action alternative includes a small number of CBM wells compared to the other alternatives)

	Number of Affected Acres			Species/Groups Affected[1]																					
				Big Game/Large Predators[2]		Sage and Sharp-tailed Grouse[2]		Raptors[2]		Waterfowl/ Shorebirds		Song Birds		Prairie Dog Colonies		Small Mammals		Reptiles and Amphibians		Bats		Small Predators	
Type of Impact	**Exploration**	**Development**	**Operation**	**Exploration**	**Devel/Ops**	**Exploration**	**Devel/Ops**	**Exploration**	**Devel/Ops**	**Exploration**	**Devel/Ops**	**Exploration**	**Devel/Ops**	**Exploration**	**Devel/Ops**	**Exploration**	**Devel/Ops**	**Exploration**	**Devel/Ops**	**Exploration**	**Devel/Ops**	**Exploration**	**Devel/Ops**
Direct Impacts																							
Habitat loss	675 acres	310 acres	500 acres	1	2	1	2	1	2	0	0	1	2	2	3	1	2	1	1	2	2	1	2
Vehicle collision / crushing				1	2	2	3	1	1	0	0	1	1	1	2	3	3	3	3	0	0	0	1
Greater public access (increased poaching, fire, and legal hunting)				1	3	1	2	1	2	1	1	0	0	1	2	0	1	0	1	0	1	2	3
Indirect Impacts																							
Disturbance and displacement from CBM-associated human presence and activities.[3]				3	3	3	3	3	3	2	2	2	2	1	1	2	2	1	1	0	1	1	2
1/2 mile perimeter disturbance area	44,696 to 105,560 acres	105,560 acres	44,696 to 105,560 acres																				
2 mile perimeter disturbance area	140,896 to 239,760 acres	239,760 acres	140,896 to 239,760 acres																				
Noise disturbance/displacement/stress				2	2	3	3	1	1	1	1	3	3	0	0	1	1	1	1	1	1	1	2
Above-ground power lines				0	0	0	3	0	3	0	2	0	2	1	2	0	1	0	0	0	0	0	0
Noxious weed habitat degradation				0	2	0	2	0	2	0	0	0	2	0	1	1	2	0	1	0	0	0	1
Presence of new CBM and user-created roads				0	3	0	3	0	2	0	1	0	2	0	2	0	2	0	2	0	0	1	2
Habitat fragmentation				0	1	0	2	0	1	0	0	0	1	0	1	0	1	0	1	0	0	1	2
Sediment runoff from roads and excess CBM water/water quality degradation				0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	1	2	0	0
Altered surface hydrology (springs and small stream flows reduced)				0	1	0	2	0	0	0	1	0	1	0	0	0	1	0	2	0	2	0	1
Increased livestock use of range due to CBM water sources				0	2	0	3	0	2	0	2	0	3	0	0	0	2	0	2	0	0	0	1

Notes:

Vulnerability of wildlife to categories of impacts are based on the nature of impact, species involved, and relative number of wells.

0 = little or no vulnerability
1 = low vulnerability
2 = moderate vulnerability
3 = high vulnerability

[1] Relative vulnerability assumes collection of site-specific data needed to follow stipulations during exploration and development on BLM lands, and strict adherence to stipulations.

[2] Vulnerability would be slightly lower for certain habitat components on BLM lands during exploration, than on non-BLM lands.

[3] Assumes displacement/disturbance within 1/2 to 2 miles around well fields with fields averaging 200 wells per field and 8 to 24 wells per square mile; varies by species with some species such as sage

to most CBM roads on private lands would be restricted by the surface owner. The open rolling nature of the terrain in the project area combined with the proliferation of four-wheel-drive trucks and all-terrain vehicles will allow the creation of many user-created roads (USDI and USDA 2001). This will cause additional road-related direct and indirect impacts over large open areas because of the great sight distances in central and southeastern Montana. For example, large, low-density species such as raptors and ravens that nest along prominent landmarks such as cliffs in open country are easily disturbed during the nesting season (Fyfe and Olendorff 1976). Some CBM roads will continue to be used by the public, and especially hunters, throughout the entire production phase and beyond because road closures are difficult to implement in open short-grass prairie habitat given large land expanses and limited budgets. This continued use would hamper reclamation efforts on some CBM roads while others will remain open by choice. Some portion of CBM roads and user-created roads would likely become permanent, with all of the associated impacts on wildlife and habitat.

Human use of all types of roads is a source of stress for many species. Roads also may affect an animal's reproductive success (Gutzwiller 1991). Golden eagles prefer to nest away from human disturbances, including roads, and have reduced nesting success in nests located closer to roads than in nests farther from roads (Fernandez 1993). Chronic physiological stress on wildlife can result in increased sickness, a decrease in individual productivity (Knight and Cole 1991, Anderson and Keith 1980, Yarmoloy et al. 1988), and eventually result in population declines (Anderson and Keith 1980).

The increased access provided by both CBM and user-created trails and roads over the span of all CBM phases and beyond would result in additional legal harvest and illegal poaching of game animals (Cole et al. 1997), target shooting of animals such as prairie dogs and other similar species (Ingles 1965), and chasing and harassing of animals (Posewitz 1994, USDI and USDA 2001). Human-caused fires are likely to increase in areas that were not regularly accessed by the general public before CBM and user-created roads were present.

Overhead power lines constructed for production wells pose problems for a variety of wildlife species. Raptors and other species of birds occasionally collide with power lines, especially during periods of relatively poor visibility. Overhead power lines can benefit some raptors in open country by providing hunting perches. However, the additional perches also result in local population declines in prey species. For example, overhead power lines constructed in the vicinity of sharp-tailed grouse leks and wintering areas can substantially increase predation rates on the grouse. Electrocution of raptors can also be a serious problem with overhead power lines and related distribution facilities. Raptor and sage grouse collisions with power lines have also been noted throughout the west including eastern Montana.

Another wildlife disturbance factor associated with CBM exploration, development, and operation is noise. The highest noise levels and greatest impacts would be expected during exploration and development, with lower noise levels during production operations. Noise levels would be similar on BLM and other lands. Animals would react to noises, but it is especially troublesome for songbirds. Male neotropical migrant birds that breed in short grass prairie, sagebrush, and riparian communities use songs to establish and defend breeding territories and attract females. Noise interferes with this ability, and with the level of interference related to the volume and frequency of the noise (Luckenbach 1975, Luckenbach 1978, Memphis State University 1971, Weinstein 1978). Other noise-related problems for birds around CBM exploration and production wells and compressors include interference with the ability to recognize warning calls and calls by juveniles. The area of disturbance would vary by species and CBM activity. Producing wells would be relatively quiet once regular production is underway. Compressors would be louder with noise levels at 50 decibels at a distance of 1/4 mile.

Stipulations prohibit surface occupancy in riparian areas and on floodplains of major rivers. However, they do not prohibit crossing of streams or construction of roads through riparian areas. Roads constructed through riparian areas and other forest and shrub stands for CBM development and operation create edge effects and alter the physical environment (Trombulak and Frissell 2000). Roads create drier conditions in the vicinity of the road, thereby altering habitat for many species. In grassland and shrubland habitats, trails and roads create edge habitat for predators and reduce patch size of remaining habitat for area-sensitive species (USDI and USDA 2001, Ingelfinger 2001). Swihart and Slade (1984) found that prairie voles (*Microtus ochrogaster*), which occur in the EIS planning area, were reluctant to cross tire tracks running through an open field. Reluctance to cross narrow gravel roads has also been observed in white-footed mice (*Peromyscus leucopus*), which also occur in the EIS planning area, and many other rodent species (Mader 1984, Merriam et al. 1989, Oxley et al. 1974). Consequently, roads can function as barriers to population dispersal and movement of species of small mammals that occur in the EIS planning area.

Many amphibian's annual life cycles require migration between habitats with different ecological properties. These species' populations depend on dispersal connections and landscape links (Gibbs 1998). Simple linear structures such as roads of all types can act as physical and psychological barriers for amphibian movement (Mader 1984, Gibbs 1998). Furthermore, motorized off-highway travel may disrupt reptile and amphibian habitat to the point where it becomes unusable (Busack and Bury 1974). Pronghorns and mountain lions have also demonstrated reluctance to crossing roads (Bruns 1977, Van Dyke et al. 1986).

Noxious weeds and exotic plants rapidly colonize disturbed sites, prevent native species from being re-established following ground disturbance, spread into undisturbed areas reducing habitat value on additional lands, and provide very poor quality wildlife habitat or forage. Furthermore, use of chemicals to control noxious weeds usually also kills non-target beneficial native plants, contributing to further habitat loss.

Roads are sources of fine sediment that can enter wetlands and intermittent and perennial drainages, especially following thunderstorms. Effects include increased turbidity (Reid and Dunne 1984), smothering wetland vegetation, and degradation of habitat for amphibians and other aquatic life (Newcombe and Jensen 1996).

There are no apparent differences between indirect impacts on wildlife on BLM, state, and private lands.

Species of Concern

Species of concern include federally listed T&E and candidate species; Montana species of concern; BLM species of concern, USFS species of concern, and MNHP species of concern. For the State of Montana species of concern, this document addresses only those listed as category S1, which are species of extreme rarity or species for which some factor of its biology makes it especially vulnerable to extinction. Chapter 3 of the EIS describes and lists all special-status species.

As discussed in the *Species of Concern* section of Chapter 3 in this EIS, there are 9 federally listed threatened, endangered, and proposed species; and 3 federal candidate species. In accordance with the ESA, listed wildlife must be protected from possible impact by oil and gas and CBM development on all lands. ESA protected plants are not protected on private lands. Additionally, there are many species classified as "species of special concern" by the Montana BLM and MNHP. By policy, BLM management cannot impact these species in a way that may cause further declines in the species' population status. These include 68 plant, 16 mammal, 6 herptile, and 22 bird species, and are listed by the state, BLM, and USFS. This section will address federally listed wildlife species protected under the ESA. General recommendations for other species of concern wildlife species can be found within the general Wildlife impact sections. Federally listed species are discussed individually because of the need for species-specific mitigation measures to avoid extensive impacts. Conclusions are summarized after all of the species are discussed.

Federally Listed Species

Bald Eagle

Bald eagles are sensitive to human presence. Disturbance to foraging, resting, roosting, or migrating eagles is possible through surface use in other areas not addressed by stipulations. Based on the assumptions listed in the introduction to the *Wildlife* section, protection of nests and nesting habitat should prevent eagles from abandoning traditional nesting sites in the project area, but periodic or complete abandonment of non-nesting habitat may occur depending on the level of human use and noise. Above-ground transmission facilities could result in the death of some bald eagles because of electrocution. Power lines also pose strike hazards for bald eagles, especially near perennial rivers and water bodies that support fish and waterfowl. Removal of large trees in wintering areas, particularly at established roost sites, would also displace bald eagles by removing perch and roost sites.

Mountain Plover

Mountain plover are most susceptible to disturbance during the nesting season, which can run from mid-April through early July. Construction activity and operations and maintenance could disturb the nesting/courting birds during this period. Noise and the presence of humans and equipment would be the main causes of disturbance. The absence of stipulations to protect mountain plover nesting areas (prairie dog towns smaller than 80 acres) would result in impacts on this species if exploration or development occurs in or near occupied nesting habitat. Prairie dog towns often are located on flat, topographically low areas, which are also preferred by CBM developers.

Interior Least Tern

As with mountain plover, this species is susceptible to disturbance during the nesting period.

Gray Wolf

Roads and the presence of humans would increase the threat from shooting, either on purpose or accidental (when mistaken for a coyote). The density of roads in occupied wolf areas could force wolves from occupied areas and could increase stress on wolves and result in the loss of some individuals.

Canada Lynx

Canada lynx would be expected mainly in western and south-central Montana, where high-elevation, dense, old-growth forests are most likely to be found. Although possible, exploration and development of CBM are not expected to occur in these habitats. Therefore, there would be no impacts to Canada lynx.

Black-Footed Ferret

Black-footed ferrets are exclusively found associated with their main prey species: prairie dogs. Prairie dogs are found throughout the project area. Any activity affecting prairie dog colonies has the potential to impact the ferret. Prairie dog colonies are frequently located on level to slightly sloping ground, which are also prime locations for CBM exploration and development.

Two BLM leasing stipulations address black-footed ferret concerns. The first states that exploration in prairie dog colonies within potential black-footed ferret reintroduction areas comply with the Draft Guidelines for Oil and Gas Activities in Prairie Dog Ecosystems Managed for Black-footed Ferret Recovery (FWS 1990, BLM 1992). If these guidelines are accepted, they specify that conditions of approval depend on the type and duration of the proposed activity, proximity to occupied ferret habitat, and other site-specific conditions. Exceptions or waivers of this stipulation may be granted if the Montana Black-Footed Ferret Coordination Committee determines that the proposed activity would have no disagreeable impacts on ferret reintroduction or recovery. The status of the Fort Belknap population allows them to be treated as a proposed species, which may require a conference with FWS if impacts are expected in the vicinity of the reservation.

The second stipulation requires that all prairie dog colonies or complexes greater than 80 acres in size be surveyed for black-footed ferret absence or presence prior to ground disturbance. The results of the survey determines if restrictions or denial of use are appropriate for the site.

Permits issued by MBOGC do not have the same stated requirements for protection of dog towns of certain sizes; however, the ESA's protection of listed wildlife does apply to state and private land. Operators are prohibited from causing harm to the ferret. As appropriate, state leases will include a survey stipulation or contact MFWP stipulation for species of concern.

Implementation of stipulations in potential and occupied habitat would avoid impacts to the ferret on BLM land.

Grizzly Bear

Threats to grizzly bears mainly result from human-bear interactions, which occasionally end in the death of the grizzly bear. If exploration moves into sparsely settled areas or previously unroaded areas within grizzly bear range, the possibility of bear-human interaction increases.

Federal Candidate Species

One candidate species may potentially found in the project area: the black-tailed prairie dog. Although not subject to the substantive or procedural provisions of the ESA, FWS encourages no action be taken that could impact candidate species and contribute to the need to list the species. The state also has a policy that the state should take no action that could contribute to these species being listed.

Black-Tailed Prairie Dog

As discussed under black-footed ferret above, BLM has stipulations governing activities that could impact black-tailed prairie dog towns larger than 80 acres and if ferrets are found to be present. However, these protections do not apply if the ferret is not present. The MFWP through a working group composed of state, federal, and private individuals is developing a Prairie Dog Conservation Plan to address how to avoid continuing impacts, which are resulting in population declines. Prairie dogs develop colonies on flat ground, which is also preferred by CBM developers. There are no special protective measures being implemented by the state or BLM at this time, although an evaluation including associated impacts to other listed species, in order to identify measures to avoid impacts is required. Construction of CBM exploration and production wells on all land ownerships is expected to impact black-tailed prairie dog towns.

BLM, USFS, and Montana Species of Concern

Under all alternatives, the variety of life forms and the large number of species of concern, the lack of specificity of project locations, and the wide variation in habitat used by these species preclude the ability to identify specific impacts to each individual species of concern. Exploration and development of CBM wells would result in a variety of direct and indirect impacts to species of concern. Specific impacts would depend on the species, the amount and type of habitat removed, and the nature and period of disturbance. Leasing stipulations as discussed above and in the *Wildlife* section would offset or offer some protection to federally listed species. However, there are no stipulations for most species of concern.

Alternative A presents a discussion of impacts to all wildlife species, of which species of concern are a subset. That discussion is not repeated here and the reader should refer to the *Wildlife* section for an understanding of impacts to wildlife species of concern. Some of these species are particularly vulnerable because of their scarcity or narrow habitat niche.

Guidelines recently developed by Connelly et al. (2000) to manage sage grouse populations and their habitat indicate that the stipulations stated above that are intended to avoid impacts on sage grouse leks, and nesting areas during exploration are not adequate to do so. Sage grouse are extremely sensitive to human disturbance and habitat alteration and breeding populations have declined dramatically throughout much of their range (Connelly and Braun 1997) including southcentral and southeastern Montana (Eustace 2001). MFWP has been monitoring certain sage grouse leks in southcentral Montana since the early 1980s. There has been an approximate 50 percent reduction in the number of these active leks since the monitoring began. Eustace attributes this decline to habitat loss and human disturbance and stated that he believes similar declines have occurred in other portions of Montana. Connelly et al. (2000) indicate that energy-related facilities should be located at least 2 miles from sage grouse leks. They further note that sage grouse populations display four types of migratory patterns: 1) distinct winter, breeding, and summer areas; 2) distinct summer areas and integrated winter and breeding areas; 3) distinct winter areas and integrated breeding and summer areas; and 4) non-migratory populations. Avoiding impacts on sage grouse requires protecting the integrity of all seasonal ranges. Average distances between leks and nests vary from 0.7 to 3.9 miles (Autenreith 1981, Wakkinen et al. 1992, Fischer 1994, Hanf et al. 1994, Lyon 2000), and movements between seasonal ranges may exceed 45 miles (Dalke et al. 1963, Connelly et al. 1988). Furthermore, sage grouse have high fidelity to all seasonal ranges (Keister and Willis 1986, Fischer et al. 1993). Females return to the same area to nest each year (Fischer et al. 1993) and may nest within 660 feet of their previous year's nest (Gates 1983, Lyon 2000). Therefore, while important, protecting a 1/4-mile radius area around leks as specified in the stipulations, is inadequate to avoid impacts on displaying and nesting birds and does nothing to protect much of the breeding area or any wintering areas. This stipulation is not adequate to avoid impacts on sage grouse from CBM activities. Sage grouse would be impacted by CBM activities that occur within 2 miles of sage grouse leks or within winter range.

Overhead power lines constructed for production wells pose several problems for sage grouse. Sage grouse occasionally collide with power lines, especially during periods of relatively poor visibility. Overhead power lines provide hunting perches for raptors. Predation rates on sage grouse increase dramatically when these lines are located in the vicinity of sage grouse leks and wintering areas, resulting in population declines (Connelly et al. 2000, Milodrgovich, G. 2001).

As previously discussed, pumping at CBM wells during development and operation may also alter near-surface hydrology by dewatering local aquifers or lowering shallow groundwater levels. Precarious effects on wildlife and habitat would include drying of sub-irrigated wet meadows, drying of springs, and reduced flow and duration in intermittent and small perennial drainages. Sage grouse could be severely impacted, as broods spend much of July and August in more mesic sites as sagebrush habitats desiccate (Gill 1965, Savage 1969, Connelly and Markham 1983, Fischer et al. 1998). Reduced availability of mesic sites would reduce sage grouse brood survival and unfavorably affect populations (Connelly et al. 2000).

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative A. If there were no CBM development on Tribal Lands, then there is expected to be minimal impacts on wildlife on the reservation. Exceptions to these minimal impacts would include disruption of migratory pathways of some wildlife, impacts due to vehicular traffic, hunting of wildlife, and noise and other impacts to wildlife near borders of the reservation. The limited CBM development forecast under this alternative is not likely to lead to any but minimal impacts.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Mitigation

Agency-applied mitigation measures related to natural resources are presented in Table MIN-5 of the *Minerals Appendix*. Agency-applied measures will be implemented and enforced during all CBM phases. Agency-applied mitigation measures are intended to compensate after-the-fact for some impacts that are not avoided through stipulations. Residual impacts are those that remain after implementation of mitigation measures.

BLM would include and enforce appropriate measures during the site-specific plan approval stage. Measures to further avoid or reduce impacts in addition to those included at the plan approval stage may be recommended. The state would apply additional mitigation measures on a case-by-case basis through the use of field rules. However, no specific additional mitigation measures have been identified for inclusion by BLM or the state at this time and no mitigation measures besides those in Table MIN-5 were considered in the analysis.

Species of Concern Mitigation Measures

Bald Eagle

Before construction begins, a wildlife biologist would survey the construction zone within a 0.5-mile width for bald eagles and bald eagle nests and identify any locations that are found. No surface occupancy or use within 0.5 miles of known nests or riparian nesting habitat would minimize impacts to nesting bald eagles.

Mountain Plover

Surveys would be made for all prairie dog towns within the roadway corridor and pad sites. If prairie dog colonies or several of the other indicators are found, FWS survey protocol for mountain plover would be followed. See the *Wildlife Appendix* for Mountain Plover Survey Guidelines. This includes surveying from May 1 through June 15 for presence or absence on potential sites. Construction would be avoided in these areas during this time period to assure that potential nesting mountain plovers are not prevented from setting up territories as a result of the presence of equipment and humans.

Interior Least Tern

Potential habitat near drilling and construction sites would be identified and appropriate surveys would be conducted for this species. Surface occupancy and use is prohibited within 1/4 mile of wetlands used by nesting interior least tern during exploration. This stipulation would minimize impacts to interior least tern. Occupied wetlands and water levels would be protected in all phases of drilling and construction and no discharge into occupied wetlands would be permitted.

Gray Wolf

Prior to construction on state lands and counties bordering Yellowstone National Park (Gallatin and Park counties), surveys would include specific searches for this animal, occupied dens, or scat. The corridor would be surveyed in the spring, before construction by a wildlife biologist for scat. If scat is found, the site would be surrounded by a buffer zone recommended through consultation with an FWS biologist. If wolves or other wolf indicators are found, FWS would be consulted and proper protocols followed.

Canada Lynx

Any construction areas or drilling pads located in high elevation, old growth forested areas, especially areas with populations of hares or rabbits, would be surveyed prior to construction for scat and individuals following established protocols. If found, the site would be avoided and surrounded by a buffer zone recommended by FWS biologists.

Black-Footed Ferret

No mitigation measures are proposed for this species.

Grizzly Bear

Garbage and other human refuse would be removed from drilling and construction sites on a daily basis in potential bear habitat to avoid attracting bears. Surveys for scat and other sign of grizzly bears in remote, sparsely roaded areas would be conducted prior to construction. If found, protocol would be established after consultation with FWS biologists.

Black-Tailed Prairie Dog

No mitigation measures are proposed for this species.

Conclusions

Agency-applied mitigation measures would reduce erosion potential and facilitate reclamation of disturbed lands during abandonment. If a state or private CBM project triggers a federally related action, the FWS would need to be consulted for federally protected species, by the Federal agency.

Stipulations would avoid some impacts for certain species. However, they would not be 100 percent effective in achieving their intent because of limits on available biological information and because of non-CBM human activities that would be facilitated by new CBM roads. Many of the impacts discussed would not be avoided. Natural resource mitigation measures (Table MIN-5, *Minerals Appendix*) generally focus on vegetation reclamation and related efforts to reduce erosion and water pollution. Measures intended to reduce surface disturbance in sensitive habitats are to be implemented "to the extent practicable." Therefore, it is likely that some sensitive habitats would be directly impacted by CBM development. The intent of reclamation is to re-establish a vegetative cover on disturbed areas rather than to restore native plant communities, as they existed prior to disturbance. Plant species diversity would be lower on reclaimed sites that before disturbance, reducing overall wildlife habitat values for the foreseeable future. Mitigation measures would not be effective at compensating for the indirect impacts on wildlife.

Some wildlife species of concern and their preferred habitat may be disturbed or lost during construction. Individual animals may be lost through collisions with vehicles and indirect impacts as described previously for general wildlife. Indirect impacts to species of concern also could result in displacement or abandonment of habitat or to increased poaching pressure. Species of concern on all lands do not have the same level of protection as ESA-protected species. Therefore, some direct and indirect impacts on individuals or even populations within metapopulations would be expected. This alternative would have the least impact on all species of concern because of the limited number of well developments and associated disturbances.

If habitat degradation is kept at a minimum, mitigation measures are followed for all listed species of wildlife, and appropriate surveys are conducted prior to construction to ensure that these species are not found within or near well sites and other project facilities and corridors and, if found, are buffered by no construction zones and work restrictions recommended by FWS biologists, federally listed wildlife species would be affected but are not likely to be critically affected, directly, by this alternative. For the life of the permit and afterward if road reclamation is not required, these species would be detrimentally affected because of increased road density and associated human activity.

There could be some displacement of bald eagles in non-nesting habitat. Black-tailed prairie dogs may be impacted by this alternative if dog towns are less than 80 acres and if no black-footed ferrets are present.

All species of concern that are not federally protected may be impacted by habitat changes caused by vegetation removal that are not fully recovered with reclamation after well abandonment, by increased access because of more roads, increased noise levels, and conflicts with CBM infrastructure and increased human pressure or by changing streambed hydrology and increased SAR and salinity values in water and soil.

The cumulative impacts on wildlife resulting from the effects of Alternative A include the direct loss of wildlife habitat, fragmentation, and wildlife mortality from collisions. Noise and human presence would disturb sensitive wildlife species over very large areas, causing local population declines for some species. This would be particularly problematic for sensitive species such as raptors, sage grouse, and other birds dependent on sagebrush habitats.

Impacts from Wyoming CBM development on wildlife and wildlife habitat would be similar to those described under Alternative A, but at a far larger scale. More than 7.5 times as many CBM wells may be developed in the Powder River basin of Wyoming than the 18,300 considered under Alternatives B, C, and D. The magnitude of direct and indirect Wyoming CBM impacts on wildlife and wildlife habitat would be about 7.5 times greater than described for Alternatives B, C, and D (described in the following sections). Large areas of riparian habitat would likely be impacted by erosion because of substantially higher flows and by higher SAR levels that are toxic to plants. Groundwater drawdown would likely dry up many springs and reduce flows or dry up intermittent streams throughout the Powder River basin of Wyoming and well into Montana. This would result in the direct loss of habitat and degrade habitat values on lands around springs and intermittent streams because natural water sources would be eliminated.

CBM development in Wyoming would have cumulative effects for many species of concern in Montana, especially under two categories: groundwater and surface water. There would be an increased flow and SAR values in the Powder, Little Powder, and Tongue rivers in Montana (See

Hydrology section for specific changes). The increase in water volume at certain times has the potential to cover sand bars and other open areas. There would be potential cumulative impacts for bald eagles and interior least tern that are present in these rivers as well because flow fluctuations and increases in SAR values would affect the food chain these species rely on and because it may affect their nesting habitat. In addition, the impact to groundwater resources from groundwater drawdown within coal seam aquifers that reach from Wyoming north into Montana could draw groundwater down an estimated 5 feet. This groundwater impact could extend as far as 14 miles into the southern border of Montana that is adjacent to the CBM development area in Wyoming. Indirect cumulative impacts along the southern border of Montana because of groundwater drawdown may result in springs drying up that all wildlife species depend upon, including listed species. Cumulative impacts from CBM development in Wyoming would have an impact, particularly those species that spend all or part of their life in or near the Powder, Little Powder, or Tongue rivers.

Alternative B

Generally, the same types of impacts on wildlife described for Alternative A would occur under Alternative B. However, Alternative B includes development or the drilling of 18,300 CBM wells. This is about 20 times as many wells; miles of roads, pipelines, and utility corridors, and facilities and 20 times more human activity than for Alternative A. CBM development under Alternative B would have widespread ecosystem-level impacts on wildlife and wildlife habitat as discussed at length for Alternative A.

Virtually every wildlife species that occurs within CBM development areas would be impacted, with sensitive species suffering the greatest impacts. For example, wintering and nesting sage grouse and nesting golden eagles would not be adequately protected by stipulations and would be expected to suffer large-scale impacts. It is likely that, at this scale of development, some species would become locally rare or vacate large areas. All of the wildlife groups listed in Table 4-17 would have a very high probability of being impacted throughout the CBM development area under Alternative B.

Table 4-15 in the *Vegetation* section notes the number of acres of direct impact (habitat loss) and the number of miles of roads, pipelines and utility corridors that would result from CBM development under Alternatives B, C, D, and E. Development under Alternative B would result in the direct loss of about 59,500 acres of wildlife habitat to well pads, roads (6,680 miles), and pipeline and utility corridors (20,679 miles). Direct and indirect impacts on wildlife from this scale of development would be both widespread and substantial.

The discussion of impacts for Alternative A indicated that elk, sage grouse, raptors, and other species are particularly sensitive to human disturbance associated with CBM development and related roads. Not all wildlife species are as sensitive to roads and disturbance as these species. However, those that are the most sensitive often include species that are declining in numbers and distribution because of this sensitivity, such as sage grouse and many raptors. Table 4-18 provides estimates of the area of habitat within which species sensitive to disturbance and roads may be affected both within and around the perimeter of CBM well fields. Potentially affected areas are estimated for both 1/2-mile and 2-mile perimeters around well fields and related activity (Fyfe and Olendorff 1976, Lyon 1983, Connelly et al. 2000). The table assumes that well field development would include 8, 16, or 24 wells per square mile and that each well field would include 200 wells. CBM well development is projected to occur over a 20-year period with an average well life of 20 years. Therefore, the information presented in Table 4-17 represents the maximum area of disturbance for sensitive wildlife species in year 20 when all wells would be developed and none would have been closed. Approximately 44 percent of the wells and associated disturbance would be in place in year 5, 72 percent in year 10, and 87 percent in year 15. By year 20, indirect impacts of CBM development would affect more sensitive species of wildlife on between 880,000 and 4.7 million acres, with an effect similar to direct habitat loss (see Table 4-17).

Sagebrush obligate song birds, which are suffering range-wide population declines, are also sensitive to disturbance and habitat fragmentation. They avoid pipeline and road corridors even when the roads are unpaved and receive little use (Ingelfinger 2001). His research in Wyoming natural gas fields found that the density of sagebrush obligates including Brewer's sparrow (*Spizella breweri*), sage sparrow (*Amphispiza belli*), and sage thrasher (*Oreoscoptes montanus*) were reduced by 50 percent within 100 meters of lightly traveled unpaved roads compared to densities in undisturbed sagebrush communities. Sage sparrow density along a natural gas pipeline route with no traffic was 64 percent lower within 100 meters of the route compared to densities in nearby undisturbed sagebrush. Ingelfinger attributed these declines to noise (along the roads), habitat fragmentation, edge

TABLE 4-18
AREA OF INDIRECT WILDLIFE DISTURBANCE AND DISPLACEMENT[1] WITHIN AND AROUND CBM WELL FIELDS FOR MORE SENSITIVE WILDLIFE SPECIES FOR ALTERNATIVES B, C, D, AND E
ASSUMES 200 WELLS PER WELL FIELD, 8, 16, OR 24 WELLS PER SQUARE MILE, AND 91.5 WELL FIELDS[2]

		Indirectly Affected Within 1/2 Mile		Indirectly Affected Within 2 Miles	
		Additional Area Affected Around Perimeter of Each Well Field	Total Affected Area Within 91.5 Well Fields and Within 1/2 Mile of Well Field Perimeters[3]	Additional Area Affected Around Perimeter of Each Well Field	Total Affected Area Within 91.5 Well Fields and Within 2 Miles of Well Field Perimeters[3]
Number of Wells Per Square Mile	Acres Per Well Field	Acres	Acres	Acres	Acres
8	16,000	7,040	2,108,160	35,840	4,743,360
16	8,000	5,120	1,200,480	28,160	3,308,640
24	5,312	4,352	884,256	25,152	2,787,456

[1]See text for discussion of individual and population level consequences of displacement.

[2]A larger average number of wells per field would reduce the affected area. For example, fields averaging 1,000 wells per field and 8 wells per square mile would impact 1,738,061 acres instead of 2,108,160 acres.

[3]Affected area around well fields assumes there is no overlap between affected areas of adjacent well fields. Overlap would reduce affected perimeter area.

avoidance, and possibly inter-specific competition with horned larks, that forage along roads. At full development there would be 6,680 miles of new roads. Assuming no overlap, 100 meters on each side of these roads would include over 530,000 acres and additional effective habitat loss would occur along pipelines. These lands are included in the information presented in Table 4-18.

Some additional direct and indirect impacts not already described for Alternative A would be expected to occur under Alternative B because of the much greater scale of CBM development. Prairie dog colonies tend to be located on relatively flat ground, and often in valleys; sites that are also favored by CBM developers. Prairie dog towns also support much higher densities of birds and mammals and greater avian species richness than on adjacent prairie (Agnew et al. 1986). Various studies have reported 163 vertebrate species on black-tailed prairie dog colonies in Montana including several species of concern such as burrowing owl and mountain plover (Reading et al. 1989, Tyler 1968, Clark et al 1982, Agnew 1986). Prairie dog colonies larger than 80 acres are protected from surface occupancy if blackfooted ferrets are found on BLM lands only. Smaller colonies receive no special protection on any lands. Road, well pad, pipeline, and utility line placement across and on prairie dog towns would result in direct mortality and impact large numbers of species through habitat loss and displacement to unsuitable habitat, which would result in the loss of displaced individuals.

Pumping at CBM wells during development and operation may also alter near-surface hydrology by dewatering local aquifers or lowering shallow groundwater levels as discussed in the *Hydrology* section of this chapter. This would occur where several wells are concentrated in a relatively small area. Effects on wildlife and habitat would include drying of sub-irrigated wet meadows, drying of springs, and reduced flow and duration in intermittent and small perennial drainages. Reduced surface water would result in more xeric vegetation and would impact all types of wildlife, but would be especially important for amphibians and certain bird species that depend on mesic plant communities. Sage grouse could be especially hard hit because broods spend much of July and August in more mesic sites as sagebrush habitats desiccate (Gill 1965, Savage 1969, Connelly and Markham 1983, Fischer et al. 1998). Reduced availability of mesic sites would reduce sage grouse brood survival and unfavorably affect populations (Connelly et al. 2000).

There would be no differences between the direct and indirect impacts on BLM, state, and private lands.

Federally Listed Species

Direct impacts to federally protected species are prohibited by law and would be the same as under Alternative A.

The potential for indirect impact would be much greater under this alternative because of the much larger amount of habitat that would be disturbed or lost with the increased level of vegetation disturbance associated with the greater number of well pads, roads, and utility lines. Increased roadways for more wells would result in greater human access, with the potential for more poaching, indirect disturbance, or harassing of protected species.

The same agency-applied mitigation measures described for Alternative A would apply to Alternative B. The effect of these mitigation measures on impacts would also be the same as under Alternative A.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative B. As before, regulations mentioned above related to wildlife would be under the jurisdiction of Tribal Laws and not state or federal laws. Exceptions to these impacts would include disruption of migratory pathways of some wildlife, impacts resulting from vehicular traffic, hunting of wildlife, and noise and other impacts to wildlife near borders of the reservation. Full scale development forecast under this alternative would increase the risk of these kinds of impact to wildlife on the reservation.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Conclusions

Same impacts as Alternative A for wildlife and species of concern; however, about 20 times greater in area and scope due to greater CBM well development and associated impacts of construction such as roads.

Cumulative impacts would be the same as described for Alternative A except that the impacts from Montana CBM development would be substantially greater.

Alternative C

The same types of impacts on wildlife described for Alternatives A and B would occur under Alternative C. However, Alternative C would have direct impacts on more acres of wildlife habitat than Alternative B. Table 4-15 in the *Vegetation* section notes the number of acres of direct impact (habitat loss) and the number of miles of roads and pipeline and utility corridors that would result from CBM development under Alternative C. Development under Alternative C would result in the direct loss of about 75,762 acres of wildlife habitat to well pads, roads (9,018 miles versus 6,680 miles for Alternative B), and pipeline and utility corridors (27,917 miles versus 20,679 miles for Alternative B). More land would be directly impacted because roads would not be required to follow existing corridors and there would be no requirement to place pipelines and utilities in corridors. Direct and indirect impacts on wildlife from this scale of development would be both widespread and substantial.

Table 4-18 indicates the minimum area on which sensitive species of wildlife would be disturbed by CBM development under Alternative C. Indirect disturbance and effective habitat loss for sensitive species would be the same as under Alternative B and would indirectly affect sensitive wildlife on between 880,000 and 4.7 million acres. Effects of disturbance were described under Alternative A.

CBM development produces excess surface water that has not been available in the past. It is unlikely that this water would go unused. Information in the *Water Resources Technical Report* (ALL 2001b) indicates that virtually all of the water produced during CBM extraction would be suitable for livestock or wildlife use. Cattle typically move up to 0.6 mile from water to graze in steep terrain, but will move up to 2 miles in relatively flat areas (Stoddart et al. 1975). CBM development areas that are greater than 0.6 to 2 miles from natural or developed perennial water sources, depending on terrain, are either not used or used lightly by livestock on a seasonal basis. Increased stock water availability from CBM-produced water would permit private land owners and state and BLM grazing permittees to adjust the distribution and management of their herds to use more of the forage within 0.6 to 2 miles of CBM wells. Each CBM production well field that is located in an area without perennial water sources could make up to several thousand acres available to more intensive cattle grazing. Utilization would be most intensive in the immediate vicinity of the water discharge location wells. Increased livestock grazing reduces forage otherwise available for wildlife and degrades habitat value for many species of wildlife (Saab et al. 1995). The additional CBM water would also be available for wildlife use.

The release of untreated CBM water to surface drainages and streams could result in serious erosion, damaging or destroying instream and streambank riparian vegetation that constitutes valuable wildlife habitat (Regele and Stark 2000). The erosion can result in increased sediment loads, which along with the potential high salinity and sodicity, can degrade the stream and impact riparian vegetation. Impacts of discharging sodic CBM waters would likely be greatest in intermittent and smaller perennial drainages during low-flow periods. Releases during low-flow periods of late summer and fall would have the greatest potential to impact riparian habitat and sensitive wildlife species such as amphibians. This is also the time when this vegetation is naturally stressed because of low water and amphibians are confined to remaining water or are burrowed into shallow mud. The potential for impacts on riparian habitat and amphibians exists along drainages and streams throughout the CBM development area.

Because of the typically low flows of the CBM wells (approximately 5 to 10 gallons per minute), it is likely that these impacts would be localized in the vicinity of the discharge, unless flow were collected from a large number of wells, which may occur. There are no apparent differences between the direct and indirect impacts on BLM, state, and private lands.

Species of Concern

Direct impacts to federally protected species are prohibited by law and are the same as under Alternative A.

The potential for indirect impacts or modification to habitat would be greater under this alternative than for Alternative B (Table 4-18) because of the greater amount of habitat that would be disturbed or lost with the increased level of vegetation disturbance associated with the greater number of well pads, roads, pipelines, and utility lines. Reclamation of disturbed areas would not necessarily restore sites to previous habitat configurations or specific habitat needs of listed species. This alternative will have the greatest acreage of disturbance from roadways, pipelines, and utilities of any alternative. Powerline strike and electrocution hazards are highest with this alternative. This alternative may affect SAR levels in rivers that will affect BLM and state species of concern and bald eagle foraging, interior least tern foraging success, and nesting habitat. Production water disposal could also develop riparian areas that would be lost after abandonment. If listed species come to rely on these areas of developed habitat, this would lead to future declines when the water source for them no longer exists.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative C.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Alternative D

The same types of direct and indirect impacts on wildlife described for the Alternatives A and B and in Tables 4-17 and 4-18 would occur under Alternative D. Areas affected by direct and indirect impacts would be similar to those reported for Alternative B with the additions noted below. The impacts of the beneficial use of water for livestock grazing described for Alternative C would also occur under Alternative D. Unlike Alternative C, CBM water discharged under Alternative D would be treated before release. Additional treated water provided to intermittent and small perennial streams may result in both impacts and benefits, depending mostly on the volume of discharge water relative to the natural flow, the steepness of the terrain, and the erosiveness of the soil. Relatively high volumes of water discharged into smaller drainages could erode the channel, destroying riparian vegetation either directly or as a result of channel down-cutting, which would reduce water availability to plants. Intermittent water sources that become perennial because of CBM discharge would attract grazing livestock for longer periods of the year, resulting in degraded range conditions and reduced forage and cover for wildlife. Increased flows may also result in improved and more extensive riparian vegetation in intermittent drainages where seasonal water stress limits the current extent or condition of the vegetation and in more widespread water availability for wildlife. However, this benefit would be offset if more livestock grazing occurs in the vicinity and downstream of the discharge points. Lack of a requirement to reclaim roads and abandoned reservoirs would increase the potential for noxious weed occurrence and resulting habitat degradation.

There are no apparent differences between the direct and indirect impacts on BLM, state, and private lands.

The same agency-applied mitigation measures described for Alternative A would apply to Alternative D. The effect of these mitigation measures on impacts would also be the same as under Alternative A.

Species of Concern

Direct impacts to federally protected species are prohibited by law and are the same as under Alternative A. The potential for indirect impacts or modification to habitat would be greater under this alternative than Alternatives A or B, but less than Alternative C. As with those alternatives, reclamation of disturbed areas will not necessarily restore sites to previous habitat configurations or specific habitat needs of listed species. There will be increased roadways with this alternative over either Alternatives A or B. As with Alternative C, production water disposal, which would be treated under this alternative, could develop riparian areas that would be lost following abandonment.

Mitigation is the same as for Alternative A, but on a larger scale.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative D.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Conclusions

Residual impacts on wildlife would be similar to those described for Alternative B.

Under all alternatives, the variety of life forms and the large number of species of concern, the lack of specificity of project locations, and the wide variation in habitat used by these species preclude the ability to identify specific impacts to each individual species of concern. Exploration and development of CBM wells would result in a variety of direct and indirect impacts to species of concern. Specific impacts would depend on the species, the amount and type of habitat removed, and the nature and period of disturbance. Leasing stipulations as discussed above and in the *Wildlife* section would offset or avoid some impacts to federally listed species. However, there are no stipulations for most species of concern.

Cumulative impacts would be similar to those described for Alternative B.

Alternative E (Preferred Alternative)

Impacts on wildlife under Alternative E would be similar to those described in Alternative C although potentially less severe for many species of concern. Project Plans would be developed and approved using the programmatic guidance outlined in the Wildlife Monitoring Protection Plan (*Monitoring Appendix*). They would include baseline inventory in areas where wildlife inventory has not been completed. Operators would be required to submit plans which demonstrate how their project design minimizes or mitigates impacts to surface resources and meets objectives for wildlife. The Wildlife Monitoring Protection Plan would be a cooperative approach which incorporates adaptive environmental management principles and establishes a framework which encourages industry, landowners, and agencies to work together constructively to incorporate conservation measures into CBM development. All CBM development would follow the programmatic guidance to address wildlife concerns, and each individual Project Plan would include a site-specific Monitoring and Protection Plan which includes mitigation specific to species or local habitats. Over the life of the CBM project, Wildlife Monitoring Protection Plans would offer some assurances that management would be adapted to address specific situations.

Mitigation measures would be the same as listed in Alternative A.

Species of Concern

Impacts would be the same as Alternative A, but this alternative would have more impact on all species of concern because of the increase in number of wells and their associated disturbances.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative E.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described in general for Alternative E.

Conclusions

Residual impacts would be generally the same as those noted for Alternative A. However, they would occur on a far greater scale, as noted above. Discharge of treated water to intermittent and small perennial streams would result in both impacts and benefits to riparian vegetation and amphibians, depending mostly on the volume of discharge water relative to the natural flow.

Habitat disturbance and poaching would be greater with this alternative than with either Alternatives A or B because of the greater potential area of disturbance.

All species of concern that are not federally protected would be impacted by habitat changes caused by vegetation removal that are not fully recovered with reclamation after well abandonment, by increased access through increased roads, or by changing streambed hydrology and increased SAR and salinity values in water and soil.

Aquatic Resources

Assumptions

The BLM has identified stipulations that would avoid or minimize impacts on biological resources and hydrological features resulting from CBM exploration, production, and abandonment activities on BLM lands (BLM 1992). These stipulations are attached in the *Minerals Appendix*. Stipulations related to aquatic resources include a prohibition on the surface occupancy or use of water bodies and streams, 100-year floodplains of major rivers, and riparian areas. In addition, surface occupancy and use is prohibited within 1/4 mile of designated reservoirs with fisheries to protect the fisheries and recreational values of reservoirs. Surface occupancy also is prohibited on slopes exceeding 30 percent to prevent excessive soil erosion, slope failure, and mass wasting, all of which would contribute increased sediment to drainages that may affect aquatic resources (BLM 1992). These stipulations may avoid some of the impacts on BLM lands, but they do not apply to CBM-related activities on non-BLM lands and therefore would not avoid impacts on non-BLM lands. The only management objective that applies to BLM lands and lands subject to state regulations is the required placement of untreated waters from exploration activities in holding pits, tanks, or reservoirs, with no discharge to waters of the United States allowed applies to BLM and state lands.

CBM exploration, production, and abandonment activities would impact aquatic resources in a number of ways. The likelihood of these impacts occurring depends on the exact nature, location, and timing of CBM activities; the proximity of CBM activities to water bodies and the presence of sensitive species and/or sensitive life stages in these water bodies; and the nature of stipulations and mitigation measures that would be implemented to minimize, avoid, or mitigate the potential occurrence of impacts. A number of these additional mitigation measures that would be applied on a case-by-case basis, as needed, are described in Table MIN-5 of the *Minerals Appendix*. Examples of mitigation measures associated with aquatic resources, some of which are directed at special status species, include considerations of the location and timing of stream crossings as they relate to spawning periods and habitat, minimization or avoidance of in-channel activities to reduce the potential for habitat loss, the development of Spill Prevention Control and Countermeasures Plans to deal with accidental spills, control of storm water pollutant run-off, and various measures to prevent eroded materials from entering drainages. The success of these actions requires a site-specific understanding of the resources to be protected and adherence to stipulations and mitigation measures during CBM activities. The assumptions stated in *Water Resources* section of this chapter also form a portion of the framework for analyzing potential impacts from CBM activities on aquatic resources.

The discussion of impacts in the following text for the No Action Alternative first describes the types of impacts that would result from CBM activities in the absence of stipulations. It then assesses the likelihood of such impacts occurring based on the nature and magnitude of CBM activities, the proximity of those activities to aquatic resources, and the rigor of stipulations that would be implemented on lands managed by BLM and on lands subject to state regulations. Conclusions address the residual impacts that would remain following the implementation of mitigation measures. Conclusions also address the cumulative impacts that would result from the residual impacts of CBM development combined with the potential effects of other projects in the area.

Many of the same types of direct and indirect impacts on aquatic resources would occur regardless of the number of CBM wells developed, although the magnitude of impact would vary. Many of the same types of stipulations and mitigation measures also would be implemented. Therefore, the detailed discussions of types of impacts first presented for the No Action Alternative are referenced, as appropriate, in subsequent discussions of impacts for Alternatives B, C, D, and E. The potentially greater magnitude and geographic extent of impacts on aquatic resources because of the substantially greater number of CBM wells that would be developed under Alternatives B, C, D, and E are discussed under those alternatives.

Impacts from Management Common to All Alternatives

Types of impacts on aquatic resources, including fish, aquatic invertebrates, and their habitat, potentially resulting from CBM development activities would be similar to those described for oil and gas exploration and development activities (MBOGC 1989). These include direct removal of habitat, habitat degradation from sedimentation, altered spawning and seasonal migration because of stream obstructions, direct loss of fish from accidental spills or pipeline ruptures releasing toxic substances, increased legal harvests of fish because of increased human access, and reduced stream flows because of removing water for drilling activities. These potential types of impacts are common to all alternatives and are described further under Alternative A (the No Action Alternative). An additional impact on aquatic resources that would only occur under Alternatives A, C, D, and E is degraded stream water quality and/or increased flows because of discharging production water. This impact also is described under the No Action Alternative. However, no impacts would result from conventional oil and gas activities because of protection of reservoirs on 1,844 acres.

Impacts from Management Specific to Each Alternative

Alternative A

Numerous dewatering problems that affect aquatic resources have been identified for drainages in the Billings RMP and Powder River RMP areas that would continue under the No Action Alternative. In the Billings RMP area, these include periodic dewatering of portions of the Yellowstone River and downstream sections of the Clarks Fork and Bighorn rivers, and chronic dewatering of the Boulder River, the upstream section of the Clarks Fork, portions of the Musselshell River, and Careless Creek. In the Powder River RMP area, dewatering problems include periodic dewatering of the downstream section of the Tongue River and chronic dewatering of the Powder River. Dewatering indicates a reduction in streamflow, usually during the irrigation season (July through September), beyond the point where stream habitat is adequate for fish. Periodic dewatering indicates a crucial problem in drought or water-short years, and chronic dewatering indicates a critical problem in virtually all years (Montana NRIS 2001).

The two most common forms of pollution in the Billings RMP and Powder River RMP area drainages are elevated sediment and salinity concentrations, primarily from non-point sources related to agricultural practices (MBOGC 1989). Levels of dissolved solids in drainages tend to increase proceeding downstream because of contributions from irrigation return flows, increased base flows that have been in contact with soil and rocks for long periods of time, and pollution from human activities. Water quality in intermittent and ephemeral drainages often is of poor quality because of the sudden and highly variable nature of discharge (snowmelt, intense rainstorms) that would result in elevated turbidity, dissolved solids, and suspended sediment levels in these and in downstream perennial drainages (MBOGC 1989). These water quality conditions would likely continue under the No Action Alternative.

Fish populations and habitat in perennial and intermittent streams in the Billings RMP and Powder River RMP areas are impacted by drought, high temperatures, prolonged cold, heavy icing, and flooding (BLM 1995). Pond habitat and fisheries in the RMP areas also would be affected by dry, low-water years when excessive water temperatures and reduced dissolved oxygen levels during summer would kill fish, and by extended periods of ice and snow and subsequent oxygen depletion during winter that would kill fish (BLM 1995). Water quality and habitat for fish in the Park, Gallatin, and Blaine counties' drainages that were discussed in Chapter 3 generally tend to be good to excellent, primarily because of the proximity to headwaters and/or the often undeveloped or remote nature of the surrounding areas. All of these resource conditions would probably continue under the No Action Alternative.

Previous studies have summarized the ways in which aquatic resources, including fish, aquatic invertebrates, and their habitat, would potentially be impacted, either directly or indirectly, by CBM activities (BLM 1992, USDI 2000, Regele and Stark 2000). Many of these impacts are the same as described for oil and gas exploration and development activities (MBOGC 1989). They include the following effects:

- Loss of aquatic and riparian habitat at stream crossings and near well sites
- Habitat degradation and loss from increased sediment delivery and sedimentation
- Altered spawning and seasonal migrations of fish because of stream obstructions
- Direct loss of fish and aquatic invertebrates from accidental spills, leakage, and runoff of toxic substances into drainages
- Increased legal and possibly illegal harvests of fish because of increased human presence
- Degraded water quality and increased stream flows from discharging saline production water into nearby drainages

Crossing streams and placing facilities such as culverts, bridges, and cattle guards during the construction or upgrading of access roads to well sites would result in the localized loss of aquatic and riparian habitat. Depending on stream location and hydrology, drainages may provide year-round (perennial) or seasonal (intermittent or ephemeral) habitat for a variety of fish species and their life stages, including spawning, incubating, rearing, holding, and over-wintering. Drainages also provide habitat for aquatic macro- and micro-invertebrates that are typically important fish foods, such as aquatic insects, zooplankton, clams, snails, and worms, as well as habitat for aquatic plants, including periphyton, phytoplankton, and vascular macrophytes. Instream activities also would alter habitat characteristics such as water depth, velocity, and habitat types that are important to native and introduced fish species as well as benthic invertebrates.

The loss of riparian habitat would be especially important in smaller drainages because of its many influences on the quality of aquatic habitat. Murphy and Meehan (1991) reported that riparian habitat would form a protective canopy that provides overhead cover for fish and moderates the extreme effects of air temperatures during summer (helps to cool streams) and winter (helps to insulate streams). Riparian habitat also helps reduce soil erosion and filters sediment before it enters streams, stabilizes streambanks, and allows for the formation of undercut banks that provide cover for fish. In addition, riparian habitat contributes litter (nutrients and food for invertebrates) and woody debris (instream cover) to drainages, and it provides habitat for insects that fall to the water's surface and are consumed by fish (Murphy and Meehan 1991). The loss of these riparian functions would result in impacts on aquatic resources.

Soil disturbance, erosion, and runoff during CBM activities would result in increased sediment delivery to streams and the degradation or loss of aquatic habitat. Examples of such activities include the construction, upgrading, use, maintenance, and retirement of access roads; the installation of culverts, bridges, and cattle guards at stream crossings; other instream activities such as fording streams; site preparation, well drilling, and related onsite facilities; and the construction and placement of pipelines for gas delivery. The potential for erosion and runoff would be greatest where wet or moist soils on steep slopes with little or no vegetative cover have been compacted by heavy equipment (BLM 1992).

Increased sediment delivery to drainages would affect aquatic resources through the sedimentation of habitat and increased levels of turbidity and suspended sediment in the water column. Increased sedimentation would cause a reduction or elimination of stream bottom habitat used by aquatic insects such as caddisflies, mayflies, and stoneflies; a subsequent reduction in aquatic insect abundance and diversity; a reduction in the permeability among interstitial spaces within spawning gravels that inhibits the flow of well-oxygenated water and the removal of metabolic wastes; a subsequent reduction in spawning success, hatching success, and fish production; and a reduction in the interchange of surface and subsurface waters in the hyporheic (mixing) zone beneath the stream channel (Nelson et al. 1991, USDI 2000). Substantially increased sedimentation would eliminate or reduce the depths of pools that provide important year-round cover for juvenile, sub-adult, and adult fish, and would cause the premature siltation of beaver ponds, which often provide year-round habitat for trout (MBOGC 1989). If severe enough, increased sediment loads would cause the erosion and migration of stream channels (Chamberlin et al. 1991), and the degradation of aquatic and riparian habitat.

Elevated turbidity and suspended sediment levels caused by increased sediment delivery would have sublethal and acute effects on fish. Nelson et al. (1991) reported that suspended sediment concentrations of 1,200 mg/l cause mortalities in under yearling salmonids, while suspended sediment concentrations as low as 100 mg/l up to 1,000 mg/l are sometimes associated with a general reduction in fish activity, impaired feeding, reduced growth, downstream displacement, and decreased resistance to other environmental stressors. MBOGC (1989) reported fish and fish food production would be affected by the abrasive effects of very fine sediment on fish embryos and fry and on immature aquatic insects. In addition, very turbid waters would exhibit increased temperatures because of the water's capacity to retain more heat. This would affect those fish and invertebrate species with the most restrictive cold-water or cool-water thermal requirements.

The most severe aquatic impacts resulting from increased sediment delivery would be to trout, whitefish, and grayling. These species have relatively narrow habitat requirements, including the need for clean, cold, well-oxygenated water and/or gravels for spawning, egg incubation, rearing, and adult success (Bjornn and Reiser 1991). The MBOGC (1989) generally concluded that in Montana, increased sediment delivery would have a greater impact on aquatic resources in high-gradient mountain streams than in low-gradient prairie streams. Mountain streams typically support the very sensitive and highly valued species of salmonids, which are generally much less tolerant of increased sediment and turbidity levels than are the warm water fish species found in the lower-gradient prairie streams and rivers in Montana. The MBOGC (1989) also noted that the potential for impacts from sediment delivery to drainages may be greatest in mountainous terrain because roads and pipelines are typically constructed close to streams where slopes are less steep.

Fish spawning migrations and localized movements would be affected by the improper placement, misalignment, or construction of culverts and bridges. Improperly designed facilities would block fish passage directly or constrain fish movements by creating hydraulic barriers caused by excessive water velocities or insufficient water depths. Furniss et al. (1991) reported that unless properly designed, stream crossings would be considered dams that are designed to fail, with subsequent impacts on fish passage and the sedimentation of habitat. Four aspects of culvert design, including diameter, length, slope, and vertical drop to the water's surface, can potentially affect fish passage, especially of smaller fish. The MBOGC (1989) reported that perched culverts or small-diameter culverts with high water velocities effectively block trout spawning migrations. Bell (1986) stated that improperly designed culverts may preclude the passage of small fish and possibly discourage larger fish from attempting passage.

Accidental spills, leakage, and runoff or leaching of petroleum products, drilling fluids stored in reserve pits, and other potentially toxic substances such as saline production water (discussed further below) would contaminate surface water drainages and have acute and chronic effects on fish and their foods (BLM 1992; USDI 2000). The effects of such contamination are influenced by the toxicity of the contaminant including its persistence and fate, volume of spill, distance from surface water and likelihood of contaminant entry, the volume and diluting ability of the receiving water, and sensitivity of organisms exposed to the contaminant. Direct effects include mortalities of aquatic organisms, while indirect effects may be exhibited through chemically induced changes in densities and community structures of aquatic organisms (Norris et al. 1991). Examples include alteration of environmental characteristics such as cover, food, or some other variable important to the well-being of fishes. Effects would be comparatively greater during low-flow than high-flow periods and in smaller rather than larger water bodies. The MBOGC (1989) concluded that the potential for impacts from accidental spills may be greatest in headwater mountain streams with relatively low flows because soils in such areas are often porous and runoff to streams is direct and rapid.

Increased human access because of new roads and increased human activity associated with CBM exploration and production may result in increased legal and illegal harvest of fish from nearby drainages (MBOGC 1989). Besides angling mortalities of game species, legal fishing activities may result in the trampling of eggs and recently emerged fry from wading in streams, and walking on or next to streambanks may cause increased bank erosion and habitat sedimentation.

A CBM activity that would result in stream flow depletion is the pumping and removal of groundwater during CBM production that is closely connected to surface water supplies. The potential for stream flow depletion from this activity depends on geological conditions in the vicinity of the well site and the degree of interconnectedness between surface water and groundwater hydrology and hydraulics. Removal of substantive amounts of groundwater in closely interconnected systems would affect aquatic habitat, particularly in smaller, shallower drainages during low-flow periods and during the summer and winter periods of extreme water temperatures. Examples of resultant habitat modifications that would impact fish and invertebrates include reduced water depths; slower water velocities; fewer and/or shallower pools and riffles; increased water temperatures during summer; exposed stream channel bottom and stream banks; reduced habitat for spawning, rearing, holding, and refugia; reduced riparian habitat quantity, quality, and function; and reduced fish and invertebrate production.

Several examples illustrate the effects, or absence of effects, of groundwater withdrawals on surface water hydrology and aquatic resources. *Southern Ute DEIS* (USDI 2000) noted the potential for slightly altered drainage patterns in surface waters because of CBM production water withdrawals from groundwater aquifers on the Southern Ute Indian Reservation in New Mexico and Colorado. That analysis estimated that between 1,600 and 2,500 acre-feet of water may be lost from instream flows, and concluded that this was not anticipated to impact fish habitat. This is equivalent to a 2.2 to 3.5 cfs reduction in instream flows spread evenly over a year. Under other circumstances and depending on the size of the drainage potentially affected, a flow reduction of about 3 cfs would have substantive effects on very small perennial and intermittent drainages, but negligible effects on very large perennial drainages. Studies also were conducted for the Deer Creek Coal bed Methane Project, which is in the Tongue River watershed in the northwestern part of the Powder River Basin (BLM 2000a). Hydrologic analysis of the Deer Creek Project indicated that because of the sealing effect of the overlying aquitards, water levels in shallow aquifer zones and in shallow wells in the project area would not be impacted by water level drawdowns caused by CBM well operations (BLM 2000a). The Deer Creek analysis concluded that flows and aquatic habitat in project area drainages should not be depleted or aquatic habitat degraded. Similar findings were presented for studies of the Castle Rock Project, which concluded that cumulative impacts on the surface water resources of the exploration area, which include the Powder River and Pumpkin Creek, are expected to be minimal to nonexistent in the short term (BLM 2000b).

Aquatic resources would be affected by the discharge to surface waters of groundwaters that are withdrawn during CBM production activities. The discharge of saline groundwaters would degrade surface water quality and increase flows, impacting aquatic habitat and biota. The effects of production water discharge would be most evident in smaller drainages during low-flow times of the year, particularly in those drainages with low levels of TDS. The specific ionic constituents comprising TDS are also important determinants of a water body's toxicity to aquatic organisms. For purposes of comparison, fresh water usually has a salinity of less than 500 mg/l while sea water has an average salinity of 35,000 mg/l. The surface discharge and runoff of production water also would cause erosion of soils and even higher concentrations of solids. For the proposed Deer Creek Project in the Tongue River watershed, TDS values of water produced from CBM wells are expected to range from 2,500 to 3,500 mg/l (BLM 2000a). Examples of TDS concentrations in groundwater found in coal aquifers of the Powder River Basin were presented previously in the *Hydrological Resources* section of this document, and ranged from 401 to 2,646 mg/l.

Based on the stipulations and assumptions described earlier, relatively few impacts on aquatic resources would be expected from exploration activities on BLM-administered lands under Alternative A. However, short-term impacts on aquatic resources resulting from CBM exploration activities on BLM-administered lands would include increased sediment delivery to nearby drainages during runoff events. Fish passage would also be impeded if culverts or bridges are used to cross drainages and are inappropriately placed. In addition, there is the potential for the accidental spill or leakage and entry of petroleum products into drainages associated with vehicles using the access roads and present at exploration sites. Increased access and human presence during exploration activities also may result in some increased harvest of game fish. There would be no anticipated change in streamflow volumes or salinity caused by exploration activities since these activities would not discharge production waters into surface drainages. Any untreated waters from exploration would be placed in holding pits, tanks, or reservoirs, with no discharge to waters of the United States allowed.

As noted in the earlier discussion of wildlife resources, nearly all of the stipulations for CBM activities on BLM lands do not apply to CBM activities on non-BLM lands (i.e., lands subject to state regulations). Therefore, the absence of stipulations that prohibit the occupancy or use of water bodies, floodplains, and riparian areas on lands subject to state regulations increases the likelihood that exploration activities within or immediately adjacent to these habitats would have a greater potential for impacting aquatic resources than on BLM-managed lands. These impacts would be in addition to those described in the preceding text for exploration activities on BLM lands. However, the magnitude of these impacts would probably still be minor because of the somewhat limited nature of exploration activities. There would continue to be the potential for increased sediment delivery, possible impedance of fish movements in streams, potential for accidental spills of petroleum products, and possibly increased fish harvest. However, there would be no effect on stream flow volume or salinity. In addition, as noted for exploration activities on BLM lands, there would be requirements for placing untreated exploration water in holding pits, tanks, or reservoirs, with no discharge to waters of the United States allowed.

The State of Montana has stressed the importance of protecting high-value recreational fish populations that occur in drainages in the CBM-emphasis area. It is expected that the state would not allow exploration activities to be conducted in a manner that would impact these highly valued fisheries. They include trout fisheries and populations of other important species of game fish, particularly in those drainages in each county that have been judged by the State of Montana to support a resource of national renown and to have outstanding, high, or substantial fisheries resource values.

Under the No Action Alternative, CBM production would only occur on the CX Ranch, where there are no specific stipulations for CBM production activities. Because of this, potential impacts from the development of 250 producing CBM wells on the CX Ranch would generally include the same impacts that were described for exploration activities on lands subject to state regulations, although they would extend over a longer period of time.

The TDS concentration in CBM-produced water from the CX Ranch is about 1,400 mg/l, while Regele and Stark (2000) reported the average TDS concentration for the Tongue River is 284 mg/l. The resultant TDS concentration from discharging 3 cfs of production water (1,400 mg/l TDS) to the Tongue River with a flow of 39 cfs (284 mg/l TDS) would be 364 mg/l TDS. This represents an 80 mg/l increase in TDS over background levels, but it is still well below the TDS guideline of 1,000 mg/l associated with possible effects on fish. This would not be the case when there is very low or sometimes no background flow in the

Tongue River, as is the case during critical drought periods. Under the very worst-case conditions, the only flow in the river would theoretically consist of CBM produced water with a TDS concentration of approximately 1,400 mg/l that has been discharged to the river. While this TDS value would exceed the 1,000 mg/l TDS concentration associated with possible effects on aquatic organisms, it would be the only source of water in the drainage and probably provide at least some refuge for aquatic organisms until background flows return.

This same type of analysis can be done by evaluating the toxicity of produced water and the dilution effect of Tongue River water using bioassays and predictive modeling. However, the results of bioassays differ substantially from and show far fewer effects on aquatic organisms than suggested by predictive modeling. The Mount et al. (1997) model would predict that the produced water from the CX Ranch wells would be lethal to 100 percent of fathead minnows. Once the water is discharged to the Tongue River, the dilution would be such that there would be no increase in toxicity to fish in the river. The model would indicate that if there was no or very little dilution of this discharge by either flowing or standing river water, it would be toxic to fish and aquatic invertebrates.

Results of actual whole effluent toxicity (WET) testing using fathead minnows and a cladoceran (water flea), *Ceriodaphnia dubia*, showed far fewer or no mortalities than predictive modeling. A representative sample of effluent from Fidelity Exploration & Production Company coal bed natural gas wells that discharges to the Tongue River and of Tongue River receiving water collected immediately upstream of the effluent outfall were used in WET testing. Acute toxicity tests (96 hours for fathead minnows and 48 hours for *Ceriodaphnia*) were conducted at Energy Laboratories, Inc. (2001) in Billings Montana, from March 22 through March 26, 2001, in accordance with Region VIII EPA guidelines. Six dilutions were used during WET testing with percent effluent in each dilution at 0 percent (pure receiving water control), 12.5 percent, 25 percent, 50 percent, 75 percent, and 100 percent (pure effluent). The effluent passed the 50 percent mortality test for both species tested, indicating there would be no mortalities at equal parts of effluent (or less) and receiving river water. At effluent levels of 75 and 100 percent, fathead minnow survival after 96 hours was 85 percent and 60 percent, respectively. *Ceriodaphnia* survival after 48 hours at effluent levels of 75 and 100 percent was 95 and 80 percent, respectively (Energy Laboratories, Inc. 2001). These test results generally indicate some mortalities of fish and insects could occur when the volume of effluent constitutes more than 50 percent of the flow in a drainage.

The abandonment of exploratory and producing wells would have few, if any, direct or indirect impacts on aquatic resources. Activities that impact aquatic habitat and biota during CBM exploration and production phases would cease with CBM abandonment. Any associated long-term effects on aquatic resources from these discontinued activities, such as sediment delivery from roads, would gradually subside as disturbed areas are reclaimed.

Special Status Species

The federally endangered pallid sturgeon, two federal candidate species (Montana Arctic grayling, Warm Springs Zaitzevian riffle beetle), and two fish species (sicklefin chub, sturgeon chub) not warranted for federal listing but of significant concern to the U.S. Fish and Wildlife Service are present in portions of the project area. Also present in portions of the project area are eight BLM-sensitive and/or state fish species of special concern, including blue sucker, northern redbelly dace, finescale dace, paddlefish, pearl dace, shorthead sculpin, shortnose gar, westslope cutthroat trout, and Yellowstone cutthroat trout. Distribution of these species was described in Chapter 3 discussions of the affected environment for aquatic resources. Because of their scarcity or narrow habitat niche, these special status species may be somewhat more vulnerable to potential project effects than were described above for all aquatic resources. However, the potential for affecting any of the federally listed, candidate, significant concern, BLM-sensitive, or state species of concern would generally be similar to that described in the preceding text for other aquatic species, and would either be low or absent. For example, all water from exploration activities would be captured in tanks and not discharged to rivers. In addition, conditions of MPDES Permits would provide legally enforceable assurances that water quality, aquatic resources, and the beneficial uses of receiving waters would not be degraded by production water discharges. Some impacts could potentially occur, however, during extreme low or no flow conditions. Release of adequate quality water from production may improve habitat that has been degraded through water withdrawals. The range and type of other potential effects discussed above for aquatic resources also apply to special status species since they are a subset of aquatic resources. Special status species could be minimally affected through construction of stream crossings, erosion generated by construction activities, and effects of other activities discussed above for aquatic resources.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative A. However, regulations mentioned above related to aquatic resources would be under the jurisdiction of Tribal Laws and not state or federal laws. If there were no CBM development on Tribal Lands, then there is expected to be minimal impacts on aquatic resources on the reservation. CBM development in Wyoming could impact surface waters on the reservation and could have an effect on aquatic life.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Mitigation

BLM would develop, include, and enforce appropriate mitigation measures for aquatic resources, including special status species, during the site-specific, plan-approval stage. Measures to further avoid or reduce impacts in addition to those included at the plan-approval stage may be recommended. The state would apply additional mitigation measures on a case-by-case basis through the use of field rules. However, there are no specific mitigation measures identified at this time and they were not considered in the analysis.

Conclusions

Relatively few residual impacts on aquatic resources, including the special status species, would be expected from exploration activities on BLM-managed lands. Some minor, short-term impacts on aquatic resources on BLM lands may result from increased sediment delivery, possible impedance of fish movements in streams, potential for accidental spills of petroleum products, and possibly increased fish harvest. Residual impacts on aquatic resources from exploration activities on lands subject to state regulations would be similar to these impacts, although possibly slightly greater in magnitude because of the lack of stipulations prohibiting surface occupancy or use of water bodies, floodplains, riparian areas, and steep slopes. Expected impacts on aquatic resources on state-regulated lands would still be relatively minor because of the limited nature of exploration activities and their dispersed pattern over a large geographic area. Residual impacts from developing 250 CBM wells on the CX Ranch would include the same potentially minor kinds of impacts that were described for exploration activities on lands subject to state regulations, although they would extend over a longer period of time. The effects of discharging saline production water from these wells to the upper Tongue River drainage basin would cause river flow to increase from about 39 cfs to 42 cfs and river TDS concentration to increase from 284 mg/l to 364 mg/l. These increases would not be expected to impact aquatic habitat or organisms in the Tongue River. In addition, the conditions of the MPDES Permit would provide legally enforceable assurances that water quality, aquatic resources, and the beneficial uses of receiving waters would not be degraded by production water discharges. Discharges of CBM produced water during extreme drought conditions of no background flow (worst-case conditions) would probably provide some refuge for aquatic organisms, even though TDS concentration would be approximately 1,400 mg/l. There also could be some mortalities of aquatic organisms, as indicated by results of WET testing, under these extreme conditions. The abandonment of CBM wells would have few, if any, direct or indirect residual impacts on aquatic resources. Long-term effects on aquatic resources associated with discontinued activities, such as sediment delivery from roads, would subside as disturbed areas are reclaimed. Agency mitigation measures implemented during abandonment would reduce erosion potential, prevent water pollution, facilitate reclamation of disturbed lands, and further reduce the potential for long-term impacts on aquatic resources, including special status species.

This assessment considers the potential cumulative impacts on aquatic resources resulting from the effects of the No Action Alternative together with the effects from five coal mines, two minerals/metals mines, five existing power plants, four oil and gas refineries, and two manufacturing facilities that are present within the project area. The greatest potential for impacts on aquatic resources from these other projects is probably from coal mines, both through the direct loss of habitat and the degradation of water quality. Surface water quality near coal mines is impacted by increased sediment load because of increased erosion during mining. This is mitigated by the use of sediment settling ponds and the vegetation of overburden and topsoil storage areas. The discharge of groundwater pumped from mine pits also may affect surface water quality and quantity, depending on the quality of groundwater within the mine vicinity and the quantity of groundwater discharged. Aquatic resources associated with nearby springs and surface streams within the area would be impacted by the lowering of water tables. In some instances, mining activities impact aquatic resources by diverting streams or drainage areas that are within the area to be mined. Original topography, including stream channels and drainage areas, are restored during mine reclamation activities. Some of these same types of impacts also may occur at minerals/metals mines, but would be less likely to occur at the power plant, oil and gas refinery, and manufacturing sites.

Other possible impacts on aquatic habitat and biota from these projects include sediment delivery from access roads located near drainages, loss of riparian habitat and function along streams, and reduction in water-based recreational activities such as fishing with the loss of aquatic habitat. The nature of effects on aquatic resources from these activities would be similar to those described for potential impacts under the No Action Alternative for CBM development. Most of these impacts would be limited in area given the generally localized nature of these other projects, and their effects are typically mitigated by following standard construction and operating procedures and BMPs and by implementing reclamation activities during or following project construction, operation, and/or abandonment. For these reasons, the effects from these other projects would not be expected to result in substantive cumulative impacts on aquatic resources potentially affected by CBM development.

Regele and Stark (2000) discussed some of the possible biological issues associated with CBM gas development in Montana, including the effects of pumping and discharging saline production water from CBM wells into surface drainages. They reported that much of the groundwater being produced from more than 3,000 CBM-producing wells in the Wyoming portion of the Powder River Basin is being discharged into rivers that flow directly into southeastern Montana. These include the Powder and Little Powder rivers and their tributaries. Some potential short-term and long-term CBM developmental effects identified by Regele and Stark (2000) include decreased surface water availability in some areas because of groundwater pumping; increased surface water flows in areas receiving CBM discharges in other areas; and water quality effects of CBM development discharges on waters and biota receiving the CBM discharges. However, Wyoming EISs and EAs found no decrease in surface water because of aquitards between production coals and surface waters.

The *Hydrology* impact analysis presented in this chapter evaluated the potential cumulative effects of full-scale CBM development and discharge of produced water to the Powder River Basin in Wyoming. That analysis recognized the substantial flow increases and associated hydrologic and water quality impacts that would occur in the Powder, Little Powder, and Tongue rivers in Montana as a result of those discharges. Impacts on aquatic habitat and biota from that magnitude of discharge also would be substantial. The *Hydrology* analysis noted, however, that the Wyoming DEQ and Montana DEQ have pledged to maintain water quality in these three rivers, and that surface water discharge permits limiting the quantity of CBM-produced waters that would be discharged would mitigate impacts from Wyoming CBM on Montana Rivers. This action also would mitigate the potential for cumulative impacts on aquatic resources from the effects of Wyoming CBM on Montana Rivers.

Alternative B

Most but not all of the same types of impacts on aquatic resources described for CBM activities under Alternative A (No Action Alternative) would occur under Alternative B. These impacts and some of their effects include the direct removal of aquatic and riparian habitat at stream crossings and near well sites, habitat degradation and loss from sedimentation, altered spawning and seasonal migration because of stream obstructions, direct loss of fish and aquatic invertebrates from accidental spills or pipeline ruptures releasing toxic substances and increased harvests of fish because of increased human access. The magnitude and geographic extent of these impacts would potentially be greater under Alternative B than Alternative A because of the activities associated with the development of an estimated 2,000 CBM exploration wells and 16,500 CBM production wells.

Impacts described under the No Action Alternative that are associated with the discharge of production water to drainages and resultant increases in stream flows and elevated levels of TDS and constituent contaminants would not occur under Alternative B. There would be a potential for the accidental spill, release, or seepage of production waters temporarily stored in holding ponds or tanks prior to their injection. However, as noted in the Water Resources impact analysis, berms around these facilities would be designed to contain and prevent the accidental runoff to nearby drainages of stored production waters, which should minimize the potential for impacting aquatic habitat and resources.

The *Hydrology* impact analysis indicates, based on the estimated groundwater depletions, those watersheds that may experience the greatest CBM development activity. The most active watersheds are projected to be the Little Bighorn and Lower Bighorn, Upper Tongue and Lower Tongue, Little Powder and Middle Powder, Mizpah, and Rosebud, where an estimated 14 to 50 percent of the groundwater resource within a watershed would be depleted after 20 years. Even though few impacts on aquatic resources are projected under Alternative B, data on fish species present, fisheries management policies, and fisheries resource values would be used to identify those watersheds and drainages that are probably most sensitive to the effects of CBM development and should be monitored closely during CBM activities. Based on these fisheries criteria, drainages probably most sensitive to the effects of CBM development are the Lower Bighorn, Upper Tongue, and Little Bighorn. The Lower Bighorn and Upper Tongue are managed as trout fisheries and have high fisheries resource values, while the Little Bighorn is managed for warm/cool water fish species and trout, and has a moderate fisheries resource value. The Lower Tongue, Little Powder, and Rosebud are probably less sensitive from a fisheries perspective, being managed as non-trout or undesignated fisheries, but they have high to substantial fisheries resource values. The Mizpah is probably the least sensitive of these drainages, being managed as a non-salmonid (warm water) fishery with a moderate to limited fisheries resource value.

Special Status Species

The types of impacts and potential project effects on special status species under Alternative B would generally be similar to those described in the preceding text for aquatic resources under this alternative. Many of these effects also would be similar to those described under Alternative A. However, they would be greater in magnitude and extent because of more exploration and production wells, and would primarily result from construction-related activities. No production water would be discharged to drainages under Alternative B and there would be no resultant potential for affecting special status species. The overall likelihood of affecting special status species would probably be low or absent, depending on species distribution. However, as noted for Alternative A, these species may be somewhat more vulnerable than the more commonly-occurring aquatic species because of their limited distribution, low abundance, and/or narrow habitat requirements.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative B. If there were no CBM development on Tribal Lands, then there is expected to be minimal impacts on aquatic resources on the reservation.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this Alternative.

Mitigation

The same agency mitigation measures described for Alternative A would apply to aquatic resources, including special status species, under Alternative B. The effect of these mitigation measures on impacts also would be the same as described for Alternative A. In addition, management features included in Alternative B would mitigate numerous potential impacts that otherwise might result from CBM development.

Conclusions

The types of residual impacts that would persist for Alternative B are the same as described for Alternative A, with the following two exceptions. Impacts would occur on a far greater scale under Alternative B than Alternative A. Also, no CBM-produced water would be discharged under Alternative B and there would be no potential for resultant residual impacts on aquatic resources including special status species, from that particular activity.

Cumulative impacts would be the same as described for Alternative A. In addition, the 1-mile-wide buffer around active coal mines under Alternative B would reduce the potential for cumulative groundwater drawdown impacts to result from coal mine projects.

Alternative C

Impacts on aquatic resources associated with Alternative C would include all of those CBM-related impacts described for Alternatives A or B, but they would be greater in magnitude. The intensity and geographic extent of CBM exploration, production, and abandonment under Alternative C would be the same as described for Alternative B. However, Alternative C emphasizes CBM exploration and development with minimal restrictions, and it would disturb many more acres than Alternative B. Alternative C also contains far fewer management prescriptions designed to avoid, minimize, or mitigate the impacts of CBM development activities on aquatic resources than Alternative B. Alternative C contains some restrictions that would reduce the potential for sediment delivery and resultant impacts, such as positioning roads, pipelines, and utility corridors where there are existing disturbances, and rehabilitating and closing new CBM-related roads following well abandonment. However, unlike Alternative B, CBM exploration and production water would be discharged, untreated, onto the ground's surface where it would subsequently enter surface water drainages. There would be no requirement for injecting CBM production water into the ground. Discharged CBM water would be available for beneficial uses by industry and landowners.

The effects of increased TDS concentrations would probably be greater on the more sensitive species of salmonids in headwater mountain streams than on native fish species in prairie streams that have evolved in an environment of naturally higher TDS levels. In addition, sensitive species of salmonids and non-native warm water fish that have not evolved in highly saline water but that now reside in prairie streams also would be at risk. These species may be particularly vulnerable because TDS levels are generally already high in prairie streams, thereby increasing the potential for TDS-related impacts from CBM production.

Regele and Stark (2000) discussed impacts on aquatic resources resulting from CBM effects on drainage hydrology and water quality that would probably have the greatest likelihood of occurring under Alternative C. Impacts from reduced surface water availability include the reduction or loss of springs and flowing reaches of stream channels that provide habitat for native flora and fauna in southeastern Montana. Regele and Stark (2000) cited studies by the MFWP that recognized the importance of perennial and intermittent prairie streams in the life history of native fishes, by providing spawning and rearing habitat for mainstem fish species. The effects of increased flows from CBM discharges would include channel erosion, soils and vegetation loss, increased sediment load and sedimentation, and degraded water quality; these effects would directly and indirectly impact fish, amphibians, aquatic invertebrates, and algae. Also, if great enough, increased TDS and salinity levels in streams receiving CBM discharges would affect fish and aquatic invertebrates, especially those species not well adapted to high TDS levels, such as salmonids found in higher-elevation streams. Regele and Stark (2000) cited studies that showed TDS concentrations should not be increased above 1,200 micromhos if a water's "excellent biological health characteristics are to be preserved." The potential development of saline seeps down-gradient of CBM holding ponds also would affect aquatic resources present in streams receiving these saline discharges. Regele and Stark (2000) cited the MFWP, which concluded that because of the limited fisheries habitat available in the arid environment of southeastern Montana, great care must be taken where there is a potential to degrade aquatic resources.

The *Hydrology* impact analysis in this chapter estimated that 0.67 billion cubic feet of CBM water would be discharged to the Montana portion of Powder River Basin drainages each year. This is equivalent to an additional, total year-round basin flow of 21 cfs and assumes a 70 percent conveyance loss prior to discharges reaching drainages. The *Hydrology* impact analysis showed that resultant flow increases over base flows would average less than 1 percent in most of the Powder River Basin drainages. The largest percent base flow changes would occur in the Little Powder and Rosebud drainages, which are managed as non-trout, undesignated fisheries and have high or substantial fisheries resource values. Rosebud Creek has been proposed to be classified as a cold water fishery by the Northern Cheyenne Tribe. It supports northern pike and rainbow trout (FWS 1980). This additional volume of water would not be expected to impact larger drainages, but it would impact smaller perennial, intermittent, and ephemeral drainages, especially if peak discharges of CBM water to smaller drainages greatly exceed this annual average. Water quality would be impacted much more than water quantity from CBM discharges because of the considerably higher TDS and constituent contaminant concentrations typically found in CBM-produced water than in surface drainages. The *Wildlife* impact analysis in this chapter notes that the potential for impacting water quality by discharging CBM production water with high salinity and sodicity would be greatest in smaller perennial and intermittent drainages during low-flow periods of the year. The effects of high TDS and constituent contaminant concentrations on aquatic organisms were discussed under Alternative A.

Surface discharges of CBM-produced water would be subject to Montana DEQ MPDES Permit requirements and limitations for discharge into identified watersheds. The volume of CBM production water potentially discharged to the Powder River Basin drainages in Montana that were listed in the *Hydrology* impact analysis has a greater potential for causing sediment, flow, and water quality-related impacts on aquatic resources than the effects of Alternatives A or B. However, these effects would be within the range of acceptable limitations stipulated under the various MPDES Permits that would have to be issued under Alternative C. For this alternative to be viable, conditions of the MPDES Permits must be able to provide legally enforceable assurances that water quality, aquatic resources, and the beneficial uses of receiving waters would not be degraded by production water discharges.

Special Status Species

The types of impacts and potential project effects on federally listed, candidate, significant concern, BLM-sensitive, and state species of concern under Alternative C would generally be similar to those described in the preceding text for aquatic resources under this alternative. Special status species would potentially be affected by changes in the quantity and quality of receiving waters from discharges of CBM-production water, construction of stream crossings, erosion generated by construction activities, and effects of other activities discussed above for aquatic resources. Since production water will not be held in tanks or improved in quality, that which reaches the Tongue, Little Powder, and Powder Rivers would likely have increased SAR values that could affect the quantity and quality of receiving waters, especially during low or no flow conditions, as well as food sources for special status species. One special status species possibly present in downstream reaches of several of these drainages and found in the Yellowstone River within the Powder River RMA that is potentially at risk is the federally-listed, endangered pallid sturgeon. Other special status species occupying similar habitat types in these particular waters also may be at risk. There also is the potential for affecting the two federal candidate species (Montana Arctic grayling and the Warm Springs zaitzevian riffle beetle) because of the nature of CBM exploration and development activities that would occur under Alternative C. However, the likelihood of risk is probably low because grayling are generally found at relatively high, cold headwater locations in the Gallatin River and the Clarks Fork within the project area, and the riffle beetle is found in a single warm spring near the City of Bozeman. Minimizing or avoiding activities in these specific areas to the extent possible would minimize the potential for affecting these candidate species.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative C.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Mitigation

The same agency mitigation measures described for aquatic resources, including special status species, under Alternative A would apply to Alternative C. The effect of these mitigation measures on impacts also would be the same as described for Alternative A. In addition, several management features included in Alternative C would mitigate some of the potential impacts that otherwise might result from CBM development.

Conclusions

The types of residual impacts that would persist for Alternative C are the same as described for Alternative A, but they would occur on a far greater scale. In addition, a large volume of CBM-produced water would be discharged under Alternative C and there would be a potential for resultant residual impacts on aquatic habitat and organisms, including special status species, from that particular activity. One of the most noteworthy potential effects of this alternative on special status aquatic species would be possible risks to the endangered pallid sturgeon.

Cumulative impacts would be the same as described for Alternative A. Unlike Alternative B, there would be no buffers around active coal mines or Indian reservations to minimize the potential for inter-related effects.

Alternative D

Impacts on aquatic resources associated with Alternative D would include all of those CBM-related impacts described for Alternatives A and/or B, but they would be greater in magnitude. The intensity and geographic extent of CBM exploration, production, and abandonment under Alternative D would be the same as described for Alternative B. However, Alternative D encourages CBM development while maintaining existing land uses and protecting downstream water consumers. Alternative D, like Alternative B, contains a number of management prescriptions designed to avoid, minimize, or mitigate the impacts of CBM development activities on aquatic resources. However, unlike Alternative B, CBM-produced water (depending on water quality) would be treated, prior to its discharge or storage in holding facilities, so that the effluent meets standards established by the Montana DEQ for downstream uses. Beneficial uses of produced water would be allowed and treatment would vary based on industrial, municipal, and agricultural uses. Treated, produced water would be discharged to drainages by pipeline or constructed watercourses to avoid the potential for erosion and sediment-related impacts on aquatic resources. The treatment of produced water prior to its discharge to surface drainages through constructed facilities would greatly reduce the potential for elevated TDS, salinity, and sodicity levels described for Alternative C.

The *Hydrology* impact analysis estimated that 2.24 billion cubic feet of CBM water would enter the Montana portion of Powder River Basin drainages each year. This is equivalent to an additional, total year-round basin flow of 71 cfs and assumes no conveyance losses because of the use of pipelines or constructed water courses to convey discharges. The *Hydrology* impact analysis showed that resultant flow increases over base flows would average 1 percent in Powder River Basin drainages. The greatest increase in base flows (approximately by a factor of 4) would occur in the Little Powder and Rosebud drainages, which would impact aquatic habitat and organisms through the same mechanisms described under Alternative A. This volume of water would not be expected to impact larger drainages, but it would impact other smaller perennial, intermittent, and ephemeral drainages, especially if peak discharges of CBM water to smaller drainages greatly exceed this annual average. Otherwise, water quality of these streams would not be impacted by discharged water since it would have been treated. As noted for Alternatives A, B, and C, conditions of the MPDES permits issued under Alternative D must be able to provide legally enforceable assurances that water quality, aquatic resources, and the beneficial uses of receiving waters would not be degraded by production water discharges.

Special Status Species

The types of impacts and potential project effects on special status species under Alternative D would generally be similar to those described in the preceding text for aquatic resources under this alternative. Many of these effects also would be similar to those described under Alternatives A and B, except they could be greater in magnitude because of the discharge of treated production water to drainages under Alternative D. Special status species potentially most vulnerable to project-related effects would include those in smaller perennial and intermittent drainages within the Powder River Basin. The overall likelihood of affecting special status species would probably be low or absent, depending on species distribution. However, as noted for the other alternatives, special status species may be somewhat more vulnerable than the more commonly-occurring aquatic species because of their limited distribution, low abundance, and/or narrow habitat requirements.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative D.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Mitigation

The same agency mitigation measures described for Alternative A would apply to aquatic resources, including special status species, under Alternative D. The effect of these mitigation measures on impacts also would be the same as described for Alternative A. In addition, management features included in Alternative D would mitigate numerous potential impacts that otherwise might result from CBM development.

Conclusions

The types of residual impacts that would persist for Alternative D are the same as described for Alternative A, with the following two exceptions. Impacts would occur on a far greater scale under Alternative D than Alternative A. Also, CBM production water discharged under Alternative D would be treated and there would be no potential for residual water quality impacts on aquatic resources, including special status species, from that particular activity.

Cumulative impacts would be the same as described for Alternative A. In addition, the 1-mile-wide buffer around active coal mines under Alternative D would reduce the potential for cumulative impacts to result from coal mine projects.

Alternative E (Preferred Alternative)

Impacts on aquatic resources associated with Alternative E (the Preferred Alternative) would generally be comparable to the CBM-related impacts described for Alternative B, which emphasizes the protection of natural and cultural resources. The objective of Alternative E is to manage CBM development in an environmentally sound manner. To meet this scope, Alternative E contains requirements designed to protect hydrologic resources by combining management options of CBM-produced water so that no degradation of water quality would be allowed in any watershed. CBM operators would be required to develop a Water Management Plan as part of their overall Project Plan that describes how impacts on surface resources would be minimized or mitigated, and how a discharge (if proposed by the operator) could occur without damaging the watershed-in accordance with a required and approved NPDES Permit and water quality laws. The lack of transportation corridor requirements under Alternative E would result in greater surface disturbances and possibly increased sediment delivery to nearby drainages compared to Alternative B. However, because of the overall beneficial effect of protective measures, relatively few impacts on aquatic resources would be expected under Alternative E. Aquatic resources in the same watersheds and drainages identified under Alternative B as being most sensitive to CBM development also should be monitored closely during CBM activities under Alternative E.

Special Status Species

The types of impacts and potential project effects on special status species under Alternative E (the Preferred Alternative) would generally be similar to those described in the preceding text for aquatic resources under this alternative. Requirements designed to protect hydrologic resources by combining management options of CBM-produced water so that no degradation of water quality would be allowed in any watershed would benefit special status species. The lack of transportation corridor requirements under this alternative would result in comparatively greater surface disturbances than under Alternative B and possibly increased sediment delivery to nearby drainages. However, because of the overall beneficial effect of protective measures, relatively few impacts on special status species would be expected under Alternative E. The same watersheds and drainages identified under Alternative B as being most sensitive to CBM development also should be monitored closely during CBM activities under Alternative E.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative E. To determine potential impacts to the Crow Reservation, monitoring wells would be installed during the exploration phase on all BLM-administered oil and gas estates that adjoin reservation boundaries in Montana. If monitoring indicates drawdown would occur on the reservation, mitigation such as the operator providing a hydrologic barrier, communitization agreement, or spacing that would protect Indian minerals from drainage, would be required.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this Alternative. The same monitoring and mitigation procedures would be used for the Northern Cheyenne Reservation.

Mitigation

The same agency mitigation measures described for Alternative A would apply to Alternative E. The effect of these mitigation measures on impacts also would be the same as described for Alternative A. In addition, management features contained in Alternative E, including the overall Project Plan and the Water Management Plan, would mitigate or minimize numerous potential impacts on aquatic resources, including special status species, that otherwise might result from CBM development.

Conclusions

The types of residual impacts that would persist for Alternative E are similar to those for Alternative B. These impacts would be essentially the same as described for Alternative A, except that impacts would occur on a far greater scale and there would be no potential for resultant residual impacts on aquatic resources, including special status species, associated with the disposal of CBM-production water.

Cumulative impacts would be the same as described for Alternative A. As with current management, there would be no buffer zone for CBM production around active coal mines.

Comparison Table for Alternatives Impacts

Table 4-19 summarizes, by alternative, the impacts resulting from the management objectives, which were described in Chapter 2.

TABLE 4-19
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing Management)	Alternative B Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize Coal Bed Methane Development	Alternative D Encourage Exploration and Development While Maintaining Existing Land Uses	Alternative E (Preferred)
Air Quality	• Alternative A represents minimal number of wells and associated equipment. Air impacts to wilderness areas, Tribal lands, and other PSD Class I areas would be below all applicable air quality standards.	• Alternative B would result in lower emissions than Alternative C.	• Alternative C would result in emissions of NO_X, CO, VOC, SO_2, methane, and PM-10. These emissions would not exceed any applicable air quality standards.	• Alternative D would result in lower emissions than Alternative C.	• Alternative E would result in lower emissions than Alternative C. • Impacts would be reduced following the mitigation measure described in the Air Quality and Climate section, *Alternative C* discussions.
Cultural Resources	• An estimated 17 cultural resource sites would be disturbed, with four of these sites being impacted from exploration activities in state planning areas; six being impacted from production activities at CX Ranch; and seven being impacted from exploration activities in BLM planning areas. • One to two of these sites could be found eligible for the National Register of Historic Places.	• An estimated 629 cultural resource sites would be disturbed, with 16 sites being from exploration activities in state planning areas, 335 from production activities in state planning areas, 10 from exploration activities in BLM planning areas, and 269 from production activities on BLM planning areas. • Of these sites, 119 to 170 could be found eligible for the National Register of Historic Places.	• Similar to Alternative B with the following exceptions: transportation corridors are not required thereby increasing the number of disturbed acres; power lines may be aboveground or buried, which would decrease the number of disturbed acres; and discharge of produced water may be directly to the ground, which would increase erosion.	• Same as Alternative B.	• The estimated number of cultural resources disturbed under Alternative E would be similar to those in Alternative B. • Impacts to important sites would be mitigated as described under the Cultural Resources section, *Impacts From Management Common to All Alternatives*.
Environmental Justice	• No adverse impacts with the exception of the undetermined Wyoming discharge influence. It is concluded that no adverse human health or environmental effects would be expected to fall disproportionately on minority or low-income populations from this alternative.	• No adverse human health impacts are foreseen from these environmental changes. The influence of Wyoming's discharge on Montana river's would constitute a potential environmental justice issue if unresolved. It is concluded that no adverse human health or environmental effects would be expected to fall disproportionately on minority or low-income populations from this alternative.	• Same as B except for adverse environmental effects would be expected from downstream water quality changes resulting in limitations to subsistence living styles. These limitations would fall disproportionately on minority or low-income populations from this alternative. Wyoming Discharge issues same as Alternative B.	• It is concluded that no adverse human health or environmental effects would be expected to fall disproportionately on minority or low-income populations from this alternative. Wyoming Discharge issues same as Alternative B.	• Same as Alternative C. • Impacts would be mitigated as described under the Environmental Justice section, *Alternative A* and by implementation of the Project Plan requirements.

TABLE 4-19
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing Management)	Alternative B Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize Coal Bed Methane Development	Alternative D Encourage Exploration and Development While Maintaining Existing Land Uses	Alternative E (Preferred)
Geology and Minerals	• Federal: – Only minor loss of CBM during Testing operations. • State: – Irretrievable commitment of CBM resources from production on state planning areas. – Prevention of conventional oil and gas development, coal mining, and surface mineral mining because of surface facilities and producing wells on CBM sites. – CBM production dewatering at nearby coal seams, which can cause underground coal fires, methane seeps, and the liberation of methane to water wells. – The presence of shallow CBM production would prevent the performance of seismic prospecting for conventional oil and gas reservoirs. • Cumulative Impacts: – Reduction in Coal resources from current and planned surface mine operations. – Drawdown of groundwater from Wyoming CBM operations, up to 14 miles north into Montana. – Potential CBM drainage along Wyoming Montana State Line.	• Federal: – Same as for the State under Alternative A but increased in magnitude and complexity to reflect full-field development. – Potential mineral drainage between Federal mineral estates and state and private developments depending on site-specific conditions. • State: – Same as Alternative A but increased in magnitude to reflect full-field development. – Mineral drainage issues same as for Federal under this alternative. • Cumulative Impacts: Same as Alternative A.	• Federal: – Same as Alternative B. • State: – Same as Alternative B. • Cumulative Impacts: Same as Alternative A.	• Federal: – Same as Alternative B. • State: – Same as Alternative B. • Cumulative Impacts: – Same as Alternative A.	• Federal: – Same as Alternative B. • State: – Same as Alternative B. • Cumulative Impacts: – Same as Alternative A. • Impacts would be mitigated following the measures outlined in the Geology and Minerals section, *Impacts From Management Common to All Alternatives*.

TABLE 4-19
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing Management)	Alternative B Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize Coal Bed Methane Development	Alternative D Encourage Exploration and Development While Maintaining Existing Land Uses	Alternative E (Preferred)
Hydrological Resources	• Federal: – No impacts to surface or groundwater resources. • State: – Minor increase in surface water flow and quality changes in the Tongue River. – Groundwater drawdown within the vicinity of the CX ranch project up to 14-miles. • Cumulative Impacts: – Wyoming's discharge of CBM production water would increase surface water flow in Montana rivers depending on the season between 8 to 70 times. – Wyoming's discharge of untreated CBM production water would alter surface water quality by increasing SAR levels to between 5 and 17 depending of the drainage system. – Drawdown of groundwater from Wyoming CBM operations, up to 14 miles north into Montana.	• Groundwater: – Groundwater drawdown in Powder River Basin watersheds from 14 to 50%, less in isolated developments across the state. Average represented as 14-miles from edge of field development. – No impacts to groundwater quality foreseen. • Surface Water – Surface water quality changes limited to accidental spills and ruptures due to injection control. – No substantial increase in surface water flow due to injection control. • Cumulative Impacts: – Wyoming impacts same as Alternative A. Full-scale Production will further drawdown Montana groundwater aquifers.	• Groundwater: – Same as Alternative B. – Potential impacts to groundwater quality from impoundment infiltration and surface discharge of untreated production water. • Surface Water – Surface water quality degradation from surface discharge of production water resulting in increased SAR values, increased TDS and other constituents. – Increased surface water flow causing riparian erosion, changes in water courses and increased sedimentation. • Cumulative Impacts: – Impacts to surface water and groundwater from Wyoming are similar to Alternative A. These coupled with Montana's full –scale production would increase aquifer drawdown and decrease surface water quality due to discharge.	• Groundwater: – Same as Alternative B. – Reduced likelihood of impacts to groundwater quality due to treatment requirement prior to discharge. • Surface Water – Surface water quality degradation reduced from treatment requirement prior to discharge. – Increased surface water flow causing riparian erosion, changes in water course and increased sedimentation. – Increased availability of surface water for irrigation and other downstream beneficial uses. • Cumulative Impacts: – Same as Alternative B, however added discharge volumes will further impact riparian areas.	• Groundwater: – Same as Alternative B. – Potential impacts to groundwater quality from impoundment infiltration and surface discharge of untreated production water. • Surface Water – Surface water quality degradation from surface discharge of production water resulting in increased SAR values, increased TDS and other constituents. – Increased surface water flow causing riparian erosion, changes in water courses and increased sedimentation. – Added management options could reduce surface water discharge and thereby, reduce surface water quality impacts. • Cumulative Impacts: – Same as Alternative C but dependent on WDEQ/MDEQ Water Quality Agreement and MDEQ non-degradation numerical standards. • The project plan will discuss how impacts would be mitigated. See also Mitigation subsections described under Hydrological Resources in Chapter 4.

TABLE 4-19
COMPARISON SUMMARY OF IMPACTS

	Alternative A	Alternative B Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural	Alternative C Emphasize Coal Bed Methane	Alternative D Encourage Exploration and Development While Maintaining	Alternative E
Indian Trust Assets	• No measurable Indian trust impacts are expected from the CBM activities planned under this alternative in Montana. • Cumulative Impacts: – Reduction in Coal resources from the Absaloka Mine operation. – Surface water quality and quantity impacts from Wyoming CBM development. – Drawdown of groundwater from Wyoming CBM operations, up to 14 miles inward on the Crow Reservation. – Potential CBM drainage along southeastern corner of Crow Reservation from Wyoming operations.	• Federal: – Groundwater drawdown beyond the 2-mile buffer zone into Reservation Lands, somewhat delayed due to buffer zone. – No surface water quality impacts foreseen. – Potential CBM drainage, dependent on specific site conditions, delayed by buffer zone. • State: – Groundwater drawdown up to 14-miles inward from reservation boundaries. – Limited short-term surface water impacts from spills and ruptures adjacent to Reservations. – Potential CBM drainage, dependent on specific site conditions, no delay due to adjacent development. • Cumulative Impacts: – Same as Alternative A. – Reduction of CBM resources if developed by Tribes, coupled with land disturbances and compounded water impacts.	• Federal: – Groundwater drawdown up to 14-miles inward from reservation boundaries. – Surface water quality and quantity impacts. – Potential CBM drainage, same as Alternative B. • State: – Groundwater drawdown same as Alternative B. – Surface water quality and quantity impacts. – Potential CBM drainage, same as alternative B. • Cumulative Impacts: – Same as Alternative B.	• Federal: – Groundwater drawdown same as alternative B. – Surface water quality impacts reduced by source treatment, increased availability of surface waters for irrigation and other beneficial uses – Increased surface water flow resulting in increase riparian erosion. – Potential CBM drainage, same as Alternative B. • State: – Groundwater drawdown same as Alternative B. – Surface water quality impacts reduced. – Potential CBM drainage, same as alternative B. • Cumulative Impacts: – Same as Alternative B.	• Federal: – Effects from groundwater drawdown lessened due to hydrologic barrier. – Surface water quality impacts reduced by source treatment, increased availability of surface waters for irrigation and other beneficial uses – Increased surface water flow resulting in increase riparian erosion. • State: – Groundwater drawdown same as Alternative B. – Surface water quality impacts reduced. • Cumulative Impacts: – Same as Alternative B. • Measures to reduce or mitigate the impacts are found in the Indian Trust section under *Alternative B*. The Project Plan would also address how effects would be mitigated.

TABLE 4-19
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing Management)	Alternative B Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize Coal Bed Methane Development	Alternative D Encourage Exploration and Development While Maintaining Existing Land Uses	Alternative E (Preferred)
Lands and Realty	• Federal: – Minimal land area displaced by roads. • State: – Increased motorized access on the CX Ranch. – Increase motorized trespass.	• Federal: – Increase fire hazard and motorized access during 20-year lease. – Limit public access. – Disrupt active logging operations. • State: – Displace agricultural lands. – Disrupt irrigation system, increase cost of farm operation. – Reduced property values. – Displace community and residential growth. – Increase dust and noise impacts on residential. – Increase cost of county road maintenance. – Increase long-term motorized access. – invite illegal trespass activities. – Increase forest pests. – Disrupt active logging operations. – Increase motorized trespass.	• All impacts in Alternative B occur in Alternative C in addition to: – Impacts to adjacent mining operations and Tongue River railroad project. – The land use displacement from roads and utility lines during the 20-year lease is greatest in Alternative C.	• All impacts in Alternative B occur in Alternative D in addition to: – Federal: Permanent loss of land use from road network. – State: Production water sodicity and salinity impacts to crops, subsurface impacts to neighboring domestic wells.	• Same as Alternative C. • Impacts would be mitigated as described in the Lands and Realty section under Alternatives B and C. • Impacts from powerlines and not requiring transportation corridors would be the same as Alternative A. • Effects to access would be the same as Alternative D.

TABLE 4-19
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing Management)	Alternative B Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize Coal Bed Methane Development	Alternative D Encourage Exploration and Development While Maintaining Existing Land Uses	Alternative E (Preferred)
Livestock Grazing	• Exploration wells located within BLM-permitted rangelands would result in the temporary loss of 69 AUMs • State: – The exploration wells and production wells located at CX Ranch would result in a maximum construction loss of 272 AUMs on state and private rangelands. – Re-vegetating parts of the well pads during production would reduce the state-permitted losses to 194 AUMs.	• Exploration wells would result in the temporary loss of 413 AUMs (BLM 163, State 250), production wells would result in a maximum construction loss of 11,960 AUMs (BLM 4,770, State 7,190). • Re-vegetating parts of the well pads during production would reduce the losses to 6,904 AUMs (BLM 2,484, State 4,420). • If all Alternative requirements were utilized fully, the area of surface disturbances could be reduced by an additional 35 percent during construction and 40 percent during production.	• Impacts to livestock grazing would be similar to Alternative B. • Additionally, suitable CBM discharge water could be used for livestock watering; increased erosion would result in increased surface disturbance to livestock, which would lead to disrupted grazing patterns, undermined fencing, and reduced forage; an increase of noxious weeds and a decrease in forage material would occur if discharged produced water is too high in saline content; and possible health effects if livestock consume produced water that is unacceptable.	• Impacts would be similar to Alternative C with some exceptions: impacts from drilling and collocation of wells would be the same as Alternative B. • Transportation corridor and road impacts would be similar to Alternative B. • There would be a reduction to forage losses from increased land application of produced water; and there would be less soil and forage loss from erosion of soils.	• Impacts to livestock grazing would be similar to Alternative B. Additionally, suitable CBM discharge water could be used for livestock watering. • Transportation corridor impacts would be the same as Alternative D. • Forage losses would be the same as Alternative D. • Impacts would be mitigated following methods outlined in the Livestock Grazing section, *Impacts From Management Common to All Alternatives*.
Paleontological Resources	• It is unlikely that any of the 12,485 acres that would be disturbed during development would contain noteworthy paleontological resources. The 575-acre Bridger Fossil Area ACEC (only paleontological resource) would not be disturbed. • Other impacts would include vandalism and removal of fossils by amateur fossil collectors resulting from increased accessibility to remote areas.	• Same as Alternative A, except increased access would include increased vandalism and removal of fossils by amateur fossil hunters.	• Same as Alternative B.	• Same as Alternative B.	• Same as Alternative B. • Impacts would be mitigated as described under the *Impacts From Management Common to All Alternatives* subsection, under Paleontological Resources.

TABLE 4-19
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing Management)	Alternative B Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize Coal Bed Methane Development	Alternative D Encourage Exploration and Development While Maintaining Existing Land Uses	Alternative E (Preferred)
Recreation	• Loss of land for recreation purposes, and the disruption to recreation activities • Exploratory activities such as drilling and testing would temporarily displace game species locally	• Impacts would be similar to Alternative A with the addition of more opportunities for Increased access to remote areas	• Impacts would be similar to Alternative B with the exception that increased erosion could lead to a reduced amount of land available for recreation activities and could disrupt habitat for game species.	• Impacts would be similar to Alternative B.	• Impacts would be similar to Alternative B with the exception that no requirements for transportation corridors could increase access to remote areas. • Impacts would be mitigated as described under the *Impacts From Management Common to All Alternatives* subsection.
Socio-Economics	• No social impacts (only small changes in employment, population, demand for services, etc.). • Small impact on economic conditions as a result of new production wells.	• Social impacts would include new jobs and new population moving to the area. • Economic impacts include generation of new personal and government income. • Additional disposal costs associated with injection of production water. • Additional demands on public services.	• Social impacts same as Alternative B, with increase in impacts on lifestyles and values. • Economic impacts same as Alternative B, with increase in impacts to water resource users.	• Social impacts same as Alternative B, with small increase in impacts on lifestyles and values. • Economic impacts same as Alternative B, with small increase in impacts to water resource users.	• Social impacts same as Alternative B, with the exception that public burden to maintain roads may increase depending on landowner access decisions. • Economic impacts same as Alternative B, except that oil and gas income may be less depending on water treatment costs. • Impacts would be mitigated as described under the Alternative A, *Mitigation* subsection.

TABLE 4-19
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing Management)	Alternative B Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize Coal Bed Methane Development	Alternative D Encourage Exploration and Development While Maintaining Existing Land Uses	Alternative E (Preferred)
Soils	• There would be a temporary increase in soil erosion, runoff, and sedimentation, mostly during construction activities. • During exploration, 675 acres of state, private, and BLM lands will be disturbed, with 812 acres of state lands disturbed for production. • 500 acres would be disturbed longer term during production, with a majority of the land reclaimed after production is ceased.	• Soil disturbances could be reduced by 35 percent or higher over Alternative A. • During exploration, 1,850 acres of state, private, and BLM lands will be disturbed, with 35,100 acres of BLM and state lands disturbed for production. • 17,450 acres would be disturbed longer term during production, with a majority of the land reclaimed after production is ceased. • No impacts will be made to soils from CBM waters.	• Impacts would be similar to Alternative B, except that the surface disturbances would not be able to be decreased by up to 35 percent and surface discharge and irrigation of produced water would increase detrimental impacts to soils. • One favorable side effect would be that more water would be available for irrigation if acceptable agricultural land is available, but if acceptable qualities of water are not used, there could be an increased detrimental impact on additional soils.	• Impacts would be similar to Alternative B with the exception that produced water would be treated prior to discharge onto the surface and not injected, which would reduce the detrimental impacts caused by application of high-SAR water to soils.	• Impacts would be similar to Alternative B, however there maybe increased disturbance to surface acres do to increased use of impoundments depending on the discharge strategies used. • Impacts would be mitigated as described under the *Impacts From Management Common to All Alternatives* subsection.
Solid and Hazardous Wastes	• Typical solid waste refuse can be disposed of in local landfills. • Drilling mud and cuttings can be disposed of onsite with the landowner's permission, but most would be hauled offsite to a commercial disposal facility. • Impacts would also occur from the use of pesticides and herbicides during access and construction activities.	• Same as for Alternative A, but with larger quantities of waste.	• Same as for Alternative B.	• Same as for Alternative B.	• Same as For Alternative B. • Impacts would be mitigated following the methods discussed under the *Impacts From Management Common to All Alternatives* subsection.

TABLE 4-19
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing Management)	Alternative B Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize Coal Bed Methane Development	Alternative D Encourage Exploration and Development While Maintaining Existing Land Uses	Alternative E (Preferred)
Vegetation	• As much as 970 acres of native habitat will be permanently impacted under this Alternative, more than half (580 acres) in grasslands. • Potential loss of plant diversity with reclamation. • On non-federal land, Ute ladies'-tresses may be impacted by disturbance.	• As much as 50,158 acres of native habitat could be impacted under this Alternative, more than half (26,962 acres) in grasslands. • Potential loss of plant diversity with reclamation. • On non-federal land, Ute ladies'-tresses may be impacted by disturbance.	• As much as 67,426 acres of native habitat could be impacted under this Alternative, more than half (34,345 acres) in grasslands. • If SAR values exceed 10 in water, riparian vegetation will be impacted, affecting as many as 3,535 acres of riparian habitat. • Potential loss of plant diversity with reclamation. • On non-federal land, Ute ladies'-tresses may be impacted by disturbance, SAR values, and water level changes, particularly inundation.	• As much as 50,158 acres of native habitat could be impacted under this Alternative, more than half (26,962 acres) in grasslands. • Hydrology changes may affect as much as 2,776 acres of riparian habitat. • Potential loss of plant diversity with reclamation. • On non-federal land, Ute ladies'-tresses may be impacted by disturbance and water level changes, particularly inundation..	• Impacts would be similar to those for Alternative C. • Impacts would be mitigated as described under the *Impacts From Management Common to All Alternatives* subsection. • The Project Plan would also address mitigation of effects.
Visual Resource Management	• Federal: – Impacts to VRM Class III and IV only. • Federal and State: – Dust emissions will reduce visibility. – Well pads, roads, and compressors will disrupt the visual landscape long-term. – Drill rigs, two-track trails, heavy road-making equipment, and generators will disrupt the visual landscape short-term.	• Type of impacts common to Alternative A will occur with Alternative B, though at a much greater scale. • View shed impacts from road network will last for 20 years and then reclaimed.	• Impacts common to Alternative B will occur with Alternative C, in addition to the following: • Above ground powerlines will greatly impact skyline and viewshed. • Visual impacts from roads and utility lines is greatest with this alternative until reclamation.	• Impacts common to Alternative B will occur with Alternative D, in addition to the following: • Production related roads will not be reclaimed and will become a permanent visual impact.	• Impacts would be similar to those for Alternative C, except the operator must specify mitigation measures in the Project Plan. • Impacts would be mitigated as described under the Alternative B, *Mitigation* subsection .

TABLE 4-19
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing Management)	Alternative B Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize Coal Bed Methane Development	Alternative D Encourage Exploration and Development While Maintaining Existing Land Uses	Alternative E (Preferred)
Wilderness Study Areas	• BLM leasing restrictions are designed to protect WSAs from substantial impact by prohibiting leasing of these lands for resource extraction. • Because there would be no production activities in BLM planning areas under this alternative, there would be no impacts.	• Same as Alternative A.	• Same as Alternative A.	• Same as Alternative A.	• Same as Alternative A. • Laws and regulations established for WSAs prohibit leasing of WSAs designated lands for resource extraction.
Wildlife	• Direct and indirect impacts would occur at a level commensurate with the level of CBM development. • Direct impacts include habitat loss, death from vehicle collisions, and effects associated with greater human access into previously untraveled areas. • Indirect impacts on wildlife include disturbance and displacement, stress, power lines, noxious weed invasion, user-created roads, habitat fragmentation, water quality degradation from road runoff, and increased livestock grazing. • Indirect impacts on wildlife would occur on 33,840 to 84,000 acres. • Through mitigation, this Alternative should not directly impact any T&E listed wildlife species.	• Same as Alternative A but on a much larger scale. Twenty-five times as many wells, roads, and utility corridors as under Alternative A. • 6,680 miles of roads (2.9 to 8.8 miles per square mile). • 20,697 miles of utility corridors (9 to 27.1 miles per square mile). • Indirect impacts to wildlife on 884,000 to 4.7 million acres. • Additional types of impacts include loss of high value habitats such as prairie dog towns, sage grouse leks, and big game winter range. • Loss of springs and intermittent streams and associated wildlife habitat because of groundwater withdrawal.	• Same as Alternative B plus: – 9,018 miles of roads (3.9 to 11.9 miles per square mile). – 27,917 miles of utility corridors (12.2 to 36.6 miles per square mile). – Indirect impacts to wildlife on 884,000 to 4.7 million acres. – Discharge of untreated CBM water into drainages would impact riparian and wetland habitat and associated species because of poor water quality and erosion – Increased livestock grazing within 2 miles of CBM discharges that occur in areas without summer water	• Same as Alternative B plus: – Discharged treated CBM water would erode riparian and wetland habitat – Increased livestock grazing within 2 miles of CBM discharges that occur in areas without summer water – Through mitigation, this Alternative should not directly impact any T&E listed wildlife species. – Potential indirect impacts to T&E species, such as human disturbance, increased poaching or collisions with vehicles, are greater than under Alternative A because of the increased number of CBM wells permits, but less than Alternative C.	• Same as Alternative C. • Measures to reduce or eliminate these effects are found in the DNRC TLMD lease stipulations, BLM standard lease stipulations and in the MBOGC field rules. These mitigations measures are described throughout the Wildlife section (See Table 4-16 and the *Species of Concern Mitigation Measures* subsection).

TABLE 4-19
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing Management)	Alternative B Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize Coal Bed Methane Development	Alternative D Encourage Exploration and Development While Maintaining Existing Land Uses	Alternative E (Preferred)
Wildlife (cont'd)	• Potential indirect impacts to T&E species, such as human disturbance, increased poaching or collisions with vehicles, are less with this Alternative because of the limited number of CBM wells permitted. • All species of concern that are not federally protected may be impacted by habitat changes caused by vegetation removal that are not fully recovered with reclamation after well abandonment, by increased access through increased roads.	• Through mitigation, this Alternative should not directly impact any T&E listed wildlife species. • Potential indirect impacts to T&E species, such as human disturbance, increased poaching or collisions with vehicles, are greater than under Alternative A because of the increased number of CBM wells permits, but less than C or D because of restricting utilities and roadways to the same corridor. • All species of concern that are not federally protected may be impacted by habitat changes caused by vegetation removal that are not fully recovered with reclamation after well abandonment and by increased access through increased roads.	– Through mitigation, this Alternative should not directly impact any T&E listed wildlife species. – Potential indirect impacts to T&E species, such as human disturbance, increased poaching or collisions with vehicles, are greater under this Alternative than any other because of the increased number of CBM wells permits. – Potential indirect impacts to T&E species from changes in riparian habitat due to increased SAR values and hydrology are likely to occur under this Alternative. Bald Eagles and Interior Least Terns may also be affected if SAR changes affect forage fish. – All species of concern not federally protected may be impacted by habitat changes caused by vegetation removal that are not fully recovered with reclamation after well abandonment, by increased access through increased roads, and/or by changing streambed hydrology and increased SAR and salinity values in water and soil. – More water would be available for wildlife.	– Potential indirect impacts to T&E species from hydrology changes caused by increased water levels may impact nesting Interior Least Terns. If hydrology changes from surface water runoff, cause riparian vegetation changes, other T&E species may be impacted as well, such as nesting Bald Eagles. – All species of concern that are not federally protected may be impacted by habitat changes caused by vegetation removal that are not fully recovered with reclamation after well abandonment, by increased access through increased roads, and/or by changing streambed hydrology.	

TABLE 4-19
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing Management)	Alternative B Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize Coal Bed Methane Development	Alternative D Encourage Exploration and Development While Maintaining Existing Land Uses	Alternative E (Preferred)
Wildlife (Aquatic Resources)	• Minor short-term impacts on aquatic resources during CBM exploration and production may result from increased sediment delivery and its effects on aquatic habitat and organisms, possible impedance of fish movements, potential for accidental spills of petroleum products, and possibly increased fish harvest. • Relatively minor long-term increases in river flow and TDS concentration from production water discharge would not be expected to impact aquatic resources. • Conditions of MPDES Permits would provide legally enforceable assurances that water quality, aquatic resources, and the beneficial uses of receiving waters would not be degraded by production water discharges. • Impacts from CBM abandonment would be minor and subside over time.	• The same types of impacts described for Alternative A (No Action) would occur under Alternative B, except as noted in the following two bullets. • The scale of potential impacts associated with sediment delivery, fish movements, petroleum spills, and fish harvest would be much greater under Alternative B because of the development of over 18,000 CBM wells across a much larger geographic area. • No CBM production water would be discharged to surface drainages under Alternative B and there would be no potential for impacting aquatic resources from this particular activity. • Based on fish species present, fisheries management policies, fisheries resource values, and the projected intensity of CBM development, the drainages most sensitive to the effects of CBM development would be the Lower Bighorn, Upper Tongue, and Little Bighorn; then the Lower Tongue, Little Powder, and Rosebud; followed by the Mizpah. • The potential for affecting aquatic resources in sensitive drainages would be less under Alternative B than under Alternatives C or D.	• The same types of impacts described for Alternative A would occur under Alternative C, but they would occur on a far greater scale because of the development of over 18,000 CBM wells. • A total of 0.67 billion cubic feet of untreated CBM production water would be discharged to drainages each year. Resultant flow and TDS increases could potentially impact aquatic organisms, especially in smaller drainages during dry times of the year. • Conditions of MPDES Permits would provide legally enforceable assurances preventing the degradation of water quality, aquatic resources, and the beneficial uses of receiving waters. • The potential for affecting aquatic resources in the sensitive drainages would be greater under Alternative C than under Alternatives B or D.	• The same types of impacts described for Alternative A would occur under Alternative D, but they would occur on a far greater scale because of the development of over 18,000 CBM wells. • The annual discharge of 2.24 billion cubic feet of treated CBM production water through pipelines or constructed water courses and resultant flow increases could impact aquatic resources in smaller drainages during dry times of the year. • The treatment of CBM production water prior to its discharge would greatly reduce the potential for elevated TDS and salinity impacts on aquatic resources. • MPDES Permits would provide legal assurances that water quality, aquatic resources, and beneficial uses of receiving waters would be protected. • The potential for affecting aquatic resources in the sensitive drainages would be greater under Alternative D than under Alternative B but less than under Alternative C.	• Same as Alternative B.

CHAPTER 5

CONSULTATION & COORDINATION

MONTANA

CHAPTER 5: CONSULTATION AND COORDINATION

Introduction

The Montana Statewide Oil and Gas Environmental Impact Statement (EIS) and Amendment of the Powder River and Billings Resource Management Plans (RMPs) was prepared by an interdisciplinary team of specialists from the Miles City Field Office, Billings Field Office, and Montana State office of the BLM, the State of Montana, and the consulting firms of ALL Consulting and CH2M HILL under contract to the BLM.

Consultation, coordination, and public involvement have occurred throughout the process through scoping meetings, informal meetings, individual contacts, newspaper releases, and *Federal Register* notices.

Preparation of the document began in January 2001. Data used was from inventories conducted before that time, from information received from the public and other agencies, and knowledge of the resource area specialists.

Public Participation

A public participation plan was prepared to provide management and team guidance for developing the RMP amendment and EIS, and to insure public involvement during the entire document preparation process. During the scoping of the plan, formal and informal public input was encouraged and sought after.

Federal Register notice was published on December 19, 2000, informing the public of the notice of intent to plan, and announcing the notice of availability for the planning criteria.

Several news releases were published in local papers. The releases announced the beginning of the plan, encouraged public involvement, and announced the availability of the planning criteria.

Brochures were mailed to more than 1,000 individuals, groups, and agencies in December 2000 notifying the public of the expected issues and upcoming public scoping meetings. A *Public Comment Summary and Recommendations Report* was prepared and made available electronically and in hardcopy in March 2001. This report summarizes the comments received from the public scoping meetings.

Public scoping meetings were conducted at five towns in the planning area with a total attendance of 329 people. Individual meetings were held with Crow and Northern Cheyenne Native American Tribes.

A total of 311 written communications with more than 2,100 comments were received after the public scoping meetings. Most of these written comments were a reiteration of the oral comments received at the public meetings. Oral and written comments covered the entire spectrum of issues, but the majority were concerned with resource management of water, lands, air and wildlife programs. The issues identified are summarized in Chapter 1, under the heading *Issues*. Records of public comments and concerns are on file in the Miles City Field Office.

Consultation with U.S. Fish and Wildlife Service on Threatened and Endangered Species

As required by Section 7 of the endangered Species Act of 1973, the BLM prepared and submitted a biological assessment to the U.S. Fish and Wildlife Service. This document defined potential impacts to threatened and endangered species as a result of management actions proposed in this RMP Amendment and EIS. The final EIS will include the biological assessment and USFWS biological opinion.

Consistency

The BLM's planning regulations require that resource management plans "be consistent with officially approved or adopted resource related plans, and the policies and programs contained therein, of other Federal agencies, State and local governments, and Indian tribes, so long as the guidance and resource management plans are also consistent with the purposes, policies, and programs of Federal laws, and regulations applicable to public lands…" (43 CFR 1610.3-2)

All Federal, state, and local agencies and Tribal councils have been requested to review this document for consistency with their plans and to inform the BLM of any inconsistencies with their plans.

The Montana Governors clearinghouse will be supplied with copies of this draft document for review to ensure consistency with the state's plans.

Official Cooperators:

- Crow Tribe
- U.S. Bureau of Indian Affairs
- U.S. Department of Energy
- U.S. Environmental Protection Agency

Distribution List

The BLM requested comments from industries, businesses, individuals, and special interest groups, federal, state, and local agencies and from Native American tribes. Information has been distributed to the organizations, agencies, and individuals listed.

A

ALL Consulting
Don Allen
American Rock Art Resources Assoc
American Wildlands
Richard Ames
Vince Ames
Amoco Corporation
Lyman Amsden
Leo Ankey
Troy Ankey
Bud Andersen
Donald W. Anderson
Jerome Anderson
Vallerye Anderson
Anschutz Exploration Corp
Apex Energy LLC
Apsalooka Energy
Walter Archer
Ed Arneson
Ron Arneson
Arapaho Business Council
Tom Asay
Associated Press
Lance Astrella
Aqua Terra Consultants
Autry C Stephens
Aviara Energy Corp
Betty Aye
Milan Ayers

B

Earl & Geraldine Bahr
Daniel Bakker
Keith Bales
Ballard Petro LLC
Banko Petroleum Management
Tom Bansak
Jim Barngrover
Elaine Barrett
Max Bartholomew
Basic Earth Science
Vern Bass
Senator Max Baucus
BC Jam Inc
Beartooth Oil & Gas
Richard Beatty
Robin Beaver
Richard Bell
Judith A. Bendel
Benge Ranch Inc
Berco Resources Inc
Keith Berwick
Bice Ranch
Jerry Biekhus
Big Horn County Commissioners
Big Horn County Planning Board
Big Sky Coal Company
R. L. Billau
Billings Area Conservation Roundtable
Billings Chamber Of Commerce
Billings Gazette
Billings Gazette - City Desk
Billings Rod & Gun Club
Evelyn Billo & Robert Mark
Bison Engineering
Norma Bixby
Brian Bjella
Bjork Lindley Danielson & Baker
Blackfeet Oil & Gas Audit
Black Hawk Resources
Black Hills Exploration & Prod Inc
Blackstone Energy
Lee Blatter
Kathleen K. Blehm
John E. Blitz
Mark Bloxham
BLM Cody Field Office
BLM Buffalo Field Office
BLM Great Falls Field Office
BLM Miles City Field Office
BLM Montana State Office
BLM New Mexico State Office
BLM Washington Office
Bloco Inc
Howard Boggess
Thomas J. Boland
Bones Brothers Ranch
Jeani L. Borchert

Bev Borer
Bill Boulware
Bowers Oil & Gas Explor Inc
Jacalyn Boyle
Brian Creek Cattle Co
Brinkerhoff Company
Briose Brothers
Broadus Chamber of Commerce
Gary Broeder
Ed Brow
Roy Brown
Bta Oil Producers
Glynn D. Buie
Charles Bumgardner
Bureau of Indian Affairs – Crow Agency
Bureau of Indian Affairs – Northern Cheyenne Agency
Bureau of Indian Affairs – Area Office
Bureau of Reclamation
Arthur Burke
Burlington Northern Railroad
Burlington Resources Oil & Gas Co
Senator Conrad Burns
John Burroughs
Robert Busk

C

Bill Cagle
Bill Campbell
Campen Consultants
Camwest Limited Partnership
Anita Canovas
Carbon County Commissioners
Caribou Land & Livestock
Kendall P. Carlson
Bill Carrel
Carrell Oil Co DBA Coco
Bob Carroll
Charles Carson
Mike Caskey
Lynne Caughlan
Cedar Hills Ranch
Celsius Energy Company
Bill Champion
Judith & Francis Chapman
Kevin Chartier
Landan Cheney
Chesapeake Operating Inc
Steve Chestnut
Liz Ching
Choctaw II Oil & Gas Ltd
Cheryl Christianson
Church Harris Johnson & Williams
Citation Oil & Gas Corp
Cline Production Co
Jack S. Clubb
Allen Clubfoots
CMS & Sons
CMS Oil & Gas
Coal Creek Mining Co
Paul Cohen
Connie Cole
Senator Mack Cole
Larry Collins
Rich Collins
Tom Collins
Colstrip Area Assoc of Business
Colt Resources Corporation
Columbus Energy Corp
Susan Colvin
Stuart Conner
Conoco Inc
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Constitution Gas Transp Co
Continental Resources Inc
Cooper Petroleum Inc
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Anne Cossitt
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Crow Tribal Chairman
Crow Tribal Contracts Office
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Crow Tribal EPA
Crow Tribe
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Bill Cudworth
Cal Cumin
Ken Cunningham
T J Cunningham
Custer Country
Custer National Forest
Custer Resource Alliance
Custer Rod & Gun Club

D

John Dane
Davis Graham & Stubbs
Davis Oil Co
Day Star Research
Douglas Day
D H Blueprint
Dean & Associates Cons
Decker Coal Co

J M De Gange
Brett Delapp
Tom Dell
Department Of Natural Resources & Conservation
Hawley Desimon
Gerry Devlin
James R. Dickey
Abigail Dillen
David Dittloff
Richard & Cleda Dix
DOI Protests Coordinator
DOI Solicitor's Office
Ben Donegan
Dowell
Jane Dunbar
Duncan Oil Inc
Dundees Place
Peter Durham
Dan Dutton

E

Ben Earley
Earth Sciences Cons Inc
Dave Easterday
Eastern Shoshone Business Council
EB Ranch
Tom Ebzery
Edm Inc
Francis Edwards
Bill Eggers
Leonard & Dorothy Ehlang
EHS Services Inc
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George Elias
Elk Point Resources
Elk River Law Office Pllp
Jim Elliott
David R. Ellis
Charley Emmons
Tom Emmons
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Encore Operating LP
Mark Engle
John Ensign
Ensign Operating Co
Environmental Information Center
Environmental Quality Council
Environmental Protection Agency Region 8
Equity Oil Co
Diane & Wayne Erhart
Kirth Erickson
Europa Energy Inc
Exodus Inc

F

Judith Fahrnow
Pat Farmer
Earl Fawcett
FCB Mineral Operations
Judy Feland
Feland & Kennedy
Felton Angus Ranch Inc
Maurice Felton
Ron Fenex
Kenneth Feyhl
Fidelity E&P
Fish Wildlife & Parks
Erhart Fisher
Mary Fitzpatrick
Dennis Flath
Gloria Flora
Tankard Floyd
Flying J Oil & Gas Inc
John Ford
Kate Forsting
Bill Fortner
Fort Peck Tribal Minerals
Fess Foster
Rena C. Frank
Frisbee Moore & Olson
Frontier Heritage Alliance
Amy Frykman
Fulton Fuel Co

G

George Galuska
Donald A. Garrity
Roger Gaskill
Dan Gaskill
Glenn Gay
Bill Gay
G B Coolidge Inc
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Georesources Inc
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Steve Gilbert
Ron Gilreath
Dorothy L Glasgow
Brandon Glenn
Gilbert Glenn
Joe Glennon
Gordon Cattle Company
Steve Gose
Governor State Of Montana
Bob Grabb
Bonnie & Douglas Graber
John W Graham Jr
Grand Resources Ltd

John Grauman
Great Northern Prop
Great Plains Resources Inc
Greater Yellowstone Coalition
Russ Greenwood
Mary Gregg
Bill Griffin
David D. Grimland
Bernice Gross
Sid & Evelyn Grovenstein
Jack J. Grynberg
James W. Guercio
Byron Guertzgen
Gundry-White Properties LLC

H

Pam Hackely
Greg Haegele
Frank Hagen
Buela L. Hagerman
Bradley Hall
Brenda Lindlief Hall
Hallwood Petroleum
Jim Hamilton
Hancock Enterprises
James N Hannah
Marian Hanson
Hardin Chamber Of Commerce
Hardrock Oil Company
Gray Harris
James Harris
Martin Hart
Hathaway Coal Company
Frank Haughton
Bob Haugland
Hawley Oil Co
Arthur Hayes Jr
Headington Oil Company
Langdon Headsmith
Laura & Jim Heck
Frank He Does It
Gary Helm
Pat Helm
Dave Helvey
L. Brooke Henderson
Vera Henderson
Lawrence Heppner
Bucky Heringer
Herold Geological Research Center
Barry C. Hessenius
Paul Hickman
Hidden Valley Ranch
John Hodnik
Margaret Hofacker
Dena Hoff
Thomas K. Hohn
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Linda Holerst
Don Holland
Holmes Ranch
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Ken Hoversland
Becky Howey
Floyd & Dora Huckins
Gary & FF Huckins
Jane Huffine
Nicholas M Hughes
Hunt Oil Company
Joan Hurdle
Robert Hurly
Hydrometrics Inc
Hydro Solutions

I

Jack Ihli
IHS Energy Group
Independent Petroleum
Industrial & Energy Min Bureau
Infinity Exploration
Thomas Inman
Inman Real Estate
Inst for Policy Res Nw Univ
International Oil Scouts Assoc
Interstate Diesel
C J Iverson

J

Reiny Jabs
Jaco Production Co
Gwen Jacobs
Jerry Jacobs
Edmond Jamieson
Phil Jaquith
J Burns Brown Operating Co
Jimar Resources Corp
Jireh Consulting
Bob Johnson
Dean Johnson
Debra Johnson
Jack Johnson
Johnson Geophysical
Johnson, Grassel & Gorham Llc
Robert G. Johnson
M K Jones
Jn Explor & Prod Ltd Ptshp
Leonard D Jungers

K

Kadrmas Lee & Jackson
Kaiser Francis Oil Co
Becky Kallevig
Ken Kamon
Herb Kane
David Karnos
Leo Karpinski
Robert E Kastner
C G Katselas
Keefe Gorsuch Kirguis LLP
Keesun Corp
Joe Kehl
Bill Kehler
Kennecott Energy
William Kennedy
June Kennick
Richard Kent
Keith Kerbel
John Robert Kerns
Michael Ketcham
Fred Kielsmeier Jr
Tami Kimball
Dale King
King of The Road
King-Sherwood Oil Co
Klabzuba Oil & Gas Inc
David Klenp
Karson Kluver
Steve Knapp
Knife River Coal Mining Company
Albert Knobloch
Jack Knobloch
Lars Knudson
Koch
Allen Kolstad
Martin Kornock
Tony Kowis
Suzin J Kratina
Larry D Krause
Frank Kuehn
Kukowski Land Co
Kummerfeld Construction Co

L

Jennie Lafranier
Clay Landry
Ken & Marcia Lane
Ted Lange
Gordon Lanouette
Mark Larsen
Vince Larsen
Larslan Water Disposal
Lyle Larson
Theresa Larson
Jeff Laszloffy
Bernard Lea
R. Leatherberry
L E Behm Inc
Don R. Lee
John R. Lee
Lee State Bureau
Ralph Lenhart
Peter Lesica
Letec
Evangeline Le Veque
Liberty County Conservation
Francis & Vonda Limpy Sr
Livingston Enterprise
Robert & Jane Lix
Alan Lloyd
John & Marilyn Lockhart
Dr Lawrence L. Loendorf
Lone Star International Energy
Michael Long
Bob Lorenz
Louis Dreyfus Nat Gas Corp
Darrell A. Lowrance
George Loyning
Luff Exploration Co
Scott Lund
Stanley Lund
Jerry Lunde
Tom Luoma
Luther Appraisal Services
Deanna Lvisborg
Lybeck Farms
Willard & Shirley Lybeck
Lyco Energy Corp
Dan Lynch

M

M & K Oil Co Inc
Susan Mac Grath
Mike Machler
William Mac Kay
Macum Energy Inc
Madison Wereline Service
Magic City Fly Fisher
Florence Magner
Glory Mahan
Joyce & Monte Malley
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Leslie Marty

Leigh Marymor
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Angela Mc Dannel
Allen Mc Droo
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Warren A. Mc Millan
Doug McRae
Wally McRae
McRae & Henry Ltd
Leonard Mc Sweyn
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Doris Medicine Bull
Medicine Wheel Coalition
Denny Mengel
M. Eric Merchant
Mercury Exploration Co
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Merit Energy Co
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Miles City Star
Chuck Millar
Ralph Miller
Zach C. Miller
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Bill Milton
Missouri River Royalty Corp
Elaine Mitchell
J. R. Mitchell
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Irene Moffett
Cody J Montalban
Montalban O&G Op Cbm Bldg
Montana Association of Churches
Montana Coal Council
Montana Department of Environmental Quality
Montana Department of Natural Resources & Conservation
Montana Farm Bureau District 5
Montana Heartland LLC
Montana Petroleum Association
Montana Power Company
Montana Power Gas Company
Montana Secretary State
Montana Tech Geophysics Dept
Montana Tech Library
Terry A. Moody
Jim Moore
Eileen Morris
Morrison-Maierle Inc
Mike Moulett
Mountain Pacific General Inc
MSU Billings
Mt Assoc of Counties
Mt Assoc of Petroleum
Mt Board of Oil & Gas Conservation
Mt Bowhunters Association
Mt Bureau of Mines & Geology
Mt Chamber of Commerce
Mt DNRC Water Resources Div
Mt Environmental Quality Council
Mt Farm Bureau Federation
Mt Fish Wildlife & Parks
Mt Native Plant Society
Mt Natural Heritage Prog
Mt Outfitters & Guides
Mt Public Lands Council
Mt State Historical Preservation Office
Mt State Parks Assoc
Mt Wilderness Assoc
Mt Wildlife Federation
David Mullen
Muller Ranch
Robert G. Munson
Murphy Explor & Prod
William R. Musgrave
Amy Myran

N

Nance Petroleum Corp
National Audubon Soc
National Wildlife Federation
Native Action
Natural Gas Processing Co
Keith & Janet Neault
H V Nees
Jean Nelson-Dean
NE Mt Land & Min Assoc Inc
New Mexico State University
North Dakota Geological
Northern Arapaho Business Council
Northern Cheyenne Chamber of Commerce
Northern Cheyenne Cultural Committee
Northern Cheyenne Tribal Chair
Northern Cheyenne Tribal Consultant
Northern Cheyenne Tribe
Northern Montana Oil & Gas
Northern Oil Production Inc
Northern Plains Resource Council
Northern Pump & Compression
Northern Rockie Regional Off
Northland Industrial Specialities
Northstar Gas Co
Earl Norwood
NRC Development Llc
NRG Associates

O

O&G Environmental Consulting LLC
Ocean Energy Resources Inc

Doug Oellermann
Office of Surface Mining
OGP Energy
Oil & Gas Oper Inc
NETA Old Elk
Theion Old Elk
Alan Olsen
Linda Olsen
Loren J. O'toole
Oxy USA Inc
Ozora Resources

P

P R Ranch Realty
Pac Enterprises
Padlock Ranch
D A Padon
Panther Creek Resources LLC
Jay & Krista Partridge
Bea Patten
Peabody Development Company
Peabody Group
Dean Pearson
Jon Peldo
Pennaco Energy Inc
Lew Penwell
Permitco Inc
E. & Karmen Petersen
Lowell Peterson
Peter Yegen Jr Yl Co Museum
Petro Eng & Mgmt Corp
Petro-Hunt LLC
Petroleum Information Corp
Ellen Pfister
Phillips Petroleum
Sheryl Phinney
John L. Pike
Mardell Plainfeather
Plains Petroleum Operating
PM Coal Company
James Poell
Portage Environmental Inc
A. Hayden Porter
F. Porter
Potlatch Oil & Refining Co
David Potter
Poulson Odell & Peterson
Powder River County Commissioners
Powder River Gas LLC
Powder River Conservation Dist
Powder River Wife
Powers Energy Corporation
Prairie Energy Inc
Preston Reynolds & Co Inc
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Jerome H. Prather
Nicol Price
Prima Exploration Inc
Kris Prinzins
Arthur Prosser
Public Lands Access Assoc
Public Lands Foundation
Pumps Plus
Terry Punt
Merle Pursley
Clarence Pursley

Q

Quaneco
Quest Petroleum
Quicksilver Resources Inc

R

Kelly F. Radue
Ranck Oil Co
Ranger Review
Harmon Ranney
Jennifer Read
C. Redcherries
Red Crown Royalties
W G Redfield
Carmen Redmond
Redstone Gas Partners LLC
Dennis Rehrig
Representative Dennis Rehberg
Jessica Rhoades
Robert B. Rhodes
Calvin Rice
Eldon Rice
Nathan A. Rice
Richardson Operating Co
Anna Marie Rider
Donna Riley
John Riley
Sue Riley
Rim Operating Inc
Rimrock Oil Co
Ritchie Exploration Inc
Ritter Laber & Associates
Raymond Rizor
Brian Roat
Blaha W. Robert
Robert Hawkins Inc
Ernie Robinson
James Robinson
Major Robinson
Brian Rochelle
Rocker Six Cattle Co
Rocky Mountain Exploration

Rocky Mountain Oil Journal
Rocky Mtn Oil & Gas Assoc
Walter Rolf
Frank Rollefsen
Anne Rood
Rosebud Audubon Conservation Office
Rosebud County Commissioners
Rosebud County Weed
Rosebud Protective Assoc
Rosebud/Treas Wildlife Assoc
Gloria Rosencranz
Warren H. Ross
G M & Marge Rossetter
Beth Ruden Family Trust
Florence Running Wolf
Rupestrian Cyberservices

S

Doug Saarel
S & L Energy Inc
S Bar B Ranch
Samedan Oil Corp
Samson Resources Company
Butch & Louann Samuelson
Gaye Samuelson
Sands Oil Co
Ronald M Sannes
Ron Santi
Savant Resources
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Kerri Schneider
Tom Schneider
Peter Schoonmaker
Lee H. Schroeder
William Schwarzkoph
Lonnie Schwend
Betty Scott
Lorraine & Howard Scott
Scurlock Permian Corp
Se Mt Sportsmen Association
Jan Sensibaugh
Service Hardware & Drilling Co
Kurt Seward
Jim Shaffer
Aletta & Randy Shannon
Elvin & Josephine Shaw
Jay Shaw
Colleen Shumway
Sheridan Chamber Of Commerce
Sheridan County Commissioners
Sheridan County News
Sheridan County Planning
P G Sheth Ph D
Sierra Club
Lance Sigismond
Kathy Sikaski
Silver Bow Ranch
Albert Skoyen
Duane & Jody Skoyen
Floyd, Julian & Ruby Skoyen
Skull Creek Oil Co
Slawson Exploration Co Inc
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Smith-Foster
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Soap Creek Assoc Inc
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Kyle Spang
Scott Spano
Spectrum Energy Inc
Spring Creek Coal Company
St. Labre Mission
St. Mary Land & Exploration Co
St. Oil Company
Robert Staffanson
Alan Stanfill
D. Starshine
State Auditor - John Morrison
State Library
State of Montana
Stateside Association
James & Helen Stephens
Wallace W Stewart
Bob Stevens
Hope Stevens
Tim Stevens
Stillwater Land Company
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Judy Stolzenburg
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Ernie Strum
John & Fay Stuker
Richard & Rosemary Stuker
Joe Stuver
Summit Resources Inc
Sunburst Consulting
Dr Linea Sundstrom
Surkalo Inc
Dean Swanson
Swanson Drilling Company LLC
Swepi LP
Robert Swinehart
Shirley Sylvester

T

T&Y Irrigation
Robert & Twila Jo Talcott
Watty & Lila Taylor
Douglas Teiszen
Herb Thackeray
The Geosolutions Group LLC
The Home-Stake Royalty Corp
The Prosp Invest & Trad Co Ltd
Deb Thomas
Eric Thompson
Ronald A Thuesen
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Arthur & Terresa Tilleman
John Dwain Tilleman
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Tomahawk Oil Co
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Tongue River Railroad
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Sal Tuzzolino
Larry Tveit
Hubert Two Leggins
Tyler Oil Company

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V

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Steven Vanfossen
W M Vaughey Jr
George Vaught Jr
Charles Verdegan
Don Vidrine
Mitzi & Jim Vorachek
John Vore

W

Verna Wagner
Ken Walchek
Jim Walcutt
William D. Walters Jr
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David Warburton
Bernt Ward
Kirk Waren
Wascana Oil & Gas Inc
Luther Waterland
Robert Watkins Estate
Rebecca W. Watson
Wavetech
Wbi Production Inc
H A Webster
Western Energy Company
Western Land Services
Western Region Land Dir
Westmoreland Resources Inc
Westport Oil & Gas Co Inc
Luella White
Neil Whitehead
Rick Whitman
Mike Whittington
Mrs Leslie Wickland
Wicklin Earth & Water
Chuck Wideman
Mike Wigen
Chuck Wilhelm
Darlene K. Willard
Larry Willard
Burt Williams
Dale & Janie Williams
Thomas L. Williams
Williston Basin Interstate Pipeline Co
Williston Industrial Supply Corp
Williston Projects Inc
Willy's Petroleum
John Wilson
Kemp J. Wilson
Wind River Historical Center
Haman Wise Sr
Terry Wisner
Dr. Don Woerner (Dvm)
Bill Wright
Mel Wright
Milton & Leslie Wright
Wyoming Department of Commerce
Wyoming Resources

X

Xeric Oil & Gas Corp

Y

Yellowstone County Commissioners
Yellowstone Valley Audubon Society
Dennis W. Yockim
G W Yoder
Heidi Youmans
Denzil R. Young
Janet Young
Mary V. Young

Z

Thomas J. Zehren
Nancy Zier
Tom Zook

List of Preparers

BLM Core Team

Mary Bloom: CBM Program Manager, Team Leader, Miles City Field Office, Miles City, Montana.

Kathy Bockness: Planning and Environmental Specialist, Technical Coordination, Miles City Field Office, Miles City, Montana.

David Breisch: Oil and Gas, Mineral Resource Specialist, Technical Coordination, Miles City Field Office, Miles City, Montana.

Marilyn Krause: Public Affairs Officer, Miles City Field Office, Miles City, Montana.

Chuck Laakso: Petroleum Engineer, Technical Coordination, BLM Miles City Field Office, Miles City, Montana.

Carol Larson: Staff Assistant, Bureau Quality Assurance Assistant, Miles City Field Office, Miles City, Montana.

BLM Support Team

Scott F. Archer: Senior Air Resources Specialist, Air Quality and Climate, National Science and Technology Center, Denver, Colorado.

Dan Benoit: Solid Minerals Geologist, Coal, Geology, Miles City Field Office, Miles City, Montana.

Dan Bricco: Recreation Planning, Recreation, Visual Resources, Miles City Field Office, Miles City, Montana.

Tom Carroll: Realty Specialist, Lands and Realty, Billings Field Office, Billings, Montana.

Ken Hanify: Natural Resource Specialist, Minerals, Billings Field Office, Billings, Montana.

Dex Hight: Hydrologist, Hazardous Materials, Hydrology, Miles City Field Office, Miles City, Montana.

Will Hubbell: Archeologist, Cultural Resources, Miles City Field Office, Miles City, Montana.

Edward Hughes: Regional Economist, Economics, Montana State Office, Billings, Montana.

Michael Kyte: Archeologist, Cultural Resources, Billings Field Office, Billings, Montana.

Shelia McNee: Supervisory Natural Resource Specialist, Livestock, Grazing, and Vegetation, Miles City Field Office, Miles City, Montana.

Robert Mitchell: Soil Scientist, Soil, Air, Miles City Field Office, Miles City, Montana.

Keith Mosbaugh: Recreation Planner, Recreation, Visual Resources, Forestry, Billings Field Office, Billings, Montana.

Larry Padden: Range Management Specialist, Livestock Grazing, Vegetation, Billings Field Office, Billings, Montana.

Jay Parks: Wildlife Biologist, Wildlife, Billings Field Office, Billings, Montana.

Larry Rau: Wildlife Biologist, Wildlife, Threatened and Endangered Species, Miles City Field Office, Miles City, Montana.

Joan Trent: Sociologist, Sociology, Environmental Justice, Montana State Office, Billings, Montana.

Pam Wall: Realty Specialist, Lands and Realty, Miles City Field Office, Miles City, Montana.

BLM Management Team

Dave McIlnay: Miles City Field Manager

Sandra Brooks: Billings Field Manager

Aden Seidlitz: Miles City Associate Field Manager

Fred O'Ferrall: Miles City Assistant Field Manager, Minerals

Dale Tribby: Miles City Supervisory Natural Resource Specialist

Fred Wambolt: Miles City Supervisory Natural Resource Specialist

David Jaynes: Billings Assistant Field Manager

BLM Coordination Support and Review

Montana State Office, Miles City Field Office, Billings Field Office and BLM Wyoming staffs:

Division of Lands and Renewable Resources

Division of Mineral Resources

Division of Administration

State of Montana Team

State Core Team

Art Compton: Administrator, Planning, Prevention and Assistance Division.

Greg P. Hallsten: State Co-Lead Agency Representative, CBM Project Manager, Montana Department of Environmental Quality, Helena, Montana.

Tom Richmond: Administrator, Montana Board of Oil and Gas Conservation, Billings, Montana.

State of Montana Support Team

Board of Oil & Gas Conservation

Jim Halvorson: State Petroleum Geologist, Montana Board of Oil and Gas Conservation, Billings, Montana.

George Hudak: UIC Director, Montana Board of Oil & Gas Conservation, Billings, Montana.

Bureau of Mines & Geology

John R. Wheaton: Hydrogeologist, Montana Bureau of Mines & Geology, Billings, Montana.

Department of Environmental Quality

Jeff Blend: Economist, Socioeconomics, Montana Department of Environmental Quality, Helena, Montana.

Dale Herbort: Cultural Resources, Montana Department of Environmental Quality, Helena, Montana.

Abe Horpestad: Water Quality Specialist, Montana Department of Environmental Quality, Helena, Montana.

Bonnie Lovelace: Water Permitting, Montana Department of Environmental Quality, Helena, Montana.

Angela McDannel: Controlled Groundwater, Coal, Montana Department of Environmental Quality, Helena, Montana.

Eric Merchant: Air Quality Specialist, Montana Department of Environmental Quality, Helena, Montana.

Tom Reid: Water Discharge Permitting, Montana Department of Environmental Quality, Helena, Montana.

Department of Fish Wildlife and Parks

Don Skaar: Fisheries, Montana Fish, Wildlife and Parks, Helena, Montana.

Department of Natural Resources and Conservation

Keith Kerbel: Water Resources Specialist, Hydrology.

Teresa Kinley: Geologist/Hydrologist, State Owned Lands and Minerals

Russel Levens: Hydrogeologist, Hydrology.

Monte Mason: Minerals Management Bureau Chief, State Owned Lands and Minerals.

Sharon Moore: Natural Resources Specialist, State Owned Lands and Minerals.

State Historic Preservation Office

Stan Wilmoth: Cultural Resources, State Historic Preservation Office, Helena, Montana.

Consultant Team

Dan Arthur, P.E.: Project Manager, Petroleum Engineer, Hydrologist, ALL Consulting, Tulsa, Oklahoma.

Roy Arthur: Database Specialist, ALL Consulting, Tulsa, Oklahoma.

Chuck Blair, CWB: Wildlife Biologist, CH2M HILL, Boise, Idaho.

Dave Bockelmann: Petroleum Geologist, Geology and Minerals, Cultural Resources, ALL Consulting, St. Louis, Missouri.

Brian Bohm: Geologist/Sociologist, Hazardous Waste, ALL Consulting, St. Louis, Missouri.

Tim Burkhardt: Socioeconomics/Planner, CH2M HILL, Portland, Oregon.

Greg Casey, P.E.: Petroleum Engineer, Environmental Science, Hydrology, ALL Consulting, Houston, Texas.

David Epperly, Ph.D., P.E.: Agricultural Engineer, Soils, Livestock Grazing, Climate, ALL Consulting, Tulsa, Oklahoma.

Judy Ferguson: Environmental Scientist, CH2M HILL, Boise, Idaho.

George Fink, P.E.: Air Quality Scientist, CH2M HILL, Boise, Idaho.

Parker Flemming: Graphic Artist, Economics, ALL Consulting, Tulsa, Oklahoma.

Lynn Foster, RFB: Senior Aquatics Scientist, CH2M HILL, Boise, Idaho.

Paula Gustafson: Editor, CH2M HILL, Boise, Idaho.

Tami Hensler, M.B.A.: Editor, ALL Consulting, Tulsa, Oklahoma.

Amy Hopper: Planner, Recreation and Wilderness Study Areas, CH2M HILL, Portland, Oregon.

Timothy Jones, PhD: Archeologist, Cultural Resources, ALL Consulting, Phoenix, Arizona.

Fred Koethke: Planner/Social, Visual Resource Management, CH2M HILL, Boise, Idaho.

Bruce G. Langhus, Ph.D., CPG: Geology and Minerals, Hydrogeology, Paleontology, ALL Consulting, Tulsa, Oklahoma.

Jonathan Matthews: Land Use and Realty, CH2M HILL, Boise, Idaho.

Dennis Mengel, Ph.D., CPSS: Assistant Project Manager, Fish and Wildlife Biologist, CH2M HILL, Boise, Idaho.

Jason Patton: GIS Specialist, ALL Consulting, Tulsa, Oklahoma.

Jon W. Seekins: Assistant Project Manager, Environmental Scientist, Indian Trust, Environmental Justice, ALL Consulting, Tulsa, Oklahoma.

Brandy Wilson: Editor, CH2M HILL, Boise, Idaho.

David Winter: Biologist, ALL Consulting, St. Louis, Missouri.

Official Cooperators

Bureau of Indian Affairs

Crow Tribe

U.S. Environmental Protection Agency

U.S. Department of Energy

APPENDICES

MONTANA

HYDROLOGY APPENDIX

Summary of Water Resources Technical Report

Introduction

During the second half of the 1990s, coal bed methane (CBM) production increased dramatically nationwide to represent a significant new source of natural gas to meet ever-growing energy demands. In Montana, oil & gas development has been growing since the first oil wells were drilled in the early 20th century. There are currently more than 200 commercially producing CBM wells in the state of Montana, all of which are located in the Powder River Basin near the town of Decker, Montana. CBM development in the Montana portion of the Powder River Basin (PRB) is in part a result of successful development in the Wyoming portion of the basin where CBM activity started as early as 1993 (Flores et al. 2001).

A primary intent of the Montana CBM Environmental Impact Statement (EIS) is to provide an overall projection of impacts associated with CBM development for the planning areas and to address issues raised as part of the public scoping process. Of primary consideration for the EIS are water resources. Due to the extraction methods required for CBM production, impacts to surface water and groundwater can potentially result from CBM development. The purpose of the Water Resources Technical Report (WRTR) (ALL 2001b) is to serve as one of many supporting documents for the subject EIS. Following is a short summary of the WRTR.

Public Scoping Issues

During the scoping process for the Montana CBM EIS, the public was provided with the opportunity to review and comment on resource issues identified as important by the Bureau of Land Management (BLM) and the State of Montana. The public was also provided an opportunity to identify new issues and comment on the Draft Planning Criteria. Water issues raised through the public scoping process include groundwater quality and quantity, surface water quality and availability, produced water management, water conservation, water rights, and groundwater resource assessment.

Study Area

The planning area for the EIS is defined as the area where oil and gas decisions will be made by the BLM and the State of Montana. The BLM's planning area is the oil and gas estate administered by the BLM in the Powder River and Billings Resource Management Planning (RMP) areas. The State of Montana's planning area is statewide, with emphasis on the state-administered oil and gas within the BLM planning area and in Blaine, Park and Gallatin counties. The planning area excludes those lands administered by other agencies (for example, Forest Service and Tribal Councils). For ease of reference, the Billings and Powder River RMP areas, and Blaine, Park, and Gallatin counties, are referred to in the document as the BLM and State "CBM emphasis area." This is the 16-county area within the BLM and state planning area where CBM development interest has been identified.

CBM Production Operations

During CBM production, water is pumped up a tubing string to be put into a water flow-line for handling or discharge. At the only producing CBM field in the Montana portion of the PRB, the water is either used in drilling new wells, pumped into ponds for use by the land owner, or discharged to the Tongue River through a MDEQ discharge permit. Assessment of management alternatives requires an accurate estimate of the amount of produced water to be produced from each well. CBM wells must pump water from the reservoir to lower pressure within the coal, to augment the formation of cleat, and to allow the natural gas to break out as a discrete phase. The amount of water that must be pumped off appears to vary not only from reservoir to reservoir, but also during the history of each individual producing well according to the specific coal bed reservoir it is producing from, and its proximity to other producing wells. The WRTR compiles average water production rates for approximately 200 wells in the CX field normalized to the age of each well (MBOGC oil and gas database). This data was prepared by averaging the water production rates from active CBM wells during each month dating from the date of first production. The exponential trend line is extrapolated from this data is: $Q = 14.661e^{-0.0242t}$ When Q is discharge per well in gallons per minute (gpm), and t is time in months. This indicates that initial discharges are approximately 15 gpm per well, and the 20-year average discharge would be 2.5 gpm. It should be noted that although the average initial discharge is approximately 15 gpm, some wells have discharges as high as 20-25 gpm.

Regional Geology

The planning area of the EIS centers on the Powder River RMP area and the Billings RMP area. The planning area contains three major basinal features – Powder River, Big Horn, and Bull Mountains – and surrounding uplifted areas. The asymmetric basins are the result of sedimentary deposition and structural subsidence with most of the fill consisting of the Fort Union Formation. The Fort Union Formation also contains most of the coals occurring in these three basins.

Fort Union Formation

The Fort Union Formation encloses the various coal seams within the Montana portion of the PRB; these coals function as the source and reservoir for the CBM, as well as aquifers carrying groundwater of varying quantity and quality. Depth to coal seams in the Montana portion of the PRB range from exposure at ground surface to 1,000 feet or more below land surface. Coal thickness varies from thin stringers to over 50 feet and can form aggregate thicknesses that exceed 100 feet. Coal seams in the Fort Union do not have significant matrix porosity and permeability; they can act as aquifers because fluids such as water and methane are contained within the coal's fracture system, known as cleat. The fractures accumulate the fluids and allow the fluids to move horizontally and vertically.

Quaternary Alluvium

Quaternary age sediments are those that are Pleistocene (the latest glacial episode) and Recent (post-glacial episode) in age; the sequence is dominated by events and effects associated with continental glaciation, including glacial till and exaggerated peri-glacial valley fill. Quaternary sediments in the PRB and most of the state are present as variable fill in stream and river valleys. Quaternary Alluvium consists of unconsolidated sand, silt, and gravel that make up the floodplains and stream terraces of creek valleys in the PRB. Alluvium aquifers are largely unconfined and connected to active river flow. Because alluvial aquifers can deliver large quantities of water-to-water supply wells, they are important stratigraphic features. Alluvial aquifers can be impacted by surface activity and can act as a conduit to carry those impacts to valuable surface water resources.

Hydrology

Hydrology identifies aquifers (porous units containing water) and aquitards (non-porous strata that serve to confine and separate aquifers) in a geographic and vertical sense. Aquifers can contain drinkable water, brackish water of limited usability, or salt water. In the EIS planning area, several formations contain drinking water but show variable reservoir quality and water quality. The Montana portion of the PRB includes many aquifers that represent different hydrologic flow regimes. The basin includes unconfined aquifers as well as confined, bedrock aquifers. Aquifers range from the unconfined Quaternary alluvium in the streambeds of rivers and creeks to the Mississippian Age Madison Formation in excess of 10,000 feet below the surface. The water quality within these aquifers ranges from less than 300 mg/L TDS to more than 30,000 mg/L TDS. The aquifers also vary in depth from the basin center to the margin. Coal aquifers are widespread, supply large numbers of water wells, and will be impacted most by CBM production. Alluvial aquifers are commonly unconfined and in direct contact with surface water and can, therefore, be impacted by surface discharge of CBM water.

Watersheds

Watersheds are important to predicting the impacts from CBM development in Montana. Water resource factors such as water quality, water use, and potential impacts are discussed throughout the report in terms of watersheds. Each watershed is drained by a single stream or river and each is bounded by a no-flow topographic boundary. Streams and rivers are profoundly influenced by their watersheds; in particular water volume and water quality vary from base flow conditions to high-flow conditions under the control of runoff from land surfaces and recharge to rivers by aquifers. The WRTR highlights the watersheds in the PRB along with potential CBM areas.

Groundwater Quality

Quality of groundwater resources are detailed in the WRTR. The report lists quality statistics for the major aquifers from various parts of the CBM emphasis area with emphasis on the coal seam aquifers.

Water Resources Impact Issues

Groundwater Drawdown from CBM Development

Groundwater drawdown from CBM production has been documented inside and adjacent to existing production in Montana. CBM production in the PRB requires drawdown of coal aquifers within the producing field in order to liberate methane. Water wells and springs to but outside of a producing CBM field may also be impacted. Drawdown can be documented by way of dedicated monitoring wells or by gauging private water wells. In Montana's CX Ranch CBM field, the MBMG has installed monitoring wells designed to track drawdown due to the coal mines in the area as well as CBM development.

Surface Water Impact from Discharge

Impacts to surface water from discharge of CBM water can be severe depending upon the quality of the CBM water. Some watersheds may be able to absorb the discharged water while others are sensitive to large amounts of low-quality CBM water. Surface water quality in the watersheds is tabulated in the WRTR. Water quality data is from stream gauging points maintained by the USGS; these multi-year collections of water quality data illustrate changes within the stream from times of high run-off (typically June for the PRB) when the river is the highest and water is mostly the result of precipitation from spring rains and melting snow. During periods of high flow the streams and rivers contain higher quality water. The USGS data also contains data on base-flow conditions (typically winter in the PRB) when streams are at their lowest flow and water quality is the lowest since much of the water is recharge from alluvial and bedrock aquifers where groundwater is often of low quality. Discharge scenarios are described and resultant water quality is computed on a watershed basis.

Mitigation

CBM production in the Montana PRB will certainly impact groundwater. Impacts to groundwater resources may however be mitigated through the use of water well agreements, limits placed on discharge and monitoring programs. Furthermore, a predictive model may be helpful as an approximation of future impacts. Groundwater rights will be protected through the use of spring/water well mitigation agreements and an approved monitoring plan to aid in the identification of potentially significant drawdown impacts. Surface water resources can be protected by limiting discharge through alternative management techniques.

Conclusions and Attachments

The WRTR concludes with a list of key water resource factors that are important to the subject of impacts. The appendices contain several pertinent documents as well as groundwater drawdown data from monitoring wells in the vicinity of the CX Ranch field, decline analysis from the CX Ranch field, and groundwater quality data from coal seam aquifers.

TMDL Schedule for CBM Emphasis Area of Montana

Section 303 (d) of the Federal Clean Water Act and Sections 75-5-701 MCA, et.seq. of the Montana Water Quality Act require Montana to develop "Total Maximum Daily Loads" (TMDLs) for lakes, rivers, and streams that are not meeting water quality standards. A TMDL is the amount of a pollutant that a waterbody can assimilate from point, non-point and natural sources and still meet water quality standards. In short, TMDLs guide the development of discharge targets for contributing sources that once implemented will restore or protect water quality.

All waters in Montana have been assigned to one of nine classifications based upon their presumed ability to support certain beneficial uses (i.e. drinking water, recreation, fisheries and aquatic life, agriculture, and industrial uses). Each classification has specific water quality standards including numerical and narrative limits. Waters that fail to meet the numerical or narrative standards are considered impaired. Montana must develop one or more TMDLs for each impaired waterbody.

In accordance with Section 303(d) of the Federal Clean Water Act, the Montana Department of Environmental Quality (MDEQ) has prepared a list of impaired and threatened waters every two years since 1992. This so called "303(d) list" identifies lakes, rivers and streams that are not meeting water quality standards and establishes priorities for TMDL development. However, Montana like the rest of the nation was slow to develop TMDLs.

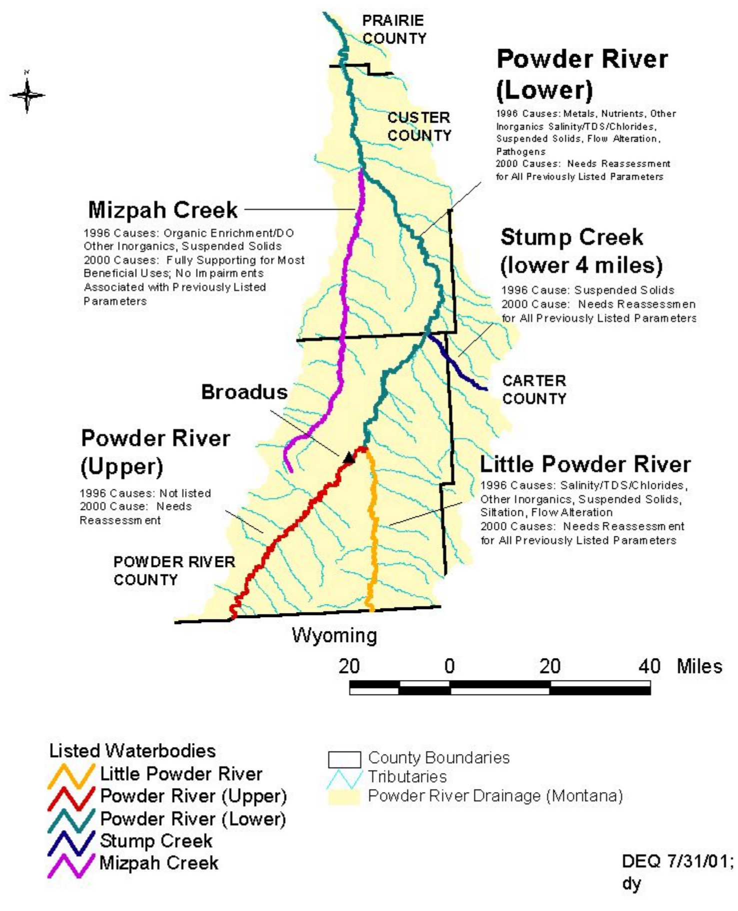
On June 21, 2000, the United States District Court of Montana ordered EPA to work with the State of Montana to develop and adopt a schedule that would result in developing all necessary TMDLs for waters on Montana's 1996 Section 303(d) list (EIS Table 3-5) by May 5, 2007. On November 1, 2000, MDEQ and EPA published a schedule that was based upon a watershed or planning area approach. MDEQ divided the state into 91 TMDL Planning Areas each with a deadline for completing all necessary TMDLs. The surface waters likely to be affected by coal bed methane (CBM) development are located in the Tongue and Powder TMDL Planning Areas. The TMDL completion dates for these planning areas are 2005 and 2006, respectively.

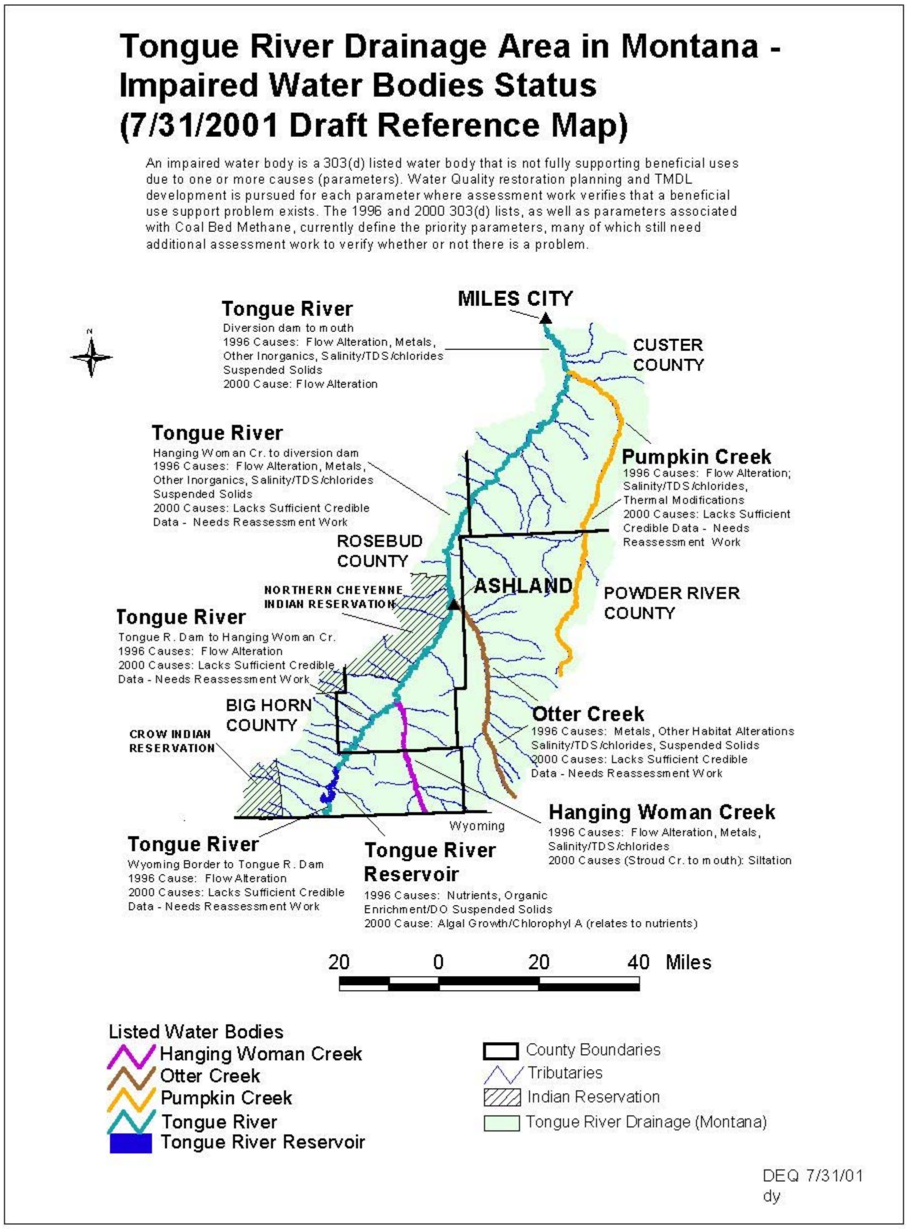
Independent of the court order, but as required by the Federal Clean Water Act and the Montana Water Quality Act, MDEQ prepared a 303(d) list in 2000. The 2000 list was approved by EPA on January 29, 2001 and is superior to earlier lists for several reasons. First, significantly more data was available for making listing decisions. Second, the public review process was substantially expanded including a lengthy comment period and 17 public meetings around the state. Third, MDEQ significantly improved the methods for making listing decisions. Fourth, MDEQ dramatically improved the supporting documentation for all listing decisions and made the information easily accessible by the public.

Although the court order mandates the 1996 list (EIS Table 3-5) as the starting point, both the 1996 and the 2000 lists should be consulted when making TMDL decisions. Figures 1 and 2 provide a summary of the waters in the Tongue and Powder river basins that are on the 1996 and 2000 lists. The figures identify the pollutants of concern, summarize the reasons for the listings, and explain the differences between the two lists.

Powder River Drainage Area in Montana - Impaired Waterbodies Status (7/31/2001 Draft Reference Map)

An impaired water body is a 303(d) listed water body that is not fully supporting beneficial uses due to one or more causes (parameters). Water Quality restoration planning and TMDL development is pursued for each parameter where assessment work verifies that a beneficial use support problem exists. The 1996 and 2000 303(d) lists, as well as parameters associated with Coal Bed Methane, currently define the priority parameters, many of which still need additional assessment work to verify whether or not there is a problem.





The 2000 list provides substantially more and better information concerning the impairments and the sources that may be contributing to the problem. However, MDEQ or EPA is required to develop *all necessary* TMDLs for each waterbody and pollutant identified as impaired or threatened on the 1996 list. A TMDL may not be necessary for a waterbody listed on the 1996 list for a couple of reasons. First, a TMDL is unnecessary if further assessment, such as was done for the 2000 list, determines that the waterbody is meeting water quality standards for the particular pollutant. During the development of the 2000 list, MDEQ determined that several waters in the Tongue, Powder, and Little Powder river basins that were listed as impaired on the 1996 list, were actually meeting water quality standards for some of the listed pollutants (i.e., Mizpah Creek was found to be fully supporting for nutrients, dissolved oxygen, inorganics and suspended solids). Second, EPA has determined that TMDLs are not necessary for "pollution" that is not associated with a specific pollutant (i.e., flow or habitat alteration). EPA described their position on this issue to MDEQ in a July 23, 2001 letter concerning a flow alteration TMDL for Big Creek, a tributary of the Upper Yellowstone River. It should be noted however, that further assessment frequently shows that flow or habitat alterations cause high levels of pollutants (i.e., flow and habitat alteration can cause violations of temperature standards).

Although, during the 2000 listing process MDEQ determined that several waterbodies on the 1996 list were meeting the water quality standards for some of the listed pollutants, it was far more common for MDEQ to determine that there was insufficient credible data to make a listing decision. MDEQ determined that many segments of the Tongue and Powder rivers and some tributaries lacked sufficient credible data to determine whether the waters are impaired, threatened, or fully supporting the numerical and narrative water quality standards. These waters are scheduled for additional assessment prior to developing TMDLs for the associated TMDL Planning Areas. The reassessment work is already underway and it is possible that MDEQ will determine that additional waterbodies are meeting the standards for listed pollutants. If so, a TMDL will not be necessary, even though the waterbody and the pollutant were listed on the 1996 list. Conversely, additional TMDLs may be necessary if the assessment demonstrates that a waterbody is impaired for other pollutants that were not originally identified on either the 1996 or 2000 lists.

The 1996 list identified many waters within the Tongue and Powder TMDL planning areas as impaired by salinity, total dissolved solids, chlorides, metals, inorganics, suspended solids, siltation, nutrients, low dissolved oxygen, pathogens, flow alteration, thermal modification, and habitat alteration. Of these pollutants, salinity, total dissolved solids, metals, and nutrients are frequently associated with produced water from CBM development. CBM development may also cause flow alterations and associated pollutants to exceed standards (i.e., total suspended solids). MDEQ is conducting a reassessment of the Tongue, Powder, and Little Powder rivers and their tributaries concurrent with this environmental impact study. The results will be used to determine whether TMDLs are necessary for these pollutants and, if so, facilitate development.

In addition, MDEQ intends to ask the Board of Environmental Review (BER) to promulgate numerical standards for electric conductivity (surrogate for total dissolved solids), sodium adsorption ratio (SAR) and bicarbonates. This environmental document proposes a range of numerical criteria for each of these pollutants strictly for the purpose of evaluating the various alternatives. It is important to understand that the BER has the responsibility to set the standards and they will base their decision on written and oral testimony presented at a public hearing and during a public comment period. The stringency of the final standards will determine whether assimilative capacity exists or if a TMDL is necessary.

The court order prohibits MDEQ from issuing any new Montana Pollutant Discharge Elimination System (MPDES) permits or renewals that would increase permitted discharges until all necessary TMDLs are established. In light of the programmatic needs associated with CBM development, MDEQ has rescheduled the TMDLs for pollutants associated with CBM discharges in the Tongue and Powder TMDL planning areas for December 2002.

As mentioned earlier, the court order prohibits MDEQ from issuing any new MPDES permits or renewals that would increase permitted discharges until all necessary TMDLs are established for a particular impaired waterbody. This provision of the court order has a direct bearing on CBM development. Unless producers choose a no discharge option, such as reinjection, MPDES permits will be required for CBM development. MDEQ and EPA are applying the court order on a pollutant-specific basis. For example, if the water is listed for nutrients and the new source will not discharge nutrients, a permit can be issued. Likewise, a permit can be renewed, if an existing source intends to increase its discharge but the effluent limit for nutrients will remain the same. Under some circumstances a permit can be issued even when the new discharge contains the pollutant of concern. By regulation, such permits must contain water quality based effluent limits that insure that the water quality standards will be met downstream of the discharge. For example, if the water quality standard is expressed as an in-stream concentration and the concentration in the discharge is less than the standard, the new source may actually improve water quality.

MDEQ is prohibited from issuing permits for discharges that would cause exceedances of a state water quality standard (i.e., where there is no assimilative capacity). This will be the case for many impaired waterbodies. Therefore, MDEQ will frequently not be able to issue a permit until a TMDL is developed for the entire watershed. A watershed TMDL will identify the major point and non-point sources contributing to the impairment and establish discharge targets for the pollutant of concern. In combination, the limits for all the sources must insure that water quality will improve to the point where the standards are met. The Montana Water Quality Act requires MDEQ to work with local landowners to implement voluntary measures (reasonable land soil and water conservation practices) to reduce pollutant loads from non-point sources. The Act also requires targets for point sources to be incorporated into MPDES permits in the form of effluent limits. The changes would normally be made during the next scheduled permit renewal and could include permits issued between now and the final development of the watershed TMDL. A watershed TMDL may include an allocation for growth to allow for new or increased discharges in the future and facilitate permitting. To provide for growth existing point and non-point sources would need to reduce their discharges even further.

As mentioned earlier, MDEQ advanced the schedule for developing watershed TMDLs for pollutants associated with produced water from CBM development to December 2002. The revised date was selected based upon an assumption that at least one TMDL will be necessary. Developing a TMDL takes time and involves completing the ongoing assessments; coordinating with landowners and CBM producers in Montana, on tribal lands, and perhaps in Wyoming; assigning allocations for point and non-point sources; drafting the TMDL and a technical support document; conducting public meetings; and obtaining EPA approval. If this environmental impact statement is completed on time, the TMDLs will follow six months later. During the interim period MDEQ will review applications for new MPDES permits or renewals on a case-by-case basis. Water quality based effluent limits may be feasible for some discharges while not possible for others. In short, CBM development may be delayed on some waters for an additional six months unless nondischarging options are employed.

MONTANA AND WYOMING POWDER RIVER INTERIM WATER QUALITY CRITERIA MEMORANDUM OF COOPERATION

WHEREAS, the State of Montana and the State of Wyoming recognize a. responsibility and an opportunity to work collaboratively to protect water quality in the Powder River Basin and to facilitate the development of Coal Bed Methane (CBM) activities in the respective states, and

WHEREAS, the State of Montana and the State of Wyoming will pursue a process that would establish respective responsibilities for managing and controlling salinity, SAR, and other pollutants of concern; and

WHEREAS, the States of Montana and Wyoming have met in several meetings to work out the technical details of this cooperative approach; and

WHEREAS, the State of Montana and the State of Wyoming realize that an interim effort is necessary until more stream flow and water quality data can be collected and analyzed to determine the assimilative capacity of waters in the Powder River drainage, and until the effects of CBM development are better known, and Montana completes the development and adoption of water quality standards, an EIS and a Total Maximum Daily Load (TMDL) plan for the basin; and

WHEREAS, the State of Wyoming recognizes Montana's downstream interests and has committed to apply certain limits on the development of CBM activities, during the term of this cooperative effort; and

WHEREAS, the State of Montana has recognized Wyoming's desire to continue to cautiously grant NPDES permits during this interim period; and

WHEREAS, the State of Wyoming will work with and support Montana's efforts to develop long-term water quality standards and an equitable allocation of the assimilative capacity if one exists.

NOW THEREFORE, the parties enter into this Memorandum of Cooperation (MOC).

I. Parties.

The parties to this MOC are the signatories as set forth on Page 4. The director of the Wyoming Department of Environmental Quality is entering into this MOC to further the purposes of the Wyoming Environmental Quality Act, W.S. 35-11-109(a)(ii). The director of the Montana Department of Environmental Quality is entering into the MOC to further the purposes of – the Montana Water Quality Act, Title 75, Chapter 5, Montana Code Annotated.

II. Purpose of MOC

The purpose of this MOC is to document the parties' commitments and their intent to protect and maintain water quality conditions within Montana during an interim period while new CBM discharges in Wyoming are cautiously allowed. At the conclusion of this interim period, the parties shall negotiate a final MOC that will include recognition of protective water quality standards and allocation of any assimilative capacity.

III. Interim Threshold Criteria for Salinity and Sodium

1. Powder River

The two states will use the highest sampled monthly values of electrical conductivity (EC) from 1990 through 1999 for the Powder River at the Moorhead gauging station as interim upper threshold criteria. Montana shall monitor the Moorhead data and report to Wyoming the average monthly EC and its comparability to the appropriate monthly value. If in any given month the average EC exceeds the threshold criteria, as listed herein, Wyoming will use its ongoing monitoring of sodium levels to determine the potential source and cause of the exceedance. The results of this investigation will be reported to Montana in a timely manner. If the exceedance is found to be attributable to CBM discharges, Wyoming will initiate appropriate steps through its regulatory mechanisms to return salinity levels into conformity with this MOC.

The Upper Threshold Salinity Monthly Values (EC in pmhos/cm) for the Powder River at the Moorhead, Montana gauging station, based on the data from the 1990's are:

January 2200
February 2300
March 2300
April 1700
May 2100
June 2200
July 2800
August 2400
September 2600
October 1900
November 2000
December 1800

The two states recognize that sodium levels and the Sodium Adsorption Ratio (SAR) may have an effect on water uses. However, at this time no clear threshold can be developed due to a lack of data. The State of Wyoming will, through its monitoring program, track sodium concentrations in the Powder River above the state line, evaluate the source of changes through various modeling techniques and report the results of these evaluations to Montana.

2. Little Powder River

The states will use statistical step tests and 90" percentile, 90% confidence limits (90/90) for EC, SAR, and Total Dissolved Solids (TDS) derived from monthly flow weighted historic data as threshold criteria to indicate whether a change has occurred. Montana shall monitor the data from the Little Powder above Dry Creek, near Weston, and report the flow-weighted results to Wyoming. The step tests and 90/90 criteria will be based on a continuous and cumulative evaluation of available data from 1985 forward. Pre-1985 data will not be used because baseline conditions delineated by the older data sets differ from post-1984 conditions. If a step test shows a significant difference or the 90/90 confidence limit is exceeded, Wyoming will conduct an evaluation as to the possible source of the trend or exceedance and report the results to Montana in a timely manner. If the difference or exceedance is found to be attributable to CBM discharges, Wyoming will initiate appropriate steps through its regulatory mechanisms to return salinity levels into conformity with this MOC.

IV. Other Pollutants of Concern

Montana accepts Wyoming's antidegradation policy as protective of Montana's water quality standards. However, should Wyoming consider an application to degrade, Montana will be included as a participant in the waiver review process so that the states may equitably allocate any assimilative capacity.

V. Monitoring Program

Wyoming and Montana are committed to the development of a monitoring program to implement this MOC and to the development of a final MOC.

VI. Standard Frequency of Data Review and Evaluation

The parties will meet periodically and review the results of their respective monitoring programs, to promptly report evaluations and results, and review the overall success of the program.

VII. Term of MOC

It is the intent of the parties that this interim MOC is for a period of 18 months from its' effective date. During the fall of 2002 the parties anticipate re- negotiating a final MOC that will address meeting downstream standards for the Powder and Little Powder Rivers and TMDLs.

VIII. Public Participation

Opportunity for public participation was provided during the technical sessions that led up to this MOC. The parties are committed to keeping the public informed about the implementation and success of this MOC. All technical information and evaluations resulting from this MOC will be available to the public.

IX. Dispute Resolution

The parties agree that disputes that arise as a result of this MOC shall be resolved through communication and cooperative problem solving involving the parties

X. Amendment

This MOC may be amended or modified at any time upon the consent of all parties.

XI. Vacating MOC

Any party may withdraw from this MOC by providing written notice to the other parties.

XII. Effective Date

This MOC is effective upon the last date of signature by a party, as listed below.

1. MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

____

Jan Sensibaugh, Director Sept. 5, 2001

2. WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY

____

Dennis Hemmer, Director Date

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GENERAL DISCHARGE PERMIT
COAL BED METHANE PRODUCED WATER

MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

AUTHORIZATION TO DISCHARGE UNDER THE

MONTANA POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with Section 75-5-101 et seq., MCA, and ARM Title 17, Chapter 30, Subchapters 6, 7, 12, and 13. Applicants with an authorization letter for this "Coal Bed Methane Produced Water General Discharge Permit", are permitted to discharge wastewater resulting from Coal Bed Methane natural gas production wells to holding ponds for the purpose of the prescribed beneficial use. Discharges are not authorized to state surface waters other than in the event of a 25-year, 24-hour rainfall event. The use of holding ponds for the prescribed beneficial use shall be in accordance with effluent limitations, monitoring requirements, and other conditions set forth herein.

This permit shall become effective on the date of issuance.

A written authorization letter from the Department is required before an applicant is authorized to discharge under the Coal Bed Methane Produced Water-General Discharge Permit.

This permit and the authorization to discharge shall expire at midnight, 5 years after the date of issuance.

FOR THE MONTANA DEPARTMENT OF
ENVIRONMENTAL QUALITY

____
Jan P. Sensibaugh, Director
Department of Environmental Quality

Dated this ______day of ______

TABLE OF CONTENTS

I. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

A. Definitions.

1. "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility.

2. "Department" means the Montana Department of Environmental Quality.

3. A "grab" sample, for monitoring requirements, is defined as a single "dip and take" sample collected at a representative point in the discharge stream.

4. "Instantaneous Maximum" is the maximum value allowable in any single sample or instantaneous measurement.

5. An "instantaneous" measurement, for monitoring requirements, is defined as a single reading, observation, or measurement.

6. "Petroleum-related water cleanup" is groundwater or collected stormwater in contact with petroleum-related spills or leaking underground storage tanks that contain petroleum-related products.

7. "Coal Bed Methane Produced Water" is the separated wastewater resulting from coal bed methane natural gas producing wells.

8. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

9. "Ephemeral Stream" means a stream or a part of a stream, which flows only in direct response to precipitation in the immediate watershed or in response to the melting of a cover of snow and ice and whose channel bottom is always above the local water table.

10. "Intermittent Stream" means a stream or reach of a stream that is below the local water table for at least some part of the year, and obtains its flow from both surface run-off and groundwater discharge.

11. “Continuous” is the measurement of effluent flow, which occurs without interruption throughout the operating hours of the facility, except for infrequent shutdowns for maintenance process changes, or other similar activities.

B. Effluent Limitations and Self-Monitoring Requirements

During the period beginning immediately and lasting through the duration of the permit, the permittee is authorized to discharge from the outfall(s) as specified in the authorization letter. Discharges at any location not authorized under an MPDES permit is a violation of the Montana Water Quality Act and could subject the person(s) responsible for such discharge to penalties under the Act. Knowingly discharging from an unauthorized location or failing to report an unauthorized discharge within a reasonable time from first learning of an unauthorized discharge could subject such person to criminal penalties as provided under Section 75-5-632 of the Montana Water Quality Act.

The discharged water must be utilized for the beneficial use as prescribed in the permittee's beneficial use letter(s) submitted with the application. No discharge is authorized by this general permit to state surface waters. All discharges must be to holding ponds for the purpose of the prescribed beneficial use.

1. Final Wastewater Effluent Limitations

Effective immediately and lasting through the present permit cycle of five years, the quality of effluent discharged through the authorized outfall shall, as a minimum, meet the limitations as set forth below:

Results shall be reported to the Department according to the procedures in Part III of the permit.

These limits have been established to ensure the beneficial use for wildlife or livestock watering and in accordance with water quality standards.

TABLE 1: FINAL NUMERIC EFFLUENT LIMITATIONS

Parameter	Concentration (mg/*l*) (1)	
	Annual Average	Daily Maximum
Total Dissolved Solids(TDS)	5,000	Not Applicable
Oil and Grease, total recoverable(2)	10	Not Applicable

(1) See the definitions in Part I.A. of the permit.
(2) Gravimetric extraction (EPA Method 413.1)

2. Other Conditions

a. Impoundments constructed for the purposes of holding CBM produced water shall not cause excessive salinity of underlying soils. If the soil salinity, as measured by electrical conductivity (EC) in a paste extract, exceeds 20 millimhos/cm in the impoundment sediments, a reclamation plan must be submitted to the Department and landowner to ensure the land is returned to its previous utility and stability. A sample must be collected whenever the annual average TDS exceed 5,000 mg/L.

b. Impoundments constructed for the purposes of holding and storing produced water from CBM development must not be located in ephemeral, intermittent, or perennial drainages as defined in Section I.A of the permit. For purposes of this permit, ephemeral, intermittent, or perennial streams are those identified as such on a 7.5 minute U.S. Geological Survey topographic map.

c. There shall be no discharge of water from the impoundment except whenever rainfall events, either chronic or catastrophic, cause an overflow of water from the impoundment designed, constructed, and operated to contain a normal volume of produced water plus runoff from a 25-year, 24 hour precipitation event.

d. An impoundment constructed for the purposes of this permit shall be designed, constructed, and operated such that an amount of "freeboard" or available volume in the impoundment will be maintained at all times to retain the volume of water resulting from a 25-year, 24 hour precipitation event. Freeboard must be based on the surface area of the impoundment and those all areas that contribute runoff to the impoundment.

e. A map showing the 25-year, 24-hour rainfall for Montana is given in Attachment A to the permit. The 25-year, 24-hour event for the location of the CBM produced water impoundment structure covered by this permit must be determined from this map.

f. For purposes of determining compliance with the effluent limitations of this permit, the amount of precipitation that occurred must be based on the data from the nearest weather station with a precipitation gauge. The permittee has the option of maintaining a functional and reliable precipitation gauge at the facility.

g. The permittee shall monitor the quality of the water in the impoundment for the parameters and at the frequency listed in Table 3. If the quality of the water, based on the annual average, exceeds the upper bound criteria listed in Table 4, the permittee shall cease discharging to the impoundment and submit a plan to dispose of the water in the impoundment.

3. Self-monitoring Requirements

As a minimum, upon the effective date of this permit, the following constituents shall be monitored at the frequency and with the type of measurement indicated; samples or measurements shall be representative of the volume and nature of the monitored discharge. If no discharge occurs during the entire monitoring period, it shall be stated on the Discharge Monitoring Report Form (EPA No. 3320-1) that no discharge or overflow occurred.

A. Effluent Monitoring

The permittee shall sample the quality of the effluent from each source discharging to the storage impoundment for the parameters and at the frequency listed in Table 2. The results of these analyses shall be reported to the Department according to the procedures in Part III of the permit.

TABLE 2: EFFLUENT MONITORING REQUIREMENTS

Parameter	**Frequency**	**Type** (1)
Effluent Flow Rate, gpm(2)	Semiannual	Continuous
Total Dissolved Solids (TDS), mg/L	Semiannual	Grab
Oil and Grease, mg/L (3)	Semiannual	Grab

(1) See the definitions in Part I.A. of the permit.
(2) If no discharge occurs during the reporting period, **"no discharge"** must be recorded on the DMR form.
(3) Gravimetric extraction (EPA Method 413.1)

B. INSTREAM (IMPOUNDMENT) MONITORING

The permittee shall sample the quality of the water in the storage impoundment for the parameters and at the frequency listed in Table 3. The results of these analyses must be reported to the Department according to the procedures in Part III of the permit.

TABLE 3: IMPOUNDMENT MONITORING REQUIREMENTS

Parameter	**Frequency**	**Type** (1)
Impoundment Freeboard, feet (2)	Semiannual	Instantaneous
Total Dissolved Solids (TDS), mg/L	Semiannual	Grab
Sodium, mg/L	Semiannual	Grab
Calcium, mg/L	Semiannual	Grab
Magnesium, mg/L	Semiannual	Grab
Sodium Adsorption Ration (SAR)	Semiannual	Calculated
Specific Electrical Conductivity (EC), uS/cm	Semiannual	Grab
Oil and Grease, mg/L(3)	Semiannual	Grab
Iron, mg/L	Semiannual	Grab
Barium, mg/L	Semiannual	Grab
Chloride, mg/L	Semiannual	Grab
Sulfate, mg/L	Semiannual	Grab

(1) See the definitions in Part I.A. of the permit.
(2) If no discharge occurs during the reporting period, **"no discharge"** must be recorded on the DMR form.
(3) Gravimetric extraction (EPA Method 413.1)

II. MONITORING, RECORDING AND REPORTING REQUIREMENTS

A. Representative Sampling.

Samples taken in compliance with the monitoring requirements established under Part I shall be collected from the wastewater prior to discharging from the permittee's property. Samples and measurements shall be representative of the volume and nature of the monitored discharge.

B. Monitoring Procedures.

Monitoring must be conducted according to test procedures approved under Part 136, Title 40 of the Code of Federal Regulations, unless other test procedures have been specified in this permit. All flow-measuring and flow-recording devices used in obtaining data submitted in self-monitoring reports must indicate values within 10 percent of the actual flow being measured.

C. Penalties for Tampering.

The Montana Water Quality Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate, any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $25,000, or by imprisonment for not more than six months, or both.

D. Reporting of Monitoring Results.

Results of the self-monitoring shall be reported semiannually on the Discharge Monitoring Report form (EPA 3320-1) to the Department (see address below), postmarked no later than the 28th day of the month following the reporting period; the due date of the first semiannual report is July 28th and the second semiannual report is January 28th.

Montana Department of Environmental Quality
Water Protection Bureau
P.O. Box 200901
Helena, Montana 59620-0901
Phone: (406) 444-3080

All reports, notifications and inquires regarding the conditions of this permit shall be submitted to the Department at the above address.

E. Additional Monitoring by the Permittee

If the permittee monitors any pollutant more frequently than required by this permit, using approved analytical methods as specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the Discharge Monitoring Report. Such increased frequency shall also be indicated.

F. Records Contents. Records of monitoring information shall include:

1. The date, exact place, and time of sampling or measurements;
2. The initials or name(s) of the individual(s) who performed the sampling or measurements;
3. The date(s) analyses were performed;
4. The time analyses was initiated;
5. The initials or name(s) of individual(s) who performed the analyses;
6. References and written procedures, when available, for the analytical techniques or methods used; and,

7. The results of such analyses, including the bench sheets, instrument readouts, computer disks or tapes, etc., used to determine these results.

G. Retention of Records.

The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least three years from the date of sample, measurement, report or application. This period may be extended by request of the Department at any time.

H. Twenty-four Hour Notice of Noncompliance Reporting.

1. The permittee shall report any noncompliance, which may endanger health or the environment as soon as possible, but no later than twenty-four (24) hours from the time the permittee first became aware of the circumstances. The report shall be made to the Water Quality Division at (406) 444-3080.

2. The following occurrences of noncompliance shall be reported by telephone to the Water Quality Division at (406) 444-3080 by the first workday (8:00 A.M.- 4:30 P.M. Mountain Time) following the day the permittee became aware of the circumstances any unanticipated bypass which exceeds any effluent limitation in the permit (See Part III.G., Bypass of Treatment Facilities.);

3. A written submission shall also be provided within five days of the time that the permittee becomes aware of the circumstances. The written submission shall contain:

   a. A description of the noncompliance and its cause;

   b. The period of noncompliance, including exact dates and times;

   c. The estimated time noncompliance is expected to continue if it has not been corrected; and,

   d. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

4. The Department may waive the written report on a case-by-case basis if the oral report has been received within 24 hours by the Water Quality Division, by phone, (406) 444-3080.

5. Reports shall be submitted to the addresses in Part II.D., Reporting of Monitoring Results.

I. Other Noncompliance Reporting.

Instances of noncompliance not required to be reported within 24 hours shall be reported at the time that monitoring reports for Part II.D. are submitted. The reports shall contain the information listed in Part II.H.3.

J. Inspection and Entry

The permittee shall allow the head of the Department or the Regional Administrator, or authorized representative thereof, upon the presentation of credentials and other documents as may be required by law, to:

1. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;

2. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

3. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and,

4. Sample or monitor at reasonable times, for the purpose of assuring permit compliance, any substances or parameters at any location.

III. COMPLIANCE RESPONSIBILITIES

A. Duty to Comply

The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal application. The permittee shall give the Department advance notice of any planned changes at the permitted facility or of an activity, which may result in permit noncompliance.

B. Penalties for Violations of Permit Conditions. The Montana Water Quality Act provides that any person who violates a permit condition of the Act is subject to a civil penalty not to exceed $25,000 per day or one year in prison, or both, for the first conviction, and $50,000 per day of violation or by imprisonment for not more than two years, or both, for subsequent convictions. Except as provided in permit conditions on Part III.G., Bypass of Treatment Facilities, nothing in this permit shall be construed to relieve the permittee of the civil or criminal penalties for noncompliance.

C. Need to Halt or Reduce Activity not a Defense

It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

D. Duty to Mitigate

The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit, which has a reasonable likelihood of adversely affecting human health or the environment.

E. Proper Operation and Maintenance

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures.

F. Removed Substances

Collected screenings, grit, solids, sludges, or other pollutants removed in the course of treatment shall be disposed of in such a manner so as to prevent any pollutant from entering any waters of the state or creating a health hazard.

G. Bypass of Treatment Facilities:

1. Bypass not exceeding limitations. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of paragraphs 2. and 3. of this section.

2. Notice:

a. Anticipated bypass. If the permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible at least 10 days before the date of the bypass.

b. Unanticipated bypass. The permittee shall submit notice of an unanticipated bypass as required under Part II.I., Twenty-four Hour Reporting.

3. Prohibition of bypass.

a. Bypass is prohibited and the Department may take enforcement action against a permittee for a bypass, unless:

(1) The bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

(2) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgement to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and,

(3) The permittee submitted notices as required under paragraph 2. of this section.

b. The Department may approve an anticipated bypass, after considering its adverse effects, if the Department determines that it will meet the three conditions listed above in paragraph 3.a. of this section.

IV. GENERAL REQUIREMENTS

A. Planned Changes

The permittee shall give notice to the Department as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when the alteration or addition could significantly change the nature or increase the quantity of pollutant discharged. This notification applies to pollutants, which are not subject to effluent limitations in the permit.

B. Anticipated Noncompliance

The permittee shall give advance notice to the Department of any planned changes in the permitted facility or activity, which may result in noncompliance with permit requirements.

C. Permit Actions

This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

D. Duty to Reapply

If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit. The application form and fee should be submitted at least 180 days before the expiration date of this permit.

E. Duty to Provide Information

The permittee shall furnish to the Department, within a reasonable time, any information which the Department may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The permittee shall also furnish to the Department, upon request, copies of records required to be kept by this permit.

F. Other Information

When the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or any report to the Department, it shall promptly submit such facts or information.

G. Signatory Requirements

All applications, reports or information submitted to the Department shall be signed and certified.

1. All permit applications shall be signed as follows:

   a. For a corporation: by a responsible corporate officer;

   b. For a partnership or sole proprietorship: by a general partner or the proprietor, respectively;

   c. For a municipality, State, Federal, or other public agency: by either a principal executive officer or ranking elected official.

2. All reports required by the permit and other information requested by the Department shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

   a. The authorization is made in writing by a person described above and submitted to the Department, and,

   b. The authorization specified either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.)

3. Changes to authorization. If an authorization under paragraph IV.G.2. is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph IV.G.2. must be submitted to the Department prior to or together with any reports, information, or applications to be signed by an authorized representative.

4. Certification. Any person signing a document under this section shall make the following certification:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

H. Penalties for Falsification of Reports

The Montana Water Quality Act provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance shall, upon conviction be punished by a fine of not more than $25,000 per violation, or by imprisonment for not more than six months per violation, or both.

I. Availability of Reports

Except for data determined to be confidential under 40 CFR Part 2, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Department. As required by the Clean Water Act, permit applications, permits and effluent data shall not be considered confidential.

J. Oil and Hazardous Substance Liability

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Clean Water Act.

K. Property Rights or Water Rights

The issuance of this permit does not convey any property or water rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state or local laws or regulations.

The permittee and adjacent landowner using produced water must comply with applicable water rights statutes under MCA, 85-2-306, before any beneficial water use commences. Information and assistance on the water rights statutes can be obtained from the Department of Natural Resources and Conservation, Water Resources Division at (406) 444-6601.

L. Severability

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

M. Transfers

This permit can not be transferred to a new permittee. A new owner or operator of a facility must apply according to the application procedures in Part IV.D of this permit 30 days prior to taking responsibility for the facility.

N. Fees

The permittee is required to submit payment of an annual fee as set forth in ARM 17.30.201. If the permittee fails to pay the annual fee within 90 days after the due date for the payment, the Department may:

1. Impose an additional assessment consisting of 15% of the fee plus interest on the required fee computed at the rate established under 15-31-510(3), MCA, or

2. Suspend the processing of the application for a permit or authorization or, if the nonpayment involves an annual permit fee, suspend the permit, certificate or authorization for which the fee is required. The Department may lift suspension at any time up to one year after the suspension occurs if the holder has paid all outstanding fees, including all penalties, assessments and interest imposed under this sub-section. Suspensions are limited to one year, after which the permit will be terminated.

O. Reopener Provision

This permit may be reopened and modified (following proper administrative procedures) to include the appropriate effluent limitations (and compliance schedule, if necessary), or other appropriate requirements if one or more of the following events occurs:

1. Water Quality Standards:

   The water quality standards of the receiving water(s) to which the permittee discharges are modified in such a manner as to require different effluent limits than contained in this permit.

2. Wasteload Allocation:

   A wasteload allocation is developed and approved by the Department and/or EPA for incorporation in this permit.

3. Water Quality Management Plan:

   A revision to the current water quality management plan is approved and adopted which calls for different effluent limitations than contained in this permit.

V. SPECIAL REQUIREMENTS

A. Authorization Letter. A written authorization letter from the Department is required before an applicant is authorized to discharge under the Coal Bed Methane Produced Water General Discharge Permit.

B. The following prerequisites must be met before an applicant can be authorized to discharge under the CBMPW-GDP.

1. The applicant shall submit a current beneficial use letter from the surface landowner(s) stating the discharged produced water will be used for wildlife or livestock watering. Landowners that receive CBM produced water must request the water and document its beneficial use. Irrigation with coal bed methane produced water to agriculture fields or rangeland is not considered a beneficial use of coal bed methane produced water.
2. The applicant shall submit a topographic map showing the exact location of the impoundment and identifying all sources and volumes of water and wastewater that contribute to the impoundment. The map must identify all surface waters and groundwater wells within a 1-mile radius of the impoundment.
3. The applicant must submit a line drawing of the proposed CBM produced water impoundment showing the location of the CBM produced water wells, collection system, inlet and outfall structure, and sample locations.
4. The applicant shall submit a chemical analysis of the proposed discharge as specified in Table 4 below. The application may be denied if the analysis indicates the water is not fit for livestock or wildlife consumption as per the maximum recommended concentrations listed below

TABLE 4: APPLICATION MONITORING REQUIREMENTS

Parameter	**Type** [(1)]	**Recommended Maximum Levels**	**Required Detection Level**
Effluent Flow Rate [(2)], gpm	Instantaneous		NA
Total Dissolved Solids (TDS), mg/L	Grab	5,000	5 mg/L
Total Suspended Solids (TSS), mg/L	Grab	None	10 mg/L
Specific Conductance, µmhos/cm	Grab	3,000[(2)]	5 µmhos/cm
pH, standard units	Grab	6 –9	0.1 standard units
Oil and Grease, mg/L[(6)]	Grab	10	1 mg/L
Total Alkalinity, mg/L	Grab	2,000[(2)]	1 mg/L as $CaCO_3$
Bicarbonate, mg/L	Grab	1,000[(2)]	1 mg/L
Calcium, mg/L	Grab	1,000[(2)]	1 mg/L
Chloride, mg/L	Grab	1,000[(2)]	5 mg/L
Nitrate (NO_3+NO_2), mg/L	Grab	100[(3)]	0.5 mg/L
Potassium, mg/L	Grab	20[(2)]	1 mg/L
Radium 226 228, and 222, picocuries/L	Grab	1 pCi/L[(2)]	0.2 pCi/L
Sodium, mg/L	Grab	800[(2)]	1 mg/L
Sulfate, mg/L	Grab	2500[(4)(5)]	10 mg/L
ARSENIC, TOTAL RECOVERABLE, MG/L	Grab	0.2-0.5[(2)]	0.003 mg/L
Beryllium, total recoverable, mg/L	Grab	1[(2)]	0.001 mg/L
Lead, total recoverable, mg/L	Grab	0.1[(2)]	0.003 mg/L
Magnesium, total recoverable, mg/L	Grab	250[(2)]	1 mg/L
Selenium, total recoverable, mg/L	Grab	0.05[(2)]	0.01 mg/L
Sodium Adsorption Ratio (SAR)	Calculated	None	NA

(1) See the definitions in Part I.A. of the permit.
(2) Puls, 1988
(3) Meyer, 1990
(4) This limit may vary based on other parameters present such as elemental sulfur and the amount of sulfate ingested with feed.
(5) Veenhuizen, 1992
(6) Gravimetric extraction (EPA Method 413.1)

MINERALS APPENDIX

MINERALS APPENDIX

Introduction

The *Minerals Appendix* contains a discussion of the CBM emphasis area's geology and stratigraphy, the Reasonable Foreseeable Development Scenario (RFD), and a description of the cumulative effects projects evaluated for this study.

Coal Bed Methane

Coalbed methane (CBM) is a product of the transformation of plant material into coal; large volumes of methane are produced as coal matures due to heat of burial. This thermogenic methane-rich gas is adsorbed and stored on internal surfaces within the coal. The pressure of fluids (mostly formation water) in the coal reservoir keeps the methane adsorbed onto the coal and minimizes the formation of fractures in the coal. When meteoric waters encounter the methane-rich coals, bacteria act upon the coals and their entrained fluids to produce more methane (PTTC 2000). This biogenic methane-rich gas is also adsorbed onto the coal surfaces. Thermogenic methane can be differentiated from biogenic methane by the ratios of their stable carbon isotopes, that is, the ratio of C^{12} to C^{13} compared to a standard such as the PeeDee belemnite, a fossil marine mollusk (Coplen 1994). Methane with relative enrichment of C^{12} is indicative of low-temperature, biogenic gas; the heavier C^{13} isotope is enriched in the high-temperature gas. Both forms of methane have been reported in CBM reservoirs (USGS 2000).

Coalbed gas reservoirs, because of their fine-grained nature, are able to hold six or seven times as much gas as conventional sand or carbonate reservoirs (USGS 2000), a factor that has made CBM a desirable resource. Methane produced from coal beds is an unconventional hydrocarbon resource that has undergone rapid nationwide development in the past fifteen years (Nelson 2000). The Powder River Basin is estimated to contain approximately 39 trillion cubic feet [TCF] TCF (Hill et al. 2000)—approximately 10 percent of which is in Montana. The methane is contained in the Tertiary-age Fort Union Formation coal beds. Under reservoir conditions, the coal is under virgin hydrostatic pressure, which confines the coal and holds in the methane. Pumping water from the coal reduces hydrostatic pressure in the aquifer. The methane releases from the coal and moves through the natural cleat of the coal toward producing boreholes. As the water is pumped off the coal bed aquifer, pressure in the coal is decreased, the coal fractures into a series of fine fractures known as cleat, and the methane is able to move through the fractures and any horizontal bedding planes toward producing boreholes.

CBM is currently produced only at the CX Ranch field in Big Horn County on the western edge of the Powder River Basin. During the first year of production, 1999, the field produced 204,433 million cubic feet (MCF) of natural gas. The subsequent year, 2000, the field produced 3.49 billion cubic feet (BCF) of natural gas (MBOGC 2001b). The operator expects to produce approximately twice as much gas during 2001 (Williams 2001).

CBM is prospective in the other RMP areas that are the subject of this EIS. In the Billings RMP area, the Bull Mountains Basin contains Fort Union Formation coals that may be similar to the Powder River Basin coals. The Big Horn Basin, Red Lodge area, and Crazy Mountains Basin also contain Fort Union Formation coals. Gallatin, Park, and Carbon counties contain unknown quantities of Cretaceous coals that may contain CBM. Blaine County contains Cretaceous coals associated with the Eagle Formation. These coals could also produce significant amounts of CBM.

CBM resources are subject to the same drainage issues as conventional oil and gas resource issues described above. It is assumed that a single CBM well will drain those resources in a single coal seam across 80 acres. Site-specific CBM drainage may, however, be different and needs to be monitored to protect federal and Indian lands.

Additional Counties

Park and Gallatin Counties do not produce oil or gas at the present time. Thick Tertiary sediments are present in the Crazy Mountains Basin, which is on strike with the Big Horn and Red Lodge Basins. These sediments may be prospective in the future as oil and gas activity progresses.

Blaine County is located in the center of the northern edge of the State; it includes the geologic features the Bears Paw Mountains and the adjacent Hogeland Basin. In 2000, 26 fields produced shallow, dry natural gas in Blaine County with little crude oil. Several small fields and the large Tiger Ridge field produce natural gas from the Eagle, Niobrara, and Second White Specks, all of which are shallow formations of the Late Cretaceous. Continued exploration and production drilling is expected to further increase production levels.

Production statistics, summarized in Figure GMA-4 (ALL 2001b), show a doubling of natural gas production in the past 15 years. Blaine County produced more than 21 percent of Montana's total gas for 1999 and it shows increases since then. Oil production has varied within narrow limits at relatively low levels.

Conventional Oil and Gas Production Trends

Montana's oil production for 1999 (the latest year for complete production statistics) was down by approximately 8 percent (from 16.61 million barrels of oil [mmbo] to 15.27 mmbo) from 1998. The oil production trend has been in place since 1984 when oil production began to decrease because of commodity prices. However, natural gas production increased by approximately 3 percent (59.7 billions cubic feet [BCF] to 61.6 BCF) over 1998. Natural gas production, because of recent discoveries, has not shown the decline of oil production, but instead has shown gradual increases in yearly production (MBOGC 2000). Drilling within the State for conventional oil and gas increased by approximately 55 percent from 1998 to 1999. Geophysical activity continued in 1999 with four seismic contractors permitted 20 projects—a significant number of which involved 3-D shooting (MBOGC 2000). Horizontal well completions continue to be popular in the State; in 1999, MBOGC approval was given for seven new horizontal wells and two horizontal re-completions of existing vertical wells. In 1999, BLM approved four new horizontal wells and one horizontal recompletion. In 2000, BLM approved 13 new horizontal wells and 16 recompletions.

Figures MIN-1 through MIN-3 were constructed using the latest data available from the production files of the MBOGC. The only area of interest that shows production increases is Blaine County, which is one of the State's most important natural gas regions.

Figure MIN-1

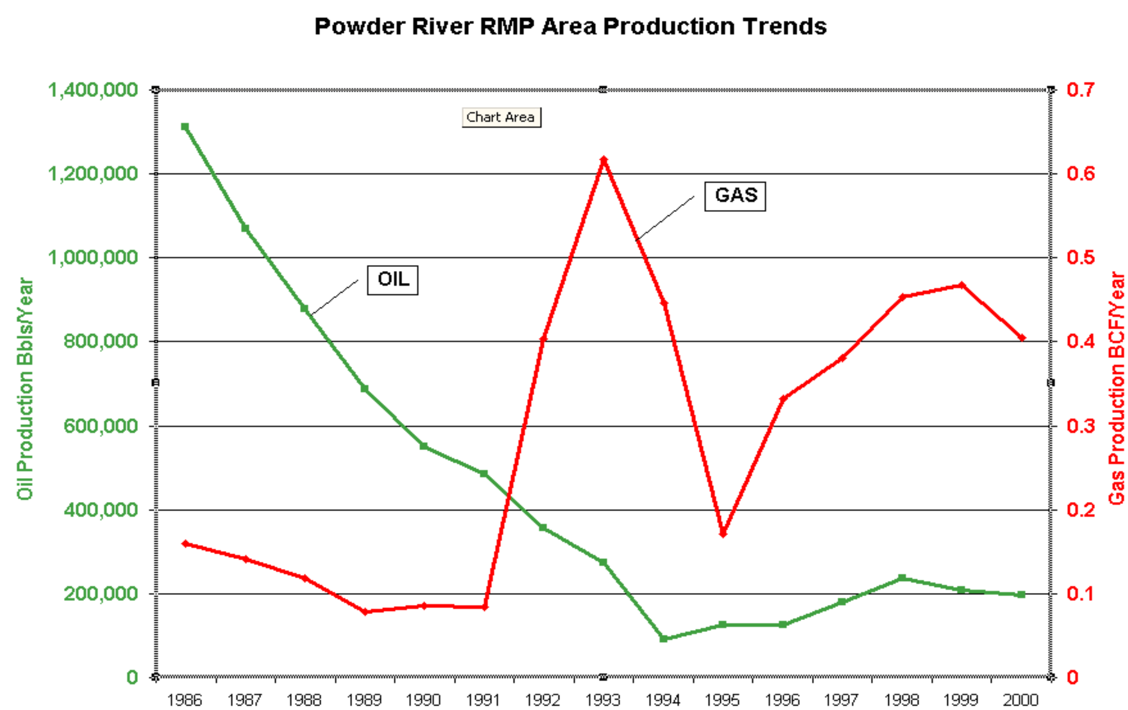


Figure MIN-2

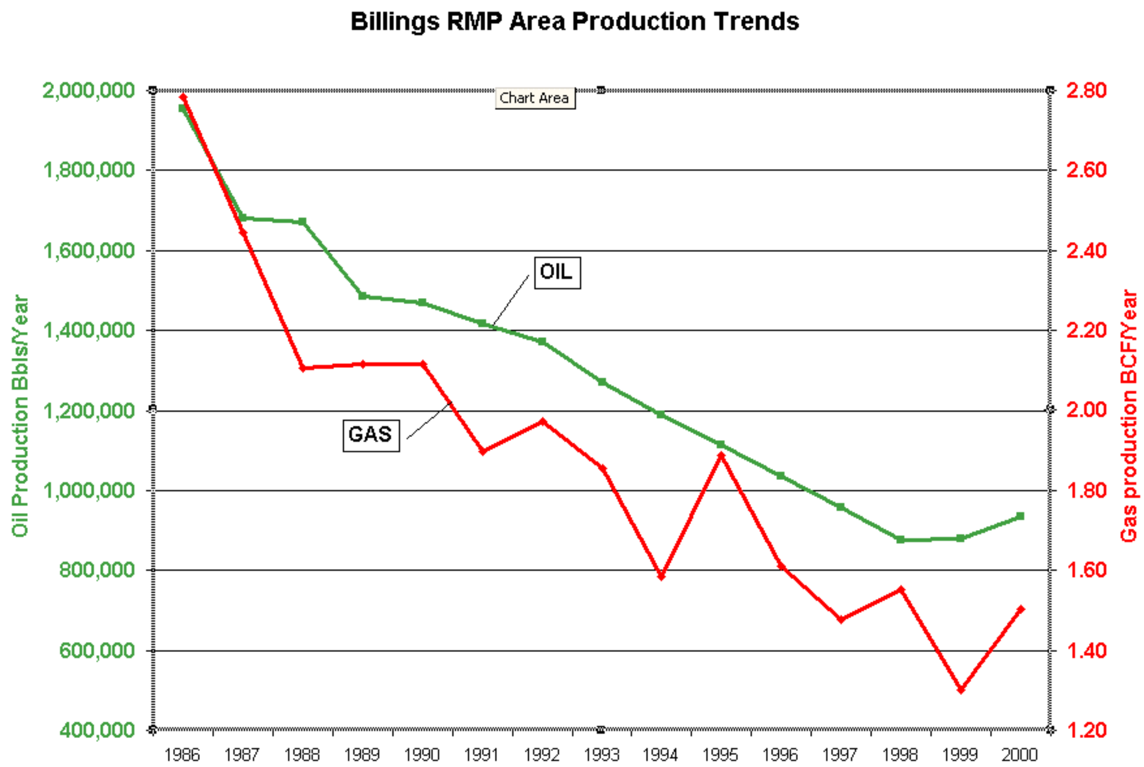
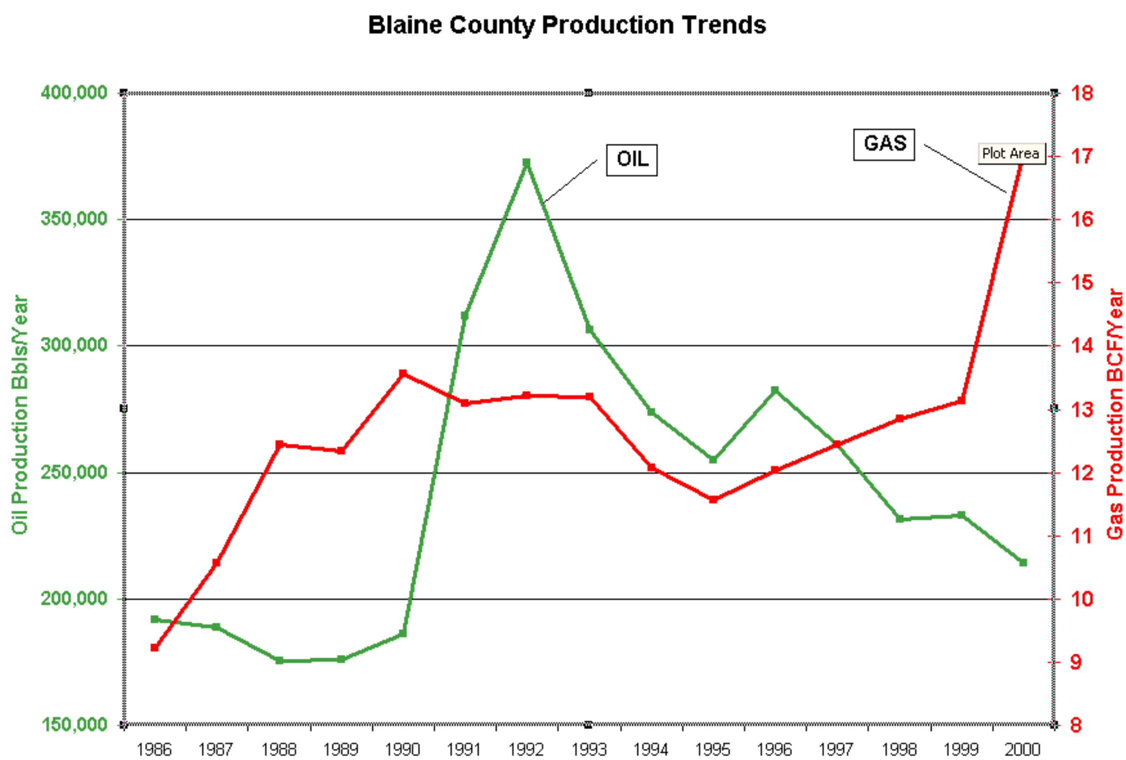

Billings RMP Area Production Trends
Chart Area
OIL
GAS
Oil Production Bbls/Year
Gas production BCF/Year
2,000,000
1,800,000
1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000

Figure MIN-3


Blaine County Production Trends
Oil Production Bbls/Year
Gas Production BCF/Year
400,000
350,000
300,000
250,000
200,000
150,000
18
17
16
15
14
13
12
11
10
9
8
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
OIL
GAS
Plot Area

REASONABLE FORESEEABLE DEVELOPMENT SCENARIO

Introduction

The Reasonably Foreseeable Development (RFD) scenario for the EIS predicts oil and gas development in five areas: the Powder River RMP area, the Billings RMP area, and in Blaine, Gallatin, and Park counties of Montana. The RFD projects drilling of both conventional and CBM wells, numbers of pipelines, and compressors needed for production of CBM wells. The RFD carries forward the production for conventional wells covered in the *Oil and Gas Amendment* for the two RMP areas.

For the purpose of the analysis, the RFD will address potential CBM development of the Crow and Northern Cheyenne reservations and the Ashland Ranger District of the US Forest Service. This is in no way to say the BLM and the State of Montana are making decisions about the reservations or the Forest Service. The predictions are made so that all potential cumulative impacts are analyzed.

Predictions for exploration and development of coal bed methane (CBM) and conventional oil and gas in the RFD are based on: the BLM RMPs for the areas; coal information from the USGS; other referenced sources; expressions of interest; and projections from the oil and gas industry (Oct 18, 2000, CBM Coordination meeting).

Coal Bed Methane

To project CBM exploration and development, the areal extent of certain coals and the rank of coals in the study areas were considered. Areas of sub-bituminous to bituminous were considered as the most likely to be explored and developed in Montana, although exploration and development has occurred mainly in sub-bituminous coal in the Wyoming portion of the Powder River Basin (Basin). The USGS produced a map showing the areas of coal, by rank, for the United States (see Map MIN-1). This information indicates sub-bituminous and bituminous coals in many parts of the study area. Powder River, Rosebud, Custer, and Big Horn counties contain the northern part of the Basin, which extends north from Wyoming. Blaine and Musselshell counties have mostly sub-bituminous coal. Carbon County has an extension of the Big Horn Basin coal, which is ranked as bituminous coal. Gallatin and Park counties have scattered areas of bituminous to sub-bituminous coals. The projection of methane gas estimated to be produced from coal beds in Montana range from a low of 1 TCF (Crockett 2001-PRB est - RMG, Casper) to a high of 17.7 TCF (estimated based on figures from Nelson 2000). This and other information for Montana is used to predict where CBM exploration is most likely to occur in study area. The RFD predicts the number of CBM wells that would be drilled and completed during the next 20 years.

Conventional Oil and Gas

Historical drilling activity and oil and gas price projections were used to project conventional oil and gas development for the RMPs. The RFD scenario describes a somewhat different level of activity than the scenario found in the BLM *Final Oil and Gas RMP/EIS Amendment* issued in 1992. This is primarily because of the use of a different span for historical drilling activity. The 1992 amendment used the span from 1973 to 1988 in forecasting future activity. This document uses a total period of 80 years in forecasting future development. This led to a slight difference in the level of drilling activity forecast.

Approximately 200 to 800 wells would be drilled in the Powder River RMP area. Approximately 250 to 975 wells would be drilled in the Billings RMP area. A total of 450 to 1,775 wells could be drilled in 20 years.

A total of 37,233 oil and gas wells have been drilled in Montana (Petroleum Information Corp 2001). In the study area (two RMP areas and three counties) 9,510 wells have been drilled. This is an average of approximately 450 wells drilled per year statewide. From 1995 through 1999 the conventional wells drilled in the state ranged from 209 to 482 (MBOGC Report 1999).

Coal Areas of Montana

The USGS produced a map showing the areas of coal in Montana. The RMPs also include maps that indicate areas of coal occurrence. The coal volume for each county was used to determine the number of potential CBM wells that could be drilled. The values for volumes of coal in each county came from the BLM RMPs for the area, study papers, or estimates based on coal thickness, and acres of identified coal fields in the county. The coal volumes are based upon all coal beds, not just ones that are likely to be developed because of their thickness, depth, and extent. In some cases the volumes are estimates rather than exact figures. The coal volume in tons was multiplied by a range of estimates of recoverable methane per ton (USGS Professional Report 1625, and Flores, et al. 2001) and then divided by an estimate of the gas production per well from CMS Energy's, October 18, 2000, presentation in Miles City (CMS 2000). The amount of gas to be produced per well (0.3 BCF per well) would be used as the lowest economic limit. This resulted in a range of wells that may be drilled over the next 20 years. The coal volume data came mostly from the Powder River and the Billings RMPs, supplemented by information from USGS and Gas Technology Institute (GTI) papers (Nelson 2000).

Coal resources in the Powder River Basin are in the Paleocene Fort Union Formation. About half of the estimated 30 trillion cubic feet of in-place CBM resource is recoverable. Less than half the coal resources occur in the Montana portion of the Basin. These sub-bituminous coals have low concentrations of gas per unit volume (Choate et al. 1984). However, because of the immense total coal thickness that reaches 170 feet in some areas in Montana (Campen 1990), vast quantities of CBM may be present.

Two formations in the Big Horn Basin contain coal. The Red Lodge-Bearcreek deposit is in the Paleocene Fort Union Formation. The coals are classed as sub-bituminous. Nine coal beds have an average total thickness of approximately 45 feet (Darrow, 1954). The Bridger Coal Field is in the upper Cretaceous Eagle Formation. The coal is bituminous in rank. Three coal beds totaling 6 feet are known in this deposit (Campen 1990). The extent of the coals is not known, although the coal may be a source of methane for certain Cretaceous sands (Judith River, Eagle) in the Dry Creek field, which is 5 to 10 miles southwest of Bridger, Montana.

Gas Well Spacing

The Montana Board of Oil and Gas Conservation (MBOGC) establishes the spacing of gas wells. Spacing for wildcat wells is 640 acres per well for each producing formation. MBOGC has the authority to change the well spacing to provide for maximum efficiency and recovery of gas reserves. Well spacing is usually changed after MBOGC has reviewed geologic, engineering and economic data provided by lease operators. The MBOGC then establishes the boundaries for a producing gas field. The planning area includes only one CBM field and numerous conventional gas fields. When a field is discovered, the exploration company would appear before MBOGC to request permanent spacing for the production. Based upon current CBM well spacing in Wyoming and Montana, spacing would probably range from one well per 80 acres to one well per 40 acres for CBM production. The spacing in the CX field is four wells per coal bed per 160 acres. Because of the number of coals in the CX field, this could result in as many as 16 wells per 160 acres or potentially 64 wells per 640 acres. The well density has not reached this level at present and because of the faulting, splitting, and joining of the coals and absence of the coals in some sections this is not likely to happen. CBM is produced from three coal seams in the CX field. Each well produces methane from a single coal seam; however, in the future, wells may be designed to produce from multiple coal seams. This would decrease the number of wells required for production in the CX field.

Oil Well Spacing

The MBOGC also sets the spacing of oil wells. The spacing for an oil well in the state of Montana is based on the depth of the well. For well depth of 0 to 6,000 feet (ft.), the statewide spacing is one well per 40 acres; for well depth of 6,001 ft. to 11,000 ft., it would be one well per 160 acres; finally, for well depth of more than 11,001 ft., it would be one well per 320 acres. MBOGC has the authority to change the well spacing to provide for maximum efficiency and recovery of gas reserves. Well spacing is usually changed after MBOGC has reviewed geologic, engineering, and economic data provided by lease operators. The MBOGC then establishes the boundaries for the producing oil field. There are numerous fields within the planning area.

Areas of Disturbance

CBM

Surface disturbance for a typical CBM well includes 0.25 acres for the well pad and 0.75 acres for the access road for a total of 1 acre disturbed for drilling operations. Part of the well pad area is reclaimed for production operations, and the entire area of disturbance is reclaimed when the well is plugged and abandoned.

Conventional Oil & Gas Wells

Surface disturbance for a typical conventional shallow gas well (less than 2,000 feet deep) includes 0.5 acres for the well pad and a 2-mile bladed road for a total of 1 acre disturbed for drilling operations. Part of the well pad area is reclaimed for production operations, and the entire area of disturbance is reclaimed when the well is plugged and abandoned.

Surface disturbance for a typical shallow oil well (less than 5,000 feet deep) includes 2 acres for the well pad and 1.5 acres for a 1-mile bladed road for a total of

3.5 acres disturbed for drilling operations. Surface disturbance for a typical deep oil well (from 5,000 to 12,000 feet deep) includes 4 acres for the well pad and 1.5 acres for a 1-mile bladed road, for a total of 5.5 acres disturbed for drilling operations. Part of the well pad area is reclaimed for production operations, and the entire area of disturbance is reclaimed when the well is plugged and abandoned.

General Assumptions

- All numbers were rounded to the nearest significant number.
- The number of BLM-administered wells will be based on the BLM-administered oil and gas acreage in the county.
- 80 percent of Big Horn County is in the Billings RMP area.

Occurrence Potential

The text in this section discusses the oil and gas occurrence potential for each county.

Big Horn County

CBM

The southeastern and eastern portion of the county contains approximately 28,700 million tons of sub-bituminous coal (Powder River RMP). The area includes one CBM field (CX Ranch).

Conventional

The county has nine oil and gas fields , including four oil fields, one conventional gas field at Toluca, and an inactive gas field at Hardin. The oil and gas fields in Big Horn County produce from the Ft. Union, Shannon, Amsden, Madison, and Tensleep formations. Production has occurred from the Frontier formation (Hardin Gas field). A total of 844 wells have been drilled to date, of which 172 have been drilled on the Crow Reservation. One gas sales line runs through the north portion of Big Horn County, but none on the Crow Reservation.

Blaine County

CBM

There are areas of sub-bituminous coal throughout much of Blaine County . The estimated coal volume of 40 million tons for the county came from the USGS-MBMG report of 1963. The county does not have any CBM production.

Conventional

Blaine County has 26 oil and gas fields, with 2,123 (Petroleum Information 2001) wells drilled to date. There are 14 gas producing fields and five producing oil fields. Production occurs from the Judith River, Eagle, Bowdoin, Phillips, and Piper formations. Pipelines and compressor stations are in place in the existing fields.

Carbon County

CBM

Carbon County includes the Silvertip, Bear Creek, Bridger and the Joliet-Fromberg coal fields. The coal ranges from Ft Union to Eagle coal and is of sub-bituminous to bituminous nature. The volume of coal is estimated at approximately 760 million tons. The estimate of the gas content of the coals for sub-bituminous will be the same as the coals in the Powder River basin. The estimate for the bituminous coals for the RFD will be from 200 to 450 standard cubic feet (SCF)/ton.

Conventional

Carbon County includes 18 identified gas and oil fields. The wells produce from the Frontier, Phosporia-Tensleep, Judith River, Claggett, Eagle, and Greybull formations. Seven hundred thirty-five wells have been drilled in this county (Dwights well data).

Carter County

CBM

Bituminous or sub-bituminous coals have not been identified in Carter County. The only coal is of lignite rank, which is not considered to have a potential to produce methane in economic quantities.

Conventional

Carter County includes the Bell Creek, Southeast Bell Creek, and Repeat oil fields, as well as two gas fields near Hammond. They produce from the Muddy and Red River formations. There have been 434 wells drilled to date in this county.

Custer County

CBM

The Powder River RMP estimated 1.3 billion tons of sub-bituminous coal is located within Custer County. The coal occurs in the southern and southwestern portion of the county.

Conventional

The Liscom Creek and Pumpkin Creek fields are located in Custer County. Gas in these fields is produced from the Shannon formation. These fields have a small sales line in place.

Gallatin County

CBM

Very little coal is identified in Gallatin county; some has been identified in the eastern edge or southern part of the county. Coal mining has also historically occurred in Gallatin County (Roberts 1966, and Calvert 1912a and 1912b). The volume is estimated to be approximately 50 million tons of sub-bituminous to bituminous coal.

Conventional

There are no oil or gas fields in Gallatin County, and only 22 conventional wells have been drilled to date.

Golden Valley County

CBM

Although there is some coal shown for Golden Valley County, there are no volumes estimated. The coal that is shown is of the sub-bituminous rank.

Conventional

Two oil and two gas fields have been identified in this county, and 124 wells have been drilled to date. The wells have produced from the Cat Creek, Lakota, Niobrara, Frontier, Heath, and Tyler formations.

Musselshell County

CBM

The RMP estimated 646.6 million tons of sub-bituminous coal in the county. These Ft. Union coals are located in the Bull Mountain Basin.

Conventional

Thirty-five fields have been identified in Musselshell County, and 1,415 wells have been drilled to date. The wells have produced from the Amsden, Cat Creek, Morrison, Heath, and Tyler formations.

Park County

CBM

Park County has scattered areas of an estimated 100 million tons of sub-bituminous and bituminous coal. Coal mining has also historically occurred in Park County (Roberts 1966, and Calvert 1912a and 1912b). A gas transmission line runs through the center of the county.

Conventional

There are no identified oil and gas fields in Park County. There have been 32 wells drilled to date in the county.

Powder River County

CBM

Based on information from the RMP, there are 27 billion tons of sub-bituminous coal in the county. The coal is located mostly in the western half of the county.

Conventional

There are seven oil and gas fields in the county, including Bell Creek, which is the second-largest producing field in Montana (based on cumulative production). The Shannon and Muddy formations are productive in the county, and 1,249 wells have been drilled to date.

Rosebud County

CBM

Rosebud County contains 11.3 billion tons of sub-bituminous coal. The coal is located in the southern and eastern portion of the county.

Conventional

Rosebud County has 18 identified oil and gas fields producing from the Tyler formation, and 1,147 wells have been drilled to date.

Stillwater County

CBM

There is one identified bituminous coal field (Stillwater) in the county and it is estimated to have 475 million tons of Eagle formation coal. The coal is estimated to contain a much higher gas content per ton than the Powder River sub-bituminous coals. The county has three gas transmission lines running through the north half of the county.

Conventional

There are 11 identified oil and gas fields in the county. The producing formations are the Frontier, Eagle, Claggett, Cat Creek, Morrison, and Virgelle. There have been Three hundred sixty-seven 367 conventional wells have been drilled to date in the county.

Sweet Grass County

CBM

The coal estimates for the county are 100 million tons. In addition, there are gas transmission lines through the center and running southeast and northeast in the county.

Conventional

There is one identified field—a six-shooter dome—is in Sweet Grass County. This is the Sixshooter Dome. The productive formations in the county are the Eagle and Lakota, and . There have been 82 conventional wells have been drilled to date.

Treasure County

CBM

The RMP's coal estimates for the county from the RMP are 100 million tons. There is a gas transmission line running through the southeastern part of the county.

Conventional

There are no identified oil and gas fields in the county and no productive formations have been identified; however, 32 conventional wells have been drilled to date.

Wheatland County

CBM

No coal has been identified in Wheatland County. A gas transmission line runs through the eastern part of the county.

Conventional

One oil and gas field—Mud Creek—has been identified in the county. The Amsden formation is productive, and 60 conventional wells have been drilled to date in the county.

Yellowstone County

CBM

Five hundred ninety million tons of coal have been identified in the county. There are four gas transmission lines in the southern part of the county.

Conventional

There are six oil and gas fields identified in the county, and 425 conventional wells have been drilled to date. The productive formations that have been identified are the Mossersand, Amsden, and Dakota.

Crow Reservation

CBM

There has been 16.1 billion tons of coal identified on the Crow Reservation.

Conventional

The reservation includes the Soap Creek, Lodge Grass, Gray Blanket, and Ash Creek oil and gas fields. There have been 172 conventional wells drilled to date on the reservation. Production occurs from the Shannon, Tensleep, Amsden and Madison formations within the reservation.

Northern Cheyenne Reservation

CBM

Based upon limited data, it is estimated that 16.3 billion tons of sub-bituminous coal lie within the reservation. The coal is believed to underlie most or all of the reservation.

Conventional

The reservation does not have any known oil or gas fields. Twenty conventional wells have been drilled to date.

Ashland District, U.S. Forest Service

CBM

Tertiary Ft. Union coal is believed to underlie most or all of the Ashland Forest.

REASONABLE FORESEEABLE DEVELOPMENT—ALTERNATIVE A

CBM

A general assumption used for this alternative for CBM wells is that the number of townships of potential development in each county would be limited to areas where coal has been identified. Additionally, other assumptions were used for Alternative A for CBM wells. These include:

- CBM drilling would only be allowed where there was a need for additional data (townships where no CBM wells had been drilled by any company).
- CBM drilling would occur but there would be no production (from federal wells). That is, the permits would be for drilling and testing but no production.
- No pipelines, power-lines, or any production facilities would be installed at any of the federal CBM wells.
- There would be no discharge of produced water allowed from any of the federal CBM wells.
- For a high number, four wells per township were assumed; for the low number, one well per township was assumed.
- It was assumed that the number of townships in each county would be limited to areas where coal has been identified.

BLM-Administered

An estimated 400 acres based on 400 CBM well would be disturbed during exploratory drilling operations, (.25 acre/location and .75 acre/access road), which is the number of wells predicted to be drilled during the 20-year analysis period. The total number of acres could be reduced if more than one methane well is drilled on the well pad—as is the pattern in the CX Field.

State-Administered

Existing Management Assumptions

There will be 325 CBM wells permitted for the Redstone project area in Big Horn County. Of these, only 250 will be allowed to produce and 75 will be for exploration only. Two hundred CBM exploration wells will be permitted for the rest of the state.

Forest Service—Administered

Currently the Custer National Forest, Ashland Ranger District, is not open for oil and gas leasing. Alternative A assumes that similar management would continue, no leases would be issued and no wells drilled.

Conventional Oil and Gas

The RFD scenario from the *Oil and Gas Amendment* contains projections for the number of wells and acres disturbed in each producing region. The disturbance for each well is based on the typical depth of wells for an area. Shallow wells generally disturb fewer acres. Tables 4.1 through 4.4 in the *Oil and Gas Amendment* (pp. 55 and 56) show totals for the planning area and each resource area. The assumptions for conventional oil and gas in this alternative are as follows:

- The unconstrained number of wells comes from the Oil and Gas Amendment RFD scenario.
- The constrained number of wells is derived from the resource analysis for wells foregone in No Surface Occupancy areas.
- The average acreage figure (total acres/total wells) for the resource area was used to estimate federal acres disturbed.
- The RFD projections have a 20-year life.
- A more detailed description of information for the assumptions is contained in the *Oil and Gas Amendment* in *Chapter 4*, *Social Economic Conditions* and in *Appendix C,* (BLM 1992).

BLM-Administered

The number of acres disturbed during drilling operations would be 1,342 acres based on 400 wells, which is the number of wells predicted to be drilled during the 20-year analysis period.

State of Montana

The number of acres disturbed during drilling operations would be 4,551 acres based on 891 new wells predicted for the 20-year analysis period in the

Powder River and Billings RMP areas. The conventional wells in Blaine, Park, and Gallatin counties will be based on historical drilling for those counties. The RFD for the State of Montana for conventional wells under this alternative is the same as Alternatives B, C, D, and E.

Forest Service—Administered

Currently the Custer National Forest, Ashland Ranger District, is not open for oil and gas leasing. Alternative A assumes that similar management would continue, no leases would be issued and no wells drilled.

Development Potential

The development potential for federal oil and gas in each county is described in the text that follows.

Big Horn County

CBM

Based on the review of unexplored coal areas in Big Horn County, there would be 20 to 64 exploration wells drilled on minerals under BLM jurisdiction. Approximately 16 to 44 of these wells would have production potential and 4 to 20 wells would be drilled and abandoned. The only disturbance would be for the access road and well pad.

Conventional

The county has potential for five to 30 additional wells to be drilled on minerals under BLM jurisdiction in the next 20 years, based on historical drilling rates.

Carbon County

CBM

Based on the unexplored coal areas in the county, the BLM could permit the drilling of approximately 24 to 72 wells under this alternative. Sixteen to 48 of these wells would have the potential to be productive, and 8 to 24 wells will be drilled and abandoned. There would be no pipelines or production facilities for these wells. The only disturbance would be for the access road and well pad.

Conventional

Carbon County has potential for 10 to 45 additional wells to be drilled on minerals under BLM jurisdiction in the next 20 years, based on historical drilling rates.

Carter County

CBM

There are no CBM wells projected to be drilled under this alternative in the county.

Conventional

The county has potential for 1 to 6 additional wells to be drilled on minerals under BLM jurisdiction in the next 20 years, based on historical drilling rates.

Custer County

CBM

Based on the unexplored coal areas in the county, the BLM could permit the drilling of from 20 to 64 wells under this alternative. Sixteen to 44 of these wells would have the potential to be productive, and four to 20 wells will be drilled and abandoned. There would be no pipelines or production facilities for these wells. The only disturbance would be for the access road and well pad.

Conventional

The county has potential for one to three additional wells to be drilled on minerals under BLM jurisdiction in the next 20 years, based on historical drilling rates.

Gallatin County

CBM

No CBM wells are projected to be drilled in this county on minerals under BLM jurisdiction with this alternative.

Golden Valley County

CBM

No CBM wells are projected to be drilled in this county on minerals under BLM jurisdiction with this alternative.

Conventional

The county has potential for one to six additional wells to be drilled on minerals under BLM jurisdiction in the next 20 years, based on historical drilling rates.

Musselshell County

CBM

Based on the unexplored coal areas in the county, the BLM could permit the drilling of 10 to 40 wells under this alternative. From eight to 30 of these wells would have the potential to be productive, and two to 10 wells will be drilled and abandoned. There would be no pipelines or production facilities for these wells. The only disturbance would be for the access road and well pad.

Conventional

The county has potential for 20 to 90 additional wells to be drilled on minerals under BLM jurisdiction in the next 20 years, based on historical drilling rates.

Park County

CBM

There are no CBM wells projected to be drilled in this county on minerals under BLM jurisdiction with this alternative.

Powder River County

CBM

Based on the unexplored coal areas in the county, the BLM could permit the drilling of from 20 to 80 wells under this alternative. Sixteen to 60 of these wells would have the potential to be productive, and four to 20 wells will be drilled and abandoned. There would be no pipelines or production facilities for these wells. The only disturbance would be for the access road and well pad.

Conventional

The county has potential for one to three additional wells to be drilled on minerals under BLM jurisdiction in the next 20 years, based on historical drilling rates.

Rosebud County

CBM

Based on the unexplored coal areas in the county, the BLM could permit the drilling of 12 to 48 wells under this alternative. Eight to 32 of these wells would have the potential to be productive, and four to 16 wells will be drilled and abandoned. There would be no pipelines or production facilities for these wells. The only disturbance would be for the access road and well pad.

Conventional

The county has potential for 10 to 40 additional wells to be drilled on minerals under BLM jurisdiction in the next 20 years, based on historical drilling rates.

Stillwater County

CBM

Based on the unexplored coal areas in the county, the BLM could permit the drilling of six to 24 wells under this alternative. Four to 18 of these wells would have the potential to be productive, and two to six wells will be drilled and abandoned. There would be no pipelines or production facilities for these wells. The only disturbance would be for the access road and well pad.

Conventional

The county has potential for three to 12 additional wells to be drilled on minerals under BLM jurisdiction in the next 20 years, based on historical drilling rates.

Sweet Grass County

CBM

Based on the unexplored coal areas in the county, the BLM could permit the drilling of two to four wells under this alternative. Up to four of these wells would have the potential to be productive, and up to two wells will be drilled and abandoned. There would be no pipelines or production facilities for these wells. The only disturbance would be for the access road and well pad.

Conventional

The county has potential for one to six additional wells to be drilled on minerals under BLM jurisdiction in the next 20 years, based on historical drilling rates.

Treasure County

CBM

Based on the unexplored coal areas in Treasure County, the BLM could permit the drilling of two to four wells under this alternative. Up to two of these wells would have the potential to be productive, and up to two wells will be drilled and abandoned. There would be no pipelines or production facilities for these wells. The only disturbance would be for the access road and well pad.

Conventional

The county has potential for one to three additional wells to be drilled on minerals under BLM jurisdiction in the next 20 years, based on historical drilling rates.

Wheatland County

CBM

There are no CBM wells projected to be drilled on minerals under BLM jurisdiction in the county.

Conventional

The county has potential for one to three additional wells to be drilled on minerals under BLM jurisdiction in the next 20 years, based on historical drilling rates.

Yellowstone County

CBM

Based on the unexplored coal areas in the county, the BLM could permit the drilling of two to six wells under this alternative. Up to three of these wells would have the potential to be productive, and up to three wells will be drilled and abandoned. There would be no pipelines or production facilities for these wells. The only disturbance would be for the access road and well pad.

Conventional

The county has potential for five to 15 additional wells to be drilled on minerals under BLM jurisdiction in the next 20 years, based on historical drilling rates.

RFD Conclusion

CBM

During the life of the plan, it is estimated that the number of CBM exploration wells that may be drilled throughout the two RMP areas would range from a low of 120 wells to a high of 400 wells on BLM-administered minerals. CBM drilling would be allowed but there would be no production (from federal wells). This means the permits would be for drilling and testing but no production. There would be no pipelines or power-lines or any production facilities installed at any of the federal CBM wells. There would be no discharge of produced water allowed from any of the federal CBM wells. This would result in approximately 400 acres of disturbance for the 400 wells (.25 acre/location and .75 acre/access road).

Powder River RMP Area

During the life of the plan, it is estimated that the number of CBM wells that may be drilled in the Powder River RMP area would range from a low of 60 wells to a high of 240 wells on BLM-administered minerals. CBM drilling would be allowed but there would be no production (from federal wells). This means the permits would be for drilling and testing but no production. There would be no pipelines or power-lines or any production facilities installed at any of the federal CBM wells. There would be no discharge of produced water allowed from any of the federal CBM wells. This would result in approximately 240 acres of disturbance for the 240 wells (.25 acre/location and .75 acre/access road).

Billings RMP Area

During the life of the plan, it is estimated that the number of CBM wells that may be drilled throughout the Billings RMP area would range from a low of 50 wells to a high of 160 wells on BLM-administered minerals. CBM drilling would be allowed but there would be no production from Federal wells. This means the permits would be for drilling and testing but no production. There would be no pipelines, power-lines, or any production facilities installed at any of the federal CBM wells. There would be no discharge of produced water allowed from any of the federal CBM wells. This would result in approximately 160 acres of disturbance for the 160 wells (.25 acre/location and .75 acre/access road).

Conventional Oil and Gas

Based on the Assumptions listed at the beginning of this section, the number of conventional oil and gas wells that could be drilled on BLM administered minerals would range from a low of 60 to a high of 260wells. No estimates of disturbance were made for conventional wells.

Powder River RMP Area

The RFD estimates that 15 to 60 of these wells would be drilled on minerals under BLM jurisdiction. Most of these wells would be drilled in or near the existing fields.

Billings RMP Area

The RFD estimates that 45 to 200 conventional wells are to be drilled on minerals under BLM jurisdiction. Most of these wells would be drilled in or near the existing fields.

REASONABLE FORESEEABLE DEVELOPMENT—Alternatives B, C, D, and E

Assumptions

CBM

The following assumptions were used to calculate the number of wells to be drilled, the number of in-field compressors, and the number of sales compressors required:

- The coal volume for each county and Indian reservation was taken from published sources such as the RMPs. For the RMPs, all tonnages are based on in-place coal with development potential defined as beds 5 feet thick or greater, with a 15:l or less stripping ratio, and 500 feet of overburden or less. This gives a greater tonnage than actual limits currently used by the mining industry in the area, where stripping limits seldom exceed 200 feet of overburden or a ratio of 6:l. Tonnage calculations are based on 1,770 tons/acre-foot. For the Northern Cheyenne Reservation, the coal volumes from the USGS/U.S. Bureau of Mines reports is based on very limited data. The coal volumes for the Crow Reservation from the USGS/U.S. Bureau of Mines report were based on more extensive data. The coal tonnages in the RMPs include strippable coal, which may or may not contain producible methane in economic quantities
- The gas content per ton (26-50-74 SCF/ton) of sub-bituminous coal came from studies by the USGS (Professional Paper 1625A). The gas content for bituminous coal (200-350-450 SCF/ton) came from a paper by Campen and Gruber (1991), with the lower values estimated to give a range of wells.
- The spacing for the CBM wells would be one well per 80 acres per coal seam. The spacing was assumed after discussions with the MBOGC, as well as our understanding that Wyoming will be using this spacing (as a general rule) for CBM wells.
- Three coal seams would be developed per 80 acres. Another way of saying this is there would be three wells per pad in each 80 acres.
- One field compressor would service 24 CBM wells. The area of disturbance would be 0.5 acres.
- One sales compressor could handle 10 field compressors. The area of disturbance would be 0.5 acres.
- Each CBM well would produce .3 BCF of gas.
- Where the wells would be located in the counties or on Indian reservations was based on either the Montana Coal Occurrences from the USGS open file report OF 96-92, the RMPs, or information from the U.S. Bureau of Indian Affairs (BIA).
- No predictions were made based on distances to coal outcrops, thickness of individual coal seams, or thickness of overburden to coals. This information will be used by companies to place individual wells.
- The coal in each county did not include the coal on the Indian reservation in that specific county. The coal (from USGS and U.S. Bureau of Mines' report)on each Indian reservation resulted in a number of wells being drilled on each reservation.
- The RFD used the coal tonnages for the Indian reservations for the thickest coals (coals over 20 feet thick) because there were no coal seam thickness given for the Indian reservations.
- The RFD assumed that areas of lignite would not have economic production of methane so no wells were forecasted in those areas. We are not aware of any companies or individuals that are currently pursuing the testing of lignite for gas. With the present technology, it is unlikely that industry will be able to produce commercial amounts of gas from lignite within Montana, for the reasonably foreseeable future.
- The number of CBM producing wells in each county would be approximately 90 percent of the total CBM wells projected for that county.
- The number of CBM dry holes would be approximately 10 percent of the total CBM wells projected for that county.
- A 0.5-mile-long gathering line would be buried from the CBM well to the field compressor. The width of disturbance would be 15 feet. Multiple flowlines would be laid in the same trench from a well pad with more than one CBM well. Whenever possible, these lines would be placed in the access

road to the wells. This would result in 0.9 acres of disturbance per line.

- There would then be steel lines going from each gathering field compressor to the sales compressor. There would be 2 miles of these steel lines per field compressor. The width of disturbance would be 25 feet. This would result in 6 acres of disturbance per line.
- The lines would go from the sales compressor to the sales lines. These would be high-pressure steel lines. There would be no more than 60 miles of these high-pressure steel lines per county. The width of disturbance would be 25 feet. This would result in 3 acres of disturbance per mile of sales line.
- Half of the projected wells would be drilled in the first 10 years and the remaining wells would be drilled in the second 10 years.
- The estimates for CBM wells did not take into account variations in topography, which could have a significant impact to actual placement and numbers of wells.
- The rate of development for the first 10 years will be as indicated in the industry projection of October 18, 2000, which is shown in Figure MIN-4. The rate of abandonment is presented in Figure MIN-5.
- For purposes of planning, the State of Montana would consider other counties, such as Blaine, Gallatin, or Park, which may have coal resources.

Conventional Wells

- Wells drilled to date in each county were taken from Dwights well data.
- The number of wells drilled to date was divided by 80 years, which is an approximation of how long exploration has been ongoing.
  - This number was divided in half, then multiplied by 10 years for the low estimate of drilling for the next 10 years.
  - The number was used as is, and was multiplied by 10 years for the moderate level of drilling for the next 10 years.
  - The number was multiplied by two (doubled), then multiplied by 10 years to calculate a high level of drilling for the next 10 years.
- The wells drilled on each reservation were counted in the total for each county.
- The percentage of dry holes for each county is based on the overall historical percentage of non-producing wells (71 percent), compared to the total wells drilled per county.
- The acres disturbed per well will be the same as shown in alternative A.

Development Potential

The development potential for CBM and conventional wells for all owners is described in the text that follows.

Big Horn County

CBM

Based on the volume of coal in these areas, Big Horn County could support from 2,500 to 7,000 CBM wells. Approximately, half of these wells (1,250 to 3,500) would be drilled on minerals under BLM jurisdiction. Producing CBM wells would range from 2,200 to 6,300 wells. Most of the wells in Big Horn County would be in the southeastern portion of the county. There would be from 100 to 250 field compressors. The number of sales compressors estimated for Big Horn County would be from 10 to 25. This level of production would require gathering and sales lines to be constructed. From 1,450 to 4,200 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and follow the roads to the field compressors. Two hundred to 500 miles of low-pressure steel-lines would be laid from the field compressors to the sales compressors. No more than 60 miles of sales lines would be laid to the main transmission lines. The sales lines would probably go north toward the main WBI pipeline or south to main lines in Wyoming.

Conventional

The county has potential for 50 to 200 additional wells to be drilled in the next 20 years, based on historical drilling rates. From 3 to 15 of these wells would be drilled on minerals under BLM jurisdiction.

Blaine County

CBM

An area of identified coal exists near Chinook where it is estimated that five to 15 CBM wells could be drilled, and of these, five to 10 wells would be producing. This would result in one field compressor and up to one sales compressor. Three to 7 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells, and would follow the roads to the field compressors. One to 2 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. No more than 20 miles of sales lines would be laid to the main transmission lines.

Conventional

During the past 5 years, 134 conventional wells were drilled in the county. The county produces a significant portion of the non-associated gas produced in Montana, therefore the gas infrastructure is present. The RFD estimates from 150 to 500 conventional wells to be drilled in the next 20 years. Forty to 120 of these wells would be drilled on minerals under BLM jurisdiction. Most of these wells would be drilled in the existing fields.

Carbon County

CBM

The coal in Carbon County varies from Tertiary Ft. Union (sub-bituminous) to the Cretaceous Eagle (bituminous). The Eagle coal can contain more gas per ton than the Ft. Union coals. Based on the coal volumes and gas content, 150 to 400 wells could be drilled. Thirty to 60 of these wells would be drilled on minerals under BLM jurisdiction. From 135 to 360 producing CBM wells mostly would be located near the identified coal fields. The number of wells would require from five to 15 field compressors and one to two sales compressors. Ninety to 240 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and would follow the roads to the field compressors. Ten to 30 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. There would be no more than 60 miles of sales lines laid to the main transmission lines.

Conventional

Based on historical drilling, it is estimated that 50 to 200 wells would be drilled in the next 20 years. From 10 to 40 of these wells would be drilled on minerals under BLM jurisdiction. Some of these would be wildcat wells, but the majority would probably be associated with the existing fields.

Carter County

CBM

CBM wells are not predicted to be drilled in Carter County because of the nonexistence of bituminous or sub-bituminous coals.

Conventional

Based on historical drilling rates, we anticipate 25 to 100 wells to be drilled in the next 20 years. Ten to 40 of these wells would be drilled on minerals under BLM jurisdiction.

Custer County

CBM

Based on the estimated quantity of coal, 100 to 300 wells will need to be drilled; of these, 90 to 270 would be producing wells. The CBM development would occur in the southwestern corner of the county. Twenty to 70 of these wells would be drilled on minerals under BLM jurisdiction. This many wells would require from five to 10 field compressors and one to two sales compressors. Additional pipelines would have to be built. Sixty to 180 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and follow the roads to the field compressors. Ten to 20 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. No more than 60 miles of sales lines would be laid to the main transmission lines.

Conventional

Based on historical drilling rates, we estimate from 15 to 60 wells will be drilled in the next 20 years. Five to 15 of these wells would need to be drilled on minerals under BLM jurisdiction.

Gallatin County

CBM

Based on the estimates of coal volume, five to 15 wells will need to be drilled; of these, five to 10 would be producing wells. This would require one in-field compressor and may require one sales compressor depending on where the wells are located in the county. There is one gas sales line going through the north part of the county. Three to 7 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and would follow the roads to the field compressors. Additionally, 1 to 2 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. No more than 20 miles of sales lines would be laid to the main transmission lines.

Conventional

Based on historical drilling activity, it is anticipated that one to five wells would need to be drilled in the next 20 years. None of these wells would be drilled on minerals under BLM jurisdiction.

Golden Valley County

CBM

No CBM wells are anticipated to be drilled in Golden Valley County.

Conventional

Based on historical drilling activity, it is anticipated that 10 to 30 wells would be drilled in the county over the next 20 years. Most of these will probably be near the existing fields. One or two of these wells would be drilled on minerals under BLM jurisdiction.

Musselshell County

CBM

Based on the estimates of coal in the county, it is projected that 60 to 150 wells would be drilled, and of these, there would be from 50 to 140 producing wells. Five to 20 of these wells would be drilled on minerals under BLM jurisdiction. These wells would require from two to five in-field compressors and one sales compressor. There are no gas sales lines running through the county. Thirty to 100 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and follow the roads to the field compressors. Five to 10 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. No more than 60 miles of sales lines would be laid to the main transmission lines.

Conventional

It is estimated that 100 to 350 wells will be drilled in the county in the next 20 years. Ten to 40 of these wells would be drilled on minerals under BLM jurisdiction.

Park County

CBM

It is estimated that 10 to 25 CBM wells would be drilled in Park County, and of these, there would be 10 to 20 producing wells. These would require one field compressors and no sales compressor. There also would be from 7 to 17 miles of plastic, low-pressure gathering lines needed. These lines would be laid in the travel routes to the wells and follow the roads to the field compressor. One to 2 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. There is a compressor station currently located in the county, so it is assumed that the gas would be compressed to sales pressure.

Conventional

Based on historical activity, an estimated one to 10 wells will be drilled in the next 20 years. None of these wells would be drilled on minerals under BLM jurisdiction

Powder River County

CBM

Based on the coals present in Powder River County, it is estimated that 2,300 to 6,700 CBM wells could be drilled. From 1,150 to 3,350 of these wells would be drilled on minerals under BLM jurisdiction. There would be 2,070 to 6,030 producing CBM wells, which would require 100 to 250 field compressors, and 10 to 25 sales compressors. There is a transmission line in the southeastern part of the county but more pipelines would have to be built to gather and transport the potential gas that could be produced from this many wells. From 1,380 to 4,000 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and follow the roads to the field compressors. Two hundred to 500 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. There would be no more than 60 miles of sales lines laid to the main transmission lines.

Conventional

Based on historical drilling rates, it is anticipated that 80 to 300 conventional wells would need to be drilled in the county over the next 20 years. Thirty to 100 of these wells would be drilled on minerals under BLM jurisdiction.

Rosebud County

CBM

Based on the coal estimates for Rosebud County, the RFD projects 1,000 to 2,800 CBM wells will be drilled. From 500 to 1,400 of these wells would be drilled on minerals under BLM jurisdiction. There would be from 900 to 2,500 producing CBM wells, which would require approximately 40 to 100 field compressors and from five to 10 sales compressors. From 600 to 1650 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and follow the roads to the field compressors. Eighty to 200 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors, and there would be no more than 60 miles of sales lines laid to the main transmission lines. There is one gas sales line that runs through the county south of Forsyth. The CBM development would occur in the southern and eastern half of the county.

Conventional

Based on historical drilling rates in the county, the RFD projects 50 to 300 wells to be drilled over the next 20 years. Five to 50 of these wells would be drilled on minerals under BLM jurisdiction.

Stillwater County

CBM

The RFD projects 300 to 700 CBM wells to be drilled in the county. Fifteen to 35 of these wells would be drilled on minerals under BLM jurisdiction. These would most likely be drilled in the vicinity of the existing coal field. From 270 to 630 would be producing CBM wells. This would require 10 to 25 field compressors and one to three sales compressors. One hundred and eighty to 420 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and follow the roads to the field compressors. Twenty to 50 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. No more than 30 miles of sales lines would be laid to the main transmission lines.

Conventional

Based on historical drilling rates, the RFD projects 25 to 100 conventional wells will be drilled in the next 20 years. Two to 5 of these wells would be drilled on minerals under BLM jurisdiction.

Sweet Grass County

CBM

Based on the estimated coal volume in Sweet Grass County, the RFD projects that 10 to 25 CBM wells could be drilled. One to 2 of these wells would be drilled on minerals under BLM jurisdiction. There would be eight to 25 producing CBM wells, which would require 1 or 2 in-field compressors and 1 sales compressor. Five to 15 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and follow the roads to the field compressors. Additionally, 1 to 3 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. No more than 10 miles of sales lines would be laid to the main transmission lines.

Conventional

Based on historical drilling rates, the RFD projects that five to 20 conventional wells will be drilled in the next 20 years. Up to 1 of these wells would be drilled on minerals under BLM jurisdiction.

Treasure County

CBM

Based on the estimated coal volume in this county, the RFD projects that 10 to 25 CBM wells could be drilled. One to 2 of these wells would be drilled on minerals under BLM jurisdiction. There would be eight to 22 producing CBM wells, which would require 1 to 2 in-field compressors and 1 sales compressor. Five to 15 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and would follow the roads to the field compressors. One to 2 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. No more than 10 miles of sales lines would be laid to the main transmission lines.

Conventional

Based on historical drilling rates, the RFD projects one to 10 conventional wells will be drilled in the next 20 years. None of these wells would be drilled on minerals under BLM jurisdiction.

Wheatland County

CBM

No CBM wells are projected to be drilled in Wheatland County.

Conventional

Based on historical drilling rates, the RFD projects five to 15 conventional wells will be drilled in the next 20 years. None of these wells would be drilled on minerals under BLM jurisdiction.

Yellowstone County

CBM

Based on the identified coal, there could be from 50 to 150 CBM wells drilled in the next 20 years. One to 10 of these wells would be drilled on minerals under BLM jurisdiction. There would be 40 to 140 producing CBM wells in the county, which would require from two to five field compressors and one sales compressor. Twenty five to 90 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and would follow the roads to the field compressors. Five to 10 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. No more than 10 miles of sales lines would be laid to the main transmission lines.

Conventional

Based on historical drilling in the county, there could be from 25 to 100 wells drilled in the county in the next 20 years. None of these wells would be drilled on minerals under BLM jurisdiction.

Crow Reservation

CBM

Based on the identified coal resources within the reservation, 1,400 to 4,000 CBM wells could be drilled; of these, 1,300 to 3,600 would be producing wells. The wells would probably be located in the eastern portion of the Crow Reservation. This would require from 50 to 150 field compressors and from five to 15 sales compressors. Eight hundred to 2,400 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and would follow the roads to the field compressors. One hundred to 300 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. No more than 60 miles of sales lines would be laid to the main transmission lines. This would result in 7,000 to 19,000 acres of disturbance.

Conventional

Based on historical drilling rates, 10 to 50 conventional wells could be drilled in the next 20 years.

Northern Cheyenne Reservation

CBM

Based on coal resources, 1,400 to 4,000 CBM wells could be drilled on the reservation; of these, there would be 1,300 to 3,600 producing wells. This would require 50 to 150 field compressors, and from five to 15 sales compressors. Eight hundred to 2,400 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and would follow the roads to the field compressors. From 100 to 300 miles of low-pressure steellines would be laid from the field compressors to the sales compressors. There would be no more than 60 miles of sales lines laid to the main transmission lines. This would result in 7,000 to 19,000 acres of disturbance.

Conventional

Based on historical drilling rates, one to five conventional wells could be drilled on the reservation in the next 20 years.

Ashland District, U.S. Forest Service

CBM

Coal resources are primarily concentrated in the southern portion of the district. Otter Creek and the Tongue River drainages have eroded or exposed many of the coal zones. Based on the coal resources, the RFD projects that approximately 200 wells may be drilled over 20 years. This would result in approximately 400 acres of disturbance.

RFD Conclusion

CBM

During the life of the plan, it is estimated that the number of CBM wells that may be drilled throughout the five study areas would range from a low of 10,000 to a high of 26,000—of which 2,975 to 8,450 would be drilled on BLM-administered minerals. This is regardless of mineral ownership, and includes the Crow and Northern Cheyenne Indian Reservations. There would be from 8,500 to 24,000 producing CBM wells, of which 2,500 to 7,500 would be BLM administered. For a graphical presentation of these predictions, refer to Map 4-1 in Chapter 4 of this EIS. Table MIN-1 at the end of this section presents the RFD Expanded Development Scenario in numerical form.

These wells would require 350 to 1,000 field compressors, and 35 to 100 sales compressors. From 5,500 to 16,000 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and would follow the roads to the field compressors. Seven hundred to 2,000 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors, and approximately 600 miles of sales lines would be laid to the main transmission lines. This would result in 36,500 to 116,500 acres of disturbance. The total acres of disturbance include the Crow Reservation, the Northern Cheyenne Reservation, and any disturbance in the Ashland District of the Custer Forest.

Powder River RMP Area

During the next 20 years, it is estimated that the number of CBM wells that may be drilled throughout the Powder River RMP area, regardless of mineral ownership, would range from a low of 6,800 to a high of 19,600. The number of wells drilled each year would range from 200 to 1,100. There also would be 6,100 to 17,000 producing CBM wells, which would require 250 to 700 field compressors and 25 to 70 sales compressors. From 4,000 to 11,300 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and would follow the roads to the field compressors. From 500 to 1,400 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. Approximately 350 miles of sales lines would be laid to the main transmission lines. This would result in 31,400 to 85,700 acres of disturbance.

Billings RMP Area

During the next 20 years, it is estimated that the number of CBM wells that may be drilled throughout the Billings RMP area, regardless of mineral ownership, would range from 1,000 to 6,600. There would be 900 to 5,950 producing CBM wells, which would require 40 to 250 field compressors and 5 to 25 sales compressors. Six hundred to 4,000 miles of plastic, low-pressure gathering lines needed. These lines would be laid in the travel routes to the wells and would follow the roads to the field compressors. From 80 to 500 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. Approximately 230 miles of sales lines would be laid to the main transmission lines. This would result in 5,200 to 30,500 acres of disturbance.

Blaine County

The RFD estimates three to 10 CBM wells could be drilled. This would result in one field compressor and up to 1 sales compressors. There would be from 2 to 7 miles of plastic, low-pressure gathering lines needed, which would be laid in the travel routes to the wells and follow the roads to the field compressors. From 1 to 2 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. No more than 20 miles of sales lines would be laid to the main transmission lines. This would result in 75 to 100 acres of disturbance.

Park County

Ten to 25 CBM wells would be drilled in Park County. These wells would require 1 field compressor and no sales compressor. Seven to 17 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and would follow the roads to the field compressor. One to 2 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. Presently, there is a compressor station located in the county so it is assumed that the gas would be compressed to sales pressure at the compressor station. This would result in 40 to 100 acres of disturbance.

Gallatin County

Based on the estimates of coal volume, it is anticipated that five to 15 wells would need to be drilled. This would require 1 field compressor, and may require 1 sales compressor depending on where the wells are located in the county. There is one gas sales line going through the north part of the county. Three to 10 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and would follow the roads to the field compressors. From1 to 2 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. No more than 20 miles of sales lines would be laid to the main transmission lines. This would result in 80 to 120 acres of disturbance.

Conventional Oil and Gas

Based on the Assumptions listed at the beginning of this section, the number of conventional oil and gas wells that could be drilled would range from 750 to 2,900. The number of wells drilled each year would range from five to 15 in each of the 17 counties if the wells were distributed equally among the counties. No estimates of disturbance were made for conventional wells.

Powder River RMP Area

The RFD estimates that 300 to 1,300 conventional wells would be drilled in the next 20 years in the Powder River RMP area. Seventy to 300 of these wells would be drilled on minerals under BLM jurisdiction. Most of these wells would be drilled in or near the existing fields.

Billings RMP Area

The RFD estimates that 250 to 975 conventional wells would be drilled in the next 20 years in the Billings RMP area. Twenty-five to 100 of these wells would be drilled on minerals under BLM jurisdiction. Most of these wells would be drilled in or near the existing fields.

Blaine County

The RFD estimates that 150 to 500 conventional wells would be drilled in Blaine County in the next 20 years. From 32 to 127 of these wells would be drilled on minerals under BLM jurisdiction. Most of these wells would be drilled in the existing fields.

Park County

Based on historical activity, it is estimated that two to eight wells will be drilled in Park County in the next 20 years. None of these wells would be drilled on minerals under BLM jurisdiction

Gallatin County

Based on historical drilling activity, it is anticipated that from one to six wells would be drilled in Gallatin County in the next 20 years. None of these wells would be drilled on minerals under BLM jurisdiction.

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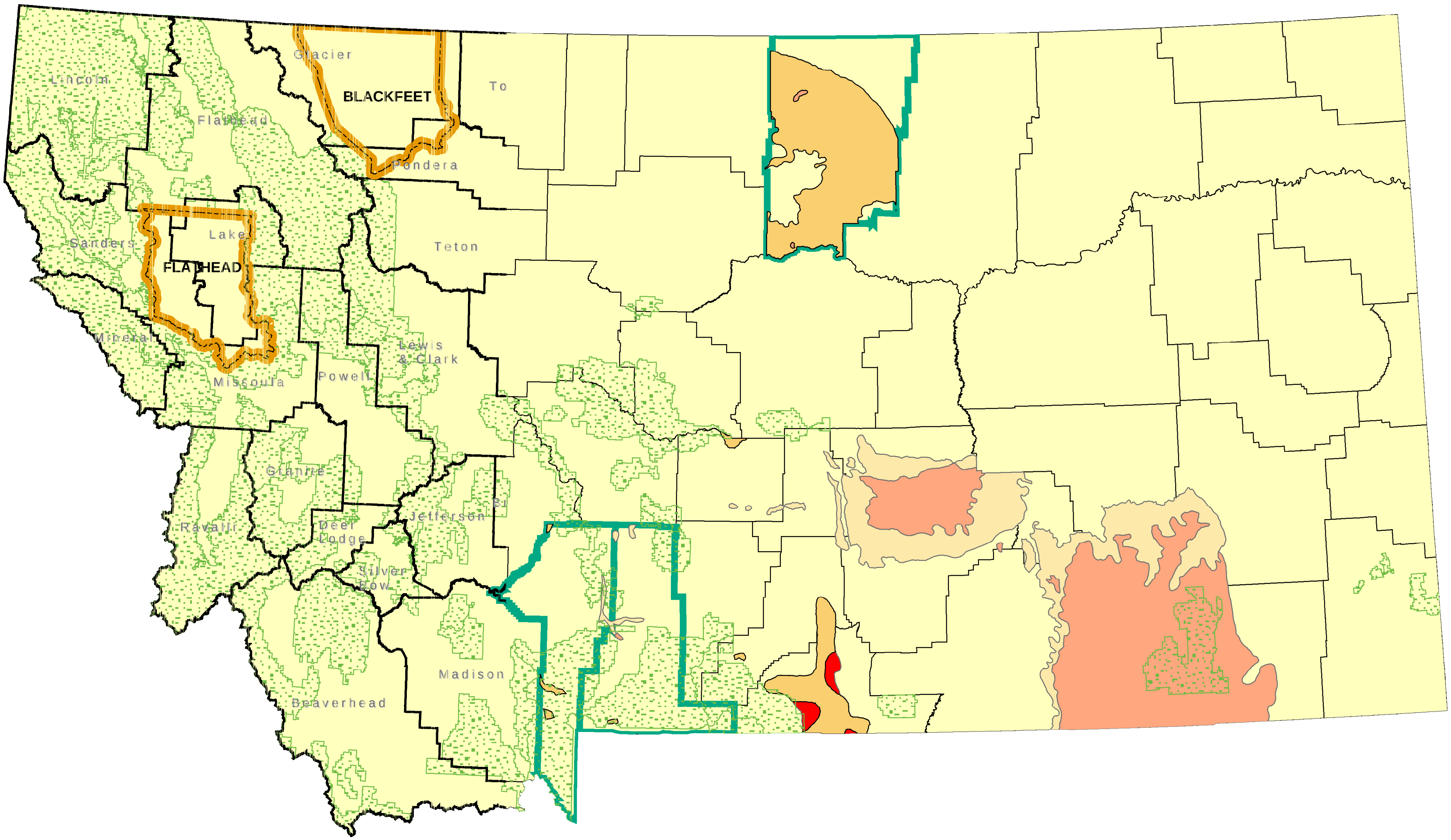
MIN-1: Coal Rank RFD Map



- Native American Reservations
- Special Consideration Counties
- Powder River RMP Area
- Billings RMP Area
- National Recreation Area
- Yellowstone National Park
- National Forest

Coal Rank

- Sub-Bituminous
- Sub-Bituminous / of doubtful value
- Med. and High Volitile Bituminous
- Med. and High Volitile Bituminous / of doubtful value

1:4,000,000

680,000 0 680,000 1,360,000 Meters

270 135 0 270 540 810 Miles

N W E S

NOTE: Coal Data is from the Coal Fields of the Conterminous United States, USGS 96-92

DATA SOURCES:

Counties: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana.
Reservations: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana.
National Forests: 1:100,000 scale, national forests, Montana State Library/NRIS, Helena, Montana
Parks: 1:100,000 scale, parks, Montana State Library/NRIS, Helena, Montana
Development Data: BLM Reasonable Foreseeable Development Scenario

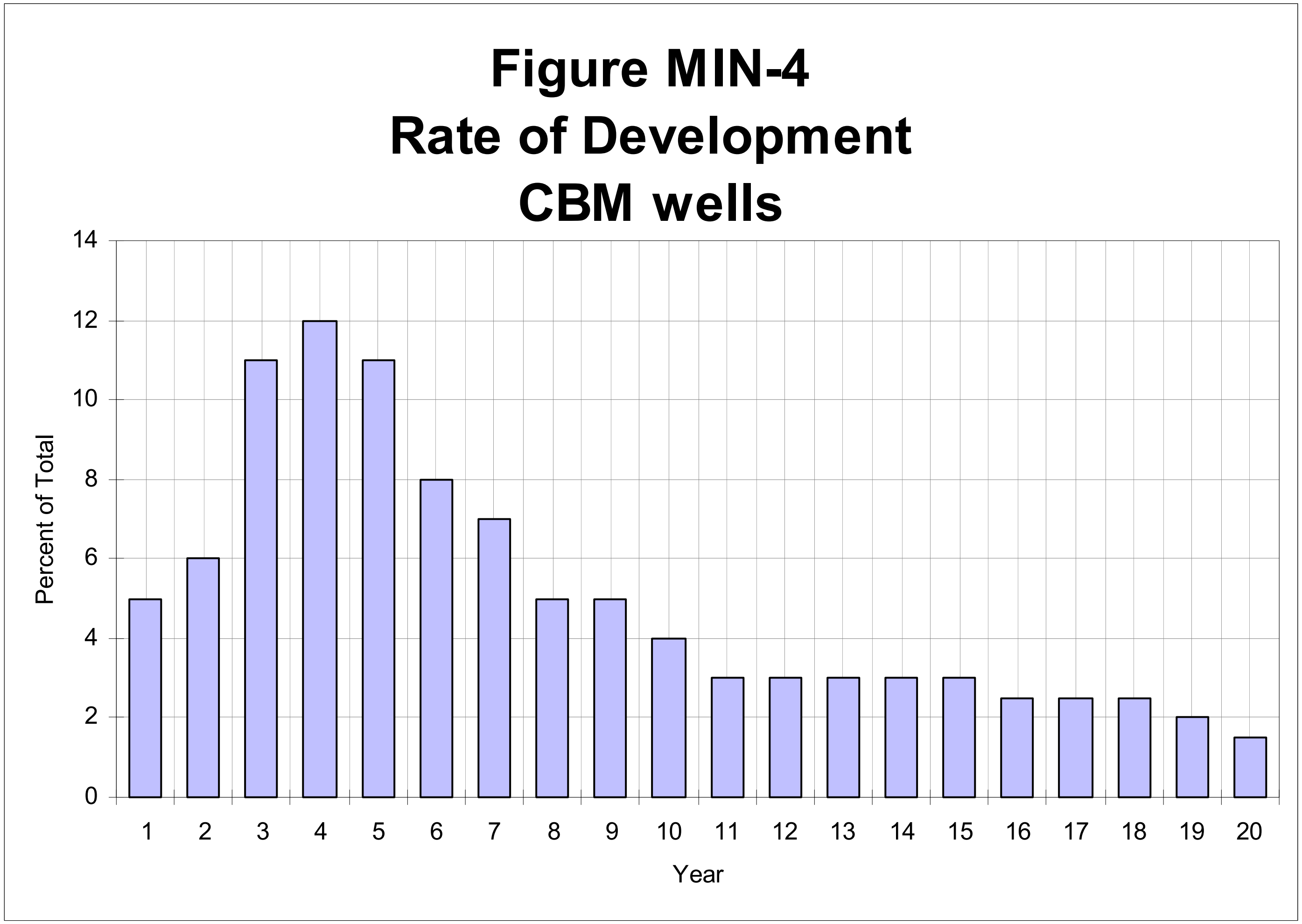


Figure MIN-4
Rate of Development
CBM wells
Percent of Total
Year
0
2
4
6
8
10
12
14
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

Figure MIN-5
Rate of Abandonment of CBM Wells

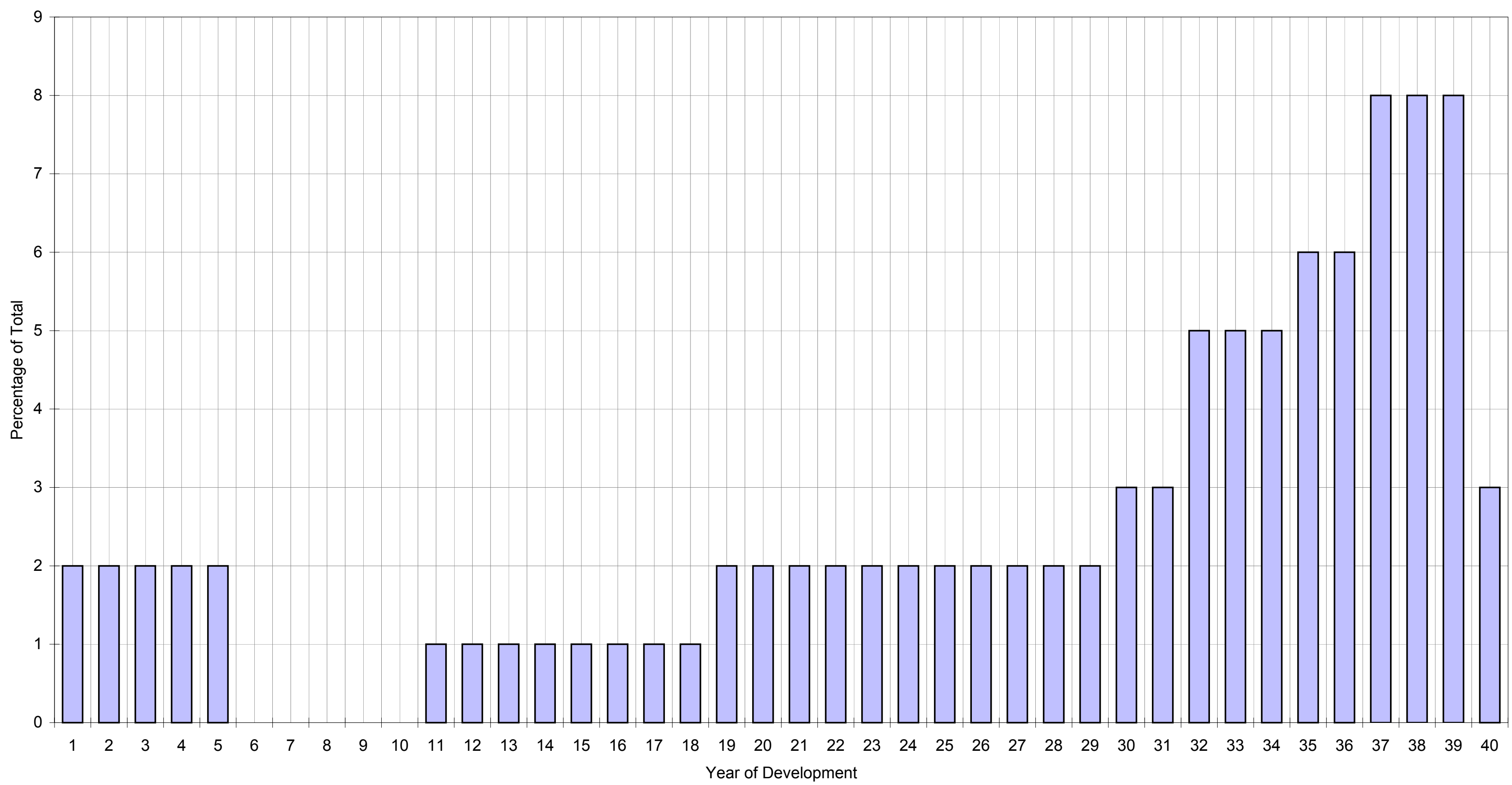


TABLE MIN-1
RFD NUMERICAL PREDICTIONS FOR EXPANDED DEVELOPMENT SCENARIO

	Total Drilled			Production			Dry Holes/Exploration			Acreage Overlying Coal Occurrences
County	**Expanded**	**State**	**BLM**	**Expanded**	**State**	**BLM**	**Expanded**	**State**	**BLM**	**Acres**
Big Horn	7,000	3,500	3,500	6,300	3,150	3,150	700	350	350	524,738
Blaine	10	10	0	9	9	0	1	1	0	1,024,000
Carbon	400	320	80	360	288	72	40	32	8	448,000
Carter	0	0	0	0	0	0	0	0	0	0
Custer	300	230	70	270	207	63	30	23	7	418,000
Gallatin	15	15	0	14	14	0	2	2	0	47,500
Golden Valley	0	0	0	0	0	0	0	0	0	103,000
Musselshell	150	130	20	135	117	18	15	13	2	764,000
Park	25	25	0	23	23	0	3	3	0	32,000
Powder River	6,700	3,350	3,350	6,030	3,015	3,015	670	335	335	713,500
Rosebud	2,800	1,400	1,400	2,520	1,260	1,260	280	140	140	1,005,500
Stillwater	700	665	35	630	599	32	70	67	4	65,500
Sweetgrass	25	23	2	23	21	2	3	2	0	0
Treasure	25	24	1	23	22	1	3	2	0	153,500
Wheatland	0	0	0	0	0	0	0	0	0	30,406
Yellowstone	150	140	10	135	126	9	15	14	1	678,000
Sub-total	**18,300**	**9,832**	**8,468**	**16,470**	**8,849**	**7,621**	**1,830**	**983**	**847**	**6,007,644**

TABLE MIN-1
RFD NUMERICAL PREDICTIONS FOR EXPANDED DEVELOPMENT SCENARIO

	Total Drilled			Production			Dry Holes/Exploration			Acreage Overlying Coal Occurrences
County	**Expanded**	**State**	**BLM**	**Expanded**	**State**	**BLM**	**Expanded**	**State**	**BLM**	**Acres**
Northern Cheyenne	4,000	0	0	3,600	0	0	400	0	0	445,000
Crow	4,000	0	0	3,600	0	0	400	0	0	332,000
Forest Service	50	0	0	45	0	0	5	0	0	501,500
Sub-total	**8,200**	**0**	**0**	**7,245**	**0**	**0**	**805**	**0**	**0**	**1,278,500**
Total	**26,500**	**9,832**	**8,468**	**23,715**	**8,849**	**7,621**	**2,635**	**983**	**847**	**7,286,144**
Powder River RMP	15,635	7,899	7,716	14,072	7,109	6,944	1,564	790	772	2,726,033
Billings RMP	2,615	1,884	753	2,354	1,695	677	262	188	75	2,178,111
Counties	50	50	0	45	45	0	5	5	0	1,103,500
Totals	**18,300**	**9,832**	**8,468**	**16,470**	**8,849**	**7,621**	**1,830**	**983**	**847**	**6,007,644**
	Big Horn County		**Drilled**	**Production**	**Dry Holes**					
Powder River RMP	83.00%		5810	5229	581					
Billings RMP	17.00%		1190	1071	119					

Note: Percentages indicate portion of Big Horn county overlying known coal occurrence within each RMP excluding the Crow Reservation lands.

CUMULATIVE PROJECTS EVALUATED

Compliance with NEPA requires analysis of cumulative effects for each alternative. Cumulative effects on the environment are those that result from the incremental impacts of an alternative when added to the other past, present and reasonably anticipated future actions, regardless of who undertakes those actions. In analyzing cumulative effects from this project, it will be important to understand the incremental impacts from other past, present, and future actions planned for the RMP areas. However, not every project can be included in the analysis or the result could become cumbersome; thus, providing decision makers with extraneous information. Therefore, the importance of scoping cannot be overstressed because it provides the initial opportunity to identify boundaries for a meaningful analysis. The cumulative effects study approach is defined by discussing the Study Area Delineation (spatial boundary); past, present, and future projects that meet a minimum criteria of magnitude as to add to the cumulative effect and time frame for the analysis and is discussed in the conclusions section of each alternative.

Study Area Delineation

The planning area for BLM is the Billings RMP area (10,791,964 acres) and the Powder River RMP area (8,567,125 acres). Acre estimates are for all land within the RMP's regardless of ownership, federal, state or private. The state planning area is statewide with emphasis on the BLM planning area and Blaine (2,711,407 acres), Park (1,788,816 acres), and Gallatin (1,683,586 acres) counties. The combination of the two RMP areas and three counties amounts to approximately 25 million acres.

The study area proposed for the EIS/RMP is exceptionally large and limits the type of analyses that can be included in the subject analysis. It is important to note that the objective of the cumulative analysis is not to perform the perfect analysis, but to select projects that would be appropriate to the subject analysis and aid in the selection of a preferred alternative. With this in mind, the objective is not to make an attempt to choose all projects throughout the entire state of Montana that might add to the cumulative effect of either BLM's or the state's action. This extreme is simply not practical; however, if the thought is more focused, cumulative impact analysis could be chosen on a practical level. Cumulative impacts that might affect other resources are not considered as regionally extensive, the projects/activities to consider may be different. For example, groundwater impacts would be limited to the general area of CBM production. This would also be the case with soils, agriculture and grazing, cultural and paleontological resources, geology and minerals, Indian trust assets, socioeconomics, and others. Other than air quality related impacts (including visual) and surface and ground water influences from Wyoming CBM development, BLM believes the proposed study area is appropriate for this plan and is consistent with other BLM plans. Using this approach, combined with the general knowledge of the area, consideration of a study area that is essentially the Powder River Basin is appropriate. We are, however, limited to some extent in what can be considered and must strive to choose those areas and projects and activities that are truly applicable to the process.

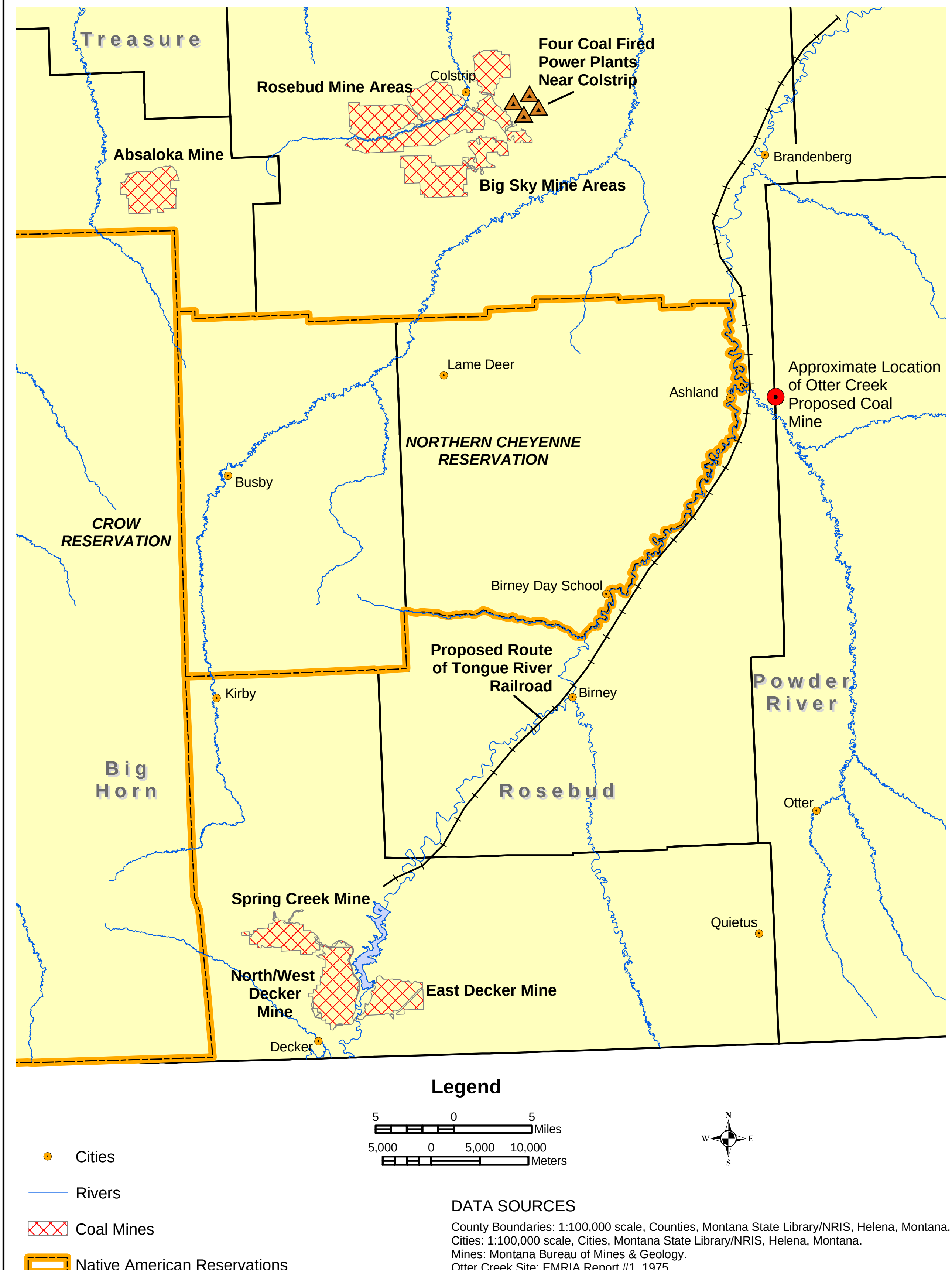
As such, the cumulative analysis for this EIS will emphasize impacts from oil and gas industry-related projects within the project study area and appropriate adjacent areas, depending on the resource being analyzed. The cumulative analysis also considered impacts from the largest foreseeable non-oil and gas industry developments. Activities and projects of sufficient magnitude that may result in cumulative impacts to the environment include natural gas and oil production; surface coal mining; railroads; highways; water storage reservoirs; power plants; potential wildfires; and effects from CBM development in Wyoming, the Ashland Ranger District and on the Crow and Northern Cheyenne reservations. Map MIN-2 indicates the locations of projects included in the cumulative effects analysis.

A discussion of each project or type included in the cumulative effects analysis follows.

Natural Gas and Oil Production

Impacts from conventional natural gas and oil production are addressed in the *Impacts from Management Common to All Alternatives* discussion under the individual resource topic section of the *Impacts From Management Specific to Each Resource and Alternative*. The impacts from conventional oil and gas development are consistent with the BLM's 1994 *Final Oil and Gas EIS RMP Plan Amendment* to the Billings, Powder River, and South Dakota RMPs, and the state's 1989 *Oil and Gas Drilling and Production in Montana Final EIS*.

MIN-2: Location Map of Cumulative Effects Projects With CBM Emphasis Area



DATA SOURCES

County Boundaries: 1:100,000 scale, Counties, Montana State Library/NRIS, Helena, Montana.
Cities: 1:100,000 scale, Cities, Montana State Library/NRIS, Helena, Montana.
Mines: Montana Bureau of Mines & Geology.
Otter Creek Site: EMRIA Report #1, 1975.

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Surface Coal Mining

There are currently 12 active surface mines in the state, ranging from 10 acres to nearly 25,000 acres. A total of approximately 61,000 acres are currently permitted in the state. Approximately 32,000 acres of the 61,000 acres permitted have been disturbed and 15,000 of these disturbed acres have been backfilled, graded, topsoiled, and permanently seeded to reclamation standards (OSM 1998).

Several mines are present in and around the CBM emphasis area. They include operating mines, mines undergoing expansion, reclamation of older mines, and future planned mines. Mines that are generally located within the Powder River Basin and have a potential to add to the cumulative impact include the Spring Creek, Decker, Big Sky, Rosebud, Absaloka, and two new mines planned for Otter Creek. These mines are located in three general areas: the Spring Creek and Decker mines are in southeast portion of Big Horn County just east of the Crow Reservation; the Absaloka mine is located just outside the northeastern corner of the Crow Reservation in Big Horn County; and the Rosebud and Big Sky mines are located near Colstrip, Montana, just north of the Northern Cheyenne Reservation. If the Otter Creek mines were to be established, they would be sited in the southwestern portion of Powder River County. Table MIN-2 shows the average annual production of each mine in the emphasis area along with environmental data for permitted acres, disturbed acres, and backfilled and re-topsoiled acres.

In addition to the quantities identified in the Table MIN-2, the Spring Creek and Rosebud mines have each applied for permits to expand their permitted surface acreage by approximately 2,500 acres and 1,500 acres, respectively. The MDEQ expects both permits to be approved before the end of 2001 (Bohman 2001). Approximately 32,900 acres remain to be disturbed by mining operations during the next 20 years. This estimate is based on current activities and foreseen future developments.

Surface water quality within the vicinity of the coal mines is impacted by increased sediment load resulting from increased erosion during mining. This is mitigated by the use of sediment settling ponds and the vegetating of overburden and topsoil storage areas. The discharge of groundwater pumped from mine pits may also affect surface water depending on the quality of groundwater within the mine vicinity and the quantity of groundwater discharged. Much of the groundwater

TABLE MIN-2
SURFACE MINES WITHIN THE CBM EMPHASIS AREA

Mine	Annual Average Production (Short Tons)	Permitted Surface Acres	Disturbed Acres	Backfilled and Re-topsoiled Acres
Spring Creek	11,000,000	4,500	2,300	300
Decker (North/West and East)	10,000,000	11,400	6,300	1,700
Big Sky (Area A&B)	2,850,000	8,100	3,600	2,600
Rosebud (Areas A, B, C, D, and E)	10,350,000	24,900	13,050	6,400
Absaloka	5,500,000	5,400	3,150	2,200
Otter Creek (Mines 1 and 2)	10,000,000[1]	3,000[2]	0	0
Total	49,700,000	57,300	28,400	13,200

Note: This table shows the cumulative disturbances and reclamation efforts associated with each of the surface mining operations within the CBM Emphasis Area.

[1]Estimated value based on production rates from similar mining operations within the region.

[2]The estimated acreage for the Otter Creek mines is from the Resource and Potential Reclamation Evaluation, Otter Creek Study Site EMRIA Report #1, 1975, and to date has not been permitted but represents the potential surface acres needed to develop this resource.

pumped from the mine pits is stored and used to control dust on roads, truck and train car loading areas, and the mine face. In some instances, mining activities require the diversion of streams or drainage areas that are within the area to be mined. Approximate original topography, including stream channels and drainage areas, are restored during mine reclamation activities. All mines are required to monitor their discharges and obtain MPDES permits. The majority of discharges are related to storm responses with the exception of the Decker mines, which has a permit for a regular discharge of 4.5 cubic feet per second into the Tongue River.

Impacts to groundwater resources resulting from surface coal mine activities are usually related to drawdown and quality issues from backfilled spoils. Coal beds are among the most dependable and utilized aquifers in eastern Montana, because of their fracture-related transmissivity and lateral continuity. Adjacent portions of these aquifers discharge water into the mining pit, which requires that it be pumped-off resulting in the lowering of the water levels within aquifers adjacent to the mine. The area affected and the distance from the mine affected depends on the particular aquifer characteristics of the area, presence of faults, rates of surface water and precipitation recharge, and other factors, and will vary depending on the location of the mine. Groundwater wells, springs, and surface streams within the area can be impacted by the lowered water levels. Those located nearest the mine experience the greatest impact. In the mining areas near Colstrip and Decker, coal aquifers have shown drawdown as much as 75 feet and a radius of impact up to 4 miles (Wheaton and Metesh 2001). The resulting total area of groundwater impact from coal mines is calculated to be 366,000 acres. The rate at which water levels recover varies between mining regions, but normally requires more than 20 years (Wheaton and Van Voast 1998).

Overburden replaced in the mine pits during reclamation is approximately inverted from its original orientation. The mineral content of these near-surface unsaturated and weathered rock layers used in typical overburden affect the groundwater quality within the area of the reclaimed mines. The resulting poor water quality is present for many years after mining is completed. Elevated levels of sodium, magnesium, calcium, bicarbonate, chlorides, and sulfates are possible, as well as increased total dissolved solids (TDS). Dissolution of these salts causes increases in TDS concentrations in the spoils aquifers that have been observed at levels 50 percent to 200 percent greater than the adjacent bedrock aquifers (Wheaton and Van Voast 1998). With time, some sites return to pre-mining quality; however, the impacts to water quality may be everlasting at other sites where soluble salts are continuously generated by weathering and oxidation.

Coal Mine Impacts on Air Quality

Coal mines have an effect on air quality within the region surrounding the surface operations. Air pollutant emissions data are available for five surface coal mines within the emphasis area; three are in Big Horn County (Absaloka, Spring Creek, and Decker mines), and two are in Rosebud County (Big Sky and Rosebud mines). Table MIN-3 shows the average air pollutant emissions from the mines within the emphasis area. Volatile organic compounds (VOCs) shown in the table would also include any fugitive methane vented from the mines.

Future impacts also would be realized from opening new mines, expanding existing mines, and installing power generation plants at existing coal mines.

Railroads

The Tongue River Railroad is a proposal to build a new coal-hauling railroad along the Tongue River from Miles City to Decker, Montana. The Tongue River Railroad Company (TRRC) was authorized to begin construction of the 117-mile railroad in 1996 by the Surface Transportation Board. Operations were scheduled to begin in 2001 but construction has not commenced and no projected start date is available. The rail system, if built, would consist of several spur lines connected to individual coal mines throughout the CBM emphasis area. The total system would measure approximately 150 miles. Assuming an average 200-foot wide right-of-way, an estimated 3,600 acres would be disturbed by construction and operation activities within the planning areas.

The construction of this rail system would create numerous other impacts, including socioeconomic issues for local towns along the route, alteration to ranch and grazing lands, reductions in air quality, impediments to Native American cultural sites, increased erosion along the Tongue River riparian areas, increased sedimentation loading in the Tongue River, introduction of noxious weeds, and increased obstructions to wildlife habitat.

TABLE MIN-3
AVERAGE AIR POLLUTANT EMISSIONS FROM SURFACE MINES WITHIN THE EMPHASIS AREA (TONS/YEAR)

Source	PM_{10}[1]	CO[2]	NO_2[3]	SO_2[4]	VOCs[5]
Existing Coal Mines (5)—Avg/Mine	412.1	323.4	290.2	56.5	18.8

Notes: This table summarizes the impacts to air quality from surface mining sources within the emphasis area (MDEQ—1999 Air Quality Monitoring Data). Values were obtained from 1999 Toxic Release Inventory for the State of Montana.
[1]PM_{10}—Particulate matter that is less than or equal to 10 microns in size.
[2]CO—Carbon monoxide
[3]NO_2—Nitrous oxides
[4]SO_2—Sulfur dioxide
[5]VOCs—Volatile organic compounds

Highways

There are no current proposals for new highways within the CBM emphasis area. It is assumed that several secondary highways, state routes, and county roads will undergo some form of repair, resurfacing, widening, or extension during the course of CBM development. Currently, a list of proposed road improvements within the CBM emphasis area is not available for analysis and quantification. These activities, however, would subject the adjacent lands to impacts associated with linear construction and surface disturbances. For the purposes of this analysis, we are assuming that 250 miles of existing road would be improved over the next 20 years.

Water Storage Reservoirs

The Tongue River flows about 100 miles from its headwaters in Wyoming's Bighorn Mountains to the Tongue River Reservoir. The reservoir is approximately 8 miles long and 1 mile wide, with an average depth of 20 feet, and was completed in 1940. Water leaving the north end of the reservoir flows about 190 miles, northeasterly, until it reaches its confluence with the Yellowstone River at Miles City.

The reservoir was enlarged in 1999, at the request of the Department of Natural Resources and Conservation (DNRC), Northern Cheyenne Tribe, and the U.S. Bureau of Reclamation. The enlargement included the reconstruction of the dam and disturbance of 157 acres. The disturbance included aggregate mining, roads, staging areas, and railroad layout areas, some of which have been reclaimed. As a result of the enlargement, the reservoir capacity was increased by 13,000 acre-feet, the surface water level raised by 4 feet, and the surface area expanded by some 400 acres to nearly 3,615 acres.

Power Generation Plants

Five existing power generation plants are located within the CBM emphasis area, and all are coal-fired. Four are located in Rosebud County near the coal mine area and one is located in Billings. The resource area most affected by the burning of coal to produce electrical power is air quality. Air quality data from all five power generation plants are available. Table MIN-4 summarizes the impacts to air quality from these plants within the emphasis area, according to the MDEQ 1999 Air Quality Monitoring Data.

There are plans to construct a coal gasification power plant in Hardin, Montana. The plant would be retrofitted into an existing manufacturing facility, resulting in reduced surface disturbances. It is understood the plant plans to use approximately 500,000 tons of coal per year supplied by the Absaloka mine, 20 miles east of Hardin. Additional information regarding the coal gasification process, estimated emission levels, and the power generation process is not available at this time.

Other power plants maybe envisioned due to the electrical industry's deregulation and the increased demand nation wide. Some of these plants may find it advantageous to locate in Montana near a source of coal or natural gas; however, no new plants were presented to the DEQ for permitting at the time of new data cut-off, June 2001.

TABLE MIN-4
AVERAGE AIR POLLUTANT EMISSIONS FROM FIVE MAJOR SOURCES WITHIN THE EMPHASIS AREA
(TONS/YEAR)

Source	PM_{10}[1]	CO[2]	NO_2[3]	SO_2[4]	VOCs[5]
Existing Power Plants (5)—Avg/Plant	55.0	453.1	5036.2	3065.5	54.1

Note: Values were obtained from 1999 Toxic Release Inventory for the State of Montana.
[1]PM_{10}—Particulate matter that is less than or equal to 10 microns in size.
[2]CO—Carbon monoxide
[3]NO_2—Nitrous oxides
[4]SO_2—Sulfur dioxide
[5]VOCs—Volatile organic compounds

Wildfires

The BLM Fire Management Program suppresses wildfires and uses prescribed fires to achieve land management objectives. Nationally, 63 percent of wildfires are caused by lighting and the remaining 37 percent by human activities. The average wildfire consumes approximately 370 acres, but the acreage can more than double in severe years that have drought, high winds, or above normal lightning.

Prescribed fires are carefully planned to remove old, woody vegetation, prepare areas for reseeding, or reduce the natural accumulation of dead vegetation. They make room for growth of more nourishing forage for livestock and wildlife, and are often designed to burn a mosaic pattern, leaving patches to serve as cover for some wildlife species. The average prescribed fire covers 150 acres of land.

Based on previous RMPs, it is estimated that 25 wildfires would occur per year in the planning area. The fires would range in size from 1/4 acre to 1,000 acres. Surface disturbances caused from fire lines would average 3 acres per fire or a total of 75 acres per year.

Wyoming CBM Production

CBM production in Wyoming is concentrated in the Powder River Basin. CBM resources of the Powder River Basin are more extensively developed in Wyoming than in Montana. Most of the surface area of the basin is located in Wyoming, with 92 percent of the coal volume located in the Powder River basin lying within Wyoming (Ellis et al., 1999). The CBM development in Wyoming has the potential to impact water resources in Montana through the drawdown of groundwater within coal seam aquifers that extend from Wyoming north into Montana and by the discharge of CBM-produced waters in Wyoming to surface waters that flow north into Montana. The potential magnitude of the impact to Montana water resources from Wyoming CBM production is tied to the RFD of CBM in Wyoming. Projections for the RFD of CBM in the Wyoming portion of the Powder River basin adjacent to Montana have been the subject of recent BLM reports.

CBM development in Wyoming has the potential to cause substantial impacts in Montana to surface water quality and groundwater resources. The Wyoming DEQ and the Montana DEQ have adopted an interim memorandum of cooperation on limiting discharge to watersheds that extend into Montana, the probability of future agreements is tentative.

The *Coalbed Methane Project Final EIS (Wyodak EIS)* (BLM 1999b) projected 6,000 CBM wells in the Buffalo Field Office Area. The water model, done as part of the EIS, estimated an average production rate of 12 gpm per CBM well. This level of development was estimated to result in an increase of approximately 1.1 percent (452 cfs to 457 cfs) in the average flow volume of the Powder River at Moorhead, Montana (BLM 1999b), and an increase of approximately 50 percent (22 cfs to 33 cfs) in the average flow volume in the Little Powder River at the Weston station, which is located approximately 20 miles south of the Wyoming/Montana border. These increases are based on yearly averages. However, during low-flow periods, the Powder River flow volume could be increased by more than 800 percent as a result of the discharge of CBM-produced waters. Flow volumes in the Little

Powder River would consist entirely of discharged CBM-produced waters (BLM 2001b).

The quality of CBM produced water from individual wells in the Wyoming portion of the PRB shows considerable variability (Rice et al, 2000); water quality parameters such as SAR vary from approximately 5 to over 30 and TDS varies from approximately 250 mg/L to more than 2000 mg/L. Watershed averages in Wyoming also show variation (BLM, 1999); water quality parameters such as SAR vary from an average of 17 in the Powder River Watershed to 9 in the Little Powder River watershed. As CBM development continues in Wyoming, these average water quality parameter values may change. Surface water quality would be affected by CBM water discharge, with yearly average SAR values increasing from 4.0 to 4.1 in the Powder River and from 6.0 to 7.5 in the Little Powder River. Impact to the quality of water within the Powder River during low-flow periods is expected to increase water quality concentrations for compounds common to CBM produced water, including increases in the SAR from values that could be as low as 1 up to approximately 17. During low-flow periods in the Little Powder River, SAR is expected to increase from approximately 6.5 to an estimated value of approximately 9. The Wyoming EIS (BLM, 1999) did not address potential impacts to the Tongue River from discharge of CBM-produced waters within Wyoming. However, it is expected that impacts of similar magnitude to those predicted for the Powder and Little Powder could occur.

Following the release of the Wyodak EIS (BLM 1999), the BLM has reassessed the RFD for the Wyoming portion of the Powder River Basin and has issued a new RFD (BLM 2001a). This more recent reasonable foreseeable development study by the BLM indicates that the total number of CBM wells in the Wyoming portion of the Powder River Basin may approach 50,000 wells (BLM 2001a). An EIS using this level of development is in progress, but some extrapolations can be made from the existing EIS. This level of development represents an increase of more than 8 times the number of CBM wells included in the 1999 Wyodak EIS, and if realized, could have a corresponding increase in impact on the quantity and quality of surface water in Montana's Powder River Basin watersheds in terms of annual average measures and especially during periods of low-flow or base-flow. However, actual impacts will be dependant upon the manner in which discharges are managed with respect to CBM development in Wyoming.

Rivers within the Wyoming portion of the PRB show considerable seasonal variation in terms of flow volume and water quality. The flow volume in the Powder River ranges from a maximum of 1,400 cfs to a minimum of 0.5 cfs. Water quality also varies because flow volume contains varying amounts of meteoric water added to the base-flow contributed by groundwater. If CBM water discharge rates are essentially constant throughout the year, resultant flows in the river would vary depending upon the ratio of CBM discharge to natural river flow. Impacts to the Powder River would include a 9 percent increase in the annual average flow volume (450 cfs to 500 cfs), as well as an increase in the annual average SAR value to 5.2. Impacts during natural low-flow periods, however, would cause the river to flow at rates 70 times normal with SAR values in excess of 17.

Annual average flow within the Little Powder River with the impact of CBM discharge water is extrapolated to increase from 22 cfs to 92 cfs and a resultant SAR of 9. Depending on how CBM-discharges are managed in Wyoming, these flow rates and water qualities could be maintained during traditionally low-flow periods when the river is normally often dry.

Impacts to the Tongue River drainage are not included in the Wyodak EIS, however, impacts to surface water quantity and quality resulting from the increase in the number of CBM wells and the resultant increase in the volume of CBM water discharged in Wyoming are possible. The Upper Tongue River watershed is currently the site of CBM production and it is expected that more development would occur. Impacts to the Tongue River in Montana are expected to be commensurate with impacts to the Powder and Little Powder Rivers by Wyoming CBM production. These impacts would result in increases in surface water quantity and decreases in quality. This could result in 3 to 5 times more water entering Montana and an increase in SAR from 0.7 to 5. This is important because Tongue River water quality is the highest in the PRB and the river feeds the Tongue River Reservoir.

Groundwater resources in Montana could also be impacted from CBM production in Wyoming. CBM-producing wells in northern Wyoming would cause a drawdown of coal aquifers on adjacent land, with groundwater drawdown possibly extending northward into Montana. Groundwater computer modeling for the Wyodak EIS indicates that the 5-foot drawdown level could extend up to 18 miles from the edge of production, given a 12-gpm per well rate of water withdrawal (BLM 1999). The modeling values are based on assumptions made regarding the known geology of the Wyoming portion of the basin, which field data has shown to differ from the Montana portion of the basin. The Wyoming coal seams that have been developed are deeper and thicker than the seams in Montana. In addition, the 12-gpm water production value for the state was a "snap-shot" derived from current production data at a single point (1997) early in the life of the PRB CBM play. The 20-year average rate of 2.5 gpm for Montana was derived from carefully organized data from a single CBM field considering production trends with time. Nonetheless, both the 12 gpm and the 2.5 gpm rates are projections that may need to be monitored and refined over time as CBM development proceeds. Given these groundwater modeling results and related assumptions, if CBM fields were located in Wyoming adjacent to the border with Montana, this could affect groundwater levels for a distance of up to 18 miles into Montana, assuming the parameters used in the Wyoming computer model are applicable to this area of Montana. Drawdown impacts of this magnitude would result in impacts to private lands, the Crow Indian Reservation, state-owned lands, and federal lands controlled by BLM.

CBM Development on Indian Reservations and the Ashland Ranger District

The development of CBM resources on the Crow and Northern Cheyenne reservations and on the Ashland Ranger District is assumed to take place during the next 20 years and is therefore included in the cumulative effects analysis. The RFD estimated that 1,400 to 4,000 wells could be developed on each reservation and 50 to 200 wells on the Ashland Ranger District. The impacts associated with this development would be similar to the impacts described within each of the resource topics per alternative and adjusted for magnitude. Of course, the land disturbances, wildlife, cultural and paleontological, visual, social economic, recreational, air quality, soils, and special status species impacts described for those resources would be experienced on the reservations and on the Ranger District. The surface and groundwater quality impacts would be felt on the reservations and on the District but they would also contribute to changes in the watersheds into which the flow.

Agency-Approved Natural Resource Mitigation Measures

Mitigation measures are restrictions on lease operations, which are intended to minimize or avoid impacts to resources or land uses from oil and gas activities. The mitigation measures listed in Table MIN-5 would be applied to permits by the approving agency. The list is not all inclusive, but presents the mitigation measures most often used in the planning area. The wording of the mitigation measure may be modified or additional measures may be developed to address specific conditions. Mitigation measures would be included as needed with approved permits during all phases of CBM development.

TABLE MIN-5
MITIGATION MEASURES THAT WOULD BE APPLIED AS APPROPRIATE TO MINIMIZE IMPACTS

Mitigation Measure	BLM	State
Disturbed areas resulting from any construction will be seeded following the BLM seeding policy, state guidance or surface owner's requirements. Depending on surface ownership seeding is usually required during the fall or late spring.	X	
To the extent practicable, vegetation will be preserved and protected from construction operations and equipment except where clearing operations are required to conduct oil and gas operations, such as for roads, well pads, pipelines, power lines, utility lines, and structures. Clearing of vegetation will be restricted to the minimum area needed for construction and equipment.	X	X
Temporary and permanent access roads will be avoided on south-facing slopes within big game winter range, where practicable.	X	
To the maximum extent practicable, all maintenance yards, field offices, and staging areas will be arranged to minimize disturbance to trees, shrubs, and other native vegetation.	X	
Topsoil removed by construction activities will be stockpiled for reclamation. Sensitive habitat areas will not be used for topsoil storage.	X	
The TLMD must provide approval prior to constructing well pads, roads, power lines, and related facilities that require surface disturbance. The lessee must comply with required mitigation measures.		X
The lessee must submit an Operating Plan or Amendment to an existing Operating Plan before any activities are conducted on the lease premises. No activities shall occur until the plan has been approved by the TLMD in writing. If the surface activity is detrimental to trust resources, surface activity may be denied.		X
The lessee must contact the surface owner in writing at least 30 days prior to any surface activity, and provide a copy of the correspondence to the TLMD.		X
No surface occupancy shall be allowed unless approved by the DNRC director. In addition, no surface occupancy is allowed on any right-of-way identified on official highway plans on file at the Department of Transportation in Helena, Montana.		X
Prior to cutting or removing timber for exploration or development activities, the lessee must acquire the approval of the appropriate TLMD area office.		X

TABLE MIN-5
MITIGATION MEASURES THAT WOULD BE APPLIED
AS APPROPRIATE TO MINIMIZE IMPACTS

Mitigation Measure	BLM	State
No surface occupancy is allowed within the bed of a navigable river, abandoned channels, or on islands and accretions. In addition, upon completion of a successful well, where river title is disputed, the lessee will file an interpleader action under Rule 22, M.R.Civ.P. in Montana District Court, and name all potential royalty claimants as defendants.		X
Any activity within 1/8 mile of a river, lake, or reservoir on or adjacent to the lease must be approved in writing by the TLMD. No surface occupancy is allowed within the bed of the river, abandoned channels, the bed of the lake or reservoir, or on islands and accretions associated with the water body.		X
No activity shall be allowed within 100 feet of any perennial or seasonal stream, pond, lake, prairie pothole, wetland, spring, reservoir, well, aqueduct, irrigation ditch, canal, or related facilities without prior approval of the TLMD.		X
Site use may be restricted if there are existing surface uses, such as center pivots, wheel lines, etc.		X
No surface occupancy of cemetery sites is permitted without written approval of the TLMD.		X
The planting of grasses, forbs, trees, or shrubs beneficial to wildlife will follow the BLM seeding policy. When needed, BLM will require installation of erosion and sedimentation control measures, such as riprap, erosion mats, mulch, bales, dikes or water bars. Riprap material and placement must be approved by the appropriate agency.	X	
Erosion control and site restoration measures will be initiated as soon as a particular area is no longer needed for exploration, production, staging, or access. Disturbed areas will be recontoured to provide proper drainage.	X	
Topsoil piles may be required to be seeded following the BLM seeding policy.	X	
Surface use may be restricted or denied if unstable soil conditions or steep topography exist.		X
All above-ground electrical poles and lines will be raptor-proofed to avoid electrocution following the criteria and outlined in the Avian Power Line Interaction Committee (APLIC) (1994) and APLIC (1996). (APLIC 1994. Mitigating Bird Collisions with Power Lines: The State of the Art in 1994. Edison Electric Institute, Washington D.C. 78 pp.; APLIC 1996. Suggested Practices for Raptor Protection on Power Lines. Edison Electric Institute. Washington, D.C. 128 pp.).	X	X
Conduct three nesting habitat surveys for mountain plover in suitable habitat between May 1 and June 15. Surface use may be deleted in accordance with 43 CFR 3101.1-2.	X	
To protect wildlife during periods important to their survival, surface disturbance would be restricted from December 1 to June 15. This would protect wildlife in crucial winter range, elk calving areas, and nesting grouse.		X

TABLE MIN-5
MITIGATION MEASURES THAT WOULD BE APPLIED
AS APPROPRIATE TO MINIMIZE IMPACTS

Mitigation Measure	BLM	State
The TLMD will contact MFWP and FWS for advice on alleviating possible conflicts caused by proposed activities—additional mitigation may be required.		X
A survey for wildlife and plant species of concern may be required prior to disturbance. Identified species will be avoided, unless otherwise authorized by the TLMD.		X
The TLMD will complete an initial review for cultural resources and, where applicable, paleontological resources of the area intended for disturbance and may require a cultural resources inventory. Based on the results of the inventory, TLMD may restrict surface activity for the purpose of protecting significant resources located on the lease premises.		X
If the lease area contains biological weed control sites, these sites must be avoided unless authorized by the TLMD.		X
Wooded areas will be avoided unless otherwise authorized by the TLMD.		X
All seed used for re-vegetation will be pure live seed certified free of noxious weeds.		X
If drainage is occurring on the land in the lease, and if a well is not drilled within 2 years after the lease is issued, the TLMD will consider cancellation of the lease for failure to drill and offset well.		X
Cuts and fills for new roads will be sloped to prevent erosion and to facilitate revegetation.	X	
Additional mitigation measures may be required to prevent the further spread of noxious weeds. Such measures may include power washing vehicles, car pooling, timing restriction for seismic activities, and other measures.		X
It is the responsibility of the operator to control noxious weeds on lands disturbed in association with oil and gas lease operations. Lease-associated weed control strategies, when required by BLM, are to be coordinated with any involved surface owners and local weed control boards. A pesticide-use proposal must be prepared, and reviewed and approved by BLM prior to any herbicide application on lands disturbed by federal oil and gas lease operations. A pesticide application record must be within 24 hours after completion of application of herbicides. Additional measures may be required to prevent the spread of noxious weeds.	X	
Activities such as stream crossings that could directly impact sensitive or protected fish species will be undertaken during non-spawning periods for these species. In the unlikely event that multiple, sensitive, or protected fish species with back-to-back spawning periods are present in the same stream reach, one of the following options will be exercised. These options include selecting a nearby, alternative stream crossing site that does not provide suitable spawning habitat for the fish species of concern; using a nearby, existing stream crossing over the channel to avoid instream disturbances; or using shore-based equipment to position and extend the pipeline or other item (e.g., temporary bridge) across the stream, thereby avoiding in-channel activities.	X	

TABLE MIN-5
MITIGATION MEASURES THAT WOULD BE APPLIED
AS APPROPRIATE TO MINIMIZE IMPACTS

Mitigation Measure	BLM	State
Operators must develop a Spill Prevention Control and Countermeasures plan to deal with accidental spills, the plan would include the strategic placement of berms and dikes.	X	
The road ditches would be flat bottomed "V" ditches would not be allowed. Place water turn outs where appropriate to lessen the water impacts upon the ditches.	X	

MONITORING APPENDIX

MONITORING APPENDIX

Introduction

For each resource, there are a series of items that will be monitored. Each item is evaluated by location, technique for data gathering, unit of measure, and frequency and duration of data gathering. When duration is not specified, the duration is for the next 20 years. The monitoring plan states the event that will be evaluated and lists the key resources that will be monitored. If an adverse impact can be corrected by a management action within the scope of this plan, the change will be implemented. If the adverse impact can be corrected only by a management action that is outside the scope of this plan and the Billings or Powder River RMPs, the management change will be a formal amendment.

The DNRC Technical Advisory Committee for the Powder River Basin Controlled Groundwater Area has proposed a groundwater monitoring plan for CBM development. The monitoring recommendations are incorporated into the monitoring table. A complete copy of that plan is located on page MON-9 of this appendix.

The BLM, FWS, and the state have developed a draft outline for a wildlife monitoring and protection plan. It is located on page MON-15 of this appendix.

Element	Item	Location	Technique	Unit of Measure	Frequency and Duration	Information Warranting a Decision Change
AIR QUALITY	particulate matter	areawide	filters on volume samplers	$\mu g/m^3$	24-hr samples 1 - 2 times yearly	exceedance of standards - operators could be required to cooperate in a coordinated air quality monitoring program
	gaseous	areawide	gas specific analyzers	parts per million interpreted as $\mu g/m^3$	Hourly samples collected at least 1 - 2 times yearly	Exceedance of standards - operators could be required to cooperate in a coordinated air quality monitoring program
CLIMATE		areas affected by land disturbance	RAWS or COOP Stations	Bulk precipitation	daily during the growing season	extremes affecting revegetation operations
CULTURAL RESOURCES	ACECs	areawide	site inspection	site, surrounding area	bimonthly between April - November	any noticeable trend indicating increased disturbance - natural or human caused
	20 percent of National Register eligible sites	areawide	site inspection	site, surrounding area	annually	any noticeable trend indicating increased disturbance - natural or human caused
	National Register eligible sites discovered as a result of oil, gas development	areawide	site inspection	site, surrounding area	case by case	any noticeable trend indicating increased disturbance - natural or human caused
	1 percent of remaining total of sites	areawide	site inspection	site, surrounding area	annually	any noticeable trend indicating increased disturbance - natural or human caused
HYDROLOGY	surface water quality	areawide on major rivers or streams where management activities are occurring or expected to occur	standard USGS quantitative measurements of water quality, including but not limited to the common anions, cations.	standard quantitative measurements of water quality, quantity	measurements to be made daily at designated locations on rivers, perennial streams including USGS stations on the Tongue River at the state line, at Brandenburg bridge, Powder River at the state line, above Locate – on other streams, field measurements will be made 15 times yearly for 5 years and 4 times per year thereafter, unless a greater sampling frequency is determined to be warranted at that time – sampling will continue for at least 5 years after production activity ceases	water quality parameters that raises the SAR above 3 for the Tongue River or changes the parameters for any sampled stream above the state of MT water quality standards, especially suspended sediments which render the water unsuitable for its classified usages.

Element	Item	Location	Technique	Unit of Measure	Frequency and Duration	Information Warranting a Decision Change
	groundwater quantity and quality	areawide on sites of occurring activities or expected management activities with priority for development of monitoring well locations within 3 to 5 miles of the outcrop lines with a minimum of one well per township in each of the affected coal aquifers. Abandoned exploration and CBM productions wells should be converted as needed for monitoring wells (see map at the end of the Appendix)	sampling of dedicated monitoring wells in the zones of extraction and zones above and below the expected activity - wells are to be placed in the affected areas to areas unaffected by management activities—sampling of springs near well monitoring sites and the springs that are important water sources near the expected development	gpm	gpm field measurements are to be monthly for the first 3 years and reduced in frequency after baseline conditions have been established. If possible baseline conditions should be established prior to development. Monitoring needs to continue until 95 percent recovery of the baseline condition or until a recovery trend is established	when a 50% reduction in the baseline has been observed
		Areawide in drainages containing alluvium	monitoring wells will be established in stream valleys that contain alluvium and downgradiant of discharge impoundments and discharge points	measurements of depth in feet	water level measurements will be taken monthly prior to production activity and during the development - water quality measurements will be taken 4 times per year	20% rise in the water table above its seasonally adjusted elevation, or a 2 unit increase in the SAR value will trigger a discontinuance of CBM evaporative ponds in that watershed, or require ponds to be lined
INDIAN TRUST	groundwater	adjacent to the Northern Cheyenne & Crow reservations	sampling of dedicated monitoring wells in the zones of extraction and zones above and below the expected activity - wells are to be placed in the affected areas to areas unaffected by management activities	standard quantitative measurements of water quality - measurement of depth in feet	field measurements 6 times yearly prior to production activities, continue throughout the activity period and for the duration of 95 percent of the recovery of pre-development conditions	for drawdown measured beyond 2 miles, BLM would require the operator to provide a hydrologic barrier, for example, an injection well between the CBM well and the reservation boundary
			monitoring wells will be established near the mouth of streams that contain alluvium	measurements of depth in feet	water level measurements will be taken monthly prior to production activity and during the development - water quality measurements will be taken 4 times per year	a 20% rise in the water table above its seasonally adjusted elevation, or a 2 unit increase in the SAR value will trigger a discontinuance of CBM evaporative ponds in that watershed, or require ponds to be lined
	natural gas	areawide	drainage evaluation	radius of drainage	as needed	if gas drainage is occurring, there would be a communitization agreement, drilling of protective wells on Indian lands, or different spacing, to protect the Indian minerals from drainage

Element	Item	Location	Technique	Unit of Measure	Frequency and Duration	Information Warranting a Decision Change
LANDS AND REALTY	rights-of-way	areawide	site inspection	site and surrounding area	minimum of once during construction, every 3-5 years during operation	
MINERALS **Oil and Gas**	geophysical Notice of Intent	areawide	line or area inspection	operations conducted in compliance with Notice of Intent	minimum of once during operations	violation of regulations, change from approved Notice of Intent, unnecessary or undue degradation
	geophysical Notice of Completion	areawide	line or area inspection	operations conducted in compliance with Notice of Completion	minimum of once during plugging, once after reclamation	violation of regulations, change from approved Notice of Completion unnecessary or undue degradation
	Application for Permit to Drill	areawide	site inspection	operations conducted in compliance with Application for Permit to Drill	minimum of once and as necessary	violation of regulations, change from approved Application for Permit to Drill
	Sundry Notice	areawide	site inspection	operations conducted in compliance with Sundry Notice	as necessary	violation of regulations, change from approved Sundry Notice unnecessary or undue degradation
	natural gas	areawide	drainage evaluation	radius of drainage	as needed	if gas drainage is occurring, there would be a communitization agreement, drilling of protective wells on Federal lands, or different spacing, to protect the federal minerals from drainage
	produced water disposal	areawide	site inspection	operations conducted in compliance with permit	minimum of once annually or as necessary	violation of regulations, change from approved permit, unnecessary or undue degradation
	spill	areawide	site inspection	area cleaned up, reclaimed	minimum of once after event and as necessary	violation of regulations, change from approved permit, unnecessary or undue degradation
	plugged, abandoned wells	areawide	site inspection	operations conducted in compliance with permit	minimum of once during operations	violation of regulations, change from approved permit, unnecessary or undue degradation
	abandoned well reclamation	areawide	site inspection	operations conducted in compliance with permit	minimum of once and as necessary until reclamation complete	violation of regulations, change from approved permit, unnecessary or undue degradation

Element	Item	Location	Technique	Unit of Measure	Frequency and Duration	Information Warranting a Decision Change
PALEONTOLOGY	significant paleontological localities, ACECs	areawide	inspection of area disturbed	fossil locality degradation caused by human activity-percentage of locality	once yearly	any noticeable trend indicating increased disturbance, such as illegal excavation or vandalism
			inspection of displaced or altered area	environmental degradation, such as erosion or trampling-number of fossils	once yearly	accelerated loss or damage to significant fossils
RECREATION	general recreation use	areawide with emphasis on dispersed use of undeveloped recreation sites	area inspections to look for vandalism, resource abuse, and install photo points	site condition	biannual (June and October) - photograph annually	user conflicts, resource degradation, or safety hazards
	concentrated recreation use	special recreation management areas, sites with recreation facilities	visitor registration, traffic counters estimates, photo points	visitor days, site condition	visitor registration boxes, counters checked once monthly at the minimum, weekly or biweekly during heavy use periods, photograph annually	increased visitor use/year or sustained use that requires additional or improved facilities
		areawide commercial, competitive activities	administrative review, site inspection for complexes with permit stipulations	permit stipulations, resource condition success of reclamation	on site during competitive events, periodic site inspection for commercial operations, administrative review annually	violation of permit stipulations, irreparable resource damage, compromise of visitor safety, recreation experience
SOILS	upland erosion	discharge points, well pads, roads, other disturbance areas	visual inspection of disturbed area	site condition or area of impact	once to twice yearly	accelerated erosion, rills, gullies
	stream bank erosion, modification	ephemeral drainages, intermittent streams, main stem of rivers in effected areas	visual inspection of streams, drainages - measurements of various fluvial characteristics	site condition or area of impact	every two years	bank avulsion, loss of stream bank vegetation, or change in vegetation characteristics outside of expected norm
	saline seeps	water discharge, holding areas	visual inspection of soil surface, vegetation	area of impact or site condition	1 - 2 times yearly	visible salt crusting or vegetation changes
	compaction	areas effected by extraction activities	penetrometer or visual inspection	pounds per square inch	1 - 2 times yearly	compaction outside permitted disturbance zone

Element	Item	Location	Technique	Unit of Measure	Frequency and Duration	Information Warranting a Decision Change
VEGETATION						
	ecological status	areas affected by disturbance through the pre-production, production, post-production processes	ecological site method in key areas	composition, production compared to potential natural community for each site	pre-development ecological status baseline data	status is reduced by 15% or a drop in class
	trend	areas affected by disturbance through the pre-production, production, post-production processes	any suitable methods as described in TR 4400-4 or the National Range Handbook	apply to the technique selected, may include number of individuals per unit area, percent cover, percent frequency, or percent species composition	every 3 to 5 years after the collection of ecological status baseline data	a change in the direction of trend away from management
Noxious Weeds	trend	areas affected by disturbance through the pre-production, production, post-production processes	Montana Noxious Weed Standards	acres, plants per square feet, species	yearly (through post production reclamation)	10 percent increase beyond objectives for the area/new species occurrence or infestation
Riparian/ wetlands	condition, trend, age class structure, streambank alteration	any federal action (including split estate)	photo plot, estimate key areas by sight inspection, Cole Browse Method, Key Forage Method, other methods found in Technical References (TR4400-3, TR4400-4, TR4400-7, TR1737-3, TR1737-8, TR1737-9) including MRWA (Montana Riparian Wetland Association) Riparian Inventory for areas not previously inventoried MRWA PFC on inventory areas	percent species composition, percent in each age class, percent utilization, height, percent of the streambank	based on activity plan schedule- a minimum of once every five years	trend away from objective or when no improvement occurs, in unsatisfactory habitat condition/functioning at risk with downward trend
Special Status and T&E Plant Species	condition	areas affected by disturbance through the pre-production, production, post-production processes	Montana Natural Heritage Program and visual inspection	presence & condition	once during the growing season, at a minimum	downward trend in plant condition caused by O&G activities

Element	Item	Location	Technique	Unit of Measure	Frequency and Duration	Information Warranting a Decision Change
WILDLIFE (see also "Wildlife Outline" at the end of this appendix)						
Aquatic Biological Diversity (flora/fauna)	population diversity	intermittent/perennial streams associated with produced water discharge	stream sampling	diversity index	every three years	downward trend overall stream biological diversity
Big Game	seasonal habitat use	project area plus 1 mile buffer	air/ground field inspection	occupancy	annually	downward trend in habitat occupancy
Black-footed Ferret	occupancy	prairie dog towns larger than 80 acres located within 0.5 mi. of proposed activity	ground inspection	occupancy	determined on a site-specific basis in coordination with FWS	habitat decline or prairie dog fatalities caused by oil & gas activities - occupancy of black-footed ferrets would be managed in a Black-Footed Ferret Management Plan
Burrowing Owl	active nest locations	specific project area plus .5 mi. buffer (within active prairie dog town)	ground inspection	occupancy	Twice yearly (June-August)	human-caused disturbance to owls related to oil & gas activities such as vandalism and harassment
Grey Wolf	occupancy	Billings RMP area	air/ground field surveys	number of sitings	annually until reintroduction objectives are met	1 to 3 year downward trend in production or occupancy
Migratory Non-game Birds	occupancy	project area plus 0.25 mi buffer	ground observations	occupancy	periodically	documented fatalities caused by oil & gas activities
Mountain Plover	active nest locations	specific project area plus 0.5 mi. buffer (within areas less than 4" average vegetation height and prairie dog towns)	ground inspection	occupancy	twice yearly (April 15 - June 30)	human-caused disturbance to mountain plovers related to oil & gas activities such as vandalism and harassment
Prairie Dog	active prairie dog colony	specific project area plus 0.5 mi buffer	air/ground inspection	occupancy	annually	documented prairie dog fatalities caused by oil & gas activities
Raptors	active nest locations (excluding burrowing owls)	project area plus 1 mi. buffer	air/ground field inspection	number of nests	every 3 years	downward trend in occupancy
	raptor productivity (including Burrowing Owl)	active nests within 1 mi of project disturbance plus 1 mi. buffer	air/ground field inspection	nest success/failure species productivity	annually	downward trend in nest success, overall productivity
	raptor productivity-selected undeveloped comparison area	project area	air/ground field inspection	nest success/failure species productivity	every five years	information used as support to determine downward trend

Element	Item	Location	Technique	Unit of Measure	Frequency and Duration	Information Warranting a Decision Change
Sage Grouse	sage grouse lek location	CBM overall project area	aerial field inspection	number, location of leks	every five years	downward trend in habitat occupancy
	sage grouse lek attendance	specific project development areas plus 2 mi. buffer	air/ground field inspection	number of males/lek	annually	downward trend in lek attendance
	sage grouse winter habitat	project area plus 2 mi. buffer	air/ground field inspection	occupancy	annually	downward trend in habitat occupancy or quality caused by oil & gas activities
Special Status Species (BLM & MNHP lists)	occupancy	specific project area plus 1 mi. buffer	ground field inspection	occupancy	annually at a minimum via species habitat requirements	downward trend in habitat occupancy or quality caused by oil & gas activities
Threatened, Endangered and proposed species other than previously described	occupancy, productivity	CBM overall project area	air/ground field inspection	occupancy	determined on a site-specific basis in coordination with FWS	habitat decline or fatalities caused by oil & gas activities - occupancy of specie would be managed in a site-specific Management Plan

REGIONAL-SCALE MONITORING OF POTENTIAL EFFECTS OF COAL BED METHANE DEVELOPMENT ON WATER RESOURCES

Prepared by the Technical Advisory Committee for the Powder River Basin Controlled Groundwater Area

Introduction

Coal bed methane (CBM) is released from coal seams by pumping groundwater from coal seams to lower ground water pressures. The coal seams targeted for CBM development in the Powder River Basin constitute important regional aquifers that provide water for domestic, livestock, agricultural, and industrial uses. Consequently, CBM production will probably affect existing water uses in the Powder River Basin, although the extent and magnitude of effects are difficult to predict.

The Montana Board of Oil and Gas Conservation (MBOGC) requires, through its Order No. 99-99, that CBM producers submit field development plans that include groundwater characterization and monitoring. In addition to complying with existing MBOGC rules for wildcat gas wells, CBM producers are required to describe baseline hydrologic conditions, to inventory existing wells and springs, to offer water mitigation agreements to existing water users, and to monitor water production and shut-in water pressures within coal bed methane fields. Water mitigation agreements must be offered for a minimum of one-half mile (expanded to one mile in Mont. Code Ann. 85-2-521) from CBM fields or greater distances if effects extend father. The U.S. Environmental Protection Agency (EPA) requires monitoring under permits for Class V injection wells used to re-inject water produced during CBM production. Specific requirements of Class V injection permits may include monitoring of injection pressure, injection rate and total volume at injection wells, and ground water elevations in monitoring wells.

There are no clear regulatory requirements for monitoring effects to ground water levels or spring flows outside the one-mile minimum specified by MBOGC or the area affected by Class V injection wells. Groundwater monitoring conducted by CBM producers within and near CBM fields, as required by MBOGC or the U.S. EPA, will not reveal broad regional effects. Therefore, regional-scale monitoring needs to be conducted outside areas of potential CBM development to allow potential effects to be evaluated before, during, and after the period of CBM production. In addition, the spacing of monitoring sites and the frequency of monitoring needs to be sufficient to distinguish potential effects attributed to CBM development from potential effects attributed to other water users, and from ambient/seasonal variations in ground water levels and spring flows.

The purpose of this document is to establish design criteria for a regional-scale monitoring program intended to detect potential effects of CBM development on existing water uses. The objectives of the regional scale monitoring program are to characterize baseline hydrologic conditions, detect changes in ground water levels and flows from springs attributable to CBM development, and verify recovery of ground water levels after CBM development ends. Regional-scale monitoring of wells and springs is intended to augment and compliment field-scale monitoring established under MBOGC Order No. 99-99 or EPA UIC Class V injection well permits.

Criteria for selecting locations and spacing for monitoring sites, consisting of wells and springs, and monitoring practices are proposed here to ensure that long-term monitoring is sufficiently comprehensive to detect effects that CBM development might have on ground-water systems. Priorities are proposed to coordinate monitoring with the pace of development and the need to evaluate potential effects, and recommendations are presented for implementing monitoring and managing monitoring data. The criteria and monitoring recommendations described below are not meant as rigid rules, but rather are intended to guide qualified personnel in selecting monitoring locations and implementing monitoring that meet the objectives stated above.

Criteria and Monitoring Practices

The portion of the Powder River Basin underlain by coals of the Tongue River Member of the Fort Union Formation is generally considered to have potential for CBM development. Within this area, however, CBM is less likely to be developed from coal seams with limited thickness and ambient ground water pressures; conditions that indicate limited potential for gas production. These areas, located primarily within two to five miles of coal outcrops, should be targeted for monitoring wells.

The Anderson-Dietz, Canyon, Wall, and Knobloch are the four primary coal seams within the Tongue River Member (Map 1). Separate monitoring sites located within five-miles of the outcrops of each of these coal zones are proposed. Clusters of wells will be completed in different coal zones where outcrop areas overlap and, where present, springs will be monitored near each monitoring site. Monitoring wells will need to be completed in alluvial aquifers, in areas where water from CBM production is discharged to surface impoundments, or in selected sandstone aquifers within coal outcrop areas or CBM fields (when not required by MBOGC or the U.S. EPA). Springs that are current, historical, or potential sources of water but located away from established monitoring sites may also be monitored.

The focus of overall monitoring of the potential effects of CBM development will change as CBM fields mature, and gas production declines and eventually ends. Monitoring performed by CBM operators that is required by MBOGC or the U.S. EPA, will gradually be discontinued as portions and eventually all of fields are played out. Abandoned producing wells or monitoring wells within CBM fields should be incorporated into the regional monitoring program as field mature, in order to effectively monitor post-production groundwater recovery in affected areas.

The need for detailed information, and the cost of installing monitoring wells and monitoring ground water-levels and spring flows, will need to be balanced to determine the ultimate spacing between monitoring sites. At a minimum, one monitoring site will be located in every township that lies within five miles of the outcrop of a targeted coal. The ultimate spacing of monitoring sites might be greater, depending on site-specific conditions such as thickness of coal zone and importance of coal or sandstone aquifers, and priorities for monitoring outlined below.

Monitoring wells may be newly constructed wells, existing monitoring or water supply wells, or abandoned or transferred CBM production wells. Ground-water levels in monitoring wells and flows of springs will need to be measured monthly to obtain a sufficient data record to characterize patterns of seasonal changes in ground-water level or spring flows, before the wells or springs can be effected by CBM development. Typically two to three years of monitoring record is desirable. Monitoring frequency should be reduced once a sufficient record of baseline conditions is established.

Priorities

The following priorities are proposed for initiating monitoring and selecting monitoring well density and frequency, to ensure that a regional ground water monitoring program is established in advance of anticipated CBM development and before potential effects of CBM development can occur.

- *Sequence of CBM development*—Areas most likely to be effected by CBM development first are the highest priority for initiating monitoring. CBM development is expected to focus initially on the Anderson-Dietz coal zone and, therefore, monitoring near its outcrop should begin first. Records of exploration wells, pipeline plans, and identification of prospective coal zones can provide more specific information regarding the sequence of CBM development.

- *Extent of water use*—Areas where water from coal-beds is heavily used are high priorities for monitoring. Within the general area of the Anderson-Dietz outcrop, areas of concentrated water use, such as the headwaters of Otter Creek, will need immediate and more intensive monitoring.

- *Proximity to political boundaries*—Monitoring should be established along political boundaries, specifically the Montana-Wyoming border and reservation boundaries, in order to detect potential effects from areas outside the regional monitoring network.

- *Sensitivity or hydrogeologic setting*—More intensive monitoring will be necessary where faulting or complex stratigraphy result in complex hydrogeologic settings.

- *Existing monitoring networks*—Monitoring should be re-established at monitoring wells near operating coal mines and coal mining prospects studied in the past. New monitoring well construction should focus on areas where wells are not available.

- *Land or mineral ownership*—Monitoring should be conducted at sites with stable land and/or mineral ownership. For example, federally owned land, or other land with long-term access easements provide more reliable long-term access for monitoring.

Implementation and Data Management

An important goal of the proposed regional monitoring program is to ensure that all monitoring data collected are made readily accessible to the public. The regional monitoring program can, and probably will, be conducted by more than one agency, with funding from various sources. However, one agency or interagency will need to coordinate or review all regional monitoring activities in order to assure that monitoring occurs where needed and to prevent duplication. Data from field-scale monitoring pursuant to MBOGC Order 99-99 and EPA UIC Class V injection well permits will need to be managed similarly. A further responsibility of the lead agency or group should be to ensure that regional- and field-scale monitoring data are compiled and made available to the public in the Ground-Water Information Center (GWIC) and the National Resource Information Systems (NRIS).

Summary of Recommendations

A regional-scale monitoring program is necessary to characterize baseline hydrologic conditions, to detect potential effects resulting from CBM development, and to verify recovery of ground water levels after the period of CBM development. The following constitutes the main elements of a regional-scale monitoring program that should accomplish these objectives:

- Monitoring is needed to augment and compliment field-scale monitoring established under MBOGC Order No. 99-99 and EPA UIC Class V injection permits.
- Groundwater levels need to be measured in wells in coals and overlying or underlying sandstone aquifers at locations near coal outcrops outside of areas of prospective CBM development.
- Groundwater levels need to be measured in wells in alluvial aquifers in areas where water CBM production is discharged to surface impoundments, or selected sandstone aquifers within CBM fields.
- Flows from springs need to be monitored when they are near well monitoring sites or if they are important water sources.
- Groundwater levels need to be measured in abandoned or transferred CBM wells as CBM fields mature.
- Monitoring sites need to be located in every township near coal outcrops at a minimum.
- Groundwater levels in wells and flows from springs need to be measured monthly to characterize ambient seasonal patterns.
- Monitoring sites need to be established to ensure that the regional monitoring program is implemented in advance of localized CBM development and, consequently, that potential effects can be detected.
- One oversight agency or interagency group responsible for collecting and compiling comprehensive and consistent data should implement the proposed regional monitoring program.
- Monitoring data need to be compiled and made available to the public through GWIC and NRIS.

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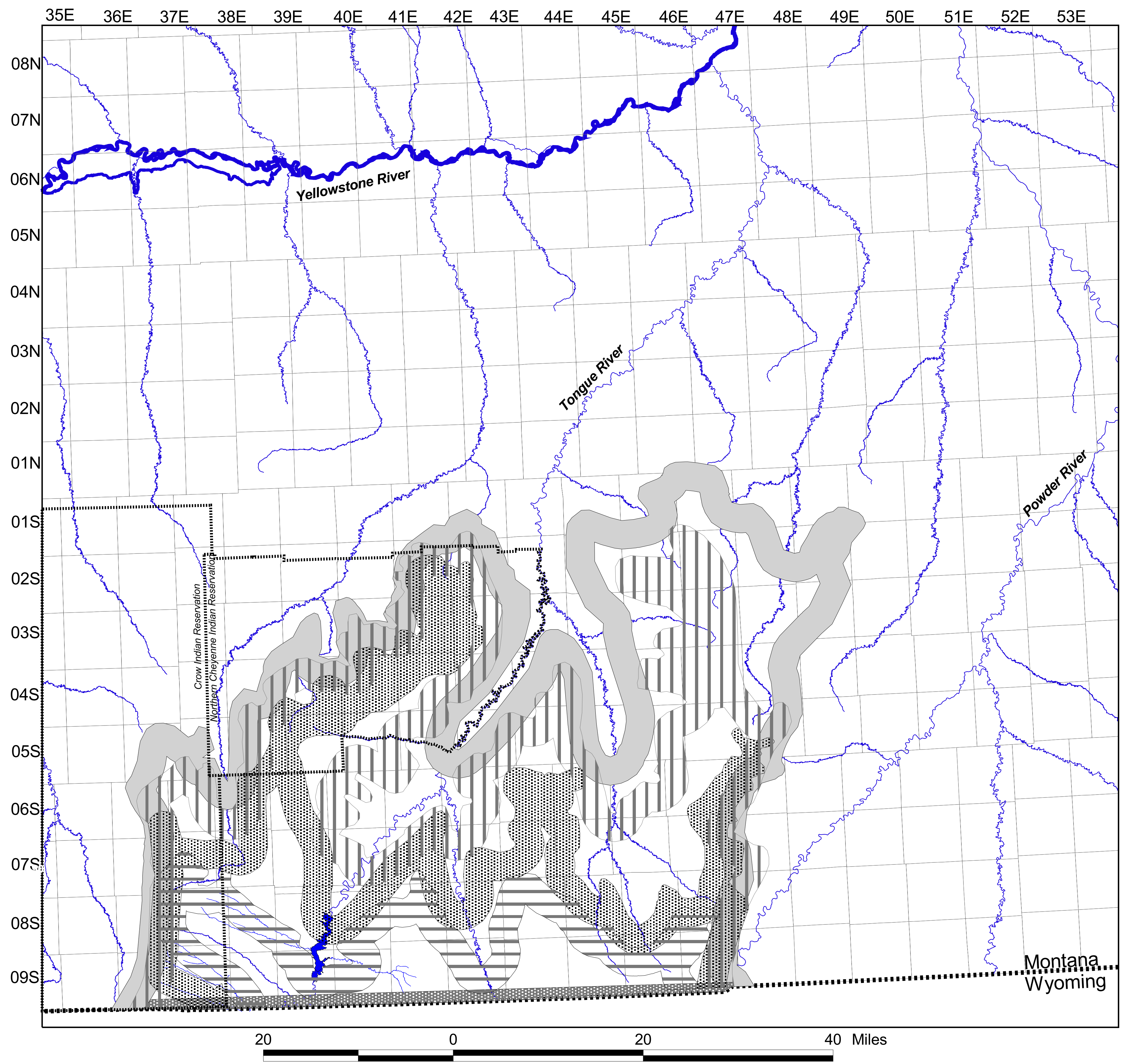
Monitoring Appendix
Map 1.
Conceptual map showing recommended areas for a regional-scale coal-bed methane monitoring program

Montana Department of Natural Resources
Technical Advisory Committee for the Powder River Basin Controlled Ground-Water Area



Legend
- Anderson
- Canyon
- Wall
- Knobloch
- State-line monitoring area

This map is part of a report prepared by the Montana Department of Natural Resources, Technical Advisory Committee for the Powder River Basin controlled ground-water area, titled: Regional-scale monitoring of potential effects of coal bed methane development on water resources. The Technical Advisory Committee proposes a minimum of 1 monitoring site in each township within three - five miles of coal outcrops. In addition, monitoring is proposed near the Montana-Wyoming border.

The Anderson, Canyon, Wall and Knobloch coal seams are the four primary seams within the Tongue River Member of the Fort Union Formation in the Montana portion of the Powder River Basin. Shaded zones represent areas that are generally 3 miles or less from these respective coal outcrops. Separate ground-water monitoring sites are proposed within each of these coal zones to study the potential effects of coal-bed methane development. Actual site locations will be based on detailed geology and field conditions.

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Wildlife Monitoring and Protection Plan

This draft document outlines the proposed principles and process for implementing a Wildlife Monitoring and Protection Plan (WMPP) during CBM development in the Powder River and Billings RMP areas. A detailed, complete plan will be included in the Final EIS.

The goal of the WMPP is to avoid or minimize impacts to wildlife and serve as a communication tool to foster cooperative relationships among CBM industry, landowners, and the agencies. This plan addresses a large geographic area composed of diverse wildlife habitats and unique situations, therefore, it is programmatic in nature; however, the need to provide management recommendations and guidance to conserve species and habitats remains. A site-specific plan, which follows the guidance provided in this programmatic document, will be required as part of each Project Plan. Implementation of this plan during the course of project development and operations would allow land managers and project personnel to achieve desired levels of wildlife productivity simultaneously with the development of natural gas reserves.

Plan Purpose

The plan serves many purposes, which include but are not limited to:

- Establish a framework to cooperate, report, and make decisions
- Determine the effectiveness of mitigation measures contained in the BLM Record of Decision and CBM Project Plans
- Determine needs for inventory, monitoring and protection measures
- Provide guidance and recommendations for the conservation of wildlife species
- Establish protocols for biological clearances of special status species
- Meet the terms and conditions of the Biological Opinion
- Provide a mechanism for a rapid response to change environmental conditions
- Validate predictive models used in the EIS and revise the models/projections as necessary based on field observations and monitoring
- Build a foundation for proactive and constructive participation in future decision making

Programmatic Guidance for the Development of Project Plans

It is proposed that operators will develop Project Plans that incorporate the programmatic guidance in this WMPP. This guidance may change over time if monitoring indicates it is not effective or unnecessary. Within the Project Plans, operators will include baseline inventory in areas where wildlife inventory has not been completed and demonstrate how their project design minimizes or mitigates impacts to surface resources and meets objectives for wildlife.

The following list of draft guidance is provided to the reader as examples of how project plans will incorporate conservation needs for wildlife species. These types of conservation actions offer flexibility for local situations and help minimize or eliminate impacts to the species of interest.

1) Use the best available information for locating structures near important wildlife breeding, brood-rearing, and winter habitat based on the following considerations:
   a. Size of structure(s),
   b. Life of the operation, and
   c. Extent to which impacts would be minimized by topography.
2) Concentrate energy-related facilities when practicable.
3) Locate storage facilities, generators and holding tanks outside the line of sight of important sage grousing breeding habitat.
4) Develop a comprehensive Project Plan prior to expanded development activities to minimize road densities.
5) Develop a route utilizing topography, vegetative cover, site distance, etc. to effectively protect identified sage grouse habitat or other important wildlife habitat in a cost efficient manner.

6) Apply mitigation measures to reduce mountain plover, swift fox, or sage grouse mortality cause by increased vehicle traffic. Construct speed bumps, use signing, or post speed limits as necessary to reduce vehicle speeds near leks or other important wildlife habitats.

7) Avoid, where possible, locating roads and power lines in crucial sage grouse breeding, nesting and wintering areas.

8) Use minimal surface disturbance to install roads and pipelines and reclaim sites of abandoned wells to restore natural plant communities.

9) Site new power lines in existing disturbed areas wherever possible.

10) Minimize the number of new powerlines in sage grouse habitat.

11) Remove unneeded structures and associated infrastructure when project is completed.

12) If possible, minimize maintenance and related activities in sage grouse breeding/nesting complexes—15 March to 15 June—between the hours of 4:00-8:00 a.m. and 7:00-10:00 p.m.

13) Protect, to the extent possible, natural springs from disturbance or degradation.

14) Design and manage discharge impoundments so as not to degrade or inundate sage grouse leks, nesting sites, wintering sites, or other special status species habitats.

15) Develop offsite mitigation strategies in situations where fragmentation or degradation of special status species habitat is unavoidable.

Implementation

Plan implementation will begin with the issuance of the Record of Decision. It will remain in effect for the life of the project unless there is sufficient evidence that wildlife populations and productivity are adequately protected. The WMPP will undergo a major review every five years to determine its effectiveness. A cooperative agreement among cooperators will be signed on an annual basis to include specific work components of the current year’s work.

SOCIOECONOMICS APPENDIX

SOCIOECONOMICS APPENDIX

Attitudes, Beliefs, Lifestyles, and Values

Population Groups

General information about population groups was developed from a number of sources, including the documents cited in the text. While the generalized characterizations are not likely to apply to all individuals, the intention is to provide an idea of the range of the attitudes and lifestyles of the population subgroups present in the study area.

The study area population is largely rural, with strong ties to the land and to the many small towns. Ranch and farm families are one of the major groups of people living in the study area. They tend to favor traditional land uses and the preservation of intergenerational family operations. They may feel reluctance toward short-term developments that will alter their lifestyle. The study area population also includes long-time small town residents. While these people generally wish to maintain their way of life, at the same time, some may seek to find a compromise between their current situation and gradual development.

Another portion of the population in the study area is Native Americans, many of whom are residents of the three Indian reservations within the study area. These groups generally desire to preserve many elements of their heritage and do not wish to become homogenized into and by the non-Indian culture. At the same time, some tribal members or subgroups are pursuing the development of energy resources for the long-term social and economic betterment of tribal members.

A small but growing population is made up of professionals, craftspeople, retirees, and others who have moved to small towns to enjoy the slower pace of life and various amenities. While the forested areas of western Montana tend to attract more of this group than eastern Montana, these people are present in the study area as well. They may participate in opposition to development proposals that appear to jeopardize the quality of their new lifestyles.

Areas where energy resources are developed often see the influx of people from other areas. Many of these people regard their employment as temporary, expect to move on to other areas, and do not play an integral part in community affairs. Long-term local residents often resent these “outsiders” while at the same time realizing some economic benefits from the business and service demands of these newcomers.

In summary, residents generally value the rural character of their lifestyle. Specific aspects of this lifestyle might include appreciation of wide-open spaces, natural landscape, fresh air and solitude. The lifestyle of rural communities often offers the desirable qualities of neighbors knowing each other, lack of urban problems, relaxed pace, personal freedom, and being a good place to raise children. Longtime residents often want to see continued control of the land at the local level without interference from outside agencies or groups.

Public Comments from EIS Scoping Process (2001)

The public comments received during the EIS scoping process convey important information about general attitudes toward coal bed methane (CBM) and other energy or mineral development. The vast majority of public comments received during scoping relayed concerns about potential impacts on water quality and quantity. Specifically, commentators were concerned with the discharge of water of poor quality (e.g., saline) and the drawdown of groundwater aquifers.

Public comments are often shaped by an individual’s lifestyle and livelihood. For example, ranching and irrigated agriculture are both dependent on the supply of water. Of the comments received by individuals engaged in farming and ranching, a great many related to concerns about potential degradation of water quality and quantity, in addition to general environmental impacts. The comments reflect a tension between the desire for new development to support the often stagnant rural economies and the concern that such development could harm the environment and the lifestyle qualities for which Montana is known, including natural beauty, wide-open spaces, and solitude.

In general the comments reflect a difference in attitudes toward CBM development among those individuals and organizations that might profit directly from CBM and those that would not. Those who own land or mineral rights where CBM could be developed tend to favor cautious and prudent development for the economic benefits it could bring to them and the local economies. Some who do not stand to benefit directly also favor responsible CBM development as soon as possible, believing the economic benefits are needed urgently to bolster stagnant or failing local economies and in turn help maintain existing rural lifestyles. Particularly in the less affluent portions of the study area, CBM and other resource development may be seen as one of the few means to meet urgent human needs in the form of employment and income.

Other individuals, including those who do not stand to benefit directly from CBM, are concerned that the quality of their life and the environment will be adversely affected; that local benefits will be minor; and that most of the benefits will accrue to outsiders. There is a perception that such outside developers, or "wildcatters," will move into a community, extract the profits, and leave a despoiled environment behind. Rural residents, including those in small developments or neighborhoods, are generally concerned about the potential for CBM development in adjacent areas to disturb the peaceful and pristine setting, to contribute unsightly development, to disturb wildlife, and to threaten the provision of adequate public services.

There is also a perception from some comments that CBM will adversely affect the lifestyles of the Native Americans living in and around the 16-county study area—particularly those on the reservations. Concerns reflect the traditional high value placed on natural resources by these groups, the importance of existing water and other natural resources in tribal economies and cultures, and the opinion that tribal members will be unduly burdened with the costs of development while not receiving many or any benefits.

Newspaper Reports

One of the largest newspapers in the study area, the *Billings Gazette*, was reviewed for information about local attitudes and concerns related to the socioeconomics of CBM. During the week of February 19, 2001, the *Billings Gazette* presented an in-depth report on CBM development in Wyoming and Montana. While the series was running, readers were invited to register their opinions about the positive and negative aspects of CBM in the Powder River Basin. Because this was not a scientific or statistical survey, the responses are likely to be biased toward those who had a concern or issue to communicate.

Of the 154 responses received, 94 agreed with the statement, "Coal bed methane development will be detrimental to Montana's environment and shouldn't be developed here." Thirty-seven respondents agreed with the statement, "Coal bed methane should be developed in Montana with regulation to reduce negative affects on water and other land uses," and 23 selected the statement, "Coal bed methane will bring jobs and money to Montana and should be developed as soon as possible." (*Billings Gazette* 2001.) Thus, roughly one-third of the respondents supported CBM development and two-thirds did not. A number of other written comments were published, which generally reflect the diversity of opinions described previously in the public comments section.

Attitudes Toward Public Lands

Attitudes about general social conditions and about U.S. Bureau of Land Management's (BLM's) management of public lands in eastern Montana were gathered by Trent (1991) in interviews with about 100 residents. The results are summarized here from the discussion in the *Big Dry RMP/EIS* (BLM 1995). The residents indicated the most important aspects of their area and community were the outdoors and wide open spaces, good people, a small town atmosphere, keeping the community alive, the ability to earn a living, enjoying outdoor recreation, and, finally, that the area is a good place to raise children.

In relation to use and management of public lands, many of the respondents stated the importance of multiple uses and support for resource protection while allowing a variety of activities on public lands. Vegetation and soils were identified as the resources most important to protect, with livestock grazing and hunting the most favored activities. Recreation was slightly less favored and oil/gas, coal, and other mineral development were less favored than recreation. Concern about local economic conditions was predominant among the respondents. Respondents were concerned about the livestock industry, citing it as the most threatened activity on public lands. The respondents also were concerned with resource protection and preserving special resource values such as wildlife habitat, riparian areas, and wetlands.

Another summary of attitudes toward public lands and resource management is provided in the *Off-Highway Vehicle Final EIS* (U.S. Department of the Interior [USDI] 2001). The document states that social values for lands and natural resources take many forms, such as commodity, amenity, environmental quality, ecology, public use, spiritual, health, and security. In the past, natural resource management tended to emphasize commodity values.

An emerging emphasis is a shift from commodities and services to environments and habitats. At the same time, in places where land use has been unrestricted, there is increasing concern by some that new regulations and uses are driving out traditional uses such as livestock grazing and off-highway vehicle use.

Oil and Gas Development

Other past data on attitudes toward oil and gas development is contained in the report "Natural Resource Development in Montana" (Wallwork and Johnson 1986). The discussion here is summarized from the *Final Oil and Gas RMP/EIS Amendment for Billings, Powder River and South Dakota* (1992). The original study consisted of interviews with 624 Montana adults. Nearly two-thirds of the respondents indicated natural resource development, in general, to be essential to the State's future economic health. The primary benefits were construed to be jobs and income, help the state and local economy, tax revenues, and the provision of needed products. Respondents indicated the primary costs or disadvantages associated with natural resource development would be environmental impacts, pollution, poor reclamation, population growth, and boom-and-bust economic cycles. About three-fifths of the respondents saw little or no conflict between natural resource development and outdoor recreation, while one-fourth felt that the two activities did conflict.

Most respondents in the 1986 interviews felt the following activities should be allowed on government lands: timber cutting (85 percent approval); oil and gas extraction (83 percent); coal mining (78 percent); and hardrock mining (79 percent). Some respondents felt the following activities should be prohibited on government lands: timber cutting (11 percent disapproval); oil and gas extraction (12 percent); coal mining (17 percent); and hard rock mining (15 percent). In response to specific questions about oil and gas leasing and development, about half the respondents felt oil and gas development to be essential to Montana's future economic health, with a higher percentage of respondents in eastern Montana feeling this way. Another third of the respondents indicated oil and gas development to be fairly essential. Responses to the pace of development were evenly split, with nearly 40 percent responding that it was just right and 40 percent feeling it was too slow. Nearly 75 percent of the respondents said they had a favorable impression of the industry. About two-fifths of the eastern Montana respondents rated the industry excellent or pretty good in its behavior as a responsible citizen of the state. Another two-fifths of these respondents rated the industry as only fair or poor in its behavior as a responsible state citizen.

Northern Cheyenne and Crow Tribes

Attitudes toward coal development among the members of the Northern Cheyenne and Crow tribes are described in the Economic, Social and Cultural Supplement to the *Powder River I Regional Draft EIS* (BLM 1989). While there may be differences in attitudes between coal development and natural gas (CBM), there are also likely to be similarities.

Northern Cheyenne attitudes toward coal development are complex. In general, tribal members have shown a determination to maximize the potential benefits of coal development (such as training and employment opportunities and possible revenue sources) and to minimize the potential adverse effects (such as air quality degradation and increased demand on tribal facilities and services). In spite of the conflict it causes with traditional values and attitudes toward land and resources, many tribal members felt that if mining is going to occur in the area anyway, then the tribe and its members should try to reap some of its benefits as well as bear some of its costs. However, other Northern Cheyenne, particularly some of the more traditional elders, were firmly against energy development because of its disruption to the land and environment. They recognized that there is a need for jobs on the reservation but felt that other jobs that were less disruptive to the land and traditional values must be found.

The attitudes of individual Northern Cheyenne members toward coal development off the reservation reflected their perceptions about whether, and to what extent, they or their friends and family were benefiting from it. Those who were benefiting from coal-related employment or who aspired to do so seemed to be in favor of this development. Those who had been refused coal-related jobs or were not interested in them felt less positive about regional coal development. Many cited both positive effects (mostly jobs) and negative effects (environmental pollution, increased traffic, and drug and alcohol problems) that they believed were associated with the coal mines and power plants that had been constructed since 1970.

For residents of the Crow Reservation, a high level of concern was found regarding the impact that off-reservation coal development could have on the reservation. Three major concerns emerged regarding off-reservation coal development: 1) that it would compete with the marketing and development of on-reservation coal; 2) that reservation services and infrastructure would be affected and experience fiscal shortfalls; and 3) that regional coal development could have an impact on Crow culture and individual behavior such as alcohol and drug abuse. Specific cultural concerns included potential loss or dilution of culture values such as sharing and the importance of family as a result of the exposure to non-Native American values.

Many people on the Crow Reservation, including tribal officials, expressed the concern that federal coal would compete directly with tribal-owned coal. If federal coal is leased, then tribal-owned coal is less likely to be leased. Tribal coal leasing was seen by some members as a way for the tribe to raise money to save its land base and to enhance the tribe’s ability to govern itself. If the tribe can generate its own revenues, it can determine how that money is spent and will no longer have to depend on the federal government to address problems.

Government Revenue Sources

Total county revenues for fiscal year 1999 are presented in Table SEA-1. The table shows that the total revenues collected in the 16 study-area counties accounted for 26.7 percent of the revenues collected by all of the counties in the State. By comparison, the study area population was 31.8 percent of the state total in 2000.

Taxes

Total taxes collected by counties are shown in Table SEA-2. With some exceptions, taxes account for a large share—often about one half—of total county revenue. Counties that are less reliant on tax revenues have other miscellaneous income or intergovernmental income, generally related to natural resources rents or royalties.

Property Taxes and Assessed Value

Property taxes are levied by counties on real property and on any specified facilities and/or improvements to that real property.

The assessed value, taxable value, and total property taxes collected for the state and each study area county are presented in Table SEA-2. The average mill levy rate for each county is also shown. Property taxes collected in the 16 study-area counties totaled more than $15 million, which is 31.9 percent of the state total. The percentage of property taxes collected in the study area is consistent with the study area population, which was similarly 31.8 percent of the state total in 2000. The taxes collected in the counties vary widely in accordance with the assessed values, taxable values, and tax rates and mill levies in each county.

Natural Resource Taxes

Natural resource taxes were a relatively small component of total tax revenues, at $100 million or 6.5 percent. Natural resource taxes include taxes on coal, oil, natural gas, and metals mining. Table SEA-3 shows the State natural gas tax revenues for 1999 and 2000. Total revenues were $11,205,901 in 2000—an increase of 8.1 percent from the previous year.

As shown in Table SEA-1, county revenues from oil and natural gas production taxes and the percent of these revenues compared to total county revenues varied greatly among the 16 study-area counties. For a number of the counties, the income was minimal or zero. The exceptions include Blaine County ($626,111 or 15.7 percent of county revenue), Carbon County ($178,443 or 4.1 percent) and Musselshell County ($256,627 or 7.1 percent).

TABLE SEA-1
TOTAL COUNTY REVENUES BY SOURCE, FISCAL YEAR 1999[1]

	Revenue Source	Amount	% of County Total
Big Horn County	Taxes	$4,481,631	44.6%
	Licenses and Permits	$114,511	1.1%
	Intergovernmental	$1,235,480	12.3%
	Oil and Gas Production Tax (LGST) **(Included in Intergovernmental above)**	$5,280	0.1%
	Charges for Services	$1,364,573	13.6%
	Fines and Forfeitures	$115,996	1.2%
	Miscellaneous Revenue	$2,090,577	20.8%
	Investment Earnings	$643,663	6.4%
	Total:	$10,046,431	100.0%

TABLE SEA-1
TOTAL COUNTY REVENUES BY SOURCE, FISCAL YEAR 1999[1]

	Revenue Source	Amount	% of County Total
Blaine County	Taxes	$1,856,603	46.7%
	Licenses and Permits	$95,030	2.4%
	Intergovernmental	$1,482,422	37.3%
	Oil and Gas Production Tax (LGST) **(Included in Intergovernmental above)**	$626,111	15.7%
	Charges for Services	$195,137	4.9%
	Fines and Forfeitures	$38,474	1.0%
	Miscellaneous Revenue	$165,916	4.2%
	Investment Earnings	$144,133	3.6%
	Total:	$3,977,715	100.0%
Carbon County	Taxes	$2,243,839	51.8%
	Licenses and Permits	$158,176	3.7%
	Intergovernmental	$1,441,197	33.3%
	Oil and Gas Production Tax (LGST) **(Included in Intergovernmental above)**	$178,443	4.1%
	Charges for Services	$196,394	4.5%
	Fines and Forfeitures	$62,692	1.4%
	Miscellaneous Revenue	$62,203	1.4%
	Investment Earnings	$164,215	3.8%
	Total:	$4,328,716	100.0%
Carter County	Taxes	$1,026,167	53.9%
	Licenses and Permits	$20,765	1.1%
	Intergovernmental	$267,473	14.1%
	Charges for Services	$100,220	5.3%
	Fines and Forfeitures	$6,569	0.3%
	Miscellaneous Revenue	$399,562	21.0%
	Investment Earnings	$82,130	4.3%
	Total:	$1,902,886	100.0%

TABLE SEA-1
TOTAL COUNTY REVENUES BY SOURCE, FISCAL YEAR 1999[1]

	Revenue Source	Amount	% of County Total
Custer County	Taxes	$2,327,867	49.8%
	Licenses and Permits	$110,737	2.4%
	Intergovernmental	$1,042,529	22.3%
	Oil and Gas Production Tax (LGST) **(Included in Intergovernmental above)**	$41,434	0.9%
	Charges for Services	$484,733	10.4%
	Fines and Forfeitures	$68,931	1.5%
	Miscellaneous Revenue	$471,159	10.1%
	Investment Earnings	$163,813	3.5%
	Total:	$4,669,769	100.0%
Gallatin County	Taxes	$9,853,528	44.8%
	Licenses and Permits	$797,126	3.6%
	Intergovernmental	$3,661,062	16.6%
	Charges for Services	$6,072,812	27.6%
	Fines and Forfeitures	$458,497	2.1%
	Miscellaneous Revenue	558,876	2.5%
	Investment Earnings	608,291	2.8%
	Total:	22,010,192	100.0%
Golden Valley County	Taxes	387,137	57.0%
	Licenses and Permits	13,242	1.9%
	Intergovernmental	174,519	25.7%
	Oil and Gas Production Tax (LGST) **(Included in Intergovernmental above)**	6,415	0.9%
	Charges for Services	22,560	3.3%
	Fines and Forfeitures	13,219	1.9%
	Miscellaneous Revenue	4,967	0.7%
	Investment Earnings	63,575	9.4%
	Total:	679,219	100.0%

TABLE SEA-1
TOTAL COUNTY REVENUES BY SOURCE, FISCAL YEAR 1999[1]

	Revenue Source	Amount	% of County Total
Musselshell County	Taxes	1,084,288	30.1%
	Licenses and Permits	73,915	2.0%
	Intergovernmental	739,530	20.5%
	Oil and Gas Production Tax (LGST) (**Included in Intergovernmental above)**	256,627	7.1%
	Charges for Services	256,627	7.1%
	Fines and Forfeitures	35,272	1.0%
	Miscellaneous Revenue	1,287,222	35.7%
	Investment Earnings	130,944	3.6%
	Total:	3,607,798	100.0%
Park County	Taxes	3,051,367	47.3%
	Licenses and Permits	202,702	3.1%
	Intergovernmental	1,352,106	21.0%
	Charges for Services	1,257,900	19.5%
	Fines and Forfeitures	229,957	3.6%
	Miscellaneous Revenue	109,530	1.7%
	Investment Earnings	241,766	3.8%
	Total:	6,445,328	100.0%
Powder River County	Taxes	1,193,285	37.7%
	Licenses and Permits	44,235	1.4%
	Intergovernmental	586,548	18.5%
	Oil and Gas Production Tax (LGST) **(Included in Intergovernmental above)**	89,261	2.8%
	Charges for Services	1,177,971	37.2%
	Fines and Forfeitures	29,218	0.9%
	Miscellaneous Revenue	50,028	1.6%
	Investment Earnings	86,243	2.7%
	Total:	3,167,528	100.0%

TABLE SEA-1
TOTAL COUNTY REVENUES BY SOURCE, FISCAL YEAR 1999[1]

	Revenue Source	Amount	% of County Total
Rosebud County	Taxes	3,736,882	50.7%
	Licenses and Permits	96,804	1.3%
	Intergovernmental	1,627,917	22.1%
	Oil and Gas Production Tax (LGST) **(Included in Intergovernmental above)**	14,024	0.2%
	Charges for Services	642,491	8.7%
	Fines and Forfeitures	86,111	1.2%
	Miscellaneous Revenue	824,751	11.2%
	Investment Earnings	349,646	4.7%
	Total:	7,364,602	100.0%
Stillwater County	Taxes	2,302,415	8.3%
	Licenses and Permits	338,758	1.2%
	Intergovernmental	24,113,855	86.8%
	Oil and Gas Production Tax (LGST) **(Included in Intergovernmental above)**	11,326	0.0%
	Charges for Services	256,559	0.9%
	Fines and Forfeitures	101,596	0.4%
	Miscellaneous Revenue	445,202	1.6%
	Investment Earnings	215,360	0.8%
	Total:	27,773,745	100.0%
Sweet Grass County	No report received		
Treasure County	Taxes	422,269	60.4%
	Licenses and Permits	16,076	2.3%
	Intergovernmental	124,734	17.8%
	Charges for Services	46,933	6.7%
	Fines and Forfeitures	47,409	6.8%
	Miscellaneous Revenue	16,561	2.4%
	Investment Earnings	25,710	3.7%
	Total:	699,692	100.0%

TABLE SEA-1
TOTAL COUNTY REVENUES BY SOURCE, FISCAL YEAR 1999[1]

	Revenue Source		Amount	% of County Total
Wheatland County	Taxes		20,477	0.84%
	Licenses and Permits		240,304	9.9%
	Intergovernmental		132,438	5.4%
	Charges for Services		25,717	1.06%
	Fines and Forfeitures		416,588	17.2%
	Miscellaneous Revenue		22,246	0.92%
	Investment Earnings		1,557,462	64.5%
		Total:	2,415,232	100.0%
Yellowstone County	Taxes		16,996,908	44.1%
	Licenses and Permits		2,732,460	7.1%
	Intergovernmental		7,946,773	20.6%
	Oil and Gas Production Tax (LGST) **(Included in Intergovernmental above)**		5,155	0.0%
	Charges for Services		8,757,415	22.7%
	Fines and Forfeitures		676,103	1.8%
	Miscellaneous Revenue		240,406	0.6%
	Investment Earnings		1,232,920	3.2%
		Total:	38,582,985	100.0%
Study Area Total (2)			**152,253,514**	
% of State Total			**6.7%**	
Montana State Total			**569,806112**	

Source: Montana Department of Commerce, Billings.
[1]Based on unaudited data reported by Counties.
[2]Does not include Sweet Grass County (no data available).

TABLE SEA-2
ASSESSED VALUES AND PROPERTY TAX COLLECTIONS BY COUNTY (2000)

	2000 Assessed Value	2000 Taxable Value	Total Property Taxes and fees Collected	Average Mill Levy
Big Horn County	$565,023,700	$21,354,436	$6,952,144	293.77
Blaine County	$284,898,249	$12,079,607	$5,685,958	362.11
Carbon County	$521,678,159	$23,754,742	$9,288,300	349.51
Carter County	$120,132,817	$6,808,649	$2,382,143	329.01
Custer County	$371,459,345	$14,389,152	$8,806,856	460.53
Gallatin County	$3,133,267,036	$118,555,127	$52,607,233	361.25
Golden Valley County	$98,470,244	$5,687,402	$1,784,283	305.79
Musselshell County	$179,355,501	$6,881,914	$3,173,428	393.23
Park County	$735,065,531	$28,466,784	$12,442,895	339.82
Powder River County	$125,672,599	$4,415,991	$2,227,445	463.94
Rosebud County	$1,957,565,773	$100,635,100	$20,804,541	173.34
Stillwater County	$697,014,674	$28,705,444	$10,708,053	319.89
Sweet Grass County	$247,083,525	$9,532,599	$3,677,085	354.74
Treasure County	$86,217,475	$4,306,117	$1,646,795	329.73
Wheatland County	$162,260,802	$10,468,500	$3,263,418	297.22
Yellowstone County	$5,245,460,701	$204,127,734	$107,952,414	378.48
Study Area Total	**$14,530,626,131**	**$600,169,298**	**$253,402,991**	**--**
% of State Total	**no data**	**35.7%**	**31.9%**	**--**
Montana	**no data**	**$1,679,739,857**	**$794,598,177**	**--**

Source: Montana Department of Revenue.

TABLE SEA-3

MONTANA NATURAL GAS PRODUCTION TAX REVENUES (1999 AND 2000)

	1999	2000	% Change 1999-2000
Natural Gas Tax Revenues	$10,367,718	$11,205,901	8.1%

Source: Montana Department of Revenue

SOILS APPENDIX

SOILS APPENDIX

The U.S. Department of Agriculture's (USDA) Natural Resources Conservation Services (NRCS) has published a general soil association map for Montana in digital format. The State Soil Geographic Database (USDA NRCS 1996) provides a general overview of soils distribution and occurrences in the planning area, and is not suitable for site-specific evaluations. More detailed information is available from the NRCS Regional offices in Montana. General soils information presented in the State Soil Geographic Database is presented in the *Soils Technical Report* (ALL 2001a). Information presented includes the areal extent, soil series characteristics, K-factor (erosion potential), salinity, and sodium adsorption ratio (SAR) for the various soil groups in the Powder River RMP and Billings RMP areas. The *Soils Technical Report* was prepared to present the potential impacts from the coal bed methane (CBM) extraction process on land and the environment, with a focus on impacts to agriculture, and including potential effects on crops, livestock, and soils. The report was used to prepare this section and provides more detailed information pertaining to soils and CBM development impacts to the environment. The complete Soils Technical Report can be accessed at http://www.mt.blm.gov/mcfo.

The layout of the soils in the study area is shown in Figures SOI-1 and SOI-2 for the Billings Resource Management Plan (RMP) Area and Powder River RMP area, respectively. A total of 163 soil mapping units composed of 205 soil series are present in the two RMP areas. The seven principal soil mapping units based on areal extent within the two RMP areas are:

- MT421 Cambeth-Megonot-Manning (4.3 percent)
- MT089 Yamac-Birney-Cabbart (4.3 percent)
- MT676 Yawdim-Delpoint-Thurlow (4.0 percent)
- MT675 Cabbart-Yawdim-Thurlow (3.9 percent)
- MT384 Marvan-Neldore-Bascovy (3.5 percent)
- MT103 Cabbart-Delpoint-Yamac (3.0 percent)
- MT559 Tanna-Rentsac-Yawdim (2.9 percent)

These seven soil mapping units comprise 26 percent of the two RMP areas, with the remaining 156 soil mapping units making up the remainder. Table SOI-1 presents all of the soil mapping units in the Billings RMP and Powder River RMP areas, along with the percent of the total RMP areas occupied by each mapping unit. Table SOI-2 presents some of the key soil characteristics related to erosion and salinity for the topmost 25 mapping units based on percent of total area.

Soils in the RMP areas are derived mainly from sedimentary bedrock and alluvium. The soils generally range from loams to clays, but are principally loams to silty clay loams.

Slope and K-factor are values that are used in the estimation of soil erosion potential. Slope values range up to greater than 40 percent; however, there are many soils that have slopes of zero to about 10 percent. Almost all of the soils have low K-factors (below 0.37). Easily eroded soils have a K-factor between 0.37 and 0.69, and resistant soils have a K-factor less than 0.37 (Jarrett 1995). Figures presenting the mean K-factor of the soils in the Billings RMP and Powder River RMP areas are included in the *Soils Technical Report* (ALL 2001). Figures SOI-1 and SOI-2 are included here to summarize the information.

Soil salinity affects the suitability of a soil for crop production and the stability of the soil. The SAR is the measure of sodium relative to calcium and magnesium, and affects the soil structure and infiltration rate of water. The *Soils Technical Report* presents a more detailed discussion pertaining to the salinity and SAR of the soils in the Billings RMP and Powder River RMP areas. As shown in Table SOI-2, most of the soils are very low in salinity. The SAR values in the study areas and statewide vary widely and, with few exceptions, are low in sodium. Based on the generally fine texture of the surface soils (clayey), much of the soil will likely be susceptible to increasing sodicity when irrigated with water having a high SAR. Permeability is the measure of vertical water movement when the soil is saturated. The soil structure, porosity, gradation and texture all influence the permeability of the soil. Those soils with a coarser texture (sandy to loamy) and good internal drainage (higher permeability) will be the least susceptible to increasing sodicity and salinity. Much of the soil is likely to be irrigable with good management.

TABLE SOI-1
AREAL EXTENT OF SOIL MAP UNITS FOR POWDER RIVER AND BILLINGS RMP AREAS

STATSGO Map Unit	Map Unit Name	Acres	Percent of Area
MT001	Abac-Peritsa-Rock Outcrop	93,754	0.48
MT003	Absarokee-Castner-Sinnigam	436,268	2.25
MT004	Absarokee-Wayden-Redcreek Family	23,322	0.12
MT006	Absarokee-Castner-Grail	15,901	0.08
MT007	Absarokee-Hilger-Big Timber	70,560	0.36
MT016	Winler-Lismas-Swanboy	21,332	0.11
MT017	Archin-Twilight-Bonfri	78,323	0.4
MT019	Assinniboine-Pring-Archin	459,121	2.37
MT024	Badland-Bullock-Neldore	129,347	0.67
MT027	Bainville-Mcrae-Rock Outcrop	453,939	2.35
MT028	Bainville-Rock Outcrop-Travessilla	205,254	1.06
MT029	Bainville-Travessilla Family-Evanston	171,636	0.89
MT037	Beauvais-Hydro-Lambeth	83,773	0.43
MT041	Bew-Toluca-Nobe	8,032	0.04
MT042	Big Timber-Cabba-Absarokee	107,565	0.56
MT048	Bitton-Shambo-Doney	428,667	2.22
MT051	Blackhall-Twilight-Zeona	21,144	0.11
MT054	Cabbart-Bonfri-Cambeth	2	<0.01
MT055	Bonfri-Gerdrum-Galbreth	3,927	0.02
MT070	Bryant-Doney-Shambo	56,522	0.29
MT075	Yamac-Busby-Cabbart	104,872	0.54
MT076	Cabba-Travessilla Family-Birney	121,597	0.63
MT078	Cabba-Campspass-Farland	6,969	0.04
MT080	Cabba-Farland-Yawdim	38,170	0.2
MT083	Cabba-Ringling-Yawdim	300,378	1.55
MT084	Cabba-Ringling-Yawdim	493,159	2.55
MT089	Yamac-Birney-Cabbart	827,152	4.27
MT090	Cabbart-Cambeth-Bonfri	183,942	0.95
MT092	Delpoint-Cabbart-Yamac	552,861	2.86

TABLE SOI-1
AREAL EXTENT OF SOIL MAP UNITS FOR POWDER RIVER AND BILLINGS RMP AREAS

STATSGO Map Unit	Map Unit Name	Acres	Percent of Area
MT095	Cabbart-Keiser-Dast	57,076	0.29
MT096	Cabbart-Pultney Family-Stormitt	43,281	0.22
MT097	Cabbart-Rentsac-Delpoint	283,471	1.46
MT099	Cabbart-Rock Outcrop-Twilight	116,567	0.6
MT100	Cabbart-Twilight-Forelle	31,738	0.16
MT103	Cabbart-Delpoint-Yamac	577,016	2.98
MT112	Castner-Savage-Chama	5,667	0.03
MT113	Castner-Chama-Regent	4,089	0.02
MT114	Castner-Darret-Windham	3	<0.01
MT120	Wayden-Castner-Cabba	47,803	0.25
MT127	Chinook-Archin-Delpoint	6	<0.01
MT145	Crago-Musselshell-Attewan	545,006	2.82
MT146	Crago-Musselshell-Fairfield	7,046	0.04
MT148	Creed-Gerdrum-Forelle	1,072	0.01
MT152	Cushman-Yawdim-Bainville	54,706	0.28
MT153	Danvers-Tinsley-Oburn	72,675	0.38
MT155	Danvers-Judith-Windham	49,063	0.25
MT157	Dast-Forelle-Delpoint	31,137	0.16
MT159	Dast-Mcrae-Travessilla Family	84,373	0.44
MT161	Degrand-Kremlin-Ethridge	10,319	0.05
MT164	Cabbart-Delpoint-Yamac	278,907	1.44
MT165	Delpoint Family-Kirby-Delpoint	33,440	0.17
MT167	Delpoint-Travessilla Family-Cabbart	216,026	1.12
MT168	Delpoint-Cabbart-Yamac	105,771	0.55
MT173	Dolus-Boxwell-Castner	22,680	0.12
MT174	Doney-Reeder-Cabba	72,377	0.37
MT175	Doney-Shaak-Wayden	232,912	1.2
MT176	Doney-Winifred-Wayden	73,711	0.38
MT182	Starley-Rock Outcrop-Babb	147,700	0.76

TABLE SOI-1
AREAL EXTENT OF SOIL MAP UNITS FOR POWDER RIVER AND BILLINGS RMP AREAS

STATSGO Map Unit	Map Unit Name	Acres	Percent of Area
MT187	Ethridge-Kremlin-Marias	9,089	0.05
MT190	Evanston-Lonna-Tinsley	19,800	0.1
MT193	Fairway Family-Tetonview-Villy	8,546	0.04
MT209	Forkwood-Vonalee-Haverdad	31,675	0.16
MT213	Garlet-Cowood-Rock Outcrop	298	<0.01
MT216	Garlet-Rubble Land-Cowood	2,132	0.01
MT217	Garlet-Sebud-Cheadle	22,544	0.12
MT218	Shadow-Garlet-Macfarlane	257,150	1.33
MT224	Gerdrum-Forelle-Archin	38,201	0.2
MT225	Harlem-Gerdrum-Ethridge	26,205	0.14
MT228	Gilt Edge-Absher-Yawdim	11,675	0.06
MT247	Harlem-Vanda-Marvan	10,450	0.05
MT249	Stormitt-Harvey Family-Nihill	48,815	0.25
MT252	Haverson-Heldt-Toluca	16,832	0.09
MT254	Havre-Glendive-Water	30,577	0.16
MT255	Havre-Harlem-Attewan	25,454	0.13
MT256	Havre-Harlem-Glendive	88,473	0.46
MT258	Havre-Ryell-Harlem	50,431	0.26
MT259	Havre-Hanly-Glendive	173,933	0.9
MT261	Havre-Rivra-Water	114,549	0.59
MT263	Havre-Kobar-Spinekop	47,424	0.25
MT264	Havre-Glendive-Yamac	10,938	0.06
MT269	Heath-Charlos-Maurice	58,449	0.3
MT271	Heldt-Fort Collins-Kobar	43,967	0.23
MT273	Helmville-Whitore-Tropal	126,307	0.65
MT301	Keiser-Hydro-Gilt Edge	112,102	0.58
MT309	Kobar-Yamac-Attewan	23,490	0.12
MT321	Lamedeer-Ringling-Twin Creek	35,383	0.18
MT323	Lap-Windham-Armington	104,714	0.54

TABLE SOI-1
AREAL EXTENT OF SOIL MAP UNITS FOR POWDER RIVER AND BILLINGS RMP AREAS

STATSGO Map Unit	Map Unit Name	Acres	Percent of Area
MT324	Lardell-Mckenzie-Kobar	28,542	0.15
MT327	Libeg-Leavitt-Hanson	17,866	0.09
MT336	Lihen-Delpoint-Tinsley	5,762	0.03
MT338	Lisam-Abor-Vanda	303,030	1.57
MT339	Lisam-Abor-Hesper	28,331	0.15
MT349	Lolo-Work-Shawa	39,683	0.21
MT365	Maginnis-Absarokee-Rock Outcrop	116,071	0.6
MT369	Marias-Havre-Harlem	143,781	0.74
MT374	Martinsdale-Fairfield-Reeder	7	<0.01
MT379	Marvan-Abor-Neldore	97,192	0.5
MT382	Marvan-Gerdrum-Vanda	200,503	1.04
MT383	Harlem-Vanda-Marvan	23,594	0.12
MT384	Marvan-Neldore-Bascovy	677,263	3.5
MT393	Mcrae-Harlem-Keiser	103,536	0.54
MT396	Midway-Shingle-Rock Outcrop	76,447	0.4
MT400	Mirror-Bross-Vasquez	56,548	0.29
MT407	Moyerson-Rock Outcrop-Orinoco	253,541	1.31
MT414	Neldore-Abor-Vanda	7,787	0.04
MT415	Neldore-Abor-Volborg	93,856	0.49
MT421	Cambeth-Megonot-Manning	829,387	4.29
MT433	Nunn-Toluca-Heldt	5,480	0.03
MT438	Bridger-Bynum-Owen Creek	16,109	0.08
MT456	Pinelli-Glendive-Busby	4,780	0.02
MT459	Prospect-Sublette-Teton	9,292	0.05
MT466	Reeder Family-Barvon-Mowbray	136,554	0.71
MT471	Rentsac-Cabbart-Blackhall	24,662	0.13
MT472	Yawdim-Rentsac-Lambeth	149,344	0.77
MT474	Broadus-Ridge-Cabba	42,375	0.22
MT475	Ringling-Cabba-Relan	16,537	0.09

TABLE SOI-1
AREAL EXTENT OF SOIL MAP UNITS FOR POWDER RIVER AND BILLINGS RMP AREAS

STATSGO Map Unit	Map Unit Name	Acres	Percent of Area
MT484	Rock Outcrop-Dryadine-Rubble Land	3,611	0.02
MT485	Garlet-Rock Outcrop-Cryoborolls	21,066	0.11
MT486	Rock Outcrop-Hanson-Whitecow	159,584	0.82
MT488	Rock Outcrop-Midway-Travessilla Family	236,799	1.22
MT489	Abor-Rock Outcrop-Delpoint	17,571	0.09
MT492	Rock Outcrop-Rubble Land-Cowood	127,770	0.66
MT497	Rock Outcrop-Water-Rubble Land	68,075	0.35
MT499	Romberg-Calicott-Hiland	28,655	0.15
MT500	Romberg-Naturita-Heldt	40,683	0.21
MT519	Savage-Forelle-Frazer	68,982	0.36
MT522	Savage-Work-Chama	4,497	0.02
MT532	Shadow-Garlet-Water	48,413	0.25
MT538	Skaggs-Starley-Raynesford	25	<0.01
MT547	Garlet-Stemple-Tigeron	1,244	0.01
MT550	Sweetgrass-Hilger-Fairfield	227,202	1.17
MT555	Tamaneen-Judith-Windham	53,564	0.28
MT559	Tanna-Rentsac-Yawdim	567,531	2.93
MT569	Yawdim-Thurlow-Cabbart	116,568	0.6
MT572	Tigeron-Garlet-Worock	142,349	0.74
MT575	Tinsley-Keiser-Yawdim	141,874	0.73
MT588	Work-Turner-Wayden	149,865	0.77
MT590	Twilight-Blackhall-Busby	22,004	0.11
MT594	Vananda-Gerdrum-Mckenzie	60,705	0.31
MT597	Vanstel-Cabbart-Delpoint	72,598	0.38
MT612	Wanetta-Hesper-Bitton	30,042	0.16
MT617	Wayden-Abac-Rock Outcrop	91,333	0.47
MT618	Wayden-Regent-Doney	82,113	0.42
MT619	Wayden-Eltsac-Maschetah	186,591	0.96
MT623	Whitecow-Mocmont-Hughesville	41,880	0.22

TABLE SOI-1
AREAL EXTENT OF SOIL MAP UNITS FOR POWDER RIVER AND BILLINGS RMP AREAS

STATSGO Map Unit	Map Unit Name	Acres	Percent of Area
MT659	Wormser-Lavina-Yawdim	29,616	0.15
MT661	Worock-Garlet-Rock Outcrop	3,050	0.02
MT668	Yamac-Havre-Birney	211,006	1.09
MT669	Yamac-Kobar-Marvan	22,214	0.11
MT673	Yawdim-Abor-Vananda	179,618	0.93
MT674	Cabbart-Yawdim-Delpoint	147,969	0.76
MT675	Cabbart-Yawdim-Thurlow	758,425	3.92
MT676	Yawdim-Delpoint-Thurlow	770,758	3.98
MT677	Yawdim-Delpoint-Gerdrum	82,348	0.43
MT678	Yawdim-Ethridge-Rock Outcrop	70,647	0.37
MT679	Cabbart-Yawdim-Hesper	189,351	0.98
MT680	Yawdim-Orinoco-Amherst	214,696	1.11
MT690	Welring-Clifterson-Shavano	2,718	0.01
MT691	Ulm-Maggin-Louviers	7,403	0.04
MT692	Shingle-Renohill-Ulm	36,589	0.19
MT693	Samday-Shingle-Parmleed	7,705	0.04
MT694	Orella-Epsie-Winler	26,102	0.13
MT695	Haverdad-Havre-Zigweid	14,472	0.07

Source: USDA NRSC State Soil Geographic Database 1996

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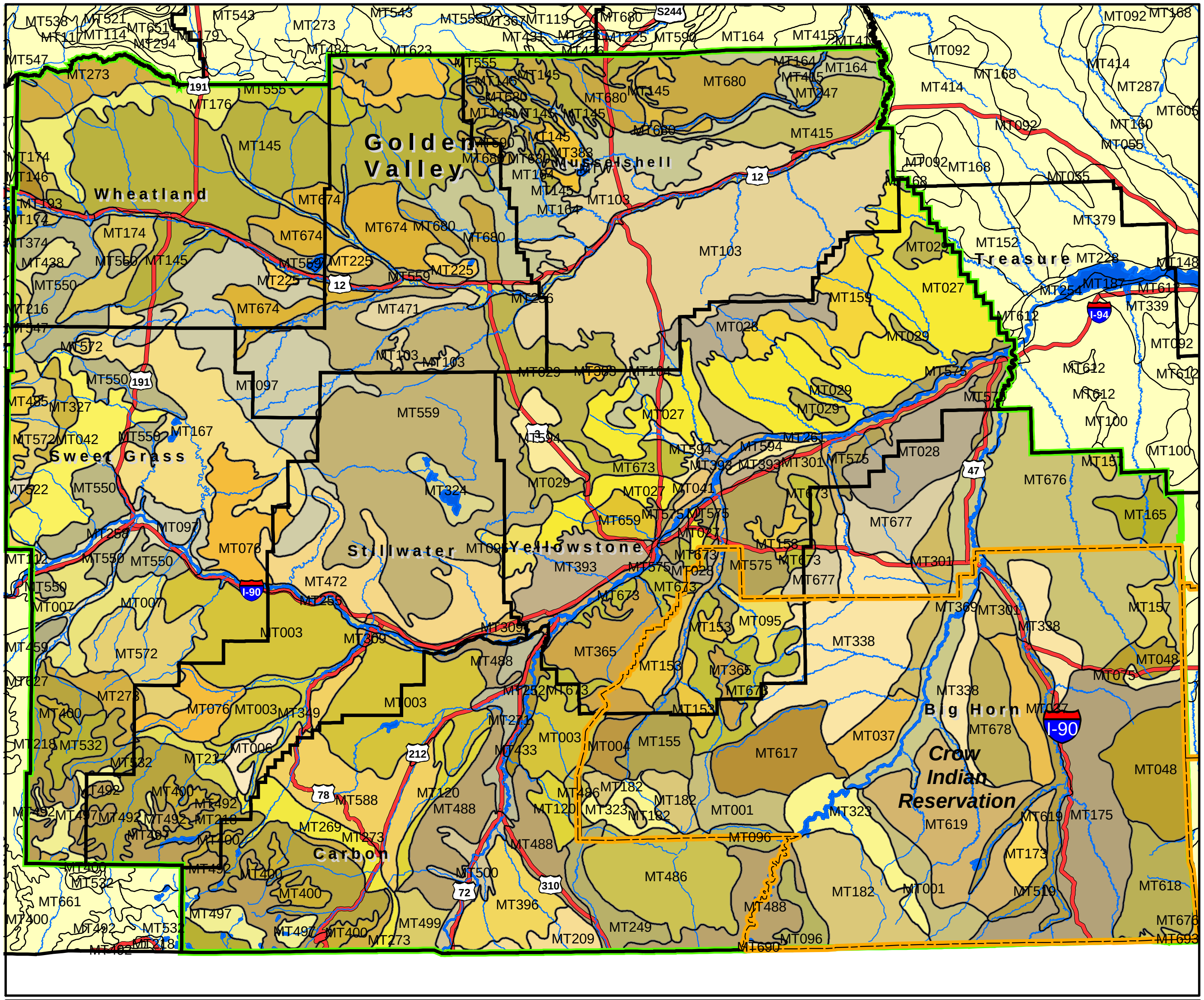


SOI-1: STATSGO Soils Types Billings RMP Area

Legend

Rivers

Highways

Billings RMP Area

Native American Reservations

Map Unit

MT001	MT176	MT472
MT003	MT182	MT484
MT004	MT193	MT485
MT006	MT209	MT486
MT007	MT213	MT488
MT027	MT216	MT492
MT028	MT217	MT497
MT029	MT218	MT499
MT037	MT225	MT500
MT041	MT247	MT519
MT042	MT249	MT522
MT048	MT252	MT532
MT075	MT255	MT538
MT076	MT256	MT547
MT092	MT258	MT550
MT095	MT261	MT555
MT096	MT269	MT559
MT097	MT271	MT572
MT100	MT273	MT575
MT103	MT301	MT588
MT112	MT309	MT590
MT113	MT323	MT594
MT114	MT324	MT617
MT120	MT327	MT618
MT145	MT338	MT619
MT146	MT349	MT623
MT152	MT365	MT659
MT153	MT369	MT661
MT155	MT374	MT673
MT157	MT383	MT674
MT159	MT393	MT676
MT164	MT396	MT677
MT165	MT400	MT678
MT167	MT415	MT680
MT168	MT433	MT690
MT173	MT438	MT693
MT174	MT459	MTW
MT175	MT471	

1:1,400,000

20 10 0 20 Miles

20,000 10,000 0 20,000 40,000 Meters

N W E S

DATA SOURCES

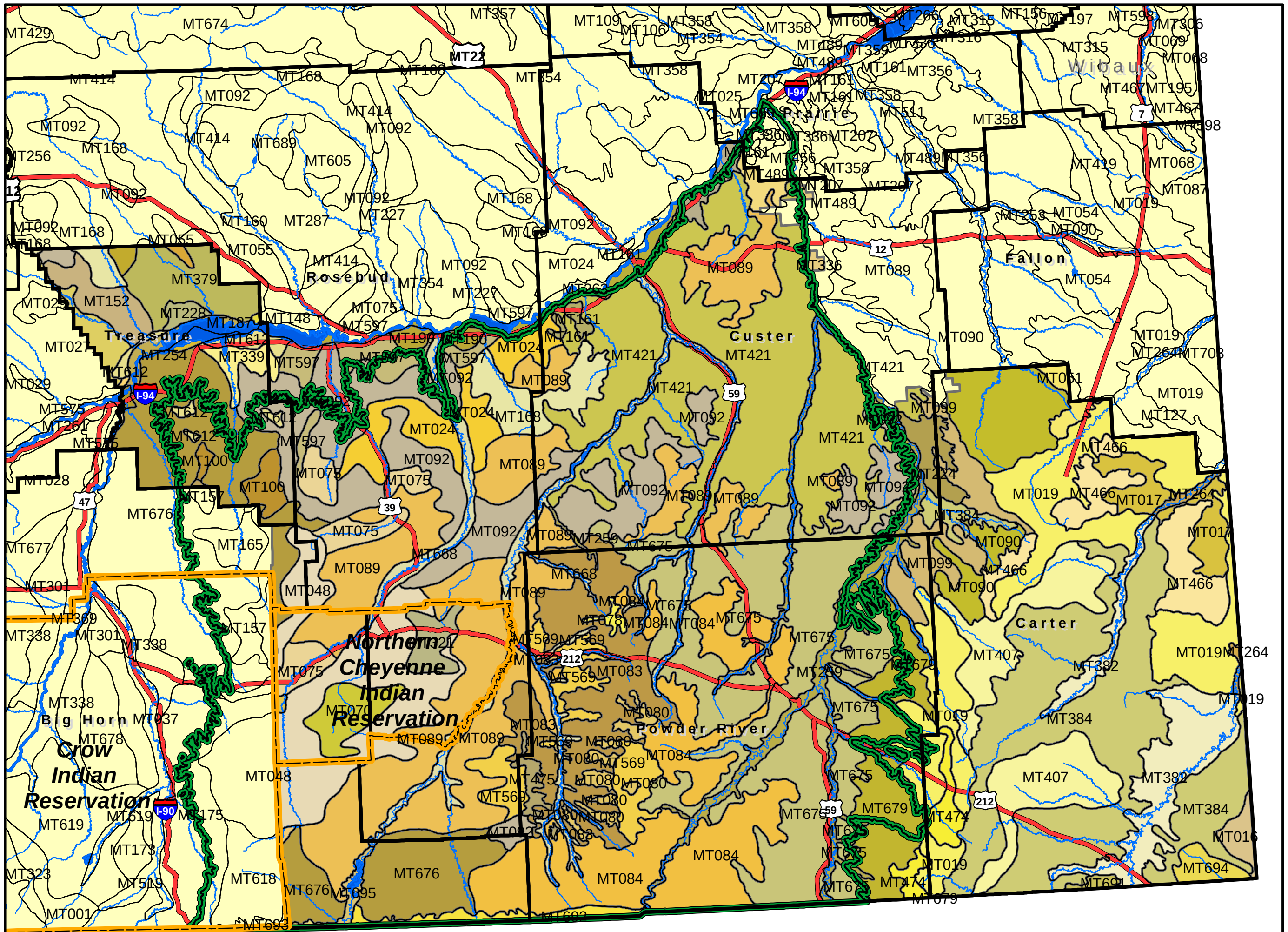
Counties: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana

Highways: 1:100,000 scale, roads, Montana State Library/NRIS, Helena, Montana.

Reservations: 1:100,000 scale, reservations, Montana State Library/NRIS, Helena, Montana.

Rivers: 1:100,000 scale, rivers, Montana State Library/NRIS, Helena, Montana.

Soils: 1:250,000 scale, USDA NRCS, STATSGO Database for Montana.



SOI-2: STATSGO Soils Types Powder River RMP Area

Legend

- Highways
- Rivers
- Powder River Geologic Basin Boundary
- Native American Reservations

Map Unit

MT016	MT152	MT421
MT017	MT157	MT456
MT019	MT161	MT466
MT024	MT168	MT474
MT027	MT175	MT475
MT029	MT187	MT489
MT048	MT190	MT569
MT051	MT224	MT575
MT054	MT228	MT597
MT055	MT254	MT612
MT070	MT259	MT618
MT075	MT261	MT668
MT078	MT263	MT669
MT080	MT264	MT675
MT083	MT321	MT676
MT084	MT336	MT679
MT089	MT339	MT691
MT090	MT369	MT692
MT092	MT379	MT693
MT099	MT382	MT694
MT100	MT384	MT695
MT127	MT407	
MT148	MT414	

N
W E
S

1:1,700,000

20 10 0 20 Miles

20,000 10,000 0 20,000 40,000 Meters

DATA SOURCES

Counties: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana
Highways: 1:100,000 scale, roads, Montana State Library/NRIS, Helena, Montana.
Reservations: 1:100,000 scale, reservations, Montana State Library/NRIS, Helena, Montana.
Rivers: 1:100,000 scale, rivers, Montana State Library/NRIS, Helena, Montana.
Soils: 1:250,000 scale, USDA NRCS, STATSGO Database for Montana.

TABLE SOI-2

SOIL SERIES CHARACTERISTICS FOR POWDER RIVER & BILLINGS RMP AREAS

STATSGO Map Unit	Major Soil Series	Surface Texture	K-factor[1]	Depth (in)	Slope (%)	Salinity[2] (mmhos/cm)	Permeability (in/hr)
MT421	Cambeth	silt loam	0.37	6	4-25		0.6-0.2
(4.3 %)	Megonot	silty clay loam	0.37	5	4-15		0.06-0.2
	Manning	loam	0.32	5	8-15		2-6
MT089	Cabbart	loam	0.37	3	15-70	0-4	0.6-0.2
(4.3 %)	Birney	channery-loam	0.2	5	25-70	0-2	0.6-0.2
	Yamac	loam	0.37	5	15-25		0.6-0.2
MT676	Yawdim	silty clay loam	0.37	3	8-35		0.2-0.6
(4.0 %)	Delpoint	loam	0.37	3	8-35	0-4	0.6-2
	Thurlow	silty clay loam	0.32	4	0-8		0.6-2
MT675	Yawdim	clay loam	0.37	3	8-70		0.2-0.6
(3.9 %)	Cabbart	silt loam	0.37	3	15-75	0-4	0.2-0.6
	Thurlow	silty clay loam	0.32	4	2-15		0.2-0.6
MT384	Marvan	silty clay	0.37	4	0-8	0-4	0.06-0.2
(3.5 %)	Neldore	clay	0.32	3	4-15	0-2	0.06-0.2
	Bascovy	clay	0.37	6	2-15	2-4	0.06-0.2
MT103	Cabbart	loam	0.37	3	6-45	0-4	0.6-2
(3.0 %)	Delpoint	loam	0.37	3	15-35	0-4	0.6-2
	Yamac	loam	0.37	5	2-8		0.6-2
MT559	Tanna	clay loam	0.37	6	2-8		0.06-0.2
(2.9 %)	Rentsac	channery-loam	0.2	7	4-15		0.6-2
	Yawdim	clay loam	0.37	3	25-60		0.2-0.6
MT092	Cabbart	loam	0.37	3	8-70	0-4	0.6-2
(2.9 %)	Delpoint	loam	0.37	3	15-25	0-4	0.6-2
	Yamac	loam	0.37	5	2-8		0.6-2
MT145	Crago	loam	0.37	4	0-4		0.6-2
(2.8%)	Musselshell	loam	0.37	3	0-2		0.6-2
	Attewan	loam	0.37	6	0-2		0.6-2

TABLE SOI-2

SOIL SERIES CHARACTERISTICS FOR POWDER RIVER & BILLINGS RMP AREAS

STATSGO Map Unit	Major Soil Series	Surface Texture	K-factor[1]	Depth (in)	Slope (%)	Salinity[2] (mmhos/cm)	Permeability (in/hr)
MT084	Cabba	silt loam	0.37	3	15-50	0-4	0.6-2
(2.6 %)	Ringling	slaty-loam	0.17	5	5-50		0.6-2
	Yawdim	clay loam	0.37	3	8-70		0.2-0.6
MT019	Assinniboine	sandy clay loam	0.32	6	2-8		0.6-2
(2.4 %)	Pring	sandy loam	0.2	10	2-8		2-6
	Archin	loam	0.43	12	2-8	0-2	0.6-2
MT027	Bainville	loam	0.37	4	2-15		0.6-2
(2.4 %)	Rock Outcrop	unweathered bedrock	0	60	25-60		0.6-2
	Mcrae	loam	0.37	5	7-15	0-2	0.6-2
MT003	Absarokee	clay loam	0.32	8	2-50	0-2	0.6-2
(2.3 %)	Castner	channery-loam	0.2	6	15-50		0.6-2
	Sinnigam	clay loam	0.37	6	2-15		0.06-0.2
MT048	Bitton	channery-loam	0.24	11	25-70	0-2	2-6
(2.2 %)	Shambo	loam	0.37	5	0-8		0.6-2
	Doney	loam	0.37	4	2-70	0-2	0.6-2
MT338	Lisam	clay	0.37	3	4-35	0-2	0.06-0.2
(1.6 %)	Abor	clay	0.37	6	4-15	0-4	0.2-0.6
	Vanda	clay	0.37	4	0-8	2-8	0.01-0.06
MT083	Cabba	silt loam	0.37	3	15-50	0-4	0.6-2
(1.6 %)	Ringling	slaty-loam	0.17	5	6-50		0.6-2
	Yawdim	clay loam	0.37	3	8-70		0.2-0.6
MT097	Cabbart	loam	0.37	3	8-35	0-4	0.6-2
(1.5 %)	Rentsac	channery-loam	0.2	7	8-35		2-6
	Delpoint	loam	0.37	3	8-15	0-4	0.6-2
MT164	Delpoint	loam	0.37	3	2-15	0-4	0.6-2
(1.4 %)	Cabbart	loam	0.37	3	2-35	0-4	0.6-2
	Yamac	Loam	0.37	5	2-15		0.6-2

TABLE SOI-2

SOIL SERIES CHARACTERISTICS FOR POWDER RIVER & BILLINGS RMP AREAS

STATSGO Map Unit	Major Soil Series	Surface Texture	K-factor[1]	Depth (in)	Slope (%)	Salinity[2] (mmhos/cm)	Permeability (in/hr)
MT218	Shadow	stony-loam	0.1	3	25-60		2-6
(1.3 %)	Macfarlane	very stony-loam	0.05	18	25-50		2-6
	Garlet	stony-loam	0.2	4	25-60		0.6-2
MT407	Moyerson	silty clay loam	0.32	4	4-50	0-4	0.06-0.2
(1.3 %)	Orinoco	silty clay loam	0.32	7	2-15		0.2-0.6
	Rock Outcrop	unweathered bedrock	0	60	0-99		0.2-0.6
MT488	Midway	silty clay loam	0.43	3	15-45	2-4	0.2-0.6
(1.2 %)	Travessilla Family	silt loam	0.32	2	15-70		0.6-2
	Rock Outcrop	unweathered bedrock	0	60	0-99		0.6-2
MT175	Doney	loam	0.37	4	8-70	0-2	0.6-2
(1.2 %)	Wayden	silty clay loam	0.37	6	8-35	0-4	0.6-2
	Shaak	clay loam	0.37	6	1-15		0.06-0.2
MT550	Sweetgrass	cobbly-clay loam	0.17	4	0-4		0.6-2
(1.2 %)	Hilger	cobbly-loam	0.2	5	2-4		0.6-2
	Fairfield	gravelly-clay	0.17	7	2-4		0.6-2
MT167	Travessilla Family	fine sandy loam	0.2	2	8-35		2-6
(1.1 %)	Delpoint	loam	0.37	3	8-15	0-4	0.6-2
	Cabbart	loam	0.37	3	8-35	0-4	0.6-2
MT680	Yawdim	silty clay	0.32	3	4-15		0.06-0.2
(1.1 %)	Orinoco	silty clay	0.28	7	4-15		0.2-0.6
	Amherst	clay loam	0.32	5	1-15		0.6-2

TABLE SOI-2

SOIL SERIES CHARACTERISTICS FOR POWDER RIVER & BILLINGS RMP AREAS

STATSGO Map Unit	Major Soil Series	Surface Texture	K-factor[1]	Depth (in)	Slope (%)	Salinity[2] (mmhos/cm)	Permeability (in/hr)
MT668	Yamac	loam	0.37	5	0-8		0.6-2
(1.1 %)	Havre	silty clay loam	0.32	8	0-2	0-2	0.2-0.6
	Birney	channery-loam	0.2	5	15-35	0-2	0.6-2

Source: USDA NRCS State Soil Geographic Database 1996

Note: Only the top 25 Map Units based on total acreage are included (percent in parenthesis). 58 percent of the soils in the study area are represented.

[1] Soil erosion factor indicates the susceptibility of a soil to sheet and rill erosion. Possible range of values is from 0.02 to 0.69, with higher values being more susceptible to erosion.

[2] Measure of the amount of soluble salts in a soil at saturation, also expressed as electrical conductivity (EC).

SOLID AND HAZARDOUS WASTE APPENDIX

SOLID AND HAZARDOUS WASTE APPENDIX

The Toxics Release Inventory (TRI) provides state reports about releases and transfers of chemicals and compounds. Each report contains overall state information regarding releases and transfers, a list of the top five chemicals released or transferred, off-site, in that state, and a list of the top ten facilities that released or transferred, off-site, the greatest amount of chemicals. All chemical and facility information was taken directly from the Envirofacts TRI database maintained by the U.S. Environmental Protection Agency (EPA).

TRI State Report Descriptions

This is a brief description of the TRI State Reports. A brief explanation of each column heading is given.

State Information

This is general TRI information relating to the state.

- Total Facilities—The total facilities reporting in that state.
- Total Forms—The total number of forms submitted. Each form has a unique Document Control Number.
- Total Forms A's—The total number of short forms submitted.
- Transfer into State—The total amount of waste chemicals (in pounds) transferred into the state.
- Transfer out of State—The total amount of waste chemicals (in pounds) transferred out of the state.
- Population—The population of a state as reported by the U.S. Census Bureau for 1990.

Reported Releases and Waste Management Activities

On-Site Releases

The amount of chemicals released as reported by facilities in that state.

- Air Emissions—Total on-site releases of a particular type in pounds where the environmental medium = 'AIR'.
- Surface Water Discharges—Total on-site releases of a particular type in pounds where the environmental medium = 'WATER'.
- Underground Injection—Total on-site releases of a particular type in pounds where the environmental medium = 'UNINJ I' or 'UNINJ IIV'.
  - Class I Wells—Total on-site releases of a particular type in pounds where the environmental medium = 'UNINJ I'.
  - Class II-V Wells—Total on-site releases of a particular type in pounds where the environmental medium = 'UNINJ IIV'.
- Releases to Land—Total on-site releases of a particular type in pounds where the environmental medium = 'RCRA C' or 'OTH LANDF'.
  - RCRA Subtitle C Landfills—Total on-site releases of a particular type in pounds where the environmental medium = 'RCRA C'.
  - Other On-Site Land Releases—Total on-site releases of a particular type in pounds where the environmental medium = 'OTH LANDF'.
- Total On-Site Releases—The sum of Air Emissions, Surfaces Water Discharges, Underground Injection, and Releases to Land.
- Transfer Off-Site to Disposal—Total off-site transfer of a particular type in pounds for disposal.

- Total On and Off-site Releases—Sum of total on-site releases and off-site transfers.

Off-Site Releases (Transfers Off-site to Disposal)

- POTW's (metals and metal compounds)—Total transfer of metals and metal compounds in pounds to POTWs as an off-site releases.
- Transfer Off-Site to Disposal—Total off-site transfer of a particular type in pounds for disposal.
- Total Off-Site Releases—Sum of total POTW's (metals and metal compounds) and off-site transfers to disposals.
- Total Releases—Sum of total on-site and off-site releases.

Source Reduction Activities

- Energy Recovery On-Site—The total amount of the toxic chemical in waste burned for energy recovery onsite, reported in section 8.2 of Form R.
- Energy Recovery Off-Site—The total amount of the toxic chemical in waste sent offsite to be burned for energy recovery, reported in section 8.3 of Form R.
- Recycling On-Site—The total amount of the toxic chemical recycled onsite, reported in section 8.4 of Form R.
- Recycling Off-Site—The total amount of the toxic chemical sent offsite for recycling, reported in section 8.5 of Form R.
- Treatment On-Site—The total amount of the toxic chemical treated onsite, reported in section 8.6 of Form R.
- Treatment Off-Site—The total amount of the toxic chemical treated offsite, reported in section 8.7 of Form R.
- Total Releases—The total amount of the toxic chemical released due to production related events by the facility to all environmental media both on and off site, reported in section 8.1 of Form R.
- Total Production Related Waste Managed—The sum of recycling, energy recovery, treatment, and total releases.

Transfers Off-Site to POTW's

- Metals and Metal Compounds—Total transfer of metals and metals compounds in pounds to POTW's as an off-site releases.
- Non-Metal TRI Chemicals—Total off-site transfer of non-metals in pounds to a POTW's as an off-site release.
- Total Transfers Off-site to POTW's—Sum of total off-site transfers of Metals and Non-Metals to POTW's.

Top Ten Chemicals for Air/Water/Land/Underground Injection Releases and the Top Ten Chemicals for Total On and Off-Site Releases

The waste chemicals that are most released into the environment for that state.

- Chemical—The name of the chemical.
- Air Emissions—Total on-site releases of a particular type in pounds where the environmental medium = 'AIR'.
- Surface Water Discharges—Total on-site releases of a particular type in pounds where the environmental medium = 'WATER'.
- Underground Injection—Total on-site releases of a particular type in pounds where the environmental medium = 'UNINJ I' or 'UNINJ IIV'.
  - Class I Wells—Total on-site releases of a particular type in pounds where the environmental medium = 'UNINJ I'.
  - Class II-V Wells—Total on-site releases of a particular type in pounds where the environmental medium = 'UNINJ IIV'.
- Releases to Lands—Total on-site releases of a particular type in pounds where the environmental medium = 'RCRA C' or 'OTH LANDF'.

  - RCRA Subtitle C Landfills—Total on-site releases of a particular type in pounds where the environmental medium = ‘RCRA C’.

  - Other On-Site Land Release—Total on-site releases of a particular type in pounds where the environmental medium = ‘OTH LANDF’.

- Total On-site Releases—The sum of Air Emissions, Surfaces Water Discharges, Underground Injection, and Releases to Land.

- Transfers Off-Site to Disposal—Total off-site transfer of a particular type in pounds for disposal.

- Total On and Off-site Releases—Sum of total on-site releases and off-site transfers.

Top Ten Facilities for Air/Water/Land/Underground Injection Releases and the Top Ten Facilities for Total On and Off-site Release

The facilities that release the most waste chemicals into the environment for that state.

- Facility—The name of the facility.

- City, County—The city name and the county name where the facility is located.

- Air Emissions—Total on-site releases in pounds by a facility where the environmental medium = ‘AIR’.

- Surface Water Discharge—Total on-site releases in pounds by a facility where the environmental medium = ‘WATER’.

- Underground Injection—Total on-site releases in pounds by a facility where the environmental medium = ‘UNINJ I’ or ‘UNINJ IIV’.

  - Class I Wells—Total on-site releases in pounds by a facility where the environmental medium = ‘UNINJ I’.

  - Class II-V Wells—Total on-site releases in pounds by a facility where the environmental medium = ‘UNINJ IIV’.

- Releases to Land—Total on-site releases in pounds by a facility where the environmental medium = ‘RCRA C’ or ‘OTH LANDF’.

  - RCRA Subtitle C Landfills—Total on-site releases in pounds by a facility where the environmental medium = ‘RCRA C’.

  - Other On-Site Land Releases—Total on-site releases in pounds by a facility where the environmental medium = ‘OTH LANDF’.

- Total On-site Releases—The sum of Air Emissions, Surfaces Water Discharges, Underground Injection, and Releases to Land by a facility.

- Transfers Off-Site to Disposal—Total off-site transfer in pounds for disposal by a facility.

- Total On and Off-site Releases—Sum of total on-site releases and off-site transfers by a facility.

1999 Toxics Release Inventory — MONTANA

Reported Releases and Waste Management Activities (in pounds)

	Original Industries	*New Industries*	*Total*
On-site Releases	48,545,330	78,582,271	127,127,601
Air Emissions	5,368,777	1,152,322	6,521,099
Surface Water Discharges	36,047	10	36,057
Underground Injection Class I Wells	0	0	0
Underground Injection Class II-V Wells	0	0	0
On-site Land Releases to RCRA Subtitle C Landfills	2,298	0	2,298
Other On-site Land Releases	43,138,208	77,429,939	120,568,147
Off-site Releases (Transfers Off-site to Disposal)*	114,245	376,802	491,047
Total On- and Off-site Releases	48,659,575	78,959,073	127,618,648
Recycled On-site	36,466,718	0	36,466,718
Recycled Off-site	180,530	33,753	214,283
Energy Recovery On-site	7,559,811	0	7,559,811
Energy Recovery Off-site	22,434	0	22,434
Treated On-site	7,916,220	2,893,460	10,809,680
Treated Off-site**	30,689	1,439	32,128
Quantity Released On- and Off-site***	49,842,158	78,950,223	128,792,381
Total Production-related Waste Managed	102,018,560	81,878,875	183,897,435
Total Non-production-related Waste Managed	6,898	17	6,915

Transfers Off-site for Further Waste Management/Disposal

	Original Industries	*New Industries*	*Total*
Recycling	232,658	6,753	239,411
Energy Recovery	23,611	0	23,611
Treatment	23,412	1,689	25,101
Publicly Owned Treatment Works (POTWs)	11,285	0	11,285
Metals and Metal Compounds*	10	0	10
Non-metal TRI Chemicals**	11,275	0	11,275
Other Off-site Transfers****	0	0	0
Off-site Transfers to Disposal *(not including metals to POTWs)*	1,368,210	376,802	1,745,012
Total Transfers Off-site for Further Waste Management/Disposal	1,659,176	385,244	2,044,420

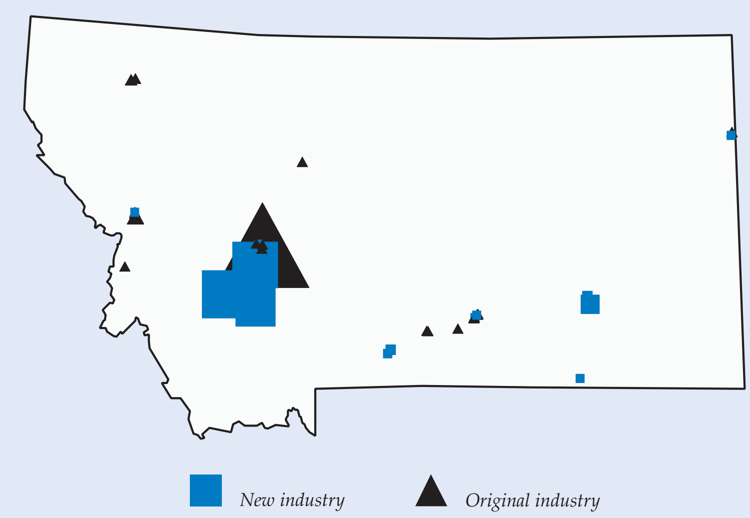
* Transfers to POTWs of metals and metal compounds are included in off-site releases. Excludes transfer amounts sent for disposal to other TRI facilities reporting that amount released on-site.
** Transfers to POTWs of non-metals are included in treated off-site waste management activity.
*** Excludes non-production-related releases; e.g. releases due to catastrophic events or remedial actions.
**** Transfers reported without a valid waste management code.

For More Information . . .

State Contact:
Tom Ellerhoff
(406) 444-5263
Fax: (406) 444-4386
E-mail: tellerhoff@state.mt.us

EPA Regional Contact:
Joyel Dhieux
(303) 312-6447
Fax: (303) 312-6044
E-mail: dhieux.joyel@epa.gov

To obtain TRI data use assistance, call TRI User Support Service (TRI-US):
(202) 260-1531
Fax: (202) 401-2347



The largest marker in the state map represents the largest facility for on-site releases in the state of Montana. All markers are proportionally-sized to represent the on-site releases at each facility within this state.

State/TRI Data

Population	882,779
Square Miles	145,556
Total Facilities	42
Total Forms	253
Form As	31

	Original Industries	*New Industries*	*Total*
National Rank for Total On- and Off-site Releases*			
Rank	19	9	18
Pounds	48,659,575	78,959,073	127,618,648
National Rank for Total On-site Releases**			
Rank	17	9	16
Pounds	48,545,330	78,582,271	127,127,601
National Rank for Total Releases within State***			
Rank	20	9	18
Pounds	48,552,624	78,959,071	127,511,695
National Rank for Production-related Waste Managed			
Rank	34	19	34
Pounds	102,018,560	81,878,875	183,897,435

* Includes transfers out-of-state for disposal. Excludes transfer amounts sent for disposal to other TRI facilities reporting that amount released on-site.
** Includes amounts released at the facility. Excludes amounts transferred to other sites.
*** Excludes transfers for disposal sent out-of-state or sent to other TRI facilities within the state reporting that amount released on-site.

1999 Toxics Release Inventory MONTANA

On-site and Off-site Releases for Top Ten Chemicals Ranked on Total Releases in the State (Original Industries)

		On-site Releases				Off-site Releases		Off-site Transfers to Disposal		
CAS Number	Chemical	Air Emissions Pounds	Surface Water Discharges Pounds	Underground Injection Pounds	On-site Releases to Land Pounds	Transfers Off-site to Disposal* Pounds	Total Releases in the State** Pounds	Transferred Into State Pounds	Transferred Within State Pounds	Transferred Out of State Pounds
--	Zinc compounds	10,562	43	0	35,577,360	345,316	35,933,281	0	5	345,311
--	Lead compounds	16,454	1	0	2,554,272	580,236	3,150,963	0	0	580,236
67-56-1	Methanol	3,088,962	16,000	0	270	0	3,105,232	0	0	0
--	Manganese compounds	786	3	0	2,976,183	10,839	2,987,811	0	0	10,839
--	Copper compounds	8,519	7	0	1,444,304	15,697	1,468,527	0	5	15,692
7664-41-7	Ammonia	781,138	13,430	0	14,105	436	809,109	0	0	436
50-00-0	Formaldehyde	465,261	2,800	0	0	0	468,061	0	0	0
--	Cadmium compounds	1,241	1	0	11,403	359,346	371,991	0	0	359,346
--	Arsenic compounds	2,788	63	0	281,882	34,971	319,704	0	0	34,971
7664-39-3	Hydrogen fluoride	228,730	0	0	0	0	228,730	0	0	0

* Excludes amounts transferred to other TRI facilities in the state reporting that amount released on-site.
** The chemical ranking is based on the amounts in this column.

On-site and Off-site Releases for Top Ten Chemicals Ranked on Total Releases in the State (Seven New Industries)

		On-site Releases				Off-site Releases		Off-site Transfers to Disposal		
CAS Number	Chemical	Air Emissions Pounds	Surface Water Discharges Pounds	Underground Injection Pounds	On-site Releases to Land Pounds	Transfers Off-site to Disposal* Pounds	Total Releases in the State** Pounds	Transferred Into State Pounds	Transferred Within State Pounds	Transferred Out of State Pounds
--	Zinc compounds	4,904	0	0	21,405,495	3,900	21,414,299	0	3,900	0
--	Copper compounds	2,687	0	0	15,177,982	3,900	15,184,569	0	3,900	0
7440-50-8	Copper	1,213	0	0	11,103,779	0	11,104,992	0	0	0
--	Lead compounds	1,260	0	0	10,749,000	1,601	10,751,861	0	1,600	1
7440-47-3	Chromium	581	0	0	7,461,120	0	7,461,701	0	0	0
--	Barium compounds	109,987	5	0	3,995,701	145,600	4,251,293	0	145,600	0
7440-02-0	Nickel	810	0	0	2,280,350	0	2,281,160	0	0	0
--	Manganese compounds	10,898	5	0	1,734,026	67,700	1,812,629	0	67,700	0
--	Arsenic compounds	500	0	0	1,530,000	1,250	1,531,750	0	1,250	0
7647-01-0	Hydrochloric acid	579,916	0	0	0	0	579,916	0	0	0

* Excludes amounts transferred to other TRI facilities in the state reporting that amount released on-site.
** The chemical ranking is based on the amounts in this column.

1999 Toxics Release Inventory MONTANA

On- and Off-site Releases for Top Ten Facilities Ranked on Total On-site Releases in the State (Original Industries)

Facility, City, County	On-site Releases: Air Emissions (Pounds)	Surface Water Discharges (Pounds)	Underground Injection: Class I Wells (Pounds)	Underground Injection: Class II-V Wells (Pounds)	On-site Releases to Land: RCRA Subtitle C Landfills (Pounds)	On-site Releases to Land: Other On-site Land Releases (Pounds)	Total On-site Releases* (Pounds)	Off-site Releases (Transfers Off-site to Disposal): Transferred Within State (Pounds)	Transferred Out of State (Pounds)
ASARCO Inc., East Helena, Lewis and Clark	50,525	1,660	0	0	0	43,058,183	43,110,368	0	1,350,974
Stone Container Corp., Missoula, Missoula	3,298,705	24,400	0	0	0	285	3,323,390	0	0
Plum Creek MDF Inc., Columbia Falls, Flathead	741,550	0	0	0	0	0	741,550	0	0
Columbia Falls Aluminum Co. L.L.C., Columbia Falls, Flathead	300,197	0	0	0	0	81	300,278	0	0
Holly Sugar Corp., Sidney, Richland	239,000	0	0	0	0	10,000	249,000	0	0
Louisiana-Pacific Corp. Missoula Particleboard, Missoula, Missoula	166,000	0	0	0	0	0	166,000	0	0
Conoco Inc. Billings Refy., Billings, Yellowstone	129,508	616	0	0	0	0	130,124	0	0
Western Sugar Co.130130, Billings, Yellowstone	64,000	3,400	0	0	0	42,100	109,500	0	0
ExxonMobil Billings Refy., Billings, Yellowstone	100,867	5,686	0	0	0	9	106,562	44	4,013
Montana Refining Co., Great Falls, Cascade	75,755	0	0	0	0	0	75,755	0	0

*The facility ranking is based on the amounts in this column; these quantities exclude transfers out of state.

On- and Off-site Releases for Top Ten Facilities Ranked on Total On-site Releases in the State (Seven New Industries)

Facility, City, County	On-site Releases: Air Emissions (Pounds)	Surface Water Discharges (Pounds)	Underground Injection: Class I Wells (Pounds)	Underground Injection: Class II-V Wells (Pounds)	On-site Releases to Land: RCRA Subtitle C Landfills (Pounds)	On-site Releases to Land: Other On-site Land Releases (Pounds)	Total On-site Releases* (Pounds)	Off-site Releases (Transfers Off-site to Disposal): Transferred Within State (Pounds)	Transferred Out of State (Pounds)
Montana Resources, Butte, Silver Bow	1,000	0	0	0	0	25,082,000	25,083,000	0	0
Montana Tunnels Mining Inc., Jefferson City, Jefferson	28,014	0	0	0	0	24,082,370	24,110,384	0	0
Golden Sunlight Mines Inc., Whitehall, Jefferson	111,632	0	0	0	0	20,376,450	20,488,082	0	0
PP&L Montana Colstrip Steam Electric Station, Colstrip, Rosebud	285,185	0	0	0	0	6,293,900	6,579,085	156,500	2
SMC Nye Mine Site, Nye, Stillwater	1,101	0	0	0	0	963,225	964,326	0	0
Colstrip Energy L.P. Rosebud Power Plant, Colstrip, Rosebud	613,223	0	0	0	0	344,454	957,677	0	0
SMC East Boulder Project, Mc Leod, Sweet Grass	0	0	0	0	0	249,523	249,523	0	0
J.E. Corette Steam Electric Station, Billings, Yellowstone	62,350	10	0	0	0	0	62,360	80,000	0
Lewis & Clark Station, Sidney, Richland	25,196	0	0	0	0	25,800	50,996	140,300	0
Conoco Helena Product Terminal, Helena, Lewis and Clark	13,109	0	0	0	0	0	13,109	0	0

*The facility ranking is based on the amounts in this column; these quantities exclude transfers out of state.

Total Production-related Waste for Top Ten Facilities Ranked on Quantity Released On- and Off-site (Original Industries)

Facility, City, County	Recycled On-site Pounds	Recycled Off-site Pounds	Energy Recovery On-site Pounds	Energy Recovery Off-site Pounds	Treated On-site Pounds	Treated Off-site Pounds	Quantity Released On- and Off-site* Pounds	Total Production-related Waste Managed Pounds	Total Non-production-related Waste Managed Pounds
ASARCO Inc., East Helena, Lewis and Clark	28,916,883	0	0	0	0	0	44,454,865	73,371,748	6,467
Stone Container Corp., Missoula, Missoula	0	0	7,084,400	0	4,153,500	0	3,305,754	14,543,654	0
Plum Creek MDF Inc., Columbia Falls, Flathead	0	0	0	0	0	0	740,300	740,300	0
Columbia Falls Aluminum Co. L.L.C., Columbia Falls, Flathead	6,342,848	0	0	0	0	0	300,278	6,643,126	0
Holly Sugar Corp., Sidney, Richland	0	0	0	0	0	0	249,000	249,000	0
Louisiana-Pacific Corp. Missoula Particleboard, Missoula, Missoula	0	0	0	3,700	0	0	166,000	169,700	0
Conoco Inc. Billings Refy., Billings, Yellowstone	0	26,923	0	24	68,890	4	118,990	214,831	0
ExxonMobil Billings Refy., Billings, Yellowstone	0	12,000	250,000	0	2,298,877	209	110,812	2,671,898	6
Western Sugar Co.130130, Billings, Yellowstone	0	0	0	0	4,000	0	105,000	109,000	0
Montana Refining Co., Great Falls, Cascade	216,100	0	0	0	0	11,079	76,440	303,619	0

*The facility ranking is based on the amounts in this column; these quantities exclude non-production-related releases.

Total Production-related Waste for Top Ten Facilities Ranked on Quantity Released On- and Off-site (Seven New Industries)

Facility, City, County	Recycled On-site Pounds	Recycled Off-site Pounds	Energy Recovery On-site Pounds	Energy Recovery Off-site Pounds	Treated On-site Pounds	Treated Off-site Pounds	Quantity Released On- and Off-site* Pounds	Total Production-related Waste Managed Pounds	Total Non-production-related Waste Managed Pounds
Montana Resources, Butte, Silver Bow	0	0	0	0	0	0	25,066,200	25,066,200	0
Montana Tunnels Mining Inc., Jefferson City, Jefferson	0	27,000	0	0	0	0	24,110,370	24,137,370	7
Golden Sunlight Mines Inc., Whitehall, Jefferson	0	0	0	0	0	0	20,424,110	20,424,110	5
PP&L Montana Colstrip Steam Electric Station, Colstrip, Rosebud	0	0	0	0	2,500,000	0	6,831,112	9,331,112	0
Colstrip Energy L.P. Rosebud Power Plant, Colstrip, Rosebud	0	0	0	0	0	0	957,677	957,677	0
SMC Nye Mine Site, Nye, Stillwater	0	0	0	0	20,460	0	943,866	964,326	0
SMC East Boulder Project, Mc Leod, Sweet Grass	0	0	0	0	0	0	249,523	249,523	0
Lewis & Clark Station, Sidney, Richland	0	0	0	0	238,000	0	191,040	429,040	4
J.E. Corette Steam Electric Station, Billings, Yellowstone	0	0	0	0	135,000	0	142,000	277,000	0
Decker Coal Co., Decker, Big Horn	0	6,753	0	0	0	0	12,217	18,970	1

*The facility ranking is based on the amounts in this column; these quantities exclude non-production-related releases.

VEGETATION APPENDIX

Habitat Types and Biological Diversity

The land classification system developed by the University of Montana, Montana Gap Analysis Project (MT-GAP), was used to estimate acreages listed for this Appendix (Fisher et al. 1998).

Grasslands

Grasslands cover approximately 10.4 million acres of the 16-county planning area. Of this acreage, 3.5 million acres are underlain by subbituminous or bituminous coal deposits. Grasslands are divided into five types (see Table VEG-1). Species richness data for these types are provided.

Altered herbaceous habitats include grasslands with 30 percent or more cover from introduced species and/or noxious weed species such as thistle (*Cirsium* spp.), cheat grass (*Bromus tectorum*), Japanese brome (*B. japonicus*), spotted knapweed (*Centaurea maculosa*), crested wheatgrass (*Agropyron cristatum*) or yellow sweetclover (*Melilotus officinalis*). Total herbaceous cover ranges from 20 to 80 percent on these sites, which are usually associated with disturbance and can have bare ground coverages in the 10 to 50 percent range (Fisher et al. 1998).

Very Low Cover Grasslands are semi-desert grasslands with total grass cover of 10 to 30 percent. They are dominated by short grasses and forbs such as blue grama (*Bouteloua gracilis*). These grasslands typically have a high amount of bare soil (20 to 60 percent) (Fisher et al. 1998).

Low to Moderate Cover Grasslands are the most abundant grassland type in Montana. They are the category that has the greatest potential for impact from CBM extraction (see Table VEG-1). Total grass coverages on these sites range from 20 to 70 percent and are dominated by short- to medium-height grasses and forbs, such as blue grama, green needlegrass (*Stipa viridula*), Idaho fescue (*Festuca idahoensis*), lupine (*Lupinus* spp.), arrowleaf balsamroot (*Balsamorhiza sagittata*), and bluebunch wheatgrass (*Agropyron spicatum*) (Fisher et al. 1998).

Moderate to High Cover Grasslands are dominated by medium to tall grass species, such as bluebunch wheatgrass, green needlegrass, big bluestem (*Andropogon gerardii*), switchgrass (*Panicum virgatum*), little bluestem (*Andropogon scoparium*), and needle and thread (*Stipa comata*). Grass coverage on these grasslands ranges from 50 to 100 percent (Fisher et al. 1998).

Montane Parklands and Subalpine Meadows are the final type of grasslands classification for Montana lands. Total herbaceous cover in these moist locations can range from 30 to 100 percent and are dominated by species such as beargrass (*Xerophyllum tenax*), several species of sedge (*Carex* spp.), pinegrass *(Calamagrostis rubescens*), arnica (*Arnica* spp.), and subalpine daisy (*Erigeron peregrinus*) (Fisher et al. 1998).

Shrublands

Of the 5 million acres designated as shrubland in the planning area, approximately 1.8 million acres are underlain by bituminous coal deposits. Shrublands in Montana are divided into seven categories: Mixed Mesic Shrubs, Mixed Xeric Shrubs, Silver Sage, Salt-Desert Shrubs, Mesic-Grassland Shrubs, Xeric-Grassland Shrubs, and Sagebrush (see Table VEG-2).

Mixed Mesic Shrub sites are characterized by 20 to 100 percent shrub cover. Dominant shrubs on these sites are alder (*Alnus* spp.), ceanothus (*Ceanothus* spp), huckleberry (*Vaccinium* spp.), ninebark (*Physocarpus malvaceus*), snowberry (*Symphoricarpos* spp.), and western serviceberry (*Amelanchier alnifolia*).

Mixed Xeric Shrub sites are characterized by shrub cover ranging from 20 to 50 percent. Dominant shrubs for this type are bitterbrush (*Purshia tridentata*), creeping juniper (*Juniperus horizontalis*), greasewood (*Sarcobatus* spp.), mountain mahogany (*Cercocarpus* spp.), and rabbitbrush (*Chrysothamnus* spp.). Associated grass species cover from 5 to 40 percent of these sites and are predominantly bluebunch wheatgrass, blue grama, Idaho fescue, and western wheatgrass (*Agropyron smithii*).

Silver Sage sites are dominated by silver sage (*Artemisia cana*). This alkali-tolerant species is most abundant in the northeastern part of Montana on moist sites near riparian areas.

Salt-Desert Shrub and Dry Salt Flat sites are dominated by Saltsage (*Atriplex nuttallii*) at 10 to 40 percent cover. These sites are usually underlain by alkali-affected soils in dry, sandy, or saline-seep areas. Species associated with these sites are blue grama, Sandberg's bluegrass (*Poa secunda*), and threadleaf sedge (*Carex filifolia*). It occurs mainly in eastern and southeastern Montana.

Mesic Shrub-Grassland Associations are shrublands with co-dominance between shrubs and grasses that together cover 10 to 50 percent of the site. These are moist, ecotonal areas between shrub-dominated and grass-dominated sites. The grass and shrub species are those found in the respective classes that make up the association.

Xeric Shrub-Grassland Associations are shrublands with a co-dominance of xeric shrubs and grass species in the ecotone between grass- and xeric shrub-dominated sites with the same dominant species as those types. Cover of both shrubs and grasses on these sites range from 10 to 50 percent.

Sagebrush shrubland sites are dominated by big sagebrush (*Artemisia tridentata* spp. *tridentata*, *vaseyana*, and *wyomingensis*) and black sagebrush (*Artemisia nova*) at 20 to 80 percent cover. These are associated with the same grass species listed under the Mixed Xeric Shrub habitat type. Sagebrush shrublands are particularly characteristic of the counties that make up the Billings RMP area where more than 40 percent (910,000 acres) of shrublands fall within this category (Fisher et al. 1998).

Forests

Of the 4.5 million acres classified as forest in the planning area, almost 1.4 million acres are underlain by bituminous coal deposits. The acreages underlain with subbituminous or bituminous coal within each forest type in the 16 counties affected by this project are given in Table VEG-3.

Riparian Areas

Table VEG-4 gives the breakdown by type for riparian areas in the project area that are underlain by coal beds. The types with the most acreage are in the Graminoid and Forb and the Shrub categories.

Graminoid and Forb Riparian areas are characterized by herbaceous species at 30 to 100 percent cover and less than 15 percent cover of shrubs and trees. Standing water may be present in areas with cattail marshes. Plant species associated with this type are sedges (*Carex* spp.), cattails (*Typha* spp.), reedgrass (*Calamagrostis* spp.), rushes (*Juncus* spp.), saxifrage (*Saxifraga* spp.), and tufted hairgrass (*Deschampsia caespitosa*).

Shrub Riparian sites are dominated by shrub cover at 20 to 100 percent and tree cover at less than 15 percent. Standing water may be present in willow marshes in this category. Shrub species potentially present on shrub-dominated sites include alder (*Alnus* spp.), black hawthorn (*Crataegus douglasii*), birch (*Betula* spp.), currant (*Ribes* spp.), red-osier dogwood (*Cornus stolonifera*), rose (*Rosa* spp.), shrubby cinquefoil (*Potentilla fruticosa*), snowberry (*Symphoricarpos* spp.), thimbleberry (*Rubus parviflorum*), twinberry (*Lonicera involucrata*), Utah honeysuckle (*Lonicera utahensis*), and willows (*Salix* spp.) (Fisher et al. 1998).

Barren Lands

Table VEG-5 shows that some of the classifications, such as Badlands and Missouri Breaks, have a significant number of species associated with them.

TABLE VEG-1
GRASSLAND TYPES AND ASSOCIATED WILDLIFE DIVERSITY

Grassland Types	Total Acres In Project Area With Underlying Bituminous Coal Beds	Distribution	Species Richness*
Altered Herbaceous Habitats	87,365	Found throughout Montana, but most concentrated in the northeastern part of the state.	66
Very Low Cover Grasslands	35,4315	Associated with alkaline soils or with disturbance.	68
Low to Moderate Cover Grasslands	2,864,901	Occurs across the state in valleys and foothills and on south aspects in the mountains.	78
Moderate to High Cover Grasslands	228,341	Associated with wet sites primarily in the valleys of central and eastern Montana.	72
Montane Parklands and Subalpine Meadows	13,563	Found at mid- to upper elevations either within forests or above timberline.	62

*Mean number of native terrestrial vertebrates species predicted by habitat type (Fisher et al. 1998). Species richness estimates are simple species counts and not intended to imply that areas with fewer species are not as important as areas with larger numbers of species.

TABLE VEG-2
SHRUBLAND TYPES AND ASSOCIATED DISTRIBUTION AND SPECIES RICHNESS

Shrubland Types	Total Acres in Project Area Underlain by Bituminous Coal Beds	Distribution	Species Richness*
Mixed Mesic Shrub	186,229	Found in western Montana and in draws or north slopes in eastern Montana	63
Mixed Xeric Shrub	733,617	Occur on dry rocky sites in valleys and low elevation mountain slopes.	75
Silver Sage	7,900	Primarily found in northeastern Montana on moist sites near riparian areas.	61
Salt-Desert Shrub and Dry Salt Flat	22,226	Usually associated with alkaline sites or blowouts in dry, sandy, or saline-seep areas in eastern Montana.	29
Sagebrush	581,160	Occur across the state in valleys and low- to mid-elevational mountain slopes.	74
Mesic Shrub-Grassland Associations	120,950	Found in central and eastern Montana valleys and some low mountain slope areas in moist ecotonal areas between shrub-dominated and grass-dominated sites.	75
Xeric Shrub-Grassland Associations	155,091	Occur primarily in eastern and central Montana valleys and some low mountain slopes on dry sites in valleys, in the ecotone between grass and xeric shrub dominated sites.	85

*Mean number of native terrestrial vertebrates species predicted by habitat type for Montana (Fisher et al. 1998).

TABLE VEG-3
FOREST TYPES IN THE PROJECT AREA UNDERLAIN BY COAL BEDS

Forest Type	Total Acres in Project Area Underlain by Bituminous Coal Deposits	Distribution	Species Richness*
Douglas-fir (*Pseudotsuga menziesii)*	23,985	Occurs across the state, except for the northeastern corner, but primarily found in western and south-central Montana.	77
Douglas-fir with Lodgepole Pine	2,446	Occurs in western and south-central Montana on mid-upper elevational slopes.	72
Limber Pine *(Pinus flexilis)*	5,170	Dry forest sites at lower elevations in central Montana and at higher elevations on limestone soils in central and eastern Montana.	53
Lodgepole Pine *(Pinus contorta)*	3,791	Occurs primarily in western and south-central Montana in mountainous regions at cooler, mid-high elevations.	65
Low Density Xeric Forest	304,760	Occurs primarily in eastern Montana on low hills on the edge of grasslands.	83
Mixed Broadleaf & Conifer Forest	28,179	Occurs across the state, primarily in moist forest areas, near riparian areas or in woody draws.	82
Mixed Subalpine Forest	71,368	Occurs at mid-high elevations in western and south-central Montana, usually on north, east, and northwest aspects.	67
Mixed Whitebark Pine Forest	218	Occurs in high elevation forest stands at or near tree line in western and south-central Montana.	39
Mixed Xeric Forest	34,382	Occurs at low-mid elevations on dry forest sites in western Montana.	76
Ponderosa Pine	857,864	Occurs across the state, except in northeastern Montana at lower elevations on dry forest sites.	79
Rocky Mountain Juniper *(Juniperus scopulorum)*	18,547	Occurs primarily in central and eastern Montana on dry forest sites.	58
Standing Burnt Forest	2,008	Occurs across the state in forested areas and includes only stands that have burned in the 5 years prior to 1998.	63
Utah Juniper *(Juniperus osteosperma)*	4,990	Occurs primarily in central and eastern Montana on dry forest sites, particularly in Carbon County.	70

*Mean number of native terrestrial vertebrate species predicted by habitat type (Fisher et al. 1998).

TABLE VEG-4
RIPARIAN AREAS IN THE PROJECT AREA UNDERLAIN BY COAL BEDS

Riparian Types	Total Acres in Project Area Underlain by Bituminous Coal Deposits	Distribution	Species Richness*
Conifer	1,205	Occurs in riparian areas in western and south-central Montana.	114
Broadleaf	44,324	Occurs in riparian areas across Montana.	123
Mixed Broadleaf & Conifer	6,789	Occurs in riparian areas of western and south-central Montana.	134
Graminoid & Forb	191,165	Occurs across the state.	72
Mixed Riparian	35,204	Occurs across the state	104
Shrub	99,671	Occurs across the state.	110

*Mean number of native terrestrial vertebrate species predicted by habitat type (Fisher et al. 1998).

TABLE VEG-5
BARREN LANDS

Barren Lands	Total Acres in Project Area Underlain by Bituminous Coal Deposits	Distribution	Species Richness*
Badlands	244,658	Occurs primarily in central and eastern Montana on sites where bare soil or rock are the dominant cover. Patches of grass or shrubs total less than 10 percent cover. Tree canopy is less than 10 percent on treed sites.	48
Mines, Quarries, Gravel Pits	15,248	Occurs across Montana and are as named.	13
Missouri Breaks	15,272	Occurs between Fort Benton in the west and Fort Peck in the east and parallels the Missouri River.	54
Mixed Barren Sites	50,489	Occurs across the state where live vegetation provides less than 10 percent cover.	17
Rock	26,982	Exposed rock, cliffs, talus slopes, or scree fields across the state.	14

*Mean number of native terrestrial vertebrate species predicted by habitat type (Fisher et al. 1998).

TABLE VEG-6
STATE OF MONTANA CRITICALLY IMPERILED PLANT SPECIES WITH POTENTIAL HABITAT IN THE 16-COUNTY AREA

Common Name (Scientific Name)	Habitat
Dwarf onion (*Allium simillimum*)	Moist, often gravelly soil of meadows and grasslands in the montane or lower subalpine zone.
Daggett rock cress (*Arabis demissa var languida*)	Canyon bottoms and outwash plains with dry, stony soils derived from limestone in juniper woodland.
Swamp milkweed (*Asclepias incarnata*)	Wet meadows and thickets.
Ovalleaf milkweed (*Asclepias ovalifolia*)	Open pine woodland in seasonally moist meadow in southeastern Montana.
Narrowleaf milkweed (*Asclepias stenophylla*)	Sandy soils of prairies and open pine woodland in southeastern Montana.
Barr's milkvetch *(Astragalus barrii)*	Gullied knolls, buttes, and barren hilltops, usually on calcareous soft shale or siltstone.
Wind River vetch (*Astragalus oreganus*)	Sandy or clayey soil in desert shrublands and sagebrush grassland in the valley zone in south-central Montana.
Wedge-leaved saltbush (*Atriplex truncata*)	Vernally moist, alkaline soil around ponds and along streams in the valleys.
Large-leafed balsamroot (*Balsamorhiza macrophylla*)	Sagebrush and grasslands in the montane zone.
Small camissonia (*Camissonia parvula*)	Sandy calcareous soils of sagebrush steppe and juniper woodlands in the valleys.
Pregnant sedge (*Carex gravida var. gravida*)	Open woods, often in ravines with deciduous trees, on the plains of southeastern Montana.
Many-ribbed sedge (*Carex multicostata*)	Grasslands and meadows in the montane and subalpine zones.
Toothed Scandinavian sedge (*Carex norvegica* ssp. *inserrulata*)	Moist alpine turf.
Birchleaf mountain-mahogany (*Cercocarpus montanus* var. *glaber*)	Open slopes and breaks on the plains of eastern Montana.
Smooth goosefoot (*Chenopodium subglabrum*)	Sparsely vegetated sand dunes and sandy terraces of major rivers on the plains of eastern Montana.
Yellow bee plant (*Cleome lutea*)	Open, often-sandy soil of sagebrush steppe in the valleys.
Miner's Candle (*Cryptantha scoparia*)	Sandy soil of sagebrush steppe in the valleys.

TABLE VEG-6
STATE OF MONTANA CRITICALLY IMPERILED PLANT SPECIES WITH POTENTIAL HABITAT IN THE 16-COUNTY AREA

Common Name (Scientific Name)	Habitat
Nine-anther dalea (*Dalea enneandra*)	Gravelly grasslands slopes on the plains of eastern Montana.
Silky prairie clover (*Dalea villosa* var. *villosa*)	Loose sand of sand dunes or eroded from sandstone outcrops in eastern Montana.
Scribner's panic grass (*Dichanthelium oligosanthes* var. *scribnerianum*)	Open ponderosa pine woodlands of valleys and plains.
White Arctic draba (*Draba fladnizensis*)	Rocky, open soil in the alpine zone.
Porsild's draba (*Draba porsildii*)	Moist, gravelly open soils in the alpine zone.
Entire-leaved avens (*Dryas integrifolia*)	Stony, limestone-derived soil of exposed ridges and plateaus in the alpine zone.
Eaton's daisy (*Erigeron eatonii* ssp. *eatonii*)	Open areas in mountains and foothills.
Beautiful fleabane (*Erigeron formosissimus* var. *viscidus*)	Meadows and forest openings in the montane and subalpine zones.
Smooth buckwheat (*Eriogonum salsuginosum*)	Barren, often bentonitic soil of badlands in the valleys.
Visher's buckwheat (*Eriogonum visheri*)	Barren, often bentonitic badlands slopes and outwashes in the plains.
Sheared cotton-grass (*Eriophorum calllitrix*)	Wet, organic soil of fens and seep areas in alpine tundra.
Hiker's gentian (*Gentianopsis simplex*)	Fens, meadows, and seeps, usually in areas of crystalline parent material, in the montane and subalpine zones.
Discoid goldenweed (*Haplopappus macronema* var. *macronema*)	Rocky, open or sparsely wooded slopes, often in coarse talus, in or near the alpine zone.
Hutchinsia (*Hutchinsia procumbens*)	Vernally moist, alkaline soil of sagebrush steppe in the valley to lower montane zones.
Large-fruited kobresia (*Kobresia macrocarpa*)	Moist tundra, solifluction* slopes, and gravelly lake shores in the alpine zone.
Island koenigia (*Koenigia islandica*)	Wet, open, gravelly soil in seepage areas in the alpine zone.
Lesica's bladderpod (*Lesquerella lesicii*)	Gravelly, limestone-derived soil of open ridges and slopes among Douglas-fir and mountain mahogany woodlands in the montane zone.
Nuttall's desert parsley (*Lomatium nuttallii*)	Dry, rocky slopes of open pine woodland in the plains.

TABLE VEG-6
STATE OF MONTANA CRITICALLY IMPERILED PLANT SPECIES WITH POTENTIAL HABITAT IN THE 16-COUNTY AREA

Common Name (Scientific Name)	Habitat
Desert dandelion (*Malacothrix torreyi*)	Dry, sandy sagebrush steppe in the valley and foothill zones.
Beardless mentzelia (*Mentzelia nuda*)	Sandy or gravelly soil of open hills and roadsides on the plains of eastern Montana
Dwarf purple monkeyflower (*Mimulus nanus*)	Dry, open, often gravelly or sandy slopes in the valleys and foothills.
Nama (*Nama densum*)	Sandy soil of sagebrush desert in the valleys.
Blue toadflax (*Nuttallanthus texanus*)	Open, sandy or acid shale soils of grasslands and woodlands on the plains of eastern Montana.
Alpine poppy (*Papaver kluanensis*)	Open, rocky slopes with delayed snowmelt in the alpine zone.
Large flowered beardtongue (*Penstemon grandiflorus*)	Sandy soils of valley plains.
Double bladderpod (*Physaria brassicoides*)	Stony or sandy soil of open grassland slopes on the plains in southeastern Montana.
Woolly twinpod (*Physaria didymocarpa* var. *lanata*)	Sandy, often calcareous soil of open grassland or shrubland slopes in the plains.
Slender-branched popcorn-flower (*Plagiobothrys leptocladus*)	Dry mud on the shores of ponds in plains and foothills.
Short-leaved bluegrass (*Poa curta*)	Sparsely vegetated soil of Douglas-fir forest floor in the montane zone.
Low arctic cinquefoil (*Potentilla hyparctica*)	Moist turf in the alpine zone.
Platte cinquefoil (*Potentilla plattensis*)	Grasslands and sagebrush steppe in the valley and montane zones in south-central Montana.
One-flowered cinquefoil (*Potentilla uniflora*)	Open, gravelly slopes and ridgetops in the alpine zone.
Bur oak (*Quercus macrocarpa*)	Low, shale-derived hills on the plains.
Arctic buttercup (*Ranunculus gelidus*)	Moist, open soil on tundra and talus slopes in the alpine zone.
High-artic buttercup (*Ranunculus hyperboreus*)	Wet soil around ponds and along streams in the montane zone.
Persistent-sepal yellow-cress (*Rorippa calycina*)	Riverbanks and shorelines in the valleys on the plains on the Missouri and Yellowstone Rivers.
Barratt’s willow (*Salix barrattiana*)	Cold, moist soil in the alpine zone.
Yellow marsh saxifrage (*Saxifraga hirculus*)	Wet, organic soil of fen in the alpine zone.

TABLE VEG-6
STATE OF MONTANA CRITICALLY IMPERILED PLANT SPECIES WITH POTENTIAL HABITAT IN THE 16-COUNTY AREA

Common Name (Scientific Name)	Habitat
Clasping groundsel (*Senecio amplectens* var. *holmii*)	Stony, open soil and talus of slopes in or near the alpine zone.
Cut-leaf groundsel (*Senecio eremophilus* var. *eremophilus*)	Moist streambanks and riparian forests in the valley and montane zones in south-central Montana.
Few-flowered butterweed (*Senecio pauciflorus*)	Moist meadows and cliffs in the montane zone.
Shoshonea (*Shoshonea pulvinata*)	Open, exposed limestone outcrops, ridgetops, and canyon rims, in thin rocky soils.
Oregon checker-mallow (*Sidalcea oregana*)	Grasslands in the valley and montane zones.
Prairie aster (*Solidago ptarmicoides*)	Open, dry grasslands, often on sandy soil or limestone on the plains of eastern Montana.
Few-flowered goldenrod (*Solidago sparsiflora*)	Sandy soil of grasslands or open woodlands on the plains.
Slender wedgegrass (*Sphenopholis intermedia*)	Wet areas in the valleys or foothills.
Fleshy stitchwort (*Stellaria crassifolia*)	Moist or wet meadows, often along streams, in the foothills to alpine zones.
Letterman's needlegrass (*Stipa lettermanii*)	Limestone talus and dry fescue grassland in the valley and foothill zones in southern Montana.
California false-hellebore (*Veratrum californicum*)	Wet meadows and streambanks in montane and subalpine zones.
Nannyberry (*Viburnum lentago*)	Openings in riparian forests on the plains.
Many-flowered viguiera (*Viguiera multiflora*)	Aspen woodlands and open slopes.

*A type of creep that takes place in regions where the ground freezes to a considerable depth and as it thaws during the warm seasons the upper thawed position creeps downhill over the frozen material. The soil moves as a viscous liquid down slopes of as little as 2 or 3 degrees and may carry rocks of considerable size in suspension.

TABLE VEG-7
STATE OF MONTANA NOXIOUS WEEDS

Common Name	Scientific Name	Category
hoary cress	*Cardaria draba*	1
Cardaria complex (combined)	*Cardaria* spp.	1
diffuse knapweed	*Centaurea diffusa*	1
spotted knapweed	*Centaurea maculosa*	1
Russian knapweed	*Centaurea repens*	1
yellow starthistle	*Centaurea solstitialis*	3
rush skeletonweed	*Chondrilla juncea*	3
oxeye daisy	*Chrysanthemum leucanthemum*	1
Canada thistle	*Cirsium arvense*	1
field bindweed	*Convolvulus arvensis*	1
common crupina	*Crupina vulgaris*	3
houndstongue	*Cynoglossum officinale*	1
leafy spurge	*Euphorbia esula*	1
orange hawkweed	*Hieracium aurantiacum*	2
meadow hawkweed	*Hieracium caespitosum*	2
yellow-devil hawkweed	*Hieracium floribundum*	2
kingdevil hawkweed	*Hieracium piloselloides*	2
common St. Johnswort	*Hypericum perforatum*	1
dyer’s woad	*Isatis tinctoria*	2
dalmatian toadflax	*Linaria dalmatica*	1
purple loosestrife	*Lythrum salicaria*	2
sulfur cinquefoil	*Potentilla recta*	1
tall buttercup	*Ranunculus acris*	2
tansy ragwort	*Senecio jacobaea*	2
saltcedar	*Tamarix ramosissima*	2
common tansy	*Tanacetum vulgare*	1

1 = Noxious weed: currently established and generally widespread in many counties.
2 = Noxious weed: recently introduced and rapidly spreading.
3 = Noxious weeds: not detected in the state or found only in small, scattered, localized infestations.

TABLE VEG-8
STATE OF MONTANA CRITICALLY IMPERILED PLANT SPECIES BY PROJECT AREA

			Additional Information			
Common Name	**Scientific Name**	**Known to Occur in the 16 Counties**	**Life Form**	**BLM**	**USFS**	**Wetland Indicator**
Dwarf onion	*Allium simillimum*	Gallatin	HP			
Daggett rock cress	*Arabis demissa var languida*	Carbon	HP	W		
Swamp milkweed	*Asclepias incarnata*	Carbon	HP			OBL
Ovalleaf milkweed	*Asclepias ovalifolia*	Carter	HP	W	S	
Narrowleaf milkweed	*Asclepias stenophylla*	Carter and Rosebud	HP	W		
Barr's Milkvetch	*Astragalus barrii*	Big Horn, Carter, Powder River, and Rosebud	HP	W	S	
Wind River vetch	*Astragalus oreganus*	Carbon	HP	W		
Wedge-leaved saltbush	*Atriplex truncata*	Park	HA	W		
Large-leafed balsamroot	*Balsamorhiza macrophylla*	Gallatin	HP	W	S	
Small camissonia	*Camissonia parvula*	Carbon	HA	S		
Pregnant sedge	*Carex gravida* var. *gravida*	Big Horn, Powder River, and Rosebud	Se			
Many-ribbed sedge	*Carex multicostata*	Gallatin and Park	Se	W		
Toothed Scandinavian sedge	*Carex norvegica* ssp. *inserrulata*	Carbon, Park, and Stillwater	Se			
Birchleaf mountain-mahogany	*Cercocarpus montanus* var. *glaber*	Treasure	SH	W		
Smooth goosefoot	*Chenopodium subglabrum*	Carter, Custer, Powder River,	HA	W		
Yellow bee plant	*Cleome lutea*	Big Horn and Carbon	HA	W		
Miner's Candle	*Cryptantha scoparia*	Carbon	HA	S		
Nine-anther dalea	*Dalea enneandra*	Custer	HP	W		

TABLE VEG-8
STATE OF MONTANA CRITICALLY IMPERILED PLANT SPECIES BY PROJECT AREA

			Additional Information			
Common Name	**Scientific Name**	**Known to Occur in the 16 Counties**	**Life Form**	**BLM**	**USFS**	**Wetland Indicator**
Silky prairie clover	*Dalea villosa* var. *villosa*	Carter	HP	W		
Scribner's panic grass	*Dichanthelium oligosanthes* var. *scribnerianum*	Powder River	PGr	W		
White Arctic draba	*Draba fladnizensis*	Carbon and Stillwater	HP			
Porsild's draba	*Draba porsildii*	Carbon	HP			
Entire-leaved avens	*Dryas integifolia*	Golden Valley	SH			
Eaton's daisy	*Erigeron eatonii* ssp. *eatonii*	Sweet Grass	HP			
Beautiful fleabane	*Erigeron formosissimus* var. *viscidus*	Carbon and Park	HP	W		
Smooth buckwheat	*Eriogonum salsuginosum*	Carbon	HA	S		
Visher's buckwheat	*Eriogonum visheri*	Carter	HA			
Sheathed cotton-grass	*Eriophorum calllitrix*	Carbon	G-L			
Hiker's gentian	*Gentianopsis simplex*	Carbon	HA	W	S	
Bractless hedge-hyssop	*Gratiola ebracteata*	Yellowstone	HA			
Discoid goldenweed	*Haplopappus macronema* var. *macronema*	Gallatin	SH		S	
Hutchinsia	*Hutchinsia procumbens*	Carbon	HA	W		
Large-fruited kobresia	*Kobresia macrocarpa*	Carbon	G-L			
Island koenigia	*Koenigia islandica*	Carbon	HA			
Lesica's bladderpod	*Lesquerella lesicii*	Carbon	HPsl	S		
Nuttall's desert parsley	*Lomatium nuttallii*	Big Horn	HP	W		
Desert dandelion	*Malacothrix torreyi*	Carbon	HA	S		

TABLE VEG-8
STATE OF MONTANA CRITICALLY IMPERILED PLANT SPECIES BY PROJECT AREA

			Additional Information			
Common Name	**Scientific Name**	**Known to Occur in the 16 Counties**	**Life Form**	**BLM**	**USFS**	**Wetland Indicator**
Beardless mentzelia	*Mentzelia nuda*	Custer, Powder River	HB	W		
Dwarf purple monkeyflower	*Mimulus nanus*	Gallatin	HA			
Nama	*Nama densum*	Carbon	HA	S		
Blue toadflax	*Nuttallanthus texanus*	Carter	HA	W		
Alpine poppy	*Papaver kluanensis*	Carbon, Park, and Sweet Grass	HPsl			
Large flowered beardtongue	*Penstemon grandiflorus*	Custer	HP			
Double bladderpod	*Physaria brassicoides*	Carter and Powder River	HP			
Woolly twinpod	*Physaria didymocarpa* var. *lanata*	Big Horn	HP			
Slender-branched popcorn-flower	*Plagiobothrys leptocladus*	Custer	HA	W		
Short-leaved bluegrass	*Poa curta*	Carbon	PGr	W		
Low arctic cinquefoil	*Potentilla hyparctica*	Carbon	HP			
Platte cinquefoil	*Potentilla plattensis*	Big Horn and Carbon	HP	W		W/FACW+
One-flowered cinquefoil	*Potentilla uniflora*	Potential, None Known	HP			
Bur oak	*Quercus macrocarpa*	Carter	TR	S		FAC-U
Arctic buttercup	*Ranunculus gelidus*	Stillwater	HPsl			
High-artic buttercup	*Ranunculus hyperboreus*	Gallatin	HP			
Persistent-sepal yellow-cress	*Rorippa calycina*	Custer and Yellowstone	HP			OBL
Barratt’s willow	*Salix barrattiana*	Carbon	SH		S	
Yellow marsh saxifrage	*Saxifraga hirculus*	Carbon	HP			

TABLE VEG-8
STATE OF MONTANA CRITICALLY IMPERILED PLANT SPECIES BY PROJECT AREA

Common Name	Scientific Name	Known to Occur in the 16 Counties	Additional Information			
			Life Form	BLM	USFS	Wetland Indicator
Clasping groundsel	*Senecio amplectens* var. *holmii*	Carbon	HP			
Cut-leaf groundsel	*Senecio eremophilus* var. *eremophilus*	Big Horn and Park	HP			FAC
Few-flowered butterweed	*Senecio pauciflorus*	Gallatin	HP			
Shoshonea	*Shoshonea pulvinata*	Carbon	HP	S	S	
Oregon checker-mallow	*Sidalcea oregana*	Gallatin	HP			
Prairie aster	*Solidago ptarmicoides*	Carter	HP			
Few-flowered goldenrod	*Solidago sparsiflora*	Stillwater	HP	W		
Slender wedgegrass	*Sphenopholis intermedia*	Big Horn and Gallatin	AGr/PGr sl	W		
Fleshy stitchwort	*Stellaria crassifolia*	Carbon	HP	W		OBL
Letterman's needlegrass	*Stipa lettermanii*	Big Horn, Carbon, Park	PGr			
California false-hellebore	*Veratrum californicum*	Gallatin,	HP	W	S	
Nannyberry	*Viburnum lentago*	Big Horn	SH			
Many-flowered viguiera	*Viguiera multiflora*	Gallatin	HP			

Agr=annual grass
FAC=facultative plant
FACN+=facultative wetland plus plant
GL=grass-like
HA=herbaceous annual
HP=herbaceous perennial
OBL=obligate wetland plant
PGr=perennial grass
S=sensitive
Se=sedge
SH=shrub
W=watch

WILDLIFE APPENDIX

Ecological Services
100 North Park, Suite 320
Helena Montana 59601

ES-61130-Billings April 17, 2001
Informal

Mr. Larry Rau
Bureau of Land Management
Miles City Field Office
111Garyowen Road
Miles City, Montana 59301

Dear Mr. Rau:

We have received your April 6, 2001 FAX of your 28 February 2001 letter regarding the development of a joint Draft Environmental Impact Statement with the Montana Department of Natural Resources and Conservation (DNRC) addressing oil and gas development. The analysis specifically addresses coal bed methane development in southeast and eastcentral portions of Montana. Under a "full development" scenario, the following counties may be affected by this action: Treasure, Rosebud, Powder River, Wheatland, Golden Valley, Musselshell, Sweet Grass, Stillwater, Yellowstone, Big Horn, Carbon, Blaine, Park, Gallatin, Carter and Custer Counties. The Bureau of Land Management (BLM) is requesting comments and concerns on the impacts of the proposed action on the following threatened, endangered and proposed species.

The threatened, endangered or proposed species which may occur in the identified counties include the bald eagle *Haliaeetus leucocephalus*, pallid sturgeon *Scaphirhynchus albus,* grizzly bear *Ursus arctros horribilis*, Canada lynx *Lynx canadensis*, Utre Ladies' Tresses *Spiranthes diluvialis*, grey wolf *Canis lupus*, interior least tern *Sterna antillarum athalassos*, black footed ferret *Mustela nigripes* and mountain plover *Charadrius montanus.*

The Peregrine falcon (*Falco peregrinus*) was delisted on August 25, 1999. Protection from take and commerce for the peregrine falcon under the Endangered Species Act is removed upon delisting. However, peregrine falcons are still protected by the Migratory Bird Treaty Act (MBTA). The MBTA and its implementing regulations (50 CFR Parts 20 and 21) prohibit take, possession, import, export, transport, selling, purchase, barter, or offering for sale, purchase or barter, any migratory bird, their eggs, parts, and nests, except as authorized under a valid permit (50 CFR 21.11). With limited exceptions, take will not be permitted under MBTA until a management plan developed in cooperation with State wildlife agencies, undergoes public review, is approved, finalized, and published in the Federal Register.

Your action in Blaine County may occur within a "nonessential experimental population" for the black-footed ferret (50 CFR Part 17, Vol. 59, No. 159, 42696-715, August 18, 1994). Section 10(j) of the Act authorizes listed species to be released as experimental populations outside their currently occupied range, but within probable historic habitat, to further species conservation. Before making a release, the Services determine by rulemaking whether that population is "essential" or "nonessential." An "essential experimental population" is a reintroduced population whose loss would be likely to appreciably reduce the likelihood of the survival of the species in the wild. A "nonessential experimental population" is a reintroduced population whose loss would not be likely to appreciably reduce the likelihood of survival of the species in the wild. For section 7 consultation purposes, section 10(j) requires that any nonessential experimental population outside a National Park or National Wildlife Refuge System unit is treated as a proposed species and a conference with the Service may be conducted. It should be noted, that the effects of your proposed action may occur outside this area where the status of the black-footed ferret remains as endangered.

The black-footed ferret is obligate to the black-tailed prairie dog and is found exclusively within prairie dog colonies except when traveling from one colony to another. The Assiniboine and Gros Ventre Tribes at Fort Belknap are a part of the black-footed ferret reintroduction effort in Montana. A total of 167 ferrets have been released on the Fort Belknap Indian Reservation between 1997 and 2000. Therefore, black-footed ferrets may reside in any active prairie dog town within the scope of effects in the action area. A copy of the Service's *Black-footed Ferret Survey Guidelines for Compliance with the Endangered Species Act" (April 1989)*, is available upon request.

In Montana, the mountain plover almost exclusively nests in active prairie dog towns. Blaine and Phillips counties both support the bulk of mountain plover that nest in Montana. This population demonstrates the highest reproductive success of the few remaining within its historic range. The contribution of this local population's recruitment to the species is significant to the point that its loss would be a severe blow to recovery of the species. The Service has established *Mountain Plover Survey Guidelines (1999)* that have been provided for your convenience as APPENDIX I to this letter.

Candidate species are those taxa for which the U.S. Fish and Wildlife Service has sufficient information on biological status and threats to propose to list them as threatened or endangered, but issuance of a proposed rule is currently precluded by higher priority listing actions (61 FR 7596-7613, February 28, 1996). The Service encourages their consideration in environmental planning and partnerships; however, none of the substantive or procedural provisions of the Act apply to candidate species. Federal agencies have policies for the conservation of federal candidate species to manage those species in such a manner as to ensure actions that they authorize, fund, or carry out do not contribute to the need to list any species, and they may have special agency guidelines for their management, i.e. The Bureau of Land Management Instruction Memorandum No. 2000-140. The candidate species found in the counties listed above, includes the black-tailed prairie dog *Cynomys ludovicianus,* Montana arctic grayling *Thymallus arcticus*, and warm spring Zaitzevian riffle beetle *Zaitzevia thermae.* On April 10, 2001, the Service made a 12-month finding for a petition to list the sicklefin chub *Hybopsis meeki* and the sturgeon chub *Hybopsis gelida* as endangered under the Endangered Species Act of 1973, as amended. We found, after review of all available scientific and commercial information, that listing either of these two species is not warranted at this time. However, significant concern for these species remains.

The Service was petitioned to list the sage grouse (*Centrocercus europhasia*) in the state of Washington on May 14, 1999. Depending upon the Service's finding, a new petition may be submitted requesting to list the sage grouse throughout its range. Sage grouse populations have been declining throughout their range. Habitat loss and fragmentation has been identified as one of the primary causes of this decline. This species is dependent on sagebrush, and any removal of this habitat component can have a potentially negative effect on this species. Re-establishment of this shrub by existing coal mines to 30% of pre-disturbance levels has been largely unsuccessful in the Powder River Basin. Additionally, sage grouse are negatively impacted by increased road densities. Indirect impacts to sage grouse are likely, and that surface and timing stipulations are unsuccessful in protection of sage grouse habitat due to split estate mineral ownership. Cumulative surface disturbance of habitat from mining, coal-bed methane production, and oil and gas development may directly affect sage grouse populations. If sage grouse are listed during development of your proposed activity, the need to consult under section 7 of the Act may be avoided by addressing project impacts to this species now.

Pursuant to Section 7 of the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 et seq.), the Bureau of Land Management, as the responsible Federal agency, must determine if the proposed actions may affect these listed species and if so, initiate formal consultation with the Fish and Wildlife Service (Service). In order to determine if formal consultation is required, the Service recommends the responsible agency prepare a biological assessment for construction projects requiring an environmental impact statement (refer to Section 402.12, 50 CFR, Part 402, June 3, 1986), or an equivalent analysis for other projects, in accordance with Section 402.14, 50 CFR, part 402. We recommend that biological assessments include the following:

1. A description of the project,

2. A description of the specific area that may be affected by the action,

3. The current status, habitat use, and behavior of threatened and endangered species in the project area,

4. Discussion of the methods used to determine the information in Item 3,

5. An analysis of the affects of the action on listed species and proposed species and their habitats, including an analysis of any cumulative effects (see Section 402.02 50 CFR, Part 402),

6. Coordination/mitigation measures that will reduce/eliminate adverse impacts to threatened and endangered species,

7. The expected status of threatened and endangered species in the future (short and long term during and after project completion),

8. A determination of the project affects for listed species,

9. A determination of "is likely to jeopardize" or "is not likely to jeopardize" for proposed species, and

10. Documentation of the basis of all conclusions, such as the data considered, citation of literature and personal contacts used in developing the assessment.

If it is determined that the proposed project is likely to adversely affect any listed species, formal consultation should be initiated with this office.

Section 9 of ESA prohibits knowingly taking listed species, which includes harm, harassment, capture, or collection activities, except when specifically permitted by the U.S. Fish and Wildlife Service. Please also be apprized of the potential application of the Migratory Bird Treaty Act of 1918 (MBTA), as amended, 16 U.S.C. 703 et seq; and the Bald Eagle Protection Act of 1940 (BEPA), as amended, 16 U.S.C. 668 et seq; to your project. The MBTA does not require intent to "take" to be proven and does not allow for "take," except as permitted by regulations. Section 703 of the MBTA provides: "Unless and except as permitted by regulations...it shall be unlawful at any time, by any means or in any manner, to...take, capture, kill, or attempt to take, capture, or kill, possess... any migratory bird, or any part, nest, or eggs of any such bird...." The BEPA prohibits knowingly taking, or taking with wanton disregard for the consequences of such an activity, any bald or golden eagles or their body parts, nest, or eggs, which includes collection, molestation, disturbance, or killing activities.

Executive Order 13186 for Migratory Bird Conservation was signed by President Clinton on January 10, 2001 and published in the Federal Register on January 17, 2001. Executive Order 13186 reaffirms that Federal Agencies are in fact subject to the Migratory Bird Treaty Act and the executive order provides an effective mechanism for implementing the United States' obligations under its treaties with Canada, Mexico, Russia, and Japan. The requirements of the Executive Order are in addition to, not in lieu of, the prohibitions of the MBTA. Federal Agencies are required to possess permits before taking migratory birds.

The Service does foresee many substantive issues with the proposed project with regard to listed or other protected species, and the proliferation of new power lines to water wells and new infrastructure is a concern. Any power lines in the vicinity, if not properly constructed, could pose electrocution and line strike hazards to listed species and other migratory birds. To conserve any listed species and other migratory birds protected by Federal law, we urge that any power lines that may need to be modified or reconstructed as a result of the project be raptor-proofed following the criteria and techniques outlined in the *Avian Power Line Interaction Committee (APLIC). 1994. Mitigating Bird Collisions with Power Lines: The State of the Art in 1994. Edison Electric Institute, Washington, D.C., 78 pp*, and Avian *Power Line Interaction Committee (APLIC). 1996. Suggested Practices for Raptor Protection on Power Lines. Edison Electric Institute/Raptor Research Foundation, Washington, D.C., 128 pp.* Copies can be obtained via the Internet at http://www.eei.org/resources/pubcat/enviro/, or by calling 1-800/334-5453).

In Montana, recent studies have identified increasing eagle and raptor mortalities when birds encounter electric power lines associated with oil and gas development. All new distribution lines should incorporate contemporary raptor protection measures. These include conventional conductor-conductor and conductor to ground spacing, insulating the bushing conductor terminations and by using insulated jumper conductors. Perches, perching deterrents, nesting platforms and nest deterrent devices should also be used.

Your letter does not mention whether wetlands might be impacted by any of the proposed projects. If so, Corps of Engineers Section 404 permits may eventually be required. In that event, depending on permit type and other factors, the U.S. Fish and Wildlife Service may be required to review permit applications and will recommend any protection or mitigation measures to the Corps of Engineers as may appear reasonable and prudent based on the information available at that time.

Coal bed methane (CBM) development will include extensive networks of pipelines, power lines and roads, which together with collection points and compressors will result in severe disturbance to terrestrial wildlife and the habitats that support them. Saline runoff from CBM wells will also affect terrestrial wildlife through loss of habitat and direct physiological impacts.

Within the affected area, six species of amphibians, 12 species of reptiles, 184 species of birds and 43 species of mammals occur. Some are secure, and could likely weather the effects of CBM development, but the status of most is unknown, as is their potential response to the proposed development. Of the 245 vertebrate species (excluding fish), 13 species and 4 communities are of concern. Attached as an addendum to this letter is a paper by Steve Regele and Judd Stark from the Montana Department of Environmental Quality on *Coal Bed Methane Gas Development in Montana, Some Biological Issues.*

CBM development will draw down existing local and regional aquifers and reduce important ground and surface water supplies. Stock ponds, springs and wells will provide less water for livestock in upland areas, resulting in hardships for local livestock producers, and forcing cattle to use riparian areas for water. Increased livestock use of riparian habitats would violate the *Standards for Rangeland Health and Guidelines for Livestock Grazing Management* adopted by the BLM in the May, 1997 final EIS.

Wastewater discharge will likely cause increased flows in normally dry watercourses such as ephemeral drainages, coulees and gullies resulting in erosion and downstream siltation in streams that are already silt laden. These waters may contain toxic elements hazardous to wildlife. The MT DEQ has identified 22 parameters of concern that could impact water quality. The sturgeon chub has only a few remaining stable populations throughout its range. The Powder River and Lower Yellowstone is probably the most important drainage left for the sturgeon chub. The Powder River is currently one of the few remaining large alkaline prairie rivers that exhibit an intact native fish and invertebrate fauna. A small change in salinity, temperature, turbidity, radioactive or toxic constituents could render extant the current population of sturgeon chub and negatively impact pallid sturgeon. American Rivers, a national river watchdog group, on 11 April 2001, ranked the Powder River as one of the Nation's top five most threatened rivers in an annual tally of endangered rivers.

If you have any questions regarding this letter, please contact Lou Hanebury of my staff at (406) 247-7367. We appreciate your efforts to consider endangered species in your project planning.

Sincerely,

R. Mark Wilson
Field Supervisor
Montana Field Office

Attachment: *Coal Bed Methane Gas Development in Montana, Some Biological Issues.*

LRH/lrh

cc: Suboffice Coordinator, Ecological Services, Billings, MT.
Field Supervisor, Ecological Services, Wyoming Field Office, Cheyenne, Wyo.

APPENDIX I

MOUNTAIN PLOVER SURVEY GUIDELINES
U.S. Fish and Wildlife Service
1999

The mountain plover (*Charadrius montanus*) is a small bird (17.5 cm, 7 in.) about the size of a killdeer (*C. vociferus*). It is light brown above with a lighter colored breast, but lacks the contrasting dark breast-belt common to many other plovers. During the breeding season it has a white forehead and a dark line between the beak and eye, which contrasts with the dark crown.

Mountain plover breeding habitat is known to include short-grass prairie and shrub-steppe landscapes; dryland, cultivated farms; and prairie dog towns. Plovers usually nest on sites where vegetation is sparse or absent, due to disturbance by herbivores, including domestic livestock and prairie dogs. Vegetation at shortgrass prairie sites is less than 4 inches tall, while shrubs visually predominate nest sites within the shrub-steppe landscape. Usually, nest sites within the shrub-steppe are on active prairie dog towns. Nests are commonly located near a manure pile or rock. In addition to disturbance by prairie dogs or livestock, they have also been found on oil drill pads. Mountain plovers are rarely found near water. They may be found on heavily grazed pastures throughout their breeding range and may selectively nest in or near prairie dog towns. Positive indicators for mountain plovers therefore include level terrain, prairie dogs, bare ground, *Opuntia* pads, cattle, widely spaced plants, and horned larks. It would be unusual to find mountain plovers on sites characterized by irregular or rolling terrain; dense, matted vegetation; grass taller than 4 inches, wet soils, or the presence of killdeer.

These guidelines were developed by Service biologists Pat Deibert, Lou Hanebury, and Bob Leachman, and Dr. Fritz Knopf, USGS-BRD. Keep in mind these are guidelines - please call Bob Leachman at 970-243-2778 if you have any suggestions.

GENERAL GUIDELINES FOR SURVEYS

On February 16, 1999, the Service proposed the mountain plover for federal listing as threatened. Because listing of this species is proposed, the Service may recommend surveys for mountain plovers to better define nesting areas, and minimize potential negative impacts. The Service recommends surveys for mountain plovers in all suitable habitat, as well as avoidance of nesting areas, to minimize impact to plovers in a site planned for development. While the Service believes that plover surveys, avoidance of nesting and brood rearing areas, and timing restrictions (avoidance of important areas during nesting) will lessen the chance of direct impacts to and mortality of individual mountain plovers in the area, these restrictions do nothing to mitigate indirect effects, including changes in habitat suitability and habitat loss. Surveys are, however, a necessary starting point. The Service has developed the following 2 survey guidelines, depending on whether the intent is to determine the presence or absence of plovers at a site during the nesting season, or to determine the density of nesting plovers.

Survey Protocol

Two types of surveys may be conducted: 1) surveys to determine the presence/absence of breeding plovers (i.e., displaying males and foraging adults), or 2) surveys to determine nest density. The survey type chosen for a project and the extent of the survey area (i.e., beyond the edge of the construction or operational ROW) will depend on the type of project activity being analyzed (e.g., construction, operation) and the users intent. One methodology outlines a breeding survey that was used in northeastern Colorado to establish the density of occupied territories, based on displaying male plovers or foraging adults. The other was developed to only determine whether plovers occupy an area.

Techniques Common to Each Survey Method

- Conduct surveys during early courtship and territorial establishment. Throughout the breeding range, this period extends from approximately mid-April through early July. However, the specific breeding period depends on latitude, elevation, and weather.

- Conduct surveys between local sunrise and 1000 and from 1730 to sunset (periods of horizontal light to facilitate spotting the white breast of the adult plovers).

- Drive transects within the project area to minimize early flushing. Flushing distances for mountain plovers may be within 3 meters for vehicles, but plovers often flush at 50 to 100 meters when approached by humans on foot.

- Use of a 4-wheel drive vehicle is preferable; however, fallow agricultural fields present an access problem. Use of ATVs has proven highly successful in observing and recording displaying males.

- Stay in or close to the vehicle when scanning. Use binoculars to scan and spotting scopes to confirm sightings. Do not use scopes to scan.

- Do not conduct surveys in poor weather (i.e., high wind, precipitation, etc.).

- Surveys conducted during the courtship period should focus on identifying displaying or calling males, which would signify breeding territories.

- For all breeding birds observed, conduct additional surveys immediately prior to construction activities to search for active nest sites.

- If an active nest is located, an appropriate buffer area should be established to prevent direct loss of the nest or indirect impacts from human-related disturbance. The appropriate buffer distance will vary, depending on topography, type of activity proposed, and duration of disturbance. For disturbances including pedestrian foot traffic and continual equipment operations, a 200-meter buffer is recommended.

SURVEY TO DETERMINE PRESENCE/ABSENCE

1. Conduct the survey between May 1 and June 15, throughout the breeding range.

2. Visual observation of the area should be made within 200 m of the proposed action to detect the presence of plovers. All plovers located should be observed long enough to determine if a nest is present. These observations should be made from within a stationary vehicle, as plovers do not appear to be wary of vehicles.

3. If no visual observations are made from vehicles, the area should be surveyed on ATV's. Extreme care should be exercised in locating plovers due to their highly secretive and quiet nature. Surveys by foot are not recommended because plovers tend to flush at greater distances when approached using this method. Finding nests during foot surveys is more difficult because of the greater flushing distance.

4. A site must be surveyed 3 times during the survey window, with each survey separated by at least 14 days.

5. Initiation of the project should occur as near to completion of the survey as possible. For example, seismic exploration should begin with 2 days of survey completion. A 14-day period may be appropriate for other projects.

6. If an active nest is found in the survey area, the planned activity should be delayed 37 days, or one week post-hatching. If a brood of flightless chicks is observed, activities should be delayed at least seven days.

SURVEY TO DETERMINE DENSITY OF NESTING MOUNTAIN PLOVERS

We are assuming people will have received training on point counts in general before using this specialized point count technique adapted to mountain plovers.

Establishing Transects

7. Identify appropriate habitat and habitat of interest within geographic areas of interest.

8. Upon arriving in appropriate habitat, drive to a previously determined random starting point.

9. For subsequent points, drive a previously determined random distance of 0.3, 0.4 or 0.5 miles.

10. Each transect of point counts should contain a minimum of 20 points.

Conducting The Point Counts

1. Conduct counts between last week in June to July 4th at eastern plains elevation in Colorado.

2. Only 1 counter is used. Do not use a counter and recorder or other combinations of field help. Drivers are okay as long as they don't help spot plovers.

3. If an adult mountain plover is observed, plot occupied territories on a minimum of 1:24,000 scale map and on a ROW diagram or site grid (see attached). The ROW diagram will be at a greater level of detail, depicting the location of breeding birds (and possible nest sites) relative to ROW centerline, construction boundary, and applicable access roads.

4. Estimate or measure distances (in meters) to all mountain plovers. Method used should be noted, e.g., estimates w/distance training, estimates w/o distance training, rangefinder or measured with tape measure, etc.

5. Record "fly-overs" as "FO" in the distance column of the data sheet.

6. If you disturb a mountain plover while approaching the point, estimate the distance from point-center to the spot from which the bird was flushed.

7. Conduct counts for 5 minutes with a 3-minute subsample to standardize with BBS.

8. Stay close to your vehicle while scanning.

Recording Data

Record the following information AT EVERY POINT, EVERY DAY.

- start time
- unique point code (don't duplicate within a field crew or across dates)
- number of mountain plovers and distance to each
- land use and/or habitat type (e.g., fallow wheat, plowed, shortgrass)
- temperature, Beaufort wind, and sky conditions (clear, partly cloudy, overcast)
- Information on the data sheet somewhere.
- your name and address
- date
- Record for each point at some point during the census.
- detailed location description of each point count including road number, distance to important intersections.
- record transect and point locations on USGS county maps.
- Universal Transverse Mercator from maps or GPS are useful.

GENERAL HABITAT INDICATORS

Positive habitat images

Stock tank (non-leaking, leaking tanks often attract killdeer)

Flat (level or "tilted) terrain

Burned field/prairie/pasture

Bare ground (minimum of 30 percent)

"Spaced" grass plants

Prairie dog colonies

Horned larks

Cattle

Heavily grazed pastures

Opuntia pads visible

Negative habitat images

Killdeer present (indicating less than optimal habitat)

Hillsides or steep slope

Prominent, obvious low ridge

Leaky stock tanks

Vegetation greater than 4 inches in height

Increasing presence of tall shrubs

Matted grass (i.e., minimal bare ground)

Lark buntings

** **SURNAME SLIP** **
FOR CORRESPONDENCE REQUIRING
FIELD SUPERVISOR SIGNATURE

AUTHOR: Lou Hanebury
FILE #: blmcbmdeis.wpd (Informal)

REVIEWER (S):

____

ASST. FIELD SUPERVISOR: ___________

SPECIAL INSTRUCTIONS: Rob/Mark/Anne

____

Anne: please review as to wolf and Grizzley special considerations?

Please print and add as addendum regelestark.doc as an attachment to this letter (**print out as a Work document**)___________________

____

COPIES: __________________________

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[Attach this slip to Field Office file copy]

TABLE WIL-1
WILDLIFE SPECIES OF CONCERN

Common Name	Scientific Name	Counties	Additional Information			
			MT	BLM	USFS	Suitable Habitat
Mammals						
Pallid bat	*Antrozous pallidus*	Carbon	S1		S	Arid areas with rocky outcrops, dry forests, riparian forests, and ponderosa pine low slope forests in south-central Montana (UM).
Townsend's big-eared bat	*Corynorhinus (Plecotus) townsendii*	All	S2S3	SS	S	Arid scrub and pine forest, uses caves, snags, old mines and buildings the Custer and Gallatin National Forests (NM).
Spotted bat	*Euderma maculatum*	Big Horn, Carbon, Powder River	S1	SS	S	Various habitats in south-central Montana from open coniferous to pastureland.
Eastern red bat	*Lasiurus borealis*		S1			Open forest, woody draws, and farm shelter-belts (M).
Northern myotis	*Myotis septentrionalis*	None known in emphasis area.	S1			Mixed and coniferous forests with small woodland pools and streams, in clearings (NM). Lower Missouri River.
Pygmy rabbit	*Brachylagus idahoensis*	None known in emphasis area.	S2S3	SS	S	Areas with tall, dense sagebrush cover.
Hispid pocket mouse	*Chaetodipus hispidus*	Carter and Powder River	S1			Arid, open prairie land.
White-tailed prairie dog	*Cynomys leucurus*	Carbon	S1	SS	S	Grasslands and plains.
Black-tailed prairie dog	*Cynomys ludovicianus*	Custer and Blaine	S3S4	SS	S	Short-grass and mixed-grass prairie in the east of the 110th meridian Fort Belknap Reservation, and Crow Reservation.
North American wolverine	*Gulo gulo luscus*	Park and Gallatin	S2	SS	S	Mature and old-growth fir, pine and larch forests, alpine shrub, talus, and riparian cottonwoods.
Spotted skunk	*Spilogale gracilis*	Carbon		SS		Rocky, brushy grasslands, riparian areas and forest/shrub ecotones.

TABLE WIL-1
WILDLIFE SPECIES OF CONCERN

Common Name	Scientific Name	Counties	Additional Information			
			MT	BLM	USFS	Suitable Habitat
Fisher	*Martes pennanti*	Park and Gallatin	S1S2	SS	S	Forests with mixed habitat, several structural classes, edges and riparian areas.
Merriam's shrew	*Sorex merriami*	All SE MT counties and Blaine	S3	SS		Sagebrush and mountain brush areas and arid forests with sagebrush or bunchgrass.
Northern bog lemming	*Synaptomys borealis*	None known in project area.	S2	SS	S	Damp pastures, tundra, cool bogs, peatlands, marshes, or moist meadows.
Preble's shrew	*Sorex preblei*	Carbon, Musselshell, Treasure, Rosebud, Big Horn	S3	SS		Dry sagebrush and sagebrush-grasslands.
Swift fox	*Vulpes velox*	All counties east of Continental Divide	S1	SS	S	Short to midgrass prairie habitat.
Herptiles						
Boreal/Western toad	*Bufo boreas*	Park, Carbon, Sweetgrass, Gallatin	S3S4		S	Breeding ponds, summer range, and overwinter refugia within lodgepole pine or spruce-fir forests.
Canadian toad	*Bufo hemiophyrs*	None known in project area.	S1	SS	S	Shallow wetlands, streams, ditches, margins of prairie wetlands.
Wood frog	*Rana sylvatica*	Big Horn**		SS		Temporary ponds, lakes, and streams with adjacent forests or brush with damp litter.
Northern leopard frog	*Rana pipiens*	All	S3S4		S	Streams, ponds, lakes, wet prairies, and other bodies of water, frequently moving into grassy, herbaceous fields or forest borders some distance from permanent water.
Snapping turtle	*Chelydra serpentiana*	Eastern Counties	S3	SS		Shallow, mud-bottomed backwaters and ponds with lush aquatic vegetation.
Spiny softshell	*Trionyx spiniferus*	Eastern Counties	S3	SS		Rivers, backwaters, lakes, and ponds with sand or mud areas for digging nests. Missouri and Yellowstone Rivers

TABLE WIL-1
WILDLIFE SPECIES OF CONCERN

Common Name	Scientific Name	Counties	Additional Information			
			MT	BLM	USFS	Suitable Habitat
Birds						
Swainson's hawk	*Buteo swainsoni*	All	S4B, SZN	SS		Shrub-steppe, prairie with scattered trees, or open woodlands.
Ferruginous hawk	*Buteo regalis*	All	S3B, SZN		S	Undisturbed plains or shrub-steppe with relatively unbroken terrain and scattered trees, rocks, or treed creek bottoms.
Northern goshawk	*Accipiter gentilis*	Carbon, Park, Gallatin, Powder River, Rosebud	S3S4	SS	S	Coniferous, deciduous, and mixed forests with a high density of large, old trees and high overstory canopy.
Burrowing owl	*Athene cunicularia*	All	S3S4	SS	S	Burrows made by prairie dogs or badgers in rangeland and prairie areas.
Great gray owl	*Strix nebulosa*	Carbon, Park, Gallatin, Sweetgrass	S3	SS		Dense, often moist, forests, with openings for hunting.
Flammulated owl	*Otus flammeolus*	Gallatin, Park	S3B, SZN	SS	S	Stands of mature ponderosa pine and Douglas-fir with tree cavities.
Canvasback duck	*Aythya valisineria*	Western and northern counties		SS		Large, shallow prairie marshes bordered by dense emergent vegetation with areas of open water.
Harlequin duck	*Histrionicus histrionicus*	Carbon, Park, Gallatin	S2B, SZN	SS	S	Summer on mountain streams and rivers, nest on the ground near water's edge or in the hollows of dead trees.
Trumpeter swan	*Cygnus buccinator*	Carbon, Park, Gallatin	S2B, S2N	SS		Shallow freshwater marshes, ponds, lakes, and slow-moving rivers with both submerged and emergent vegetation.
White-faced ibis	*Plegadis chihi*	Carbon, Park	S1B, SZN	SS		Freshwater wetlands (marshes, ponds, swamps) with islands of emergent vegetation.
Long-billed curlew	*Numenius americanus*	All		SS		Open grasslands and prairies, often near water.

TABLE WIL-1
WILDLIFE SPECIES OF CONCERN

Common Name	Scientific Name	Counties	Additional Information			
			MT	BLM	USFS	Suitable Habitat
Columbian sharp-tailed grouse	*Tympanuchus phasianellus columbianus*	None known in project area	S1		S	Native bunchgrass and sagebrush-steppe with plant species diversity and structural diversity
Cassin's kingbird	*Tyrannus vociferans*	Southeastern counties	S1			Open country with pinyon-juniper or Ponderosa pine, open scrub, and shrub-steppe.
Loggerhead shrike	*Lanius ludovicianus*	All		SS		Edge habitat with open country, thinly wooded or scrubby land with clearings, meadows, and aspen stands bordering dense, ungrazed or lightly grazed grassland.
Blue-gray gnatcatcher	*Polioptila caerulea*	Carbon	S1			Juniper and limber pine in the Pryor Mountains of south-central Montana.
Sage sparrow	*Amphispiza belli*	NI		SS		Sagebrush steppe species, not confirmed in Montana.
Baird's sparrow	*Ammodramus bairdii*	Eastern Counties	S3S4B SZN		S	Open tall to mixed grass areas with mixture of mostly native prairie grasses and forbs.
Hairy woodpecker	*Picoides villosus*	All		SS		Various types of forest stands throughout Montana.
Pileated woodpecker	*Dryocopus pileatus*	Park, Gallatin		SS		Mature forests with large snags.
Three-toed woodpecker	*Picoides tridactylus*	Carbon, Park, Gallatin, Big Horn, Sweetgrass		SS		Pine-dominated mature forests and burned areas in early successional stages.
Black-backed woodpecker	*Picoides articusi*	Park, Gallatin	S3	SS	S	Coniferous forests, especially early post-fire habitat
Dickcissel	*Spiza americana*	Eastern Counties	S1	SS		Hayfields, pastures, weedy fallow fields, and the weedy margins of ditches and roadsides

TABLE WIL-1
WILDLIFE SPECIES OF CONCERN

Common Name	Scientific Name	Counties	Additional Information			
			MT	BLM	USFS	Suitable Habitat
Fish						
Yellowstone Cutthroat Trout	*Oncorhynchus clarki bouvieri*	Western Counties	S2	SS	S	Mountain lakes and streams with varying habitat structures and water velocities.
Westslope Cutthroat Trout	*Oncorhynchus clarki lewisi*	Gallatin	S3	SS	S	Small, isolated streams in mountainous areas.
Blue sucker	*Cycleptus elongatus*	Eastern Counties	S3	SS		Deep water of large rivers and reservoirs with low turbidity and swift current.
Paddlefish	*Polyodon spathula*	Eastern Counties	S1S2			Historically found in calm, open waters of large rivers in the Mississippi River drainage as far north as the Missouri River in Montana.
Shorthead sculpin	*Cottus confusus*	NI	S3		S	Cold, fast riffles in streams with gravel.
Northern redbelly dace X Finescale dace*	*Phoxinus eos X Phoxinus neogaeus*	Western Counties	S3	SS		Boggy lakes, creeks, and ponds, often with cool, dark, tea-colored water.

*Hybrid, always female.
**Possible/not confirmed.
M=migratory.
UM=unknown migration.
NM=nonmigratory, year-round resident.
NI=no information.
S and SS=species of concern.
S1=critically imperiled in the state.
S2=vulnerable to extinction.
S3=rare or restricted in range.
B= Breeding status of a migratory species.
Z= Ranking not applicable.
N= Non-breeding status of a migratory species.

Table WIL-2

Aquatic Resources Characteristics of Major Drainages and Representative Tributaries in the Billings and Powder River Resource Management Plan Areas and in Park, Gallatin, and Blaine Counties[1]

Location and Drainage	Length (miles)[2]	Aesthetics[3]	Fisheries Management[4]	Fisheries Resource Value[5]	Number of Fish Species Present	Dewatering Problem Identified?[6]
Billings Resource Management Area						
Yellowstone River West of Billings	134	National renown, clean stream and natural setting, stream and area fair	Trout	Outstanding, high, substantial	20	Periodic
Boulder River	66	Natural beauty, pristine	Trout	Outstanding, high, substantial	9	Chronic
Stillwater River	73	Natural beauty, clean stream and natural setting	Trout	Outstanding, high, substantial	9	No
Clarks Fork of the Yellowstone						
Downstream Section	43	Stream and area fair	Non-trout	Substantial	19	Periodic
Upstream Section	30	Clean stream and natural setting	Trout	Substantial	12	Chronic
Yellowstone River East of Billings	26	Clean stream and natural setting, stream and area fair	Warm/cool water and non-trout	High	28	Periodic
Bighorn River						
Downstream Section	59	Stream and area fair	Trout	High	30	Periodic
Little Bighorn River	116	Natural beauty, clean stream and natural setting	Warm/cool water and trout	Moderate	8	No
Upstream Section	38	National renown	Trout	Outstanding	17	No
Musselshell River	246	Clean stream and natural setting, stream and area fair	Trout	High, substantial	32	Chronic
Careless Creek	56	Clean stream and natural setting, stream and area fair	Warm/cool water and trout	Substantial, moderate, limited	10	Chronic
Powder River Resource Management Area						
Yellowstone River	64	Clean stream and natural setting	Non-trout	High	40	No
Rosebud Creek	208	Stream and area fair	Undesignated	High, substantial	21	No
Tongue River						

Table WIL-2

Aquatic Resources Characteristics of Major Drainages and Representative Tributaries in the Billings and Powder River Resource Management Plan Areas and in Park, Gallatin, and Blaine Counties[1]

Location and Drainage	Length (miles)[2]	Aesthetics[3]	Fisheries Management[4]	Fisheries Resource Value[5]	Number of Fish Species Present	Dewatering Problem Identified?[6]
Downstream Section	93	Clean stream and natural setting, stream and area fair	Non-trout	High, substantial	33	Periodic
Pumpkin Creek	172	Clean stream and natural setting, stream and area fair	Non-trout and undesignated	Substantial, moderate, limited	20	No
Upstream Section	114	Clean stream and natural setting	Trout	High	26	No
Otter Creek	103	Stream and area fair	Undesignated	Substantial, moderate	20	No
Hanging Woman Creek	47	Clean stream and natural setting	Undesignated	Substantial, moderate	23	No
Powder River						
Downstream Section	156	Low	Non-trout	High	21	Chronic
Mizpah Creek	150	Low, clean stream and natural setting	Non-trout and undesignated	Moderate, limited	18	No
Little Powder River	72	Stream and area fair	Non-trout	Substantial	13	No
Upstream Section	77	Low, natural and pristine beauty	Warm/cool water	High	21	Chronic
Little Missouri River	103	Clean stream and natural setting	Non-trout	High	18	No
Park County						
Yellowstone River	104	National renown	Trout	Outstanding	12	No
Shields Creek	65	Clean stream and natural setting	Trout	High, substantial	10	Periodic
Gallatin County						
Missouri River	27	National renown	Trout	High	13	Periodic
Gallatin River	102	National renown, clean stream and natural setting	Trout	Outstanding, high	12	Chronic/Periodic
Madison River	20	National renown	Trout	Outstanding	13	No
Jefferson River	19	Clean stream and natural setting	Trout	Substantial	12	Chronic

Table WIL-2

Aquatic Resources Characteristics of Major Drainages and Representative Tributaries in the Billings and Powder River Resource Management Plan Areas and in Park, Gallatin, and Blaine Counties[1]

Location and Drainage	Length (miles)[2]	Aesthetics[3]	Fisheries Management[4]	Fisheries Resource Value[5]	Number of Fish Species Present	Dewatering Problem Identified?[6]
Blaine County						
Missouri River	38	National renown	Non-trout	Outstanding	26	No
Cow Creek	54	Clean stream and natural setting	Trout	Moderate	8	No
Milk River	110	Stream and area fair	Non-trout	High	31	No
Lodge Creek	73	Stream and area fair	Non-trout	High	18	No
Peoples Creek	113	Clean stream and natural setting	Trout and non-trout	Substantial, moderate	14	No

[1]Information derived from the Montana Natural Resource Information System on the Internet at http://nris.state.mt.us/wis/mris1.html. Multiple values for a resource characteristic indicate river reach differences within a given drainage.

[2]Estimated length of drainage within the Resource Management Area or county.

[3]Aesthetics ratings in descending order are: national renown; natural and pristine beauty with some development; clean stream and natural setting; stream and area fair; and low.

[4]Categories of fisheries management are: trout; non-trout; warm/cool water; and undesignated.

[5]Fisheries resource values ratings in descending order are: outstanding; high; substantial; moderate; and limited.

[6]Dewatering indicates a reduction in streamflow beyond the point where stream habitat is adequate for fish and usually occurs during the irrigation season (July through September). Periodic dewatering indicates a significant problem in drought or water-short years, and chronic dewatering indicates a significant problem in virtually all years.

Table WIL-3

Common and Scientific Names and Relative Abundance of Fish Species Present in Major Drainages and Representative Tributaries in the Billings Resource Management Plan Area[1]

Common Name	Scientific Name	Yellowstone River West of Billings	Boulder River	Stillwater River	Clarks Fork of the Yellowstone		Yellowstone River East of Billings	Bighorn River		Little Bighorn River	Musselshell River	Careless Creek
					Downstream Section	Upstream Section		Downstream Section	Upstream Section			
Goldeye	*Hiodon alasoides*	A, C, U, R			A		A	A	C, R		A, C, R	
Lake chub	*Couesius plumbeus*				U	C	R	R			R	A
Common carp[2]	*Cyprinus carpio*	C, U, R			R		C	A, C	A, C		A, C, U	
Western silvery/plains minnow	*Hybognathus argyritis/placitus*				U	R		C, U	R		A, C, U	
Brassy minnow	*Hybognathus hankinsoni*										U, R	
Emerald shiner	*Notropis atherinoides*	C, U, R				R	C	U			C, R	
Sand shiner	*Notropis stramineus*										A, U, R	
Northern redbelley/finescale dace	*Phoxinus eos/neogaeus*										U	U
Fathead minnow	*Pimephales promelas*							U			U	U
Flathead chub	*Platygobio gracilis*						A, C	C			A, C, U, R	A
Longnose dace	*Rhinichthys cataractae*	R	C	A, C, U	C	C	A	A, C	A		A, C, U	A
River carpsucker	*Carpiodes carpio*	C, U			C		C	C	U, R		U, R	
Longnose sucker	*Catostomus catostomus*	A, C, U	A	C, U	A, C	C	C	A	C	C	A, C, U, R	C
White sucker	*Catostomus commersoni*	A, C, U		A, U	A	A	C	A, C	A, C	C	A, C, U	A, C
Mountain sucker	*Catostomus platyrhynchus*	A, U	C	C, R	C	A	A	C		P	A, C	C
Smallmouth buffalo	*Ictiobus bubalus*						R	R			R	
Bigmouth buffalo	*Ictiobus cyprinellus*						R	R				
Shorthead redhorse	*Moxostoma*	A, C			U		A	A, C	U, R		A, C	C

Table WIL-3

Common and Scientific Names and Relative Abundance of Fish Species Present in Major Drainages and Representative Tributaries in the Billings Resource Management Plan Area[1]

Common Name	Scientific Name	Yellowstone River West of Billings	Boulder River	Stillwater River	Clarks Fork of the Yellowstone		Yellowstone River East of Billings	Bighorn River		Little Bighorn River	Musselshell River	Careless Creek
					Downstream Section	Upstream Section		Downstream Section	Upstream Section			
	macrolepidotum											
Black bullhead[2]	*Ameiurus melas*	U									R	
Yellow bullhead[2]	*Ameiurus natalis*						U					
Channel catfish	*Ictalurus punctatus*	C, U, R			U, R		A	C, U	R	C	C, U	
Stonecat	*Noturus flavus*	U			C		C	U			C, U, R	
Northern pike[2]	*Esox lucius*						R	R	R		U, R	
Yellowstone cutthroat trout	*Oncorhynchus clarki bouvieri*	R	C, U	C, U, R	R	R						
Rainbow trout[2]	*Oncorhynchus mykiss*	C	A, C, U	A, C, U	U, R	R	U	C, U	A	C		
Mountain whitefish	*Prosopium williamsoni*	A, C	A	A, C, U	C	A	U	U	C	C	C, U	
Brown trout[2]	*Salmo trutta*	C	A	A, C, U	R	U	U	C, U	A	C	C, R	
Brook trout[2]	*Salvelinus fontinalis*	R	A, U	C, U, R								C
Arctic grayling	*Thymallus arcticus*					R						
Burbot	*Lota lota*	C, U, R			C		C	C, U	R			
Plains killifish	*Fundulus zebrinus*							R				
Mottled sculpin	*Cottus bairdi*	A, C, U	C		R						A, C	
Green sunfish[2]	*Lepomis cyanellus*							R, I			R, I	
Smallmouth bass[2]	*Micropterus dolomieu*						C	U, R	R	C	C, U, R	
Largemouth bass[2]	*Micropterus salmoides*						R				I	
Black crappie[2]	*Pomoxis nigromaculatus*						I	I			I	

Table WIL-3

Common and Scientific Names and Relative Abundance of Fish Species Present in Major Drainages and Representative Tributaries in the Billings Resource Management Plan Area[1]

Common Name	Scientific Name	Yellowstone River West of Billings	Boulder River	Stillwater River	Clarks Fork of the Yellowstone		Yellowstone River East of Billings	Bighorn River		Little Bighorn River	Musselshell River	Careless Creek
					Downstream Section	Upstream Section		Downstream Section	Upstream Section			
Yellow perch[2]	*Perca flavescens*						R	R			U	
Sauger	*Stizostedion canadense*	U			R		U	U	R		C, U	
Walleye[2]	*Stizostedion vitreum*						R	U	R		R	
Freshwater drum	*Aplodinotus grunniens*						R	R			R	

[1]Information derived from the Montana Natural Resource Information System on the Internet at http://nris.state.mt.us/wis/mris1.html. Multiple values for relative abundance indicate variation among river reaches and/or study results within a given drainage. Relative abundance: A = abundant; C = common; U = uncommon; R = rare; I = incidental; P = present.

[2]Indicates species is not native.

Table WIL-4

Common and Scientific Names and Relative Abundance of Fish Species Present in Major Drainages and Representative Tributaries in the Powder River Resource Management Plan Area[1]

Common Name	Scientific Name	Yellowstone River	Rosebud Creek	Tongue River		Pumpkin Creek	Powder River		Little Powder River	Little Missouri River
				Downstream Section	Upstream Section		Downstream Section	Upstream Section		
Pallid sturgeon	*Scaphirhynchus albus*	R								
Shovelnose sturgeon	*Scaphirhynchus platorynchus*	A		A			A	A		
Paddlefish	*Polyodon spathula*	C		R						
Goldeye	*Hiodon alasoides*	A	U	A		U, R	C	C	C	U
Lake chub	*Couesius plumbeus*	R	U			C, U				C
Common carp[2]	*Cyprinus carpio*	A	C	C	C	C, U	R	C, U, R	U	U
Western silvery/plains minnow	*Hybognathus argyritis/placitus*	C, U		U		C	A	A, C	A	C
Brassy minnow	*Hybognathus hankinsoni*	R	R			C	R	R		
Sturgeon chub	*Macrhybopsis gelida*	U, R		R			C	C		
Golden shiner[2]	*Notemigonus crysoleucas*									C
Emerald shiner	*Notropis atherinoides*	A		C	C					
Sand shiner	*Notropis stramineus*	R		R		C	U	U	U	A
Northern redbelley/finescale dace	*Phoxinus eos/neogaeus*	U								
Fathead minnow	*Pimephales promelas*	C	U	C		A, C	C		C	C
Flathead chub	*Platygobio gracilis*	A	A	A	A	C, U	A	A	R	A
Longnose dace	*Rhinichthys cataractae*	U	C	C	U	U	U	C, U	R	C
Creek chub	*Semotilus atromaculatus*	R		R	R		R	R		C
River carpsucker	*Carpiodes carpio*	A	U	C	C	C, R	U	U	C	U
Longnose sucker	*Catostomus catostomus*	C	U	C	A					
White sucker	*Catostomus commersoni*	A	C	C	A	C, U	C		U	C

Table WIL-4

Common and Scientific Names and Relative Abundance of Fish Species Present in Major Drainages and Representative Tributaries in the Powder River Resource Management Plan Area[1]

Common Name	Scientific Name	Yellowstone River	Rosebud Creek	Tongue River		Pumpkin Creek	Powder River		Little Powder River	Little Missouri River
				Downstream Section	Upstream Section		Downstream Section	Upstream Section		
Mountain sucker	*Catostomus platyrhynchus*	U		U	C	R				
Blue sucker	*Cycleptus elongatus*			U						
Smallmouth buffalo	*Ictiobus bubalus*	C		U	C					
Bigmouth buffalo	*Ictiobus cyprinellus*	C		U						
Shorthead redhorse	*Moxostoma macrolepidotum*	A	A	A	A	C, U	U	C, U	A	A
Black bullhead[2]	*Ameiurus melas*		R	U	U	U				U
Yellow bullhead[2]	*Ameiurus natalis*			U	U					
Channel catfish	*Ictalurus punctatus*	A	C	A	C	C, U	C	C, U	C	C
Stonecat	*Noturus flavus*	A	U	C	C	U, R	U	U	U	
Northern pike[2]	*Esox lucius*	U	C	U	U					
Rainbow trout[2]	*Oncorhynchus mykiss*	R			U		R	U, R		
Mountain whitefish	*Prosopium williamsoni*		U		U					
Brown trout[2]	*Salmo trutta*	R			U			U		
Brook trout[2]	*Salvelinus fontinalis*		U					U		
Burbot	*Lota lota*	A	C	U			R	R		
Plains killifish	*Fundulus zebrinus*									U
Rock bass[2]	*Ambloplites rupestris*	R		U	C					
Green sunfish[2]	*Lepomis cyanellus*	R			U	U	R	R	U	U
Pumpkinseed[2]	*Lepomis gibbosus*	R		U	U	U				
Smallmouth bass[2]	*Micropterus dolomieu*	R								

Table WIL-4
Common and Scientific Names and Relative Abundance of Fish Species Present in Major Drainages and Representative Tributaries in the Powder River Resource Management Plan Area[1]

				Tongue River			Powder River			
Common Name	**Scientific Name**	**Yellowstone River**	**Rosebud Creek**	**Downstream Section**	**Upstream Section**	**Pumpkin Creek**	**Downstream Section**	**Upstream Section**	**Little Powder River**	**Little Missouri River**
Largemouth bass[2]	*Micropterus salmoides*	R								
White crappie[2]	*Pomoxis annularis*	U	R	U	U	U				
Black crappie[2]	*Pomoxis nigromaculatus*	U		R	R					
Yellow perch[2]	*Perca flavescens*	U		U						
Sauger	*Stizostedion canadense*	A	C	C	C	R	A	A, U		U
Walleye[2]	*Stizostedion vitreum*	C, U	U	U	C		R	R		
Freshwater drum	*Aplodinotus grunniens*	U								

[1]Information derived from the Montana Natural Resource Information System on the Internet at http://nris.state.mt.us/wis/mris1.html. Multiple values for relative abundance indicate variation among river reaches and/or study results within a given drainage. Relative abundance: A = abundant; C = common; U = uncommon; R = rare; I = incidental; P = present.

[2]Indicates species is not native.

Table WIL-5

Common and Scientific Names and Relative Abundance of Fish Species Present in Major Drainages and Representative Tributaries in Park, Gallatin, and Blaine Counties[1]

		Park County		Gallatin County				Blaine County				
Common Name	**Scientific Name**	**Yellowstone River**	**Shields Creek**	**Missouri River**	**Gallatin River**	**Madison River**	**Jefferson River**	**Missouri River**	**Cow Creek**	**Milk River**	**Lodge Creek**	**Peoples Creek**
Pallid sturgeon	*Scaphirhynchus albus*							R				
Shovelnose sturgeon	*Scaphirhynchus platorynchus*							C				
Paddlefish	*Polyodon spathula*							U				
Goldeye	*Hiodon alasoides*							C		C		
Lake chub	*Couesius plumbeus*							U		C	C	
Common carp[2]	*Cyprinus carpio*	R		A		U	C	C		C	C	U
Utah chub[2]	*Gila atraria*					U						
Western silvery/plains minnow	*Hybognathus argyritis/placitus*							C	C	U	C	C, U
Brassy minnow	*Hybognathus hankinsoni*									R		
Sturgeon chub	*Macrhybopsis gelida*							U				
Pearl dace	*Margariscus margarita*										U	
Emerald shiner	*Notropis atherinoides*							C		C	U	
Spottail shiner[2]	*Notropis hudsonius*									U		
Northern redbelley/finescale dace	*Phoxinus eos/neogaeus*									C	U	C
Fathead minnow	*Pimephales promelas*							U	C	C, U	A	
Flathead chub	*Platygobio gracilis*			A			U	A, C		C		C
Longnose dace	*Rhinichthys cataractae*	C, U	C, U	C	U	A	C	C	C	C	U	C
Redside shiner	*Richardsonius balteatus*						U					
River carpsucker	*Carpiodes carpio*							C		U		
Longnose sucker	*Catostomus catostomus*	A, C	A, U	C	C	A	C	C	C	U	R	U
White sucker	*Catostomus commersoni*	A, C	A, U	C	C	A	C		C	A	C	A, C

Table WIL-5
Common and Scientific Names and Relative Abundance of Fish Species Present in Major Drainages and Representative Tributaries in Park, Gallatin, and Blaine Counties[1]

		Park County		Gallatin County				Blaine County				
Common Name	**Scientific Name**	**Yellowstone River**	**Shields Creek**	**Missouri River**	**Gallatin River**	**Madison River**	**Jefferson River**	**Missouri River**	**Cow Creek**	**Milk River**	**Lodge Creek**	**Peoples Creek**
Mountain sucker	*Catostomus platyrhynchus*	U, R	C	R	U	U	R		R			R
Blue sucker	*Cycleptus elongatus*							U				
Smallmouth buffalo	*Ictiobus bubalus*							C		U		
Bigmouth buffalo	*Ictiobus cyprinellus*							U		U		
Shorthead redhorse	*Moxostoma macrolepidotum*	U, R						C		U		
Black bullhead[2]	*Ameiurus melas*									A, C	C	
Channel catfish	*Ictalurus punctatus*							A		U		
Stonecat	*Noturus flavus*			U		U		C		C	U	
Northern pike[2]	*Esox lucius*							U		C	C	U
Cisco[2]	*Coregonus artedi*							U				
Lake whitefish[2]	*Coregonus clupeaformis*									C	R	
Yellowstone cutthroat trout	*Oncorhynchus clarki bouvieri*	C, U	C, U, R		R							
Westslope cutthroat trout	*Oncorhynchus clarki lewisi*				R							
Rainbow trout[2]	*Oncorhynchus mykiss*	C	R	C	A	A, U	U			I		U
Mountain whitefish	*Prosopium williamsoni*	A	A, C	A	A	C	A					
Brown trout[2]	*Salmo trutta*	C	C, U	C	A, C, U	U	C					
Brook trout[2]	*Salvelinus fontinalis*	R	U		U	R			A			C
Arctic grayling	*Thymallus arcticus*				R							
Burbot	*Lota lota*			U			U	U		C, R		
Brook stickleback	*Culaea inconstans*									R	C	U
Mottled sculpin	*Cottus bairdi*	A	A, C	C	A, C	A	C		C			C

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Smallmouth bass[2]	*Micropterus dolomieu*									U		
Largemouth bass[2]	*Micropterus salmoides*			R								
Black crappie[2]	*Pomoxis nigromaculatus*									U		
Iowa darter	*Etheostoma exile*									U		
Yellow perch[2]	*Perca flavescens*					R				C	C	
Sauger	*Stizostedion canadense*							C		C	U	
Walleye[2]	*Stizostedion vitreum*							U		C	U	U
Freshwater drum	*Aplodinotus grunniens*							U				

[1]Information derived from the Montana Natural Resource Information System on the Internet at http://nris.state.mt.us/wis/mris1.html. Multiple values for relative abundance indicate variation among river reaches and/or study results within a given drainage. Relative abundance: A = abundant; C = common; U = uncommon; R = rare; I = incidental; P = present.

[2]Indicates species is not native.

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MONTANA

GLOSSARY

ABANDON. To cease producing gas from a well when it becomes unprofitable. A wildcat (exploration) well may be abandoned after it has been proven nonproductive. Usually, some of the casing is removed and salvaged, and one or more cement plugs placed in the borehole to prevent migration of fluids between formations.

ABNORMAL PRESSURE. Pressure exerted by a formation and exceeding or falling below the normal pressure to be expected at a given depth. Normal pressure increases approximately 0.465 psi per foot of depth. Formations with abnormally high pressure must be controlled to prevent a blowout.

ACRE-FOOT. A term used in measuring the volume of fluid. An acre-foot is the amount of fluid required to cover 1 acre to a depth of 1 foot, or 43,560 cubic feet (325,829 gallons).

AIR QUALITY. Air quality is based on the amount of pollutants emitted into the atmosphere and the dispersion potential of an area to dilute those pollutants.

ALKALINITY. The quantity and kinds of compounds present in water that collectively shift the pH to the alkaline side of neutrality. See **salinity**.

ALLOTMENT CATEGORIZATION. The grouping of livestock grazing allotments into the categories "M" (maintain current satisfactory condition), "I" (improve current unsatisfactory condition), and "C" (manage custodially while protecting existing resource values).

ALLUVIUM. General term for debris deposited by streams on river beds, floodplains, and alluvial fans, especially deposits brought down during a flood. Applies to stream deposits of recent time. Does not include below water sediments of seas and lakes.

ANIMAL UNIT. A standardized unit of measurement for range livestock or wildlife. Generally, one mature cow, one horse, five sheep, 9.6 antelope, 5.8 deer, or 1.9 elk, based on an average forage consumption of 26 pounds of dry matter per day.

ANIMAL UNIT MONTH. A standardized unit of measurement of the amount of forage necessary for the complete sustenance of one animal for one month; also, the measurement of the privilege of grazing one animal for one month.

ANNULUS OR ANNULAR SPACE. The space around a pipe in a wellbore, the outer wall of which may be the wall of either the borehole or the casing.

ANTICLINE. An arched, inverted-trough configuration of folded and stratified rock layers.

AQUIFER. A body of rock that is sufficiently permeable to conduct groundwater and to yield economically significant quantities of water to wells and springs.

APPLICATION FOR PERMIT TO DRILL, DEEPEN OR PLUG BACK (APD). The Department of Interior application permit form to authorize oil and gas drilling activities on federal land.

AREA OF CRITICAL ENVIRONMENTAL CONCERN. An area that needs special management attention to preserve historic, cultural, or scenic values; to protect fish and wildlife resources or other natural systems or processes; or to protect life and provide safety from natural hazards.

ARTESIAN. Groundwater with sufficient pressure to flow without pumping.

BANKHEAD-JONES FARM TENANT ACT OF 1937. This Act enabled the government to buy marginal farms and to put the farms back into grazing.

BASIN. A closed geologic structure in which the beds dip toward the center; the youngest rocks are at the center of a basin and are partly or completely ringed by progressively older rocks.

BEDROCK. The solid, unweathered rock underlying soils.

BEST AVAILABLE CONTROL TECHNOLOGY (BACT). The best available air pollution control technology for a given emission source as defined by the applicable air quality regulatory authority.

BITUMINOUS. The most abundant rank of coal (synonymous with soft coal). It is dark brown to black and burns with a smoky flame.

BLOCK MANAGEMENT. Through cooperation with the Montana Fish, Wildlife, and Parks, a Memorandum of Understanding allows the BLM, the private landowners, and Montana Fish, Wildlife, and Parks to close off some public lands administered by

BLM in exchange for opening up private lands to hunting. This is done on a rotating basis from year to year.

BLOOEY PIT. The pit that receives cuttings and other discharges from a well drilled with air.

BLOWOUT. An uncontrolled expulsion of gas, oil, or other fluids from a drilling well. A blowout, or "gusher," occurs when formation pressure exceeds the pressure applied to it by the column of drilling fluid and when blowout prevention equipment is absent or fails.

BLOWOUT PREVENTER. Equipment installed at the well head to prevent the escape of pressure either from the annular space between the casing and drill pipe or from an open hole during drilling and completion operations.

BRACKISH WATER. Water that contains relatively moderate concentrations of any soluble salts. Brackish water is saltier than fresh water but not as salty as salt water or brine water.

BRINE. Water containing relatively large concentrations of dissolved salts, particularly sodium chloride. Brine has higher salt concentrations than ordinary ocean water.

BRINE PIT. An excavated pit used to hold brine produced from a well.

BROWSE. As a verb, to consume or to feed on (as a plant); as a noun, the tender shoots, twigs, and leaves of trees and shrubs, often used as food by cattle, antelope, deer, elk, and other animals.

BUFFER ZONE.

1. An area between two different land uses that is intended to resist, absorb or otherwise preclude developments or intrusions between the two use areas.

2. A strip of undisturbed vegetation that retards the flow of runoff water, causing deposition of transported sediment and reducing sedimentation in the receiving stream.

CANOPY COVER. The percentage of ground area under an overstory vegetation that would not be impacted by raindrops falling straight down.

CASING. Steel pipe placed in a gas well to prevent the hole from caving.

CBM EMPHASIS AREA. For this environmental impact statement, the emphasis area is the Billings and Powder River RMP areas, and Blaine, Park, and Gallatin counties. This is the 16-county area within the BLM State and planning area where there is CBM development interest. See also **planning area**.

CHANNEL INTEGRITY (STABILITY). A relative term describing erosion or movement of the channel walls or bottom because of water flow.

CHECKERBOARD PATTERN. One in which ownership of sections of land alternates between federal and other ownership, usually private. On a map with different colors denoting type of ownership, the pattern resembles a checkerboard.

CLAYEY. A soil containing more than 35 percent clay. The textural classes are sandy clay, silty clay, clay, clay loam, and silty clay loam.

CLOSED MUD SYSTEM. A drill mud system that reuses or reclaims all the drilling fluid used. Oil-based mud systems are often closed mud systems.

COAL BED METHANE. A clean-burning natural gas found deep inside and around coal seams. The gas has an affinity to coal and is held in place by pressure from groundwater. Mining for coalbed methane involves drilling into coal seams and discharging large volumes of groundwater to release the gas.

COLLUVIAL. Loose, incoherent geological deposits at the bottom of a slope or cliff, having fallen from above.

COMPACTION. The process of packing firmly and closely together; the state of being so packed; for example, mechanical compaction of soil by livestock or vehicular activity. Soil compaction results from particles being pressed together so that the volume of the soil is reduced. It is influenced by the physical properties of the soil, moisture content, and the type and amount of compactive effort.

COMPLETION. The activities and methods to prepare a well for production. Includes installation of equipment for production from a gas well.

CONDITION OF APPROVAL (COA). Conditions or provisions (requirements) under which an Application for a Permit to Drill or a Sundry Notice is approved.

CONTINENTAL DEPOSITS. A sedimentary deposit laid down on land (whether a true continent or only an island) or in bodies of water (whether fresh or saline) not directly connected with the ocean, as opposed to a marine deposit; a glacial, stream, lake, or windborne deposit formed in a nonmarine environment.

CONTROLLED SURFACE USE (CSU). Use or occupancy is allowed (unless restricted by another stipulation), but identified resource values require special operational constraints that may modify the lease rights. CSU is used for operating guidance, not as a substitute for the NSO or Timing stipulations.

CORRIDOR. A strip of land through which one or more existing or potential facilities may be located.

CRUCIAL WINTER RANGE. That portion of the winter range on which a wildlife species is dependent for survival during periods of heaviest snow cover.

CULTURAL RESOURCE. A term that includes items of historical, archaeological, or architectural items; a remnant of human activity.

CUMULATIVE IMPACT. The impact on the environment that results from the positive or negative impacts of an action when added to other past, present, and reasonable foreseeable future actions, regardless of what agency or person performed such action(s).

DANCING GROUNDS. An area used in the spring by sharp-tailed grouse for courtship displays and breeding.

DECIBEL OR dB. A unit for measuring sound intensity, usually measured on the decibel A weighted scale (dBA) which approximates the sound levels heard by the human ear at moderate sound levels.

DECIVEW OR dV. A standard visual index appropriate for characterizing visibility through uniform hazes, designed to be linear with respect to perceived visual changes over its entire range (from pristine to polluted conditions) in a way that is analogous to the decibel scale for sound. The deciview haze index is calculated based on the logarithmic distribution of the extinction coefficient, where a 10.0 deciview change is about a 10 percent change in extinction coefficient; a small but perceptible scenic change under many circumstances ("just noticeable change").

DEVELOPMENT WELL. A well drilled in proven territory (usually within 1 mile of an existing well).

DISPOSAL WELL. A well into which produced water from other wells is injected into an underground formation for disposal.

DRAINAGE (GEOMORPHIC). A collective term for all the water bodies by which a region is drained; or, all the water features shown on a map.

DRAINAGE (OIL AND GAS). The uncompensated loss of hydrocarbons from Federal, Indian tribal or Indian-allotted mineral lands from wells on adjacent non-jurisdictional lands or jurisdictional lands with lower participation, allocation, royalty rate, or distribution of funds, resulting in revenue losses to the Federal or Indian lessors.

DRILL RIG. The mast, drawworks, and attendant surface equipment of a drilling or workover unit.

DRILL STEM TEST. The use of a drill-stem testing tool to test a formations potential productivity. The tool is lowered to the formation and is packed off from the above formations. The tool is then operated to sample the formation and the results recorded. Also, called a formation test.

DROP STRUCTURE. An in-stream structure of various materials designed to reduce the energy and force of stream flow.

DRY HOLE. Any well incapable of producing oil or gas in commercial quantities. A dry hole may produce water, gas or even oil, but not enough to justify production.

ECOLOGICAL CONDITION. The present state of vegetation of a site in relation to the potential natural community for the site. Ecological status is use independent. It is an expression of the relative degree to which the kinds, proportions, and amounts of plants in a plant community resemble that of the potential natural community. Four ecological status classes correspond to 0-25, 26-50, 51-75, or 76-100 percent similarity to the potential natural community and are generally called early seral, mid-seral, late seral, and potential natural community, respectively.

ECOLOGICAL SITE. A kind of land with a specific potential natural community and specific physical site characteristics, differing from other kinds of land in its ability to produce vegetation and to respond to management.

ECOSYSTEM. A biological community, together with its nonliving environment, forming an interacting system inhabiting an identifiable space.

EMERGENT AQUATIC VEGETATION. An aquatic plant having part of its vegetative parts above water.

ENDANGERED SPECIES. Those species of plants or animals classified by the Secretary of the Interior or the Secretary of Commerce as endangered pursuant to Section 4 of the Endangered Species Act of 1973, as amended. See also Threatened and Endangered Species.

ENHANCED RECOVERY. The use of artificial means to increase the amount of hydrocarbons that can be recovered from a reservoir. A reservoir depleted by normal extraction practices usually can be restored to production by secondary or tertiary methods of enhanced recovery.

ENTRAINED PARTICULATES. Particulates contained within auto exhaust; mainly made of carbons.

EPHEMERAL STREAM. A stream that flows only after a storm or during snowmelt, and whose channel is, at all times, above the water table.

EPOCH. An interval of time based on similar rock formations and fossil groups. Used primarily as subdivisions of the Tertiary and Quaternary Periods.

EXPLORATION. Building a two-track road to drill test wells for coalbed methane. See also **development**.

EXPLORATION WELL. A well drilled in an area where there is no oil or gas production. Same as a "wildcat" well.

FAULT. A fracture surface in rocks along which movement of rock on one side has occurred relative to rock on the other side.

FLOODPLAIN. The relatively flat area or lowlands adjoining a body of standing or flowing water that has been or might be covered by floodwater.

FLOW LINE. A small diameter pipeline through which fluids move on lease before being sold.

FORAGE. Forms of vegetation available for animal consumption.

FORB. A broad-leaved herb that is not grass or grasslike.

FORMATION (GEOLOGIC). A rock body distinguishable from other rock bodies and useful for mapping or description. Formations may be combined into groups or subdivided into members.

FRAC FLOWBACK. During the drilling process, fluid or product returns along fractures in the rock to the point where it is difficult to control; for example, flowback from a point high in the borehole or at the ground surface away from the boring.

GABIONS. A hollow cylinder of wickerwork or strap iron constructed like a basket, filled with stones and sunk to form a bar, dike, or similar structure.

GEOMORPHIC. Pertaining to the form of the earth or its surface features.

GROUND COVER. Vegetation, mulch, litter, or rocks.

GROUNDWATER. Subsurface water that is in the zone of saturation. The top surface of the groundwater is the "water table." Source of water for wells, seepage, and springs.

GULLYING. The erosion process whereby water accumulates in narrow channels and, over short periods, removes the soil from the narrow area to considerable depths, ranging from 2 feet to as much as 80 to 100 feet deep.

GULLY PLUG. Any form of material placed in an existing gully to reduce the erosional effects of moving water and thereby starting a healing process of the gully.

HABITAT. In wildlife management, the major elements of habitat are considered to be food, water, cover, and living space.

HAZARDOUS WASTE. (A) Any substance designated pursuant to section 311(b)(2)(A) of the Federal Water Pollution Control Act. (B) Any element, compound, mixture, solution, or substance designated pursuant to section 102 of this Act. (C) Any hazardous waste having the characteristics identified under or listed pursuant to section 3001 of the Solid Waste Disposal Act (but not including any waste the regulation of which under the Solid Waste Disposal Act has been suspended by Act of Congress. (D) Any toxic pollutant listed under section 307(a) of the Federal Water Pollution Control Act. (E) Any hazardous air pollutant listed under section 112 of the Clean Air Act. (F) Any imminently hazardous chemical substance or mixture with respect to which the Administrator has taken action pursuant to section 7 of the Toxic Substances Control Act. The term does not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a hazardous substance under subparagraphs (A) through (F) of this paragraph, and the term does not include natural gas, natural gas liquids, liquefied natural gas, or synthetic gas usable for fuel (or mixtures of natural gas and such synthetic gas).

HYDROGEN SULFIDE or H_2S. A colorless, inflammable, cumulatively poisonous gas that smells like rotten eggs. May be present in some oil or gas wells.

INFILTRATION. The flow of a fluid into a solid substance through pores or small openings; specifically, the movement of water into soil or porous rock.

INJECTION WELL. A well used to inject fluids into an underground formation to increase reservoir pressure.

INTERMITTENT STREAM. A stream that flows most of the time but occasionally is dry or reduced to pool stage when losses from evaporation or seepage exceed the available streamflow.

LAND AND WATER CONSERVATION FUNDS. Federal revenues generated by a tax on federal off-shore oil and gas development through the Land and Water Conservation Fund Act; used to acquire highly desirable lands for the United States by the various governmental agencies.

LEASABLE MINERALS. Federal minerals subject to lease under the Mineral Leasing Act of 1920, as amended, and supplemented. Includes minerals, such as oil, gas, coal, geothermal, tar sands, oil shale, potassium, phosphate, sodium, asphaltic materials.

LEASE.

1. A legal document that conveys to an operator the right to drill for oil and gas.

2. The tract of land, on which a lease has been obtained, where producing wells and production equipment are located.

LEASE NOTICE. Provides more detailed information concerning limitations that already exist in law, lease terms, regulations, or operational orders. A lease notice also addresses special items the lessee should consider when planning operations, but does not impose new or additional restrictions. Lease notices attached to leases should not be confused with NTLs (Notices to Lessees).

LEK. A traditional breeding area for grouse species where territorial males display and establish dominance.

LIGNITE. A brownish-black coal that is intermediate between peat and subbituminous coal.

LITHIC SCATTER. The waste material, chips, and flakes resulting from stone tool manufacture.

LOAMY. Soil that is intermediate in texture and properties between sandy and clayey soils. Textural classes are sandy loam, fine sandy loam, very fine sandy loam, loam, silt loam, sandy clay loam, and clay loam with clay content between 18 and 35 percent.

LOCALITY. The area where paleontologic material is discovered.

LOCATABLE MINERALS. Minerals or materials subject to disposal and development through the Mining Law of 1872 (as amended). Generally includes metallic minerals such as gold and silver and other materials not subject to lease or sale.

MESIC AREA. A habitat having a moderate amount of moisture available for the support of plant life.

MINERAL MATERIALS. Widespread deposits of common clay, sand, gravel, or stone that are not subject to disposal under the 1872 Mining Law, as amended.

MITIGATION MEASURES. Methods or procedures developed for the purpose of reducing or lessening the impacts of an action.

MONITORING. Specific studies that evaluate the effectiveness of actions taken toward achieving management objectives.

NO SURFACE OCCUPANCY. Use or occupancy of the land surface for fluid mineral exploration or development is prohibited to protect identified resource values.

NOTICE TO LESSEES (NTL). The NTL is a written notice issued by the Authorized Officer. NTLs implement regulations and operating orders, and serve as instructions on specific item(s) of importance within a State, District, or Area.

PARENT MATERIAL. The unconsolidated and chemically-weathered mineral or organic matter from which the horizons of soils develop by natural processes.

PARTICULATE MATTER. Finely divided solid or liquid particles in the air or in an emission, including dust, smoke fumes, mist, spray and fog.

PERENNIAL STREAM. A permanent stream that flows 9 months or more out of the year.

PERMEABILITY. The ease with which gases, liquids or plant roots pass through a layer of soil. Accepted as a measure of this property is the rate at which soil transmits water while saturated, and may imply how well water passes through the least permeable soil layer.

pH. A measure of acidity or alkalinity. A solution with a pH of 7 is neutral, pH greater than 7 (to 14) is alkaline, and a pH less than 7 (to 0) is acidic.

POST-FLPMA LEASES. Oil and gas leases issued after the passage of the Federal Land Policy and Management Act of 1976. Where occurring in Wilderness Study Areas, these leases have no valid existing rights and could not impair wilderness values.

POTENTIAL NATURAL COMMUNITY. The biotic community that would become established if all successional sequences were completed without interferences under the present environmental conditions.

PARTS PER MILLION (PPM). A measurement to identify the amount of particulates in air or water.

POD. Describes the general location of a series of wells that tap individual coal seams within a single 80-acre spacing unit. For example, within the Powder River Basin, three coal seams are layered beneath the surface. On the surface, an operator may drill three separate wells to different depths to tap these individual seams. The wells may be located within 20 feet of each other, representing a pod of wells.

PRAIRIE DOG COLONY COMPLEX. A group of prairie dog colonies distributed so that individual black-footed ferrets can migrate among them commonly and frequently. This distance has been determined to be 7 kilometers (4.4 miles).

PRE-FLPMA LEASES. Oil and gas leases issued prior to the passage of the Federal Land Policy and Management Act of l976. Where occurring in Wilderness Study Areas, these leases have valid existing rights which allow development even if wilderness values may be impaired.

PREVENTION OF SIGNIFICANT DETERIORATION OR PSD. A system established by the Clean Air Act to prevent areas with existing clean air from degrading up to levels of the National Ambient Air Quality Standards. There are three classes of locations, each allowing incremental degradation beyond legally defined “baseline” levels:

> **Class I.** An area that allows only minimal degradation above “baseline.” The Clean Air Act designated existing national parks over 6,000 acres and national wilderness areas over 5,000 acres in existence on August 7, 1977, as mandatory Federal Class I Areas. These areas also have special visibility protection. In addition, four tribal governments have redesignated their lands as Class I Areas.
>
> **Class II.** An area that allows moderate degradation above “baseline.” Most of the United States (outside nonattainment areas) is Class II.
>
> **Class III.** Any area that allows the maximum amount of degradation above “baseline.” Although the U.S. Congress allows air quality regulatory agencies to redesignate Class II lands to Class III, none have been designated.

PRODUCED WATER. Water produced from oil and gas wells.

RAPTOR. Bird of prey with sharp talons and strongly curved beaks (hawks, falcons, owls, and eagles).

RECLAMATION. Rehabilitation of a disturbed area to make it acceptable for designated uses. This normally involves regrading, replacement of topsoil, revegetation, and other work necessary to restore it for use.

RESERVE PIT.

> 1. Usually an excavated pit that may be lined with plastic, that holds drill cuttings and waste mud.
>
> 2. Term for the pit that holds the drilling mud.

RIGHT-OF-WAY GRANT. A document authorizing a nonpossessory, nonexclusive right to use federal lands for the limited purpose of construction, operation, maintenance, and termination of a pipeline, road, or powerline.

RILL. Small, conspicuous water channel or rivulet that concentrates runoff; usually less than 6 inches deep.

RIPARIAN/WETLAND AREA. An area of land directly influenced by permanent water. It has visible vegetation or physical characteristics reflective of permanent water influence. Lakeshores, streams and permanent springs are typical riparian areas. Excluded are such sites as ephemeral streams or washes that do not exhibit the presence of vegetation dependent upon free water in the soil.

ROAD. A vehicle route that has either been improved and maintained by mechanical means to ensure relatively regular and continuous use, or been established where vehicle travel has created two parallel tracks lacking vegetation.

SALINITY. A measure of the salts dissolved in water. See **alkalinity**.

SEDIMENT. Soil, rock particles and organic or other debris carried from one place to another by wind, water, gravity, ice, or other geologic agent.

SEDIMENTARY ROCK. A layered rock resulting from the consolidation of sediment, such as shale, sandstone, and limestone.

SEISMIC OPERATIONS. Use of explosive or mechanical thumpers to generate shock waves that can be read by special equipment to give clues to subsurface conditions.

SERAL COMMUNITY. One of a series of plant communities that follow one another in time on any given area.

SERAL STAGE. A potential plant community made up of a mix of trees and shrubs.

SHEET EROSION. The detachment of soil material from the land surface by raindrop impact and its subsequent removal by runoff.

SHUT IN. To close the valves on a well so it ceases production.

SHRUB. A low, woody plant, usually with several stems; may provide food and/or cover for wildlife.

SODIUM-AFFECTED SOIL. A nontechnical term for sodic soil (also called alkali soil) that contains sufficient sodium to interfere with the growth of most crop plants and in which the exchangeable sodium percentage is 15 or higher. It is also a generic way of describing nonsaline-alkali soil or saline-alkali soil.

SOIL DEPTH CLASSES. Classes overlap from 0 to 60 or more inches with specific depths as follows: very shallow 0-10 inches, shallow from 5-30 inches, moderately deep from 20-50 inches, deep from 30-60 inches, and very deep from 50 to more than 60 inches.

SOIL SERIES. The lowest category of soil classification, being a subdivision of a family and consisting of soils which are essentially alike in all major profile characteristics except in the texture of the "A" horizon (or surface layer).

SOIL SURVEY. The systematic examination, description, classification, and mapping of soils in an area, usually a county. Soil surveys are classified according to the level of detail of field examination. Order I is the most detailed, then Order II, on to Order V which is the least detailed. Most BLM soil surveys are Order II or III.

SOLID WASTE. Any solid, semi-solid, liquid, or contained gaseous material that is intended for disposal.

SOUR WELL. A condition caused by the presence of hydrogen sulfide in an oil or gas well.

SPACING UNIT. The number of acres that one oil or gas well will efficiently drain. The Montana Oil and Gas Commission establishes the size of spacing units for each oil and gas field.

SPECIES OF SPECIAL INTEREST OR CONCERN. Animals not yet listed as endangered or threatened but that are undergoing status review by a federal or state agency. This may include animals whose populations could become extinct by any major habitat change. A species that is particularly sensitive to some external disturbance factors.

SPLIT ESTATE. Surface and minerals of a given area in different ownerships. Frequently, the surface is privately-owned while the minerals are federally-owned.

SPUDDING. To begin drilling; to start the hole.

STEEP SLOPE. Slope greater than 30 percent.

STEP OUT WELL. A well drilled some distance from a proven well to determine the limits of the oil or gas reservoir.

STIPULATION. A condition or requirement attached to a lease or contract, usually dealing with protection of the environment, or recovery of a mineral.

STRUCTURAL IMPROVEMENTS. Improvements such as fences, reservoirs, springs, pipelines, waterspreaders, wells, water troughs, land treatments and instream structures. These improvements are for the livestock grazing, wildlife, recreation, watershed and soils programs.

STRUTTING GROUND. An area used in the spring by sage grouse for courtship displays and breeding. Synonymous with the term "lek."

SUBBITUMINOUS. A black coal, intermediate in rank between lignite and bituminous coal. Distinguished from lignite by higher carbon and lower moisture content.

SULFUR DIOXIDE OR SO_2. A colorless gas formed when sulfur oxidizes, often as a result of trace amounts of sulfur in fossil fuels.

SWEET WELL. An oil or gas well lacking any significant amounts of hydrogen sulfide.

SYNCLINES. A downward, trough-shaped configuration of folded, stratified rocks.

TERRACE DEPOSITS. A terrace is one of a series of level surfaces in a stream valley, flanking and more or less parallel to the stream channel. It is above the level of the stream, and represents the dissected remnants of an abandoned flood plain, stream bed, or valley floor produced during a former stage of erosion or deposition.

TOTAL DISSOLVED SOLIDS (TDS). The dry weight of dissolved material, organic and inorganic, contained in water.

TMDL (Total Maximum Daily Load). A TMDL is the total amount of a pollutant that a water body may receive from all sources without exceeding water quality standards. A TMDL can also be defined as a reduction in pollutant loading that results in meeting water quality standards.

TRANSMISSION LINE. A large diameter pipeline through which oil or gas moves off lease after being sold.

TURBIDITY. An interference to the passage of light through water due to insoluble particles of soil, organic material, micro-organisms, and other materials.

UNDERGROUND INJECTION CONTROL PROGRAM. A program administered by the Environmental Protection Agency, primacy State, or Indian Tribe under the Safe Drinking Act to ensure that subsurface waste injection does not endanger underground sources of drinking water.

UNDERSTORY VEGETATION. Plants, usually grasses, forbs, and low shrubs, growing beneath the canopy of other plants.

USABLE WATER. Those waters containing up to 10,000 parts per million of total dissolved solids.

VIEWSHED. Landscape that can be directly seen under favorable atmospheric conditions, from a viewpoint or along a transportation corridor.

WATER QUALITY. The chemical, physical, and biological characteristics of water with respect to its suitability for a particular use.

WATERSHED. All lands which are enclosed by a continuous hydrologic drainage divide and lie upslope from a specified point on a stream.

WELL COMPLETION. See **completion**.

WETLANDS. Permanently wet or intermittently flooded areas where the water table (fresh, saline, or brackish) is at, near, or above the soil surface for extended intervals; where hydric wet soil conditions are normally exhibited, and where water depths generally do not exceed two meters.

WILDCAT. A well drilled in an area where no oil or gas production exists.

WILDCAT WELL. An exploratory well drilled in an area where there is no oil or gas production (see exploration well).

WILDERNESS STUDY AREA (WSA). An area deter-mined to have wilderness characteristics. WSAs are submitted to the President and Congress for wilderness designation. These areas are an interim designation, valid until either designated as wilderness or released to multiple-use management.

WORKOVER. To perform one or more remedial operation on a producing well to increase production. Deepening, plugging back, pulling, and resetting the liner are examples of workover operations.

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