Western Energy Company's Rosebud Mine Area F

Final Environmental Impact Statement

November 2018

OFFICE OF SURFACE MINING RECLAMATION AND ENFORCEMENT

DEQ
Montana Department of Environmental Quality

Estimated OSMRE Total Costs Associated with Developing and Producing this EIS:

$1,805,000 (Approximate)

Western Energy Area F
Final Environmental Impact Statement

Montana Department of Environmental Quality
Office of Surface Mining Reclamation and Enforcement

Lead Agencies:	U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement (OSMRE) Montana Department of Environmental Quality (DEQ)	
Cooperating Agencies:	U.S. Department of the Interior, Bureau of Land Management	
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Abstract: This Final Environmental Impact Statement (EIS) describes the land, people, and resources potentially affected by Western Energy Company's (Western Energy) proposed new permit area (C2011003F), known as Area F (project or project area), at the existing Rosebud Mine, which surrounds the city of Colstrip, Montana, and the Colstrip Steam Electric Station (Colstrip Power Plant).

If DEQ approves the Area F permit and a new federal mining plan is approved as proposed, then 6,746 permit acres would be added to the Rosebud Mine. Mining operations in the project area would last 19 years, and about 70.8 million tons of recoverable coal would be removed. As with other permit areas of the Rosebud Mine, all coal mined in the project area would be sold and combusted locally at two power plants—the Colstrip and Rosebud Power Plants. At the current rate of production, mining in the project area would extend the operational life of the Rosebud Mine by 8 years.

The proposed project area is located in Rosebud and Treasure Counties adjacent to existing Permit Area C, about 12 miles west of Colstrip. The surface lands of the project area are privately owned, but the subsurface lands (coal) are owned by both federal and private entities and leased to Western Energy. Current land uses include grazing land, pastureland, cropland, and wildlife habitat. Tributaries of Horse Creek and West Fork Armells Creek, which lie within the Yellowstone River watershed, drain the project area. The area of disturbance within the project area would be 4,260 acres. Of these, 2,159 acres would be disturbed by mining; the remainder would be disturbed by highwall reduction, soil storage, scoria pits, haul-road construction, and other miscellaneous disturbances.

This EIS analyzes in detail the proposed project, known as the Proposed Action (Alternative 2), along with No Action (Alternative 1). One action alternative (Alternative 3), which modifies the Proposed Action to include additional environmental protection measures above those required under the Montana Strip and Underground Mine Reclamation Act, is also analyzed. DEQ and OSMRE, the two respective lead agencies, prepared this EIS in compliance with the Montana Environmental Policy Act and the National Environmental Policy Act.

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Contents

Tables

Figures

Appendices

LIST OF ACRONYMS AND ABBREVIATIONS

AADT	annual average daily traffic
ACHP	Advisory Council on Historic Preservation
ACI	Energy
ACS	American Community Survey
AHR	Annual Hydrology Report
AML	abandoned mine lands
AMM	abandoned mine methane
AMPD	U.S. Environmental Protection Agency Clean Air Markets Program Data
AMRF	Abandoned Mine Reclamation Fund
AOC	Administrative Order of Consent
APE	area of potential effect
AQS	Air Quality Service
AR5	Fifth Assessment Report of the IPCC
ARM	Administrative Rules of Montana
ARMP	Approved Resource Management Plan
asl	above sea level
ASLM	Assistant Secretary for Land and Minerals Management
AUM	animal unit month
AVF	alluvial valley floor
BACT	Best Available Control Technology
BART	Best Available Retrofit Technology
BGEPA	Bald and Golden Eagle Protection Act of 1940
BLM	Bureau of Land Management
BLM-MT/DK	Bureau of Land Management Montana/Dakotas
BLS	U.S. Department of Labor, Bureau of Labor Statistics
BMP	Best Management Practices
BP	before present
BTCA	best technology currently available
BTU	British thermal units
CAA	Clean Air Act
CAMx	Comprehensive Air Quality Model with Extensions
CAP	criteria air pollutant
CASTNET	Clean Air Status and Trends Network
CCAC	Climate Change Advisory Committee
CCR	coal combustion residuals
CDC	Center for Disease Control
CELP	Colstrip Energy Limited Partnership
CEMS	Continuous Emissions Monitoring System
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERP	Contingency and Emergency Response Plan
CFB	circulating fluidized bed
CFR	Code of Federal Regulations
cfs	cubic feet per second
cf/t	cubic feet per short ton
CH_4	methane
CHIA	cumulative hydrologic impacts assessment
CMM	coal mine methane

CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COPC	chemicals of potential concern
Corps	U.S. Army Corps of Engineers
CPRD	Colstrip Park and Recreation District
CSAPR	Cross-State Air Pollution Rule
CWA	Clean Water Act
dB	decibel
dBA	decibel (A-weighted)
DEQ	Montana Department of Environmental Quality
DNRC	Montana Department of Natural Resources and Conservation
DOI	U.S. Department of the Interior
DPM	diesel particulate matter
dv	deciview
DV	design value
EC	electrical conductivity
Eco-SSL	ecological soil screening level
EHP	effluent holding pond
EIA	Energy Information Administration
EIS	Environmental Impact Statement
ELG	effluent limit guidelines
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
ERA	ecological risk assessment
ERO	Resources Corporation
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FGDM	flue gas desulfurization material
FLIGHT	Facility Level Information on Greenhouse Gases Tool
FLPMA	Federal Land Policy and Management Act
FR	Federal Register
FWP	Montana Fish, Wildlife & Parks
FY	fiscal year
GHG	greenhouse gas
GIS	geographic information systems
GNP	Great Northern Properties LP
gpm	gallons per minute
Gt	gigatons
Guidelines	Clean Water Act Section 404(b)(1) Guidelines
GWP	Global Warming Potential
HAP	hazardous air pollutant
HFC	hydrofluorocarbons
Hg	mercury
HHRA	human health risk assessment
HI	hazard index
HVTL	high voltage transmission line
HWC	Hazardous Waste Coordinator
ICMM	International Council on Mining and Metals
IMPROVE	Interagency Monitoring of Protected Visual Environments

IPAC	USFWS Information, Planning, and Conservation System
IPCC	Intergovernmental Panel on Climate Change
kg/ha	kilograms per hectare
kV	kilovolt
L_{dn}	day-night average noise level
L_{eq}	equivalent noise level
LANL	Los Alamos National Laboratory
LBA	lease by application
LBM	lease by modification
LOAEL	lowest observed adverse effect level
LQG	Large Quantity Generator
m/s	meters per second
MAAQS	Montana Ambient Air Quality Standards
MAQP	Montana Air Quality Permit
MBTA	Migratory Bird Treaty Act
MCA	Montana Code Annotated
MCFO	Miles City Field Office
MDA	Montana Department of Agriculture
MDHHS	Montana Department of Health and Human Services
MDN	Mercury Deposition Network
MDSL	Montana Department of State Lands
MDT	Montana Department of Transportation
MEGAN	Model of Emissions of Gases and Aerosols in Nature
MEIC	Montana Environmental Information Center
MEMS	Mercury Emissions Monitoring System
MEPA	Montana Environmental Policy Act
MFSA	Major Facility Siting Act
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mg/m^3	milligrams per cubic meter
MLA	Mineral Leasing Act
MMT	million metric tons
$MMtCO_2e$	million metric tons of carbon dioxide equivalent
MNHP	Montana Natural Heritage Program
MOA	memorandum of agreement
MOU	Memorandum of Understanding
MOVES	Motor Vehicle Emissions Simulator
MP	milepost
MPDD	Mining Plan Decision Document
MPDES	Montana Pollutant Discharge Elimination System
mph	miles per hour
MQAP	Montana Quality Assurance Plan
MSGWG	Montana Sage-Grouse Working Group
MSHA	Mine Safety and Health Administration
MSU	Montana State University
MSUMRA	Montana Strip and Underground Mine Reclamation Act
MT	Montana
MW	megawatts
MWAM	Montana Department of Transportation Wetland Assessment Method
MYED	Mid Yellowstone Electric Cooperative Inc.
N_2O	nitrous oxide

NAAQS	National Ambient Air Quality Standards
NADP	National Atmospheric Deposition Program
NCA	National Climate Assessment
NCAR	National Center for Atmospheric Research
NCCV	National Climate Change Viewer
ND	normalized difference
NEI	National Emissions Inventory
NEPA	National Environmental Policy Act
NLEB	northern long-eared bat
NO_x	nitrogen oxide
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NOAEL	no observed adverse effect level
NOI	Notice of Intent
NHPA	National Historic Preservation Act
NRC	National Research Council
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSPS	New Source Performance Standards
NSR	New Source Review
NTN	National Trends Network
NWR	National Wildlife Refuge
O_3	ozone
OEA	Office of Environmental Analysis
OSAT	Ozone Source Apportionment Technology
OSHA	Occupational Safety and Health Administration
OSMRE	Office of Surface Mining Reclamation and Enforcement
PA	programmatic agreement
PAP	permit application package
PCI	per-capita income
PD	Preliminary Determination
PFYC	Potential Fossil Yield Classification
PHC	probable hydrologic consequences
PM	particulate matter
PLS	pure live seed
PMT	postmine topography
ppb	parts per billion
PPE	personal protective equipment
PPL	Colstrip Power Plant
ppm	parts per million
ppt	parts per trillion
PSAT	Particulate Source Apportionment Technology
PSD	Prevention of Significant Deterioration
PTE	potential to emit
QA	quality assurance
QC	quality control
RCP	representative concentration pathway
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
RRA	Resource Recovery Act
RRPP	Resource Recovery and Protection Plan

RMP	Resource Management Plan
SAR	sodium adsorption ratio
scf	standard cubic feet
SCORP	Montana State Comprehensive Outdoor Recreation Plan
SEDCAD	Sediment, Erosion, Discharge by Computer Aided Design
SFHA	Special Flood Hazard Area
SH	State Highway
SHPO	State Historic Preservation Office
SHWMP	Solid and Hazardous Waste Management Plan
SIP	State Implementation Plan
SMCRA	Surface Mining Control and Reclamation Act
SOC	Species of Concern
SO_2	sulfur dioxide
SPCCMP	Spill Prevention Control and Counter Measure Plan
SSL	soil screening level
STEP	stage two evaporation pond
T&E	Threatened and Endangered
TBTU	trillion British thermal units
TCLP	Toxicity Characteristic Leaching Procedure
TCP	traditional cultural property
THC	total hydrocarbon
TMDL	Total Maximum Daily Load
tpy	tons per year
TRI	Toxic Release Inventory
TRRC	Tongue River Railroad Company Inc.
TRV	toxicity reference value
TSDF	treatment, storage, and disposal facility
UCL	Upper Confidence Limit
UDP	Unanticipated Discovery Plan
USC	United States Code
USDA	U.S. Department of Agriculture
USFS	USDA Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UWPHI	University of Wisconsin Population Health Institute
VER	valid existing rights
VOC	volatile organic compound
VRM	Visual Resource Management
Water Rights Bureau	Montana Department of Natural Resources and Conservation, Water Resources Division, Montana Water Rights Bureau
W/m^2	watts per square meter
WCI	Western Climate Initiative
WEPP	USDA Water Erosion Prediction Project
WGIII	Working Group III
WRAP	Western Regional Air Partnership
WRI	World Resources Institute
$\mu g/m^3$	micrograms per cubic meter
µS/cm	micro Siemens/centimeter

GLOSSARY

active mining period	Areas in a surface mining operation where mining is taking place or areas where mining is complete and reclamation activities are taking place.
air pollutant	Any substance in air that could, in high enough concentration, harm animals, humans, vegetation, and/or materials. Such pollutants may be present as solid particles, liquid droplets, or gases. Air pollutants fall into two main groups: (1) those emitted from identifiable sources and, (2) those formed in the air by interaction between other pollutants.
air quality	A measure of the health-related and visual characteristics of the air, often derived from quantitative measurements of the concentrations of specific injurious or contaminating substances.
air quality modeling	A mathematical simulation of how air pollutants disperse and react in the atmosphere to affect ambient air quality.
air quality related values	Air quality related values (AQRVs) are resources sensitive to air quality and include a wide array of vegetation, soils, water, fish and wildlife, and visibility.
alkalinity	The extent to which water or soil contains soluble mineral salts.
alluvium	Unconsolidated material that is deposited by flowing water.
alternative	A NEPA term that refers to a way of achieving the same purpose and need for a project that is different from the recommended proposal; alternatives should be studied, developed, and described to address any proposal which involves unresolved conflicts concerning different uses of available resources. Analysis scenarios presented in a comparative form, to facilitate a sharp definition of the issues resulting in a basis for evaluation among options by the decision maker and the public.
ambient	Surrounding, existing. Of the environment surrounding a body, encompassing on all sides. Most commonly applied to air quality and noise.
anaerobic decomposition	The decomposition of organic material without oxygen, resulting in the release of methane and other anaerobic products.
analysis area	The geographical area being targeted in the analysis as related to the area of the proposed project.
annuals	Plants that complete their life cycle and die in one year or less.
anthropogenic	Impacts originating in human activity.
appropriation	The act of diverting, impounding, or withdrawing, including by stock for stock water, a quantity of water for a beneficial use.
aquifer	A water-bearing geological formation capable of yielding water in sufficient quantity to constitute a usable supply.
attainment area	An area that the U.S. Environmental Protection Agency has designated as being in compliance with one or more of the National Ambient Air Quality Standards (NAAQS) for sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and particulate matter. An area may be in attainment for some pollutants but not for others.
backfilling and grading	The operation of refilling an excavation and finishing the surface.
Bald and Golden Eagle Protection Act	An act enacted in 1940 that prohibits "take" of a bald or golden eagle without a permit from the Secretary of the Interior. "Take" is defined as "take, possesses, sell, purchase, barter, offer to sell, export, or import, at any time or in any manner, any bald eagle … [or any golden eagle], alive or dead, or any part, nest, or egg thereof."

baseflow	The contribution of near-channel alluvial ground water and deeper bedrock ground water to a stream channel.
baseline	The existing conditions against which impacts of the alternatives are compared.
Best Management Practices	Structural, non-structural, and managerial techniques that are recognized to be the most effective and practicable means to reduce or prevent water pollution.
bioavailable	The state of a toxicant such that there is increased physicochemical access to the toxicant by an organism. The less the bioavailability of a toxicant, the less its toxic effect on an organism.
biodiversity	A term that describes the variety of life-forms, the ecological role they perform, and the genetic diversity they contain.
blasting	The act of removing, opening, or forming by or as if by an explosive.
bond liability	The time period consisting of four reclamation phases that correspond to bond release. See Section 1.6.4 for definitions of the four reclamation phases in the bond liability period.
bond release	Return of a performance bond to the coal operator after the regulatory agency has inspected and evaluated the completed reclamation operations and determined that all regulatory requirements have been satisfied.
borrow materials	Soil or rock dug from one location to provide fill at another location.
box cut	The initial mine cut made through the overburden to expose a portion of a coal seam.
broadcast seeding	A means of planting where seed is distributed on the ground surface mechanically or by hand.
candidate species	Those species under consideration for possible listing as “endangered” or “threatened” in accordance with the 1973 Endangered Species Act.
carbon cycle	The biogeochemical cycle by which carbon is exchanged, or cycled, among Earth’s oceans, atmosphere, ecosystem, and geosphere.
carbon sequestration	The process by which atmospheric carbon dioxide is taken up by trees, grasses, and other plants through photosynthesis and stored as carbon in biomass and soil. The sink of carbon sequestration in forests and wood products helps offset sources of carbon dioxide to the atmosphere, such as deforestation, forest fires, and fossil fuel emissions.
carcinogenic parameters	Elements or compounds capable of causing cancer.
carrying capacity	The maximum number of animals that can be sustained over the long term on a specified land area.
catchment	A geographic area that collects rain or snowfall.
Class I area	A specifically designated area where the degradation of air quality is stringently restricted (e.g., many national parks, wilderness areas).
climate	The average weather conditions over lengthy periods of time. Typically quantified using mean and variability of temperature, precipitation, and wind over a 30-year period.
climate change	A change in global or regional climate patterns, especially a change due to an increase in the average atmospheric temperature.
clinker	Baked sedimentary rock that developed where coal seams exposed at or near the surface have burned.
CO2 equivalent (CO2e)	The emission or concentration of carbon dioxide that would cause the same radiative forcing over a given time period as an amount of a greenhouse gas or mixture of greenhouse gases.
colluvial	Rock detritus and soil accumulated at the foot of a slope.

colluvium	A general term applied to deposits on a slope or at the foot of a slope that were moved there chiefly by gravity.
confluence	The point where two streams meet.
corridor	A defined tract of land, usually linear, through which a species must travel to reach habitat suitable for reproduction and other life-sustaining needs.
Cretaceous	The third and latest of the periods included in the Mesozoic Era. Also, the system of strata deposited in the Cretaceous period and related most commonly to the age of the dinosaurs.
criteria air contaminant (CAC) (or criteria air pollutant)	A set of air pollutants that cause smog, acid rain, and other health hazards. They are typically products of fossil-fuel combustion and are emitted from many sources in industry, mining, transportation, electricity generation, and agriculture. The following six CACs were the first set of pollutants recognized by EPA as needing standards on a national level: particulate matter, nitrogen oxides, ozone, carbon monoxide, sulfur oxides, and lead.
criteria pollutant	An air pollutant that is regulated by the National Ambient Air Quality Standards (NAAQS). Criteria pollutants include sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and two size classes of particulate matter, less than 10 micrometers (0.0004 inch) in aerodynamic diameter, and less than 2.5 micrometers (0.0001 inch) in aerodynamic diameter. Pollutants may be added to, or removed from, the list of criteria pollutants as more information becomes available. Note: Sometimes pollutants regulated by state laws also are called criteria pollutants.
critical load	Quantitative estimate of the level of exposure of natural systems to pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur.
cumulative impact	The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.
day-night average noise level or L_{dn}	A noise metric that reflects a 24-hour A-weighted noise dose. Also equivalent to a 24-hour A-weighted L_{eq}.
dBA or decibels A scale	A logarithmic unit for measuring sound intensity, using the decibel A-weighted scale, which approximates the sound levels heard by the human ear at moderate sound levels, with a 10-decibel increase being a doubling in sound loudness.
deep rip	Breaking up compacted soil or overburden, to a depth below normal tillage.
degradation	A process by which the quality of water in the natural environment is lowered. When used specifically in regard to DEQ’s nondegradation rules, this term can relate to a reduction in quantity as well.
dendritic	The branching of natural drainage systems.
deposition	Deposition is the process whereby aerosols and gases move from the atmosphere to the earth's surface.
dilution	The reduction of a concentration of a substance in air or water.
direct impact	An impact caused by an action and that occurs at the same time and place as the action.
disturbed area	An area where vegetation, topsoil, or overburden is removed or upon which topsoil, spoil, and processed waste is placed as a result of mining.

downgradient	The direction that ground water flows, which is from areas of high ground water levels to areas of low ground water levels.
drill seeding	A mechanical method for planting seed in soil.
drilling	The act of boring or driving a hole into something solid.
edge effects	An edge is the boundary or interface between two biological communities or between different landscape elements. Edges exist, for instance, where older forested patches border newly harvested units. The intensity of edge microclimatic gradients, or the "edge contrast," depends on how sharply the two adjacent habitats differ. Edge effects, broadly defined, are the influences of one patch type on a neighboring patch type. Edge effects on organisms are both positive and negative; they cause some species to increase and others to decrease.
effluent	Waste liquid discharge.
electrical conductivity (EC)	A measure of soluble salts in soil (salinity of a soil).
embeddedness	The degree to which rocks are covered by the substrate material (sand, clay, silt, etc.).
emission	Effluent discharged into the atmosphere, usually specified by mass per unit time, and considered when analyzing air quality.
emissions inventory	An emission inventory is an accounting of the amount of pollutants discharged into the atmosphere.
endangered species	Any species of plant or animal that is in danger of extinction throughout all or a significant portion of its range. Endangered species are identified by the Secretary of the Interior in accordance with the 1973 Endangered Species Act.
Endangered Species Act	An act of Congress, enacted in 1973, to protect and recover threatened or endangered plant or animal species and their habitats. The Secretary of the Interior, in accordance with the act, identifies or lists the species as "threatened" or "endangered."
Environmental Assessment (EA)	A concise public document that a federal agency prepares under the National Environmental Policy Act to provide sufficient evidence and analysis to determine whether a proposed action requires preparation of an Environmental Impact Statement (EIS) or whether a Finding of No Significant Impact can be issued. An EA must include brief discussions on the need for the proposal, the alternatives, the environmental impacts of the proposed action and alternatives, and a list of agencies and persons consulted.
environmental consequences	Environmental effects of project alternatives, including the proposed action, which cannot be avoided; the relationship between short-term uses of the human environment, and any irreversible or irretrievable commitments of resources which would be involved if the proposal should be implemented.
Environmental Impact Statement (EIS)	A document prepared to analyze the impacts on the environment of a proposed action and released to the public for review and comment. An EIS must meet the requirements of NEPA, CEQ, and the directives of the agency responsible for the proposed action.
ephemeral stream	A stream that flows only as a direct response to rainfall or snowmelt events, having no baseflow from ground water.
equivalent noise level or L_{eq}	An environmental noise metric of the exposure resulting from the accumulation of sound levels over a particular period.
evaporation	The physical process by which a liquid is transformed to a gaseous state.
evapotranspiration	The water lost from an area through the combined effects of evaporation from free surfaces and transpiration from plants.

factor-of-safety	Forces causing sliding divided by forces resisting sliding (e.g., at a factor-of-safety of 1.0, the forces causing sliding are the same as those resisting sliding).
fault	A fracture or fracture zone where there has been displacement of the sides relative to one another.
forb	Any herbaceous plant, usually broadleaved, that is not a grass or grass-like plant.
fossil fuel	Buried combustible geologic deposits of organic materials, formed from decayed plants and animals that have been converted to crude oil, coal, natural gas, or heavy oils by exposure to heat and pressure in Earth's crust over hundreds of millions of years.
fugitive emissions	1. Emissions that do not pass through a stack, vent, chimney, or similar opening where they could be captured by a control device. 2. Any air pollutant emitted to the atmosphere other than from a stack. Sources of fugitive emissions include pumps; valves; flanges; seals; area sources such as ponds, lagoons, landfills, piles of stored material (e.g., coal); and road construction areas or other areas where earthwork is occurring.
genus	A group of related species used in the classification of organisms (plural = genera).
global warming	The observed century-scale rise in the average temperature of the Earth's climate system and its related effects.
global warming potential (GWP)	A relative measure of how much heat a greenhouse gas traps in the atmosphere. It compares the amount of heat trapped by a certain mass of the gas in question to the amount of heat trapped by a similar mass of carbon dioxide.
greenhouse effect	A phenomenon in which greenhouse gases trap solar energy in the atmosphere and cause it to warm.
greenhouse gas (GHG)	A gas that absorbs short-wave radiation emitted by the earth, which warms the earth by trapping energy that would have otherwise been released into space.
habituate	Become accustomed to.
hardness	A measure of the amount of calcium and magnesium dissolved in the water.
harmful parameters	Elements and compounds that threaten human and other animal health and safety.
hazardous air pollutants (HAPs)	Air pollutants not covered by the National Ambient Air Quality Standards (NAAQS) but which may present a threat of adverse human health effects or adverse environmental effects. Those specifically listed in 40 CFR 61.01 are asbestos, benzene, beryllium, coke oven emissions, inorganic arsenic, mercury, radionuclides, and vinyl chloride. More broadly, HAPs are any of the 189 pollutants listed in or pursuant to section 112(b) of the Clean Air Act. Very generally, HAPs are any air pollutants that may realistically be expected to pose a threat to human health or welfare.
haze	A form of air pollution caused when sunlight encounters tiny pollution particles in the air, which reduce the clarity and color of what we see, and particularly during humid conditions.
heavy metals	Metallic elements with high molecular weights, generally toxic in low concentrations to plants and animals.
highwall	The face of exposed overburden and mineral in surface mining operations or for entry to underground mining operations.
historic properties	Cultural resources that are listed on or eligible for listing on the NRHP.

home range	An area in which an individual animal spends most of its time doing normal activities.
hydraulic conductivity	The rate of flow of water through geologic material.
hydric soil	A soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part.
hydrophytic	Growing either partly or totally submerged in water.
hydrostratigraphic unit	A body of rock having considerable lateral extent and composing a geologic framework for a reasonably distinct hydrologic system.
incised	Having a margin that is deeply and sharply notched.
indirect impact	An impact caused by an action but that occurs later in time (reasonably foreseeable) or farther away in distance.
intermittent stream	A stream or reach of stream that is below the local water table for at least some of the year, and obtains its flow from both surface runoff and ground water discharge.
intervisible	Mutually visible, or in sight, the one from the other, as stations.
land farming	A process by which petroleum-contaminated soil is bioremediated above ground by stimulating aerobic microbial activity within the soil through aeration and/or the addition of minerals, nutrients, and moisture. It is a proven, effective technology for reducing concentrations of nearly all the constituents of petroleum products typically found at petroleum-contaminated sites.
land use	The activities and inputs undertaken in a certain land cover type, or the way in which land is managed (e.g., grazing pastures, managed forests).
land-use change	Change in the use of land by humans that may result in a change in land cover.
lek	An assembly area where animals, especially grouse, carry on display and courtship behavior.
life-of-mine	Length of time after permitting during which coal is extracted and mine-related activities can occur.
lithology	The structure and composition of a rock formation.
loading	The quantity of material or chemicals entering the environment, such as a receiving stream.
long-term effect	A change in a resource or its condition that does not immediately return the resource to pre-mine condition, appearance, or productivity; long-term impacts would apply to changes in condition that continue beyond the bond liability period but would be expected to eventually return to pre-mine condition, or as required under the Surface Mining Control and Reclamation Act (SMCRA) or the Montana Surface and Underground Mine Reclamation Act (MSUMRA).
macroinvertebrates	Small animals without backbones that are visible without a microscope (e.g., insects, small crustaceans, and worms).
macrophytes	Plants visible to the unaided eye. In terms of plants found in wetlands, macrophytes are the conspicuous multicellular plants.
mainstem	The primary channel in a stream or river.
mean	The average number of a set of values.
median	A numerical value in the midpoint of a range of values with half the value points above and half the points below.
mesic	Having intermediate or moderate moisture or temperature; or reference to organisms adapted to moderate climates.
metapopulation	Multiple populations of an organism within an area in which interbreeding can occur, but is limited due to geographic barriers.

metasedimentary	A rock type that is composed of formerly small-sized particles (“sedimentary,” like the grains of sands on lakeshores) that are then exposed to high pressures and temperatures and become compacted into solid stone and are altered chemically.
metric	A value calculated from existing data and used for summarization purposes.
Migratory Bird Treaty Act	Enacted in 1918 between the United States and several other countries. The act forbids any person without a permit to “pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird, included in the terms of this Convention…for the protection of migratory birds…or any part, nest, or egg of any such bird.”
mitigation	An action to avoid, minimize, reduce, eliminate, replace, or rectify the impact of a management practice.
mixing zone	A limited area of a surface water body or a portion of an aquifer where initial dilution of a discharge takes place and where water-quality changes may occur and where certain water-quality standards may be exceeded.
Montana Natural Heritage Program	The Montana Natural Heritage Program provides information on Montana’s species and habitats, emphasizing those of conservation concern.
mycorrhizae	Important structures that develop when certain fungi and plant roots form a mutually beneficial relationship where energy moves primarily from plant to fungus and inorganic resources (principally phosphate) move from fungus to plant.
National Ambient Air Quality Standards (NAAQS)	The allowable concentrations of air pollutants in the ambient (public outdoor) air. National ambient air quality standards are based on the air quality.
National Emissions Standards for Hazardous Air Pollutants (NESHAPs)	Emissions standards set by the Environmental Protection Agency for air pollutants which are not covered by NAAQS and which may, at sufficiently high levels, cause increased fatalities, irreversible health effects, or incapacitating illness. These standards are found in 40 CFR Parts 61 and 63.
National Environmental Policy Act of 1969 (NEPA)	A Federal environmental law that established a U.S. national policy promoting the enhancement of the environment; also established the President's Council on Environmental Quality (CEQ). NEPA's most significant effect was to set up procedural requirements for all federal government agencies to prepare Environmental Assessments (EAs) and Environmental Impact Statements (EISs) containing statements of the environmental effects of proposed federal agency actions.
nitrogen cycle	The process by which nitrogen circulates among the air, soil, water, plants, and animals of the earth, and undergoes many different transformations in the ecosystem, changing from one form to another as organisms use it for growth and, in some cases, energy.

No Action Alternative	A NEPA term that refers to the alternative in which the proposed Federal action is not taken (40 CFR 1502.14(d)). For many Federal actions, the No Action Alternative represents a scenario in which current conditions and trends are projected into the future without another proposed action, such as updating a land management plan. In other cases, the No Action Alternative represents the future in which the Federal action does not take place and the project is not implemented.
nonattainment area	An area that the U.S. Environmental Protection Agency has designated as not meeting (i.e., not being in attainment of) one or more of the National Ambient Air Quality Standards (NAAQS) for sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and particulate matter. An area may be in attainment for some pollutants, but not for others.
noncriteria pollutants	The entire range of contaminants other than criteria air contaminants (see “criteria air contaminants” definition), including other toxic and hazardous pollutants.
noxious weed	Any exotic plant species established or that may be introduced in the state that may render land unfit for agriculture, forestry, livestock, wildlife, or other beneficial uses, or that may harm native plant communities.
opportunistic species	A species that can adapt to, and take advantage of, a variety of habitats or situations. This ability provides a benefit to the species in its distribution, numbers, and survival during changing conditions.
overburden	Geologic material of any nature that overlies a deposit of ore or coal, excluding topsoil.
overpressure	Noise from blasting activities, which is assessed using flat-weighted decibels (dB) rather than dBA. Also, blast overpressure.
ozone (ground level)	A gas compound created by chemical reactions between oxides of nitrogen and volatile organic compounds in the presence of sunlight. Emissions from industrial facilities and electric utilities, motor-vehicle exhaust, gasoline vapors, and chemical solvents are some of the major sources of nitrogen and volatile organic compounds. Ozone at ground level is a harmful air pollutant because of its effects on people and the environment, and it is the main ingredient in “smog.”
particulate matter (pm)	A complex mixture of extremely small particles and liquid droplets that get into the air. Once inhaled, these particles can affect the heart and lungs and cause serious health effects. PM10 includes only those particles equal to or less than 10 micrometers (0.0004 inch) in aerodynamic diameter; PM2.5 includes only those particles equal to or less than 2.5 aerodynamic micrometers (0.0001 inch) in diameter.
peak flow	The maximum flow of a stream in a specified period of time.
perennial stream	A stream or reach of a stream that flows continuously during all of the year as a result of ground water discharge or surface runoff.
perennials	Plants that live longer than 2 years.
periphyton	Organisms (as some algae) that live attached to underwater surfaces.
permafrost	Ground (soil, rock, or sediment) that remains frozen for more than two consecutive years.
permeable	Allowing the passage of fluids.
pH	A method of expressing the acidity or basicity of a solution; the pH scale runs from 0 to 14, with a value of 7 indicating a neutral solution. Values greater than 7 indicate basic or alkaline solutions, and those below 7 indicate acidic solutions.
phreatic surface	The boundary between saturated and unsaturated soil zones in an aquifer.

piping	Creation of tunnels or cavities from the movement of water in soil.
Pleistocene	The first epoch of the Quaternary Period in the Cenozoic Era with respect to the age of Earth. Characterized by the spreading and recession of the ice sheets, and by the appearance of modern humans.
population	A collection of individuals that share a common gene pool. In this document, local population refers to those breeding individuals within the analysis area.
postmining land use	The specific use or management-related activity to which a disturbed area is restored after completion of mining and reclamation.
postmining topography	The relief and contour of the land that remains after backfilling of the mine pit, grading, and recontouring have been completed.
potentiometric surface	An imaginary surface representing the total head of ground water in a confined (often bedrock) aquifer that is defined by the level to which water will rise in a well.
Precambrian	The period of time that extends from about 4.6 billion years ago (the point at which Earth began to form) to the beginning of the Cambrian Period, 541 million years ago.
prevention of significant deterioration (of air quality) (PSD)	Regulations established to prevent significant deterioration of air quality in areas that already meet NAAQS. Specific details of PSD are found in 40 CFR 51.166.
prime farmland	Land that (a) meets the criteria for prime farmland prescribed by the United States Secretary of Agriculture in the Federal Register and (b) historically has been used for intensive agricultural purposes.
probable maximum flood	The largest flood that may be expected from a combination of the most severe weather and hydrologic conditions that are reasonably possible in a drainage basin.
Proposed Action	A NEPA term referring to a plan that contains sufficient details about the intended actions to be taken, or that will result, to allow alternatives to be developed and its environmental impacts analyzed.
public health	The science of protecting the safety and improving the health of communities through education, policy making and research for disease and injury prevention.
radiative forcing	Change in energy flux caused by drivers of climate change, or the difference in energy from incoming sunlight and the infrared energy radiated back to space.
raptors	Birds of prey (e.g., hawks, owls, vultures, eagles).
reclamation	Per MSUMRA at Section 82-4-203(44), Montana Code Annotated (MCA), reclamation means backfilling, subsidence stabilization, water control, grading, highwall reduction, topsoiling, planting, revegetation, and other work conducted on lands affected by surface mining or underground mining under a plan approved by the department to make those lands capable of supporting the uses that those lands were capable of supporting prior to any mining or to higher or better uses.
recontouring	The movement of quantities of earth, usually by mechanical means, to reconfigure the relief and contour of the land.
regeneration	Regrowth of a tree crop or other vegetation, whether by natural or artificial means.
regional haze	Visibility impairment that is caused by the emission of air pollutants from numerous sources located over a wide geographic area. Such sources include, but are not limited to, major and minor stationary sources, mobile sources, and area sources. (40 CFR 51.301)

reporting values	Values listed as reporting values in DEQ Circular WQB-7, and that are the detection levels that must be achieved in reporting ambient monitoring results to the department unless otherwise specified in a permit, approval, or authorization issued by DEQ.
representative concentration pathway (RCPs)	A trajectory of greenhouse gas emissions, concentrations, and land use/land cover that represents one of many possible future scenarios that would result in a specific radiative forcing.
residuum	Unconsolidated and partly weathered mineral materials disintegrated of consolidated rock in place.
revegetation	Plant growth that replaces original ground cover following land disturbance.
riparian areas	Areas with distinct resource values and characteristics that comprise an aquatic ecosystem, and adjacent upland areas that have direct relationships with the aquatic system. This includes floodplains, wetlands, and lake shores.
ripped	Torn, split apart, or opened.
saline soil	A nonsodic soil containing sufficient soluble salt to adversely affect the growth of most plants.
saturation percent	The water content of a saturated soil paste, expressed as a dry weight percentage.
scoria (clinker)	Baked and fused rock resulting from in-place burning of coal deposits.
scree	An accumulation of broken rock fragments lying on a slope or at the base of a hill or cliff.
sedge	A grass-like plant, often associated with moist or wet environments.
sediment-control pond/sediment trap	A sediment-control structure, including a barrier, dam, or excavation depression, that slows down runoff water to allow sediment to settle out.
seep	A place where ground water flows slowly out of the ground.
segregation	The separation of water from sources of contamination in a mine.
seismic	Of or produced by earthquakes. Of or relating to an earth vibration caused by something else (e.g., an explosion).
sensitive species	Those species, plant and animal, identified by the Montana Natural Heritage Program for which population viability is a concern, as evidenced by (1) significant current or predicted downward trends in population numbers or density or (2) significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.
short-term effect	A change that within a short period would no longer be detectable as the resource is returned to its pre-mine condition, appearance, or use. In this EIS a "short period" is defined as the length of the Area F bond liability period (see **Chapter 1, Section 1.6, Financial Assurance** for a description of the bond liability period).
slopewash alluvium	Soil and rock material that has been moved down a slope predominantly by the action of gravity assisted by the action of running water that is not concentrated into channels.
sodic soil	A nonsaline soil containing sufficient exchangeable sodium to adversely affect plant growth and soil structure.
sodium adsorption ratio (SAR)	A relation between soluble sodium and soluble divalent cations that can be used to predict the exchangeable sodium percentage of soil equilibrated with a given solution.
soil erodibility	A measure of the inherent susceptibility of a soil to erosion, without regard to topography, vegetation cover, management, or weather conditions.

soil pH	The negative logarithm of the hydrogen ion activity of a soil. The degree of acidity or alkalinity.
soil texture	Soil textural units are based on the relative proportions of sand, silt, and clay.
soil threshold concentration	The metal concentration that equals 1 percent of the 95 percent Upper Confidence Limit (95 percent UCL) on the mean of the background concentration.
spoil	Overburden that has been removed during surface or underground mining operations.
spring	A localized point of discharge where ground water emerges onto the land or into a surface water body.
stratigraphy	The arrangement of strata.
stratum	A section of a formation that consists of primarily the same rock type.
subpopulation	A well-defined set of interacting individuals that comprise a portion of a larger, interbreeding population.
sustainability	The ability of a population to maintain a relatively stable population size over time.
taxon	Any formal taxonomic group such as genus, species, or variety.
temporary reclamation	Revegetation of mine facilities (e.g., soil stockpiles and dam embankments) conducted during operations to reduce erosion, sedimentation, noxious weed invasion, and visual impacts. The revegetation will be redisturbed upon mine facility removal.
Tertiary	The earlier of two geologic periods in the Cenozoic Era, in the classification generally used. Also, the system of strata deposited during that period.
threatened species	Any species likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range, as identified by the Secretary of the Interior in accordance with the 1973 Endangered Species Act.
total dissolved solids (TDS)	A measure of the amount of material dissolved in water (mostly inorganic salts).
total suspended solids (TSS)	A measure of the amount of undissolved particles suspended in water.
toxic parameter	A chemical that has an immediate, deleterious effect on the metabolism of a living organism.
Toxicity Characteristic Leaching Procedure (TCLP)	An analytical test to determine the mobility of both organic and inorganic analytes present in liquid, solid, and multiphasic wastes. This test is usually to determine if a waste meets the definition of toxicity under RCRA.
transect	A line, strip, or series of plots from which biological samples, such as vegetation, are taken.
trigger value	A value listed in DEQ Circular WQB-7 for a toxic parameter, used to determine if proposed activities will cause degradation.
unconsolidated deposits	Sediment not cemented together, containing sand, silt, clay, and organic material.
ungulate	An animal having hooves.
upgradient	The direction from which ground water flows.
viability	Ability of a population to maintain sufficient size so that it persists over time in spite of normal fluctuations in numbers; usually expressed as a probability of maintaining a specific population for a specific period.
viewshed	The portion of the surrounding landscape that is visible from a single observation point or set of points.

visibility	The distance to which an observer can distinguish objects from their background. The determinants of visibility include the characteristics of the target object (shape, size, color, and pattern), the angle and intensity of sunlight, the observer's eyesight, and any screening present between the viewer and the object (i.e., vegetation, landform, even pollution such as regional haze).
visibility extinction	Reduction of visibility due to light extinction caused by the absorption and scattering of ambient particulate matter.
visual quality objective	A desired level of scenic quality based on physical and sociological characteristics of an area. Refers to the degree of acceptable alterations of the characteristic landscape.
waterbar	A shallow ditch dug across a road at an angle to prevent excessive flow down the road surface and erosion of road surface materials.
water-dependent ecosystems	Parts of the environment in which the composition of species and natural ecological processes are determined by the permanent or temporary presence of flowing or standing surface water or ground water. These include the instream areas of rivers, riparian vegetation, springs, wetlands, floodplains, estuaries, karst systems, and ground water–dependent terrestrial vegetation.
waters of the U.S.	Waters that include the following: all interstate waters, intrastate waters used in interstate and/or foreign commerce, tributaries of the above, territorial seas at the cyclical high-tide mark, and wetlands adjacent to all the above.
water table	The boundary between saturated and unsaturated soil zones in an aquifer.
wetlands	Areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated-soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.
wetted area	The area at a stream cross-section that contains water.
windrose	A graphic tool use to illustrate prevailing wind patterns (speed and direction) over a given period of time at a particular location.

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EXECUTIVE SUMMARY

BACKGROUND AND OVERVIEW

This Environmental Impact Statement (EIS) has been prepared by the Montana Department of Environmental Quality (DEQ) and the U.S. Department of the Interior (DOI), Office of Surface Mining Reclamation and Enforcement (OSMRE) Western Region Office, in cooperation with the DOI Bureau of Land Management (BLM) Miles City Field Office. This EIS analyzes the potential environmental effects of a proposed new permit area (C2011003F) known as Area F (project or project area) at the Rosebud Mine, which is an existing 25,949-acre surface coal mine annually producing 8.0 to 10.25 million tons of low-sulfur subbituminous coal (see **Section 2.2, Existing Operations**). Western Energy Company (Western Energy), a subsidiary of Westmoreland Coal Company (Westmoreland), is the operator of the Rosebud Mine and the project proponent.

The Rosebud Mine is located in Rosebud County and surrounds the city of Colstrip and the Colstrip Steam Electric Station, which is commonly known as the Colstrip Power Plant (**Figure S-1** and **Figure S-2**). Permit Areas D and E of the Rosebud Mine extend to the east of Colstrip for 3.5 miles, and Permit Areas A, B, and C extend 12 miles to the west of Colstrip. The project area would be located adjacent to the western boundary of Area C (**Figure S-2**) in Township 2 North, Range 38 and 39 East, and Township 1 North, Range 39 East, and would expand the mine to the west into Treasure County. Situated in the northern Powder River Basin, the Rosebud Mine is generally east and north of the Little Wolf Mountains. Tributaries of Horse Creek and West Fork Armells Creek, including Black Hank Creek, Donley Creek, Robbie Creek, and McClure Creek (all of which lie within the drainage of the Yellowstone River), drain the project area. A ridge in the western portion of the project area divides the Horse Creek and West Fork Armells Creek drainages.

If DEQ approves the Area F permit (C2011003F) and a new federal mining plan for the project area is approved as proposed, then 6,746 permit acres would be added to the Rosebud Mine (see **Section 2.4, Alternative 2 – Proposed Action**), and, at the current rate of production, the operational life of the mine would be extended by 8 years. Without the addition of the project, the operational life of the Rosebud Mine would be expected to end in 2030, which is the expected end of operation for the currently mined Permit Area B, one of three active permit areas (see **Section 2.2.6, Life of Operations**). Although the project area would be a new permit area and an expansion of the Rosebud Mine's surface disturbance, Western Energy does not propose to increase the total annual production output of the mine.

The area of disturbance within the project area would be 4,260 acres. Of these, 2,159 acres would be disturbed by mining; the remainder would be disturbed by highwall reduction, soil storage, scoria pits, haul-road construction, and other miscellaneous activities. The surface of the permit area is entirely privately owned, but the subsurface is both privately (3,479 acres) and federally (3,267 acres) owned. Western Energy holds leases for the federal (M82186) and private coal (G-002 and G-002-A). Current surface land uses in the project area include grazing land, pastureland, cropland, and wildlife habitat. A county road, a gas-transmission pipeline, and high-voltage electric transmission lines cross the project area.

Mining operations in the project area, which would commence after all permits and approvals have been secured and a performance bond has been posted, would last 19 years. Western Energy estimates that 70.8 million tons of recoverable coal reserves exist in the project area and would be removed during the 19-year operations period. As with other permit areas of the Rosebud Mine, all coal would be sold and combusted locally at two power plants—the Colstrip and Rosebud Power Plants (see **Section 1.2.2, Coal Combustion)**.

A single EIS has been prepared (DEQ and OSMRE 2013) to meet the requirements of the Montana Environmental Policy Act (MEPA) (Title 75, Chapter 1, Parts 1 through 3, of the Montana Code Annotated [MCA]) and its implementing rules (Administrative Rules of Montana [ARM] 17.4.601 et seq.); the National Environmental Policy Act (NEPA) (42 United States Code [USC] Section 4321 et seq.); the Council on Environmental Quality's (CEQ's) NEPA regulations (40 Code of Federal Regulations [CFR] Parts 1500 to 1508); DOI's NEPA regulations (43 CFR 46) and Department Manual 516; and the OSMRE *NEPA Handbook* (OSMRE 1989). The BLM *NEPA Handbook* (BLM 2008) also was considered in the preparation of the document.

This EIS will help DEQ managers make a more fully informed decision with respect to the approval of Western Energy's mine permit application package (PAP) for the project area (see **Appendix A** for links for digital download). DEQ will decide whether to approve the permit in accordance with the requirements of the Montana Strip and Underground Mine Reclamation Act (MSUMRA) (82-4-201 et seq., MCA) and its implementing rules (ARM 17.24.301-1309). DEQ may not withhold, deny, or impose conditions on the Area F permit based on the information contained in this EIS per 75-1-201(4), MCA.

This EIS also will help DEQ managers make a more fully informed decision regarding two other Western Energy applications: (1) an application for a new Montana Pollutant Discharge Elimination System (MPDES) permit MT-0031828 for project area outfalls into the Black Hank Creek, Donley Creek, Robbie Creek, McClure Creek, and Trail Creek drainages, and (2) an application to modify Montana Air Quality Permit (MAQP) #1570-07 to include the project area. This EIS serves as the MEPA-compliant review for these two permitting decisions as well as for the MSUMRA operating permit.

This EIS will help OSMRE prepare the Mining Plan Decision Document (MPDD) for the DOI Assistant Secretary for Land and Minerals Management (ASLM) recommending approval, disapproval, or conditional approval of the project area mine plan. A MPDD will be prepared because Western Energy's proposed project constitutes a major revision to the current Rosebud Mine operations. BLM is a cooperating agency on this EIS because it is the federal agency responsible for leasing federal coal lands under the Mineral Leasing Act (MLA) of 1920, as amended (30 USC Section 181 et seq.).

The decision regarding a selected alternative and supporting reasoning will be documented in two Records of Decision (RODs), one issued by DEQ and one issued by OSMRE. DEQ's ROD will be issued as a document identified as Written Findings at least 15 days after the Final EIS is published. OSMRE's ROD will be released along with the ASLM decision on the MPDD. OSMRE intends to issue the ROD within 90 days after the Final EIS is published. BLM will not issue a ROD but will review Western Energy's Resource Recovery and Protection Plan and other requirements of the federal lease and make a finding (43 CFR 3482.2).

History of Mine Operations at Colstrip

Coal has been mined at Colstrip for over 90 years. The Northern Pacific Railway established the city of Colstrip and its associated mine in the 1920s to access coal from the Fort Union Formation. The Rosebud Mine operation began production in 1968. In 2001, Westmoreland purchased the Rosebud Mine; its subsidiary, Western Energy, continues to operate the mine today. Past and current mine operations are described in detail in **Section 2.2, Description of Past and Existing Mine and Reclamation Operations** and summarized below.

The Rosebud Mine produces 8.0 to 10.25 million tons of low-sulfur (0.64 percent) subbituminous coal annually and 300,000 tons of high-sulfur "waste coal" annually (Spang 2013). Between 1975 and 2016, Western Energy recovered a total of 462,192,473 tons of coal from the Rosebud Mine (Peterson 2017). Currently, three active mine areas at the Rosebud Mine operate under permits issued by DEQ: Area A

(4,262 acres, permit C1986003A), Area B (6,231 acres, permit C1984003B), and Area C (9,432 acres, permit C1985003C). Two permitted mine areas are no longer actively mined and are being actively reclaimed: Area D (4,554 acres, permit C1986003D) and Area E (1,470 acres, permit C1981003E).

Production from the Rosebud Mine is limited by the conditions of its DEQ-issued air quality permits. MAQP #1483-08 limits annual coal production from Areas A, B, and D to 13 million tons per year. Coal production from Areas C and F is limited to 8 million tons per year per MAQP #1570-08 with an Area F–specific production cap of 4 million tons per year per the Preliminary Determination (PD) for MAQP #1570-07 (see **Section 1.4.1.2, Montana Department of Environmental Quality, Clean Air Act of Montana**). Western Energy has one MPDES Permit (MT-0023965)[1] that covers discharge of mine drainage and drainage from existing coal preparation areas, coal storage areas, and reclamation areas into 151 outfalls (see **Section 1.4.1.2, Montana Department of Environmental Quality, Montana Water Quality Act**).

Coal Combustion

Although the Rosebud Mine has shipped coal by rail as recently as 2010, all coal currently produced by the mine is consumed locally at the Colstrip Power Plant and the Rosebud Power Plant (**Figure S-2**). Coal mined in the proposed project area would be burned in Units 3 and 4 of the Colstrip Power Plant and in the Rosebud Power Plant. Operational information about the two power plants is summarized below and detailed in **Section 1.2.2, Coal Combustion**.

Colstrip Power Plant

The Colstrip Power Plant is located in the city of Colstrip and surrounded by permit areas A, B, D, and E of the Rosebud Mine. It is operated by Talen Energy (formerly PPL Montana) and currently owned by Talen Energy, Puget Sound Energy Inc., Portland General Electric Company, Avista Corporation, PacifiCorp, and NorthWestern Energy. The Rosebud Mine delivers between 7.7 and 9.95 million tons of coal annually to the Colstrip Power Plant primarily by a covered conveyor system (shown on **Figure S-2**), although some coal from Area A is transported by haul truck.

The Colstrip Power Plant has four coal-fired generating units capable of producing a total of 2,100 megawatts of electricity and is the second-largest coal-fired plant west of the Mississippi River. Units 1 and 2 were constructed in 1972 and began commercial operation in 1975 and 1976. Each unit has about 307 megawatts of generating capacity. Under a 2016 consent decree, Colstrip Units 1 and 2 must cease operations on or before July 1, 2022. Units 3 and 4 started operating in 1984 and 1986, and each has about 740 megawatts of generating capacity (PPL Montana 2014). Some owners of Units 3 and 4 (Puget Sound Energy and Avista) have agreed to a depreciation schedule that assumes the remaining useful life of those units is through the end of 2027; however, no retirement plan or closure date has been set. Power from the Colstrip Power Plant is marketed through the Western Electricity Coordinating Council, a regional member of the North American Electricity Reliability Council that includes all of the western states and the Canadian provinces of Alberta and British Columbia.

Rosebud Power Plant

The Rosebud Power Plant is a 38-megawatt coal-fired power plant located 6 miles north of the city of Colstrip (shown on **Figure S-2**) that has been operating commercially since May 1990. It is owned by

[1] In a recent opinion issued by Judge Kathy Seeley of the First Judicial District Court, Lewis and Clark County (Cause No. CDV-2012-1075), the 2016 renewal of Final Modified Permit MT0023965 was invalidated. As a result, and subject to a pending appeal of the Seeley decision in the Montana Supreme Court, the effective MPDES Permit is the one issued by DEQ in 1999.

Rosebud Energy Corporation, Harrier Power Corporation (Paragon), and Colmac Montana Inc. The Rosebud Power Plant was designed to burn low-BTU (British thermal unit) "waste coal" from the Rosebud Mine, which is coal not suitable for use at the Colstrip Power Plant due to the high sulfur content and low calorific value. This waste coal is typically encountered horizontally in the top 1-foot layer of the Rosebud deposit (see **Section 3.6, Geology**). Western Energy hauls 300,000 tons of coal annually from the Rosebud Mine (via a fleet of five covered haul trucks) to the Rosebud Power Plant (Spang 2013).

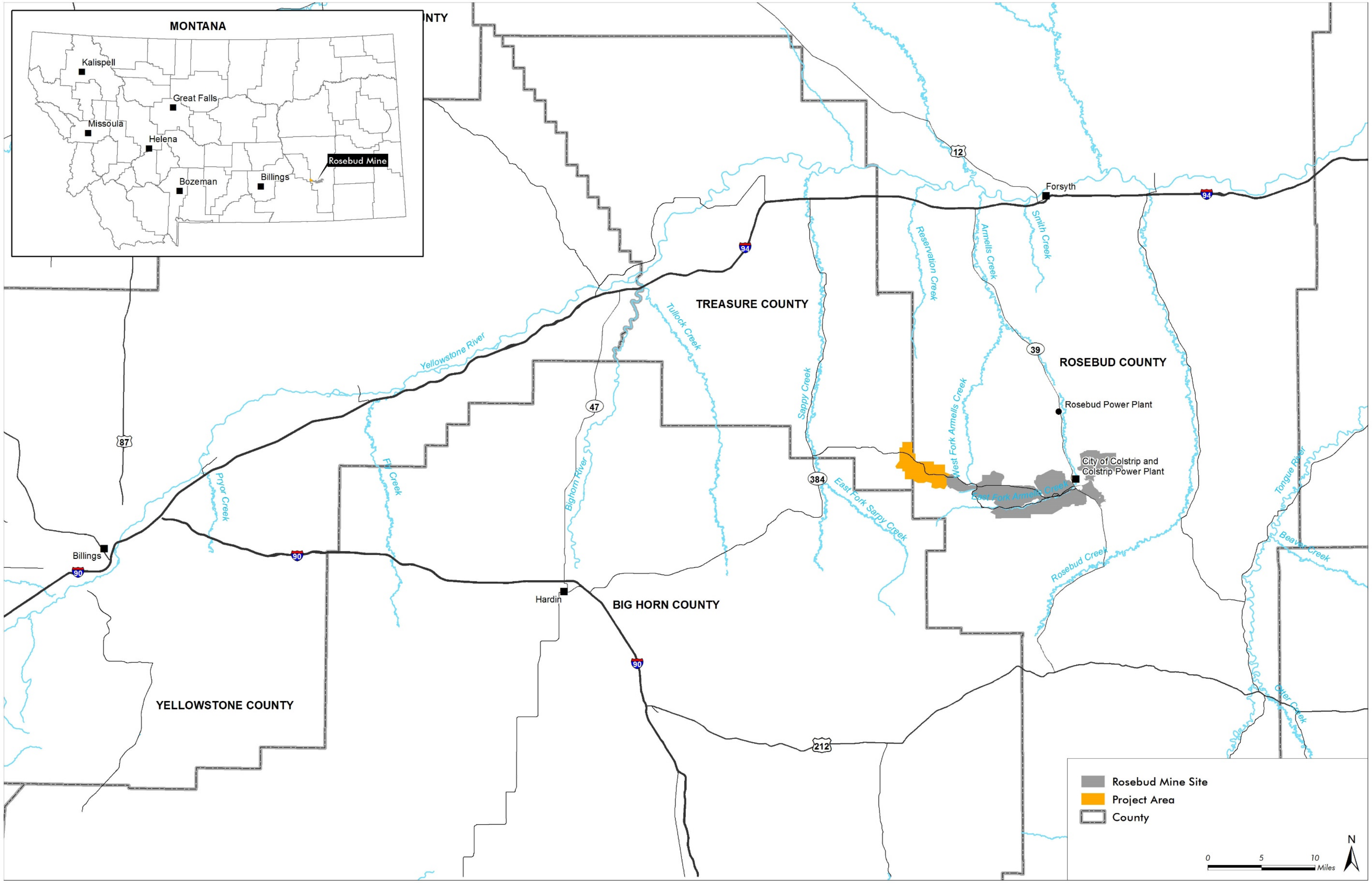

Figure S-1. Project Location.

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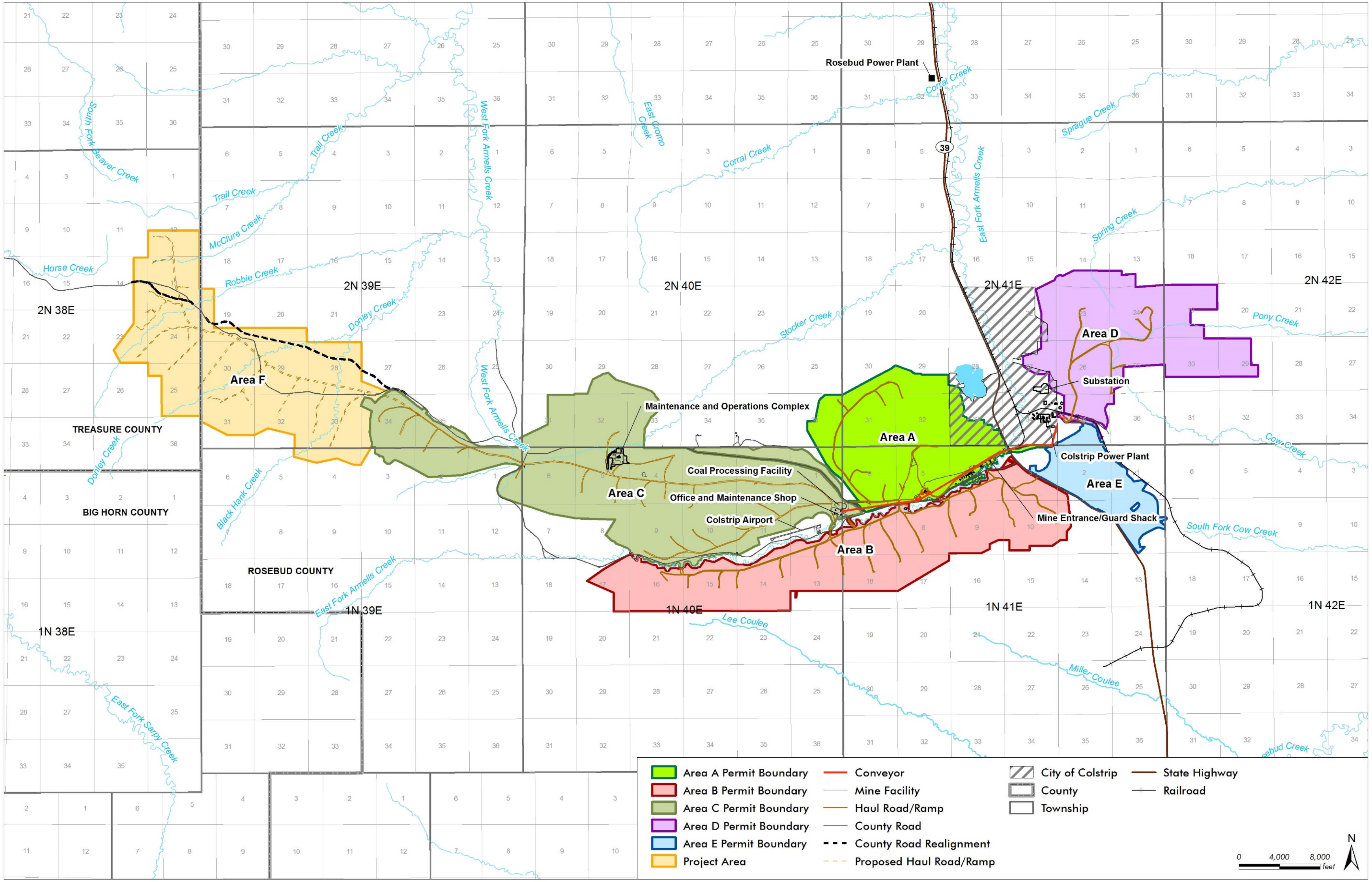

Figure S-2. Location of Mine Facilities and Permit Areas.

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PURPOSE, NEED, AND BENEFITS

As described in NEPA, purpose and need are used to define the range of alternatives analyzed in an EIS (40 CFR 1502.13). Each agency's statutory authorities and policies determine its underlying purpose and need. MEPA and its implementing rules, ARM 17.4.617(1), require that any EIS prepared by a state agency include a description of the purpose and benefits of the proposed project. The purpose, need, and benefits of the Proposed Action are described in the sections below.

Purpose

The purpose of the Proposed Action is to allow continued operations at the Rosebud Mine by permitting and developing a new surface-mine permit area known as permit Area F. This EIS evaluates the environmental effects of the Proposed Action (and alternatives). DEQ's purpose is to review and make a decision on Western Energy's surface-mine operating permit application under MSUMRA, Section 82-4-221 et seq., MCA (see **Section 1.4.1.2, Montana Department of Environmental Quality**). OSMRE's purpose is to review and make a recommendation to the ASLM (in the form of a MPDD) to approve, disapprove, or approve with conditions the proposed federal surface mine plan for the project area (see **Section 1.4.1.1, Office of Surface Mining Reclamation and Enforcement**). The ASLM will decide whether the mining plan is approved, disapproved, or approved with conditions.

Need

Western Energy is required to obtain a surface-mine operating permit (pursuant to MSUMRA) and approval of a federal surface-mine plan (30 CFR 746) for the project area in order to access additional coal reserves. The OSMRE need for the action is to provide Western Energy the opportunity to exercise its valid existing rights (VER) granted by BLM under federal coal lease M82186 to access and mine undeveloped federal coal resources located in the project area. In addition, it is OSMRE's responsibility under the Surface Mining Control and Reclamation Act (SMCRA) Public Law 95-87, Title I, Section 102 to "assure that the coal supply essential to the Nation's energy requirements and to its economic and social well-being is provided and strike a balance between protection of the environment and agricultural productivity and the Nation's need for coal as an essential source of energy." Further, the need for the action is to provide Western Energy the opportunity to develop privately held leases (G-002 and G-002-A) for coal resources located in the project area within the bounds of all applicable laws, regulations, and policies.

The DEQ need for the action is to analyze the potential environmental impacts from the project in order to make a more fully informed decision prior to approval or disapproval of the permit application under Section 82-4-227, MCA. DEQ is responsible for ensuring that when there may be significant environmental impacts, a Final EIS is completed and published at least 15 days prior to the release of DEQ's written findings on the permit application.

Benefits

The project would provide the following federal, state, and local benefits:

- an ongoing fuel source (70.8 million tons of coal) for the Colstrip Power Plant (Units 3 and 4) and the Rosebud Power Plant, which are sources of high-capacity power
- continued employment for workers at the mine
- an ongoing tax base (direct, indirect, and induced) to federal, state, and local governments
- ongoing royalty payments to mineral resource owners
- continued support to local businesses

AGENCY AUTHORITY AND ACTIONS

Two lead agencies are responsible for the analysis of this project: OSMRE and DEQ. BLM is acting as a cooperating agency. A single EIS for the Western Energy Area F Project is being prepared to provide a coordinated and comprehensive analysis of potential environmental impacts. Before implementation of the proposed project could begin, various other permits, such as an air quality permit and a MPDES permit from DEQ, as well as various other certificates, licenses, or approvals would be required from multiple state and federal agencies. The applicable statutes and regulations for each lead agency, as well as the decisions to be made, are described in the EIS in **Section 1.4, Agency Authority and Actions**. Two tables in that section summarize the other state and federal approvals needed for the project.

The State-Federal Cooperative Agreement (Agreement) between DEQ and OSMRE (codified in 30 CFR 926.30) outlines the decision process for a surface coal mine in Montana (MT). Under the Agreement, DEQ reviews an operator's (in this case, Western Energy's) PAP to ensure the permit application for the proposed action complies with the permitting requirements and that the coal-mining operation would meet the performance standards of the approved MT program as outlined in MSUMRA (Section 82-4-221 et seq., MCA) and its implementing rules (ARM 17.24.301-1309). OSMRE, BLM, and other federal agencies such as the U.S. Fish and Wildlife Service (USFWS) review the proposed action to ensure it complies with the terms of the coal lease(s), MLA, NEPA, and other federal laws and regulations. DEQ makes a decision to approve or deny the permit application component of the PAP in accordance with MSUMRA. OSMRE, in accordance with 30 CFR 746.1 through 746.18, reviews DEQ's permit and recommends approval, disapproval, or conditional approval of the mining plan to the ASLM.

PUBLIC PARTICIPATION AND KEY ISSUE IDENTIFICATION

Scoping

During formal public scoping, DEQ and OSMRE sought input from the public, interested organizations, tribes, and government agencies. DEQ held its public scoping period between October 5 and November 5, 2012, and hosted two public open houses in Colstrip on October 16, 2012. OSMRE held its public scoping period between August 27 and November 8, 2013, and hosted an open house and hearing in Colstrip on September 12, 2013.

The intent of the scoping process was to gather comments and concerns from those who have interest in, or may be affected by, the Proposed Action and to identify key issues for analysis and alternatives development. A detailed accounting of DEQ and OSMRE scoping processes can be found in the Public Scoping Report (ERO 2013a) and Public Scoping Report II (ERO 2013b), respectively. Both reports are available on the agencies' websites: http://deq.mt.gov/Public/eis (DEQ) and http://www.wrcc.osmre.gov/initiatives/westernEnergy.shtm (OSMRE).

Key Analysis Issues

Eight key issues were identified through the public and agency scoping process and used to guide the EIS interdisciplinary team's analysis and alternatives development. These issues include effects on surface and ground water quality and quantity (Issues 1 and 2), effects on wetlands (Issue 3), effects on wildlife and key habitats (Issue 4), effects of the Proposed Action and continued operation of existing power plants on climate change (Issues 5 and 6), effects on human health (Issue 7), and reclamation (Issue 8). See **Section 1.5.2.1, Key Issues Identified During Scoping for Detailed Analysis** for a description of these issues.

Tribal Consultation

OSMRE initiated tribal consultation with the Northern Cheyenne, Fort Peck Assiniboine and Sioux, and Crow Tribes on April 14, 2014, regarding the identification of and effects on traditional cultural properties and archeological sites of significance to the tribes (see **Section 6.1.3, Tribal Consultation Process**).

Public Comment Period for the Draft EIS

OSMRE and DEQ conducted a 60-day public comment period on the Draft EIS. The initial 45-day public comment period on the Draft EIS began on January 4, 2018 and was noticed in the *Federal Register*, on agency websites, in legal notices, and in local newspapers. At the request of the Northern Plains Resource Council and Montana Environmental Information Center, the comment period was extended by the agencies to March 5, 2018 (a 15-day extension). OSMRE and DEQ jointly hosted a public open house and town hall meeting in Colstrip, Montana, on February 13, 2018. Substantive public comments received during the public comment period and agency responses are included in **Appendix F, Comments on the DEIS and Responses**.

ALTERNATIVES ANALYZED

Alternatives were developed based on requirements for alternatives under regulations and rules implementing NEPA and MEPA. NEPA regulations do not specify the number of alternatives that need to be considered by federal agencies, including OSMRE, in the EIS but indicate that a reasonable range of alternatives should be evaluated (40 CFR 1502.14). Likewise, MEPA regulations require a “reasonable alternatives analysis.” In addition, both NEPA and MEPA regulations require analysis of a “no action alternative” in an EIS. Under MEPA, DEQ is required to consider alternatives that are realistic and technologically available and that represent a course of action that bears a logical relationship to the proposal being evaluated, per ARM 17.4.603(2)(b).

Besides the No Action Alternative (Alternative 1) and the Proposed Action (Alternative 2), one action alternative was considered (Alternative 3) in this EIS. Alternatives 1, 2, and 3 are summarized below and described fully in **Chapter 2**.

Alternative 1 – No Action

Alternative 1 **(Section 2.3, Alternative 1 – No Action)** considers a scenario where federal and private coal in the project area would not be mined; the project Purpose and Need (**Section 1.3, Purpose, Need, and Benefits**) relates to both lease types. As described in **Section 1.6.2, Private Coal Alternative**, it would be logistically challenging and would not be economically feasible to mine private coal without the federal coal leases in the project area.

Under the No Action Alternative, Western Energy’s application for the project would not be approved by DEQ for one or more of the conditions outlined in **Section 1.4.1.2, Montana Department of Environmental Quality, Conditions for Denial**. Without an approved state permit, OSMRE would not make a recommendation to the ASLM regarding a federal mining plan for the project. Without an approved permit and federal mining plan, Western Energy would not develop the project, resulting in 33,885,390 tons of federal coal not being recovered from lease M-82816 and 37,036,115 tons of private coal not being recovered from private leases G-002 and G-002a. It would also result in 4,260 acres of previously undisturbed ground not being disturbed. The environmental, social, and economic conditions described in **Chapter 3** would continue, unaffected by the construction and operation of the project. The conditions under which OSMRE could select the No Action Alternative or DEQ could deny Western

Energy's application for an operating permit for the project area, MPDES permit, or air quality permit are described in **Section 1.4, Agency Authority and Actions**.

Under the No Action Alternative, project coal would not be available for combustion in the Colstrip Power Plant or the Rosebud Power Plant. For analysis purposes, this EIS assumes that the power plants would continue operations as described in **Section 1.2.2, Coal Combustion at Colstrip**. Selection of the No Action Alternative would not change the status of the other five areas of the Rosebud Mine that are currently permitted and being mined and/or reclaimed by Western Energy (see **Section 2.2, Description of Existing Mine and Reclamation Operations**), nor would it change the status of other areas of the Rosebud Mine that are in the permitting process (see **Section 5.2.2, Related Future Actions)**.

Alternative 2 – Proposed Action

Alternative 2 is the Proposed Action as put forward by Western Energy in its permit application; it is summarized below and described in detail, including the proposed sequence of operations, reclamation plan, measures to protect the hydrologic balance, and proposed monitoring and mitigation measures, in **Section 2.4, Alternative 2 – Proposed Action**. For purposes of preparing this EIS, Alternative 2 assumed that Western Energy had addressed all of the permit application deficiencies identified by DEQ (see **Appendix B** for the last deficiency letter). DEQ determined that the permit application is acceptable under MSUMRA on October 5, 2018.

After operational start-up, Western Energy proposes to mine 2,159 acres within the proposed 6,746-acre permit area (**Figure S-3**). During the first 12 years of production, 4 million tons of coal would be mined annually, with the rate dropping to 3.25 million tons annually during the last 7 years of production. Proposed mine features for the project area include mine pits, scoria pits, soil stockpiles, overburden stockpiles, haul roads, haul-road ramps, and the area of disturbance.

Mining in the first 6 years would occur between Donley Creek and Black Hank Creek and in a small section east of Black Hank Creek. In years 7 through 13, mining would occur between Robbie and Donley Creeks, except for several passes on the west side of Robbie Creek. In years 14 through 16, mining would occur between McClure Creek and Robbie Creek. In year 17, mining would be north of McClure Creek before moving to the area west of Black Hank Creek that would be mined in the final 2 years of mine life in the project area.

The coal-mining method proposed for the project area would be the same area surface-mining method that Western Energy currently uses in other permitted areas (A, B, C, D, and E) of the Rosebud Mine. In advance of each mining pass, soil would be removed from the area and stockpiled according to type for later use during reclamation. Next, the overburden (material covering the coal seams) would be drilled and blasted. Overburden from the initial cut would be stockpiled as spoil. A dragline (or mobile equipment in some limited instances) would then be used to strip the overburden from succeeding mine passes. Spoil would be cast into the mined-out pit created by the preceding pass.

After the dragline exposes the coal seam in each pass, the coal would be drilled and blasted. A loading shovel, front-end loader, or backhoe would load blasted coal into coal haulers. The coal would be transported on an established haul road to Area C or Area A for crushing (**Figure S-2**). After crushing, most of the coal would be sent via an existing 4.2-mile conveyor to the Colstrip Power Plant. Coal with higher sulfur content (an estimated 105,000 tons/year from the project area) would be trucked to the Rosebud Power Plant, which is also in Colstrip.

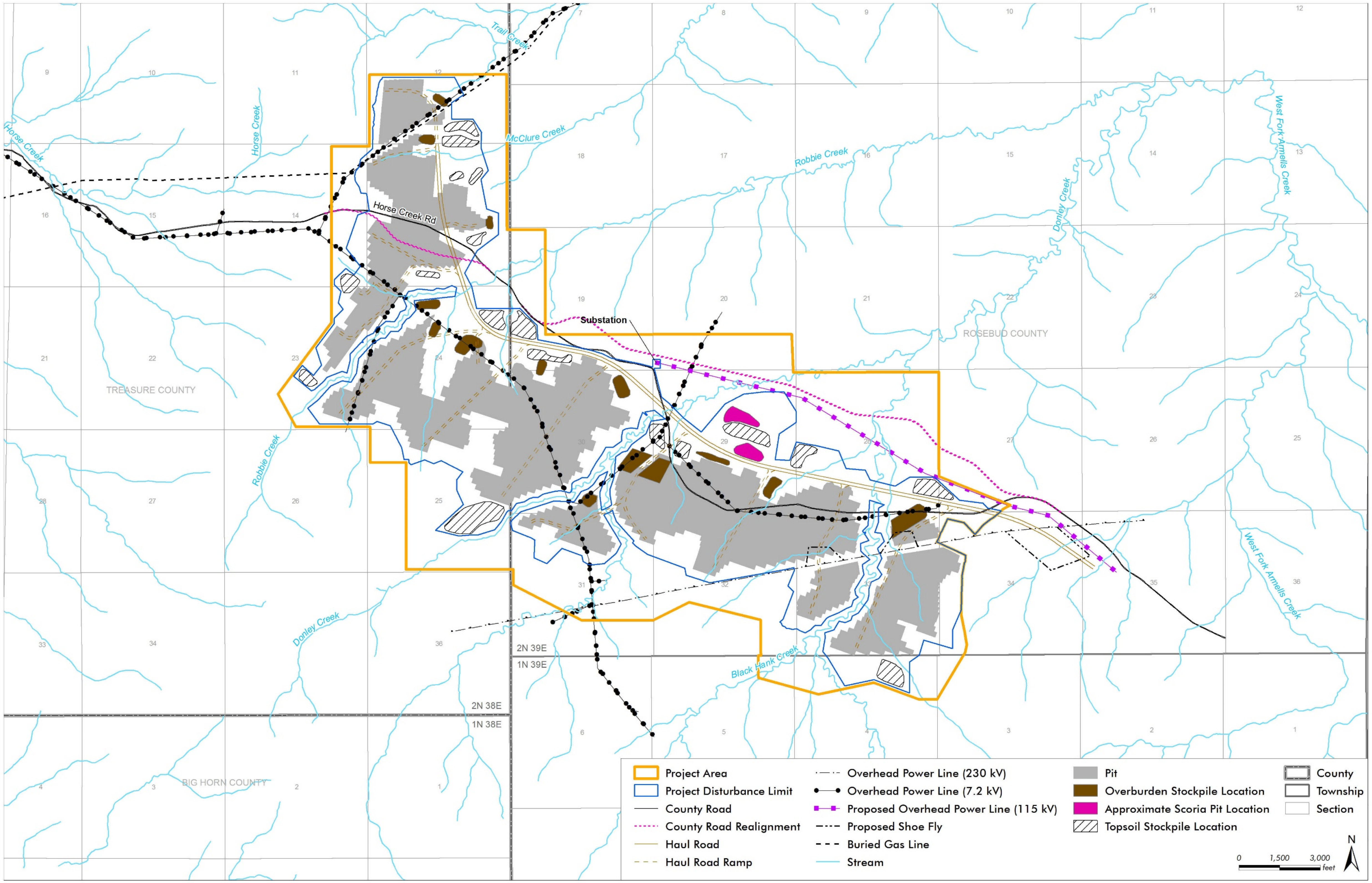

Figure S-3. Proposed Project Area, Alternative 2.

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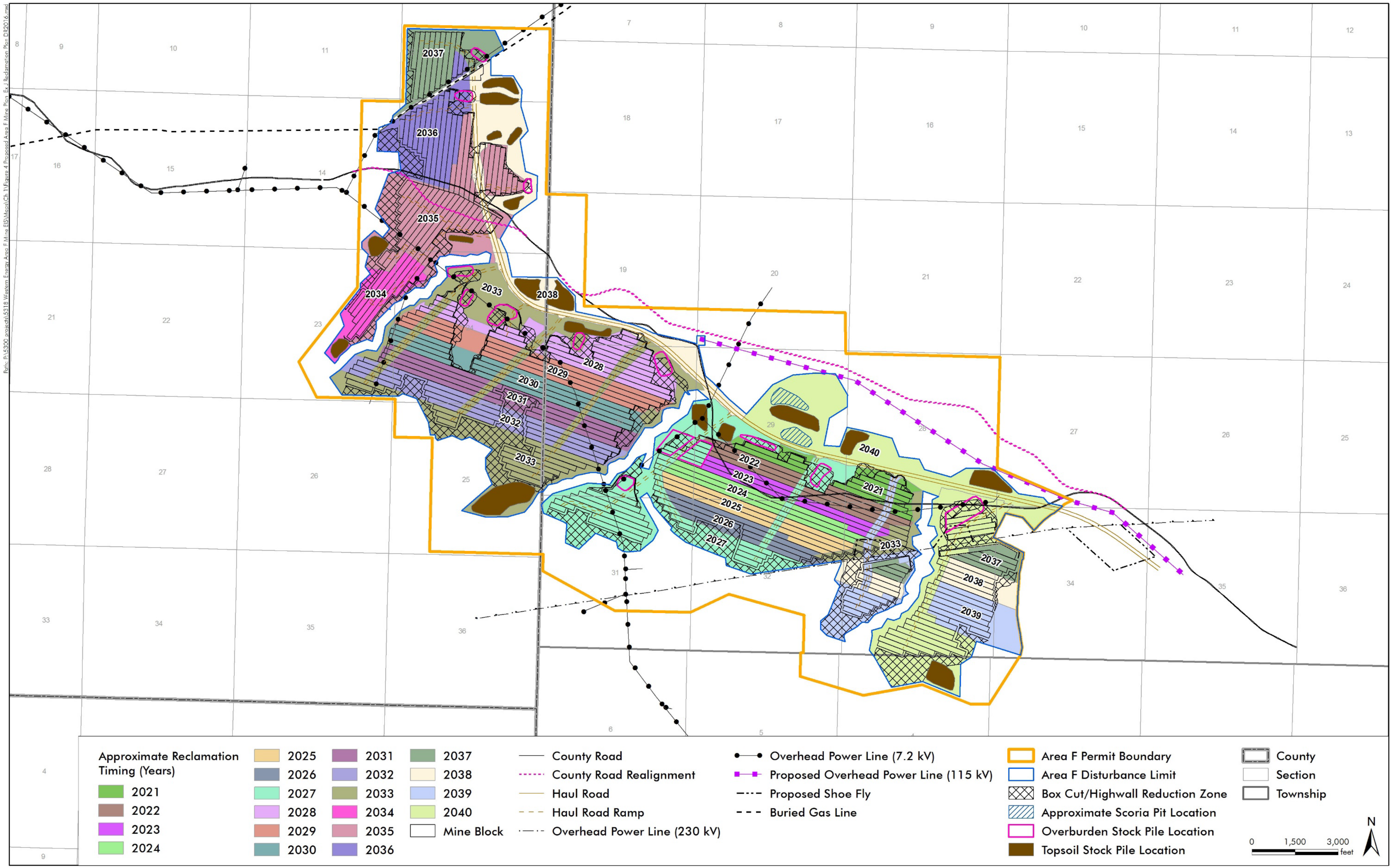

Figure S-4. Proposed Area F Reclamation Plan (Grading, Application of Soil, and Seeding). [Please note that years in the figure show the relative sequence, but may not be the actual year of reclamation]

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To accommodate the proposed mine plan, Western Energy proposes to mine around an electric-transmission line and a gas-transmission pipeline that cross the project area and to relocate portions of the electric distribution lines that run throughout the project area. Western Energy also proposes to relocate Horse Creek Road, a county road that transverses the project area. Specifically, a 4.2-mile segment of Horse Creek Road in the northeast/north-central portion of the permit area (owned and maintained by Rosebud County) and a 1.3-mile segment in the northwestern portion of the permit area (owned and maintained by Treasure County) would be rerouted. The road relocation would be done in two phases. The longer segment, which is in Rosebud County, would be relocated during initial development of the project. The west end of the realignment, which is in Treasure County, would be relocated when mining moves into the northwestern corner of the project area (about 12 years later).

Reclamation would begin within two years of mining the initial pass and would continue as subsequent mine passes are completed until Phase IV bond release (**Figure S-4**). Reclamation would facilitate the following postmine land uses: grazing land, cropland, and wildlife habitat. The major reclamation steps planned to occur before and after mining include, but are not limited to, soil-material salvage and redistribution, pit backfilling, grading and contouring to the postmining topography, drainage construction, revegetation, and postmine monitoring. In addition to the reclamation of the landscape disturbed by mining operations, other disturbed areas that would require reclamation include the road system, mine plant facilities, sedimentation ponds, and temporary diversion structures.

Alternative 3 – Proposed Action Plus Environmental Protection Measures

Alternative 3 is summarized below and described in **Section 2.5, Alternative 3 – Proposed Action Plus Environmental Protection Measures**. Under this alternative, which is sometimes referred to as the Action alternative in this EIS, OSMRE would require Western Energy to implement additional environmental protection measures that are above and beyond the requirements of MSUMRA. These measures are conceptual in nature and were designed to minimize environmental effects and to address key issues identified during the scoping process (see **Section 1.5.2.1, Key Issues Identified During Scoping for Detailed Analysis**).

Under this alternative, Western Energy would develop, mine, and reclaim the project area as proposed in the PAP with the exception of those areas where OSMRE has prescribed environmental protection measures. Required measures would include development of a water-management plan, additional requirements for the wetland mitigation plan, and development of practices designed to improve reclamation (soil stockpiling, soil redistribution, and drainage-basin design) and revegetation success for wildlife habitat. Alternative 3 also includes requirements for a geological survey and paleontology mitigations.

Alternatives Considered but Dismissed

Alternatives considered but dismissed from further analysis are also described in **Chapter 2**. Seven alternatives were suggested by the public in scoping comments or by specialists based on professional experience but were not analyzed in detail for a variety of reasons, including operational feasibility and failure to meet the project Purpose and Need. Dismissed alternatives include: (1) coal conservation; (2) private coal-mining; (3) underground mining; (4) mining within a smaller disturbance area, for a shorter duration, and/or within a different timeframe; (5) transporting coal by rail to western and international ports; (6) alternative land uses; and (7) alternative energy generation.

AFFECTED ENVIRONMENT

Twenty-three resource areas were analyzed in detail in the EIS. The following paragraphs provide a brief summary of the resources, analysis areas, and baseline conditions described in **Chapter 3, Affected Environment**. One resource, alluvial valley floors (AVF), was considered but was dismissed from detailed analysis following DEQ's AVF determination (see **Section 3.25, Resources Considered but Dismissed**).

Topography (Section 3.2). The project area is located in the Pine Breaks region of southeastern MT and is distinguished from neighboring plains areas by its more rugged topography. Prominent monoliths of eroded sandstone exist in some parts of the project area. The analysis area used to assess direct and indirect effects on topography is the 4,260-acre mining disturbance area, which includes all mining areas, stockpiles, scoria pits, haul roads, and haul-road ramps.

Air Quality (Section 3.3). The analyses are used to assess direct and indirect effects on air quality in a rectangular region that encompasses a 300-kilometer (km)-radius extent from the power plants. This area was conservatively chosen due to the long-range transport of pollutants from the elevated stacks of the Colstrip and Rosebud Power Plants. All of the reported concentrations from monitoring sites in MT are well below the national and state standards, and in the entire analysis area, only a single SO_2 monitor, located more than 400 km from the project area, reported values that exceeded the national standard.

Climate and Climate Change (Section 3.4). The Rosebud Mine falls within the Great Plains climate region, where winters are long and severe in the north (including MT) with average annual temperatures around 40°F. Regional greenhouse gas emissions were assessed using the same analysis area as for air quality. The Great Plains region has seen heavier and more frequent rainfall and has seen a 16-percent increase in rainfall from heavy precipitation events since 1958. Rising temperatures are leading to increased demand for water and energy, and changes in crop growth cycles due to warming winters and changes in rainfall have been observed. Trends in greenhouse gas emissions at national and global scales show a long-term increase in global carbon dioxide concentrations—the primary indicator of global warming.

Public Health (Section 3.5). The analysis area for direct effects on public health is the project area; for indirect effects, the analysis area was expanded to include local communities and populations including the city of Colstrip, the Northern Cheyenne Indian Reservation, the Crow Reservation, and the town of Lame Deer. Quality of life in the analysis area is relatively low compared to other MT counties. Rates of premature deaths are nearly twice that of MT as a whole, while adult smoking, obesity, and physical inactivity occur at greater rates. Chronic disease (cardiovascular disease, diabetes, cancer, asthma, etc.) rates generally are higher in the analysis area than in the rest of MT. Incidence rates of infectious diseases within the analysis area are not remarkably different from the state's rates, except for sexually transmitted diseases and salmonellosis incidence, which are both higher in the analysis area than in the rest of MT. Deaths by injury rates are higher compared to the rest of the state. The analysis area has a relatively poor food environment compared to both MT and the United States, indicating that nutritional health of the communities is poor, and access to healthy food is limited.

Geology (Section 3.6). The Rosebud Mine is located in the northwestern portion of the Powder River structural basin, a broad northeast-trending synclinal structural basin in eastern Wyoming and southeastern MT bounded on three sides by mountain uplifts. The analysis area for direct and indirect effects on geology was defined as the project area. The Paleocene Fort Union Formation is the predominant bedrock unit within this analysis area and consists of gently dipping (less than a few degrees) sedimentary rocks. The Fort Union Formation is composed of sandstone, siltstone, mudstone, claystone, and coal beds. Coal targeted for removal in the project area is within the Tongue River Member of the Fort Union Formation.

Water Resources – Surface Water (Section 3.7). The analysis area for direct effects on surface water quantity and quality was defined as streams that may be impacted by mining in the project area by changes in flow and/or changes in water quality. The analysis area included locations where project mining and related disturbances would occur and the watersheds of the streams in and downstream of the project area that flow through or receive water from the mining disturbance area (e.g., West Fork Armells Creek). The water quality of surface water resources in the direct effects analysis area, specifically within the proposed Area F permit boundary, represents largely natural conditions that have been minimally affected by human-made disturbances within or upstream of the project area. Water quality is variable in the project area primarily due to the dominance of either direct runoff from snowmelt or rainfall or ground water discharge to surface water during various times of the year.

Indirect effects were assessed in an analysis area that included all of the Armells Creek watershed and parts of the Sarpy Creek and Rosebud Creek watersheds within and downstream of a 32-km circular area determined by mercury-deposition modeling completed for special status species. Within the last 5 years, mercury, selenium, and copper concentrations in the streams where data have been collected have nearly all been low: most results were well below standards except for selenium in the East Fork Armells Creek in Colstrip and in Spring Creek. Within the last 5 years, nitrate+nitrite and total nitrogen concentrations in the streams where data have been collected have nearly all been low: there were total nitrogen concentrations approaching the standard in Rosebud Creek upstream of Pony Creek and in Spring Creek near the mouth.

Water Resources – Ground Water (Section 3.8). The analysis area for direct effects on ground water hydrology and quality was defined as the project area and the surrounding area where direct effects on ground water are predicted to occur based on ground water modeling. Six hydrostratigraphic units, which combine various lithologic units, were modeled and assessed: alluvium, overburden (all lithologies that overlie the Rosebud Coal, including clinker), Rosebud Coal, interburden (Tongue River Member between the Rosebud and McKay Coals), McKay Coal, and Sub-McKay (Tongue River Member below the McKay Coal). Ground water in the area around the project area is used for both stock and rural domestic water needs. Well yields are generally low (less than 10 gallons per minute [gpm]) but adequate for the intended use, which is stock watering. Ground water wells produce water from the various sandstone units of the Tongue River Member and the thicker coals, such as the Rosebud and McKay Coals.

The analysis area for indirect effects on ground water was defined as the property boundary of the Colstrip Power Plant and the area around the Rosebud Power Plant. The analysis area includes similar geology and ground water hydrology as the project area.

Water Resources – Water Rights (Section 3.9). The analysis area for direct impacts on surface water rights and ground water rights was defined as the project area as well as the surrounding area that may be affected by mining in the project area. Indirect impacts on surface water rights were assessed within the same analysis area as for surface water. Indirect impacts on ground water rights were assessed within the same analysis area as for ground water. There are 122 surface water and ground water rights on record within and near the project area as well as downgradient water rights that may be affected by mine operations; nearly all are for stock water use, and a few are for domestic use.

Vegetation (Section 3.10). The analysis area for direct effects on vegetation was defined as the project area. The analysis area for indirect effects on vegetation was defined as the operational boundaries of the Colstrip and Rosebud Power Plants plus a 32-km area around each of the power plants using trace-metal deposition modeling completed for special status species. Both the direct and indirect effects analysis areas have limited human disturbance, but some vegetation communities have been affected by livestock grazing, agriculture, roads, utility corridors, and wildfire. Six major vegetation communities were identified in the direct effects analysis area: grassland, conifer (Ponderosa pine)/sumac, sagebrush, pastureland, mixed shrubland, and woody draw. Similar communities were identified in the indirect effects analysis area.

Wetlands and Riparian Zones (Section 3.11). Based on baseline inventories of wetlands, the analysis area for direct impacts on wetlands and riparian zones was defined as the project area plus a 500-foot buffer. Indirect impacts on wetlands and riparian zones were assessed within the same indirect effects analysis area as for surface water resources. The project area supports few (11) wetlands because of its location near the top of the watershed and the semiarid climate; however, more wetlands are present within the proposed Area F permit boundary than in other Rosebud Mine permit areas.

Fish and Wildlife Resources (Section 3.12). The analysis area for direct impacts on fish and wildlife species and their habitats was defined as the project area plus a 1-mile perimeter buffer. Indirect impacts on fish and wildlife species and their habitats were assessed within the operational boundaries of the Colstrip and Rosebud Power Plants plus a 32-km area around each of the power plants based on trace-metal deposition modeling completed for special status species. Wildlife habitat types within the direct effects analysis area consist primarily of grasslands, conifer/sumac woodlands, and upland shrublands, which together encompass about 80 percent of all habitat types. Agricultural lands and pasture comprise about 15 percent, and interspersed patches of lowlands, sandstone piles/cliffs, and disturbed/developed lands comprise the remaining 5 percent.

Special Status Species (Section 3.13). The analysis area for direct impacts on special status species and their habitats was defined as the project area plus a 15-mile perimeter buffer that included portions of Rosebud and Treasure Counties. Indirect impacts on special status species and their habitats were assessed within the operational boundaries of the Colstrip and Rosebud Power Plants plus a 32-km area around each of the power plants based on trace-metal deposition modeling. A total of 3 federally-listed endangered species and 42 species of concern (7 mammal, 21 bird, 6 reptile, 6 fish, and 2 amphibian species) may be found within the direct and indirect effects analysis areas. Three plant species are listed as federally threatened in MT but do not occur within the direct and indirect effects analysis areas. Thirteen vegetation species of concern potentially occur in the indirect effects analysis area; the direct effects analysis area contains suitable habitat for nine of these species, but none were documented in the project area during the field assessments in 2005–2007 (updated in 2014).

Cultural and Historic Resources (Section 3.14). Impacts on cultural resources were assessed within the 8,280-acre area of potential effect (APE) by two Class III cultural resource surveys completed in 2010 (PAP, Appendix A-1) and 2012 (PAP, Appendix A-2). The APE was defined as the entirety of the project area or the proposed permit boundary. A total of 105 cultural resources were documented within the APE; however, the majority of the sites (81) have been evaluated as not eligible for listing on the National Register of Historic Places (NRHP). Sixteen sites are recommended eligible for listing on the NRHP. Both historic districts intersecting the APE—the Castle Rock and Lee Historic Districts—have been recommended eligible for the NRHP. A programmatic agreement that provides for continued Section 106 compliance for the life of mining operations has been executed between OSMRE, Western Energy, SHPO, DEQ, and BLM.

Socioeconomic Conditions (Section 3.15). The analysis area for direct and indirect socioeconomic impacts was defined as Rosebud, Treasure, and Big Horn Counties. Affected incorporated municipalities in the analysis area include Colstrip, Forsyth, Hysham, and Hardin. Two reservations—the Northern Cheyenne Indian Reservation and the Crow Reservations—are also within the analysis area and comprise the majority of Big Horn County. Coal mining and agriculture both play major roles in Big Horn County's economy. Rosebud County's traditional major industries of coal mining, the railroad, and agriculture remain the driving forces of the area's economy. Rosebud County has experienced a declining economy within the last several decades. Treasure County's principal industries are farming and ranching.

Environmental Justice (Section 3.16). Environmental justice impacts were assessed using the same analysis area as for socioeconomic conditions. The populations living in the analysis area meet the environmental justice guidelines for minority and low-income residents.

Visual Resources (Section 3.17). The analysis area for direct effects on visual resources was defined as the viewshed of the project area, which included the project area and surrounding lands with potential views of the proposed operations (and associated infrastructure). Indirect visual impacts (regional haze) were assessed using the same analysis area as for air quality. The surface within the analysis area has limited visible human disturbance, but some changes to vegetation are evident from livestock grazing, agriculture, roads, utility corridors, and wildfire. The existing Rosebud Mine is located west, south, and east of Colstrip. As expected, the existing mine operations look industrial, with large buildings, conveyors, coal piles, large equipment, draglines, evaporative ponds, and land scars of bare soil from the open pits, maintenance, and haul roads.

Recreation (Section 3.18). The analysis area for direct effects on recreation was defined as the project area plus a 2,000-foot buffer. Hunting for big game (mule deer, white-tailed deer, pronghorn, and elk) and upland birds is the main form of recreation in the analysis area, which is primarily privately owned. Western Energy allows public access to inactive areas of the mine through Montana Fish, Wildlife & Parks' (FWP) Block Management Program.

Paleontology (Section 3.19). Direct and indirect effects on paleontological resources were assessed within the same analysis area as for Geology. A Class III cultural resources and paleontological inventory was conducted in 2012, and no paleontological resources were noted in the analysis area. A 2015 pre-disturbance paleontological resources survey identified nine fossil localities and found that the most common fossils in the analysis area are plant elements.

Access and Transportation (Section 3.20). The analysis area for direct and indirect effects on access and transportation was defined as the project area and the transportation network surrounding the Rosebud Mine and Colstrip and Rosebud Power Plants (i.e., the existing haul road and access roads of the Rosebud Mine, county roads [i.e., Castle Rock Road and Horse Creek Road], the section of State Highway [SH] 39 between the Rosebud Mine and the Rosebud Power Plant, and the Rosebud and Colstrip Power Plants plus an approximate 0.5-mile buffer area around the power plants). The Rosebud Mine is primarily accessed from the east via Castle Rock Road, a Rosebud County road that runs west off of SH 39 about 1 mile south of Colstrip. Major mine facilities such as the mine office, the maintenance shop, and the operations and maintenance complex are located on Castle Rock Road.

Solid and Hazardous Waste (Section 3.21). The analysis area for direct effects from solid and hazardous waste was defined as the Rosebud Mine site, including the proposed project area. The analysis area for indirect effects from coal combustion residuals (CCR) was defined as the sites of the Colstrip and Rosebud Power Plants and the CCR storage area associated with the Colstrip Power Plant. Wastes generated as part of active coal mining within areas A, B, and C of the Rosebud Mine are handled under Western Energy's Waste Management Program, which consists of a Solid and Hazardous Waste Management Plan, a Spill Prevention Control and Counter-Measure Plan, and a Contingency and Emergency Response Plan. Hazardous wastes generated at the Rosebud Mine include greases, lubricants, paints, flammable liquids, solvents, and any other material that meets the definition of a hazardous waste. CCR generated at the Colstrip Power Plant is impounded in ponds at the plant site and at two separate locations about 3 miles east and northwest of Colstrip. CCR generated at the Rosebud Power Plant is conveyed pneumatically to an ash silo for temporary storage, then periodically transferred into a plant-ash truck and transported to an on-site ash monofill disposal area where it is hydrated with industrial wastewater from the plant to consolidate and solidify the ash.

Noise (Section 3.22). The analysis area for direct effects from noise was defined as the nearest residences around the existing Rosebud Mine and proposed project area and within the city of Colstrip. Indirect effects were assessed at residences near the Rosebud and Colstrip Power Plants. Within the Colstrip city limits, existing noise sources include traffic on SH 39 and other local roads, the activities of residents, operation of the Colstrip and Rosebud Power Plants (the Rosebud Power Plant is about 6 miles to the north of Colstrip), and the coal conveyors.

Land Use (Section 3.23). Direct effects on land use were assessed using the same analysis area as for recreation (the project area plus a 2,000-foot buffer). Current surface land uses in the project area include grazing, pastureland, cropland, and wildlife habitat. Indirect effects on land use were assessed at the locations of the Colstrip and Rosebud Power Plants plus a 0.5-mile buffer. The land uses in the indirect effects analysis area primarily consist of agricultural crop production, grasslands, forest/grazing, open grazed sparse woods, and irrigated land.

Soil (Section 3.24). The analysis area for direct effects on soil was defined as the project's 4,260-acre mining disturbance area. Indirect effects on soil were assessed within the operational boundaries of the Colstrip and Rosebud Power Plants plus a 32-km radius around each of the power plants based on trace-metal deposition modeling completed for special status species. According to the baseline soil study, all of the soil in the project area is suitable for use in reclamation and revegetation with the exception of some areas of subsoil that are very rocky and exceed DEQ's guidelines for rock fragments.

POTENTIAL ENVIRONMENTAL IMPACTS

This EIS discloses and analyzes the environmental effects that may result from selection and implementation of the Proposed Action and alternatives described in **Chapter 2**; these effects are presented in **Table S-1** below. Detailed resource impacts analyses are provided in **Chapter 4** (direct and indirect effects) and **Chapter 5** (cumulative effects).

Table S-1. Summary Comparison of Direct and Indirect Environmental Impacts.

Resource	Alternative 1 – No Action	Alternative 2 – Proposed Action	Alternative 3 – Proposed Action Plus Environmental Protection Measures
Topography	No impacts	Changes in topography during mining would be noticeable and would be short-term, major, and adverse. In the years immediately following reclamation, impacts from erosion would be negligible. Over time, differential erosion of the spoil would create a hummocky terrain with fragments of more resistant stone scattered throughout the analysis area; these impacts would be long-term, minor, and adverse. Differential erosion of backfilled areas and unmined drainage basins over an unknown geologic time would result in topographic inversion of the analysis area; these impacts would be long-term, major, and adverse.	Impacts would be similar to those described for Alternative 2. Improved water management during mining may result in decreased short-term erosion rates, and tighter elevation control may result in a more stable land surface.
Air Quality	No impacts	Air emissions would not result in exceedances of any NAAQS. Direct and indirect impacts on air quality would be short-term, negligible to minor, and adverse. Deposition impacts would be long-term, negligible to minor, and adverse.	Impacts would be the same as those described for Alternative 2.
Climate and Climate Change	No impacts	Direct and indirect greenhouse gas emissions would contribute incrementally to climate change. Direct impacts on climate change would be negligible relative to other GHG emission sources.	Impacts would be the same as those described for Alternative 2.

Table S-1. Summary Comparison of Direct and Indirect Environmental Impacts.

Resource	Alternative 1 – No Action	Alternative 2 – Proposed Action	Alternative 3 – Proposed Action Plus Environmental Protection Measures
Public Health	There would be no immediate effects on the public health of the analysis area's overall population and sensitive subpopulations, including those with chronic disease and American Indian populations. There may be long-term negligible impacts on public health within the direct effects analysis area resulting from fugitive dust from reclamation activities. If and when the Rosebud Mine does close, revenues that support access to public health services, such as hospitals, libraries, schools, and other services, would cease, resulting in direct and indirect moderate to major long-term effects on social services and resources.	The public's exposure to diesel particulate matter (DPM) and fugitive dust, including coal dust, would be low due to limited exposure time and extent. Deposition of airborne contaminants of potential concern on soils and surface waters may occur, but it is not likely that the public would be exposed to these except incidentally. Project impacts on air concentrations of PM would result in a short-term minor adverse impact on public health within the project area and public access roads. Members of the public would not be permitted within the project area where PM and other hazardous substances would be present at higher concentrations. Any potential exposure of sensitive receptors to PM would be incidental and limited in duration. Therefore, the direct impacts on public health from PM2.5 and PM10, including from DPM and coal dust, would be short-term, negligible to minor, and adverse. There is a low likelihood that human consumption or contact with contaminated surface or ground water would occur from the Proposed Action. With monitoring and mitigation activities, increased risk to public health from exposure to water because of the Proposed Action is not likely. The Proposed Action would have a short-term moderate beneficial impact on public health as it relates to economics and social services; a short-term negligible impact on community health; and a short-term minor adverse effect on land use as it relates to public health. Effects on public safety from noise and from solid and hazardous waste would be none to negligible.	Impacts would be similar as those described for Alternative 2.

Table S-1. Summary Comparison of Direct and Indirect Environmental Impacts.

Resource	Alternative 1 – No Action	Alternative 2 – Proposed Action	Alternative 3 – Proposed Action Plus Environmental Protection Measures
Geology	No impacts	Horizontal continuity of the geology in the analysis area would be lost during mining, and the overburden would be vertically altered. Rock-outcrop features of historical significance would also be lost. Impacts would be short- and long-term, major, and adverse. Impacts would last until the spoil used to replace the geologically distinct layers was eroded away.	Impacts would be similar to those described for Alternative 2. Rock-outcrop features of historical significance would be identified prior to disturbance as part of a geological resources survey, and if DEQ determines the feature should remain in place, the mine plan would be adjusted to avoid long-term major adverse impacts.
Water Resources – Surface Water	Impacts due to current and future mining and/or reclamation in other areas of the Rosebud Mine would continue.	Impacts on stream and spring flows, pond levels, and hydrologic balance due to road relocation and construction would be short-term, minor, and adverse. Impacts from changes in flow volumes, timing of flows, and frequency of flows would be long-term, minor to moderate, and adverse. Impacts due to mining activities within the 100-year floodplains would be short-term, minor, and adverse. Impacts on surface water quality due to mining would be long-term, minor to moderate, and adverse. Some surface water resources would be permanently lost or changed.	Impacts on stream and spring flows, pond levels, and hydrologic balance would be similar to those described for Alternative 2. Pit water would be managed to protect surface water quality outside of the analysis area. Postmine topography would be designed using 5-foot (instead of 10-foot) contours. DEQ approval would be required for drainage designs with estimated 2-year, 24-hour peak flows greater than 5 cfs (vs. the standard 15 cfs).
Water Resources – Ground Water	No impacts	Mining of the project area would permanently remove the Rosebud Coal aquifer and result in long-term reduction or elimination of the bedrock ground water contribution to baseflow in the perennial and intermittent reaches of the major tributaries. Long-term ground water drawdown due to mining would extend upgradient to the south beyond the mine area. Drawdown may affect existing water users of the Rosebud Coal aquifer. Mining would permanently remove springs in the project area whose ground water source is either the Rosebud Coal or overburden that would be removed. Replacement of the Rosebud Coal with spoil would have long-term, moderate, adverse impacts on ground water quality in the analysis area. When the spoil is sufficiently resaturated to discharge to alluvium in the major tributaries, impacts on alluvial ground water quality would likely be long-term, minor to moderate, and adverse.	Impacts would be similar to those described for Alternative 2. Pit-water handling requirements during mining would reduce potential impacts on alluvial ground water downgradient of storage ponds.

Table S-1. Summary Comparison of Direct and Indirect Environmental Impacts.

Resource	Alternative 1 – No Action	Alternative 2 – Proposed Action	Alternative 3 – Proposed Action Plus Environmental Protection Measures
Water Resources – Water Rights	Impacts due to current and future mining and/or reclamation in other areas of the Rosebud Mine would continue.	If a surface or ground water right became unusable for its specified purpose due to flow or water quality changes, the impact would be short-term, moderate, and adverse; a suitable replacement source would be provided by Western Energy. If a water right were impacted by mining but still contained sufficient water of adequate quality to meet beneficial use needs, the impact would be short-term, negligible to minor, and adverse.	Impacts would be the same as those described for Alternative 2.
Vegetation	No impacts	The removal of 4,260 acres of vegetation for mining activities would result in direct impacts that are short-term, moderate, and adverse. Decreased vegetation vigor and diversity, and the potential for changes to vegetation communities from a reduced amount of surface and ground water in the area, would result in impacts that are long-term, minor, and adverse. The indirect impacts on vegetation from power-plant emissions would be long-term, minor, and adverse.	Impacts would be similar to those described for Alternative 2. Development of a water-management plan and modifications to reclamation practices related to soil stockpiling, soil redistribution, and seeding to better manage water and improve reclamation success would have a beneficial effect on vegetation.
Wetlands and Riparian Zones	No impacts	Surface disturbance and changes to surface and ground water during mining activities would result in impacts that are short- and long-term, moderate, and adverse. A wetland mitigation plan would reduce the loss of wetland function and values. Indirect impacts on wetlands from power-plant emissions would be negligible.	Impacts would be similar to those described for Alternative 2. Development of a water-management plan and additional requirements for the wetland mitigation plan would have a beneficial effect on wetlands and would reduce long-term adverse impacts.

Table S-1. Summary Comparison of Direct and Indirect Environmental Impacts.

Resource	Alternative 1 – No Action	Alternative 2 – Proposed Action	Alternative 3 – Proposed Action Plus Environmental Protection Measures
Fish and Wildlife Resources	No impacts	Mining activities would result in loss of habitat due to surface disturbances that remove vegetation, direct mortality or injury due to vehicle or construction equipment collisions, and behavioral shifts such as a change in movement or displacement to other areas due to increased human activity and noise from blasting and mining operations. Direct impacts on small mammals, carnivores, big game, migratory birds, shorebirds, raptors, reptiles and amphibians, and aquatic species would be short- and long-term, negligible to minor, and adverse. Impacts on bats would be short- and long-term, moderate, and adverse. Indirect impacts from power-plant emissions would be negligible.	Impacts would be the same as those described for Alternative 2. Development of a water-management plan in conjunction with a nonjurisdictional wetland mitigation plan would result in potential beneficial impacts on most wildlife species that depend on wetland and riparian habitat.
Special Status Species	No impacts	Mining activities would result in loss of habitat due to surface disturbances that remove vegetation, direct mortality or injury due to vehicle or construction equipment collisions, and behavioral shifts such as a change in movement or displacement to other areas due to increased human activity and noise from blasting and mining operations. There would be no impacts on federally listed threatened and endangered species. Direct impacts on state species of concern would be short- and long-term, moderate, and adverse. Indirect impacts from power-plant emissions would be negligible.	Impacts would be the same as those described for Alternative 2. Development of a water-management plan in conjunction with a nonjurisdictional wetland mitigation plan would result in potential beneficial impacts on most wildlife species that depend on wetland and riparian habitat.
Cultural and Historic Resources	No impacts	Surface disturbance from mining and wetland mitigation activity may result in disturbance or destruction of historic properties located within the analysis area, and these impacts would be long-term, major, and adverse. Adverse impacts would be resolved through both a property-specific Memorandum of Agreement and a long-term PA stipulating measures for continued Section 106 compliance.	Wetland mitigation has the potential to adversely affect known and unknown historic properties. A PA would stipulate measures for Section 106 compliance prior to undertaking wetland mitigation.

Table S-1. Summary Comparison of Direct and Indirect Environmental Impacts.

Resource	Alternative 1 – No Action	Alternative 2 – Proposed Action	Alternative 3 – Proposed Action Plus Environmental Protection Measures
Socioeconomic Conditions	Annual economic impacts associated with continued operation of the Rosebud Mine would be short-term and negligible since the mine would continue to support local economic activity. With the retirement of the Colstrip Power Plant Units 1 and 2 in 2022, impacts of changes in mine operation would likely be short-term and moderate since the mine would support local economic activity at a reduced level. Eventual mine closure would likely result in long-term, moderate to major negative impacts.	Impacts would be the same as those described for Alternative 1.	Impacts would be the same as those described for Alternative 1.
Environmental Justice	When the Rosebud Mine eventually closes, all populations within Rosebud County will be negatively affected, including the substantial environmental justice populations. Impacts would be long-term, negligible, and adverse.	Alternative 2 would delay the onset of adverse economic impacts, possibly allowing time for other sectors to develop. Therefore, impacts would be short-term and minor because the mine would continue to support local economic activity during the life of the mine.	Impacts would be the same as those described for Alternative 2.
Visual Resources	No impacts	Mining activities would change the visual landscape for drivers traveling along Horse Creek Road through the project area through changes to geology and topography, and removal of vegetation; the impact would be short-term, moderate, and adverse. For seven residences adjacent to the Rosebud Mine, active mining adjacent to existing mining areas may be visible in a small portion of the viewshed from a few locations. Depending on location, impacts would range from none to long-term, moderate, and adverse.	Impacts would be similar to those described for Alternative 2. Measures to improve revegetation success and a pre-mining geological resource survey to identify rock-outcrop features to be left intact may help the area return to pre-mine visual conditions more quickly.

Table S-1. Summary Comparison of Direct and Indirect Environmental Impacts.

Resource	Alternative 1 – No Action	Alternative 2 – Proposed Action	Alternative 3 – Proposed Action Plus Environmental Protection Measures
Recreation	No impacts	All current use of the land for recreation (primarily hunting) would be unavailable during mine operations. Hunting opportunities on mine-related disturbance areas would be lost until revegetation and forage production were comparable to pre-mining levels associated with adjacent land. Impacts would be long-term, moderate, and adverse.	Impacts would be the same as those described for Alternative 2.
Paleontology	No impacts	Paleontological resources not identified or salvaged prior to mining would be permanently lost, resulting in impacts that are short- and long-term, major, and adverse. However, previously unknown paleontological resources may also be identified during mining activities and potentially salvaged, resulting in a beneficial impact.	The Unanticipated Discovery Plan required under Alternative 3 would increase the potential for discovery of paleontological resources of scientific interest. Discovery would not ensure protection but would help minimize unintentional destruction of these resources.
Access and Transportation	The haul road from Area C West would likely be decommissioned 15 to 20 years earlier.	A 4.2-mile segment of Horse Creek Road in the northeast/north-central portion of the analysis area would be relocated, and a 1.3-mile segment in the northwestern portion would be rerouted. Impacts from the relocation/reroute of Horse Creek Road would be short-term, minor, and adverse. The impacts due to haul, ramp, and service roads would be short-term, negligible, and adverse because the overall transportation system would not be disrupted.	Impacts would be the same as those described for Alternative 2.
Solid and Hazardous Waste	No impacts	Potential leaks or releases of solid or hazardous wastes would result in impacts that are short-term, negligible, and adverse. Impacts from boron toxicity related to the receipt and use of bottom ash at other permit areas of the mine would be short-term, negligible, and adverse.	Impacts would be the same as those described for Alternative 2.
Noise	No impacts	Direct impacts due to noise from mining and reclamation in the project area would be short- and long-term, negligible to minor, and adverse for the nearest rural residences. Indirect impacts due to noise from operation of the Rosebud and Colstrip Power Plants would continue to be moderate to minor for the residences in Colstrip and for those adjacent to the Rosebud Power Plant.	Impacts would be the same as those described for Alternative 2.

Table S-1. Summary Comparison of Direct and Indirect Environmental Impacts.

Resource	Alternative 1 – No Action	Alternative 2 – Proposed Action	Alternative 3 – Proposed Action Plus Environmental Protection Measures
Land Use	No impacts	All current land uses within the analysis area would be temporarily disturbed during mine operations based on the timing of the approved mine plan. Impacts on grazing land would be long-term, moderate, and beneficial. Impacts on cropland would be long-term, moderate, and adverse. Impacts on cropland would be long-term, moderate, and adverse.	Impacts would be similar to those described for Alternative 2. Loss of soil productivity and associated loss of cropland/grazing-land productivity would vary slightly, with productivity potentially returning to postmine conditions more quickly.
Soil	No impacts	Soil salvage, storage, and respreading would result in soil erosion and changes to physical, chemical, and biological soil characteristics. During mining, soil erosion impacts would be short-term, minor, and adverse. Erosion rates in reclaimed areas would return to pre-mine rates within 2 years once vegetation stabilizes the surface. It would be many years before physical, chemical, and biological soil characteristics return to pre-mine conditions; impacts in reclaimed areas would be long-term, minor, and adverse.	Contouring soil stockpiles during mining would reduce short-term erosion from stockpiles compared to Alternative 2. Applying organic amendments such as grass to the upper 4 inches of soil in small problem areas (i.e., areas lacking sufficient organic matter, areas with limited vegetation cover, or areas susceptible to erosion) would enhance soil productivity and reduce erosion when compared to Alternative 2. Long-term impacts on soil would be the same as those described for Alternative 2.

WHERE TO OBTAIN MORE INFORMATION

More information on the Rosebud Mine and the project area can be found on the agencies' websites (DEQ: http://deq.mt.gov/Public/ea/coal and OSMRE: https://www.wrcc.osmre.gov/initiatives/westernenergy.shtm). If you have any additional questions or concerns, please contact the individuals listed below.

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CHAPTER 1. PURPOSE AND NEED

1.1 INTRODUCTION

This Environmental Impact Statement (EIS) has been prepared by the Montana Department of Environmental Quality (DEQ) and the U.S. Department of the Interior (DOI), Office of Surface Mining Reclamation and Enforcement (OSMRE) Western Region Office, in cooperation with the DOI Bureau of Land Management (BLM) Miles City Field Office. This EIS analyzes the potential environmental effects of a proposed new permit area (C2011003F), known as Area F (project or project area), at the Rosebud Mine, which is an existing 25,949-acre surface coal mine annually producing 8.0 to 10.25 million tons of low-sulfur subbituminous coal (Spang 2013) (see **Section 2.2, Existing Operations**). Western Energy Company (Western Energy), a subsidiary of Westmoreland Coal Company (Westmoreland), is the operator of the Rosebud Mine and the project proponent.

The Rosebud Mine is located in Rosebud County and surrounds the city of Colstrip and the Colstrip Steam Electric Station, which is commonly known as the Colstrip Power Plant. Permit Areas D and E of the Rosebud Mine extend to the east of Colstrip for about 3.5 miles, and Permit Areas A, B, and C extend about 12 miles to the west of Colstrip. The project area would be located adjacent to the western boundary of Area C (**Figure 1**) in Township 2 North, Range 38 and 39 East, and Township 1 North, Range 39 East and would expand the mine to the west into Treasure County (**Figure 2**). Situated in the northern Powder River Basin, the Rosebud Mine is generally east and north of the Little Wolf Mountains. Tributaries of Horse Creek and West Fork Armells Creek, including Black Hank Creek, Donley Creek, Robbie Creek, and McClure Creek (all of which lie within the drainage of the Yellowstone River), drain the project area. A ridge in the western portion of the project area divides the Horse Creek and West Fork Armells Creek drainages.

If DEQ approves the Area F permit (C2011003F) and a new federal mining plan for the project is approved as proposed, then 6,746 permit acres would be added to the Rosebud Mine (see **Section 2.4, Alternative 2 – Proposed Action**), and, at the current rate of production, the operational life of the mine would be extended by 8 years. Without the addition of the project, the operational life of the Rosebud Mine would be expected to end in 2030, which is the expected end of operation for the currently mined Permit Area B, one of three active permit areas (see **Section 2.2.6, Life of Operations**). Although the project would be a new permit area and an expansion of the Rosebud Mine's surface disturbance, Western Energy does not propose to increase the total annual production output of the mine.

The area of disturbance within the project area would be 4,260 acres. Of these, 2,159 acres would be disturbed by mining; the remainder would be disturbed by highwall reduction, soil storage, scoria pits, haul-road construction, and other miscellaneous disturbances. The surface of the permit area is entirely privately owned, but the subsurface is both privately (3,479 acres) and federally (3,267 acres) owned. Western Energy holds leases for the federal (M82186) and private coal (G-002 and G-002-A). Current surface land uses in the project area include grazing land, pastureland, cropland, and wildlife habitat. A county road, a gas-transmission pipeline, and high-voltage electric transmission lines cross the project area.

Mining operations in the project area, which would commence after all permits and approvals have been secured (**Table 1** and **Table 2**) and a performance bond has been posted, would last 19 years. Western Energy estimates that 70.8 million tons of recoverable coal reserves exist in the project area and would be removed during the 19-year operations period. As with other permit areas of the Rosebud Mine, all coal would be combusted locally at two power plants—the Colstrip and Rosebud Power Plants (see **Section 1.2.2, Coal Combustion**).

A single EIS has been prepared (DEQ and OSMRE 2013) to meet the respective requirements of the Montana Environmental Policy Act (MEPA), Title 75, Chapter 1, Parts 1 through 3, of the Montana Code Annotated (MCA) and its implementing rules, the Administrative Rules of Montana (ARM) 17.4.601 et seq.; and the National Environmental Policy Act (NEPA), 42 United States Code (USC) Section 4321 et seq.; the Council on Environmental Quality's (CEQ's) NEPA regulations, 40 Code of Federal Regulations (CFR) Parts 1500 to 1508; DOI's NEPA regulations (43 CFR 46) and Department Manual 516; and the OSMRE *NEPA Handbook* (OSMRE 1989). The BLM *NEPA Handbook* (BLM 2008) also was considered in the preparation of the document.

This EIS will help DEQ managers make a more fully informed decision with respect to the approval of Western Energy's mine permit application package (PAP) for the project area (see **Appendix A** for links for digital download). DEQ will decide whether to approve the permit in accordance with the requirements of the Montana Strip and Underground Mine Reclamation Act (MSUMRA) (82-4-201 et seq., MCA) and its implementing rules (ARM 17.24.301-1309). DEQ may not withhold, deny, or impose conditions on the Area F permit based on the information contained in this EIS per 75-1-201(4), MCA.

This EIS also will help DEQ managers make a more fully informed decision regarding two other Western Energy applications: (1) an application for a new Montana Pollutant Discharge Elimination System (MPDES) permit MT-0031828 for project area outfalls into the Black Hank Creek, Donley Creek, Robbie Creek, McClure Creek, and Trail Creek drainages, and (2) an application to modify Montana Air Quality Permit (MAQP) #1570-07 to include the project area. This EIS serves as the MEPA-compliant review for these two permitting decisions as well as for the MSUMRA operating permit.

This EIS will help OSMRE prepare the Mining Plan Decision Document (MPDD) for the DOI Assistant Secretary for Land and Minerals Management (ASLM) recommending approval, disapproval, or conditional approval of the project area mining plan. A MPDD will be prepared because Western Energy's proposed project constitutes a major revision to the current Rosebud Mine operations. BLM is a cooperating agency on this EIS because it is the federal agency responsible for leasing federal coal lands under the Mineral Leasing Act (MLA) of 1920, as amended (30 USC Section 181 et seq.).

The decision regarding a selected alternative and supporting reasoning will be documented in two Records of Decision (RODs), one issued by DEQ and one issued by OSMRE. DEQ's ROD will be issued as a document identified as Written Findings at least 15 days after the Final EIS is published. OSMRE's ROD will be released along with the ASLM decision on the MPDD. OSMRE intends to issue the ROD within 90 days after the Final EIS is published. BLM will not issue a ROD but will review Western Energy's Resource Recovery and Protection Plan and other requirements of the federal lease and make a finding (43 CFR 3482.2).

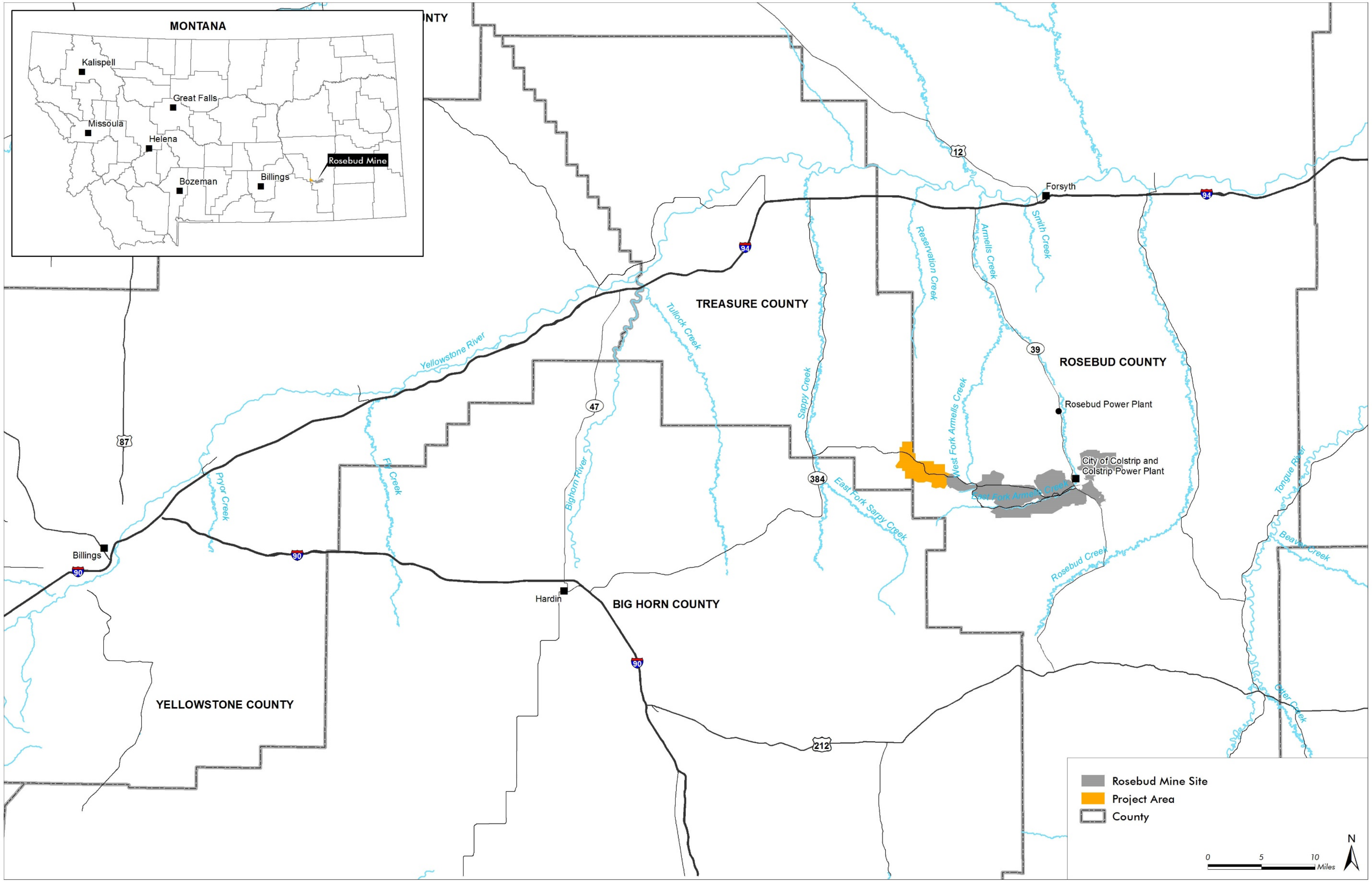

Figure 1. Project Location.

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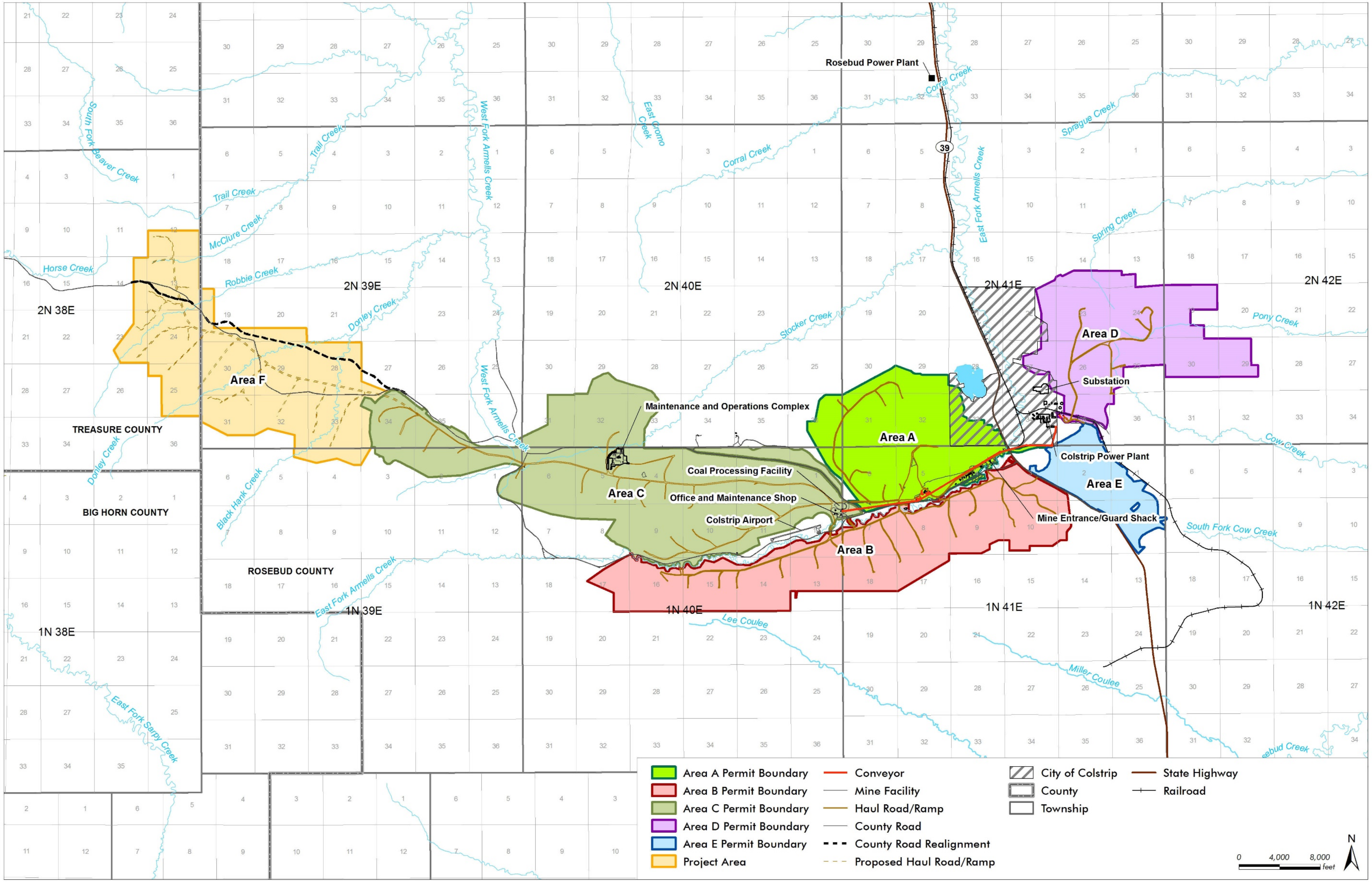

Figure 2. Location of Mine Facilities and Permit Areas.

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1.1.1 Document Structure

This EIS discloses the potential direct, indirect, and cumulative environmental impacts that would result from the proposed project and alternatives. The document is organized into seven chapters:

- Executive Summary – The summary provides a brief overview of the proposed project, alternatives, and effects. It also includes a list of acronyms, a glossary, and the table of contents (including lists of figures and tables).
- Chapter 1. Purpose and Need – Chapter 1 includes the following: background and overview of the proposed project; the purpose of and need for the proposed project; agencies' roles, responsibilities, and decisions; an overview of public notice and participation; identification of the key scoping issues; and a description of the bond process for surface coal mines (financial assurance).
- Chapter 2. Description of Alternatives – Chapter 2 describes existing operations at the Rosebud Mine and provides a detailed description of Western Energy's Proposed Action (Alternative 2) as well as the No Action alternative (Alternative 1) and Alternative 3. Alternative 3, sometimes called the Action alternative in this document, was developed by the lead agencies based on key issues raised by the public and other agencies. It includes additional environmental protection measures to avoid or reduce impacts. Chapter 2 also includes a description of alternatives that were considered but dismissed.
- Chapter 3. Affected Environment – Chapter 3 describes the existing conditions and the direct and indirect effects analysis areas used for the resource-specific analyses in Chapter 4. Chapter 3 is organized by resource.
- Chapter 4. Environmental Consequences – Chapter 4 discloses the direct and indirect environmental impacts of implementing the Proposed Action or other alternatives. Like Chapter 3, this analysis is organized by resource. In addition, Chapter 4 includes a Regulatory Restriction Analysis per 75-1-201(3)(iii), MCA, which is an analysis of impacts on Western Energy's private property rights and whether alternatives that reduce, minimize, or eliminate the regulation of those rights have been analyzed.
- Chapter 5. Cumulative Effects – Chapter 5 discloses the cumulative environmental impacts of implementing the Proposed Action or other alternatives when considering related past, present, and reasonably foreseeable future actions. This chapter also discloses irreversible and irretrievable commitments of resources.
- Chapter 6. Consultation and Coordination – Chapter 6 provides a list of preparers and agencies consulted during the development of the Final EIS, describes formal consultation with Indian Tribes, and describes consultation done with the U.S. Fish and Wildlife Service regarding special status species.
- Chapter 7. References – Chapter 7 includes a list of references cited in the analysis.

The following appendices provide more detailed information to support the analyses presented in the Final EIS:

- Appendix A – List of all of Western Energy's permit (C2011003F) application documents for the project with links for digital download.
- Appendix B – DEQ's October 2017 Eighth Round Acceptability Deficiency Letter to Western Energy
- Appendix C – Seed Mixtures
- Appendix D – Air Quality Permits, Monitoring Data, and Supplemental Information:

  - D-1 Montana Air Quality Permit #1570-08 (Area C) and Montana Air Quality Permit #1570-07 Preliminary Determination (Areas C and F)
  - D-2 Montana Air Quality Permit #1483-08 for Areas A/B/D/E
  - D-3 County Level Monitoring Data
  - D-4 Monitored Visibility Trends for IMPROVE sites
  - D-5 Historic Deposition Trends
  - D-6 Supplemental Information for Cumulative Effects for Air Quality
  - D-7 Supplemental Information, Rosebud Area F Photochemical Model (CAMx) Inputs and Configuration
  - D-8 Supporting Information for Air Quality Impact Analysis for Rosebud Mine Area F DEIS
- Appendix E – List of Surface Water and Ground Water Rights
- Appendix F – Comments on the DEIS and Responses
- Appendix G – BBC IMPLAN Analysis
- Appendix H – Programmatic Agreement

Additional documentation, including Western Energy's permit application (including deficiency responses), may be found in the project record located at DEQ's Coal & Opencut Mining Bureau offices in Helena, Montana (MT), and the OSMRE Casper Area Office in Casper, Wyoming.

1.1.2 Terms Used in this EIS

Terms used in this EIS are defined in the **Glossary**, which can be found at the front of this document along with a list of abbreviations and acronyms. In this EIS, the terms "effect" and "impact" are used interchangeably and synonymously. An environmental impact or effect is any change from the present condition of any resource or issue that may result from the decision by DEQ and OSMRE to implement the Proposed Action or an alternative to the Proposed Action. An environmental impact may be adverse, beneficial, or both. See **Section 4.1.1, Definitions,** for more definitions related to effects/impacts and key differences between terminology used under NEPA and MEPA.

1.2 BACKGROUND AND OVERVIEW

1.2.1 History of Mine Operations at Colstrip

Coal has been mined at Colstrip for over 90 years. The Northern Pacific Railway established the city of Colstrip and its associated mine in the 1920s to access coal from the Fort Union Formation. Coal mining began in 1924, providing fuel for the railway's steam locomotive trains. During the initial 34 years of mining, 44 million tons of coal were mined. By 1958, diesel-powered locomotives replaced steam engines, and mining ceased in the Colstrip area.

In 1959, the Montana Power Company purchased rights to the Rosebud Mine and the city of Colstrip with plans to build power-generation facilities. The Rosebud Mine operation began production in 1968. In 2001, Westmoreland purchased the Rosebud Mine; its subsidiary, Western Energy, continues to operate the mine today. Although the Rosebud Mine has shipped coal by rail as recently as 2010, all coal currently produced by the mine is consumed locally at the Colstrip Power Plant and the Rosebud Power Plant (see **Section 1.2.2, Coal Combustion**). Past and current mine operations are described in **Section 2.2, Description of Past and Existing Mine and Reclamation Operations**. Western Energy's Proposed

Action is described in detail in **Section 2.5, Proposed Action**. Past MEPA documents for the Western Energy Rosebud Mine can be obtained at DEQ's Centralized Service Division upon request.

1.2.2 Coal Combustion

1.2.2.1 Colstrip Power Plant

The Colstrip Steam Electric Station, commonly known as the Colstrip Power Plant, is located within the city of Colstrip and surrounded by permit areas A, B, D, and E of the Rosebud Mine (**Figure 2**). The Montana Power Company started construction of the Colstrip Power Plant in the early 1970s and operated it until the late 1990s. PPL Montana began operating the Colstrip Power Plant in 1999. Talen Energy (formerly PPL Montana) now operates the Colstrip Power Plant, which currently is owned by Talen Energy, Puget Sound Energy Inc., Portland General Electric Company, Avista Corporation, PacifiCorp, and NorthWestern Energy.

The power plant has four coal-fired generating units capable of producing a total of 2,100 megawatts of electricity and is the second-largest coal-fired plant west of the Mississippi River. Colstrip Power Plant Units 1 and 2 were constructed in 1972 and began commercial operation in 1975 and 1976. Units 3 and 4 were sited and constructed pursuant to a certificate issued by DEQ under the Major Facility Siting Act (MFSA), MCA Section 75-20-101, et seq. ("Certificate"). The Certificate governs Units 3 and 4 and their associated facilities (DEQ 2015a). An EIS was prepared for this action in compliance with MEPA (Montana Department of Natural Resources and Conservation [DNRC] 1975). Units 3 and 4 started operating in 1984 and 1986. Units 1 and 2 each have about 307 megawatts of generating capacity, and Units 3 and 4 each have about 740 megawatts of generating capacity (PPL Montana 2014). Power from the Colstrip Power Plant is marketed through the Western Electricity Coordinating Council, a regional member of the North American Electricity Reliability Council that includes all of the western states and the Canadian provinces of Alberta and British Columbia.

The Rosebud Mine delivers between 7.7 and 9.95 million tons of coal annually to the Colstrip Power Plant primarily by covered conveyors (shown on **Figure 2**). Coal from Permit Areas A and B of the Rosebud Mine currently is used in Units 1 and 2 of the Colstrip Power Plant. Units 3 and 4 were originally limited to burning coal from Permit Areas C, D, and E, but in 2015 DEQ approved an amendment to the Certificate also allowing the use of coal from Permit Areas A, B, F, and G (DEQ 2015a). Currently, only coal from Area C is being burned in Units 3 and 4. Coal from the project area would be used in Units 3 and 4 if DEQ approves the permit and DOI approves a federal mining plan (see **Section 1.4, Agency Authority and Actions**). An amendment to the Area B permit area, known as Area B AM 5 (AM5), which is described in **Section 5.2.2, Reasonably Foreseeable Future Actions**, is in the beginning stages of the permitting process. If approved, coal from AM 5, which was previously referred to as Area G, would be dedicated to Units 3 and 4.

2012 AOC Settlement Agreement

In August 2012, DEQ and PPL Montana (now Talen Energy as stated above) entered into an Administrative Order of Consent (AOC) to address seepage from coal-ash ponds at the Colstrip Power Plant. Water seeping out of the ponds has impacted ground water with boron, chloride, and sulfate, as well as other constituents (see discussion in **Section 3.8, Water Resources – Ground Water**). Talen Energy uses an extensive well network to monitor the impacts and to capture and return impacted water to the ponds. Because project coal would be combusted in Units 3 and 4, seepage from the coal-ash ponds is analyzed as an indirect effect in **Section 4.8, Water Resources – Ground Water**.

2016 Consent Decree for Units 1 and 2

In 2013, the Sierra Club and the Montana Environmental Information Center (MEIC) filed litigation against the owners of the Colstrip Power Plant, alleging violations of the Clean Air Act (CAA). The lawsuit claimed that numerous modifications had been made to the Colstrip Power Plant without the installation of modern pollution controls as required by the CAA. Puget Sound Energy and Talen Energy (each 50 percent share owners of Units 1 and 2) reached a settlement with MEIC and the Sierra Club, and on July 12, 2016, the United States District Court of Montana filed a consent decree containing the terms of the settlement. Specifically, Colstrip Units 1 and 2 must cease operations on or before July 1, 2022, and set emission limits for nitrogen oxide (NO_x) and sulfur dioxide (SO_2) from these units prior to shutdown (see also **Section 3.3, Air Quality**).

Even if project area coal were available prior to the 2022 retirement date, it would not be combusted in Units 1 and 2. Colstrip Units 3 and 4, which would combust project area coal, are not included in the terms of the agreement.

Legislative Action by Western States

In 2016, Oregon and Washington passed and signed measures related to the Colstrip Power Plant. The new Oregon law requires that the state eliminate coal as a power source by 2030, and as described above, Oregon currently receives power from the Colstrip Power Plant through the Western Electricity Coordinating Council. The new Washington law relates only to Colstrip Units 1 and 2: it created a funding mechanism to assist with the closure process and cleanup of these units.

2017 Multiparty Settlement Stipulation and Agreement

In 2017, as part of a multiparty settlement stipulation and agreement (2017 agreement), an owner of Units 3 and 4, Puget Sound Energy, agreed to a depreciation schedule that assumes the remaining useful life of those units is through the end of 2027. This date is not a closure date, but rather the date by which the owner will have recovered the cost of their investment in Units 3 and 4 plus a rate of return. A retirement plan or closure date has not been set for Units 3 and 4.

The 2017 agreement also included a depreciation schedule for Units 1 and 2. This schedule does not impact the units' closure date, which in the case of Units 1 and 2, has been established by the 2016 Consent Decree to be July 1, 2022. The 2017 agreement also includes funding for future decommissioning and remediation of all units of the Colstrip Power Plant and addresses transition issues for the Colstrip community.

Beyond the 2017 agreement, other owners of Units 3 and 4 have also begun to establish depreciation schedules. For example, one of the terms of the settlement agreement for the merger of Hydro One and Avista (if approved) is a depreciation schedule for Units 3 and 4.

1.2.2.2 Rosebud Power Plant

The Rosebud Power Plant is a 38-megawatt coal-fired power plant located about 6 miles north of the city of Colstrip (see **Figure 2**) that has been operating commercially since May 1990. The Rosebud Power Plant is owned by Rosebud Energy Corporation, Harrier Power Corporation (Paragon), and Colmac Montana Inc. (ACI Energy 2014). The Rosebud Power Plant was designed to burn low-Btu (British thermal unit) "waste coal" from the Rosebud Mine, which is coal not suitable for use at the Colstrip Power Plant due to the high sulfur content and low calorific value. This waste coal is typically encountered horizontally in the top 1-foot layer of the Rosebud deposit. The lower 0.8-foot portion of the

Rosebud Coal bed also has a high sulfur content, but this higher-sulfur zone near the base of the bed is not recovered (see **Section 3.6, Geology**). Western Energy hauls 300,000 tons of coal annually from the Rosebud Mine (via a fleet of five covered haul trucks) to the Rosebud Power Plant (Spang 2013). Three (out of the five total) trucks operate daily, with each truck delivering an estimated 6.5 loads daily (19.5 total loads daily).

1.3 PURPOSE, NEED, AND BENEFITS

As described in NEPA, purpose and need are used to define the range of alternatives analyzed in an EIS (40 CFR 1502.13). Each agency's statutory authorities and policies determine its underlying purpose and need. MEPA and its implementing rules, ARM 17.4.617(1), require that any EIS prepared by a state agency include a description of the purpose and benefits of the proposed project. The purpose, need, and benefits of the Proposed Action are described in the sections below.

1.3.1 Purpose

The purpose of the Proposed Action is to allow continued operations at the Rosebud Mine by permitting and developing a new surface-mine permit area, known as proposed permit Area F. This EIS evaluates the environmental effects of the Proposed Action (and alternatives). DEQ's purpose is to review and make a decision on Western Energy's surface-mine operating permit application under MSUMRA, Section 82-4-221 et seq., MCA (see **Section 1.4.1.2, Montana Department of Environmental Quality**). OSMRE's purpose is to review and make a recommendation to the ASLM (in the form of a MPDD) to approve, disapprove, or conditionally approve the proposed federal surface-mining plan for the project area (see **Section 1.4.1.1, Office of Surface Mining Reclamation and Enforcement**). The ASLM will decide whether the mining plan is approved, disapproved, or approved with conditions.

1.3.2 Need

Western Energy is required to obtain a surface-mine operating permit (pursuant to MSUMRA) and approval of a federal surface-mining plan (30 CFR 746) for the project area in order to access additional coal reserves. The OSMRE need for the action is to provide Western Energy the opportunity to exercise its valid existing rights (VER) granted by BLM under federal coal lease M82186 to access and mine undeveloped federal coal resources located in the project area. In addition, it is OSMRE's responsibility under Surface Mining Control and Reclamation Act (SMCRA) Public Law 95-87, Title I, Section 102 to "assure that the coal supply essential to the Nation's energy requirements, and to its economic and social well-being is provided and strike a balance between protection of the environment and agricultural productivity and the Nation's need for coal as an essential source of energy." Further, the need for the action is to provide Western Energy the opportunity to develop privately held leases (G-002 and G-002-A) for coal resources located in the project area within the bounds of all applicable laws, regulations, and policies.

The DEQ need for the action is to analyze the potential environmental impacts from the project in order to make a more fully informed decision prior to approval or disapproval of the permit application under Section 82-4-227, MCA. DEQ is responsible for ensuring that when there may be significant environmental impacts, a Final EIS is completed and published at least 15 days prior to the release of DEQ's written findings on the permit application.

1.3.3 Benefits

The project would provide the following federal, state, and local benefits:

- An ongoing fuel source (70.8 million tons of coal) for the Colstrip Power Plant (Units 3 and 4) and the Rosebud Power Plant, which are sources of high-capacity power
- Continued employment for workers at the mine
- An ongoing tax base (direct, indirect, and induced) to federal, state, and local governments
- Ongoing royalty payments to mineral resource owners
- Continued support to local businesses

1.4 AGENCY AUTHORITY AND ACTIONS

Two lead agencies are responsible for the analysis of this project: OSMRE and DEQ. BLM is acting as a cooperating agency. A single EIS for the Western Energy Area F Project is being prepared to provide a coordinated and comprehensive analysis of potential environmental impacts. Before implementation of the proposed project could begin, various other permits, certificates, licenses, or approvals would be required from the two lead agencies and other agencies. **Table 1** provides a summary of the required federal permits, licenses, and approvals, and **Table 2** provides a summary of state requirements. **Table 1** and **Table 2** are not comprehensive lists of all permits, certificates, or approvals needed but list the primary federal and state agencies with permitting responsibilities. The roles and responsibilities of the agencies with primary environmental permitting and regulatory responsibilities are discussed in the following sections.

The major decisions to be made by the lead agencies and by other agencies are described below in agency-specific sections. Federal and state agency decision-making is governed by each agency's laws, including statutes, rules, and regulations that form the legal basis for the conditions that the project must meet to obtain necessary permits, approvals, or licenses. These laws also set forth the conditions under which each agency could deny Western Energy the necessary permits or approvals. The regulatory framework governing each agency's decisions is briefly introduced below and described in detail in each **Chapter 3** resource section under the heading "Regulatory Framework."

Table 1. Federal Permits, Consultations, Licenses, and Approvals Required for the Project.

Permit, License, or Approval	Purpose
U.S. Department of the Interior (ASLM/OSMRE)	
Federal Mining Plan (30 CFR 746)	To allow Western Energy to mine federal coal leases. Review of the proposed plan is coordinated with DEQ and federal agencies such as BLM. OSMRE recommends approval, disapproval, or conditional approval of the mining plan to the DOI ASLM.
U.S. Department of the Interior (BLM)	
Resource Recovery and Protection Plan (30 CFR 746.13)	To allow Western Energy to mine federal coal leases. BLM must make a finding and recommendation to OSMRE with respect to Western Energy's Resource Recovery and Protection Plan and other requirements of Western Energy's lease. BLM also will submit a recommendation regarding the federal mining plan.
U.S. Fish and Wildlife Service	
Endangered Species Act of 1973 (ESA) Section 7 Consultation (16 USC § 1536)	To protect Threatened and Endangered (T&E) species and any designated critical habitat. OSMRE will consult with U.S. Fish and Wildlife Service (USFWS).
Federal Water Pollution Control Act (Clean Water Act) Section 404 Permit Review (33 USC § 1344)	To comment on the Section 404 permit to prevent loss of or damage to fish or wildlife resources. Consult with the U.S. Army Corps of Engineers (Corps).
U.S. Army Corps of Engineers	
Clean Water Act (CWA) Section 404 Permit (33 USC § 1344)	To allow discharge of dredged or fill material into wetlands and waters of the U.S., subject to review by EPA, USFWS, OSMRE, and DEQ. Consult with Montana State Historic Preservation Office (SHPO).

Table 2. State Permits, Licenses, and Approvals Required for the Project.

Permit, License, or Approval	Purpose
Montana Department of Environmental Quality (DEQ)	
Montana Strip and Underground Mine Reclamation Act (Section 82-4-201, et seq., MCA) Surface Mine Operating Permit	To allow surface coal mining. Proposed activities must comply with state environmental standards and criteria. Approval may include stipulations for final design of facilities and monitoring plans. A sufficient reclamation bond must be posted with DEQ before implementing an operating permit modification. Coordinate with OSMRE.
Clean Air Act of Montana (Section 75-2-102, et seq., MCA) Air Quality Permit	To control particulate emissions of more than 25 tons per year.
Montana Water Quality Act (Section 75-5-201 et seq., MCA) MPDES Permit	To establish effluent limits, treatment standards, and other requirements for point source discharges, which includes storm water discharges to state waters including ground water. Coordinate with EPA.
CWA 401 Certification (33 USC § 1341)	To ensure that any activity that requires a federal license or permit (such as the Section 404 permit from the Corps) complies with MT water quality standards.
Hazardous Waste and Solid Waste Registration (various laws)	To ensure safe storage and transport of hazardous materials to and from the site and proper storage, transport, and disposal of solid wastes.
Montana State Historic Preservation Office (SHPO)	
National Historic Preservation Act of 1966 Cultural Resource Clearance (Section 106 Review) (16 USC § 470)	To review and comment on federal compliance with the National Historic Preservation Act (NHPA).

1.4.1 Lead Agencies

1.4.1.1 Office of Surface Mining Reclamation and Enforcement

Applicable Statutes and Regulations

National Environmental Policy Act

NEPA requires federal agencies to prepare an EIS for major federal actions that have the potential for significant impacts on the human environment (42 USC Section 4321-4370e). OSMRE concluded that approval of the mining plan for operations contemplated by the proposed permit for the project area as required by 30 CFR 746.1 through 746.18 would be a major federal action that may significantly affect the quality of the human environment and issued a Notice of Intent (NOI) to prepare an EIS in the *Federal Register* on August 27, 2013. Preparation of an EIS is required to assist OSMRE in determining its recommendation regarding the mining plan. NEPA and its administrative rules define the process to be followed by federal agencies when preparing an EIS.

Connected Actions

OSMRE – Denver Field Division – Casper Area Office evaluated the project and the Colstrip Power Plant as potentially connected actions. OSMRE determined in a letter dated April 24, 2014, that the project and the Colstrip Power Plant are not connected actions by applying guidance found in the BLM *NEPA Handbook* (H-1790-1). The guidance states, “Actions are connected if they automatically trigger other actions that may require an EIS, cannot or would not proceed unless other actions are taken previously or simultaneously, or if the actions are interdependent parts of a larger action and depend upon the larger action for their justification under 40 CFR 1508.25(a)(i, ii, iii)." In the letter, OSMRE concluded that "Area F and the power plants are not connected actions because the power plant[s] are existing operational facilities, and no pending actions or reasonably foreseeable future actions are currently proposed for the power plant[s]. Therefore, Area F is the only proposed action and, as such, is not connected to a currently existing and operational power plant facility, regardless of the power plant facility's physical location" (OSMRE 2014a). A similar argument would also apply to the Rosebud Power Plant. Effects from the two power plants are considered indirect effects in the EIS analyses.

Surface Mining Control and Reclamation Act

OSMRE is an office of DOI charged with administration of SMCRA. SMCRA establishes a program of cooperative federalism that allows the states to enact and administer their own regulatory programs within limits established by federal minimum standards and with prescribed backup enforcement authority by OSMRE (30 CFR 1253). MT operates an approved state program under SMCRA and, therefore, has primary jurisdiction over the regulation of surface coal-mining and reclamation operations on non-federal and non-Indian lands within the state. See 45 CFR 21560; 30 CFR 926.15, 926.16 and 926.30. Under Section 1273(c) of SMCRA, a state with a permanent regulatory program approved by the DOI Secretary, such as DEQ, can elect to enter into a cooperative agreement for state regulation of surface coal-mining and reclamation operations on federal lands within the state. OSMRE granted DEQ this authority, and DEQ regulates permitting and operation of surface coal mines on federal lands within MT under the authority of MSUMRA, Section 82-4-221, MCA (see **Section 1.4.1.2, Montana Department of Environmental Quality** below).

State-Federal Cooperative Agreement

The state-federal Cooperative Agreement (Agreement) between DEQ and OSMRE is codified in 30 CFR 926.30. Under the Agreement, DEQ reviews an operator's (in this case, Western Energy's) PAP to ensure the permit application for the proposed action complies with the permitting requirements and that the coal-mining operation would meet the performance standards of the approved MT program (see **Section 1.4.1.2, Montana Department of Environmental Quality** below for a description of this process). OSMRE, BLM, and other federal agencies such as the U.S. Fish and Wildlife Service (USFWS) review the proposed action to ensure it complies with the terms of the coal lease, the MLA, NEPA, and other federal laws and regulations. DEQ makes a decision to approve or disapprove, in whole or in part, the permit application component of the PAP in accordance with MSUMRA's implementing rules, ARM 17.24.405 (see **Section 1.4.1.2** below). OSMRE, in accordance with 30 CFR 746.1 through 746.18, reviews DEQ's permit and recommends approval, disapproval, or conditional approval of the mining plan to the DOI ASLM.

Decision

The decision to be made is selection of an action that meets the legal rights of Western Energy while protecting the environment and that is in compliance with applicable laws, regulations, and policies.

The following are possible OSMRE decisions:

- Recommendation that the DOI ASLM approve a mining plan based on the Proposed Action
- Recommendation that the DOI ASLM deny a mining plan based on the Proposed Action
- Recommendation that the DOI ASLM conditionally approve a mining plan based on a preferred alternative

As required by 30 CFR 746.13, OSMRE would base its recommendation to the DOI ASLM on the following factors:

- Western Energy's PAP, including the Resource Recovery and Protection Plan
- Information prepared in compliance with NEPA
- Documentation ensuring compliance with the applicable requirements of other federal laws, regulations, and executive orders other than SMCRA
- Comments and recommendations or concurrence of other federal agencies, as applicable, and the public
- The findings and recommendations of BLM with respect to the Resource Recovery and Protection Plan and other requirements of Western Energy's lease and the MLA
- The findings and recommendations of DEQ with respect to the permit application
- The findings and recommendations of OSMRE with respect to the additional requirements of 30 CFR 746

OSMRE will document its decision in a ROD, which will be released along with the ASLM decision on the MPDD after the Final EIS is published.

1.4.1.2 Montana Department of Environmental Quality

Applicable Statutes and Rules

The MT legislature has enacted statutes and the Board of Environmental Review has adopted administrative rules defining the requirements for construction, operation, and reclamation of a coal surface mine; discharge of mining waters; discharge of air emissions; and storage of hazardous and solid wastes. DEQ, which has jurisdiction over coal-mining activities within MT, is required to evaluate the surface-mine permit application submitted by Western Energy and to reevaluate existing permits for modification, such as an air quality permit or MPDES permit, under the major laws and regulations summarized in the following sections.

Montana Environmental Policy Act

MEPA requires the state to conduct an environmental review when making decisions or planning activities that may have a significant impact on the human environment, such as granting a permit for the project. DEQ concluded in its Round I Completeness Deficiency for Rosebud Coal Mine Area F letter that making a decision to approve or deny Western Energy's Area F permit application would be a major state action that requires preparation of an EIS (Yde 2012). MEPA and its administrative rules define the process to be followed when preparing an EIS. Under MEPA, an EIS may include a review of actual or potential impacts beyond MT's borders that are regional, national, or global in nature, such as climate change, if the review is conducted by a state and federal agency to the extent the review is required by the federal agency per Section 75-1-201(2), MCA. Review of the effects of the Proposed Action on climate change is a requirement of the federal portion of this EIS.

Montana Strip and Underground Mine Reclamation Act

MSUMRA requires that Western Energy apply for and obtain a surface-mine operating permit prior to engaging in coal surface-mining operations in the project area. If approved, this permit would be subject to renewal at 5-year intervals by applying to DEQ at least 240 days (but not more than 300 days) prior to the renewal date (see ARM 17.24.416). In order to renew its permit, Western Energy would have to be in compliance with MSUMRA, environmental protection standards, and permit conditions. Some of the key requirements of MSUMRA are listed below. MSUMRA is discussed in detail in **Chapter 3** resource sections under the “Regulatory Framework” headings.

- The permit application must contain a determination of the probable hydrologic consequences (PHC) of coal mining and reclamation operations, both on and off the mine site, with respect to the hydrologic regime and quantity and quality of water in surface water and ground water systems, so that cumulative impacts of all anticipated mining in the area upon the hydrology of the area and particularly upon water availability can be made (see Section 82-4-222, MCA). DEQ cannot approve the permit application until it (1) prepares a cumulative hydrologic impacts assessment (CHIA) of the Proposed Action and all anticipated mining upon surface and ground water systems in the cumulative impact area, and (2) determines, based on the information provided in the PHC and other relevant information compiled by the DEQ Coal Program, that the mining operations described in the proposed Area F permit application are designed to prevent material damage to the hydrologic balance outside the permit area as required by 82-4-227(3), MCA. Hydrologic balance is defined by MSUMRA in Section 82-4-203(24), MCA, as “the relationship between the quality and quantity of water inflow to, water outflow from, and water storage in a hydrologic unit, such as a drainage basin, aquifer, soil zone, lake, or reservoir, and encompasses the dynamic relationships among precipitation, runoff, evaporation, and changes in ground water and surface water storage.” Material damage is defined by MSUMRA in Section 82-4-203(31), MCA, as the “degradation or reduction by coal mining and reclamation operations of the quality or quantity of water outside of the permit area in a manner or to an extent that land uses or beneficial uses of water are adversely affected, water quality standards are violated, or water rights are impacted. Violation of a water quality standard, whether or not an existing water use is affected, is material damage.” DEQ makes its determination regarding material damage as part of its permitting decision; material damage is not assessed in this EIS, which has been prepared to comply with MEPA and NEPA.
- The permit application must contain information on how the applicant would restore or avoid disturbance to wetlands, riparian vegetation along rivers and streams and bordering ponds and lakes, and other habitats of unusually high value for fish and wildlife, and, where practicable, enhance such habitats upon reclamation of the disturbed surface area per ARM 17.24.751(2)(f).
- Reclamation and revegetation of land affected by mining must be done as rapidly, completely, and effectively as the most advanced technology would allow (see 82-4-231, MCA). Mining operations are required to have a detailed reclamation plan that must contain a description of the reclamation operations proposed, including the following information: (a) a description of postmining land uses; (b) a detailed timetable for reclamation; (c) a detailed estimate of reclamation costs (for the performance bond); (d) a backfilling and grading plan; (e) a description of postmining drainage basin reclamation that ensures protection of the hydrologic balance, achievement of postmining land-use performance standards, and prevention of material damage to the hydrologic balance in adjacent areas; (f) drainage channel designs appropriate for preventing material damage to the hydrologic balance in adjacent areas and for meeting performance standards; (g) plans for removal, storage, and redistribution of soil, overburden, spoil, and other material; (h) a revegetation plan (type, acreage, schedule, seed mixtures, revegetation methods, equipment, and success criteria); and (i) a list of reclamation of facilities and sites (see ARM 17.24.313).

State-Federal Cooperative Agreement

As discussed above in **Section 1.4.1.1, Office of Surface Mining Reclamation and Enforcement**, for permitting actions involving federal coal lands, MT has entered into a Cooperative Agreement (30 CFR 926.30) with DOI. Before mining could commence under a permit issued by DEQ pursuant to MSUMRA on federal lands, the DOI ASLM must decide to approve, disapprove, or conditionally approve a federal mining plan for the permit in question. OSMRE makes a recommendation to the DOI ASLM in a MPDD (see **Section 1.4.1.1** above).

State and Federal Water Quality Statutes

The Montana Water Quality Act, Section 75-5-101 et seq., MCA, and ARM 17.30.101 et seq. regulate discharges of pollutants into state surface waters through a MPDES permit application process and the adoption of water quality standards. Water quality standards, including the MT nondegradation policy, specify the changes in surface water or ground water quality that are allowed from a wastewater discharge. A MPDES permit may also include limits for discharges of storm water and would require development of a storm water pollution prevention plan.

The Clean Water Act (CWA), 33 USC Section 1251 et seq., requires that applicants for federal permits or licenses for activities that may result in a discharge to waters of the U.S. obtain certification from the state under Section 401 of the act that the discharge would comply with state water quality standards. Section 404 permits, issued by the U.S. Army Corps of Engineers (Corps), require 401 certification. DEQ provides Section 401 certification pursuant to state regulations.

State and Federal Air Quality Statutes

Air quality is regulated under federal and state requirements. Under the federal CAA, the U.S. Environmental Protection Agency (EPA) sets national standards for air quality and air pollutant concentrations. Under the CAA, states develop and implement procedures including monitoring, permitting, control measures, and enforcement to achieve and maintain these EPA-designated standards. EPA has primary and secondary National Ambient Air Quality Standards (NAAQS) for seven criteria pollutants: carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter, fine particulate matter, and sulfur dioxide. Under the CAA of MT, DEQ has established Montana Ambient Air Quality Standards (MAAQS). EPA approved the state's air quality program and has given DEQ authority to regulate air quality in MT. DEQ requires a permit for the construction, installation, and operation of equipment or facilities that may cause or contribute to air pollution.

DEQ Decisions

Montana Strip and Underground Mine Reclamation Act

Permit Application Review Process

Western Energy submitted an application to DEQ for a new surface-mine operating permit for the project (Permit ID Number C2011003F) on November 2, 2011 (see **Appendix A**). DEQ will determine whether the application satisfies the requirements of MSUMRA.

After a completeness review of Western Energy's application in November and December of 2011, DEQ identified several deficiencies, including incomplete information on wildlife and ground water monitoring programs and the lack of a reclamation bond estimate. DEQ requested additional information from Western Energy on January 10, 2012 (Yde 2012). Western Energy resubmitted the application with its deficiency response on May 7, 2012. After a second completeness review, DEQ deemed the revised application to be complete on August 1, 2012, and began its review of the application for acceptability.

Western Energy's application has been revised several times to address the deficiency comments provided by DEQ. Please see **Appendix A** for a list of reviews and revisions completed to date. For purposes of preparing this EIS, the agencies have assumed that Western Energy will address all of the permit application deficiencies outlined in DEQ's October 2017 Eighth Round Acceptability Deficiency letter to Western Energy, which is included in **Appendix B**. Within 45 days from the date that DEQ determines that the application is acceptable (October 5, 2018) and 15 days after the Final EIS is published, DEQ shall prepare and issue Written Findings, also called a ROD, approving or denying the application in whole or in part, per 82-4-231(8)(f), MCA, and ARM 17.24.405, and documenting DEQ's determination. DEQ will submit its Written Findings to OSMRE.

Conditions for Issuing a Permit

Because DEQ determined that an EIS was needed before making a permit decision, DEQ must complete and publish the Final EIS at least 15 days prior to issuing its written findings granting or denying the permit application per Section 82-4-231(8)(c), MCA. Prior to approval of Western Energy's Area F permit by DEQ, Western Energy must affirmatively demonstrate to DEQ that it will comply with the applicable laws and rules and that postmining reclamation will be carried out in accordance with the requirements of MSUMRA.

Because federal coal is involved, DEQ will submit its ROD and supporting documentation to OSMRE for review. OSMRE will then prepare a MPDD recommending approval, disapproval, or conditional approval of the federal mining plan by the DOI ASLM (see **Section 1.4.1.1, Office of Surface Mining Reclamation and Enforcement** above). OSMRE will document its decision in a ROD, which will be released along with the ASLM decision on the MPDD after the Final EIS is published. Before DEQ can issue a permit for the approved application, DEQ must have concurrence from the federal regulatory authority, and the mine operator must submit a reclamation bond to DEQ per Section 82-4-223, MCA, and ARM 17.24.405(7)(b) (see **Section 1.6, Financial Assurance** below for a discussion of the reclamation bonding process).

Conditions for Denial

DEQ may not approve a permit application for a new surface mine under certain circumstances, which include an inadequate reclamation plan; inadequate protection of water resources outside the permit area; unacceptable impacts on exceptional topographic features, cultural resources, or scientific characteristics; a proposed location on a significant alluvial valley floor; unacceptable impacts on critical biological productivity or ecological fragility; and the threat of a public hazard or designation of the land as unsuitable for mining (Section 82-4-227 and 228, MCA; ARM 17.24.1131–1148). DEQ must also withhold a permit in the event that information contained in OSMRE's Applicant Violator System identifies unabated or uncorrected violations of SMCRA or other environmental laws by affiliates or control entities of Western Energy (Section 82-4-227, MCA; ARM 17.24.1265). If DEQ denies the permit, Western Energy can modify and resubmit its permit application to address issues or concerns identified by DEQ during the permit review process.

Montana Water Quality Act

As part of its compliance with MT water quality regulations and standards, Western Energy currently holds one MPDES permit for the Rosebud Mine. MPDES Permit MT-0023965 (DEQ 1999), the effective permit, following the Seeley decision, was issued in 1999 and covers discharge of mine drainage and drainage from coal preparation areas, coal storage areas, and reclamation areas into 151 outfalls. The receiving waters include East Fork Armells Creek, Stocker Creek, Lee Coulee, West Fork Armells Creek, Black Hank Creek, Donley Creek, Cow Creek, Spring Creek, and Pony Creek (see **Section 5.2.1.7, MPDES Permit for Existing Areas of the Rosebud Mine**).

For the project to comply with MT water quality regulations and standards, Western Energy must either modify its existing permit or apply for a new MPDES permit for the project. After considering a modification of its existing permit and submitting an application for such an action to DEQ in October 2015 (withdrawn due to timing concerns), Western Energy instead decided to pursue a new MPDES permit for the project to authorize 55 discharge outfalls. The receiving waters for project area discharge include Black Hank Creek, Donley Creek, Robbie Creek, McClure Creek, and Trail Creek. Western Energy submitted the new MPDES permit MT-0031828 application to DEQ on May 23, 2016. DEQ subsequently reviewed the application and found it to be deficient on June 23, 2016. Western Energy submitted revised permit application documents to DEQ on September 6, 2016. DEQ determined that the application was complete on October 6, 2016. Western Energy submitted its current and complete application to DEQ on May 8, 2017. DEQ is in the process of writing the permit and will tier to the analysis in this EIS to ensure MEPA compliance for the permit.

Clean Air Act of Montana

Rosebud Mine's five existing operating areas (A, B, C, D, and E) are currently covered by three Montana Air Quality Permits (MAQP):

- MAQP #1570-08, (modification) issued October 31, 2014, for Area C
- MAQP #1483-08, issued October 23, 2001, for areas A, B, D, and E
- MAQP #4436-00, issued August 13, 2009, for operating a portable crusher

Expansion of an existing mine that could result in changes in air quality, such as the addition of the project area, must be approved by DEQ's Air Resources Management Bureau under ARM 17.8.748. Western Energy must demonstrate compliance with all applicable aspects of DEQ's Air Quality Operating Permit Program. This includes review of compliance with established emission limitations, ambient standards through modeling analyses, and establishment of control measures to meet best available control technology requirements.

Western Energy applied for a modification of MAQP #1570-06 on April 18, 2013, to allow expansion of the geographic extent of the mine to include the project area and supplied supplemental information to DEQ on June 12, 2013. DEQ issued a Preliminary Determination, MAQP #1570-07, on July 22, 2013 (DEQ 2013). A final decision on MAQP #1570-07 is pending completion of this EIS (MAQP #1570-07 Preliminary Determination is in **Appendix D**). Modification 1570-08 was approved on October 31, 2014, and is the current active version of the MAQP. This modification authorized replacement of the particulate matter control technology on the secondary crushers and the transfer points on the overland conveyor. MAQP #1570-08 replaced MAQP #1570-06 and incorporated a *de minimis* action approved by DEQ on July 20, 2013, which increased the annual production capacity limit by 500,000 tons to a total of 8 million tons per year. It also updated permit language and rule references and updated the emission inventory.

1.4.2 Cooperating Agency

1.4.2.1 Bureau of Land Management

Applicable Statutes and Regulations

BLM is responsible for leasing federal coal lands under the MLA. As a cooperating agency, BLM will provide information, comments, and technical expertise to OSMRE regarding those elements of the EIS, and the data and analyses supporting them, in which BLM has jurisdiction or special expertise, or for which OSMRE requests their assistance (BLM and OSMRE 2014).

Recommendation

Unlike OSMRE and DEQ, BLM does not have a decision to make but will make a recommendation to OSMRE. Western Energy proposes to mine a federal coal lease (M82186). In order for OSMRE to make a recommendation on the MPDD to the DOI ASLM, BLM must review and approve Western Energy's Resource Recovery and Protection Plan (which is included in the PAP) and other requirements of Western Energy's lease (43 CFR 3482.2).

1.4.3 Other Agencies

The following agencies are not cooperating agencies in the preparation of the EIS, but they do have roles to play in the development of the project.

1.4.3.1 U.S. Fish and Wildlife Service

Applicable Statutes and Regulations

USFWS has responsibilities under the Endangered Species Act (ESA) (16 USC Section 1536, et seq.), Migratory Bird Treaty Act (16 USC Section 703, et seq.), and Bald and Golden Eagle Protection Act (16 USC Section 668).

Consultation

Under Section 7 of the ESA, USFWS must determine if implementation of a project would jeopardize the continued existence of any species listed or proposed as threatened and endangered (T&E) under the ESA, or adversely modify critical or proposed critical habitat. OSMRE initiated informal Section 7 consultation with USFWS to determine if there were any issues of concern with the proposed project (see complete description of the consultation process and conclusions in **Section 6.1.2, U.S. Fish and Wildlife Section 7 Process**).

Under the Proposed Action (Alternative 2) and Alternative 3 – Proposed Action Plus Environmental Protection Measures (see **Sections 2.4** and **2.5**), a portion of the indirect effects analysis area for special status species falls within the area of influence for the northern long-eared bat. OSMRE has complied with the USFWS's programmatic biological opinion (BO) for the January 5, 2016 Northern Long-Eared Bat 4(d) Rule (USFWS 2017a) and fulfilled the Section 7 consultation requirements under the ESA through submission of the streamlined consultation form on June 21, 2017 to the Montana Ecological Field Services Office. There are no effects on the northern long-eared bat beyond those previously disclosed in the USFWS's BO for the final 4(d) rule. Any taking that may occur incidental to Alternative 2 or 3 is not prohibited under the final 4(d) rule (50 CFR 17.40(o)). This project is consistent with the activities outlined in the BO, and the 4(d) rule does not prohibit incidental take of the northern long-eared bat that may occur as a result of this project. Therefore, the BO satisfies the OSMRE responsibilities under Section 7 of the ESA of 1973, as amended, 16 USC 1531 et seq., relative to the northern long-eared bat for this project.

Additionally, USFWS and OSMRE were able to conclude that no other federally listed T&E species or their critical habitats exist within the direct and indirect effects analysis areas for special status species (see **Section 3.1, Special Status Species**), and no further USFWS consultation is needed.

1.4.3.2 U.S. Army Corps of Engineers

Applicable Statutes and Regulations

Section 404 of the CWA establishes a program to regulate the discharge of dredged and fill material into waters of the U.S., including wetlands. Responsibility for administering and enforcing Section 404 is shared by the Corps and EPA. The Corps administers the day-to-day program, including individual permit decisions and jurisdictional determinations; develops policy and guidance; and enforces Section 404 provisions. EPA develops and interprets environmental criteria used in evaluating permit applications, identifies activities that are exempt from permitting, reviews and comments on individual permit applications, enforces Section 404 provisions, and has authority to veto Corps permit decisions.

Determination

Western Energy submitted a wetland delineation report for the project (Cedar Creek Associates, Inc. 2013) to the Corps in December 2013; see **Section 3.11, Wetlands and Riparian Zone**, for a description of the wetlands analysis area. The Corps prepared an approved jurisdictional determination for the project based on the 2013 wetland delineation report and determined that the 12 wetlands in the analysis area are isolated and therefore not jurisdictional waters of the U.S. under the authority of Section 404 of the CWA (Corps File No. NWO-2012-01315-MTB) (Corps 2014). Regarding other waters of the U.S., the Corps determined that Trail Creek, McClure Creek, Robbie Creek, and Donley Creek are not waters of the U.S. because no defined bed and bank were observed within these drainages. The seeps and springs associated with the wetlands in the analysis area also were determined to not be jurisdictional waters of the U.S. The only two potential waters of the U.S. identified in the 2013 wetland delineation report (Stock Pond F043 and a stock pond near Wetland A) were determined by the Corps to be isolated and nonjurisdictional (Corps 2014).

1.4.3.3 U.S. Environmental Protection Agency

EPA does not have a decision-making role but has responsibilities under the CAA to review each EIS and federal action potentially affecting the quality of the human environment (42 USC Section 7401, et seq.). EPA evaluates the adequacy of information in the EIS and the overall environmental impact of the Proposed Action and alternatives. EPA also reviews Section 404 permit applications, provides comments to the Corps, and has veto authority under the CWA for decisions made by the Corps on Section 404 permit applications. EPA has oversight responsibility for CWA programs delegated to and administered by DEQ. EPA may also intervene to resolve interstate disputes if discharges of pollutants in an upstream state may affect water quality in a downstream state.

1.5 PUBLIC OUTREACH

1.5.1 Scoping

Two formal public scoping periods were held before preparation of this EIS. DEQ held its scoping period in fall 2012. OSMRE did not become a lead agency on the EIS until 2013, so a second scoping period was held in fall 2013. The intent of both scoping periods was to gather comments, concerns, and ideas from those who have interest in or may be affected by the Proposed Action. A detailed accounting of DEQ and OSMRE scoping processes can be found in the Public Scoping Report (ERO 2013a) and Public Scoping Report II (ERO 2013b), respectively. Both reports are available on the agencies' websites: http://deq.mt.gov/Public/eis (DEQ) and http://www.wrcc.osmre.gov/initiatives/westernEnergy.shtm (OSMRE). A summary of public scoping activities is provided below.

1.5.1.1 DEQ Scoping

DEQ held its public scoping period between October 5 and November 5, 2012, and hosted two public open houses in Colstrip on October 16, 2012.

Public Notice

Several methods were used to inform the public and solicit comments, including a press release and media advisory, distribution of a scoping newsletter, and public open houses. DEQ sent a press release via email on September 28, 2012, to 14 media outlets and the Montana Governor's Office and a newsletter via postal mail on October 4, 2012, to about 75 individuals (the mailing list included elected officials and local governments, state and federal agencies, Tribes, adjacent and nearby landowners, and individuals that had expressed previous interest in the Rosebud Mine). The press release and newsletter briefly described the proposed project, identified the project location and major linear facilities, provided the environmental review timeline, and provided information for the public open houses (held on October 16, 2012). A written comment form was included as a newsletter insert.

Open Houses

DEQ held two public open houses at the Isabel Bills Community Center in Colstrip on Tuesday, October 16, 2012. Government agency representatives, elected officials, business owners, and individuals attended the scoping open houses. The first open house, held from 2:30 p.m. to 4:30 p.m., had an attendance of eight. The second open house, held from 6:30 p.m. to 8:30 p.m., had an attendance of six. At the beginning of each open house, DEQ's MEPA coordinator briefly introduced DEQ resource specialists in attendance and the EIS/permitting processes. A brief description of the project by a Western Energy representative followed. Informational handouts were provided, including the scoping newsletter and comment form and a flow chart of the EIS/permitting process. Resource-specific exhibits were on display around the room, and attendees were invited to visit each exhibit, gather information, write comments, and ask questions of resource specialists. The resource specialists included staff from DEQ as well as ERO Resources Corporation (ERO), the third-party consultant assisting DEQ and OSMRE with preparation of the EIS (ERO 2013a).

1.5.1.2 OSMRE Scoping

OSMRE held its public scoping period between August 27, 2013, and November 8, 2013. OSMRE's public scoping period was scheduled to conclude on October 11, 2013, but due to the federal government shutdown (October 1 through October 16, 2013), OSMRE extended the public scoping period through November 8, 2013. OSMRE and DEQ hosted a joint open house and public hearing in Colstrip on September 12, 2013.

Public Notice

Several methods were used to inform the public and solicit comments, including a press release and media advisory, legal notices, distribution of a scoping newsletter, and a public open house and hearing. OSMRE published a Notice of Intent to prepare an EIS and initiated public scoping via the *Federal Register* on August 27, 2013. On August 30, 2013, OSMRE sent a newsletter announcing the public scoping period and the open house and hearing to about 425 people via email or postal mail. The newsletter briefly described the proposed project and the reason for federal involvement, identified the project location and major linear facilities, provided the environmental review timeline, and provided information for the public open house and hearing (held on September 12, 2013). A written comment form was included as a newsletter insert.

On September 3, 2013, OSMRE sent a media advisory to 48 media outlets and the Montana Governor's Office announcing the scoping period and public open house and hearing. Notice of the scoping period extension was published by the same media outlets on October 24, 2013.

Legal notices of the scoping period and the open house and hearing were placed in two newspapers (one local and one regional) on September 2, 2013. Legal advertisements for the scoping period extension were also placed in both newspapers on October 30, 2013.

Open House and Hearing

OSMRE and DEQ held a joint public open house and hearing at the Isabel Bills Community Center in Colstrip from 3 to 7 p.m. on Thursday, September 12, 2013. A total of 11 government agency representatives, elected officials, news media, business owners, and individuals attended.

The open-house portion of the meeting was held from 3 to 4 p.m. Beginning at 4 p.m., OSMRE's project coordinator introduced agency and Western Energy representatives attending the meeting and gave a PowerPoint presentation describing the NEPA process. DEQ's MEPA coordinator briefly described the state's MEPA/permitting processes, and a company representative described Western Energy's mine operations.

Following the presentations, ERO facilitated the oral testimony process. Four attendees gave oral testimony in front of a certified court reporter. Written testimony was also accepted during the meeting.

Informational handouts were provided to attendees, including the scoping newsletter and comment form. Resource-specific exhibits were on display around the room, and attendees were invited to visit each exhibit, gather information, write comments, and ask questions of resource specialists. The resource specialists included staff from OSMRE, DEQ, BLM, and ERO (ERO 2013b).

1.5.1.3 Tribal Consultation

Tribes are sovereign nations and receive special considerations during the public involvement process. Although Tribes were contacted as part of the public scoping process, the agencies also solicited input from Tribes directly and outside of the public scoping process. Tribal consultation is described in **Section 6.1.3, Tribal Consultation Process**.

1.5.2 Scoping Issue Identification

During public scoping, the public identified a number of potential issues or concerns. Some of these related to existing laws and regulations, such as the NEPA/MEPA process (consider cumulative effects of past, present, and reasonably foreseeable actions; analyze connected actions; and analyze indirect effects, such as coal combustion) and financial assurance (bond amounts and Western Energy's ability to pay for mine reclamation). Commenters also raised concerns over the potential adverse impacts of the project on environmental resources including air quality, water quantity and quality, wildlife (especially special status species, such as T&E species), and climate change. A complete set of public scoping comments can be found in the Public Scoping Report (ERO 2013a) and Public Scoping Report II (ERO 2013b). All comments received have been considered in the preparation of this document. The section below describes those scoping issues that the EIS interdisciplinary team identified as key issues considered during alternatives development.

1.5.2.1 Key Issues Identified during Public Scoping for Detailed Analysis

The following statements summarize the key issues of concern identified during scoping (see **Section 1.5.1, Scoping**) and used to guide the EIS interdisciplinary team's alternatives development. The issue statements below are intended to capture the essence of public and agency concerns. Detailed resource impacts analyses are provided in **Chapter 4** (direct and indirect effects) and **Chapter 5** (cumulative effects).

Issue 1: Effects on surface water quality and quantity

The project area lies within the Trail Creek, McClure Creek, Black Hank Creek, Donley Creek, and Robbie Creek drainages. Commenters expressed concern about water quality and quantity impacts on these surface waters.

Issue 2: Effects on ground water quality and quantity

The public expressed concern that surface coal-mining activities in the project area would affect ground water quality and quantity since mining would remove the Rosebud Coal aquifer from beneath most of the project area and replace it with spoil (overburden removed during mining).

Issue 3: Effects on wetlands and non-wetland waters of the U.S.

Small nonjurisdictional wetlands associated with drainages, springs, seeps, depressions, and impoundments are present within the project area. Commenters expressed concern that construction and operation of the project may directly or indirectly affect wetlands within and surrounding the project area, including altering their function and values.

Issue 4: Effects on wildlife and their habitats

Comments received during scoping indicated that impacts on wildlife, particularly special status species (such as T&E species), are a concern to the public. Commenters also expressed concern that construction and operation of the project may impact the quality or quantity of key habitat for all wildlife species.

Issue 5: Effects of the project on climate change

Comments received during public scoping indicated a need to thoroughly evaluate and disclose the potential for and impacts of methane emissions as a result of surface mining in the project area, including economic effects (lost methane emissions) and the feasibility of recapturing methane.

Issue 6: Effects of the power plants on climate change and environmental resources

Public scoping comments requested that OSMRE and DEQ thoroughly evaluate and disclose the indirect and cumulative impacts of combusting project coal in the Colstrip Power Plant and the Rosebud Power Plant on climate change, environmental justice populations, and environmental resources such as air, water, and wildlife. The public also requested that the power plants be analyzed as connected actions under NEPA, including their direct effects, but these issues were dismissed (see **Section 1.5.2.2, Scoping Issues Eliminated from Detailed Analysis**).

Issue 7: Effects on human health and environment

Public scoping comments expressed concern about the potential risks to human health and the human environment, particularly risks to environmental justice populations, both from mining coal in the project area (direct effects) and from the combustion of project coal in the Colstrip Power Plant and the Rosebud Power Plant. Commenters requested that DEQ and OSMRE thoroughly evaluate and disclose the potential risks in the EIS.

Issue 8: Reclamation

Comments received during public scoping indicated that reclamation of the project area is of concern to the public. Public comments discussed a need to evaluate and disclose the potential for successful reclamation and revegetation within the project area in the EIS.

1.5.2.2 Scoping Issues Eliminated from Detailed Analysis

Below are issues brought forward by the public during scoping that were eliminated from detailed analysis. These issues were dismissed because they are covered by existing laws and regulations or are not applicable to the proposed project. For a list of resources dismissed from detailed analysis, please see **Section 3.1.1, Resources Analyzed**.

Bonding and financial assurance

Comments were received during public scoping requesting that the agencies thoroughly evaluate and disclose Western Energy's ability to pay for mine reclamation. Before receiving a permit for project operations (if an action alternative is selected), Western Energy would be required to tender a performance bond payable jointly to DEQ and OSMRE as financial assurance (30 CFR 926.30, Article IX). Before being issued a permit by DEQ, Western Energy must file with DEQ a bond payable to the State of Montana with surety satisfactory to DEQ in an amount to be determined by DEQ (see Section 82-4-223, MCA). A complete description of DEQ's bonding procedure, including bond release by reclamation phase, is provided in ARM 17.24.1101 et seq., and a discussion of financial assurance is included in **Section 1.6, Financial Assurance**. Because financial assurance is covered by existing rules enforced by the state, this issue, except as discussed in **Section 1.6**, was eliminated from detailed analysis.

Analysis of the Colstrip and/or Rosebud Power Plants as connected actions under NEPA

Public scoping comments indicated the need for OSMRE and DEQ to analyze the Colstrip and/or Rosebud Power Plants as connected actions under NEPA and to thoroughly evaluate and disclose the direct impacts of the Colstrip Power Plant and/or the Rosebud Power Plant.

Indirect and cumulative impacts were also mentioned in public comments and were carried forward for analysis as Issue 6 (see above). The indirect effects of combusting project coal in Units 3 and 4 of the Colstrip Power Plant and in the Rosebud Power Plant are analyzed in **Chapter 4** of this EIS. Cumulative effects of past, present, and future combustion of coal (other than from the project area) in all four units of the Colstrip Power Plant and in the Rosebud Power Plant are analyzed in **Chapter 5**.

As described above in **Section 1.4.1.1, Office of Surface Mining Reclamation and Enforcement, Applicable Statutes and Regulations, NEPA, Connected Actions**, OSMRE evaluated the project and the Colstrip Power Plant (which would also apply to the Rosebud Power Plant) as potentially connected actions. OSMRE concluded that "Area F and the power plants are not connected actions because the power plant[s] are existing operational facilities, and no pending actions or reasonably foreseeable future actions are currently proposed for the power plant[s]. Therefore, Area F is the only proposed action and, as such, is not connected to a currently existing and operational power plant facility, regardless of the power plant facility's physical location" (OSMRE 2014a). Based on this guidance, direct effects of the power plants and analysis as connected actions under NEPA were not given further consideration in this EIS.

1.5.3 Public Comment Period for the Draft EIS

OSMRE and DEQ conducted a 60-day public comment period on the Draft EIS. The initial 45-day public comment period on the Draft EIS began on January 4, 2018 and was noticed in the *Federal Register*, on agency websites, in legal notices, and in local newspapers. At the request of the Northern Plains Resource Council and Montana Environmental Information Center, the comment period was extended by the agencies to March 5, 2018 (a 15-day extension). OSMRE and DEQ jointly hosted a public open house and town hall meeting in Colstrip, Montana, on February 13, 2018. Substantive public comments received during the public comment period and agency responses are included in **Appendix F, Comments on the DEIS and Responses**.

1.6 FINANCIAL ASSURANCE

A performance bond guarantees that reclamation of the permit area will be performed. Before receiving a permit for project operations (if an action alternative is selected), Western Energy would be required to tender a performance bond payable jointly to DEQ and OSMRE as financial assurance (30 CFR 926.30, Article IX). A complete description of DEQ's bonding procedure, including bond release by reclamation phase, is provided in ARM 17.24.1100 and is summarized in the sections below. These bonding requirements apply to all permit areas of the Rosebud Mine, including the proposed permit Area F. See **Table 5** in **Chapter 2** for the amount of bond held by DEQ for each existing permit area of the Rosebud Mine.

1.6.1 Bond Amount

The amount of financial assurance that Western Energy would have to provide would be based on DEQ's estimated cost (with OSMRE's concurrence) to complete site reclamation, restoration, and abatement work in the event that Western Energy could not or would not perform the required reclamation. In addition to estimating direct and indirect reclamation costs, which are based on current industry standards, the bond amount would cover the estimated cost for DEQ to contract, manage, and direct construction at the site during reclamation, plus any contingencies (e.g., hiring a third-party contractor, interim and long-term site monitoring, and maintenance) and inflation (see ARM 17.24.1102). The principal amount of the performance bond must be sufficient to cover the estimated cost to DEQ to ensure compliance with state reclamation requirements and federal reclamation requirements under SMCRA.

1.6.2 Timing of Bond Calculation

The performance bond is calculated in accordance with ARM 17.24.1102. A performance bond cost estimate for the Proposed Action is provided in Western Energy's PAP, Exhibit G. The final performance bond calculation would be made by DEQ (with federal concurrence) prior to issuing a ROD (Written Findings) and the permit, if the permit application is approved (see **Section 1.4.1.2, Montana Department of Environmental Quality, DEQ Decisions**). The performance bond would be in the form of a surety bond or a collateral bond (see ARM 17.24.1105).

1.6.3 Bond Review

Pursuant to ARM 17.24.1104, DEQ would be required to conduct a review of the bond amount whenever the operating permit is reviewed: "The amount of the performance bond must be increased, as required by the department, as the acreage in the permit area increases, methods of mining operation change, standards of reclamation change or when the cost of future reclamation, restoration, or abatement work increases. The department shall notify the permittee of any proposed bond increase and provide the permittee an opportunity for an informal conference on the proposal. The department shall review each outstanding performance bond at the time that permit reviews are conducted under ARM 17.24.414 through 17.24.416 and reevaluate those performance bonds in accordance with the standards in ARM 17.24.1102."

1.6.4 Bond Release

DEQ would be primarily responsible for approval and release of the performance bond, although OSMRE would have to concur with bond release under 30 CFR 926.30, Article IX(B). The criteria and schedule for bond release are outlined in MSUMRA's implementing rules (see ARM 17.24.1116). Specifically, "the department [DEQ] may not release any portion of the performance bond until it finds that the permittee [in this case, Western Energy] has met the requirements of the applicable reclamation phase as defined in this rule. The department [DEQ] may release portions of the performance bond applicable to a permit following completion of reclamation phases on the entire permit area or on incremental areas within the permit area" (ARM 17.24.1116(1)). Bond release is completed by reclamation phase. The four phases of reclamation that correspond to bond release, collectively known as the "bond liability period," are described in the following sections.

1.6.4.1 Phase I

Phase I reclamation consists of the completion of backfilling, grading, and drainage control as outlined in the approved reclamation plan and the plugging of all drill holes that are not approved to be retained as monitoring wells per ARM 17.24.1116(6)(a).

1.6.4.2 Phase II

Phase II reclamation consists of surface stabilization to prevent accelerated erosion per ARM 17.24.1116(6)(b). First, the soil replacement and the tillage of spoil and soil must be completed in accordance with the approved reclamation plan. At least two growing seasons (spring and summer for 2 consecutive years) must elapse after seeding or planting of the affected area. The established vegetation must be consistent with the species composition, cover, production, density, diversity, and effectiveness required by the revegetation criteria. Soil must be protected from accelerated erosion. Noxious weeds must be under control. Finally, for prime farmlands, production must be returned to the appropriate level.

1.6.4.3 Phase III

Phase III reclamation consists primarily of monitoring actions to ensure that postmining land uses have been achieved per ARM 17.24.1116(6)(c). The established landscape must be stable and consistent with the approved postmining land use. The area of reclamation cannot be contributing suspended solids to stream flow or runoff outside the permit area in excess of the requirements of ARM 17.24.633 or the permit. If an impoundment is to remain in place, DEQ must be satisfied that the sound future management plan for that impoundment has been satisfactorily implemented. Finally, the area of reclamation must meet the special conditions provided in 82-4-235(4)(a), MCA.

1.6.4.4 Phase IV

Phase IV reclamation is the last stage of reclamation. To be deemed complete, the following steps must be achieved per ARM 17.24.1116(6)(d): (1) reclamation phases I–III must be complete for all disturbed lands within the designated drainage basin; (2) fish and wildlife habitats and related environmental values must be restored, reclaimed, or protected in accordance with MSUMRA, its implementing rules, and the approved permit; (3) disturbance to the hydrologic balance must be minimized and off-site material damage prevented in accordance with MSUMRA, its implementing rules, and the approved permit; (4) water supplies adversely affected by mining and reclamation operations must be replaced and must function in accordance with MSUMRA, its implementing rules, and the approved permit; (5) the essential hydrologic functions and agricultural productivity on alluvial valley floors must be reestablished; (6) any alternative land-use plan approved pursuant to ARM 17.24.821 and ARM 17.24.823 must be successfully implemented; and (7) all other reclamation requirements of MSUMRA, its implementing rules, and the approved permit must be met.

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CHAPTER 2. PROPOSED ACTION AND ALTERNATIVES

2.1 INTRODUCTION

This chapter provides background information on Western Energy's existing operations at the Rosebud Mine and describes the alternatives considered for the project by the Montana Department of Environmental Quality (DEQ) and the Office of Surface Mining Reclamation and Enforcement (OSMRE) decision-makers: Alternative 1 – No Action, Alternative 2 – Proposed Action, and Alternative 3 – Proposed Action Plus Environmental Protection Measures. This chapter also describes alternatives that were considered but eliminated from detailed analysis.

The description of Alternative 2 is based on the permit application package (PAP) submitted by Western Energy to DEQ for the project. Readers desiring greater detail can review the additional descriptions, maps, and drawings contained in the PAP, which is available for digital download (see **Appendix A** for links) or the DEQ Office at 1218 East 6th Avenue, Helena, MT 59601.

2.1.1 Alternatives Development

Alternatives were developed based on requirements for alternatives under regulations and rules implementing the National Environmental Policy Act (NEPA), the Montana Environmental Policy Act (MEPA), and the Montana Strip and Underground Mine Reclamation Act (MSUMRA). NEPA and MEPA regulations do not specify the number of alternatives that need to be considered by federal agencies, including OSMRE, in the EIS but indicate that a reasonable range of alternatives should be evaluated (40 CFR 1502.14). In addition, NEPA and MEPA regulations require analysis of a No Action alternative in an EIS.

Under NEPA, an alternative is any reasonable course of action, other than the Proposed Action, that would still meet the identified purpose and need. Under MEPA, "alternative" means an alternative approach or course of action that would appreciably accomplish the same objectives or results as the proposed action; design parameters, mitigation, or controls other than those incorporated into a proposed action by an applicant or by an agency prior to preparation of the EIS; or no action or denial per ARM 17.4.603(2). In accordance with ARM 17.4.603(2)(b), DEQ is "required to consider only alternatives that are realistic, technologically available, and that represent a course of action that bears a logical relationship to the proposal being evaluated."

Alternative 3 was developed in response to issues and concerns identified during scoping. The public involvement process and the key issues identified for the project are discussed in **Section 1.5, Public Scoping Outreach**. Alternatives that meet the purpose and need of the Proposed Action (see **Section 1.3, Purpose and Need**), that are technically feasible within the project time frame, and that are economically feasible, as determined solely by the economic viability for similar projects having similar conditions and physical locations and determined without regard to the economic strength of the specific project sponsor, were analyzed fully in this EIS. Alternatives considered but eliminated from detailed analysis are discussed at the end of this chapter in **Section 2.6, Alternatives Considered but Eliminated from Further Analysis**.

2.2 DESCRIPTION OF PAST AND EXISTING MINE AND RECLAMATION OPERATIONS

2.2.1 Past and Existing Production

The Montana Power Company began production at the Rosebud Mine in 1968 to serve the Colstrip Power Plant, which began commercial operations in the mid-1970s (see description in **Section 1.2.2, Coal Combustion**). Past MEPA documents for the Rosebud Mine can be obtained at DEQ's Centralized Service Division upon request.

In 2001, Westmoreland purchased the Rosebud Mine; its subsidiary, Western Energy, continues to operate the mine today. The Rosebud Mine operates 24 hours per day, 7 days per week and employs an average of 421 employees (see **Section 3.15, Socioeconomics**).

The Rosebud Mine produces 8.0 to 10.25 million tons of low-sulfur (0.64 percent) subbituminous coal annually and 300,000 tons of high-sulfur "waste coal" annually (Spang 2013). Between 1975 and 2016, a total of 462,192,473 tons of coal was recovered from the Rosebud Mine (see **Table 3**; Peterson 2017). All coal currently produced by the mine is consumed locally at the Colstrip Power Plant and the Rosebud Power Plant (see **Section 1.2.2, Coal Combustion**). Low-sulfur coal goes to the Colstrip Power Plant via conveyors, and high-sulfur coal is trucked to the Rosebud Power Plant (Spang 2013). In the past (as recently as 2010), coal was also shipped by rail from the mine. A railroad spur in Area D was used to ship 5,000 to 10,000 tons per year to small customers using a few coal cars at a time. In Area A, a rail loop was used to load large trains with about 2 million tons per year for shipment to larger customers (Mahrt 2017). Western Energy no longer ships coal from the Rosebud Mine by train.

Table 3. Coal Produced by Rosebud Mine between 1975 and 2016.

Permit Area	Permit Number	Coal Sold (Tons)
A	C1986003A	65,683,816
B	C1984003B	76,497,490
C	C1985003C	203,777,718
D	C1986003D	82,894,405
E	C1981003E	33,339,045
Total		**462,192,473**

Source: Peterson 2017.

2.2.2 Existing Operating Permits, Disturbance, and Reclamation

As of 2016, the surface mine operation includes 25,949 permitted acres, of which 18,626 acres have been disturbed. See **Table 4** for a summary of permitted and disturbed acres.

Currently, three active mine areas at the Rosebud Mine operate under permits issued by DEQ[2]: Area A (4,262 acres, permit C1986003A), Area B (6,231 acres, permit C1984003B), and Area C (9,432 acres, permit C1985003C) (**Chapter 1, Figure 2**). These active permit areas have been mined since 1976 (Areas A and B) and 1983 (Area C) and are expected to meet current production capacity until 2018. Western Energy added 49 acres to the Area B permit area in December 2015 (AM4) (see also **Section 5.2.2, Related Future Actions,** for pending permit applications).

[2] All acres for surface mine permit areas indicate total acreage prior to any bond release.

Reclamation has occurred concurrently with mine operations in all permit areas as required by MSUMRA. **Table 5** provides an overview of bond release by permit area. Two permitted mine areas are no longer actively mined and are being actively reclaimed: Area D (4,554 acres; permit C1986003D) and Area E (1,470 acres, permit C1981003E). Mining occurred in Area D between 1986 and 2013 and in Area E from 1976 (or prior) until 1988.

2.2.3 Other Existing Permits

Production from the Rosebud Mine is limited by the conditions of its DEQ-issued air quality permits. Montana Air Quality Permit (MAQP) #1483-08 limits annual coal production from Areas A, B, and D to 13 million tons per year. Coal production from Areas C and F is limited to 8 million tons per year per MAQP #1570-08 with a project area–specific production cap of 4 million tons per year per the Preliminary Determination (PD) for MAQP #1570-07.

As described in **Section 5.2.1.7, MPDES Permit for Existing Areas of the Rosebud Min**e, Western Energy has one Montana Pollutant Discharge Elimination System (MPDES) Permit (MT-0023965)[3] that covers discharge of mine drainage and drainage from existing coal-preparation areas, coal-storage areas, and reclamation areas into 151 outfalls. The receiving waters include East Fork Armells Creek, Stocker Creek, Lee Coulee, West Fork Armells Creek, Black Hank Creek, Donley Creek, Cow Creek, Spring Creek, and Pony Creek. Western Energy has applied to DEQ for a new MPDES permit (MT-0031828) for the project (see **Chapter 1, Montana Water Quality Act**). The receiving waters for project area discharges include Black Hank Creek, Donley Creek, Robbie Creek, McClure Creek, and Trail Creek.

[3] In a recent opinion issued by Judge Kathy Seeley of the First Judicial District Court, Lewis and Clark County (Cause No. CDV-2012-1075), the 2016 renewal of Final Modified Permit MT0023965 was invalidated. As a result, and subject to a pending appeal of the Seeley decision in the Montana Supreme Court, the effective MPDES Permit is the one issued by DEQ in 1999.

Table 4. Rosebud Mine Permitted and Disturbed Acreage.

Permit Area	Permit Number	Year Mine Disturbance Began	Life of Mine Permitted Acreage[1]	Facilities (acres)[2]	Cumulative Disturbance (acres)[3]
A	C1986003A	1976	4,262	462	3,052
B	C1984003B	1976	6,231	465	4,264
C	C1985003C	1983	9,432	792	6,979
D	C1986003D	1986	4,554	73	3,083
E	C1981003E	Prior to 1976	1,470	35	1,248
Rosebud Mine Total			**25,949**	**1,827**	**18,626**

Source: Derived from a similar table in the 2017 Annual Report prepared by the DEQ Coal & Opencut Mining Bureau-Coal Section and reflects numbers reported by Western Energy for reporting year January 1, 2016–December 31, 2016.

[1] Total acreage in the surface mine permit area prior to any bond release.

[2] Includes roads, mine offices, equipment storage areas, coal storage barns, dams and impoundments, conveyor routes or other routes, power lines, pipelines, etc.

[3] Includes all surface which has been disturbed. (Cumulative Disturbance = Facilities + Active Mining + Complete Backfill and Grading).

Table 5. Reclamation Bond Amount and Phased Bond Release by Area of the Rosebud Mine.

Permit Area	Permit Number	Acres Released from Phase I[1]	% of Disturbance Area Released from Phase I	Acres Released from Phase II[1]	% of Disturbance Area Released from Phase II	Acres Released from Phase III[1]	% of Disturbance Area Released from Phase III	Acres Released from Phase IV[1]	% of Permit Area Released from Phase IV[2]	Bond Retained by DEQ
A	C1986003A	1,596	52%	1,248	41%	489	16%	0	0	$ 9,120,740
B	C1984003B	1,137	27%	756	18%	218	5%	186	3%	$73,650,000
C	C1985003C	3,368	48%	1,502	22%	50	1%	50	1%	$56,207,281
D	C1986003D	2,674	87%	929	30%	27	1%	27	1%	$20,134,194
E	C1981003E	1,097	88%	969	78%	691	55%	388	26%	$1,190,812
Rosebud Mine Total		**9,872**	53%	**5403**	29%	**1,475**	8%	**651**	3%	**$170,303,027**

Source: Derived from a similar table in the 2017 Annual Report prepared by the DEQ Coal & Opencut Mining Bureau-Coal Section and reflects numbers reported by Western Energy for reporting year January 1, 2016–December 31, 2016.

[1] Bond-release phases are tied to reclamation. Please see **Section 1.6.4, Bond Release** for a description of bond-release phases.

[2] Phase IV has been demonstrated as a percentage of the Life of Mine Permit Area as it includes both disturbed and undisturbed acres.

2.2.4 Existing Rosebud Mine Support Facilities

The Rosebud Mine includes the following existing facilities (**Figure 2**) and equipment:

- Three active permitted mine operations: Area A, Area B, and Area C
- A primary coal-processing facility (crusher) in Area C and a second crusher in Area A
- Conveyor-belt systems from Areas A and C to the Colstrip Power Plant
- A maintenance and operations complex
- Haul roads with scoria surface
- Scoria pits (mined for use on road surfaces)
- Mine offices
- A mine-entrance guard shack and vehicle-weighing scale
- Four electric-powered draglines for removal of overburden, coal excavation, backfilling, and grading
- Front-end loaders, excavators, and a fleet of haul trucks for removal of overburden, coal excavation, coal transportation to the conveyor-belt system, soil salvage, and soil application
- A fleet of five covered trucks that haul crushed coal to the Rosebud Power Plant; three trucks operate daily, with each truck delivering 6.5 loads daily (19.5 total loads daily)
- Area D railroad spur (not used since 2010); when it operated, it was used to ship a few cars of coal at a time to small customers
- Area A railroad loop (not used since 2010); when it operated, it was capable of loading large trains

2.2.5 General Sequence of Operations

The general sequence of operations for surface mining is similar in all active permit areas. In advance of each mining pass, soil is removed from the disturbance area and stockpiled according to type for later use during reclamation. Next, the overburden (sedimentary rock material covering the coal seams) is drilled and blasted. A dragline is then used to strip the overburden from succeeding mine passes. Spoil is cast into the mined-out pit created by the preceding pass.

After the dragline exposes the coal seam in each pass, the coal is drilled and blasted. A loading shovel, front-end loader, or backhoe loads the coal into coal haulers. The coal is transported on an established haul road to Area C or Area A for crushing. After being processed in the Area C crusher, crushed coal is sent to the Colstrip Power Plant via an existing 4.2-mile conveyor. If processed in the Area A crusher, which is adjacent to the Colstrip Power Plant, it is sent on an existing short conveyor. High-sulfur coal is trucked to the Rosebud Power Plant from both crusher sites.

The Rosebud Mine currently delivers between 7.7 and 9.95 million tons of coal annually to the four-unit, 2,100-megawatt Colstrip Power Plant primarily by conveyor. Coal from Areas A and B is used in Units 1 and 2 of the Colstrip Power Plant. Coal from all areas of the Rosebud Mine is allowed for use in Units 3 and 4, although currently only coal from Area C is sent to Units 3 and 4 (DEQ 2015a).

Coal with higher sulfur content and low calorific value (typically the first 1-foot layer encountered in the deposit) is trucked to the Rosebud Power Plant. Neither the Rosebud Power Plant nor the Colstrip Power Plant is owned or operated by Western Energy or Westmoreland (coal combustion is described in **Section 1.2.2, Coal Combustion**).

2.2.6 Life of Operations

The operational life (active mining and initial stages of reclamation: grading, application of soil, and seeding) of the project is expected to be 19 years (**Figure 3**) and would extend the operational life of the Rosebud Mine by 8 years. If approved, the first 7 years of project operations would account for as much as 50 percent of the total output of the Rosebud Mine (Peterson 2016a). After that, the project would account for around 30 percent of the mine's total production.

As discussed above, the Rosebud Mine has three other active mine areas. Area A is expected to be mined until 2022 (Peterson 2016b). Area B, as currently permitted, is expected to be mined until 2030 (Peterson 2016b). Area C is expected to be mined until 2022 (Peterson 2016b). Areas A, B, and C are expected to account for 50 percent of the total output of the mine until 2019 and 40 percent of the total output until 2022 (the last year of active mining for Areas A and C) (Peterson 2016a).

Western Energy has submitted a permit amendment application seeking to include another 9,000 acres of mining in Area B. If the Area B South Extension (AM5) is approved, Area B would be mined until 2043, and the additional coal contained therein (about 70 million tons) would account for as much as 70 percent of the total production of the mine (during the years 2026–2037) (see **Section 5.2.2, Reasonably Foreseeable Future Actions**). Western Energy is also seeking to make modifications to a federal coal lease (MTM 80697) that would impact 160 acres within Areas B and C at a future date.

Without the addition of the project or Area B AM5, the operational life of the Rosebud Mine would be expected to end in 2030 (**Figure 3**).

The analyses in this EIS are based on the assumptions above regarding the operational life of the Rosebud Mine. Changes to production rates, additions of other mine permit areas, or changed market conditions may influence the operational life of the Rosebud Mine as a whole or of individual permit areas.

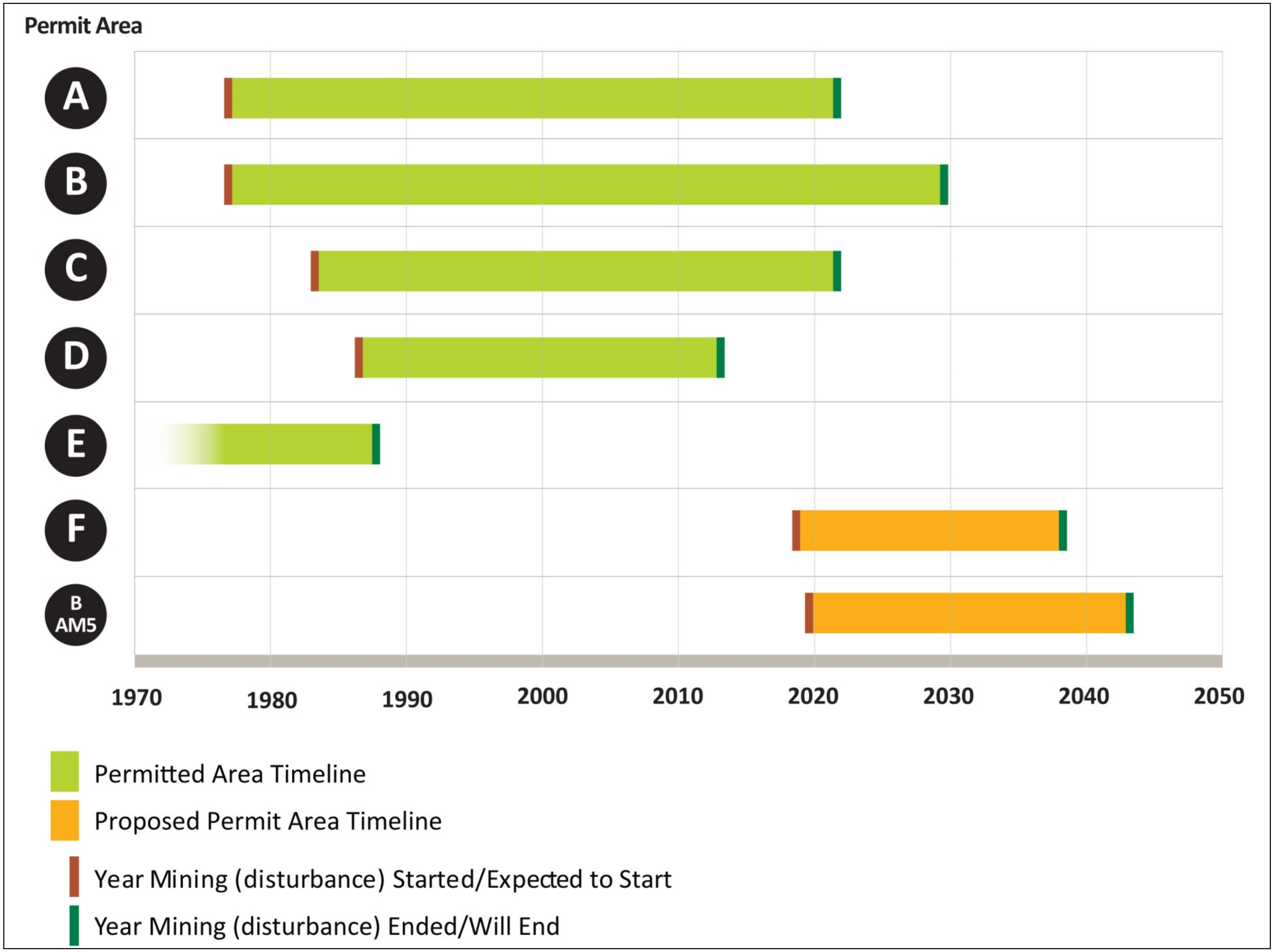

Figure 3. Operational Timeline for the Rosebud Mine.

2.3 ALTERNATIVE 1 – NO ACTION

The No Action alternative considers a scenario where federal and private coal in the project area would not be mined; the project's Purpose and Need (**Section 1.3, Purpose, Need, and Benefits**) relates to both lease types. As described in **Section 2.6.2, Private Coal Alternative**, it would not be economically feasible to mine private coal without the federal coal leases in the project area.

Under the No Action alternative, Western Energy's application for the project would not be approved by DEQ for one or more of the conditions outlined in **Section 1.4.1.2, Montana Department of Environmental Quality, Conditions for Denial**. Without an approved state permit, OSMRE would not make a recommendation to the DOI Assistant Secretary of Land and Minerals Management regarding a federal mining plan for the project. Without an approved permit and federal mining plan, Western Energy would not develop the project, resulting in 33,885,390 tons of federal coal not being recovered from lease M-82816 and 37,036,115 tons of private coal not being recovered from private leases G-002 and G-002a. It would also result in 4,260 acres of previously undisturbed ground not being disturbed. The environmental, social, and economic conditions described in **Chapter 3** would continue, unaffected by the construction and operation of the project. The conditions under which OSMRE could select the No Action alternative or DEQ could deny Western Energy's application for an operating permit for the project, MPDES permit, or air quality permit are described in **Section 1.4, Agency Authority and Actions**.

2.3.1 Power Plants

Under the No Action alternative, project coal would not be available for combustion in the Colstrip Power Plant or the Rosebud Power Plant. For analysis purposes, this EIS assumes that the power plants would continue operations as described in **Section 1.2.2, Coal Combustion at Colstrip**.

There are restrictions on the type of coal the power plants can use. For example, the Colstrip Power Plant is restricted in Units 3 and 4 to burning only "Rosebud seam coal from the Colstrip area" by the terms of its Major Facility Siting Act (MFSA) certificate (DEQ 2015a). The certificate further states that coal must come from permit areas of the Rosebud Mine (DEQ 2015a). There are similar restrictions in the air quality permits for the power plants.

For the purpose of this analysis, it is assumed that if project coal is not mined, the power plants would continue to burn coal from other areas of the Rosebud Mine. However, the Colstrip Power Plant also could modify its MFSA certificate to allow it to burn coal from sources other than the Rosebud Mine. This EIS assumes that the power plants would be able to achieve any modifications necessary to their MFSA certificates, air quality permits, or other applicable permits. Any changes to permits associated with the power plants, such as air quality permits or MFSA certificates, would be the responsibility of the power plant operators and are outside the scope of this analysis. In sum, selection of the No Action alternative would not change the operating status of the power plants. The indirect effects of the combustion of project coal at the power plants are considered in the indirect effects analyses for this EIS (see **Chapter 4**).

2.3.2 Other Rosebud Mine Permit Areas

Selection of the No Action alternative would not change the status of the other five areas of the Rosebud Mine that are currently permitted and being mined and/or reclaimed by Western Energy (see **Section 2.2,**

Description of Past and Existing Mine and Reclamation Operations and **Table 4**). Existing permit areas are considered in the cumulative effects analyses for this EIS (see **Chapter 5**).

Selection of this alternative also would not change the status of other areas of the Rosebud Mine that are in the permitting process, such as the AM5 permit application submitted to DEQ to expand Area B by 9,000 acres or the application submitted to BLM to modify federal coal lease MTM 80697 (tracts in Areas B and C). These proposed changes to Areas B and C are considered in the cumulative effects analyses for this EIS (see **Section 5.2.2, Related Future Actions**).

2.4 ALTERNATIVE 2 – PROPOSED ACTION

Alternative 2 is the Proposed Action as put forward by Western Energy in its PAP. The sections below summarize the Proposed Action. For a complete description of the Proposed Action, please refer to Western Energy's PAP (a link for digital download is included in **Appendix A**).

For purposes of preparing this EIS, Alternative 2 assumed that Western Energy had addressed all of the permit application deficiencies identified by DEQ (see **Appendix B** for the last DEQ deficiency letter**)**. DEQ determined that the permit application is acceptable under MSUMRA on October 5, 2018. For a description of the permit review process, see **Section 1.4.1.2, Montana Department of Environmental Quality**.

2.4.1 Permit and Disturbance Areas

The project area is shown in **Chapter 1, Figure 1**. The surface of the project area (6,746 acres) is privately owned, and the subsurface is both privately (3,479 acres) and federally (3,267 acres) held (see **Chapter 3, Section 3.23, Land Use**). Western Energy holds leases for the federal (M82186) and private coal (G-002 and G-002a).

Western Energy proposes to mine 2,159 acres within the proposed 6,746-acre project area. Of those 2,159 acres, 1,130 acres are in private subsurface ownership, and 1,029 acres are in federal subsurface ownership. Western Energy's generalized mining plan is shown in **Figure 4**. For additional detail, including the anticipated annual mine sequencing proposed for the project, please see Exhibit A in Western Energy's PAP (link for digital download is in **Appendix A**).

The total life-of-mine surface disturbance within the project area would be 4,260 acres due to mining, highwall reduction, soil storage, scoria pits, haul-road construction, and other miscellaneous disturbances (see **Table 6** for total surface disturbance and **Table 7** for approximate annual disturbances). Western Energy does not propose to construct any facilities or storage areas in the project area, since any that would be needed already exist and are available for use in other permit areas (see **Figure 4**). Construction-related disturbance in the project area would be limited to roads (see **Section 2.4.3.4, Roads**) and utilities (see **Section 2.4.3.3, Utility Corridors in the Project Area**).

Table 6. Approximate Project Area Surface Disturbance.

Disturbance Area	Acres
Mining Area	2,158.6
Soil Storage Area	197.1
Scoria Pits	45.0
Haul Roads	210.9
Other Disturbances[1]	1,747.9
Acreage with Two or More Types of Disturbance	99.4
Total Disturbance	**4,260.1**

[1]Other disturbances mostly include undisturbed ground near or adjacent to other disturbed areas including ponds, sediment traps, and ditching associated with surface-water sediment controls; ramps connecting haul roads to the mining area; and electrical substations.

Table is based on Table 303-1 from Western Energy's PAP. Acreages are rounded to the nearest whole number in the text of this EIS.

Although the project would be a new permit area and an expansion of the Rosebud Mine's surface disturbance, Western Energy does not propose to increase the total annual production output of the mine. The project would replace, in part, coal production from other mine permit areas nearing the end of active mine life or may replace production in areas that would no longer be actively mined (see **Section 2.2.6, Life of Operations**). Overall, production from the Rosebud Mine would be less than current levels. During the first 12 years of production, 4 million tons of coal would be mined annually from the project area, with the rate dropping to 3.2 or 3.3 million tons annually during the last 7 years of production. The area of active disturbance in the project area would be of similar scale to past activity in other permit areas. As a condition of its air quality permit for the project area (PD 1570-07), Western Energy would be limited to 4 million tons of annual coal production from the project area and limited to 8 million tons of combined annual coal production from the project area and Area C.

Table 7. Estimated Annual Production by Year and Acres Disturbed.

Operation Year	Tons (x 1000)	Acres Disturbed	
		Annual	Total
1	4	600	600
2	4	114.8	714.8
3	4	114.8	829.6
4	4	114.8	944.4
5	4	514.8	1,459.1
6	4	114.8	1,573.9
7	4	114.8	1,688.7
8	4	514.8	2,203.5
9	4	114.8	2,318.3
10	4	114.8	2,433.1
11	4	114.8	2,547.8
12	4	114.8	2,662.6
13	3.3	493.3	3,155.9
14	3.2	93.3	3,249.2
15	3.3	93.3	3,342.4
16	3.2	493.3	3,835.7
17	3.3	93.3	3,928.9
18	3.2	93.3	4,022.2
19	3.3	93.3	4,115.5
Begin Closure	0.0	72.4	4,187.9
	0.0	72.4	4,260.3

Table is based on Table 303-2 from Western Energy's PAP.

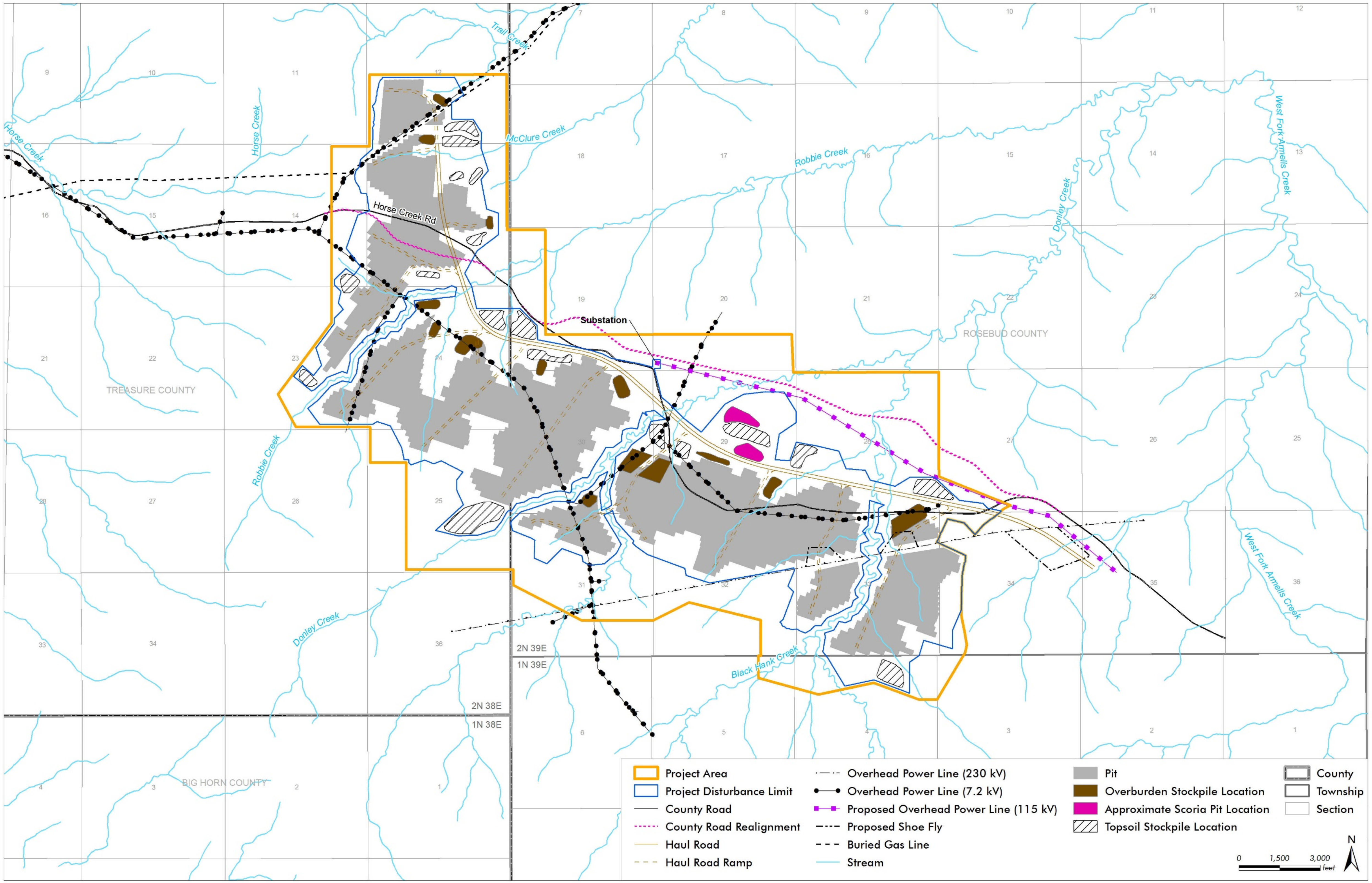

Figure 4. Proposed Project Area, Alternative 2.

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2.4.2 Coal Recovery

Two distinct coal seams underlying the project area, the Rosebud and McKay, are presently mineable by surface technology. Western Energy, however, proposes to mine only the Rosebud seam, which is the highest coal seam in the project area stratigraphic sequence. The Rosebud Coal seam averages 18.6 feet thick with a maximum thickness of 26.0 feet. The McKay seam is 67 feet below the Rosebud seam and is of poorer quality (see **Section 3.6, Geology**, including **Figure 18, Generalized Column of the Local Stratigraphy**).

Based on computer modeling, Western Energy estimates that 70.8 million tons of recoverable coal reserves exist in the project area under three coal leases (two private and one federal). Recoverable coal means the amount of coal remaining after deducting the tonnage that represents a cleaning loss of 1.5 feet of coal, which results in a 94-percent recovery factor. Not all coal within the lease boundary would be mined due to operational limitations such as protection of drainages, poor coal quality, high stripping ratios, equipment maneuverability, location of existing utilities, and the 94-percent coal-recovery factor (see **Table 8**). The mine plan, as proposed under Alternative 2, protects the drainages of Black Hank, Donley, and Robbie Creeks by leaving their stream corridors undisturbed (**Figure 4**). Due to economic circumstances and other dynamic factors affecting the mining and marketing of coal, Western Energy may at a future date propose changes to the mine plan and mine plan boundaries that would alter recoverable coal volumes. Any modifications would be subject to review by DEQ and may require additional review under MEPA or NEPA (if the modification requires review by OSMRE).

Western Energy's objective is to recover as much of the Rosebud Coal deposit from the project area as possible given the operational constraints described above and safety considerations (**Figure 5**). Based on those considerations, Western Energy estimates total recoverable coal production during the life of the project would be 70.8 million tons (see **Table 8**). The average quality of mineable coal is defined by British thermal units (Btu) per pound (8,590) and percent sulfur (0.63 percent), moisture (26.29 percent), ash content (8.49 percent), and sodium (1.25 percent as sodium oxide).

Table 8. Coal Reserve Volumes (Tons).[1]

Coal Reserve	Coal Lease G-002 (Private)	Coal Lease G-002a (Private)	Coal Lease M-82816 (Federal)	Total
Total coal within lease area	100,390,436	1,436,280	62,138,589	**163,965,305**
Loss attributable to recovery factor [2]	2,361,000	3,000	2,163,000	**4,527,000**
Coal not mined due to undisturbed stream corridors	12,323,193	0	829,781	**13,152,974**
Coal not mined due to existing utilities	2,161,658	0	6,065,170	**8,226,828**
Coal not mined due to poor quality	19,629,169	0	2,529,222	**22,158,391**
Coal not mined due to equipment maneuverability	2,599,661	0	1,338,779	**3,938,440**
Coal not mined due to high stripping ratio	24,318,470	1,394,450	15,463,661	**41,176,581**
Previously mined coal	0	0	0	**0**
Mineable coal reserves in lease	36,997,285	38,830	33,748,976	**70,785,091**

[1]Coal reserves within the project area coal lease boundaries were calculated by Western Energy using grid files in SurvCADD/AutoCADD. This process yields a volume of coal to which an in situ density of 1.1 tons/cubic yard was applied to determine available reserves.
[2]About 2.7 percent of total coal: unrecoverable based on 94-percent coal-recovery factor.
Table is based on Table 322-2: Coal Volumes from Western Energy's PAP.

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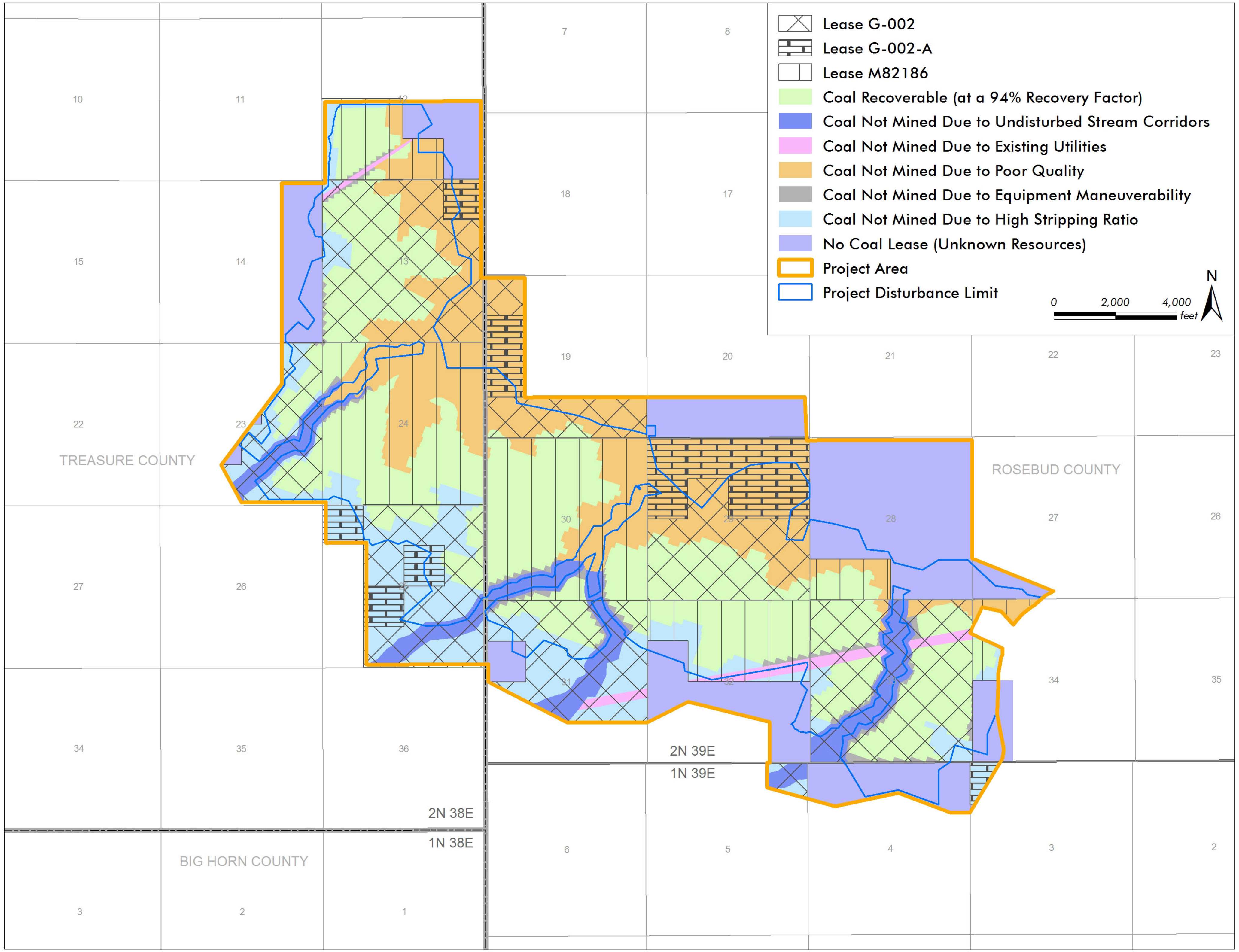

Figure 5. Coal Recovery in the Project Area.

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2.4.3 Mine Plan

According to Western Energy, there are 70.8 million tons of recoverable coal reserves in the project area (**Table 8**). As with other permit areas of the Rosebud Mine (see **Section 2.2, Description of Past and Existing Mine and Reclamation Operations**), Western Energy proposes to use the area surface-mining method (U.S. Patent 2,291,669; August 4, 1942). Mining operations would run 24 hours a day, 7 days a week. Mining would be done by dragline excavation and would continue with the box-cut and progress as shown in Exhibit A to Western Energy's PAP. The proposed sequence of operations is discussed in detail in the sections below.

2.4.3.1 Signs and Markers

Before the start of any mining activities, the perimeter of the project area would be clearly marked using durable and easily recognized markers. Signs identifying the mine area would be installed at all points where public road corridors penetrate the mine permit boundary. These signs would not be removed until after the release of all reclamation bonds.

Signs reading "Blasting Area" would be displayed conspicuously along the edge of any blasting area that comes within 50 feet of any road within the project area, or within 100 feet of any public road right-of-way (see **Section 2.4.3.7, Blasting**). Additionally, durable orange signs measuring no less than 50 square inches and reading "No Trespassing / Danger Blasting Area / Western Energy Co." would be posted where the public can access active mine areas (areas where mining is taking place or areas where mining has taken place) via two-track ranch roads or public roads that penetrate the mine permit boundary.

2.4.3.2 Equipment

A list of the major equipment Western Energy proposes to use in project operations is shown below in **Table 9**. Not all of the equipment listed would be used in the project area, and equipment in the mining area would vary depending on need. Reclamation and revegetation activities (described in **Section 2.4.4, Reclamation Plan**) would require the use of similar equipment plus farm tractors with implements.

Table 9. Equipment List.

Mining and Reclamation Equipment	
Draglines	Articulated Dump Trucks
Coal Drills	Backhoe
Overburden Drills	Explosives Trucks
Coal Haulers	Service Trucks
Dozers	Welding Trucks
Water Wagons	Maintenance Trucks
Motor Graders	Reclamation Tractors
Front-End Loaders	Hydroseeder
Hydraulic Excavators	Scraper
Tractor Implements (Reclamation and Revegetation)	
Chisel Plow	Grass Drill
Mower	Straw Crimper
Disc	Roller-Harrow Packer
Broadcast Seeder	Bale Buster
Giddings Soil Sampler	Tree Planter

Table is based on Table 308-1 from Western Energy's PAP.

Draglines would be the primary overburden stripping tool. In its other permit areas, Western Energy currently uses three Marion 8050 draglines, each weighing 6.5 million pounds, with 60-cubic-yard buckets that hold 90 tons of material (about the size of a single-car garage) and one Marion 8200 dragline weighing 8.5 million pounds with an 80-cubic-yard bucket (105 tons of material). Draglines are electric and are fed with a 12.5-kilovolt (kV) trailing cable. Mobile equipment such as trucks, excavators, and bulldozers would be used when the placement of the material is better suited to loading and hauling equipment or when a dragline is unavailable.

2.4.3.3 Utility Corridors in the Project Area

Western Energy's surface mining operations would be conducted in a manner that minimizes damage, destruction, or disruption of services provided by electric lines and gas pipelines that pass over, under, or through the project area. To accommodate the proposed mine plan (**Figure 4**), Western Energy proposes to mine around an electric transmission line and a gas transmission pipeline that cross the project area and to relocate portions of the electric distribution lines that run throughout the project area as described below and shown on **Figure 6**.

Transmission Line

A 230-kV high-voltage transmission line (HVTL) and corresponding easement owned by Mid Yellowstone Electric Cooperative Inc. (MYED) bisects the southern portion of the project area on an east-west axis. This HVTL conveys power generated at the Colstrip Power Plant into Northwestern Energy's power grid. Western Energy proposes to mine around the line, leaving a 300-foot buffer.

Distribution Lines

About 10 miles of 7.2-kV medium-voltage distribution lines owned by MYED in Township 2 North, Range 38 and 39 East (T2N R38 and 39E) would need to be relocated. Western Energy and MYED have prepared an Area F Electrical Relocation Plan (Western Energy 2014) that outlines the preferred steps that would be taken to relocate the distribution lines. Relocations would be done in three phases (figures depicting the relocations are available in ARM 17.24.308 of Western Energy's PAP).

Phase 1

- The distribution line to a stock well located in Section 27 of T2N 38E would be removed. The well lies in the middle of the haul road that would be extended to the project area. Western Energy proposes to relocate the well within Section 27, provide solar power to the new location, and decommission the old MYED distribution line.
- The main portion of the MYED feeder line that runs through the project area would be relocated. In the first phase, a new main branch line would be constructed along Horse Creek Road in Sections 13 and 14 of T2N R38E, and Sections 19 and 20 of T2N R29E. Once the branch is established, the stock well in Section 20 of T2N R39E would be connected to the new main branch line.

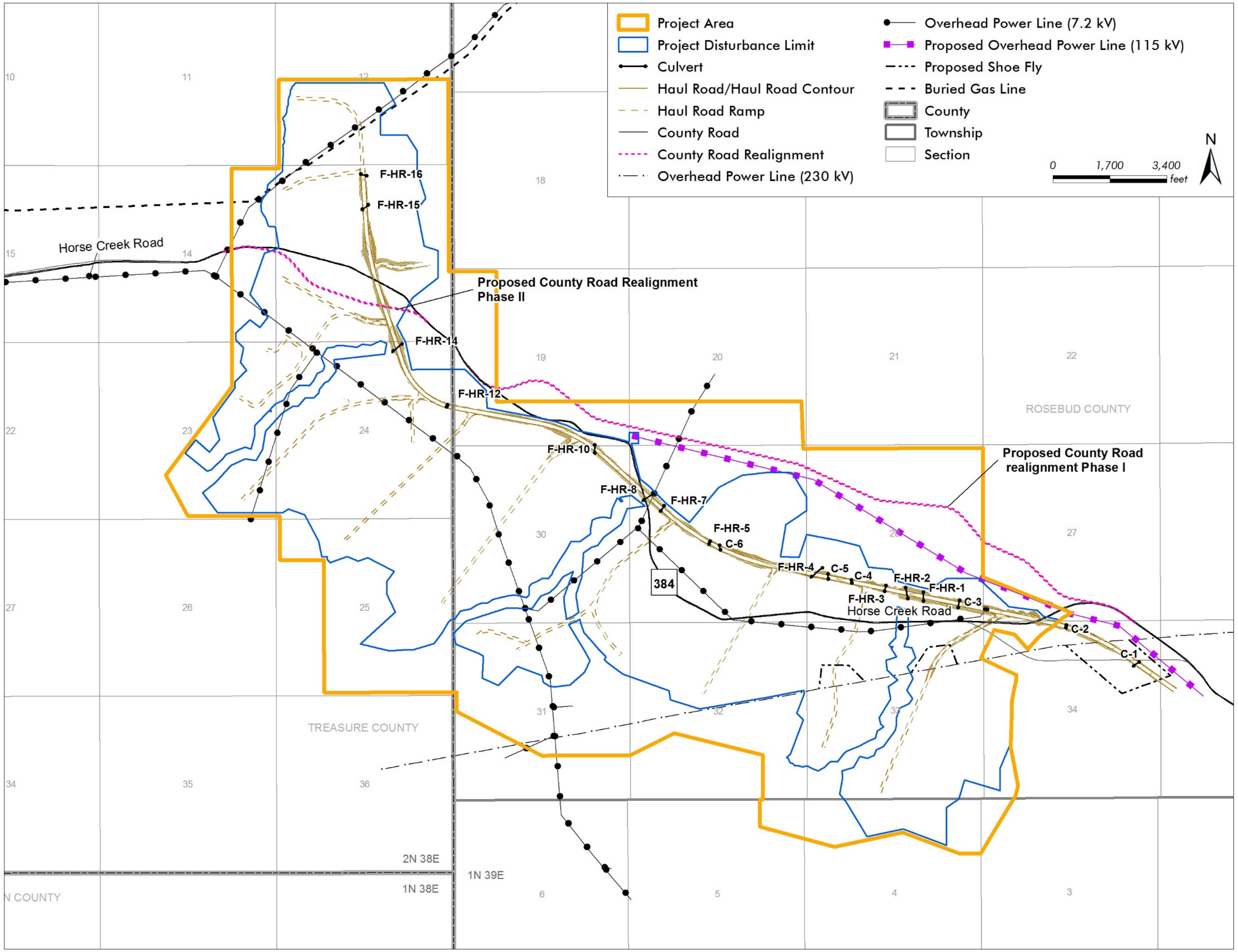

Figure 6. Road Construction and Utilities in the Project Area.

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Phase 2

- The southwest-northeast line (existing main branch) in Sections 30 and 29 of T2N R39E would be relocated outside the disturbance boundary in Sections 29, 30, and 31 of T2N R39E. Once established, power would be fed down the new MYED feeder line to this branch, supplying power to wells south of the mining area.
- The western end of the existing main branch line in Section 24 of T2N R38E and Sections 30 and 31 of T2N R39E would be removed.

Phase 3

- The existing main branch in Sections 13, 14, and 24 of T2N R38E would be removed. A new line would be constructed that connects to the new main branch in the southeast corner of Section 13 of T2N R38E and runs through the drainage and outside the disturbance boundary to reconnect to the line in the southeast corner of Section 23 of T2N R38E. This new line would continue service to the stock well in Section 26.
- The final portion of the existing main branch would be removed along with a portion of the new main branch to facilitate mining in the northern part of the project area.

Gas Line

About 1.4 miles of a 12-inch underground natural gas transmission pipeline owned and operated by Westmoreland Power Inc. is buried in the northern portion of the project area (see **Figure 6**). The pipeline alignment is collocated with an existing 7.2-kV electric transmission corridor. Western Energy proposes to mine around the pipeline, leaving a 100-foot buffer. Before blasting within 1,000 feet of the pipeline, Western Energy proposes to develop blasting and design procedures in cooperation with Westmoreland Power that would be consistent with the pipeline regulations in effect at that time. Western Energy would submit the blasting and design procedures to DEQ for review and approval prior to blasting activities.

Utility Construction

Western Energy would ensure electric power lines and other transmission facilities within the project area are designed and constructed to minimize collisions and electrocutions of raptors, waterfowl, and other wildlife species. A new 115-kV electric power line would be constructed parallel to the relocated portion of the haul road in Rosebud County (see **Figure 6**). All power lines would be constructed in accordance with "Suggested Practices for Raptor Protection on Power Lines: The State of the Art in 1996" (Avian Power Line Interaction Committee 1996) or alternative guidance manuals approved by DEQ.

2.4.3.4 Roads

Western Energy's road system comprises four basic types of roads: access, haul, ramp, and service roads.

Access Roads

The Rosebud Mine is primarily accessed from the east via Castle Rock Road, a Rosebud County road that runs westward off of State Highway 39 about 1 mile south of Colstrip. Major mine facilities such as the mine office, maintenance shop, and operations and maintenance complex are located on Castle Rock Road (**Chapter 1, Figure 2**). Horse Creek Road, which transects the project area for 5.25 miles, would provide access to the project area from both the east and the west. Access roads would not be used for haul truck traffic (see **Haul Roads** below). From the east, the project area can be accessed by traveling west through Area C along Castle Rock Road and West Armells Creek Road (Rosebud County roads) to Horse Creek Road. The project area abuts the western edge of Area C. The project area can also be accessed from the west off of Sarpy Road (Route 384) via Horse Creek Road. Route 384 ultimately connects westward to Interstate 90 just south of Hardin or northward to Interstate 94 east of Hysham.

All mine access roads are county roads owned and maintained by Rosebud or Treasure Counties. Access roads vary in width from 25 to 80 feet. Castle Rock Road is paved from State Highway 39 to the Rosebud Mine Area C Office (about 10 miles). The remainder of Castle Rock Road and Horse Creek Road are aggregate-surfaced.

Haul Roads

Mine haul traffic would not use the mine access roads but rather would continue to use the existing aggregate-surfaced haul roads consistent with current mine practice. Western Energy proposes to extend its Area C haul road westward into the project area by 5.25 miles (see **Chapter 1**, **Figure 2**). Exhibit O in Western Energy's PAP shows the design for the project haul road and typical haul-road cross-sections. About 200,000 to 300,000 cubic yards of initial box-cut overburden would be used as fill for the construction of the project haul road between Ramps F-1 and F-2. The project haul road extension is shown in **Figure 7**.

Haul roads provide the main routes for the coal haulers and are used as the main source of ingress and egress to operational areas throughout the Rosebud Mine. Project coal would be transported by haul truck via the new project area haul road extension to the Area C or Area A truck dumps for crushing and handling. From there, in accordance with Western Energy's contract with the Colstrip Power Plant, most of the coal would be sent via the existing 4.2-mile conveyor to the Colstrip Power Plant (see **Chapter 1**, **Figure 2**). Coal with higher sulfur content would be trucked to the Rosebud Power Plant via an existing haul road and State Highway 39.

Ramp Roads

A series of haul-road ramps would be constructed in the project area to connect the active mining and reclamation area pits to the new project area haul road (**Figure 7**). Ramp roads would be moved and/or advanced with the development of each new mine area within the project area.

Service Roads

Service roads provide access to areas of the mine that are not accessible using the haul roads. Service roads include all other roads in the mine that are generally used for support functions. Service roads can range from single-track to 80 feet wide and may or may not be surfaced with road material. Western Energy would consult with DEQ prior to construction of any service road wider than a two-track.

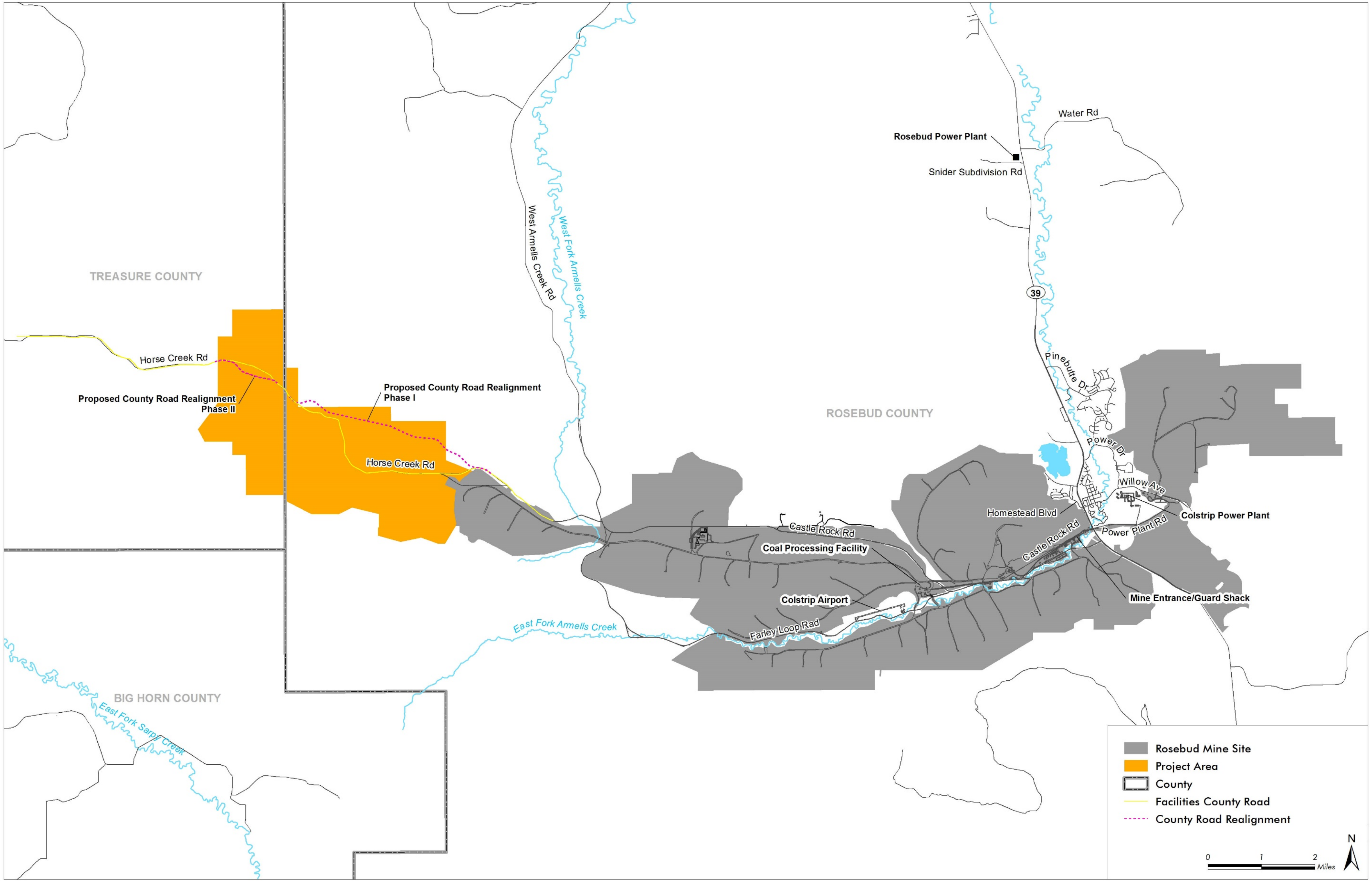

Figure 7. Local Roads.

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Road Construction

Construction Method

Existing access roads and new and existing haul roads (see **Figure 6**) would be graded, constructed, and maintained according to sound engineering and construction practices incorporating appropriate limits for grade, width, surface material, surface-drainage control, and culvert placement. Roads would not be constructed or surfaced with waste coal, acid-producing materials, or toxin-producing materials. Surface material would be suitable for anticipated traffic volumes, weights, and speeds. Temporary and permanent erosion-control measures such as sediment impoundments (ponds/standard traps), alternate sediment-control measures (best management practices, or BMPs), and roadside ditches and culverts would be constructed before any disturbance or in conjunction with soil stripping and roadway construction in order to control, treat, and/or contain runoff from the roadway construction and soil-stripping operations (see **Section 2.4.5.2, Surface Water Management and Sediment-Control Measures**). All cut-and-fill slopes would be re-soiled and revegetated or otherwise stabilized at the first seasonal opportunity. Cutslopes would not be greater than 1v:1.5h (ratio of vertical rise to horizontal run) for unconsolidated materials or 1v:0.25h in rock.

Western Energy proposes to use the same haul-road construction method for the project that it currently uses in other permit areas. Two-way haul roads would typically be 80 feet wide on tangent and surfaced with road material to provide for all-weather use. Wider roads may be constructed in certain areas as needed to accommodate the dragline. As haul roads advance in conjunction with mining and reclamation operations, construction would be staged to provide a sound base, usually by watering and wheel-compacting the sub-base. Haul roads would generally be constructed with 0 to 3 percent grades, but roads with grades up to 8 percent and a maximum pitch grade of 12 percent may be constructed.

Western Energy proposes to use the same ramp-road construction method for the project that it currently uses in other permit areas. Ramp roads would be maintained at 5 percent or steeper grades and surfaced with road material to provide for all-weather use. Spoil grading adjacent to ramp roads would allow for soiling and revegetation activities to proceed at the first appropriate period favorable for planting. Grading would not delay or prevent Western Energy from achieving the approved postmine topography.

Relocation of Horse Creek Road

To accommodate the proposed mine plan (see **Figure 4**), Western Energy proposes to relocate Horse Creek Road in two locations. Specifically, a 4.2-mile segment in the northeast/north-central portion of the project area (owned and maintained by Rosebud County) and a 1.3-mile segment in the northwestern portion of the project area (owned and maintained by Treasure County) would be rerouted (see **Figure 7**). The road relocation would be done in two phases. The longer segment, which is in Rosebud County, would be relocated during initial development of the project. The west end of the realignment, which is in Treasure County, would be relocated when mining moves into the northwestern corner of the project area (about 12 years later). Any modification of the existing road alignment would involve the counties' rights-of-way. Before any mining activities in the areas that involve county road relocation, Western Energy would work with the Rosebud and Treasure County Boards of Commissioners to plan and develop a means for relocating the road as necessary. DEQ would be required to hold a public hearing, appropriately noticed, to determine whether the interests of the public and affected landowners would be protected. See ARM 17.24.1135(3-4). A written finding based on the information from the public hearing would be produced and submitted by DEQ. See ARM 17.24.1135(5).

Designs for the road relocations would be submitted to DEQ for review and approval. Where the haul road crosses the county road, appropriate traffic control would be incorporated into the design and included in the submittal. Road relocations (by phase) would need to be approved and constructed prior to mining-related activities (other than surveying and monitoring).

Western Energy would primarily use pit run, crushed, and screened scoria for road-construction materials. Due to varying degrees of suitability of scoria on and near the mine and due to varying thicknesses of road-bed materials including base and finish, the materials used would vary by location. The plans and drawings for roads would be prepared by, or under the direction of, a qualified licensed professional engineer with experience in the design and construction of roads, and certified by the engineer. The as-builts for new construction and reconstruction of haul roads as required would be submitted within six months of the haul road being used for transport of coal, soil, or spoil.

Road impacts on environmental quality would be mitigated through BMPs to the greatest extent practicable. Following abandonment, roads would be reclaimed in accordance with the approved reclamation plan (see **Roads** under **Section 1.4.11.1** for a more detailed discussion). All bridges and culverts would be removed and natural drainage patterns restored. Stream crossings would include bridges, culverts, or other structures designed and constructed to meet the requirements of ARM 17.24.602.

Bottom Ash

Western Energy does not propose to use bottom ash for any purpose in the project area. In other permit areas of the Rosebud Mine, Western Energy does use bottom ash from the Colstrip Power Plant in the construction of parking facilities, as a sanding agent for ramp and haul roads during periods of poor road conditions due to weather, and as tank and culvert bedding. See **Section 3.21, Solid and Hazardous Waste** for a description of current use of bottom ash at the Rosebud Mine.

Fugitive Dust Control

Western Energy currently maintains a Fugitive Dust Control Plan in accordance with ARM 17.24.761 and the work practice standards established within its current Montana Air Quality Permit (MAQP). Western Energy proposes the ongoing maintenance and implementation of a dust control plan for the project, which includes the following Best Available Control Technology (BACT) for the control of fugitive particulate matter:

- All unpaved roads would be watered to reduce fugitive dust. A chemical dust suppressant such as magnesium chloride or lignin sulfonate would be used as needed.
- Vehicle speeds would be restricted on haul roads to reduce the amount of fugitive dust.
- Unpaved haul and access roads would be chemically stabilized with nontoxic soil cement or dust palliatives mixed into the upper 1 to 2 inches of road surface as necessary.
- All roads would be routinely maintained by means including but not limited to wetting, scraping or surfacing, chemical dust-suppression addition, sanding, and replacement of surfacing materials.

2.4.3.5 Approximate Mining Sequence

Western Energy's proposed 19-year mine plan is shown in **Figure 4**. For a detailed view of the mining sequence, including initial box-cut locations, please see Exhibit A in Western Energy's PAP. The project would extend mining operations at the Rosebud Mine by 8 years based on past Rosebud Mine sales. The

Rosebud Mine reported 9.0 million tons of sales in 2014 and estimates 70.8 million tons of recoverable coal reserves are in the project area.

Mining in the first six years would occur between Donley Creek and Black Hank Creek and in a small section east of Black Hank Creek. In years 7 through 13, mining would occur between Robbie and Donley Creeks, except for several passes on the west side of Robbie Creek. Years 14 through 16, mining would occur between McClure Creek and Robbie Creek. In year 17, mining would be north of McClure Creek before moving to the area west of Black Hank Creek that would be mined in the final 2 years of project mine life.

The typical mining sequence would be topsoil salvage (see **Section 2.4.3.6, Soil Removal and Stockpiling**) and blasting (see **Section 2.4.3.7, Blasting**) followed by excavation (primarily by dragline) of overburden (see **Section 2.4.3.8**) and coal (see **Section 2.4.3.9**).

2.4.3.6 Soil Removal and Stockpiling

Soil would be salvaged using the protocol currently used in other Rosebud Mine permit areas. Western Energy would conduct soil-salvage operations in a manner and at a time that minimizes erosion, contamination, degradation, compaction, and deterioration of the biological properties of the soil. Prior to any surface disturbance in the project area, any vegetation that would interfere with soil removal and use would be removed. All soil suitable for reclamation use (topsoil, subsoil, and tree soil) would be removed (see **Soil Salvage Protocol** below) and salvaged for immediate use (see **Section 2.4.4.5**, **Postmining Topography and Drainage Basin Design**) or stockpiled (see **Soil Stockpiles** below). The extent and depth of soil removed would be based on pre-mine soil surveys provided in Appendix G of the PAP and pre-disturbance soil-sampling programs.

Temporary and permanent erosion-control measures, such as sediment impoundments (ponds/standard traps), alternate sediment-control measures (BMPs), and perimeter ditches would be constructed prior to any disturbance or in conjunction with soil stripping and roadway construction in order to control, treat, or contain runoff from the roadway construction and soil-stripping operations (see **Section 2.4.5.2, Surface Water Management and Sediment-Control Measures**).

Soil would be salvaged from all large disturbances such as mine pits and roads. Standard soil removal and stockpiling practices would not be necessary for minor disturbances that occur at the site of small structures, such as power poles, signs, fences, or where operations would not destroy vegetation and cause erosion.

Soil Salvage Protocol

Three soil classes would be salvaged: lowland soil, upland soil, and tree soil (see **Section 3.24**, **Soils** for discussion and figure). These classes are based on suitable topsoil and subsoil thickness as well as soil texture and include five generalized soil map units (see descriptions in **Section 3.24, Soil**). Lowland soil corresponds to soil map unit 500 (very deep, fine-textured drainage soil). Upland soil corresponds to soil map unit 300 (very deep, fine-textured soil on gently sloping uplands) and a portion of soil map unit 400 (coarse-textured soil of rolling uplands). Tree soil corresponds to soil map units 100 (shallow upland soil) and 200 (very deep residual soil of uplands) and a small portion of map unit 400 (coarse-textured soil of rolling uplands). The upland soil-salvage class makes up about 3,183 acres of the total disturbance, the lowland class makes up 170 acres, and the tree class makes up the remaining 947 acres.

Soil removal for lowland and upland soil would be done in two lifts: 12 inches of topsoil (lift 1), and 12 inches of subsoil (lift 2). Tree soil would be removed in one 24-inch lift. In advance of each dragline pass, topsoil and subsoil would be removed from the mining area using a double-lift soil-handling method. In the first lift, topsoil would be salvaged to a depth of 12 inches, and in the second lift, 12 inches of subsoil would be salvaged. Soil removal would be accomplished primarily by articulated dump trucks that would remove, transport, and deposit the soil on graded areas or in soil-storage areas. Other mobile equipment including but not limited to front-end loaders, blades, dozers, and haul equipment (bottom and/or end-dump) may also be used to assist in the operation (see **Section 2.4.3.2, Equipment**). To ensure that soil is salvaged to an appropriate depth, Western Energy would stake out small areas within the soil-salvage area and observe soil-salvage edges. If Western Energy demonstrates and DEQ finds that multiple lifts are not necessary to achieve reclamation consistent with MSUMRA rules and the reclamation plan, single lifts may be used to remove topsoil and subsoil. After removal of topsoil and subsoil, tree soil would be salvaged in a similar manner, except that a single-lift method would be used in depths up to 24 inches.

To the maximum extent possible, salvaged soil would be immediately redistributed on areas graded to the approved approximate postmining topography (see **Section 2.4.4.5, Postmining Topography and Drainage Basin Design**). Soil salvage and replacement operations would be conducted in a manner and at a time that minimizes erosion and compaction. Soil redistribution would be accomplished with bulldozers, graders, and other equipment as necessary (e.g., front-end loaders, bottom/end-dump haul trucks). The number of passes over the graded/soiled surfaces would be limited to the extent possible to minimize compaction.

Soil Stockpiles

If graded areas were not immediately available for redistribution, then topsoil, subsoil, and tree soil would be stockpiled in separate locations. Soil stockpiles would be placed on undisturbed, non-salvaged areas or on graded spoil and located away from sensitive areas (e.g., wetlands and streams) in areas that would minimize impacts from wind, water erosion, and ongoing mine operations. Stockpiles would be identified with signs denoting the type of soil (i.e., topsoil, subsoil, or tree soil). Proposed soil stockpile locations are shown in **Figure 4**.

Inactive soil stockpiles would be seeded during the first appropriate season with either the pasture mix described in **Table 313-5A, Appendix C** of this EIS or other appropriate reclamation seed mixes (see **Section 2.4.4.7, Seeding** for method). Normal seeding periods would be fall (September through November) and spring (March through May). Active soil stockpiles that would be used within 1 year would be appropriately marked but not seeded.

Until an adequate vegetative cover is established, semipermanent sediment-control measures, such as silt fences or ring ditches with berms placed adjacent to stockpiles, would be used as necessary to control sediment eroded from stockpiles (active and inactive). Compaction, contamination, and degradation of the stockpiles would be minimized. Once stockpiled, the soil material would not be rehandled until replaced on graded disturbances, unless authorized by DEQ.

Weed control would be an important aspect of soil storage and protection. Western Energy's Weed Control Plan (see **Section 2.4.4.9, Noxious Weed Control**) describes the measures that would be employed to minimize noxious weeds.

Undisturbed Soil

Undisturbed soil would be protected to the extent possible from contamination and degradation. Some activities involving vehicle travel may be necessary on undisturbed areas, including activities associated with power distribution, fence building or removal, compliance monitoring by Western Energy or contractors (e.g., ground water well monitoring, soil sampling), and other permit requirements. Western

Energy would, to the extent possible, limit vehicle travel on undisturbed areas, especially during wet soil conditions. To the extent possible the non-salvaged topsoil beneath the stockpiles would not be disturbed when removing stockpiled soil.

2.4.3.7 Blasting

After soil removal, explosives—principally ammonium nitrate and fuel oil or emulsion—would be used to loosen overburden (geologic material covering the coal seams) and coal deposits. Drill-hole spacing for overburden blasting would be determined by overburden depth, dragline bench elevations, and blast-hole diameters. Typical overburden blast patterns would follow current practice and use 9⅞- and 12¼-inch-diameter blast holes spaced 25 to 45 feet apart.

Blasting is intended to achieve maximum overburden or coal displacement while not exceeding maximum particle velocity in any direction outside the project area. If blasting operations occur within 5,000 feet of private or public buildings (mining buildings and facilities are exempt), the maximum peak particle velocity in any direction would not exceed 1 inch per second in the immediate vicinity of the structures. Maximum peak particle velocity in any direction would not exceed 0.75 inch per second in the immediate location of a structure located 5,000 feet or farther away.

Access to the blasting area, which would be marked as described in **Section 2.4.3.1, Signs and Markers**, would be controlled through the use of road blocks in order to protect the public and livestock and to prevent unauthorized entry. At least 10 minutes before each blast, access to the blasting area would be blocked to prevent unauthorized entry. Prior to blasting, two signals would be used: a 60-second warning-siren wail, and a 10-second all-clear wail. Both signals would be audible within a 0.5-mile range of the blast. Access to and travel in or through the blasting area would not resume until after Western Energy's authorized representative determines that no unusual circumstances, such as imminent slides and undetonated charges, exist in the blasting area.

At least 30 days before blasting, all residents or owners of dwellings or other structures within 0.5 mile of the project area boundary would be advised to request a pre-blasting survey. Surveys requested more than ten days before the planned initiation of blasting must be completed by the operator before the initiation of blasting. The purpose would be to determine and document the pre-blasting condition and other physical factors potentially affected by blasting. Assessments of structures such as pipes, cables, transmission lines, and wells and other water systems would be limited to surface condition and readily available data. Special attention would be given to the pre-blasting condition of wells and other water systems used for human, animal, or agricultural purposes and to the quantity and quality of the water.

Prior to blasting within 1,000 feet of the natural gas pipeline and the 230-kV power line that cross the project area, Western Energy would follow blasting and design procedures developed in cooperation with the utility owners and approved by DEQ (see **Section 2.4.3.3, Utility Corridors in the Project Area**).

A blasting schedule would be published at least 10 days but not more than 20 days before beginning a blasting program and republished at least every 12 months, per ARM 17.24.623(3). The blasting schedule would be published once in the "Independent Press" (Forsyth) for general circulation in Rosebud County. Copies of the schedule would be distributed to local governments, public utilities, and each residence within 0.5 mile of the project area. Copies sent to residences would be accompanied by information advising the owner or resident on how to request a pre-blasting survey.

2.4.3.8 Overburden Removal

Following overburden blasting, bulldozers would level the blasted material, creating a stable working base for the dragline. Draglines would be the primary overburden stripping tool; however, mobile equipment such as trucks, excavators, and bulldozers would be used when the placement of the material is better suited to loading and hauling equipment or when a dragline is unavailable (see **Section 2.4.3.2**, **Equipment**).

Typically, removal of blasted overburden in an area in which vegetation and salvageable soil have been removed would commence by excavation of the box-cut. After coal is removed from the box-cut area, overburden removal in adjacent strips would commence by cast-blasting overburden (spoil) into the area where coal was removed. The dragline would then be stationed to excavate remaining overburden to expose the coal seam by digging and casting the overburden into the mined area to form spoil ridges or piles. Afterwards, surface mining (also known as "area mining") would progress sequentially.

The mining sequence would begin with initial box-cuts (passes FA-1, FB-1, FB-5, and FB-8). About 200,000 to 300,000 cubic yards of initial box-cut overburden (spoil) would be used as fill for the construction of the project area haul road (see **Haul Roads**), while the remainder would be placed in spoil stockpiles (**Figure 4**). Box-cut spoil that is stockpiled would be used to backfill final ramps and pit voids or to construct ridges in the postmine topography (see **Section 2.4.4.2, Backfilling and Grading**).

Actions would be taken to minimize impacts on ground water quality and quantity. Disturbance to clinker zones, which are considered to be primary hydrologic recharge areas, would be minimized. Stockpiles would be located to avoid placement over recharge areas to prevent potential water quality impacts. In addition, dragline spoil would be cast inward instead of outward in these areas to protect water quality and quantity. No special handling of overburden is anticipated at this time because of the favorable quality of the overburden. Any areas of suspect overburden or coal evident at the surface of graded spoil would be sampled as described below in **Section 2.4.7, Monitoring Plans**. Overburden storage piles would be shaped with dozers or draglines, or hauled by the truck/loader fleet as necessary to create the approved approximate postmine topography (see **Section 2.4.4.5, Postmining Topography and Drainage Basin Design**).

2.4.3.9 Coal Removal

Following dragline exposure of the Rosebud Seam in each pass, the coal would be drilled and blasted. Front-end loaders or excavators would load coal into haulers for transport (see **Equipment**). Removal of coal would leave a strip-shaped void, known as the pit.

Western Energy would recover as much of the Rosebud Coal as possible under prevailing pit conditions. Safety wedges may be left when necessary to ensure the safety of the working area. A typical wedge would have a triangular cross-section with a base 10 feet wide and a height of 20 feet. It is estimated that there would be 4 to 5 tons of coal per foot of wedge remaining. Western Energy estimates that 75 percent of this coal could be recovered with a backhoe and front-end loader. However, several variables could change this recovery rate, including loss of haul roads, sloughing of the spoil, scheduling, and quality of coal. Western Energy would remove the wedge in all areas where safety permits. An atypical wedge, one that could be as wide as 100 feet and unlimited in length, would be left in place when prevailing pit conditions jeopardize the safety of the working area. Some pit conditions that would cause an atypical wedge to be left are spoil-slope failure, highwall and endwall instability, excessive moisture in the spoil or overburden material, and excessive water in the pit.

Coal would be transported via coal haulers on an established haul road to Area C or Area A for crushing. After crushing, most coal from the project area would be transferred via conveyor to the Colstrip Power Plant for use in Units 3 and 4. Coal with higher sulfur content and low calorific value (typically the first 1-foot layer encountered in the deposit) would be trucked to the Rosebud Power Plant.

2.4.3.10 Fire Management

Western Energy maintains ongoing field inspections of materials that are conducive to spontaneous combustion, such as coal that is exposed to the atmosphere (in storage piles, exposed unmined coal, or waste coal). If a fire does occur, proper precautionary steps would be taken to extinguish the fire in a safe manner and in such a way as to reduce the possibility of recurrence. If necessary, coal fires would be covered with overburden or spoil material to limit burning ability. Only persons authorized by Western Energy and who have an understanding of the procedures would be involved in coal-fire control operations.

To minimize the risk of damage to the electric trailing cable from grass fires, Western Energy would mow to a minimum width of 10 feet on each side of the 12.5-kV electric trailing cables that power the drag lines (see **Section 2.4.3.2, Equipment**). Mowing would be done on native areas of the mine permit. Western Energy would maximize the use of exposed overburden and spoil areas with minimal vegetation for placement of the cables. Pursuant to Mine Safety and Health Administration regulations and fire safety protocols, junction boxes would be located on areas cleared of vegetation either by mowing or stripping.

2.4.4 Reclamation Plan

Western Energy would reclaim all mining-related land disturbances to a use equal to or better than what existed prior to mining as provided for in Sections 82-4-231 and 232, MCA. Western Energy would utilize direct haul (hauling soil directly from the stripping area to graded areas ready for soil replacement) whenever possible. The initial stages of reclamation (grading, application of soil, and seeding) would begin within 2 years of mining and continue as subsequent mine passes are completed in the project area until Phase IV bond release (bond-release phases are discussed in **Section 1.6.4, Bond Release**). The timing and sequence for completing this stage of reclamation is shown in **Figure 8**. Reclamation would facilitate the following postmine land uses: grazing land, cropland, and wildlife habitat (see **Section 2.4.4.1, Postmine Land Uses**).

Reclamation, as it relates to bond release, would occur in four phases (see **Section 1.6.4, Bond Release**). Phase I would include pit backfilling and grading (**Section 2.4.4.2, Backfilling and Grading**) to meet the postmine topography (**Section 2.4.4.5, Postmining Topography and Drainage Basin Design**). Phase II would consist of surface stabilization to prevent accelerated erosion, soil application (**Section 2.4.4.6, Soil Application**), revegetation (**Section 2.4.4.8, Revegetation Plan**), and sediment-control measures (**Section 2.4.5.2, Surface Water Management and Sediment-Control Measures)**. Phase III would ensure that the postmining land uses have been met and would include extensive monitoring of the reclaimed landscape, including monitoring of vegetation (**Section 2.4.7.4, Revegetation Monitoring Plan**), soil (**Section 2.4.7.3, Soil/Spoil Monitoring Plan**), and surface water and ground water resources (**Section 2.4.7.6, Surface and Ground Water Monitoring**). Phase IV would ensure the restoration of the hydrologic balance (**Section 2.4.5, Protection of the Hydrologic Balance**), among other final reclamation measures as described in **Section 1.6.4, Bond Release.**

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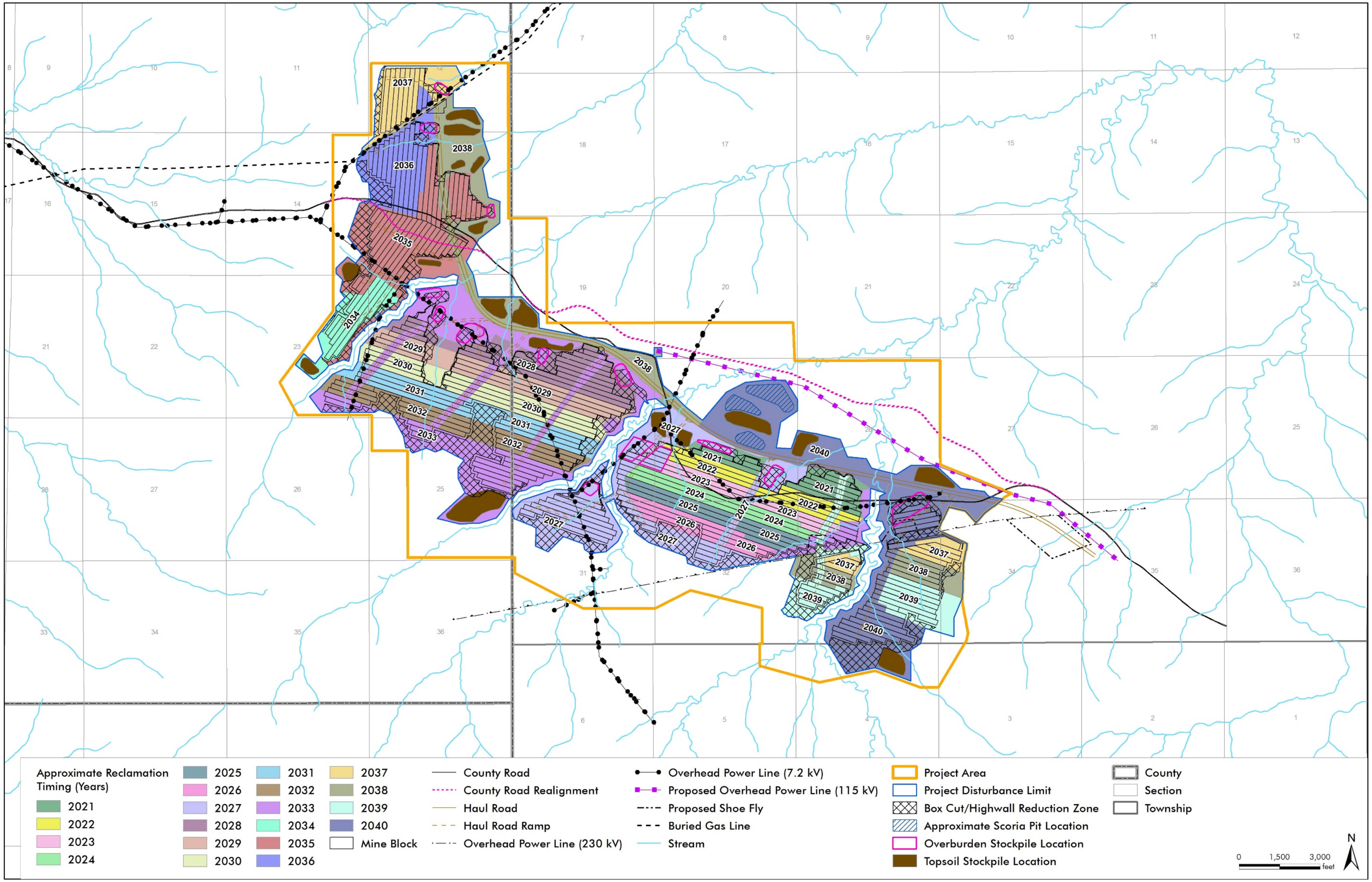

Figure 8. Proposed Project Area Reclamation Plan (Grading, Application of Soil, and Seeding). [Please note that years in the figure show the relative sequence, but may not be the actual year of reclamation]

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In addition to the reclamation of the landscape disturbed by mining, other disturbed areas that would require reclamation include the road system, mine plant facilities, sediment-control structures, and temporary diversion structures (see Section **2.4.4.11**, **Special Reclamation Cases**).

2.4.4.1 Postmine Land Uses

Pre-mine land uses within and adjacent to the project area include livestock grazing, pastureland, agricultural cropland, wildlife habitat,[4] and industrial/commercial (i.e., scoria/gravel storage sites, ranch yards, and active mine lands). For further details, see **Section 3.23, Land Use**. The primary pre-mine surface land use within the project area and the adjacent areas outside the Rosebud Mine boundary is livestock grazing. Livestock currently graze all vegetation types within the project area. The 513 acres (5.7 percent) of nonirrigated cropland in the project area are used for small-grain production. Wheat is the primary crop with small acreages of barley and oats.

Western Energy proposes postmine land uses similar to pre-mine land uses, with the exception of pastureland, which would not be a postmine land use (see **Section 4.23, Land Use**). Cropland acres would be significantly reduced. Western Energy proposes the postmining target acres based on landowner preference for grazing land over cropland and pastureland (**Table 10**).

Table 10. Proposed Postmine Revegetation Acres.

Pre-Mining Land Use	Acres to Be Disturbed	Postmine Revegetation Target Acres
Cropland	469	318
Fish and Wildlife Habitat	8	9
Grazing Land	3,229	3,930
Pastureland	516	0
Industrial/Commercial (county road ROW, scoria pit, and ranch yard)	37	3
	4,259	**4,260**

Based on Table 313-1 from Western Energy's PAP. Please note that the total disturbance acres presented in this table vary slightly from those presented in **Table 6**. This difference is attributable to rounding errors.

2.4.4.2 Backfilling and Grading

Following coal extraction, each strip would be backfilled with spoil materials generated by the dragline from the successive pass (see **Figure 8**). Spoil that is determined to be potentially harmful to postmine vegetation development would be buried under at least 8 feet of "clean" overburden material in accordance with ARM 17.24.505(2).

Dragline operations result in a spoil ridge, which would be graded to the approved approximate postmining topography (see **Section 2.4.4.5, Postmining Topography and Drainage Basin Design**). Grading of the spoil would be done with dozers, scrapers, a truck/loader fleet, or draglines. Grading would occur within four spoil ridges of the active pass, except adjacent to ramp roads as described in the PAP (see **Ramp Roads** under **Section 2.4.4.11, Special Reclamation Cases**). All final surface preparation of graded surfaces would be done on the contour. Western Energy would provide DEQ with an updated existing topography map of all areas being graded. The topography map would show the

[4] Please note that all land-use types with appropriate habitat (e.g., grazing land) can support wildlife use. The land use designated "wildlife habitat" is defined in 82-4-203, MCA, as "land dedicated wholly or partially to the production, protection, or management of species of fish or wildlife."

amount of pit advance and the actual graded contours. This map would be included in Western Energy's Area F Annual Report.

If such grading and preparation along the contour is hazardous to equipment operators, then grading and preparation in a direction other than generally parallel to the contour would be used. In all cases, grading and preparation would be conducted in a manner that minimizes erosion and provides a surface for replacement of soil that would minimize slippage.

During the final phases of spoil grading, surface drainages would be reconstructed to the approved approximate postmining topography (see **Figure 9** and **Section 2.4.4.5, Postmining Topography and Drainage Basin Design**). Appropriately sized sedimentation ponds would be constructed at the lowest end of reconstructed drainages to prevent untreated runoff from exiting the disturbed areas (see **Section 2.4.5.2, Surface Water Management and Sediment-Control Measures**).

2.4.4.3 Disposal of Waste Materials

All exposed mineral seams remaining after mining would be covered with a minimum of 4 feet of the best available nontoxic and noncombustible material.

All debris and acid or acid-forming, toxic or toxic-forming, combustible, or other waste materials exposed, used, or produced during mining would be covered with a minimum of 8 feet of the best available nontoxic and noncombustible material; or, if necessary, these materials would be treated to neutralize toxicity to prevent water pollution and sustained combustion and to minimize adverse impacts on plant growth and land uses. To prevent the occurrence or threat of water pollution, acid-forming or toxic-forming materials would not be buried or stored close to a drainage course.

Final disposal of non-coal wastes, if encountered, would be in an approved landfill site for solid wastes. Any waste materials meeting the definition of "hazardous" under the Solid Waste Disposal Act (42 USC Section 3251), as amended, would be handled in accordance with the act and its implementing rules.

Some waste materials would be accumulated and reclaimed for reuse within the project area in other mining-related activities such as conveyor belt de-icing. Excess waste liquid not used within the mine would be handled under Western Energy's Waste Management Program.

2.4.4.4 Highwall Reduction

Final highwalls (the unexcavated face of exposed overburden and mineral in the mined area) would be backfilled with spoil or graded in accordance with the postmine topography (**Section 2.4.4.5, Postmining Topography and Drainage Basin Design**). Highwall reduction would begin at or beyond the top of the highwall and would be sloped to the graded spoil bank. Highwalls would be reduced so the steepest slope would be no greater than whatever slope is necessary to achieve the minimum 1.3 long-term static factor of safety. A lesser slope may be used whenever necessary to achieve postmining slope stability.

In all cases, the final pit would be backfilled such that all exposed coal seams would be covered with at least 4 feet of nontoxic, noncombustible material. Cross-sections would be utilized to evaluate the blending of undisturbed terrain and disturbed ground to provide a smooth and stable transition in the topography. Final highwall reduction would not encroach into any established buffer zone (see **Section 2.4.8.1, Air Quality**).

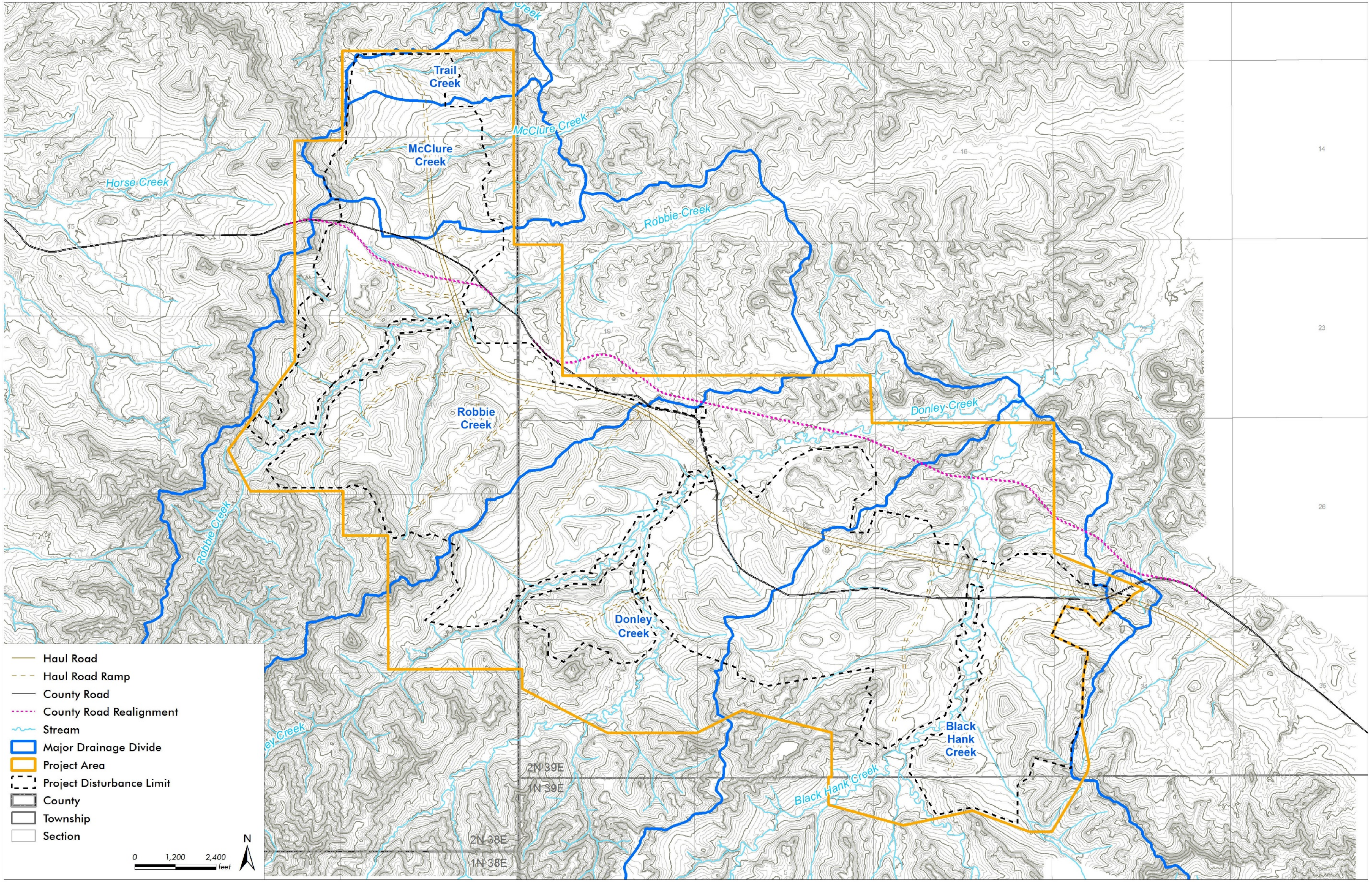

Figure 9. Postmine Topography.

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Highwall reduction alternatives may be considered for replacement of bluff features that existed before mining. Bluff reduction features would increase postmine habitat diversity such as cliff features needed for wildlife (discussed in **Special Habitat Features** in **Section 2.4.4.10, Wildlife Habitat Enhancement**) and reduce the disturbance area created during highwall reduction. Highwall reduction alternatives would be considered only if:

- postmining bluffs were compatible with proposed postmining land uses
- postmining bluffs had a long-term static safety factor of at least 1.3
- similar geometry and function existed between pre-mining and postmining bluffs
- the postmining bluff horizontal linear extent would not exceed pre-mining condition

2.4.4.5 Postmining Topography and Drainage Basin Design

Postmining Topography

The postmine landscape would be restored to the approximate original contour to facilitate postmine land uses (see **Section 2.4.4.1, Postmine Land Uses**).The postmine topography (PMT) that Western Energy proposes to meet at final bond release is shown in **Figure 9**. The PMT shows the general topography (ridges, drainages, slopes, etc.) that would serve as Western Energy's grading template for matching the pre-mining topography (see description and figure in **Section 3.2, Topography**); it does not depict detailed diversity features. During final grading, Western Energy may be able to add additional drainage features to more closely approximate original contours and avoid long-term geomorphic problems including long uniform slopes, inappropriate channel or slope profiles, or inadequate drainage density. Examples of some of the diversity features that Western Energy may be able to include during final grading include additional tributaries, over-steep slopes of various exposures in headwater locations, incised tributary or dry wash areas, complex side slopes, small anomalies (e.g., hogbacks and knolls), and scoria pits. These features are not shown on **Figure 9**, but probable locations are shown on Exhibit B in Western Energy's PAP.

To mitigate the general lack of water in the vicinity of the project area (due to climate and not primarily as a consequence of mining), Western Energy proposes enhancement features within the postmine topography to capture water when available and use it to enhance habitat for wildlife and livestock and to establish wetlands. These features would be in the form of small depressions that would store water following runoff events, thereby providing water sources, promoting establishment of wetland species, and diversifying the postmine habitat types within the project area. These small depressions would also help retain sediment within the project area.

Drainage Basin Design

With the exception of haul-road crossings, Western Energy proposes to leave the main channels of Black Hank, Donley, McClure, and Robbie Creeks undisturbed. For channels that contain critical hydrologic, ecologic, or land-use functions such as wetlands or steep erosive upland drainages, detailed drainage designs would be submitted to DEQ for approval.

Drainage-basin design would be based on pre-mine conditions. See **Section 3.2, Topography** for a discussion of pre-mine topography. A pre-mine and postmine comparative analysis of geomorphic characteristics (general shape [i.e., U-shaped or V-shaped], incised depth, and incised width) would be used to determine reclamation recontouring and drainage (see Table J-2; PAP, Appendix J). Aerial and ground surveys also would be utilized to evaluate other drainage characteristics, such as channel profiles, drainage patterns, and separation of flow between adjacent drainages. The pre-mine survey would also ensure that drainages and slope contours are designed and constructed consistent with the approved postmine topography.

Reclaimed drainage basins—valleys, channels, streams (perennial, intermittent, ephemeral), and floodplains—would be constructed to meet approved postmine topography and approximate original contours, and to enable the drainage channels to remain in dynamic equilibrium with the drainage basin system. Each major postmine drainage basin would be constructed to provide for long-term relative stability of the landscape, separation of flow between adjacent drainages, an average channel gradient that exhibits a concave longitudinal profile (per field and aerial surveys), and the capacity to safely pass the runoff from a 6-hour precipitation event with a 100-year recurrence interval. Drainage basins and channels would be designed to prevent adverse impacts on the hydrologic balance in adjacent areas and to meet the performance standards of ARM 17.24.634.

2.4.4.6 Soil Application

Western Energy would utilize direct haul (hauling soil directly from the stripping area to graded areas ready for soil replacement) whenever possible. Topsoil-replacement depths would be as appropriate for the specified vegetation community in the revegetation plan (see **Section 2.4.4.8, Revegetation Plan**) and are summarized in **Table 11**.

Table 11. Soil Reapplication Depths.

Soil Salvage Class	Generalized Soil Map Units Included	Soil Reapplication Depths
Lowland Soil	Very deep, fine-textured drainage soil (Soil Map Unit 500)	• Reapplication depth = 24 inches +/- 6 inches • Reapplication depth range = 18 to 30 inches
Upland Soil	• Very deep, fine-textured soil of gently sloping uplands (Soil Map Unit 300) • A portion of the coarse-textured soil of gently sloping uplands (Soil Map Unit 400)	• Reapplication depth = 18 inches +/- 6 inches • Reapplication depth range = 12 to 24 inches
Tree Soil	• Shallow upland soil (Soil Map Unit 100) • Very deep residual soil of uplands (Soil Map Unit 200) • Most soil map units of the coarse-textured soil of gently sloping uplands (Soil Map Unit 400)	• Reapplication depth = 9 inches +/- 6 inches • Reapplication depth range = 3 to 15 inches

Soil laydown depths would vary across a reclamation unit in an attempt to resemble a pattern consistent with natural soil depth (e.g., shallower on ridgetops and deeper in swales and depressions). Variability of the soil laydown depths within a reclamation type would depend on desired vegetation results. For instance, in a cropland area where uniform production is desired, soil laydown depths would be restricted to a narrow variance from the target laydown depth. In grasslands where more vegetation variability is desired, a larger variance from the target depth would be allowed. Topsoil replacement would occur in accordance with reclamation plan contours with the following exceptions: when equipment-operator safety would be an issue; on pond embankments, road ditches, and incised drainages; and on areas where equipment turning radius would be limited.

Quality-control measures ensuring proper redistribution depth would be implemented. Some activities involving vehicle travel may be necessary on redistributed soil in reclaimed areas including fence building, removal, and maintenance; compliance monitoring of ground water, soil, vegetation, and erosion control; surveying; and related reclamation management activities. Western Energy would limit vehicle travel on reclaimed areas to the extent practicable, especially during wet conditions.

2.4.4.7 Seeding

Recommended seed mixtures, minimum seeding amounts, and indigenous species are shown on **Tables 313-2** through **313-7** in **Appendix C** of this EIS. Seed mixtures (**Tables 313-2** through **313-5A**) have been formulated to include species found during pre-mine vegetation surveys and monitoring of reference areas, and are required to meet the postmine land use. Western Energy would not use seed that is more than 2 years old.

While nearly all revegetation would be accomplished by drill-seeding, broadcast-seeding (including hand-broadcasting of areas where it is difficult to maneuver equipment or for interseeding stands with established trees or shrubs) may be used as an acceptable alternative. Interseeding would normally be accomplished using broadcast seeding. Very steep or rocky areas may be hydro-seeded. The revegetation sequence is as follows:

- After soil laydown, a field would be deep-ripped (up to 2 feet but no less than 1 foot) to reduce subsurface compaction and prevent slippage.
- Reclaimed croplands would be fertilized as necessary following soil testing.
- The site would then be chisel-plowed and/or disked as needed to break up surface compaction, creating a better seedbed. A cultipacker (a heavy iron roller, usually with iron cleats, used to firm and smooth the seedbed) would be used either as a separate implement pass or as part of the drill-seed pass. Western Energy would minimize the number of equipment passes to avoid overworking soil prior to seeding.
- Seeding would be accomplished using approved mixtures, methods, and rates. Drill-seeding would be done on the contour whenever possible. Depending on availability and to enhance species diversity, species may be substituted from the approved substitute species listed with each seed mixture. If further species substitution is necessary, species from **Tables 313-6** and **313-7** in **Appendix C** would be used. For example, if prairie coneflower (*Ratibida columnifera*) seed is not available in a particular year, then it could be replaced by purple coneflower (*Echinacea purpurea*) seed. When choosing substitute species, species of similar morphology and function would be selected.
- Shrub and tree revegetation types would be established as discussed below in **Section 2.4.4.8, Revegetation Plan** for each vegetation type approximating the revegetation map (**Figure 10**). Shrub and tree species that are difficult to establish by direct seeding would be planted by other means (e.g., containerized or bare-root seedlings would be grown from indigenous seed sources in contracted greenhouses). Sprigs may also be used for certain species. This should ensure that at least some plants would be established to provide a reliable and natural seed source. Species may be planted to cover the entire delineated community or in dense clumps within the community.
- Planting of woody species would be done at a rate sufficient to meet the approved standard (ARM 17.24.724).
- On mixed-shrub sites, a minimum of three tree or shrub species from the following list would be hand-planted in micro-environmental locations conducive to establishment of woody species: big sagebrush (*Artemisia tridentata*), skunkbush sumac (*Rhus trilobata*), chokecherry (*Prunus Virginiana)*, rose species (*Rosa* spp.), silver sagebrush (*Artemisia cana*), plum (*Prunus*), rubber rabbitbrush (*Ericameria nauseosa*), currant (*Ribes*), ponderosa pine (*Pinus ponderosa*), and Rocky Mountain juniper (*Juniperus scopulorum*).

Normal seeding periods would be fall (September through November) and spring (March through May). If favorable temperature and moisture conditions exist outside of the normal seeding periods, Western Energy may elect to extend the normal season. The exact species composition, stocking rates, and seeding rates used in reclamation would be identified in the Area F Annual Report.

On slopes 3h:1v or greater, mulch in the form of native grass hay or straw would be applied after seeding at 1,500 to 3,000 pounds per acre on soiled slopes determined to be susceptible to erosion. A crimper may be used to anchor the mulch into the soil. Instead of grass hay or straw mulch, the slopes may be hydro-mulched after seeding. Hydro-mulch would be applied at a minimum rate of 500 pounds per acre. Another mulching alternative is the use of rock mulch to promote water infiltration and control erosion. Cover crops of small grains may also be used to establish sufficient vegetation to control erosion.

On slopes less than 3h:1v, Western Energy may mulch as field conditions warrant or as determined in consultation with DEQ. Mulching treatments would be noted in the Area F Annual Report on a field-by-field basis.

Western Energy would conduct periodic measurements of vegetation on reclaimed land during the 10-year period of responsibility until final bond release (see **Section 2.4.7.4, Revegetation Monitoring Plan** and Section 82-4-235[2], MCA).Various vegetative parameters in comparison with native reference areas or pre-approved standards would be evaluated during any 2 years after year 6 of the responsibility period for Phase III bond-release applications.

2.4.4.8 Revegetation Plan

To promote successful vegetation reestablishment, Western Energy's proposed reclamation design considers the relationship between topography, substrate, and vegetation. Revegetation is divided into reclamation types, and each reclamation type represents a particular plant community type or combination of communities that existed in the area prior to mining. The pre-mine communities associated with the reclamation types are documented in the pre-mine vegetation surveys (see description in **Section 3.10, Vegetation**). The species content and pure live seed (PLS) percentage of seed mixes may vary from year to year based on availability and selection from the approved substitution list. Native woody species (trees and shrubs) would be reestablished. Seeding and woody species plantings would be completed following grading, soil laydown, and seedbed preparation (see **Section 2.4.4.7, Seeding**).

Western Energy used pre-mine vegetation communities (see **Section 3.10, Vegetation**) as a baseline for postmine vegetation planning. Locations of vegetation communities for postmine reclamation (see **Figure 10**) were selected after examining pre-mine topographic associations for each reclamation type and selecting comparable areas on the postmine topography. Western Energy may adjust final locations during the grading process as opportunities to develop appropriate topography (e.g., slope, aspect, position on slope, extent of feature, etc.) are identified. This is particularly applicable to reclamation types requiring more specific topographic features, aspect, or substrates (e.g., mixed-shrub, conifer). Cropland and pastureland uses, in addition to specific topographic limitations, require addition of wildlife enhancement features; however, Western Energy proposes reductions in cropland (compared to pre-mine acres) and no pastureland (see **Section 2.4.4.1, Postmine Land Uses**). The requirement for wildlife habitat enhancement features would be met by the inclusion of a combination of grassed waterways with various shrub plantings, incised drainages with concentrated woody species plantings, irregular field shapes, or placement near native vegetative and topographic escape cover as appropriate (see **Section 2.4.4.10, Wildlife Habitat Enhancement**).

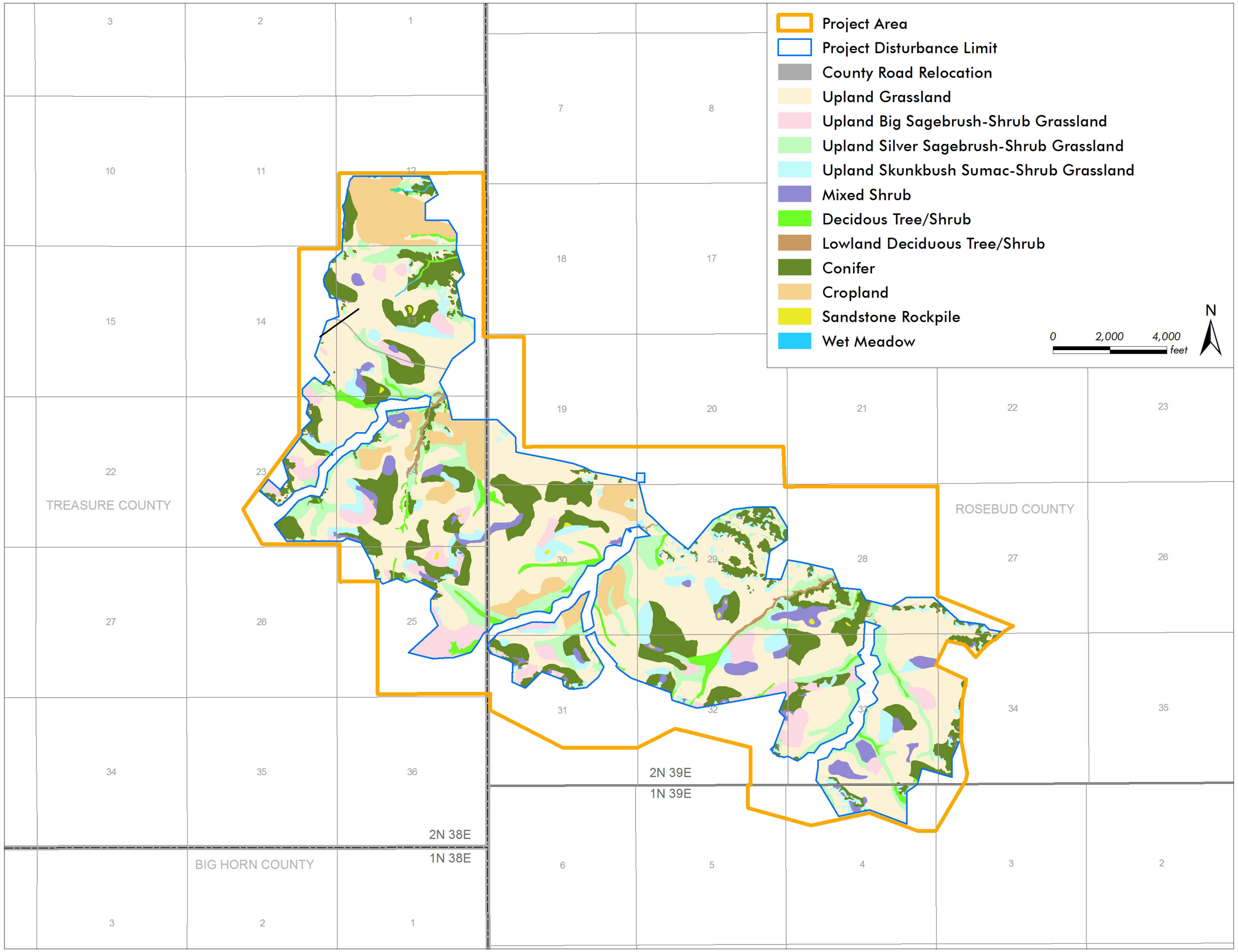

Figure 10. Revegetation Plan.

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Variable soil laydown depths are intended to promote vegetation community establishment, growth, and success. Actual soil laydown depths would vary across a reclamation unit in an attempt to resemble a pattern consistent with natural soil depth (e.g., shallower on ridgetops and deeper in swales and depressions) and would allow for vegetative diversity. Average depths would be within defined variances for each reclaimed vegetation or land-use unit.

To promote vegetative diversity by increasing establishment of woody species and forbs, Western Energy proposes to use suitable spoil (as defined in DEQ's Soil, Overburden and Graded Spoil Guideline), sandy or sandy loam subsoil, or scoria as a soil substitute. Sites identified as having similar slope complexity and aspect to native sites supporting the desired woody species would be selected for soil substitution. When available, tree substrate including pockets of deeper tree subsoil and sandy or otherwise suitable overburden may be salvaged and direct-hauled or stockpiled as needed to provide additional suitable conifer root-zone material. This same practice may be used to provide additional rooting material to promote establishment of shrubs, particularly skunkbush. Subsoil and spoil would be field-tested for texture and pH, ensuring suitability for the intended revegetation. The actual number and location of soil-substitution acres would be determined by field conditions (aspect, slope, and substrate suitability and availability). Soil substitution would not exceed 10 percent of the approved acreage for a given reclamation type unless further approved by DEQ. Soil substitution would be used to promote the establishment of woody species. Soil-substitution areas would be seeded with the conifer mix (see **Table 313-4** in **Appendix C**). A lower seeding rate for this seed mix should reduce competition with herbaceous species, allowing better establishment of woody species and thus promoting revegetation diversity as well as allowing future use of normal husbandry practices (e.g., interseeding and grazing). Nurse crops may be used to reduce erosion and increase moisture retention, benefiting woody species seedings and plantings. Soil-substitution areas would be designated on annual field maps, and DEQ would be notified (e.g., soil and vegetation discipline-specific inspections) of any soil substitutions.

Western Energy proposes to increase the number of acres available for postmine grassland (grazing land) compared to pre-mine grassland (see **Section 2.4.4.1, Postmine Land Uses**). To address wildlife considerations on grazing lands, Western Energy proposes the inclusion of shrub species in all seed mixes except those used on lowland and pastureland. Soil substitution and variable soil laydown depths would also encourage shrub establishment and survival within the various reclamation types, further compensating for the reduced shrubland and conifer acres. Postmine tree and shrub-stand size and shape would vary to generally resemble pre-mine shrub and tree stands. These stands are usually irregular in shape and range from 0.3 to 20 acres in size. It is anticipated that the relatively small size and the often linear or irregular shape of the stands would expedite natural invasion of herbaceous species. If, following woody species establishment, the herbaceous component has not established as required to be comparable to the respective reference area or technical standard, the woody species stand would be interseeded per DEQ's Vegetation Guidelines. Interseeding would be completed at least 6 years before the end of the bond liability period in accordance with DEQ's Vegetation Guidelines.

Lowland

Lowland reclamation types are associated with reconstructed drainages and lowland surface water run-in sites. These are ephemeral drainage areas that collect surface runoff from surrounding sites and accumulate moisture, effectively increasing soil moisture content. Lowland areas are typically located within larger ephemeral drainages. In general, lowlands are found within drainages between the transition points (the point at which the gentle slope of the drainage bottom transitions from the steeper slopes of the adjacent hillsides) on the valley slopes. Lowland areas contain stabilizing grass, as well as woody species that provide food and cover for both wildlife and livestock. Grassland, silver sagebrush, grassland shrub complex, and deciduous tree/shrub reclamation types occur in this topographic position.

Lowland soil would be salvaged in two equal lifts of 12 inches each for a total salvage depth of 24 inches. Topsoil and subsoil lifts would be redistributed to replicate pre-mine conditions. Topographic position would be replicated by targeting this reclamation type for the area from the main drainage upslope to the lower transition point of the side slope, 10 to 30 feet above the drainage bottom.

Erosion features found within the native lowland type have little or no topsoil; therefore, soil-substitution sites may be incorporated into postmine reclamation to mimic these sites. Areas of soil substitution would be used for reestablishment of the silver sagebrush grassland and deciduous trees and shrubs.

Deciduous Tree/Shrub

The deciduous tree/shrub type, found primarily as small stands (<0.3 acre) associated with elevated moisture conditions, adds to the vegetative and structural diversity within the lowlands. The woody species associated with this type (see **Table 313-6** in **Appendix C**) provide a variety of habitat components for upland game birds, raptors, and songbirds, as well as many mammals.

This type occurs on a variety of soil conditions including very shallow soil in dry washes with steep cut-banks to deeper soil in swales and drainage-ways. To promote successful reestablishment of this type, woody species would typically be reestablished as small, linear stands along incised drainages. Other suitable sites include dry washes and cut-banks, as well as depressions along drainage bottoms, sediment ponds, and stock ponds.

The reclamation objective for the deciduous tree/shrub type would be to provide establishment and diversity of woody species along drainages. Deciduous woody species would be preferred; silver sagebrush and big sagebrush would be subordinate shrub species.

Soil used for reclamation of this type would include direct-hauled lowland soil and any stockpiled material except tree soil. Stockpiled material classified as sandy soil appropriate for establishment of woody species would be used on a limited basis. Soil would be replaced in two lifts of equal depth (two 12-inch lifts). The average replacement sample depths taken would be 24 inches ± 6 inches.

Soil-substitution sites may be incorporated into postmine reclamation to mimic sites where little or no soil was present pre-mine. Areas of soil substitution would be used for establishing deciduous woody species.

Due to the small size of the deciduous shrub/tree plantings, it is expected that herbaceous species would invade from the adjacent reclamation/native areas and that seeding would not be necessary. Interseeding would be completed as necessary to control erosion and obtain the desired vegetative conditions.

Shrub-clump wildlife habitat enhancement features would be established on 5 percent of the reclamation type by hand-planting tubelings or bare-root stock at a density of 300 plants per acre in a mosaic of small patches spaced unevenly across the reclamation type.

The success of establishing deciduous tree/shrub types would be determined by comparison to a deciduous-shrub reference area following approval by DEQ. Technical standards for determining successful vegetation establishment in this type may be used following approval by DEQ.

Upland

Upland reclamation types occur on level, nearly level, and moderate slopes. They are more xeric than the lowlands but do have sites of elevated moisture levels including snow-catchment areas such as the lee sides of hillocks and ridges, incised drainages, dry washes, and small basins. Uplands are interspersed with various shrub associations that provide utility for both wildlife and livestock. Grassland, shrub-grassland (skunkbush sumac, shrub complex, silver sagebrush, and big sagebrush types), mixed-shrub, and deciduous tree/shrub reclamation types occur in the uplands.

Soil on the pre-mine upland sites in the project area is not as deep as that found on lowland sites. With the exception of skunkbush sumac areas, soil would be salvaged in two 9-inch lifts. Pockets of deeper soil would be created during reclamation to promote additional vegetative diversity. These pockets would be located on the lee side of hillocks and ridges and other areas where soil material naturally accumulates due to the landscape position (i.e., deposition from wind and water erosion). Soil depth in these pockets would vary; however, it would not exceed 36 inches ± 6 inches. Since erosion features found within the upland type have little or no topsoil, soil-substitution sites would be incorporated into postmine reclamation to mimic these sites. Areas of soil substitution would be used for reestablishment of the shrub-grassland, mixed-shrub, and deciduous tree/shrub reclamation types.

Grassland

The upland grassland reclamation type is present on each of the pre-mine soil types found within upland areas in the project area. Western wheatgrass (*Pascopyrum smithii*), bluebunch wheatgrass (*Pseudoroegneria spicata*), prairie junegrass (*Koeleria macrantha*), needle-and-thread (*Hesperostipa comate*), blue grama (*Bouteloua gracilis*), and Kentucky bluegrass (*Poa pratensis*) were the primary grass species found in the pre-mine uplands. Shrubs (primarily silver sagebrush), sub-shrubs including fringed sagebrush (*Artemisia frigida*) and broom snakeweed (*Gutierrezia sarothrae*), and the perennial succulent yucca (*Yucca* spp.) are normally found scattered throughout the grassland type. Small clumps of deciduous shrubs including skunkbush sumac, chokecherry, western snowberry (*Symphoricarpos occidentalis*), and rose are also found scattered throughout the pre-mine upland grassland.

The objective of the upland grassland reclamation type would be to promote establishment of a diversity of herbaceous species to provide postmine utility for livestock and wildlife. Shrubs are desired and would generally be found in small stands as well as scattered throughout as a result of including shrub seeds in the seed mix.

Soil used for reclamation of this type would include direct-hauled and stockpiled material; tree soil would not be used. Stockpiled material classified as sandy soil appropriate for establishment of woody species would be used on a limited basis.

Soil would be replaced in two lifts of equal depth (two 9-inch lifts). The average replacement depth would be 18 inches ± 6 inches.

Soil-substitution sites may be incorporated into postmine reclamation to mimic sites where little or no soil was present pre-mine. Areas of soil substitution would be used for reestablishment of silver sagebrush, big sagebrush, skunkbush sumac, chokecherry, western snowberry, and rose.

The Upland Mixture (see **Table 313-3** in **Appendix C**) would be seeded at the approved rate. In addition to the shrubs in the seed mix, shrub-clump wildlife habitat enhancement features would be established on 5 percent of the reclamation type by hand-planting tubelings or bare-root stock of species at a density of 300 plants per acre in a mosaic of small patches spaced unevenly across the reclamation type.

Lowland and upland grassland reclamation types would be combined and compared to the grassland reference area. Technical standards for determining successful reclamation including shrub establishment may be used following approval by DEQ.

Shrub Grassland

Four reclamation types (silver sagebrush, big sagebrush, skunkbush sumac, and shrub complex) are grouped within a general shrub-grassland classification. To promote shrub establishment success, shrub seeding and plantings would occur in substrates with similar texture and chemistry as pre-mine stands of the same shrub species.

Silver Sagebrush

The silver sagebrush reclamation type is found in areas of deeper soil on terraces and benches adjacent to drainages, swales, and other sediment-deposition areas. These areas normally experience higher moisture accumulation than other sites. Similar areas would be targeted for silver sagebrush grassland reclamation.

The objective of the silver sagebrush reclamation type would be to establish silver sagebrush in conjunction with a diversity of herbaceous species. Other woody species (see **Lowland**) would be seeded or planted; however, they would not dominate.

Soil used for reclamation of the silver sagebrush type would include direct-hauled and stockpiled material. Tree soil would not be used for reclaiming this type. Stockpiled material classified as sandy soil appropriate for establishment of woody species would be used on a limited basis.

Soil would be replaced in two lifts of equal depth (two 9-inch lifts). The average replacement sample depth taken would be 18 inches ± 6 inches.

Since silver sagebrush is not totally dependent on surface moisture and for the reasons listed above, soil substitution would be used to provide substrate diversity, promoting additional shrub establishment and vegetative diversity. Soil substitution sites would be incorporated into postmine reclamation to mimic sites where little or no soil was present pre-mine. Areas of soil substitution would be used for reestablishment of silver sagebrush, big sagebrush, skunkbush sumac, chokecherry, western snowberry, and rose.

To promote improved shrub establishment, the Upland Mixture (see **Table 313-3** in **Appendix C**) would be seeded at 50 percent of the normal approved rate. In addition to the shrubs in the seed mix, shrub-clump wildlife habitat enhancement features would be established on 5 percent of the reclamation type. This would be aided by hand-planting tubelings or bare-root stock in a mosaic of small patches spaced unevenly across the reclamation type.

Lowland and upland sagebrush reclamation types would be combined and compared to the sagebrush reference area. Technical standards for determining successful reclamation including shrub establishment in this type may be used following approval by DEQ.

Big Sagebrush

The big sagebrush reclamation type is located in pre-mine upland areas containing soil with relatively high clay content. Similar areas would be targeted in postmine reclamation. Since big sagebrush is not totally dependent on surface moisture and because it was found in poor pre-mine soil, soil substitution would also be used to establish portions of this subtype.

The objective of this reclamation type would be to establish big sagebrush in conjunction with a diversity of herbaceous species. Other woody species would be seeded or planted; however, they would not dominate.

To the extent possible, soil with a higher clay content would be identified during the soil-salvage and laydown process. To promote better big sagebrush establishment, this soil would be direct-placed in topographic positions favorable to big sagebrush (e.g., the lee side of ridges and hills, swales, and other areas of soil deposition and snow accumulation). Other areas of soil laydown containing a higher percentage of clay, as identified by field-testing, would be seeded or planted with big sagebrush. Soil used for reclamation of this type would include direct-hauled and stockpiled material. Sandy soil and tree soil would not be used for reclaiming the big sagebrush type.

Soil would be replaced in two lifts of equal depth (two 9-inch lifts). The average replacement sample depth taken would be 18 inches ± 6 inches.

Soil substitution would be used to provide substrate diversity, promoting additional shrub establishment and vegetative diversity. Soil-substitution sites would be incorporated into postmine reclamation to mimic sites where little or no soil was present pre-mine. Areas of soil substitution would be used for reestablishment of silver sagebrush, big sagebrush, skunkbush sumac, chokecherry, western snowberry, and rose.

To promote better shrub establishment, the Upland Mixture (see **Table 313-3** in **Appendix C**) would be seeded at 50 percent of the normal approved rate. In addition to the shrubs in the seed mix, shrub-clump wildlife habitat enhancement features would be established on 5 percent of the reclamation type. This would be aided by hand-planting tubelings or bare-root stock in a mosaic of small patches spaced unevenly across the reclamation type**.**

Lowland and upland sagebrush reclamation types would be combined and compared to the sagebrush reference area. Technical standards for determining successful reclamation, including shrub establishment, may be used following approval by DEQ.

Skunkbush Sumac

While the skunkbush sumac reclamation type is found on all pre-mine aspects and slopes, it is primarily located on steep southern-exposure slopes with little or no topsoil and limited overstory. The skunkbush community is characterized as occurring on sandy, shallow soil on ridges, knolls, and south-facing slopes close to ponderosa pine and is found on south slopes with coarse-textured, well-drained soil (sandy clay loams).

The objective of this reclamation type is to establish skunkbush sumac in conjunction with a diversity of herbaceous species. Other woody species would be seeded or planted; however, they would not dominate. Establishment of skunkbush sumac would target warmer south- to southwest-facing slopes.

Soil exhibiting an unusually high degree of coarse and sandy texture would be used for reclaiming the skunkbush type. Soil used for reclamation of this type would include direct-hauled and stockpiled material and would include scoria-derived soil, sandy soil, and tree soil.

Graded sites consisting of scoria, sand, or sandy loam materials and/or steep slopes that would provide well-drained conditions suitable for skunkbush would be covered with 9 ± 6 inches of coarse-textured material (tree soil). Soil would be replaced in one 9-inch lift. The average replacement sample depth taken would be 9 inches ± 6 inches.

On selected sites, soil substitution would also be utilized to provide suitable growth media for this species. Spoil and subsoil exhibiting an unusually high degree of coarse and sandy texture would be used for reclaiming this type.

To promote better shrub establishment, the Conifer Mixture (see **Table 313-4** in **Appendix C**) would be seeded at 50 percent of the normal approved rate. In addition to the shrubs in the seed mix, shrub-clump wildlife habitat enhancement features would be established on 5 percent of the reclamation type. This would be aided by hand-planting tubelings or bare-root stock in a mosaic of small patches spaced unevenly across the reclamation type**.**

The skunkbush sumac reclamation type would be compared to the skunkbush sumac reference area. Technical standards for determining successful reclamation of this type may be used following approval by DEQ.

Shrub Complex

The shrub complex reclamation type does not correspond to a specific pre-mining vegetation community. In postmine reclamation, it comprises stands of various shrub species established as a result of natural seeding, re-sprouting from materials in direct-haul soil, plantings of approved seed mixes, and transplants (both native and nursery stock). In most cases, shrub complexes would closely resemble adjacent native and reclaimed areas from which seed dispersed, resulting in the subsequent revegetation of the site. In some cases, the vegetation may result from more than one factor (e.g., direct-haul soil, natural seed dispersal, seeding, and planting); therefore, the site may more closely resemble the mixed-shrub reclamation type. Shrub complexes provide intermediate-height structural features for vertical habitat enhancement and additional food sources primarily for wildlife. Shrub-complex acres may be substituted for other planned revegetation types with DEQ approval.

The objective of this reclamation type would be to promote establishment and diversity of woody species. Silver sagebrush, big sagebrush, and deciduous woody species are desired. These areas would often resemble native areas containing little or no soil.

The shrub-complex reclamation type would be primarily established by natural seeding or plant invasion on a variety of substrates. In most cases, plants naturally select the sites, and the substrate that is present is suitable. In cases where planting or seeding occurs, soil would include direct-hauled and stockpiled material, except tree soil. Stockpiled material classified as sandy soil appropriate for establishment of woody species may be used in selected areas to promote woody-species diversity.

When soil replacement occurs, soil would be replaced in two lifts of equal depth (two 9-inch lifts). The average replacement sample depth taken would be 18 inches ± 6 inches. In selected areas, suitable subsoil (e.g., sandy material) may be applied in a single 18-inch lift and used as surficial growth media.

The shrub-complex reclamation type usually results from natural invasion from adjacent vegetated areas. These areas generally consist of spoil (ungraded, partially graded, or graded); therefore, soil substitution would be accepted for these areas.

The Shrub Complex Mixture (**see Table 313-4C** in **Appendix C**) would be used at the approved seeding rate. Vegetation (both herbaceous and woody species) normally would become established due to invasion from adjacent vegetated areas, in which case interseeding of the Shrub Complex Mixture would be completed as needed. In certain instances where the establishment is below desired levels, the area would be seeded. In other instances, it may be desirable to establish shrub complexes from scratch, in which case the area would be seeded with the Shrub Complex Mixture at the approved rate. In addition to the shrubs in the seed mix, shrub-clump wildlife habitat enhancement features would be established on 5 percent of the reclamation type. This would be aided by hand-planting tubelings or bare-root stock in a mosaic of small patches spaced unevenly across the reclamation type.

The success of establishing shrub complexes would be determined by comparison to the sagebrush reference area. Technical standards for determining successful reclamation of this type may be used following approval by DEQ.

Mixed Shrub

The mixed-shrub reclamation type is defined as sites that would need minimal grading and that would have opportunistic rock placement and no soil redistribution. Designed for wildlife habitat, the mixed-shrub type would provide topographic relief for escape and thermal cover, as well as diverse shrubs that are an important seasonal food source. The variety of slopes with various surface materials favors woody species establishment. Slopes would not exceed the angle of repose and would meet the static safety factor of 1.3. Mixed-shrub sites would be spaced throughout the postmine landscape, as approved by DEQ, utilizing pre-mine mixed-shrub-type overburden material where possible. Sediment traps would be located in low spots within the transition zone to control sediment during the establishment period. Rock placement would occur following the guidelines described in **Section 2.4.4.10, Wildlife Habitat Enhancement**.

The objective of the mixed-shrub reclamation type is to promote woody species establishment and diversity. Silver sagebrush, big sagebrush, and deciduous woody species are desired. These areas would often resemble native areas containing little or no soil.

Areas of spoil suitable for the establishment of shrubs would be graded into complex slopes. Slope complexity is very important, as is the need for reduced compaction; therefore, these sites would be minimally worked utilizing appropriate equipment. Where possible, a veneer of scoria would be blended into the top 4 to 6 inches. This would reduce surficial crusting, allowing increased water infiltration.

Soil would not be applied on these sites, including a 50- to 100-foot transition zone. Since these areas would be established on graded spoil, soil substitution is required for this reclamation type.

The Mixed Shrub Mixtures (see **Tables 313-4A** and **313-4B** in **Appendix C**) would be used at the approved rates. In addition to the shrubs in the seed mix, shrub-clump wildlife habitat enhancement features would be established on 5 percent of the reclamation type. This would be aided by hand-planting tubelings or bare-root stock in a mosaic of small patches spaced unevenly across the reclamation type.

The success of establishing the mixed-shrub reclamation type would be determined by comparison to the mixed-shrub reference area. Technical standards for determining successful reclamation of this type, including shrub establishment, may be used following approval by DEQ.

Deciduous Tree/Shrub

The upland deciduous tree/shrub reclamation type occurs as small stands associated with elevated moisture conditions and adds to the vegetative and structural diversity within the uplands. The shrubs and trees associated with this type (see **Table 313-6** in **Appendix C**) provide a variety of habitat components for a diverse wildlife community.

Stands of deciduous trees and shrubs would be established in appropriate topographic locations (e.g., swales, depressions, lee sides of ridges) using a variety of growth media.

The objective of the upland deciduous tree/shrub reclamation type would be to provide establishment and diversity of woody species. Deciduous woody species are preferred; silver sagebrush and big sagebrush are subordinate shrub species.

Soil used for reclamation of the deciduous tree/shrub type would include direct-hauled and any stockpiled material. Stockpiled material classified as sandy or with a high percentage of coarse fragments, appropriate for the establishment of conifers or upland shrubs, would be used on a selected basis. The average laydown depth would be 18 inches.

Soil-substitution sites may be incorporated into postmine reclamation to mimic sites where little or no soil was present pre-mine. Areas of soil substitution would be used for reestablishment of deciduous woody species.

Due to the small size of the deciduous shrub/tree plantings, it is expected that herbaceous species would invade from the adjacent reclamation or native areas and seeding would not be necessary. Interseeding would be completed as necessary to control erosion and obtain the desired vegetative conditions. In addition to the shrubs in the seed mix, shrub-clump wildlife habitat enhancement features would be established on 5 percent of the reclamation type. This would be aided by hand-planting tubelings or bare-root stock in a mosaic of small patches spaced unevenly across the reclamation type**.**

The success of establishing the tree/shrub reclamation type would be determined by comparison to the tree/shrub reference area. Technical standards for determining successful woody species establishment in this type may be used following approval by DEQ.

Conifer

Conifer-shrub vegetation complexes characterize the conifer reclamation type. The complexes are typically located at or near the summit of hilltops, on steeper side-slopes, and along drainages. This type is associated primarily with wildlife habitat and would provide food and cover for numerous wildlife species. This type would also provide seasonal forage and cover for livestock. Western Energy would grade these sites to simulate the topographic diversity found in native headwater locations.

Native ponderosa pine typically inhabits areas with topsoil depths of 0.8 to 2.8 inches. Total soil depths in the project area are similar to those found on skunkbush sites and typically range from 12 inches to 22 inches. All growth media (including topsoil and subsoil) would be salvaged from pre-mine conifer stands that are to be disturbed by mining. Sandy or scoria overburden may also be salvaged and used as suitable growth substrate for the establishment of conifers.

Sandy-textured soil would be used for conifer establishment. Coarse-textured subsoil would also be used on appropriate grade sites and should reduce soil crusting and increase moisture infiltration.

Western Energy would spread the conifer reclamation acres across the project area in about the same ratio as observed in the pre-mine surveys and would seed the Conifer Mixture (see **Table 313-4** in **Appendix C**) as described below. Within the selected conifer sites, and assuming a 60-percent pre-mine ponderosa pine/grassland acreage ratio, Western Energy would plant tubelings on about 60 percent of the conifer type acres in clumps of variable density, simulating the pre-mine savannah-like conditions.

The objective of the conifer reclamation type would be to provide successful establishment of ponderosa pine and Rocky Mountain juniper and to demonstrate that these species can naturally reproduce within reclaimed areas. A diversity of woody species would also be obtained. Deciduous shrubs, silver sagebrush, and big sagebrush are preferred shrub species.

Soil used for reclamation of the conifer type would include direct-hauled and stockpiled tree soil. In addition to the conifer soil that is salvaged prior to mining, soil exhibiting an unusually high degree of coarse fragments would be targeted for conifer reclamation.

Redistributed conifer soil would be placed at an approximate depth of 9 inches. All areas to be planted with conifers would be deep-ripped as specified in ARM 17.24.702(4)(b). If trees are planted in bare spoil, the areas would be deep-ripped prior to planting. Increased variability in soil depths would be desired; therefore, the average laydown-depth samples taken would be 9 inches ± 6 inches.

Spoil is one of the few reclamation locations where pines have demonstrated natural volunteerism from seed, an important attribute for self-regenerating plant communities consistent with ARM 17.24.711. Therefore, spoil characterized as sandy, sandy loam, or loam or with a high percentage of competent coarse fragments would be classified as suitable for conifer establishment. Suitability would be determined using either regular soil testing or field analysis, with at least two samples per substitution area. Spoil would be utilized as a substrate for tree soil and may be used for conifer soil substitution at appropriate grade sites (upper headwater areas and complex north- or northeast-facing slopes). Use of this type of substrate would promote root penetration, water infiltration, and drainage, thereby increasing the overall success of conifer establishment. The use of scoria on appropriate sites would replicate the pre-mine characterizations of shallow, rocky soil. Therefore, scoria may also be utilized for soil substitution. Redistributed scoria would be placed over suitable spoil as described above, at an approximate depth of 9 inches and ripped as needed to form a rocky surface with enough fines for seedling establishment.

The conifer type, including both ponderosa pine and Rocky Mountain juniper, was found on all pre-mine slopes and aspects. To promote good establishment and growth of conifers, most reclaimed stands would be targeted for cooler slopes, typically facing from northwest or north to southeast. Individual conifer tubelings would be hand-planted at a rate of 300 per acre, placed to maximize survival potential (i.e., in shaded locations next to rocks, logs, and hummocks). Ponderosa pine would be the dominant species, except in areas where finer-textured soil is present. The Conifer Mixture (see **Table 313-4** in **Appendix C**) would be seeded at the approved rate. In addition to the shrubs in the seed mix, shrub-clump wildlife habitat enhancement features would be established on 5 percent of the reclamation type. This would be aided by hand-planting tubelings or bare-root stock in a mosaic of small patches spaced unevenly across the reclamation type.

The success of establishing the conifer reclamation type would be determined by comparison to the conifer reference area. Technical standards for determining successful conifer and woody species establishment in this type may be used following approval by DEQ.

Other Reclamation Types

Cropland

Agricultural development in the Colstrip vicinity includes various small grains (barley, wheat, and oats) and hay (alfalfa). While this reclamation type is primarily intended for livestock usage or as cash crops, agricultural fields would be utilized by various wildlife species on a seasonal basis. Cropland use, in addition to specific topographic limitations, requires addition of wildlife habitat enhancement features. This requirement would be met by the inclusion of a combination of grassed waterways with various shrub plantings, incised drainages with concentrated woody species plantings, irregular field shapes, or placement near native vegetative and topographic escape cover as appropriate. Habitat-enhancement features may also include sandstone rock piles, tree-shrub brush piles, and shrub-clump features, all established on adjacent reclamation types (see **Section 2.4.4.10**, **Wildlife Habitat Enhancement**). The shrub-clump features would be established by hand-planting tubelings or bare-root stock of species listed above under “Grassland” at a density of 300 plants per acre. The designated wildlife habitat enhancement features would equal 5 percent of the cropland and pastureland area.

Small Grains

Small grains are grown as a cash crop and for supplemental livestock feed. The pre-mine acreage of small grains may be replaced. Replacement of the pre-mine acres would include consideration of the general pre-mine distribution of the acreage, land ownership, and overall postmine land use. To limit erosion and potential soil loss, Western Energy would use minimal-till farming, leaving standing stubble until seedbed preparation.

Hayland

Hayland is used to grow supplemental winter forage for livestock. Alfalfa, cool-season grasses, or a combination would be planted and harvested. Pre-mine land ownership, distribution of pre-mine acres, and overall postmine land use patterns would be considered during implementation of the hayland type.

The objective of including hayland in reclamation of the area disturbed by mining would be to restore a portion of the pre-mine agricultural and economic base present prior to disturbance. A secondary objective would be to maintain vegetative cover such that erosion is minimized and does not affect the postmine land use.

Soil used for the hayland reclamation type would include direct-hauled and stockpiled material. Tree soil would not be used for reclaiming this type. Stockpiled material classified as sandy soil (as determined from hand analysis) appropriate for establishment of woody species would be used on a limited basis.

Soil would be replaced in two lifts of equal depths (two 12-inch lifts). The minimum replacement sample depth taken would be 24 inches. Soil substitution is inappropriate for hayland and would not be used.

Small grains or hay would be planted. The two agricultural types may be used in rotation (normally 7 to 10 years).

Appropriate cropland (small grain or hayland) reference areas would be used to determine successful reclamation of this type. Technical standards for determining successful reclamation would be used following approval by DEQ.

Pastureland

Western Energy does not propose any pastureland postmining. If Western Energy were to propose pastureland at a future date, the objective of the pastureland reclamation type would be to return the agricultural base present in the area prior to mining.

2.4.4.9 Noxious Weed Control

Western Energy has prepared and the Rosebud County Weed Board has approved a Noxious Weed Control Plan for active permit areas of the Rosebud Mine in accordance with the Montana County Noxious Weed Control Act, Sections 7-22-2101 through 7-22-2153, MCA, as amended. The purpose of the plan is to control the existing population and prevent new establishment of noxious weeds on all lands within the project area until Phase IV bond release.

After the permitting process for the project is complete, the Rosebud County Weed Coordinator and the Treasure County Weed Coordinator would conduct noxious weed inspections on the project area. The Noxious Weed Control Plan would then be amended to include the project and submitted to the Rosebud and Treasure County Weed Boards.

All activities conducted under the approved plan would be included in Western Energy's Area F Annual Report to DEQ. The reported information would include amounts, types, and locations of chemical applications; numbers and species of biological agents; and the types and locations of mechanical control methods.

2.4.4.10 Wildlife Habitat Enhancement

Western Energy's proposed **Revegetation Plan** (**Section 2.4.4.8**) has been developed to replace pre-mine habitats following mining with the objective of establishing important forage and cover-plant species as part of the postmine landscape. Management techniques (e.g., mowing, burning, and grazing) may be employed to enhance wildlife use of the reclaimed areas in compliance with ARM 17.24.718.

Opportunities to enhance postmine wildlife habitat such as wetlands, cliff features, rock piles, and cropland would be requested where appropriate field conditions allow. Western Energy also proposes to implement opportunistic rock and boulder placement for habitat-enhancement features.

Special Habitat Features

Sandstone

Sandstone outcrops and cliffs are common features of the pre-mine landscape and are used by many wildlife species. Raptor and cliff-dwelling bird species use them for nesting or hunting perches. Several other species (e.g., sagebrush lizards and scorpions) are also associated with these structures, which are usually destroyed during the mining process. Two postmine types (rock piles and cliffs) would be designed to mitigate this loss.

Sandstone Rock Piles

Sandstone rock piles would be opportunistically placed on upland reclamation surfaces including ridges, hilltops, and side slopes as equipment and adequate rock becomes available. Rocks and boulders would be placed in graded areas before soiling or on soiled and seeded/planted fields under dry or frozen conditions. With concurrence of DEQ, rocks and boulders may be placed on native areas within the permitted disturbance limits. Overall ground disturbance would be minimized by utilizing one or a few access corridors to target areas. A combination of shrubs and trees would be planted around these rock piles including silver sagebrush, big sagebrush, rose, skunkbush sumac, ponderosa pine, and Rocky Mountain juniper. Herbaceous mixes would not be planted.

Sandstone Cliff Features

Sandstone cliff features may be created with DEQ approval in lieu of highwall reduction. Western Energy would demonstrate both slope stability and replacement of pre-mine features during the permitting process for each of these features. Chokecherry and plum, in addition to the species listed above, may be planted at the base of these cliffs depending on their aspect.

Ponds

Stock ponds were present in the area prior to mining. Replacement of these facilities is important to the maintenance of the postmine land uses (e.g., livestock grazing and wildlife habitat). Selected sediment ponds would be retained as postmine ponds. The following would be considered when determining which sediment ponds would be retained: the presence of aquatic vegetation, reliability as a seasonal or yearlong water source, and location within a pasture or pasture system. The desired goal is to provide reliable water sources for livestock, encourage better livestock distribution, and provide a seasonal water source for wildlife.

Wetlands/Wet Meadows

Small wetlands associated with springs, seeps, depressions, and impoundments are present prior to mining activity. Retaining sediment ponds with associated wetland vegetation and creating small depressions in the uplands and along drainage courses would replace these wetlands. If a spring or seep becomes established during reclamation, it would be fenced to protect the flow and associated wetland vegetation and to encourage additional vegetation establishment (see **Section 2.4.8.5, Wetland Mitigation Plan** for other steps Western Energy proposes to take regarding wetlands).

Singing Posts

To encourage postmining use of the revegetated area by songbirds, fence posts would be established as “singing posts” for use by territorial males. In addition, nest boxes suitable for small cavity-nesting species would be placed throughout the area.

2.4.4.11 Special Reclamation Cases

In addition to the reclamation of the landscape disturbed by actual mining, other disturbed areas that would require reclamation include the road system, mine plant facilities, sediment-control structures, and temporary diversion structures.

Roads

Haul Roads

Haul roads constructed in the project area for mining operations would be removed as their usefulness is eliminated. Removal and reclamation would include the removal and disposal of the scoria surface, soil sampling, and grading, followed by deep-ripping with a dozer. After the scoria is removed, haul roads would be sampled at 1,000-foot centers prior to soil laydown. Soil sampling (pH, electrical conductivity [EC], sodium adsorption ratio [SAR], and salt concentration) would determine if problems have occurred due to chemical dust-suppressant treatment of the roads. If road beds are affected, materials would be removed to an approved location prior to soil distribution. Any grading necessary to blend the road area into adjacent land would be followed by surface scarification and distribution of soil. The roads would then be revegetated per the approved revegetation plan.

Ramp Roads

A maximum of six spoil ridges may occur for a distance of 500 feet on either side of the ramp roads. Ramp roads would be graded as soon as possible to remain at an overall 5-percent or steeper grade from the spoil side of the current pit. Ramp-road removal and reclamation would occur as described above under **Haul Roads**.

Access and Service Roads

Access and service road removal and reclamation would occur as described under **Haul Roads**.

Mine Plant Facilities

These facilities are designed to serve the long-term life-of-mine needs. Reclamation procedures for these areas would be similar to those for haul roads except all buildings and structures would first be removed from the project area.

Sediment-Control Structures

Sediment-control structures such as sediment-control ponds are designed to be semipermanent and would remain in place and effective until DEQ approves removal. All disturbed areas associated with the removal of the structures would be graded, soiled, and revegetated in accordance with the approved reclamation plan. Ponds approved as permanent impoundments would remain in place.

Temporary Diversion Structures

Included in this category are diversions, berms, and sediment traps designed to serve a short-term use. These structures would be removed during the normal course of mining operations to accommodate overburden removal, backfilling, normal grading, and soiling, or when DEQ approves the removal of the structures.

2.4.5 Protection of the Hydrologic Balance

Western Energy's plan for protection of the hydrologic balance is presented in Appendix J of Western Energy's PAP. Western Energy's proposed protection measures include ground water management, surface water management, operation of sediment-control measures (sediment ponds, diversions, ditches and culverts, and pit dewatering), pond maintenance and inspection, reclamation sediment-control measures, and protection of existing water rights. The following sections provide more details on these measures. Please refer to Appendix J of Western Energy's PAP for a complete description.

2.4.5.1 Ground Water Management

Western Energy's mining and reclamation plans for the project include measures to minimize impacts on ground water. Those measures are summarized in the sections below.

Ground Water Flow

The mining process would result in a reduction in ground water levels to the base of the Rosebud Coal (see **Section 4.8, Water Resources – Ground Water** for a discussion of impacts); however, the volume of water expected to be encountered during mining would not be sufficient to require pre-mine dewatering of these aquifers. All pit inflow would be handled within the pit by diverting or pumping water received from the entire cut face to collection points. Ground water discharge associated with mining would come from overburden and the Rosebud Coal (about 80 gallons per minute, or gpm), as well as alluvium/colluvium associated with the ephemeral drainages (about 46 gpm) and would result primarily from release of water held in storage. Flow rates are based on ground water modeling shown in Appendix I-B of Western Energy's PAP.

Ground water inflow to an active pit would be managed in the following ways: (1) pumped directly into water wagons using one or two 6-inch to 8-inch pumps and used for haul-road dust suppression, (2) pumped to adjacent sediment ponds, or (3) pumped to an inactive pit that is separated from the active pit by a cross-pit ramp. Pit inflow contained in sediment ponds would be either used for haul-road dust suppression or allowed to seep and evaporate. During periods of relatively high sustained pit inflows, water transferred to sediment ponds (and not required for dust-suppression purposes) would be discharged to native receiving drainages. Discharges to Black Hank Creek, Donley Creek, Robbie Creek, McClure Creek, and Trail Creek would comply with the terms of Western Energy's MPDES permit (proposed outfall locations are shown on **Figure 11**).

Ground Water Recharge

To restore the approximate recharge capacity of the mine area, Western Energy proposes reclamation of disturbed lands in accordance with its Reclamation Plan, **Section 2.4.4**. See specifically the discussions of postmine topography in **Section 2.4.4.5, Postmining Topography and Drainage Basin Design**, topsoil replacement in **Section 2.4.4.5**, and the **Revegetation Plan**, **Section 2.4.4.8**. Spoil would be backfilled as soon as possible (see **Section 2.4.4.2, Backfilling and Grading**). To ensure that there is not a low-permeability barrier at the soil-spoil interface (i.e., to aid ground water movement), graded spoil would be scarified prior to placement of soil. Overburden would be replaced in the excavations, graded to the approved approximate postmine topography, and covered with soil. Salvaged soil (silt loams, sandy loams, and loams) would be similar in texture to the pre-mining soil; however, the soil structure would be different (see discussion in **Section 4.24, Soil**).

To minimize impacts on bedrock ground water, disturbance to the primary recharge areas consisting of clinker would be minimized. During mining, soil stockpiles from known clinker zones would be maintained, and special placement of dragline spoil would be inward instead of outward during the box-cut in clinker zones. See **Section 4.8, Water Resources – Ground Water** for a discussion of impacts on ground water recharge.

Western Energy proposes to reestablish or mitigate impacts on springs and wetlands as part of reclamation. Proposed mitigation for wetlands is discussed in **Section 2.4.8.5, Wetland Mitigation Plan**. Impacts on springs are discussed in **Section 4.7, Surface Water**, and wetlands are discussed in **Section 4.11, Wetlands and Riparian Zones**.

2.4.5.2 Surface Water Management and Sediment-Control Measures

The main Black Hank, Donley, and Robbie drainage channels would not be mined through, and upgradient flows (stream flow coming from outside the permit boundary into the project area) would not be captured or impeded. The primary means of restoring pre-mining runoff volumes in the project area would be reclamation of disturbed lands in accordance with Western Energy's reclamation plan (**Section 2.4.4**). See specifically the discussions of postmine topography in **Section 2.4.4.5, Postmining Topography and Drainage Basin Design**, topsoil replacement in **Section 2.4.4.6, Soil Application**, and the Revegetation Plan, **Section 2.4.4.8**. Pre-mining channel morphology and gradients have been documented by surveyed longitudinal and cross-sectional channel profiles and would be used to reclaim channels to their approximate pre-mining conditions.

Measures to minimize impacts on surface water quality (i.e., sediment-control measures) are described in the sections below. Sediment impoundments (ponds and standard traps), alternate sediment-control measures, and perimeter ditches would be constructed prior to any disturbance or in conjunction with soil stripping (**Section 2.4.3.5**) and roadway construction (**Section 2.4.3.4**) in order to control, treat, or contain runoff from the roadway construction and soil-stripping operations. Sedimentation ponds and standard traps in the remaining sub-drainages would be constructed as required. If a perimeter haul road were constructed in advance of mining, perimeter ditches, alternate sediment-control measures, and standard sediment traps would be constructed as required for runoff control, treatment, or containment.

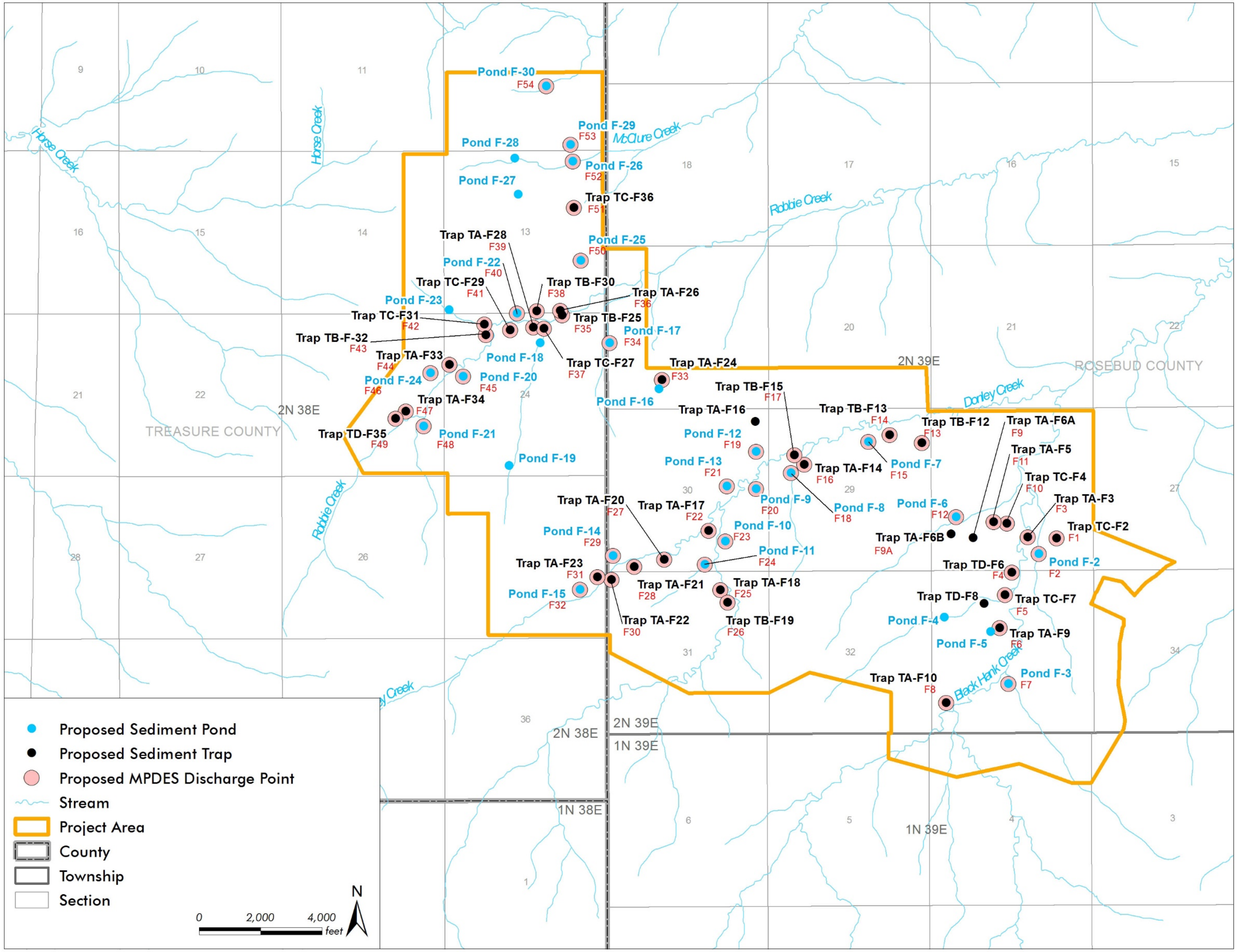

Figure 11. Proposed MPDES Outfalls and Sediment Ponds and Traps.

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Sediment-Control Measures

Runoff from disturbed lands would be intercepted and treated by the implementation of sediment-control measures. During mining, runoff from undisturbed land above the pit would be intercepted by the pit or by temporary impoundments or traps in the drainages above the pit. Very large runoff events would be intercepted by the pit. Interception by the pit would ensure that runoff would not cause water-quality problems in drainages downstream of the project area. A system of ditches and sediment traps proposed for the perimeter haul road is shown on **Figure 7** and **Figure 11**. Ditches along the haul road would direct runoff to either sediment-control ponds or traps. In areas where the haul road would cross drainages, sediment traps would be provided to collect runoff from the road embankment. Ditches would roughly parallel the access roads to intercept runoff from disturbed lands. Through use of this containment system, Western Energy proposes to prevent any sediment or untreated runoff from leaving the project area.

Sediment-control measures would be designed, constructed, and maintained to prevent additional contributions of sediment to stream flow or to runoff outside the project area, minimize disturbances to the prevailing hydrologic balance at the mine site and in adjacent areas, prevent adverse impacts on the quality and quantity of water in surface water and ground water systems, meet the effluent standards required by the MPDES permit, and minimize erosion.

Western Energy would also use sediment-control measures for roads and other disturbed areas. Measures implemented to reduce erosion include:

- minimizing the areas of disturbance
- timely placement of structural BMPs
- controlling sediment at the source
- reclaiming areas as soon as possible

Western Energy would periodically inspect, maintain, and replace (if needed) structural BMPs. The following sediment-control measures may be used by Western Energy:

- rock riprap – used in the stream channel to reduce water velocity and promote sediment deposition
- straw bales – used to inhibit sediment runoff at the toe of medium slopes
- deep ripping – used to increase infiltration in clays or highly compacted soil
- contour berms – used to divert flow in an erosive area; if the berms were to remain for more than one year, they would be vegetated to reduce sediment transport
- diversion channels – used to divert runoff around selected areas; the diversion channels would be designed to convey flow from a 10-year, 24-hour storm event
- check dams – placed in channels to reduce erosion by decreasing flow velocities; check dams would be sized to pass the flow from a 10-year, 24-hour storm event
- mulch – used in areas where temporary soil stabilization would be required
- geotextiles – used in channels or diversions where erosion was present; if used, the material may be removed before or during the removal of the channel
- roughened surface – used to increase infiltration in selected areas
- complex slope – when grading the reclaimed land, a complex slope would include a convex upper slope, straight middle slope, and concave lower slope; by grading complex slopes, the profile would become more stable, and sediment deposits would occur at the bottom of the slope
- grading – used to achieve more stable slope profiles and stable gradients
- vegetation – vegetate all reclaimed lands

- livestock grazing – may be used in areas of established vegetation to improve postmine sediment control; controlled livestock grazing can have positive sediment-control impacts on reclaimed areas such as increasing vegetation cover and production, creating surface roughening, promoting soil formation, and increasing soil microbial populations, all of which serve to control erosion and sedimentation

Ponds and Traps

Sediment-control ponds, either temporary or permanent, would be used individually or in series and would be constructed before any disturbance of an area that would drain into the pond. Pit water also would be pumped to sediment ponds (see **Pit Dewatering, Section 2.4.5.2**).

For drainage areas less than 40 acres in size, a sediment-control trap may be constructed instead of a pond. Sediment traps function similarly to ponds. Proposed design details for sediment ponds and traps are presented in Appendix J of Western Energy's PAP. Sediment-control ponds and traps would be located as near as possible to the disturbed area and out of major stream courses. Sediment-control pond and sediment trap locations are shown in **Figure 11**.

Sediment-control ponds and traps would be constructed, at a minimum, with sufficient capacity to fully contain runoff volumes resulting from a 10-year, 24-hour precipitation event or other event as directed by DEQ, plus adequate storage volume for 3 years of sediment accumulation. Spillways would be designed to convey the peak discharge from a 25-year, 24-hour precipitation event runoff or other event as directed by DEQ or Mine Safety and Health Administration (MSHA). Ponds designed for a 25-year, 24-hour storm or greater would be considered full retention ponds, and a spillway would not be designed or constructed. Incised structures would be designed to contain the 10-year, 24-hour runoff and would not require a spillway. Pit water pumped to sediment ponds would be limited to accommodate a design runoff event. Immediately after construction, sediment-control ponds and traps would be accurately surveyed to provide a baseline for future measurements of sediment volume.

All sediment-control ponds and traps would be inspected annually and after runoff-producing storm or snowmelt events to ensure that they are maintained in good working condition, including embankment integrity, outlet works function, and spillway condition. The results of such inspections would be included in Western Energy's Annual Hydrology Report (AHR) to DEQ and would include a summary of the current status of each pond with respect to the "As-Built" volume, the current sediment volume contained in the pond, the current drainage area, and runoff regulatory requirements, if any.

Western Energy proposes to install a staff gage in each sediment pond to assess sediment volume, water depth, and remaining storage capacity. When the sediment storage volume is depleted by 60 percent, accumulated sediment would be removed. Anytime a sediment pond is cleaned, Western Energy would resurvey the pond following cleaning to verify that the required storage volumes are restored.

Western Energy proposes to discharge water treated in sediment ponds through permitted outfalls (see **Figure 11**) in accordance with its MPDES permit.

Diversions

Western Energy does not propose any stream-channel diversions as part of project mine operations. Temporary diversions proposed are limited to roadside ditches associated with haul and access roads (see discussion in next section).

Roadside Ditches and Culverts

Roadside ditches, in conjunction with the use of culverts, would be used to establish positive drainage from all road facilities (see **Figure 6** and **Figure 11**). Design and construction of these structures would be consistent with the requirements of ARM 17.24.605. Drainage ditches would typically be flat-bottomed to allow for construction and cleaning with a scraper or other mobile equipment, including dozers and loaders, and would be constructed to convey a 10-year, 24-hour storm peak discharge with a minimum of 1 foot of freeboard. Similarly, culverts would be sized to convey the peak discharge from a 10-year, 24-hour storm.

Pit Dewatering

Western Energy proposes to address ground water inflow into active pits in the following manner: (1) pump pit water directly into water wagons and use it for haul-road dust suppression, (2) pump pit water into adjacent sediment ponds, or (3) pump pit water into an inactive pit that is separated from the active pit. Pit inflow contained in sediment ponds would be used for haul-road dust suppression or allowed to seep and evaporate. During periods of relatively high sustained pit inflows, water transferred to sediment ponds that is not required for dust-suppression purposes would be discharged to native receiving drainages (Black Hank Creek, Donley Creek, Robbie Creek, McClure Creek, and Trail Creek). These discharges would comply with the terms of Western Energy’s MPDES discharge permit.

2.4.5.3 Protection of Existing Water Rights

Western Energy would have to “replace the water supply of any owner of interest in real property who obtains all or part of his supply of water for domestic, agricultural, industrial, or other legitimate use from surface or underground source if such supply has been affected by contamination, diminution, or interruption” caused by project mining operations (ARM 17.24.648). The following sections describe sources of replacement water and Western Energy’s proposed approach for ground water and surface water.

Surface Water Use

Existing surface water rights within and adjacent to the project area are used for stock watering. Some water is stored in human-made impoundments (e.g., stock ponds) for use by livestock and wildlife. Some stock ponds are sourced partially or completely by spring discharges. Existing surface water rights are described in **Section 3.9, Water Resources – Water Rights**, and potential impacts on water rights are described in **Section 4.9, Water Resources – Water Rights**. Possible replacement sources are discussed below under **Replacement Water**.

Ground Water Use

Existing ground water rights within and adjacent to the project area are used for domestic purposes and stock watering. Existing ground water rights are described in **Section 3.9, Water Resources – Water Rights**, and potential impacts on water rights are described in **Section 4.9, Water Resources – Water Rights**. Possible replacement sources are discussed below under **Replacement Water**.

Replacement Water

Western Energy is required to provide a replacement water supply if an existing water source that is used for a legitimate purpose, such as domestic or agricultural use, becomes inadequate or unusable due to mining operations in the project area (see ARM 17.24.648). The most likely source may be the Sub-

McKay aquifer because it generally yields more water than the coal aquifers. Approximate yields in Sub-McKay wells range from 3.5 to 35 gpm (PAP, Appendix O), which should be sufficient for stock and domestic use. The water quality is comparable to the existing quality of the streams, springs, and wells in and near the project area. Power would be needed to operate the pumps in any wells installed for replacement water. Water could also be delivered by truck or pipeline from other areas, which may be a viable alternative for domestic water rights but may be cost prohibitive for stock watering.

2.4.6 Contingencies for Cessation of Operations

2.4.6.1 Temporary Cessation of Operations

Western Energy proposes to address temporary cessation of operations procedures if and when surface mining operations temporarily cease.

2.4.6.2 Permanent Cessation of Operations

Upon permanent cessation of operations (other than planned closure per the mine plan), Western Energy would close or grade and otherwise permanently reclaim all affected areas in accordance with ARM 17.24.522 and the permit approved by DEQ. All surface openings, equipment, structures, or other facilities not required for monitoring would be removed and the affected land reclaimed. Equipment needed for reclamation would not be permanently removed from the mine until reclamation is complete. Some of the reclamation equipment may be periodically used in other mine areas at the Rosebud Mine or may be removed temporarily from the site for short-term activities such as community service, firefighting, use at the power plants, or maintenance. Notification of these activities, which require removal of equipment, would occur only if the ability to complete backfilling and grading within the time frames required by regulation would be impacted.

2.4.7 Monitoring Plans

Western Energy developed monitoring programs for soil, vegetation, wildlife, hydrology, air resources, and contaminated areas. These are summarized below, and the full plans are available in the permit application. For all monitoring activities, vehicular access would be by existing roads and trails, with occasional light overland travel by light utility vehicles, and with motor equipment for repair of roads and trails. To the extent possible, travel would occur during dry conditions.

In the event that weather conditions or other factors result in inadvertent significant disturbance such as rutting or tracking, Western Energy would repair and seed damaged areas with an approved seed mix as soon as practical. In instances when Western Energy repairs inadvertent disturbances, the activities would be conducted in such a way as to ensure that the areas affected are returned to their approved post-disturbance land use, and Western Energy would include those actions in the monthly report.

Where installation or major maintenance of monitoring features would result in substantial disturbance to the land surface, Western Energy would notify DEQ of such activities in advance or, in the case of unforeseen disturbance, in a timely manner.

2.4.7.1 Air Quality

Historically (1992 through 2000), Western Energy has used seven air-quality monitoring sites located throughout the Rosebud Mine complex in conjunction with production data to demonstrate compliance with the National Ambient Air Quality Standards (NAAQS) for PM_{10} (airborne particulate matter measuring 10 microns in size). In August 2012, Western Energy also established PM_{10} monitors near the eastern boundary of Area A and at the northern end of the project area. The new monitors have been recording ambient concentrations for the project area to expand on existing baseline data. Monitoring would continue at these sites during project operations as required by MAQP #1570-07. (DEQ issued a Preliminary Determination for Area F, MAQP #1570-07, on July 22, 2013. MAQP #1570-07 would replace MAQP #1570-06, pending final approval.) Western Energy would submit quarterly and annual monitoring reports to DEQ to demonstrate that ambient concentrations do not exceed or approach ambient PM_{10} standards.

OSMRE has also required Western Energy to consider the impacts of $PM_{2.5}$ (airborne particulate matter measuring 2.5 microns in size) in this EIS (OSMRE 2014a). Western Energy established a $PM_{2.5}$ monitor at the northern end of the project area in February 2013 to meet this requirement and would continue to monitor at this location when mining commences in the project area. The PM monitoring stations are presented in **Figure 16** in **Section 3.3, Air Quality**.

2.4.7.2 Cultural Resources

Western Energy is party to a Memorandum of Agreement (MOA) along with DEQ, OSMRE, BLM, and the Montana State Historic Preservation Office (SHPO). The MOA, covering the first 5 years of mine life, requires annual reporting and includes a plan to recover site-specific data through archeological excavation. See **Section 3.14, Cultural and Historic Resources** for a description of the MOA. A Section 106 Programmatic Agreement (PA) was also developed for the project and officially executed on March 27, 2017. It is also described in **Section 3.14, Cultural and Historic Resources** and is available in **Appendix H** of this Final EIS.

2.4.7.3 Soil/Spoil Monitoring Plan

This plan includes the systematic sampling and analysis of graded spoil and soil. The purpose of soil sampling would be to evaluate soil-redistribution depth. Sampling intensity to typify soil redistribution depth would be 1 sample per 5 acres soiled, or a minimum of 2 samples per designated reclamation field.

In consultation with DEQ, if it is determined that soil-chemistry analysis is necessary, representative samples of each redistributed soil lift would be collected. At a minimum, the following parameters would be analyzed for each soil-chemistry sample, per DEQ's Soil and Spoil Guidelines (updated August 1998):

- pH
- saturation percentage
- EC
- SAR
- texture

The sampling intensity would be 1 sample per 1,000 feet on a square-grid basis. The square grid for spoil sampling is taken from the Limbaugh coordinate grid system that overlays all mine maps. Spoil samples would be submitted to an accredited soil lab to be tested for the parameters listed above.

The upper 4 feet of graded spoil would be sampled prior to topsoil/subsoil redistribution. Additional sites would be sampled adjacent to sample sites that exhibit suspect material in order to gage the size of the potential problem. Sampling intensity of the additional sites and those sites that exhibit an abundance of coal (i.e., "coaly spoil") would be determined by consultation with DEQ. Sampling procedures and intensity of potential sodic spoil would be determined by consultation with DEQ. All graded spoil analysis results would be submitted to DEQ.

2.4.7.4 Revegetation Monitoring Plan

Western Energy proposes a three-phase revegetation monitoring plan during the bond liability period. See **Section 1.6.4** for a description of the bond-release phases. For discussions of seeding and revegetation, see **Sections 2.4.4.7, Seeding** and **2.4.4.8, Revegetation Plan**.

The first phase, known as the "establishment period," would begin when the first seed mix is applied and end when the vegetation is deemed capable of supporting sustained livestock grazing. The second phase, known as the "management period," would extend from the end of the establishment period to the beginning of the evaluation period. The combined duration of the evaluation and management periods would be a minimum of 8 years.

Qualitative vegetation monitoring during the first two phases would be conducted annually on every revegetated field every year after initial seeding or planting until Phase II bond release is achieved. After Phase II bond release, monitoring would be done every third year, at a minimum. The initial monitoring assessment would occur either the same calendar year the field was initially seeded or the following calendar year. To ensure consistency and accuracy, a Periodic Revegetation Form would be completed by a qualified professional for each monitoring event.

The third and final phase of vegetation monitoring, known as the "evaluation period," would be a period of any 2 years after year 6 of the bond-liability period. During this period, cover, production, biological diversity, and density data would be gathered from both reclaimed and referenced areas for the specific task of determining reclamation success.

2.4.7.5 Wetland Monitoring

A wetland delineation report was completed for the project area in 2013, and 12 isolated wetlands were identified (Cedar Creek Associates, Inc. 2013). Of the 12 wetlands, 7 wetlands (identified as B, C, D, E, F, F-081, and F-028) across 8.38 acres would be impacted by the proposed project (see **Section 4.11, Wetlands and Riparian Zones** for a discussion of effects). Western Energy proposes to monitor wetland conditions as mining progresses through the project area. The purpose of wetland monitoring would be to detect potential impacts and intervene, if required (PAP, Appendix N-1).

Wetland monitoring would consist of monitoring the streams, springs, ponds, and ground water associated with wetlands (see **Section 2.4.7.6, Surface and Ground Water Monitoring**); monitoring benthic macroinvertebrate communities; and undertaking annual wildlife surveys, as part of a mine-wide wildlife monitoring program (see **Section 2.4.7.7, Wildlife**) (PAP, Appendix N-1). **Table 12** provides an overview of the parameters to be monitored through each of these plans.

Table 12. Overview of Parameters to Be Monitored and Monitoring Plans.

Monitoring Type	Description	Relevant Plan
Stream monitoring	Surface water monitoring would be undertaken in drainages, including drainages that contain wetlands (Robbie Creek, Trail Creek, Donley Creek). At all surface water monitoring sites, flow, field parameter data and crest gage readings would be collected on a monthly basis. Water quality samples would be taken on a quarterly, event-based basis. Sediment samples would be collected on a monthly basis and after major precipitation and snowmelt events.	Monitoring and Quality Assurance Plan (see **Section 2.4.7.6, Surface and Ground Water Monitoring**)

Table 12. Overview of Parameters to Be Monitored and Monitoring Plans.

Monitoring Type	Description	Relevant Plan
Pond monitoring	Pond monitoring would include monitoring of Pond 5, which feeds wetland F049. Water level measurements would be collected monthly throughout the year, and field parameters would be collected on a monthly basis from March through November. Water quality samples would be collected semiannually.	Monitoring and Quality Assurance Plan (see **Section 2.4.7.6, Surface and Ground Water Monitoring**)
Spring monitoring	Springs, including those that feed wetlands, would be monitored monthly. Spring flow data and field parameter data would be collected on a monthly basis from March through November. During winter months springs are typically frozen. Water quality samples would be collected on a semiannual basis. The frequency of spring sampling would be increased to quarterly once mining commences in the drainage in which the spring is located.	Monitoring and Quality Assurance Plan (see **Section 2.4.7.6, Surface and Ground Water Monitoring**)
Ground water monitoring	Ground water monitoring wells would be located throughout the project area, including upgradient and downgradient of the proposed disturbance area. Water level measurements would be collected quarterly, except for the majority of alluvial wells, where measurements would be taken monthly. Water quality samples would be collected semiannually, annually, or every third year, dependent on well characteristics.	Monitoring and Quality Assurance Plan (see **Section 2.4.7.6, Surface and Ground Water Monitoring**)
Wildlife surveys	Annual wildlife monitoring for Rosebud Mine, including the project area, would be undertaken for big game, upland game birds, raptors, and songbirds.	Wildlife Monitoring Plan (see **Section 2.4.7.7, Wildlife**)
Aquatic macroinvertebrate surveys	Aquatic macroinvertebrate surveys would be undertaken during the permit renewal cycle. Surveys would follow the 2012 DEQ protocol, *Sample Collection, Sorting, Taxonomic Identification, and Analysis of Benthic Macroinvertebrate Communities Standard Operating Procedure*.	To be developed

Based on Table 6 in PAP, Appendix N-1.

2.4.7.6 Surface and Ground Water Monitoring

The surface and ground water monitoring plan for the Rosebud Mine including the proposed project, known as the Monitoring and Quality Assurance Plan (MQAP), is presented in Appendix P of Western Energy's PAP. The MQAP outlines the proposed project area monitoring program for streams, springs, ponds, ground water, and precipitation/climate; **Table 12** provides a brief overview of plan parameters. The MQAP integrates all planning, data collection, and reporting activities and specifies how quality assurance (QA) and quality control (QC) measures are applied to ensure that the results obtained meet statutory requirements. Monitoring data collected under the MQAP would be incorporated into Western Energy's AHR for the entire Rosebud Mine, which would be submitted to DEQ no later than December

31 and June 30 of each year. The AHR summarizes data collected in each permit area of the Rosebud Mine.

The hydrology monitoring program outlined in the MQAP consists of periodic collection of surface and ground water quality and quantity data as shown in the monitoring schedule (PAP, Appendix P). The monitoring schedule and requirements, except those required by the MPDES permit, would be reviewed and updated annually, or as needed in consultation with DEQ. The MQAP does not provide requirements for the collection and analysis of MPDES-mandated water quality and quantity data. Those project-specific requirements would be listed in the MPDES permit.

The data collected under the MQAP would be used to inform decision-making regarding the following:

- comparison of monitoring results to applicable water quality standards and analysis of long- and short-term flow, water level or water depth, and water quality changes or trends
- evaluation of the impacts on the hydrologic balance occurring on or off the project area as a result of mining or reclamation activity in the project area

The locations of all MQAP surface and ground water monitoring sites are shown on **Figure 12**. Monitoring and reporting of ground and surface water would be done in compliance with ARM 17.24.314, ARM 17.24.633, ARM 17.24.645, and ARM 17.24.646. Surface and ground water monitoring would be performed until final phase (Phase IV) bond release (see **Section 1.6.4, Bond Release**).

Stream Monitoring

Stream monitoring sites have already been established in the vicinity of the project area. Monitoring is focused on the West Fork Armells drainage (sub-drainages include Black Hank, Donley, Robbie, McClure, and Trail Creeks), as only 0.01 percent of the project area and none of the mine passes are located in the Sarpy Creek drainage. Each active stream-monitoring site is described in detail in the MQAP (Appendix P-B, Section 3; PAP, Appendix P).

Nine active stream monitoring sites (see **Figure 12**) are located either downstream from proposed mining activities (impacts assessment) or upstream from proposed mining activities (representative of background conditions). For a description of the surface water hydrology in the area, see **Section 3.7, Water Resources – Surface Water**. Continuous flow data are currently collected at two stream-monitoring sites on Donley Creek drainage (SW-89 and SW-90) but may be collected at other sites in the future (CG-103, in the vicinity of CG-101, on McClure Creek downstream of mining, and on Trail Creek). In 2016, water-quality sampling site SW-200 was established immediately downstream from SW-90 on Donley Creek to assess possible impacts on water quality from haul-road disturbance. Also in 2016, crest gages were established in the Black Hank and Robbie Creek drainages to provide ongoing characterization of the runoff in those drainages.

At all stream monitoring sites, flow and field parameter data are already collected on a monthly basis. Water quality samples at these sites would be taken on a quarterly, event-based basis. Sediment samples would be collected on a monthly basis and after major precipitation and snowmelt events. Crest gage readings are already collected on a monthly basis. More details on the monitoring methods, including frequency and the types of data collected and scheduled for collection, are provided in the MQAP (Appendix P-B, Section 3; PAP, Appendix P).

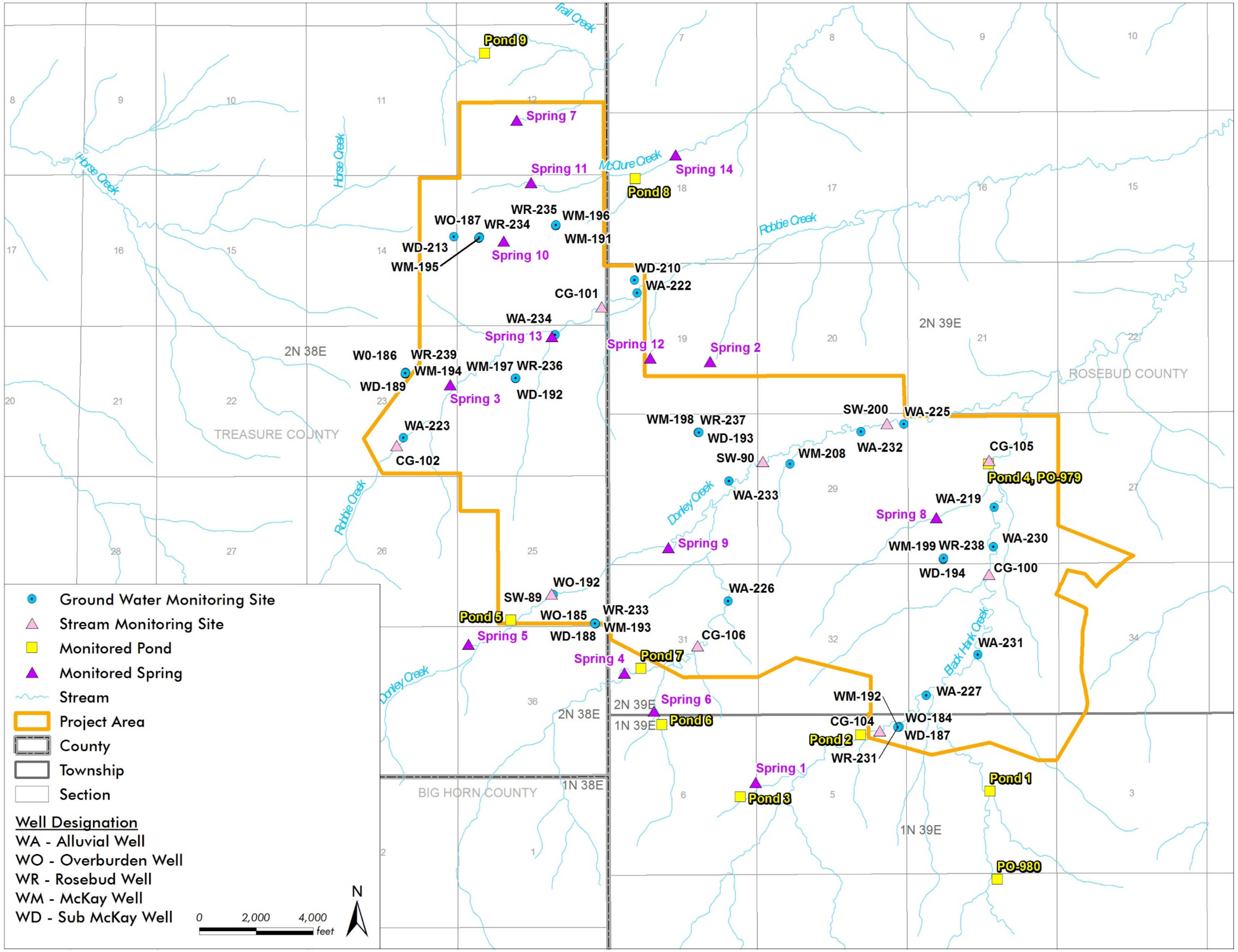

Figure 12. Surface and Ground Water Monitoring Sites.

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Spring Monitoring

Spring monitoring sites have already been established in the vicinity of the project area to provide baseline conditions prior to mining (see **Figure 12**). Springs 1 through 9, which are located in or near the project area, have been monitored since 2011, and Springs 10 through 14 have been monitored since 2015. A detailed description of all active spring monitoring sites is provided in the MQAP (Appendix P-B, Section 3; PAP, Appendix P).

All active monitoring spring sites are visited monthly. Flow data and field parameter data are collected monthly from March through November. Water quality samples are collected semiannually. The frequency of spring sampling would be increased to quarterly once mining commences in the drainage in which the spring is located.

Pond Monitoring

Background data are currently being collected at stock pond monitoring sites (see **Figure 12**) prior to the start of mining. A detailed description of all pond-monitoring sites is provided in the MQAP (Appendix P-B, Section 3; PAP, Appendix P).

All active pond monitoring sites are visited monthly. Stock pond water level measurements are collected monthly throughout the year, and field parameters are collected monthly from March through November. Water quality samples are collected semiannually. The frequency of pond monitoring would be increased to quarterly once mining commences in the drainage in which the pond is located.

Ground Water Monitoring

Ground water monitoring sites have already been established in the vicinity of the project area. Monitoring sites (see **Figure 12**) are located either downgradient from proposed mining activities (impact assessment) or upgradient from proposed mining activities (to collect background water quality data and assess impacts on ground water levels). Baseline ground water monitoring at the project area started in 2005. Each ground water monitoring site is described in detail in the MQAP (Appendix P-B, Section 3; PAP, Appendix P).

Ground water wells have been completed in all applicable hydrogeologic units for the project area (WA – alluvium; WO – overburden; WS – spoil; WR – Rosebud Coal; WM – McKay Coal; WD – Sub-McKay). Each of the hydrogeologic units is monitored by collecting water level measurements and water quality samples. Monitoring wells are sampled quarterly to collect baseline data. Upon approval of the Area F Permit, water quality samples would be collected semiannually, annually, or every third year. More details on the monitoring methods, including frequency and the types of data collection occurring and scheduled to occur, are provided in the MQAP (Appendix P-B, Section 3; PAP, Appendix P).

Several of the monitoring wells would be destroyed during mining. Replacement wells would be installed downgradient from and outside of the disturbance boundary for each disturbed well at least 1 year prior to its removal. In addition, wells would be installed north of the mine in T2N, R38E, Section 12 at least 1 year prior to mining in Section 12. New wells would be sampled quarterly for a period of at least 1 year. After 1 year, the sampling frequency may be reduced upon approval by DEQ.

Climate Monitoring

Precipitation data are collected from one on-site rain logger. The location is shown on **Figure 12**. Climate data including temperature and precipitation for the vicinity are available from the Colstrip weather station (241905-7).

2.4.7.7 Wildlife

Western Energy already monitors for wildlife and would continue to do so during operations and reclamation (see **Section 3.12, Fish and Wildlife Resources**). The annual wildlife monitoring report would cover the period from December 1 through November 30 of the following year. The annual report would be submitted to DEQ by March 1 of the year following completion of the annual data collection.

The wildlife survey area includes the entire project area and a surrounding 1-mile perimeter.

Survey forms would be developed by Western Energy and approved by DEQ prior to the respective surveys. All pertinent information and data would be recorded on the forms.

All surveys would be conducted by a professional wildlife biologist. This person would have a sound understanding of the wildlife species inhabiting the area and would be able to properly observe and identify the various wildlife species—particularly the songbirds.

2.4.7.8 Other Monitoring Plans

Survey Monuments Monitoring

Survey monuments or aerial targets monitoring would consist of periodic monitoring and establishment and maintenance of survey and aerial points.

2.4.8 Mitigation Plans

2.4.8.1 Air Quality

Mitigation measures would be as described in Western Energy's Fugitive Dust Control Plan (applicable to the entire mine) and as required by the MAQP #1570-07. DEQ issued a Preliminary Determination for Area F, MAQP #1570-07, on July 22, 2013. MAQP #1570-07 would replace MAQP #1570-06, pending final approval.

2.4.8.2 Buffer Zones

All mining activities, including highwall reduction and related reclamation, would cease at least 100 feet from a property line, permanent structure, unmineable or unreclaimable steep or precipitous terrain, or any area determined by DEQ to be of unique scenic, historical, cultural, or other value. If special values or problems are encountered, DEQ may modify buffer-zone requirements. The transition from undisturbed ground to the disturbed area would be blended to provide a smooth transition in topography.

2.4.8.3 Cultural Resources

A Programmatic Agreement (PA), a Section 106 program alternative under the National Historic Preservation Act (NHPA) among OSMRE, DEQ, BLM, SHPO, and Western Energy was prepared and officially executed on March 27, 2017. The PA stipulates continued Section 106 compliance, including a treatment plan to resolve future adverse impacts on historic properties (see **Section 3.14, Cultural and Historic Resources**).

2.4.8.4 Water Rights and Replacement

In accordance with ARM 17.24.648, Western Energy would replace the water supply of any owner of interest in real property who obtains all or part of a supply of water for domestic, agricultural, industrial, or other beneficial use from a surface or underground water source if such supply has been affected by contamination, diminution, or interruption resulting from Western Energy's operation (see discussion above in **Replacement Water**).

2.4.8.5 Wetland Mitigation Plan

As noted above in **Section 2.4.7.5, Wetland Monitoring**, 7 wetlands (identified as B, C, D, E, F, F-081, and F-028) across 8.38 acres would be impacted by the proposed project (see **Section 4.11, Wetlands and Riparian Zones** for a discussion of effects). Western Energy completed a functional assessment for the wetlands that are proposed to be impacted using the Montana Wetland Assessment Method (MWAM). The MWAM assessment includes a desktop-based MWAM functional assessment and field visits, which occurred in July and August 2016, during the active growing season for wetland vegetation, to complete the functions and values assessment.

Mine Plan Mitigation and Avoidance Measures

Western Energy's proposed mine plan (see **Section 2.4.3, Mine Plan**; **Figure 4**) includes mine geometry and operational mitigation measures to avoid or lessen potential wetland impacts (PAP, Appendix N-1):

1. The main drainages of Black Hank, Donley, and Robbie Creeks are not with the disturbance boundary, minimizing disturbance to the hydrologic balance, including the disturbance to wetlands and recharge areas that feed wetlands.

2. Ditch and pond locations would be strategically placed at the edge of disturbance to intercept and contain surface runoff from leaving the permit boundary (**Figure 11**). The placement of these ponds would allow runoff water to slowly infiltrate and possibly recharge some of the wetland areas.

3. The haul road would be 120 feet wide and designed to minimize wetland and spring crossings. Ditches along the haul road would direct runoff to either sedimentation ponds or sediment traps. In areas where the haul road crosses the ephemeral drainages, sediment traps would be provided to collect runoff from the road embankment.

4. The mine plan leaves the three main ephemeral drainages (Black Hank, Donley, and Robbie) unmined to limit impacts on alluvial aquifers.

5. All discharges to public waters would comply with Western Energy's MPDES permit for the project.

The mine plan would also avoid or lessen potential wetland impacts through the following sequence and timing considerations:

1. Western Energy would conduct concurrent reclamation in the project area (see **Section 2.4.4, Reclamation Plan**).

2. Reclamation of disturbed lands to approximate topography, vegetation, and soil conditions would be the principal procedures used to restore the approximate recharge capacity of the mine area.

The reclamation plan (**Section 2.4.4, Reclamation Plan**; **Figure 8**) would avoid and lessen potential wetland impacts through the following measures:

1. Reclamation of mined lands would approximate pre-mining conditions, particularly along the principal stream courses, and minimize the disturbance to scoria zones to mitigate the effects of mining on recharge capacity.

Mitigations for the Loss of Wetland Function and Values

To mitigate for the loss of wetland function and values associated with impacts on these wetlands, Western Energy would implement mitigation prior to ground disturbance as described in the PAP, Appendix N-1. Mitigation options for the project could include three options and would be determined in consultation with DEQ:

1. restoring other wetlands within the same watershed service area (i.e., HUC 1010000111, which is part of the Lower Yellowstone-Sunday sub-basin)

2. potentially enhancing wetlands that may only be minimally impacted by proposed mining activities, such as Wetland D

3. reclamation planning in the project area to develop wetlands in the early mining stages of the project, prior to impacting wetlands in the later stages of the project

Indirect impacts on wetlands would be minimized through implementation of the following plans:

1. A Hydrologic Control Plan

2. A Spill Prevention and Countermeasures Control Plan (includes measures to prevent and control spills that may occur due to mining activities)

3. An Operations Plan

2.5 ALTERNATIVE 3 – PROPOSED ACTION PLUS ENVIRONMENTAL PROTECTION MEASURES

2.5.1 Introduction to the Alternative

Under Alternative 3, OSMRE would require Western Energy to implement additional environmental protection measures (described in the sections below) that are above and beyond the requirements of MSUMRA. In accordance with 75-1-201(4)(a), MCA, DEQ cannot impose measures on any permit, in this case, the operating permit for the project area, as part of the MEPA review process beyond what is required for compliance with MSUMRA and other state statutes. However, the project sponsor (in this case, Western Energy) and DEQ can mutually develop measures that may, at the request of a project sponsor, be incorporated into the proposed operating permit. Also, although not required by law, the

Secretary of the Interior holds the authority to impose additional conditions on the federal mining plan, as stated under 30 CFR 746.13.

The Alternative 3 environmental protection measures are conceptual in nature and were designed to minimize environmental effects and to address key issues identified during the scoping process (see **Section 1.5.2.1, Key Issues Identified During Scoping for Detailed Analysis**). Under this alternative, Western Energy would develop, mine, and reclaim the project area as proposed in the PAP and described above in **Section 2.4, Alternative 2 – Proposed Action** with the exception of those areas where OSMRE has prescribed environmental protection measures. In addition, Western Energy would incur the additional costs of implementing these environmental protection measures.

Under Alternative 3, the level of mining would be the same as under Alternative 2. The amount of surface disturbance also would be very similar to Alternative 2; however, to implement some of the environmental protection measures, the location of the disturbance within the permit boundary may be different than under Alternative 2. For example, one environmental protection measure requires that lined storage ponds be located away from permit boundaries; this would be a departure from the locations proposed under Alternative 2.

2.5.2 Environmental Protection Measures

2.5.2.1 Additional Requirements for a Water Management Plan

Western Energy would be required to modify the Water Management Plan for the project. The plan would be submitted to DEQ for approval prior to disturbance. The plan would include additional mitigation measures to protect water quality and water-dependent ecosystems and would be implemented in association with the Wetlands Mitigation Plan/Fish and Wildlife Plan. The Water Management Plan would include the measures listed in the following sections.

Enhancement of Wetland Habitats

Where MPDES discharge points and sediment ponds are located upstream of existing water-dependent ecosystems, measures would be taken to manage pond releases, where practicable, to enhance wetland and riparian environments in drainages undisturbed by mining (Black Hank, Donley, Robbie, McClure, and Trail Creeks). This may include managing the timing and volume of MPDES releases to augment or mimic water budgets of downstream ecosystems.

Pit Water

Where pit water must be managed by pumping into storage ponds, measures would be taken to assess and evaluate the potential for pit water stored in sediment ponds to affect water resources outside of the project area. Where it is determined that pit water could affect off-permit water resources, Western Energy would be required to implement measures to minimize impacts on the hydrologic balance. These measures may include:

- Limit or eliminate storage of pit water in sediment ponds along the project area boundary.
- Line all perimeter sediment ponds where pit water is stored.
- Install shallow monitoring wells below all unlined sediment ponds that receive pit water.
- Implement other measures, as approved, that allow the assessment and evaluation of potential effects of pit water on the hydrologic balance.

Ground Water

To protect downslope waterbodies, if pit water were stored in unlined sediment ponds, Western Energy would install alluvial monitoring wells below and within 50 feet of such sediment ponds. Monitoring wells would be sampled monthly, and results would be included in Western Energy's AHR. If concentrations of any parameters increased to concentrations that would adversely affect beneficial uses of the alluvial water (based on the ground water classification) ground water, Western Energy would resample for that parameter immediately after receiving laboratory results. If the sample again showed the same or similar increase, Western Energy would submit a mitigation plan to DEQ to reduce the alluvial ground water concentration so that adverse impacts on beneficial uses would be eliminated.

2.5.2.2 Additional Requirements for the Wetland Mitigation Plan

Western Energy would have additional requirements for the Wetland Mitigation Plan for the project area. Western Energy outlined some of the steps it would take to develop such a plan in its PAP in Appendix N (see summary description in **Section 2.4.8.5, Wetland Mitigation Plan**). The additional requirements to the plan are described in the following sections.

Require a Natural Water Source for Off-Site Mitigation Areas

All mitigation sites proposed outside of the project area would be supported by a natural water source to ensure long-term viability of the wetland.

Require Mitigation Sites to Be within the Same Watershed

All proposed mitigation sites would be located outside of the drawdown area but within the same watershed of impacted wetlands.

Require a Deed Restriction or Easement

Approved mitigation sites would be protected with an easement or deed restriction.

Soil Salvage

Western Energy would salvage soil and sod from the nonjurisdictional wetlands in the project area that would be directly affected by mining or haul-road construction (wetlands B, C, and D). The Wetland Mitigation Plan would include a description of the thicknesses of salvageable soil in each impacted wetland. If possible, salvage would be completed in the dry season to allow maximum salvage of soil and sod. Salvage would be completed in two lifts: the first lift would consist of O (layer which forms above the mineral soil) and A (topsoil) horizons, and the second lift would consist of suitable subsoil. New wetlands would be created as soon as possible after salvage to take advantage of the viable seed bank. If salvaged soil must be stockpiled, the first and second lifts would be stockpiled separately.

Managed Water Releases

Per the Water Management Plan (see **Section 2.5.2.1, Additional Requirements for a Water Management Plan**), wetlands that are impacted by changes to hydrology could be augmented with managed water releases, such as directing the water releases to the upstream end of the wetlands or creating a stock pond that would seep or direct water to the wetlands. This would provide a new water source for the wetlands that could prevent them from drying up due to the ground water drawdown.

2.5.2.3 Reclamation

Western Energy would be required to modify its reclamation practices related to soil stockpiling, soil redistribution, and seeding as described below in order to better manage water and to improve reclamation success. Western Energy would also be required to use a different methodology for postmine topography and drainage-basin design (as described below) to improve water management.

Soil Salvage and Stockpiling

Salvaged soil would be stockpiled if necessary and redistributed in a manner consistent with the Non-jurisdictional Wetland Mitigation Plan (**Section 2.5.2.2, Additional Requirements for the Wetland Mitigation Plan**). Stockpiles for all soil types would be contoured to prevent erosion.

Organic Amendments

To improve vegetation success on small-acreage problem areas (i.e., areas lacking sufficient organic matter, areas with limited vegetative cover, or areas susceptible to erosion), a DEQ-approved locally available organic amendment such as a grass mulch would be incorporated into the upper 4 inches of respread soil to improve nutrient content and the organic matter level to 1 percent by volume. Grass mulch is already used on other permit areas to mitigate erosion.

Postmine Topography

Western Energy would use 5-foot contours to design the postmine topography for the project instead of the 10-foot contours used under the Proposed Action (see **Figure 9**).

Drainage Basin Design

For select drainages with estimated 2-year, 24-hour peak discharges greater than 5 cubic feet per second (cfs), Western Energy would submit drainage designs to DEQ for review and approval prior to disturbance. The Proposed Action calls for designs to be submitted only for drainages with estimated 2-year, 24-hour peak discharges greater than 15 cfs (see **Section 2.4.4.5, Postmining Topography and Drainage Basin Design**).

2.5.2.4 Other Mitigations

Geological Resources Survey

Prior to disturbance, Western Energy would be required to complete and submit to DEQ a Geological Resources Survey that inventories unique rock features in the project area. Rock features that are irreplaceable or of historical significance would be identified. If DEQ determines the feature should remain in place, the mine plan would be adjusted to mine around the feature. The Geological Resources Survey would also identify unique features (e.g., important for wildlife habitat) that could be moved for later use or replicated during reclamation (see **Special Habitat Features** in **Section 2.4.4.10, Wildlife Habitat Enhancement**).

Paleontology Resources Survey

A field paleontological assessment of the project area was completed by paleontologists in accordance with BLM guidelines and policies in 2015 (SWCA 2016). Based on the results of this survey, a BLM-permitted professional paleontologist approved by the lead agencies would create a mitigation plan for project paleontological resources. For example, the plan might include specifying areas of avoidance to protect fossils, and areas recommended for salvage prior to ground disturbance. The plan would also include an Unanticipated Discovery Plan (UDP). The UDP would allow for forethought to be given as to what to do in the event that potentially significant finds are made during mining operations. To aid in the discovery of paleontological resources during mining, the UDP may include site-worker environmental awareness training that specifies if any mineralized bones or other potential fossils are discovered by personnel during mining activities, the fossils should be left in place and untouched until the appropriate personnel are contacted. In addition, the UDP might consider ceasing excavations within a specified distance of the discovery of any subsurface vertebrate fossils or other potentially significant fossil remains (including plant and invertebrate fossils) within the project area.

Generally, one condition of leasing requires operators to report finds during operations that are of potential scientific interest. The UDP reduces possible operational delays by outlining the procedure to be followed in the event that something of potential scientific interest is uncovered. It usually includes a requirement to stop operations in the immediate area of the discovery and contact information for people who should be notified, which usually includes operations environmental inspectors, consulting paleontologists who can be called in to evaluate the find, BLM contact information, and the surface owners. Since paleontological resources belong to the owner of the surface estate, they would determine whether the resource is salvaged and what to do with it afterward (e.g., donate to a public museum or retain for personal use).

2.6 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM FURTHER ANALYSIS

As discussed above in **Section 2.1.1, Alternatives Development**, the alternatives development process was designed to identify a reasonable range of alternatives for detailed analysis in the EIS. The agencies developed alternatives in accordance with their respective state and federal authorities (described in **Section 1.4, Agency Authority and Actions**). Seven alternatives were considered during the development process but were eliminated from further analysis. These alternatives were suggested by the public in scoping comments or by specialists based on professional experience and are discussed in the following sections.

2.6.1 Coal Conservation Alternative

Under a coal conservation alternative, Western Energy would be allowed to mine through all lands within the project area, including surface waters such as streams, creeks, and ponds. This alternative would allow for the greatest quantity of coal recovery and could be permitted if Western Energy could prove no material damage would result from mining. State regulations such as ARM 17.24.651 provide protection of stream channels; however, there are no rules that specifically prohibit mining through major watercourses, as long as the provisions and performance criteria of these regulations are met.

This alternative was dismissed from further analysis due to the much greater level of environmental impacts, some of which are discussed here, that precluded further consideration. Specifically, there would be greater or additional impacts on surface and ground water hydrology (as compared to the Proposed Action), including changes in stream flow and stream morphology, water quality impacts due to additional spoil areas, downgradient water quality impacts, impacts on water rights, and permanent impacts on springs. Similarly and relatedly, aquatic life and riparian-dependent species would experience greater impacts. There also would be greater or additional impacts on wildlife, including loss of habitat and habitat connectivity. Finally, increased erosion and sedimentation would be expected under this alternative.

2.6.2 Private Coal Alternative

Western Energy holds leases for federal (M82186) and private (G-002 and G-002a) coal. With this alternative, Western Energy would be limited to mining private coal only. This alternative was considered because it facilitates a situation where DEQ would grant approval for an operating permit to mine private coal, but OSMRE would prohibit a mine plan to remove federal coal.

These leases are not in continuous ownership blocks but rather are located in a checkerboard pattern (see **Section 3.23, Land Use**). Western Energy estimates that there are 101,826,716 tons of coal within the private coal lease areas. Based on Western Energy's proposed mine plan (i.e., one that protects drainages and considers coal-recovery limitations as explained in **Section 2.4.2, Coal Recovery**), 37,036,115 tons of coal would be recoverable within the private lease areas.

This alternative was considered by DEQ and OSMRE and eliminated from detailed study for several reasons. First, mining only the private leases would not be consistent with the Purpose and Need (see **Section 1.3, Purpose and Need**). Western Energy holds a VER granted by BLM under federal coal lease M82186 to access and mine undeveloped federal coal resources located in the project area pursuant to reasonable environmental controls. BLM regulations require full recovery of the coal (30 CFR 816.59).

Second, mining only private coal would be logistically challenging—if not operationally impossible in some areas—due to the checkerboard nature of the coal ownership (surface is entirely private). Smaller box cuts and setbacks would have to be used to avoid disturbing the federal coal resource. This practice would necessitate leaving large wedges of private coal in place (perhaps as much as half of the private coal) in violation of MSUMRA's requirements for coal recovery and conservation (ARM 17.24.322). In addition, the disturbance necessary to mine the private leases only would be similar to the level of disturbance (and thereby have similar effects) for Alternatives 2 and 3 because the surface overlying federal coal would still be disturbed for highwall layback and ancillary actions that support mining. Other impacts, such as noise and visual impacts, also would still occur.

Finally, for OSMRE to prohibit the mining of coal that is currently leased and part of a federal Logical Mining Unit (MTM 85589) without the possibility of significant impacts from the action would be inconsistent with the overall objective of 30 CFR, Part 816 and more specifically 30 CFR 816.59 (Coal Recovery).

2.6.3 Underground Mining Alternative

Public comments received during the public scoping period requested the agencies to consider an alternative that requires Western Energy to use underground mining methods in the project area to extract the coal. This alternative was considered by DEQ and OSMRE and eliminated from detailed study because surface impacts would not be eliminated or even greatly reduced by the use of underground mining methods (underground mining of shallow coal could result in excessive subsidence related disturbance) and because the alternative does not comply with MEPA's criteria for a reasonable alternative. MEPA requires that "any alternative proposed must be reasonable, in that the alternative must be achievable under current technology and the alternative must be economically feasible as determined solely by the economic viability for similar projects having similar conditions and physical locations and determined without regard to the economic strength of the specific project sponsor" in accordance with 75-1-201(b)(iv)(I), MCA.

Underground mining alternatives are economically infeasible for coal recovery in the project area, regardless of operator, for several reasons including the following:

1. The facilities and equipment needed for underground mining are different from surface mining. The amount of recoverable coal reserves in the project area would not support the capital expenditures required for purchasing additional facilities and equipment. New facilities and equipment required for underground mining include but are not limited to wash plant and associated infrastructure (ponds, thickeners, conveyors, and permanent coal-waste storage areas); coal stockpile reclaiming systems; maintenance and support facilities; underground mining equipment; underground conveyor systems, drives and power stations; vehicles for transporting men and supplies to the underground workings; several continuous miners (a mining machine that produces a constant flow of ore from the working face of the mine); shuttle cars (electric-powered, rubber-tired vehicles that haul coal); large and small ventilation fans; and roof bolters (a hydraulically driven miner-mounted bolting rig used to install rock bolts in mines).
2. Any type of underground mining would require hiring all new miners with the appropriate skills or training current employees in an entirely new mining method.
3. The process for Western Energy to design and engineer a new underground mine would add significantly to the cost.
4. The volume of coal recovery associated with the various underground mining methods is significantly lower than that associated with surface mining. The coal reserve in the project area is so shallow that using underground methods such as room and pillar mining would facilitate no more than 50-percent coal recovery.
5. There are many safety concerns associated with underground mining, such as roof and rib instability, that are not currently present at the Rosebud Mine. Geological conditions of the coal seam have not been evaluated to understand whether underground mining could occur safely pursuant to accepted mine engineering principles.

In summary, surface impacts would not be eliminated or even greatly reduced by the use of underground mining methods, and the economic burden to shift to underground mining would be prohibitive.

2.6.4 Mining within a Smaller Disturbance Area, for a Shorter Duration, and/or within a Different Time Frame

The agencies discussed other changes to the mine plan including mining within a smaller permit area or disturbance area, for a period shorter than 21 years (duration of disturbance; see **Table 7**), and/or using a sequence that would result in different periods of disturbance. These options were dismissed from further consideration for the following reasons: (1) they are not operationally feasible (see the discussion under **Section 2.6.2, Private Coal Alternative**) or would be substantially similar in design, (2) they would have effects that are substantially similar to Alternatives 2 and 3 and should be considered holistically, rather than by smaller permit areas over time, and (3) they would not be permitted under ARM 17.24.322.

2.6.5 Transport Coal by Rail to Western and International Ports

The concept of using rail transport to western ports such as Portland or Seattle, and for export to foreign markets such as Pacific Rim countries, was introduced by members of the public during the public scoping periods. Comments received by the agencies expressed concern about the impacts (to air quality, public health, etc.) from rail transport of coal. This alternative was considered by DEQ and OSMRE and eliminated from detailed study for several reasons. First, shipping coal from the project area to western ports would be a connected action and not part of the Proposed Action (surface coal mine in the project area as described in **Section 2.4, Alternative 2 – Proposed Action**), so analyzing it as an alternative would be outside the scope of this EIS. Second, even if shipping of coal were part of the Proposed Action, which it is not, there is no accessible loading area in the project area. Coal from the project area would need to be transported to the rail spur in Area D (used for small shipments) or the rail loop in Area A (used for large coal trains), or additional infrastructure such as a railroad loop, loadout facility, and coal stockpiles would need to be created in the project area. Western Energy has not proposed to construct any of the needed infrastructure—which likely would be cost prohibitive—in the project area, nor has Western Energy proposed to use the existing rail facilities in Areas A and D, which have not been used since 2010 (see **Section 2.2.4, Existing Rosebud Mine Support Facilities**).

Western Energy has not foreclosed consideration of sale of project area coal to other parties in the future. If, and when, Western Energy seeks to sell project area coal to other buyers, whether domestic or international, and the sale necessitates construction of a coal load-out or rail facility requiring federal or state approval, Western Energy would engage with the appropriate agencies to obtain the necessary permits. The scope of the necessary environmental review would be determined at that time. Currently, there is no proposal from Western Energy to ship project area coal.

2.6.6 Alternative Land Uses

Comments were submitted during the public scoping periods asking the agencies to consider alternative uses of the land, besides mining, that would be environmentally and economically more stable. This alternative was eliminated from detailed study because it would be inconsistent with the Purpose and Need for the action. As described in **Section 1.3**, the Purpose and Need is predicated upon DEQ review of an application for a plan of operations for a surface mine and OSMRE review of a federal surface mining plan (to be included as part of the approved surface mining permit).

2.6.7 Alternative Energy Generation

Comments were submitted during the public scoping periods asking the agencies to consider alternatives to continued coal energy generation at Colstrip, such as renewable energy or conservation. This alternative was eliminated from detailed study because it would be inconsistent with the Purpose and Need for the action. As described in **Section 1.3**, the Purpose and Need is predicated upon DEQ review of an application for a plan of operations for a surface mine and OSMRE review of a federal surface mining plan (to be included as part of the approved surface mining permit).

2.7 SUMMARY OF IMPACTS AND IDENTIFICATION OF PREFERRED ALTERNATIVE

Table 13 summarizes and compares the potential direct and indirect impacts on natural, cultural, and human resources, including intensity and duration, associated with the alternatives. Direct and indirect impacts are described fully in **Chapter 4**; cumulative impacts are discussed in **Chapter 5**.

DEQ has identified Alternative 2 – Proposed Action, consistent with Western Energy's Application for C2011003F (certified as acceptable on October 5, 2018), as its preferred alternative. OSMRE has also identified Alternative 2 as its preferred alternative. Each agency will document its selected alternative and decision rationale in a ROD as required by MEPA (ARM 17.4.629) and NEPA (40 CFR 1505.2). A discussion of each agency's decision-making process is provided in **Section 1.4.1, Lead Agencies**.

Table 13. Summary Comparison of Direct and Indirect Environmental Impacts.

Resource	Alternative 1 – No Action	Alternative 2 – Proposed Action	Alternative 3 – Proposed Action Plus Environmental Protection Measures
Topography	No impacts	Changes in topography during mining would be noticeable and would be short-term, major, and adverse. In the years immediately following reclamation, impacts from erosion would be negligible. Over time, differential erosion of the spoil would create a hummocky terrain with fragments of more resistant stone scattered throughout the analysis area; these impacts would be long-term, minor, and adverse. Differential erosion of backfilled areas and unmined drainage basins over an unknown geologic time would result in topographic inversion of the analysis area; these impacts would be long-term, major, and adverse.	Impacts would be similar to those described for Alternative 2. Improved water management during mining may result in decreased short-term erosion rates, and tighter elevation control may result in a more stable land surface.
Air Quality	No impacts	Air emissions would not result in exceedances of any NAAQS. Direct and indirect impacts on air quality would be short-term, negligible to minor, and adverse. Deposition impacts would be long-term, negligible to minor, and adverse.	Impacts would be the same as those described for Alternative 2.
Climate and Climate Change	No impacts	Direct and indirect greenhouse gas emissions would contribute incrementally to climate change. Direct impacts on climate change would be negligible relative to other GHG emission sources.	Impacts would be the same as those described for Alternative 2.

Table 13. Summary Comparison of Direct and Indirect Environmental Impacts.

Resource	Alternative 1 – No Action	Alternative 2 – Proposed Action	Alternative 3 – Proposed Action Plus Environmental Protection Measures
Public Health	There would be no immediate effects on the public health of the analysis area's overall population and sensitive subpopulations, including those with chronic disease and American Indian populations. There may be long-term negligible impacts on public health within the direct effects analysis area resulting from fugitive dust from reclamation activities. If and when the Rosebud Mine does close, revenues that support access to public health services, such as hospitals, libraries, schools, and other services, would cease, resulting in direct and indirect moderate to major long-term effects on social services and resources.	The public's exposure to diesel particulate matter (DPM) and fugitive dust, including coal dust, would be low due to limited exposure time and extent. Deposition of airborne contaminants of potential concern on soils and surface waters may occur, but it is not likely that the public would be exposed to these except incidentally. Project impacts on air concentrations of PM would result in a short-term minor adverse impact on public health within the project area and public access roads. Members of the public would not be permitted within the project area where PM and other hazardous substances would be present at higher concentrations. Any potential exposure of sensitive receptors to PM would be incidental and limited in duration. Therefore, the direct impacts on public health from PM2.5 and PM10, including from DPM and coal dust, would be short-term, negligible to minor, and adverse. There is a low likelihood that human consumption or contact with contaminated surface or ground water would occur from the Proposed Action. With monitoring and mitigation activities, increased risk to public health from exposure to water because of the Proposed Action is not likely. The Proposed Action would have a short-term moderate beneficial impact on public health as it relates to economics and social services; a short-term negligible impact on community health; and a short-term minor adverse effect on land use as it relates to public health. Effects on public safety from noise and from solid and hazardous waste would be none to negligible.	Impacts would be similar as those described for Alternative 2.

Table 13. Summary Comparison of Direct and Indirect Environmental Impacts.

Resource	Alternative 1 – No Action	Alternative 2 – Proposed Action	Alternative 3 – Proposed Action Plus Environmental Protection Measures
Geology	No impacts	Horizontal continuity of the geology in the analysis area would be lost during mining, and the overburden would be vertically altered. Rock-outcrop features of historical significance would also be lost. Impacts would be short- and long-term, major, and adverse. Impacts would last until the spoil used to replace the geologically distinct layers was eroded away.	Impacts would be similar to those described for Alternative 2. Rock-outcrop features of historical significance would be identified prior to disturbance as part of a geological resources survey, and if DEQ determines the feature should remain in place, the mine plan would be adjusted to avoid long-term major adverse impacts.
Water Resources – Surface Water	Impacts due to current and future mining and/or reclamation in other areas of the Rosebud Mine would continue.	Impacts on stream and spring flows, pond levels, and hydrologic balance due to road relocation and construction would be short-term, minor, and adverse. Impacts from changes in flow volumes, timing of flows, and frequency of flows would be long-term, minor to moderate, and adverse. Impacts due to mining activities within the 100-year floodplains would be short-term, minor, and adverse. Impacts on surface water quality due to mining would be long-term, minor to moderate, and adverse. Some surface water resources would be permanently lost or changed.	Impacts on stream and spring flows, pond levels, and hydrologic balance would be similar to those described for Alternative 2. Pit water would be managed to protect surface water quality outside of the analysis area. Postmine topography would be designed using 5-foot (instead of 10-foot) contours. DEQ approval would be required for drainage designs with estimated 2-year, 24-hour peak flows greater than 5 cfs (vs. the standard 15 cfs).
Water Resources – Ground Water	No impacts	Mining of the project area would permanently remove the Rosebud Coal aquifer and result in long-term reduction or elimination of the bedrock ground water contribution to baseflow in the perennial and intermittent reaches of the major tributaries. Long-term ground water drawdown due to mining would extend upgradient to the south beyond the mine area. Drawdown may affect existing water users of the Rosebud Coal aquifer. Mining would permanently remove springs in the project area whose ground water source is either the Rosebud Coal or overburden that would be removed. Replacement of the Rosebud Coal with spoil would have long-term, moderate, adverse impacts on ground water quality in the analysis area. When the spoil is sufficiently resaturated to discharge to alluvium in the major tributaries, impacts on alluvial ground water quality would likely be long-term, minor to moderate, and adverse.	Impacts would be similar to those described for Alternative 2. Pit-water handling requirements during mining would reduce potential impacts on alluvial ground water downgradient of storage ponds.

Table 13. Summary Comparison of Direct and Indirect Environmental Impacts.

Resource	Alternative 1 – No Action	Alternative 2 – Proposed Action	Alternative 3 – Proposed Action Plus Environmental Protection Measures
Water Resources – Water Rights	Impacts due to current and future mining and/or reclamation in other areas of the Rosebud Mine would continue.	If a surface or ground water right became unusable for its specified purpose due to flow or water quality changes, the impact would be short-term, moderate, and adverse; a suitable replacement source would be provided by Western Energy. If a water right were impacted by mining but still contained sufficient water of adequate quality to meet beneficial use needs, the impact would be short-term, negligible to minor, and adverse.	Impacts would be the same as those described for Alternative 2.
Vegetation	No impacts	The removal of 4,260 acres of vegetation for mining activities would result in direct impacts that are short-term, moderate, and adverse. Decreased vegetation vigor and diversity, and the potential for changes to vegetation communities from a reduced amount of surface and ground water in the area, would result in impacts that are long-term, minor, and adverse. The indirect impacts on vegetation from power-plant emissions would be long-term, minor, and adverse.	Impacts would be similar to those described for Alternative 2. Development of a water-management plan and modifications to reclamation practices related to soil stockpiling, soil redistribution, and seeding to better manage water and improve reclamation success would have a beneficial effect on vegetation.
Wetlands and Riparian Zones	No impacts	Surface disturbance and changes to surface and ground water during mining activities would result in impacts that are short- and long-term, moderate, and adverse. A wetland mitigation plan would reduce the loss of wetland function and values. Indirect impacts on wetlands from power-plant emissions would be negligible.	Impacts would be similar to those described for Alternative 2. Development of a water-management plan and additional requirements for the wetland mitigation plan would have a beneficial effect on wetlands and would reduce long-term adverse impacts.

Table 13. Summary Comparison of Direct and Indirect Environmental Impacts.

Resource	Alternative 1 – No Action	Alternative 2 – Proposed Action	Alternative 3 – Proposed Action Plus Environmental Protection Measures
Fish and Wildlife Resources	No impacts	Mining activities would result in loss of habitat due to surface disturbances that remove vegetation, direct mortality or injury due to vehicle or construction equipment collisions, and behavioral shifts such as a change in movement or displacement to other areas due to increased human activity and noise from blasting and mining operations. Direct impacts on small mammals, carnivores, big game, migratory birds, shorebirds, raptors, reptiles and amphibians, and aquatic species would be short- and long-term, negligible to minor, and adverse. Impacts on bats would be short- and long-term, moderate, and adverse. Indirect impacts from power-plant emissions would be negligible.	Impacts would be the same as those described for Alternative 2. Development of a water-management plan in conjunction with a nonjurisdictional wetland mitigation plan would result in potential beneficial impacts on most wildlife species that depend on wetland and riparian habitat.
Special Status Species	No impacts	Mining activities would result in loss of habitat due to surface disturbances that remove vegetation, direct mortality or injury due to vehicle or construction equipment collisions, and behavioral shifts such as a change in movement or displacement to other areas due to increased human activity and noise from blasting and mining operations. There would be no impacts on federally listed threatened and endangered species. Direct impacts on state species of concern would be short- and long-term, moderate, and adverse. Indirect impacts from power-plant emissions would be negligible.	Impacts would be the same as those described for Alternative 2. Development of a water-management plan in conjunction with a nonjurisdictional wetland mitigation plan would result in potential beneficial impacts on most wildlife species that depend on wetland and riparian habitat.
Cultural and Historic Resources	No impacts	Surface disturbance from mining and wetland mitigation activity may result in disturbance or destruction of historic properties located within the analysis area, and these impacts would be long-term, major, and adverse. Adverse impacts would be resolved through both a property-specific Memorandum of Agreement and a long-term PA stipulating measures for continued Section 106 compliance.	Wetland mitigation has the potential to adversely affect known and unknown historic properties. A PA would stipulate measures for Section 106 compliance prior to undertaking wetland mitigation.

Table 13. Summary Comparison of Direct and Indirect Environmental Impacts.

Resource	Alternative 1 – No Action	Alternative 2 – Proposed Action	Alternative 3 – Proposed Action Plus Environmental Protection Measures
Socioeconomic Conditions	Annual economic impacts associated with continued operation of the Rosebud Mine would be short-term and negligible since the mine would continue to support local economic activity. With the retirement of the Colstrip Power Plant Units 1 and 2 in 2022, impacts of changes in mine operation would likely be short-term and moderate since the mine would support local economic activity at a reduced level. Eventual mine closure would likely result in long-term, moderate to major negative impacts.	Impacts would be the same as those described for Alternative 1.	Impacts would be the same as those described for Alternative 1.
Environmental Justice	When the Rosebud Mine eventually closes, all populations within Rosebud County will be negatively affected, including the substantial environmental justice populations. Impacts would be long-term, negligible, and adverse.	Alternative 2 would delay the onset of adverse economic impacts, possibly allowing time for other sectors to develop. Therefore, impacts would be short-term and minor because the mine would continue to support local economic activity during the life of the mine.	Impacts would be the same as those described for Alternative 2.
Visual Resources	No impacts	Mining activities would change the visual landscape for drivers traveling along Horse Creek Road through the project area through changes to geology and topography, and removal of vegetation; the impact would be short-term, moderate, and adverse. For seven residences adjacent to the Rosebud Mine, active mining adjacent to existing mining areas may be visible in a small portion of the viewshed from a few locations. Depending on location, impacts would range from none to long-term, moderate, and adverse.	Impacts would be similar to those described for Alternative 2. Measures to improve revegetation success and a pre-mining geological resource survey to identify rock-outcrop features to be left intact may help the area return to pre-mine visual conditions more quickly.

Table 13. Summary Comparison of Direct and Indirect Environmental Impacts.

Resource	Alternative 1 – No Action	Alternative 2 – Proposed Action	Alternative 3 – Proposed Action Plus Environmental Protection Measures
Recreation	No impacts	All current use of the land for recreation (primarily hunting) would be unavailable during mine operations. Hunting opportunities on mine-related disturbance areas would be lost until revegetation and forage production were comparable to pre-mining levels associated with adjacent land. Impacts would be long-term, moderate, and adverse.	Impacts would be the same as those described for Alternative 2.
Paleontology	No impacts	Paleontological resources not identified or salvaged prior to mining would be permanently lost, resulting in impacts that are short- and long-term, major, and adverse. However, previously unknown paleontological resources may also be identified during mining activities and potentially salvaged, resulting in a beneficial impact.	The Unanticipated Discovery Plan required under Alternative 3 would increase the potential for discovery of paleontological resources of scientific interest. Discovery would not ensure protection but would help minimize unintentional destruction of these resources.
Access and Transportation	The haul road from Area C West would likely be decommissioned 15 to 20 years earlier.	A 4.2-mile segment of Horse Creek Road in the northeast/north-central portion of the analysis area would be relocated, and a 1.3-mile segment in the northwestern portion would be rerouted. Impacts from the relocation/reroute of Horse Creek Road would be short-term, minor, and adverse. The impacts due to haul, ramp, and service roads would be short-term, negligible, and adverse because the overall transportation system would not be disrupted.	Impacts would be the same as those described for Alternative 2.
Solid and Hazardous Waste	No impacts	Potential leaks or releases of solid or hazardous wastes would result in impacts that are short-term, negligible, and adverse. Impacts from boron toxicity related to the receipt and use of bottom ash at other permit areas of the mine would be short-term, negligible, and adverse.	Impacts would be the same as those described for Alternative 2.
Noise	No impacts	Direct impacts due to noise from mining and reclamation in the project area would be short- and long-term, negligible to minor, and adverse for the nearest rural residences. Indirect impacts due to noise from operation of the Rosebud and Colstrip Power Plants would continue to be moderate to minor for the residences in Colstrip and for those adjacent to the Rosebud Power Plant.	Impacts would be the same as those described for Alternative 2.

Table 13. Summary Comparison of Direct and Indirect Environmental Impacts.

Resource	Alternative 1 – No Action	Alternative 2 – Proposed Action	Alternative 3 – Proposed Action Plus Environmental Protection Measures
Land Use	No impacts	All current land uses within the analysis area would be temporarily disturbed during mine operations based on the timing of the approved mine plan. Impacts on grazing land would be long-term, moderate, and beneficial. Impacts on cropland would be long-term, moderate, and adverse. Impacts on cropland would be long-term, moderate, and adverse.	Impacts would be similar to those described for Alternative 2. Loss of soil productivity and associated loss of cropland/grazing-land productivity would vary slightly, with productivity potentially returning to postmine conditions more quickly.
Soil	No impacts	Soil salvage, storage, and respreading would result in soil erosion and changes to physical, chemical, and biological soil characteristics. During mining, soil erosion impacts would be short-term, minor, and adverse. Erosion rates in reclaimed areas would return to pre-mine rates within 2 years once vegetation stabilizes the surface. It would be many years before physical, chemical, and biological soil characteristics return to pre-mine conditions; impacts in reclaimed areas would be long-term, minor, and adverse.	Contouring soil stockpiles during mining would reduce short-term erosion from stockpiles compared to Alternative 2. Applying organic amendments such as grass to the upper 4 inches of soil in small problem areas (i.e., areas lacking sufficient organic matter, areas with limited vegetation cover, or areas susceptible to erosion) would enhance soil productivity and reduce erosion when compared to Alternative 2. Long-term impacts on soil would be the same as those described for Alternative 2.

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CHAPTER 3. AFFECTED ENVIRONMENT

This chapter describes the condition of the affected environment (including its human elements), the resource-specific analysis areas for direct and indirect effects, and the regulatory framework (state and federal laws and regulations) applicable to each resource. Resources analyzed in this Environmental Impact Statement (EIS) are listed in **Section 3.1, Resources Analyzed**. The general setting for the project area is described in **Section 3.1.2, General Setting**, to provide context for the resource-specific discussions in this chapter.

The environmental baseline information summarized in this chapter was obtained from the review of published sources, unpublished data, communication with government agencies, and review of field studies of the area. This chapter provides the scientific and analytic basis for the comparison of the Proposed Action and alternatives as presented in **Chapter 2** of this EIS.

3.1 RESOURCES ANALYZED AND GENERAL SETTING

3.1.1 Resources Analyzed

Based on internal agency scoping and comments received during public scoping, the 23 resources listed in **Table 14** were identified for detailed assessment in this EIS. Direct and indirect effects on these resources are disclosed in **Chapter 4**, and cumulative impacts are disclosed in **Chapter 5**. **Table 14** also provides resource-specific section references. One resource, alluvial valley floors (AVF), was considered but was dismissed from detailed analysis following the Montana Department of Environmental Quality's (DEQ) AVF determination (DEQ 2016a). Key language from DEQ's AVF determination and reasons the resource was dismissed from further analysis in this EIS are identified in **Section 3.25, Resources Considered but Dismissed**.

Table 14. Resources Analyzed.

Resource	Chapter and Section		
	Affected Environment	Direct and Indirect Effects	Cumulative Effects
Topography	3.2	4.2	5.4.1
Air Quality	3.3	4.3	5.4.2
Climate and Climate Change	3.4	4.4	5.4.3
Public Health and Safety	3.5	4.5	5.4.4
Geology	3.6	4.6	5.4.5
Water Resources – Surface Water	3.7	4.7	5.4.6
Water Resources – Ground Water	3.8	4.8	5.4.7
Water Resources – Water Rights	3.9	4.9	5.4.8
Vegetation	3.10	4.10	5.4.9
Wetlands and Riparian Zones	3.11	4.11	5.4.10
Fish and Wildlife Resources	3.12	4.12	5.4.11
Special Status Species	3.13	4.13	5.4.12
Cultural and Historic Resources	3.14	4.14	5.4.13
Socioeconomic Conditions	3.15	4.15	5.4.14
Environmental Justice	3.16	4.16	5.4.15
Visual Resources	3.17	4.17	5.4.16
Recreation	3.18	4.18	5.4.17
Paleontology	3.19	4.19	5.4.18
Access and Transportation	3.20	4.20	5.4.19

Table 14. Resources Analyzed.

Resource	Chapter and Section		
	Affected Environment	Direct and Indirect Effects	Cumulative Effects
Solid and Hazardous Waste	3.21	4.21	5.4.20
Noise	3.22	4.22	5.4.21
Land Use	3.23	4.23	5.4.22
Soil	3.24	4.24	5.4.23

3.1.2 General Setting

The proposed 6,746-acre project area is located about 12 miles west of Colstrip, Montana (MT) in Township 2 North, Range 38 and 39 East, and Township 1 North, Range 39 East (**Figure 1**). Straddling the border between Rosebud and Treasure Counties, the project area would expand the existing Rosebud Mine to the west into Treasure County (**Figure 2**). The Northern Cheyenne Indian Reservation is 13 miles south of the project area in Big Horn and Rosebud Counties. The northeast corner of the Crow Reservation is about 9 miles southwest of the project area in Big Horn County.

Situated in the northern Powder River Basin, the project area is generally east and north of the Little Wolf Mountains. The region has a semiarid climate and flat to rolling topography of shale and sandstone punctuated by occasional buttes. Tributaries of Horse Creek and West Fork Armells Creek, including Black Hank Creek, Donley Creek, Robbie Creek, McClure Creek, and Trail Creek (all of which lie within the drainage of the Yellowstone River), drain the project area. A ridge in the western portion of the project area divides the Horse Creek and West Fork Armells Creek drainages.

The project area is in the Northwest Great Plains Ecoregion, which encompasses the Missouri Plateau section of the Great Plains. Precipitation is variable, ranging from 5 to nearly 24 inches per year (over the past 40 years) and averaging 15 inches. The wettest months are May and June, and the driest are November through February. Large precipitation events of 1 to 3 inches in a day occur fairly frequently, and monthly precipitation totals of 4 to 10 inches have been recorded in April through September. Average annual snowfall is about 35 inches, and the snowiest month is January, averaging 6.9 inches. December, February, and March are nearly as snowy, averaging about 6 inches of snow.

The project area consists primarily of native grasslands, conifer/sumac woodlands, and upland shrublands, which together encompass about 80 percent (5,385 acres). Agricultural lands and pasture comprise about 15 percent (1,048 acres), and interspersed patches of lowlands, sandstone piles and cliffs, and disturbed or developed lands comprise the remaining 5 percent (313 acres).

3.2 TOPOGRAPHY

3.2.1 Introduction

This section provides an overview of the topography within the direct and indirect effects analysis areas and the governing regulatory authorities. The project area would include 6,746 permitted acres, of which 4,260 acres would be disturbed and require reclamation to the approximate original pre-mine contour to facilitate postmine land uses and hydrologic flow. The analysis area for topography is defined below in **Section 3.2.1.2, Analysis Area**.

3.2.1.1 Regulatory Framework

Specific federal and state regulatory requirements related to topography concern the reclamation of the postmine area to approximate original contours.

Federal Requirements

SMCRA outlines the minimum federal coal-mining requirements to restore land to a condition capable of supporting preexisting uses or to higher or better uses. As described in **Section 1.4.1.1, Office of Surface Mining Reclamation and Enforcement, Surface Mining Control and Reclamation Act**, DEQ operates an approved state program under SMCRA and, therefore, has primary jurisdiction over the regulation of surface coal-mining and reclamation operations on non-federal and non-Indian lands within the state.

State Requirements

DEQ regulates permitting and operation of surface coal mines on federal lands within MT under the authority of MSUMRA (Section 82-4-221 et seq., MCA) and its implementing rules (ARM 17.24.301-1309). MSUMRA (ARM 17.24.313) outlines the requirements for postmine reclamation of topography. The postmine topography (PMT) that Western Energy proposes to meet at final bond release under Alternative 2 is described in **Section 2.4.4.5, Postmining Topography and Drainage Basin Design** and shown in **Figure 9**. A discussion of the reclamation phases as they relate to bond release is provided in **Section 1.6**.

Local Requirements

There are no local requirements related to topography within or near the analysis area.

3.2.1.2 Analysis Area

Direct Effects Analysis Area

The analysis area for direct effects on topography is the proposed 4,260-acre mining disturbance area within the project area and includes all mining areas, stockpiles, scoria pits, haul roads, and haul-road ramps.

Indirect Effects Analysis Area

The analysis area for indirect effects on topography includes the area associated with direct effects and adds to it the watersheds of the streams in and downstream of the project area.

3.2.2 Pre-Mine Topography

The project area is located in the Pine Breaks region of southeastern MT and is distinguished from neighboring plains areas by its more rugged topography. Pre-mining topography is shown in **Figure 13**. Project area topography is rugged along the western and southern limits and relatively flat to rolling within the central and eastern portions of the area. Prominent monoliths of eroded sandstone exist in some parts of the project area. Differential erosion of softer, more erosive materials surrounding harder material such as sandstone and thermally metamorphosed stone (clinker) are responsible for much of the topographic relief in the area. Surface elevation topographic relief within the project area ranges from 3,980 feet within the southwestern portion of the project area to 3,320 feet where Black Hank Creek flows out of the northeastern portion of the project area (Meyer and Ferguson 2012).

The project area lies within the Yellowstone River watershed and is drained by several tributaries of West Fork Armells Creek. Tributaries to West Fork Armells Creek within the project area include Trail, McClure, Robbie, Donley, and Black Hank Creeks. A small area is also drained by Horse Creek, a tributary to Sarpy Creek (**Figure 13**).

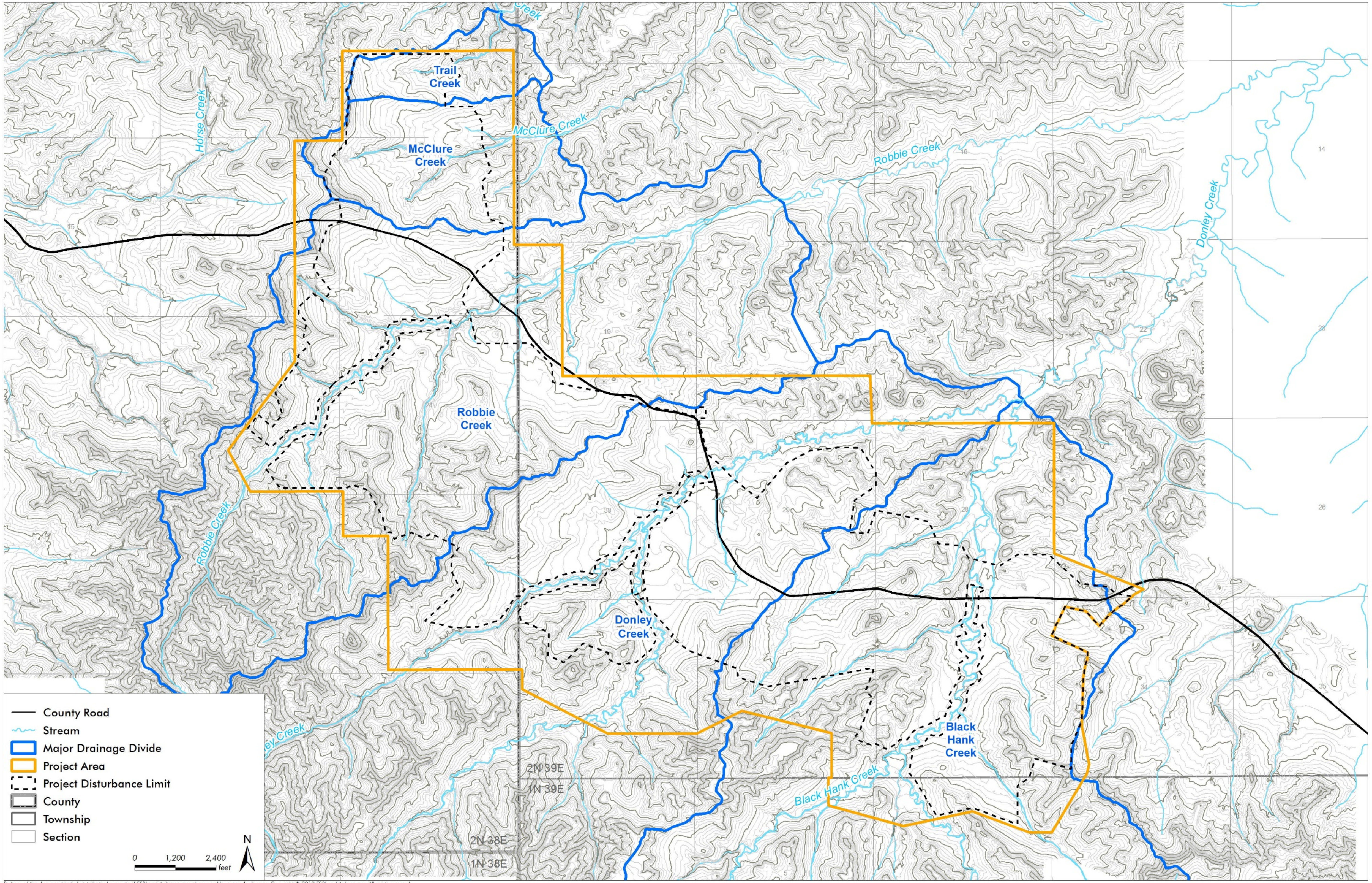

Figure 13. Pre-Mine Topography.

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3.3 AIR QUALITY

3.3.1 Introduction

Operations associated with coal mining including drilling, blasting, hauling, collection, transportation, and combustion (i.e., indirect effects) can be sources of emissions and air pollution. The following sections describe the affected environment with respect to air quality, including the governing regulatory framework, historic and existing emissions, and current regional air quality. The analysis area for air quality is defined below in **Section 3.3.1.2, Analysis Area**.

3.3.1.1 Regulatory Framework

The regulations pertaining to the Affected Environment and Alternatives 2 and 3 are discussed in the context of federal and state requirements separately below. Because the United States Environmental Protection Agency (EPA) has delegated authority to DEQ to administer and enforce the rules set forth under the Federal Clean Air Act (CAA) in the state of MT, in some instances, MT regulations are discussed together with the federal requirements.

Coal from the project area would be burned at Units 3 and 4 of the Colstrip Steam Electric Station (Colstrip Power Plant) and at the Rosebud Power Plant. Hence, the two power plants are indirect sources of emissions for the Proposed Action (see **Section 3.3.1.2, Analysis Area)**. Therefore, regulations relevant to the two power plants are provided in addition to regulations applicable to the Rosebud Mine.

Federal Requirements

Ambient Air Quality Standards

The CAA is a federal law designed to regulate and protect the air quality in the U.S. and is administered by EPA. Under the CAA, EPA is required to establish National Ambient Air Quality Standards (NAAQS) for six criteria air pollutants (CAPs) that are considered harmful to public health and the environment: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM) with diameter 10 microns or less (PM_{10}), fine PM with diameter 2.5 microns or less ($PM_{2.5}$), and sulfur dioxide (SO_2) (EPA 2016a). The NAAQS, which are listed in **Table 15**, include both primary standards to protect public health (including the health of sensitive populations), and secondary standards to protect public welfare (including protection against decreased visibility and damage to animals, crops, vegetation, and buildings).

EPA has delegated authority to DEQ to administer and enforce the rules set forth under the CAA in the state of Montana, including the NAAQS. In addition to the NAAQS, individual states have the option to adopt more stringent standards and to include other pollution sources. Under Montana's implementation of the CAA, DEQ established air quality regulations under the Administrative Rules of Montana (ARM), Title 17, Chapter 8, Subchapters 1 through 17 (ARM 17.8.101-17.8.1713).

To determine compliance and assess progress against the NAAQS, the EPA utilizes a CAP-specific statistic referred to as a design value (DV), which describes the status of a given location's air quality relative to the NAAQS. The DV of each CAP at a given location is calculated using ambient monitoring data following the form of the respective NAAQS (listed in the footnotes of **Table 15**). The calculated DVs are then used to officially designate the status of each area as either "attainment" (demonstrates compliance with NAAQS), "nonattainment" (exceeds the NAAQS), "maintenance" (in the process of redesignating to attainment by continuing to show compliance with the NAAQS after having initially been in nonattainment), or “unclassifiable” (insufficient data for compliance determination).

Once a nonattainment designation occurs, state and local air agencies must develop a federally enforceable State Implementation Plan (SIP) to outline the control measures and strategies that will be used to attain and maintain compliance with the NAAQS (40 CFR Part 51). In developing a SIP, states are required to demonstrate that the plans adequately provide for timely attainment and maintenance of the NAAQS. In addition, states are encouraged to investigate alternative strategies and assess the cost and benefit of each in respect to achieving and maintaining attainment.

Table 15. National and Montana Ambient Air Quality Standards.

Pollutant	Averaging Time	National Ambient Air Quality Standards (NAAQS)		Montana Ambient Air Quality Standards (MAAQS)
		Primary	Secondary	
Carbon Monoxide (CO)	8 hours	9 ppm [a]	NA	9 ppm [b]
	1 Hour	35 ppm [a]	NA	23 ppm [b]
Lead (Pb)	Rolling 3 month	0.15 μg/m^3 [c]	0.15 μg/m^3 [c]	NA
	Quarterly	1.5 μg/m^3 [c, o]	1.5 μg/m^3 [c, o]	1.5 μg/m^3 [c]
Nitrogen Dioxide (NO_2)	1 hour	100 ppb [d]	NA	0.30 ppm [b]
	Annual	53 ppb [e]	53 ppb [e]	0.05 ppm [f]
Ozone (O_3)	1 hour	NA	NA	0.10 ppm [b]
	8 hours	0.070 ppm [g]	0.070 ppm [g]	NA
Particulate matter ≤ 2.5 μm diameter ($PM_{2.5}$)	Annual	12.0 μg/m^3 [h]	15.0 μg/m^3 [h]	NA
	24 hours	35 μg/m^3 [i]	35 μg/m^3 [i]	NA
Particulate matter ≤ 10 μm diameter (PM_{10})	Annual	NA	NA	50 μg/m^3 [j]
	24 hours	150 μg/m^3 [k]	150 μg/m^3 [k]	150 μg/m^3 [k]
Sulfur Dioxide (SO_2)	1 hour	75 ppb [l]	NA	0.50 ppm [m]
	3 hours	NA	0.5 ppm [a]	NA
	24 hours	0.14 ppm [a, p]	NA	0.10 ppm [b]
	Annual	0.030 ppm [e, p]	NA	0.02 ppm [f]
Fluoride in Forage	Monthly	NA	NA	50 μg/g [c]
	Grazing Season	NA	NA	35 μg/g [c]
Hydrogen Sulfide (H_2S)	1 hour	NA	NA	0.05 ppm [b]
Settleable PM	30 days	NA	NA	10 g/m^2 [c]
Visibility	Annual	NA	NA	3 x 10^{-5}/m [f, n]

Source: EPA 2016a; DEQ 2016b.
[a] Not to be exceeded more than once per year.
[b] Not to be exceeded more than once over any 12 consecutive months.
[c] Not to be exceeded.
[d] Not to be exceeded by the 98th percentile of 1-hour daily maximum concentrations averaged over 3 years.
[e] Not to be exceeded by the annual mean.
[f] Not to be exceeded by the arithmetic average over any four consecutive quarters.
[g] Not to be exceeded by the annual fourth-highest daily maximum 8-hour concentration averaged over 3 years.
[h] Not to be exceeded by the annual mean averaged over 3 years.
[i] Not to be exceeded by the 98th percentile of 24-hour concentrations averaged over 3 years.
[j] Not to be exceeded by 3-year average of annual means.
[k] Not to be exceeded more than once per year on average over 3 years.
[l] Not to be exceeded by the 99th percentile of 1-hour daily maximum concentrations averaged over 3 years.
[m] Not to be exceeded more than eighteen times in any 12 consecutive months.
[n] This standard only applies to Class I areas designated under ARM 17.8 Subchapter 8.
[o] The 1978 Pb NAAQS is retained in East Helena, MT until EPA approves attainment and/or maintenance demonstrations for the revised Pb NAAQS.
[p] The 1971 SO_2 NAAQS are retained in Laurel, MT and East Helena, MT until EPA approves attainment and/or maintenance demonstrations for the revised SO_2 NAAQS.
μg/g = micrograms per gram.
μg/m^3 = micrograms per cubic meter.
mg/m^3 = milligrams per cubic meter.
ppb = parts per billion.
ppm = parts per million.
NA = Not Applicable.

Title V Operating Permits

The Title V Operating Permit program was established by the 1990 amendments to the CAA and requires major stationary sources of air pollution to obtain a permit defining all applicable emission limits and monitoring requirements with the purpose of ensuring that these rules and regulations are met. A major source is defined here as any source that emits or has the potential to emit 100 tons per year or more of any criteria air pollutant.

The applicable requirements include all rules and regulations that the source is subject to, including any promulgated rules with future-effective compliance dates. These include but are not limited to applicable requirements of Federal Implementation Plans (FIPs), SIPs, consent decrees, and the CAA.

Stationary non-fugitive emissions at the Rosebud Mine are less than 100 tons per year of any pollutant; therefore, the Rosebud Mine is not subject to the Title V Operating Permit requirements.

The Colstrip and Rosebud Power Plants are major sources and have Title V operating permits, OP0513-13 and OP2035-03, respectively, that outline all of the applicable requirements for each facility.

New Source Performance Standards

The New Source Performance Standards (NSPS) are technology-based emission limits that apply to specific categories of new or significantly modified stationary sources (40 CFR Part 60). The applicable source categories of the NSPS to the facilities that would burn project area coal are the Fossil-Fuel-Fired Steam Generators (40 CFR Part 60, Subpart D), Electric Utility Steam Generating Units (40 CFR Part 60, Subpart Da), and Coal Preparation and Processing Plants (40 CFR Part 60, Subpart Y). 40 CFR Subpart D applies to fossil-fuel-fired steam generating facilities for which construction commenced after August 17, 1971, while Subpart Da more specifically applies to electric utility steam generators for which construction, modification, or reconstruction commenced after September 18, 1978. Colstrip Units 1 through 4 are subject to Subpart D since their construction commenced before 1978 (permits were issued for construction of Units 1 and 2, and Units 3 and 4 in 1973 and 1977, respectively (TRD #0513-13)), while the Rosebud Power Plant and the Continuous Emissions Monitoring Systems (CEMS) of Colstrip Units 3 and 4 are subject to Subpart Da (see **Section 1.2.2, Coal Combustion** for a history of the power plants). The coal handling facilities of both Colstrip and Rosebud Power Plants are subject to Subpart Y, which sets performance standards for coal processing and handling facilities that process more than 200 tons of coal per day and were constructed or modified between October 27, 1978 and April 28, 2008.

New Source Review and Prevention of Significant Deterioration

The New Source Review (NSR) program of the CAA requires a preconstruction permit that outlines air emission limits and required operating procedures for any new or modified source for which the construction or modification would result in a significant net emissions increase of regulated pollutants. The NSR program applies to sources in both nonattainment and attainment areas through the Nonattainment NSR program and the Prevention of Significant Deterioration (PSD) program, respectively (EPA 2006).

Both Colstrip and Rosebud Power Plants are located within attainment areas for the NAAQS, and thus are subject to the PSD program. The PSD program requires installation of the Best Available Control Technology (BACT) for all regulated pollutants, and the BACT determination must be performed on a case-by-case basis while considering available technology along with economic, energy, and environmental impacts (EPA 1978a). In addition to the BACT requirements, a PSD review includes an air quality analysis to quantify the impacts of the proposed project in order to ensure that air pollutant concentrations do not result in nonattainment of the NAAQS or exceed defined PSD increments in specific national parks and wilderness areas, known as Mandatory Federal Class I Areas, or at other Class II areas defined by the Federal Land Managers (see **Attainment Status** below for a discussion of these areas within the analysis area; Federal Class I Areas are shown in **Figure 18**).

Mercury and Air Toxics Standards

The 1990 CAA Amendments require the EPA to regulate and limit the emissions of air toxics that cause or may cause cancer or other major adverse health effects. There are currently 187 of these air toxics, referred to as hazardous air pollutants (HAPs), listed in Section 112 of the CAA. In 2012, the EPA promulgated the Mercury and Air Toxics Standards (MATS) that sets emission limits for mercury, acid gases, and HAPs at new and existing coal-fired power plants (40 CFR 63, Subpart UUUUU). These emission limits, also known as the National Emission Standards for Hazardous Air Pollutants (NESHAP) for Coal- and Oil-Fired Electricity Utility Steam Generating Units, require the installation of the maximum achievable control technology (MACT). As existing coal-fired generating facilities, the Colstrip and Rosebud Power Plants must comply with specific HAP emission limits for the following pollutants:

a. Filterable particulate matter (PM) or total non-mercury HAP metals or individual HAP metals (antimony, arsenic, cadmium, chromium, copper, lead, selenium and others)
b. Hydrogen chloride or sulfur dioxide
c. Mercury

Montana promulgated mercury emission standards applicable to mercury-emitting generating units from January 1, 2010 under ARM 18.7.771 that are more stringent than the federal mercury emission standards in 40 CFR 63, subpart UUUUU. Both the Colstrip and Rosebud Power Plants had already installed mercury control systems and Mercury Emissions Monitoring Systems (MEMS) in 2011 to comply with Montana's mercury emission standards and, therefore, no additional mercury emission controls were required under MATS. The only additional modification required for MATS was modification of the air pollution control systems on Colstrip Units 1 and 2 to meet the PM emission limit (DEQ 2015c). In particular, the installation of sieve trays to enhance the performance of pollution control scrubbers was fully completed for Unit 2 by June 2015 and for Unit 1 by May 2016. The Colstrip Power Plant initially demonstrated compliance with MATS in September 2016. During the second quarter 2018 compliance demonstration, the Colstrip Power Plant operator identified an exceedance of the non-mercury metals portion of MATS. The Colstrip Power Plant operator is currently working to identify the cause of this exceedance (DEQ 2018).

Regional Haze Rule

The Regional Haze Rule (RHR) was promulgated in 1999 with the aim of improving and protecting visibility in 156 Mandatory Federal Class I Areas (40 CFR 51.308). This rule requires states to develop long-term goals in the form of regional haze implementation plans that provide for reasonable progress toward achieving natural visibility in each Federal Class I area by reducing existing visibility impairment and preventing future impairments resulting from man-made air pollution. The reasonable progress goals (RPGs) of the RHR require improvement on the most impaired days while ensuring that no degradation in visibility occurs on the least impaired days, with the ultimate goal of attaining natural conditions in each Federal Class I area by 2064. The RPGs must consider "the cost of compliance, the time necessary for compliance, the energy and non-air quality environmental impacts of compliance, and the remaining useful life of any potentially affected sources (40 CFR 51.308)." Each state must account for all Federal Class I areas within their state, along with Federal Class I areas in other states in which visibility may be impaired by emissions from within their state.

Three visibility metrics are used to determine progress toward to the goals of the RHR: baseline conditions, current conditions, and natural conditions (40 CFR 51.308). Baseline conditions are the point of reference against which progress is measured, and were established between 2000 and 2004 for the most and least impaired days if data was available, or when progress tracking started. Current conditions are used to evaluate progress, and the period for calculating current visibility conditions is the most recent 5-year period for which data are available. Natural conditions are the estimated visibility conditions in the absence of man-made emissions and are the ultimate goal to be reached by 2064.

Best Available Retrofit Technology (BART)

The RHR requires the implementation of the Best Available Retrofit Technology, or BART, for industrial facilities emitting air pollutants that negatively impact visibility by contributing to regional haze. The BART requirements of the RHR apply to facilities that were built between 1962 and 1977 and emit more than 250 tons per year of visibility impairing pollution, such as $PM_{2.5}$, oxides of nitrogen (NOx) and SO_2. Colstrip Units 1 and 2 are sources that are subject to BART, while Units 3 and 4 were constructed outside the period required for BART analysis.

The RHR required that all states revise their SIP to implement measures to make reasonable progress toward visibility goals no later than December 17, 2007 (40 CFR 51.308). EPA promulgated a Federal Implementation Plan (FIP) to assure reasonable progress for visibility improvement in Federal Class I areas impacted by emissions from Montana (EPA 2012). The final rule became effective in 2012 and included required upgrades of the air pollution control systems at Colstrip Units 1 and 2, but did not require upgrades at Colstrip Units 3 and 4. Subsequently, a decision by the Ninth Circuit Court found the EPA's BART determination for NOx and SO_2 emissions to be arbitrary and capricious and vacated portions of the FIP setting BART emission limits for Colstrip Units 1 and 2, and remanded it to the EPA (Case 12-73710, 06/09/2015, ID: 9566382, Docket Entry: 76-1).

2016 Consent Decree

On July 12, 2016, the United States District Court of Montana filed a consent decree containing the terms of a settlement reached as a result of a 2013 lawsuit brought by Sierra Club and the Montana Environmental Information Center against the owners of Colstrip for alleged violations of the CAA (see also discussion in **Section 1.2.2.1, Colstrip Power Plant**). The consent decree requires the operation of Colstrip Units 1 and 2 boilers to cease on or before July 1, 2022, and upon being filed it also set more restrictive emission limits for NOx and SO_2. The consent decree does not include any modification to the operation of Colstrip Units 3 and 4, and thus does not impact the analysis for the direct or indirect effects of the Proposed Action, but would apply to cumulative effects due to operation of Colstrip Units 1 and 2.

State Requirements

Several of the Montana state requirements have been discussed above along with the federal requirements. Some additional features are presented below.

Montana Ambient Air Quality Standards

The Montana Ambient Air Quality Standards (MAAQS) are promulgated under ARM 17.8.201-230. These are presented along with the NAAQS in **Table 15**.

The Montana Settleable PM standard was designed for much larger particles than those covered under the federal NAAQS for PM_{10} and $PM_{2.5}$. Montana utilizes a number of measures through permitting and enforcement that serve to provide reasonable precautions against excess PM generation. These include

ARM 17.8.308 which includes but is not limited to the following requirements: (1) No person shall cause or authorize the production, handling, transportation, or storage of any material unless reasonable precautions to control emissions of airborne particulate matter are taken. Such emissions of airborne particulate matter from any stationary source shall not exhibit an opacity of 20 percent or greater averaged over six consecutive minutes, except for emission of airborne particulate matter originating from any transfer ladle or operation engaged in the transfer of molten metal which was installed or operating prior to November 23, 1968. (2) No person shall cause or authorize the use of any street, road, or parking lot without taking reasonable precautions to control emissions of airborne particulate matter. In addition, when Montana PM, PM_{10}, and $PM_{2.5}$ sources trigger permitting, they must go through a BACT analysis and controls that, while reducing PM_{10} and $PM_{2.5}$ would also provide total PM reductions.

The fluoride in forage standard addresses excess fluoride in vegetation that is foraged. The other two Montana-specific standards are a 1-hour standard for hydrogen sulfide (H_2S) and a standard for visibility that is applicable to Class I areas.

Montana Major Facility Siting Act

The Montana Major Facility Siting Act (MFSA) governs the siting and construction of major facilities related to the generation, conversion, or distribution of energy with the goal of meeting the electricity and energy demands while maintaining a clean and healthful environment (Montana Environmental Quality Council 1985, ARM Title 17 Chapter 20). Colstrip Units 3 and 4 were sited and constructed under a MFSA certificate, which governs Units 3 and 4 and the associated facilities (see discussion in **Section 1.2.2.1, Colstrip Power Plant**). MFSA requires that Colstrip only burn coal from the Rosebud seam and that the inlet sulfur content of coal burned not exceed 1 percent. Daily testing of the sulfur content of the coal is required to ensure compliance (DEQ 2015c).

Local Requirements

There are no local regulations applicable to air quality.

3.3.1.2 Analysis Area

For the purpose of this analysis, the analysis area for air quality is determined by the analysis area for indirect/cumulative effects due to the long-range transport of pollutants from the elevated stacks of the Colstrip and Rosebud Power Plants. The region within a distance of 300 kilometers (km) is typically considered as the analysis area for coal-fired power plants by OSMRE (e.g., Four Corners Power Plant-Navajo Mine Draft EIS (OSMRE 2014b). For this EIS, a slightly larger rectangular region that encompasses the 300-km extent shown in **Figure 14** was conservatively chosen as the analysis area. **Figure 14** also shows the Federal Class I Areas located within the analysis area. The analysis area was selected such that Federal Class I areas that intersected the 300-km circle were included in their entirety.

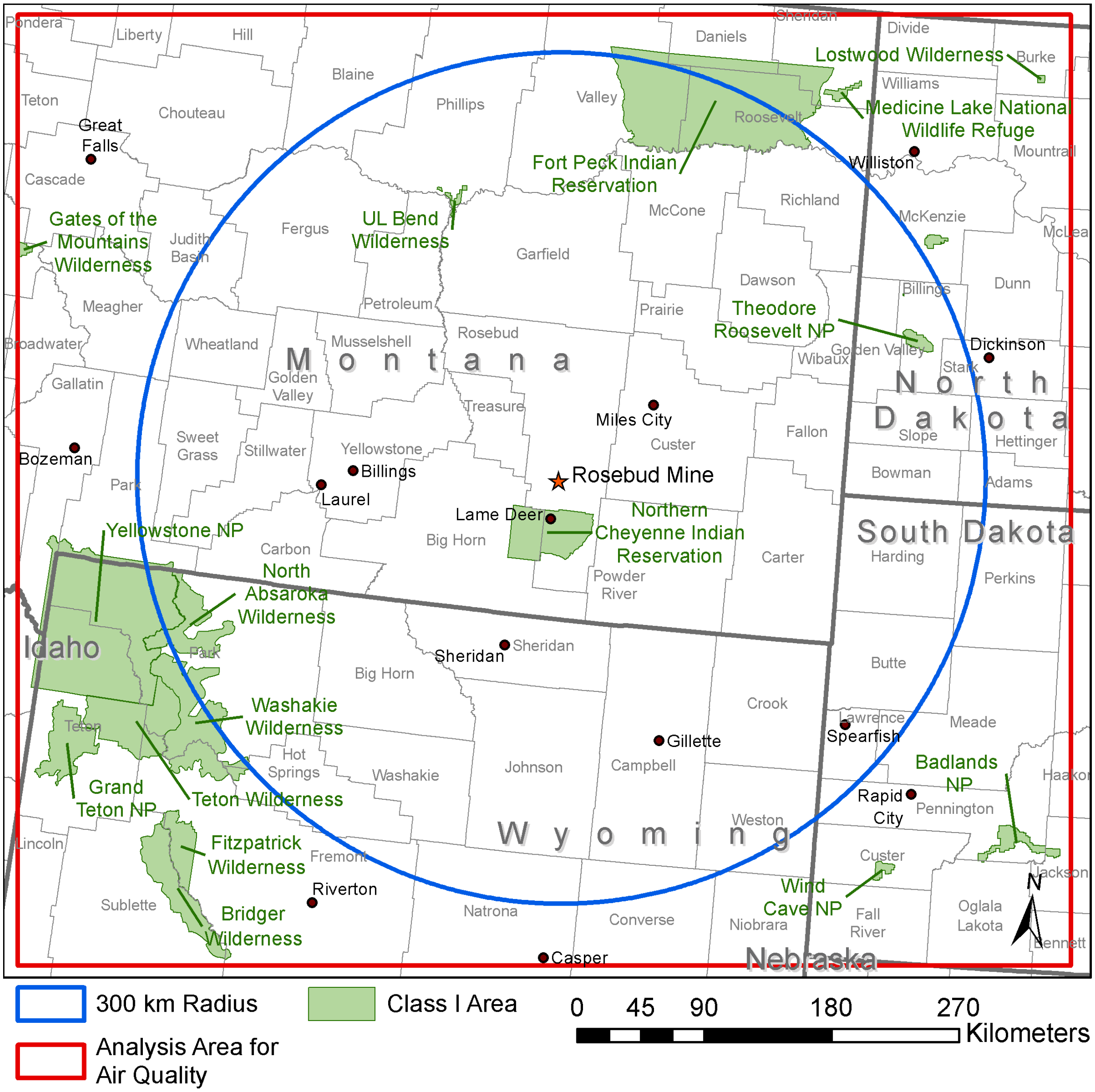

Figure 14. Analysis Area for Air Quality for Indirect/Cumulative Effects.

km = kilometers.

3.3.2 Local and Regional Meteorological Patterns

The climate in southeastern Montana is classified as semiarid continental and is characterized by hot, moderately dry summers; cool, dry falls; cold, dry winters; and cool, moist springs. Temperatures range from an average of 25.0 degrees Fahrenheit (°F) in December to 72.7 °F in July (based on 2000-2016 data, NOAA 2017a). The average annual precipitation at Colstrip is 15.85 inches (from 2000-2016 data, NOAA 2017a).

The project area consists of undeveloped rangeland and forestland used primarily for livestock grazing and is bounded to the southwest by the Little Wolf Mountains. Areas to the north, east, and west of the mining areas are characterized by forested, rolling hills and plateaus comprised of ponderosa pine and skunkbrush sumac, with slopes and valleys characterized as grassland and sagebrush shrublands. The local terrain affects local wind patterns.

The wind rose presented in **Figure 15** shows prevailing wind patterns as measured at Frank Wiley Field Airport in Miles City, MT from 2011-2015 (DEQ 2016c). This station is the closest to the mine (approximately 80 km to the northeast) with a complete meteorological dataset, has similar terrain, and is influenced by similar eastern Montana weather patterns. Data from this meteorological station were also used in the air dispersion modeling performed by DEQ for the Initial Designation of the 2010 1-hour SO_2 Standard for Colstrip (DEQ 2016c). The wind directions are primarily from the west-northwest and south-southeast.

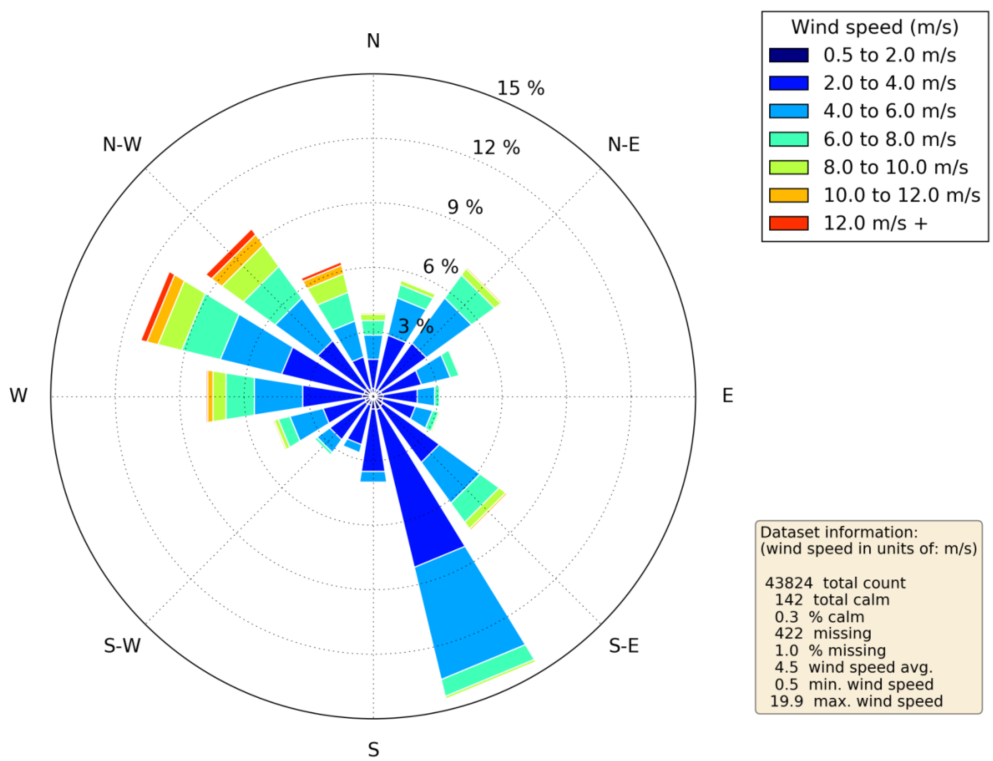

Figure 15. Wind Rose of Frank Wiley Field Airport in Miles City, MT for 2011 – 2015.
m/s = meters per second.

3.3.3 Air Quality Monitoring at Rosebud Mine

Western Energy operated seven PM_{10} air-quality monitoring sites throughout the Rosebud Mine complex from 1992 through 2000. The first and second highest monitored values from this period are presented in **Table 16**. The annual mean of the monitoring sites over the 10-year monitoring period was 14 μg/m^3, while the maximum 24-hour concentration measured at any site was 80 μg/m^3. These concentrations were well below the PM_{10} NAAQS, constituting 28 percent and 53 percent of the annual and 24-hour design values, respectively (**Table 16**).

Table 16. Air Quality Monitoring PM_{10} Values at the Rosebud Mine from 1992 – 2000.

Pollutant	Averaging Time	NAAQS/MAAQS		Monitored Values (1992 - 2000)	
		Primary Standard	Secondary Standard	1st High	2nd High
PM_{10}	24-hour	150 μg/m³	150 μg/m³	80 μg/m³ (53% of standard)	78 μg/m³ (52% of standard)
	annual	50 μg/m³	—	14 μg/m³ (28% of standard)	— [1]

Source: Monitoring data from Bison Engineering 2013a.
[1] 2nd high not shown because the standard is based on the first high.
μg/m³ = micrograms per cubic meter.

In 2001, Western Energy was permitted by DEQ to terminate their ambient monitoring network based on a review of the monitoring data from the mine (MAQP #1570-06). In 2012, Western Energy deployed two modern, real-time Met One Beta Attenuation Monitors to monitor PM_{10}. One monitor is located on the eastern boundary of Area A adjacent to State Highway 39, while the other is on the northern boundary of the project area (Bison Engineering 2013a). These monitors are still in operation, but the project area monitor was modified to measure $PM_{2.5}$ in January 2014. The data collected from 2012-2016 at these monitors is presented in **Table 17**. All of the monitored values fall well below the level of the NAAQS (and MAAQS) for PM_{10} and $PM_{2.5}$.

Table 17. Monitored PM Concentrations at the Rosebud Mine from 2012 – 2016.[1]

Parameter	Units	Site	2012	2013	2014 [a]	2015	2016	NAAQS
PM_{10} 2nd highest 24-hour average	μg/m³	Area A[2]	74	47	57	83	80	150
		Area F	62	28	—	—	—	
PM_{10} Annual Average	μg/m³	Area A[2]	18	12	12	15	14	50
		Area F	12	9	—	—	—	
$PM_{2.5}$ 98th percentile 24-hour average	μg/m³	Area F	—	—	12	31	12	35
$PM_{2.5}$ annual average	μg/m³	Area F	—	—	5.1	5.6	3.7	12.0

Source: Monitoring data from Western Energy 2017a.
[1] The PM_{10} Beta Attenuation Monitor in Area F was modified to measure $PM_{2.5}$ on January 15, 2014. Therefore, the Area F 2nd highest 24-hour average PM_{10} and annual average PM_{10} are not available for 2014.
[2] Area A PM_{10} data were not available for November and December of 2016.
μg/m³ = micrograms per cubic meter.

3.3.4 Existing Regional Air Pollutant Sources and Emissions

There are a number of existing sources of air pollutants that affect air quality in the cumulative and indirect impacts analysis area. In the immediate surroundings of the project area, the primary sources of air pollution are the existing permit areas of the Rosebud Mine, and Colstrip and Rosebud Power Plants, while in the larger analysis area there are a number of other major regional point and area sources, including other mines and electric generation facilities. The emissions from these sources are quantified and discussed in the following sections.

3.3.4.1 Existing Emissions from Rosebud Mine

Western Energy currently holds MAQP for Area C (MAQP #1570-08), and Areas A, B, D, and E (MAQP #1483-08) of the Rosebud Mine (see discussion under **Clean Air Act of Montana** in **Section 1.4.1.2,**

Montana Department of Environmental Quality). Of these areas, only Areas A, B, and C are still actively mined, while Areas D and E are undergoing reclamation. Emission sources in the active mining areas include fugitive dust sources (topsoil removal and unloading, overburden drilling, blasting, and removal, coal drilling, blasting, removal, loading, dumping, crushing, conveying, haul and access roads, and wind erosion from disturbed areas), mobile and stationary diesel engines, and explosive use for overburden and coal blasting. While Areas D and E are no longer actively mined, ongoing reclamation operations in these areas result in fugitive dust emissions (from topsoil handling and wind erosion). Western Energy also holds a MAQP for a portable crushing facility that is used throughout the mine to crush rock for use on mine roads (MAQP #4436-00). Emissions from the crusher during the period of the Proposed Action are characterized under **Emissions from the Rosebud Mine and the Portable Crusher** in **Section 5.3.2.1, Cumulative Emissions.**

Western Energy employs a number of control methods to reduce emissions at the mine, including but not limited to, the application of chemical dust suppressant (a mixture of lignin sulfonate and water) and water on haul and access roads, prompt revegetation of disturbed areas, and the use of an enclosure when drilling coal and overburden. In addition, a recent BACT determination for controlling fugitive particulate emissions led to the installation of a Foam Dust Suppression System on the coal processing and conveying facilities (MAQP #1570-08). The MAQPs for Area C (MAQP #1570-08) and for Areas A, B, D, and E (MAQP #1483-08) are included in Appendix D-1 and Appendix D-2, respectively. The permits list all applicable rules and regulations, emissions limitations, and reporting requirements.

Criteria Air Pollutant Emissions

DEQ reports annual emission inventories of CO, NOx, PM_{10} filterable, $PM_{2.5}$ filterable, PM condensable, total PM, and SO_2 for the permitted sections of the mine based on activity data provided by Western Energy. The annual Rosebud Mine CAP emissions reported by DEQ from 2010 to 2015 are presented in **Table 18**. In addition to the CAPs, emissions of volatile organic compounds (VOCs) are also shown as they contribute to ozone and secondary particulate matter. Mobile exhaust emissions are not included in the totals shown below as they are not permitted sources and are not included in the annual emission inventories. The total CAP emissions are almost entirely from low-level, fugitive sources with the largest sources being fugitive dust emissions from wind erosion of exposed areas, and vehicle traffic on haul and access roads.

Table 18. Historic CAP Emissions Reported from Rosebud Mine.

Year	PM_{10}	$PM_{2.5}$	NOx	SO_2	CO	VOC
	(tons/year)					
2010	1557.7	345.9	200.8	21.5	724.1	1.5
2011	1312.3	263.6	162.2	16.9	569.4	1.5
2012	1307.2	271.9	212.7	22.2	747.1	2.0
2013	1267.1	301.4	200.6	21.1	709.7	1.8
2014	1545.1	361.3	238.9	26.6	894.1	1.0
2015	1514.7	350.4	302.1	33.1	1111.7	1.7

Source: Montana DEQ Annual Emission Inventory Reporting Records (2010-2015).
Note: Lead (Pb) is included under hazardous air pollutants.

Hazardous Air Pollutant Emissions

Operations associated with the mining, processing, and handling of coal result in the emission of HAPs. The primary sources of HAPs at the mine are the fugitive coal dust sources and diesel exhaust. Raw coal contains a number of HAPs such as antimony, arsenic, beryllium, cadmium, chromium, copper, lead, manganese, mercury, nickel and selenium. The generation of coal dust at the mine suspends these compounds in the air where they can potentially impact human health and ecosystems via inhalation and deposition on soils and waterbodies. The exhaust of the diesel equipment at the mine also releases toxic gases and particulate matter, referred to as diesel particulate matter (DPM). DPM is considered a carcinogenic air toxic, but is not currently regulated by the EPA (EPA 2002). Further information on hazardous air pollutant emissions from the mine is provided in **Project Area Hazardous Air Pollutant Emissions** under **Section 4.3.3.1, Direct Impacts** and in **Hazardous Air Pollutant Emissions** in **Section 5.3.2.1, Cumulative Emissions**

3.3.4.2 Existing Emissions from Colstrip and Rosebud Power Plants

The Colstrip Power Plant, which is described in detail in **Section 1.2.2.1**, is surrounded by Areas A, B, D and E of the Rosebud Mine, and receives coal directly from the mine via enclosed conveyors. The facility is comprised of four coal-fired boilers (Units 1-4) with an approximate total generating capacity of 2,100 megawatts. Each unit employs wet Venturi scrubbers for SO_2 and PM control, advanced low oxides of nitrogen (NO_x) firing and digital controls for NO_x control, and mercury oxidizer/sorbent systems for mercury control. The operators are also required to maintain Continuous Emissions Monitoring Systems (CEMS) for SO_2, NO_x, carbon dioxide (CO_2) and opacity along with MEMS for mercury compliance monitoring. Units 1 and 2 are older units that generate approximately 307 megawatts each and will be retired by July 1, 2022 as part of the 2016 consent decree (see **Section 1.2.2.1, Colstrip Power Plant**).

The Rosebud Power Plant is located approximately 6 miles north of the Rosebud Mine along State Highway 39 and is approximately a 38-megawatt electric generating facility designed to burn low-British thermal unit (Btu) waste coal through utilization of a low temperature circulating fluidized bed (CFB) boiler (see **Section 1.2.2.2, Rosebud Power Plant**). Limestone is injected with the waste coal prior to combustion to control SO_2, and a baghouse is employed to control PM.

The existing sources of air pollution at these facilities include the boilers (which primarily burn coal but also utilize distillate fuel oil or liquid propane gas for start-up), fugitive dust sources (on-road and non-road vehicles, coal/ash handling and storage, and the limestone handling systems), emergency diesel generators, and mobile exhaust.

Criteria Air Pollutant Emissions

The annual CAP emissions reported to DEQ for 2010 to 2015 for the boiler emissions from Colstrip and Rosebud Power Plants are presented in **Table 19**. In addition to CAP emissions, emissions of VOC are also shown because they contribute to ozone and secondary particulate matter. All of the sources listed previously are included except for on-road and non-road mobile exhaust emissions as these sources are not included in the annual DEQ emission inventories. Instead, mobile exhaust emissions from on-road and non-road mobile sources were estimated from the 2012-2013 emission inventory in the modeling study done for the Bureau of Land Management Montana Dakotas State Office (BLM-MT/DK) (BLM 2016a). On-road and non-road exhaust emissions are expected to be very small at the Colstrip Power Plant because of limited use of mobile source equipment at the facility. The estimated mobile exhaust emissions from the Colstrip Power Plant are shown in **Table 20**.

Table 19. Total Historic CAP Emissions Reported from Colstrip and Rosebud Power Plant Boilers.

Year	PM_{10}	$PM_{2.5}$	NOx	SO_2	CO	VOC
Colstrip Units 1 and 2	(tons/year)					
2010	643.8	540.2	8080.3	10541.8	734.8	102.8
2011	502.9	421.2	6312.6	7460.8	574.5	80.4
2012	367.8	308.7	4650.5	4571.9	420.2	58.8
2013	636.1	532.9	8453.2	8402.0	718.6	100.6

Table 19. Total Historic CAP Emissions Reported from Colstrip and Rosebud Power Plant Boilers.

Year	PM_{10}	$PM_{2.5}$	NOx	SO_2	CO	VOC
2014	584.0	488.5	7622.4	5823.8	658.1	92.1
2015	512.3	428.7	5807.5	3757.9	574.9	80.5
Colstrip Units 3 and 4	(tons/year)					
2010	1625.0	1329.6	10054.5	4766.8	1818.5	254.4
2011	1323.5	1086.6	8067.1	3832.9	1486.3	207.8
2012	1362.8	1120.2	8242.7	4193.6	1523.4	213.2
2013	1138.9	932.2	6542.8	3441.9	1270.9	177.9
2014	1393.3	1120.1	7965.2	4286.1	1530.7	214.2
2015	1613.2	1295.2	9336.7	5166.1	1759.1	246.2
Rosebud Power Plant	(tons/year)					
2010	14.5	5.6	875.4	1181.4	0.2	7.0
2011	25.2	25.2	843.1	1032.9	0.3	5.4
2012	13.7	4.7	951.0	1168.9	0.2	6.2
2013	17.2	5.3	938.6	1198.4	0.4	7.0
2014	16.4	5.0	849.4	1165.3	2.6	6.7
2015	16.5	5.0	856.4	1195.3	3.4	6.7

Source: Montana DEQ Annual Emission Inventory Reporting Records (2010-2015).

Table 20. Estimated CAP Emissions from Colstrip Mobile Sources.

Mobile Sources	PM_{10}	$PM_{2.5}$	NOx	SO_2	CO	VOC
	(tons/year)					
On-road Equipment	0.017	0.010	0.44	0.0016	3.25	0.69
Non-road Equipment	0.020	0.019	0.16	0.0004	3.11	0.14

Source: 2012-2013 emission inventory in BLM-MT/DK modeling study (BLM 2016a).

Hazardous Air Pollutant Emissions

The combustion of coal in power plant boilers releases a large number of hazardous trace metals and organic and inorganic compounds contained within the coal. Mercury is the only HAP whose emission rates are continuously monitored at the Colstrip and Rosebud Power Plants. The historic mercury emissions are shown for both facilities in **Table 21**. Stack testing was performed at the Colstrip Power Plant in 2010 and 2011 to estimate the emission rates of selected metal HAPs. The annual metal HAP emissions data based on this testing are shown in **Table 22**.

Emission rates of select HAP metals from the Rosebud Power Plant were estimated using emission limits described in the MATS (ARM 17.8.771) with the exception of copper, which does not have an explicitly defined emission limit. The emission limits provided by the MATS rule have units of pounds per trillion Btu (TBtu), and thus estimation of annual emission rates requires boiler heat input. For the Rosebud Power Plant, the heat content of the waste coal (7920 Btu per lb of coal) and maximum waste coal consumption (364,000 tons per year) provided in the plant's MAQP (OP2035-03) were used to estimate heat input for use in emission estimations. The emission rates of copper were acquired from an Electric Power Research Institute (EPRI) trace substance database for coal combustion units (EPRI 2014). The estimated emission rates of the select HAP metals from the Rosebud Power Plant are provided in **Table 23**.

Table 21. Historic Mercury Emissions from the Colstrip and Rosebud Power Plants.

Year	Total Mercury Emissions		
	Colstrip Units 1 and 2	Colstrip Units 3 and 4	Rosebud Power Plant
	(lb/year)		
2010	32.6	117.9	2.5
2011	26.4	86.2	1.2
2012	18.4	81.6	2.6
2013	36.0	81.6	1.4
2014	28.7	103.2	1.4
2015	23.6	121.0	0.9

Source: Mercury Emissions Monitoring System data from DEQ.

Table 22. Historic Metal HAP Emissions from the Colstrip Power Plant.[1]

Year	Antimony	Arsenic	Cadmium	Chromium	Copper	Lead	Selenium
Colstrip Units 1 and 2	(lb/year)						
2010	50.2	116.2	31.5	166.7	693.7	271.6	493.2
2011	39.3	91.0	24.7	130.5	543.2	212.7	386.2
2012	29.8	69.0	18.7	99.0	411.9	161.2	292.8
2013	50.0	115.6	31.4	166.0	690.7	270.4	491.0
2014	45.4	104.9	28.5	150.5	626.4	245.2	445.3
2015	40.6	93.9	25.5	134.8	560.9	219.6	398.7
Colstrip Units 3 and 4	(lb/year)						
2010	116.6	269.6	73.2	387.0	1610.4	630.4	1144.8
2011	98.0	226.7	61.5	325.3	1353.7	529.9	962.3
2012	101.7	235.2	63.8	337.5	1404.5	549.8	998.4
2013	83.3	192.6	52.3	276.4	1150.3	450.3	817.7
2014	99.9	231.0	62.7	331.6	1379.9	540.2	980.9
2015	115.0	266.0	72.2	381.8	1588.8	622.0	1129.4

lb/year = pounds per year.
[1] Metal HAP emissions from Colstrip are based on 2010/2011 stack test data from Colstrip Unit 3 and annual heat input from EPA's Clean Air Markets Data (https://ampd.epa.gov/ampd/).

Table 23. Estimated Current Metal HAP Emissions from the Rosebud Power Plant.[1]

Emissions (lb/year)						
Antimony	Arsenic	Cadmium	Chromium	Copper	Lead	Selenium
4.6	6.3	1.7	16.1	74.4	6.9	28.8

lb/year = pounds per year.
[1] 40 CFR Part 63, Subpart UUUUU does not provide an emission limit for copper, and so the emission rate was based on Venturi scrubber control class of the EPRI Pisces database for coal fired power plants.

There is no current monitoring or stack test data available for non-metal HAP emissions from the Colstrip and Rosebud Power Plants, so the non-metal HAP emissions were acquired from the 2014 National Emissions Inventory (NEI) (EPA 2016b). The available non-metal HAP emission rates for the Colstrip Power Plant are shown in **Table 24**. The only non-metal HAP with emission rates available for the Rosebud Power Plant from the 2014 NEI is hydrogen fluoride (HF) with an annual emission rate of 30.6 lb/year.

Table 24. 2014 Existing Non-metal HAP Emissions from the Colstrip Power Plant.

Hazardous Air Pollutant	Emission Rate (lb/year)
2,4-Dinitrotoluene	1.28E-03
2-Chloroacetophenone	3.20E-02
5-Methylchrysene	1.00E-04
Acenaphthene	2.33E-03
Acenaphthylene	1.14E-03
Acetaldehyde	2.60E+00
Acetophenone	6.86E-02
Acrolein	1.33E+00
Anthracene	9.64E-04
Benz[a]Anthracene	3.66E-04
Benzene	5.95E+00
Benzo[a]Pyrene	1.74E-04
Benzo[g,h,i,]Perylene	1.24E-04
Benzyl Chloride	3.20E+00
Beryllium	8.82E-03
Biphenyl	7.78E-03
Bis(2-Ethylhexyl)Phthalate	3.34E-01
Bromoform	1.78E-01
Carbon Disulfide	5.95E-01
Chlorobenzene	1.00E-01
Chloroform	2.70E-01
Chrysene	4.57E-04
Cobalt	2.48E-02
Cumene	2.43E-02
Cyanide	1.14E+01
Dimethyl Sulfate	2.19E-01
Ethyl Benzene	4.30E-01
Ethyl Chloride	1.92E-01
Ethylene Dibromide	5.49E-03
Ethylene Dichloride	1.83E-01
Fluoranthene	3.25E-03
Fluorene	4.16E-03
Formaldehyde	1.10E+00
Hexachlorobenzene	5.00E-03
Hexane	3.06E-01
Hydrochloric Acid	4.83E+00
Hydrogen Fluoride	1.10E+01
Indeno[1,2,3-c,d]Pyrene	2.79E-04
Isophorone	2.65E+00
Methyl Bromide	7.32E-01
Methyl Chloride	2.43E+00
Methyl Methacrylate	9.18E-02
Methyl Tert-Butyl Ether	1.60E-01
Methylene Chloride	1.33E+00
Methylhydrazine	7.78E-01
Naphthalene	5.95E-02
Phenanthrene	1.24E-02
Phenol	7.32E-02
Propionaldehyde	1.74E+00
Pyrene	1.51E-03
Styrene	1.14E-01
Tetrachloroethylene	1.97E-01
Toluene	1.10E+00
Vinyl Acetate	3.48E-02
Xylenes (Mixed Isomers)	1.70E-01

Source: 2014 National Emissions Inventory (EPA 2016b).
lb/year = pounds per year.

3.3.4.3 Existing Emissions from Other Regional Sources

There are a large number of other regional sources of air pollution within the cumulative and indirect impacts analysis area for air quality that contribute to cumulative effects. **Table 25** presents the major point sources (emissions of any air pollutant greater than 100 tons/year) in the cumulative and indirect impacts analysis area for air quality from the emissions inventory from the BLM-MT/DK air quality modeling (BLM 2016a), which is based on the 2011 NEI from the EPA but updated to be representative of 2013/2014 emissions. The emissions inventory of the BLM-MT/DK modeling study covered a larger geographical extent than the analysis area for air quality, and thus the emissions are a subset of the total regional emissions from that study. Examples of major point sources include mines, such as the Absaloka and Decker coal mines, power plants, refineries, other industrial facilities, etc. In addition to the major point sources listed in **Table 25**, there are numerous other point sources and numerous low-level, area sources in the cumulative and indirect impacts analysis area of both anthropogenic and natural origin. Examples of such sources are small industrial or residential operations, and agriculture. The future emissions and impacts of other regional sources are discussed in **Chapter 5, Cumulative Effects** during the lifetime of the Proposed Action.

Table 25. Other Major Regional Point Source Emissions in the Indirect/Cumulative Impacts Analysis Area.

Facility	Latitude	Longitude	Emission Rate (tons/year)				
			NOx	SO_2	PM_{10}	$PM_{2.5}$	VOC
Absaloka Mine	45.804	-107.079	109	21	458	60	1
Antelope Mine	43.478	-105.342	1083	70	1483	214	41
Belle Ayr Mine	44.100	-105.364	730	17	939	402	0
Bill	43.162	-105.262	168	1	4	4	11
Billings Logan Intl	45.808	-108.560	64	9	7	6	37
Phillips 66 Refinery, Billings	45.781	-108.493	510	37	102	85	345
Black Hill Power & Light Company (Ben French)	44.089	-103.264	769	479	4	3	3
Black Thunder Mine	43.700	-105.290	11726	163	4272	1791	0
Buckskin Mine	44.442	-105.534	312	33	1047	563	5
Caballo Mine	44.104	-105.359	791	79	48	48	50
Calumet Montana Refining	47.525	-111.290	169	17	47	34	410
Casper Asphalt Hot Plant (Ct-1523)	42.859	-106.370	77	9	2	0	130
Casper Refinery	42.859	-106.243	235	274	57	52	257
CHS Inc. Refinery Laurel	45.659	-108.768	471	221	63	48	1104
Coal Creek Mine	43.968	-105.284	9100	12	334	122	0
Colony East Plant	44.866	-104.150	390	63	106	27	1
Colony Plant	44.861	-104.143	140	33	123	24	1
Colony West Plant	43.723	-103.987	410	50	94	28	1
Cordero Rojo Complex	44.029	-105.367	784	81	1441	421	29
Countertops Inc	44.048	-103.189	36	3	35	35	169
Dave Johnston (CEM)	42.838	-105.777	6894	8661	1044	624	105
Dave Johnston (non-CEM)	42.838	-105.777	10	3	477	276	0
Decker Mine	45.054	-106.822	47	6	387	41	0
Dry Fork Coal Mine	44.178	-105.388	299	16	205	18	12
Dry Fork Station	44.388	-105.460	632	795	199	18	1
Eagle Butte Mine	44.387	-105.507	648	10	841	198	0
Elmore Pit	44.359	-105.378	138	47	6	5	4
EXXONMOBIL Billings Refinery	45.814	-108.433	243	769	227	220	498
Frannie Lime Plant	44.996	-108.625	223	32	57	22	0
GCC Dacotah	44.087	-103.271	900	215	37	37	72
Glasgow	48.191	-106.626	126	1	3	3	8
Glendive	47.100	-104.716	102	1	3	3	6
Grass Creek Mine	43.925	-108.700	0	0	325	14	0

Table 25. Other Major Regional Point Source Emissions in the Indirect/Cumulative Impacts Analysis Area.

Facility	Latitude	Longitude	Emission Rate (tons/year)				
			NOx	SO_2	PM_{10}	$PM_{2.5}$	VOC
Graymont Western- Us Inc	46.328	-111.617	405	93	51	19	0
Great Falls Terminal	47.521	-111.221	0	0	0	0	125
Hardin Generating Station	45.729	-107.607	71	1	2	2	4
Hinsdale	48.393	-107.090	142	1	4	4	9
CRH US - Trident Plant	45.945	-111.478	13	1	138	63	1
Huntley	45.900	-108.298	138	1	4	3	9
Koch Pit (761S)	42.902	-110.107	110	0	6	4	0
Lovell Plant	44.859	-108.224	205	23	87	16	0
MDU - Glendive	47.054	-104.740	3839	72	0	0	1
MDU - Lewis & Clark Station	47.679	-104.153	675	791	82	68	6
Montana Sulphur & Chemical	45.814	-108.428	1	1927	1	1	0
Neil Simpson One	44.286	-105.387	282	791	351	347	7
Neil Simpson Two	44.285	-105.380	550	488	80	80	19
Newcastle Refinery	43.848	-104.214	88	324	97	87	78
North Antelope Rochelle Mine	43.532	-105.258	3325	197	2898	932	113
Pete Lien And Sons Inc.	44.078	-103.188	161	0	24	8	5
PPL Montana - JE Corette Plant	45.773	-108.484	1401	2205	197	89	20
Rawhide Mine	44.414	-105.460	450	34	305	21	22
Richardton Ethanol Plant	46.878	-102.297	180	76	168	163	60
Rocky Mountain Power	45.764	-107.600	304	353	270	270	3
Sheridan	44.814	-106.951	117	1	3	3	7
Sidney Sugar Facility	47.717	-104.136	149	49	59	28	2
Signal Peak Energy - Bull Mountain Mine	46.270	-108.421	16	0	184	28	0
Smith Ranch-Highland Operations	43.051	-105.685	80	3	193	24	18
Spring Creek Mine	45.112	-106.904	164	19	789	86	0
Stillwater Mine	45.389	-109.876	16	1	116	33	0
Western Sugar Cooperative	45.769	-108.499	147	80	28	16	5
Worland Plant	44.011	-107.974	25	1	159	135	0
Worland Plant #02	44.023	-107.962	2	0	0	0	136
WYGEN Station I	44.286	-105.384	578	511	93	30	8
WYGEN Station II	44.291	-105.381	242	169	44	12	3
WYGEN Station III	44.291	-105.379	196	318	69	7	18
Wyodak Mine	44.217	-105.466	237	4	229	85	6
Wyodak Plant	44.288	-105.383	3017	2249	1567	141	60
Yellowstone Power Plant	45.808	-108.427	516	2106	59	50	11

Source: Emission inventory in the Bureau of Land Management Montana/Dakotas modeling study (BLM 2016a).

3.3.5 Regional Air Quality

Regional air quality is a product of the concentrations of various air pollutants and is assessed through the use of extensive ambient air monitoring networks deployed throughout the country. In order to evaluate existing regional air quality within the cumulative and indirect impacts analysis area, ambient monitoring data was acquired from a number of monitoring networks and databases including the EPA's Air Quality Service (AQS), the Interagency Monitoring of Protected Visual Environments (IMPROVE) network, and the Clean Air Status and Trends Network (CASTNET), as well as the National Trends Network (NTN) and Mercury Deposition Network (MDN) that are part of the National Atmospheric Deposition Program (NADP).

3.3.5.1 Criteria Air Pollutants

To assess regional air quality for criteria air pollutants, air concentration data was acquired from EPA's AQS database. This database compiles ambient air data collected from monitors operated by federal, state, local, and tribal agencies. EPA provides data in both raw and processed formats. In this study, monitor level data provided by EPA in the form of the NAAQS design values was acquired for all monitors within the cumulative and indirect impacts analysis area for 2011 to 2015. This data was then compared to the NAAQS to assess regional air quality.

The AQS monitors operated within the cumulative and indirect impacts analysis area are shown in **Figure 16** and listed in Table D-3-1 of Appendix D-3. Table D-3-7 in Appendix D-3 presents county level monitoring data for each of the CAPs except for lead, as there are no monitoring sites in the analysis area for lead. In counties in which data from multiple monitors is available, the monitor that reported the highest values is shown.

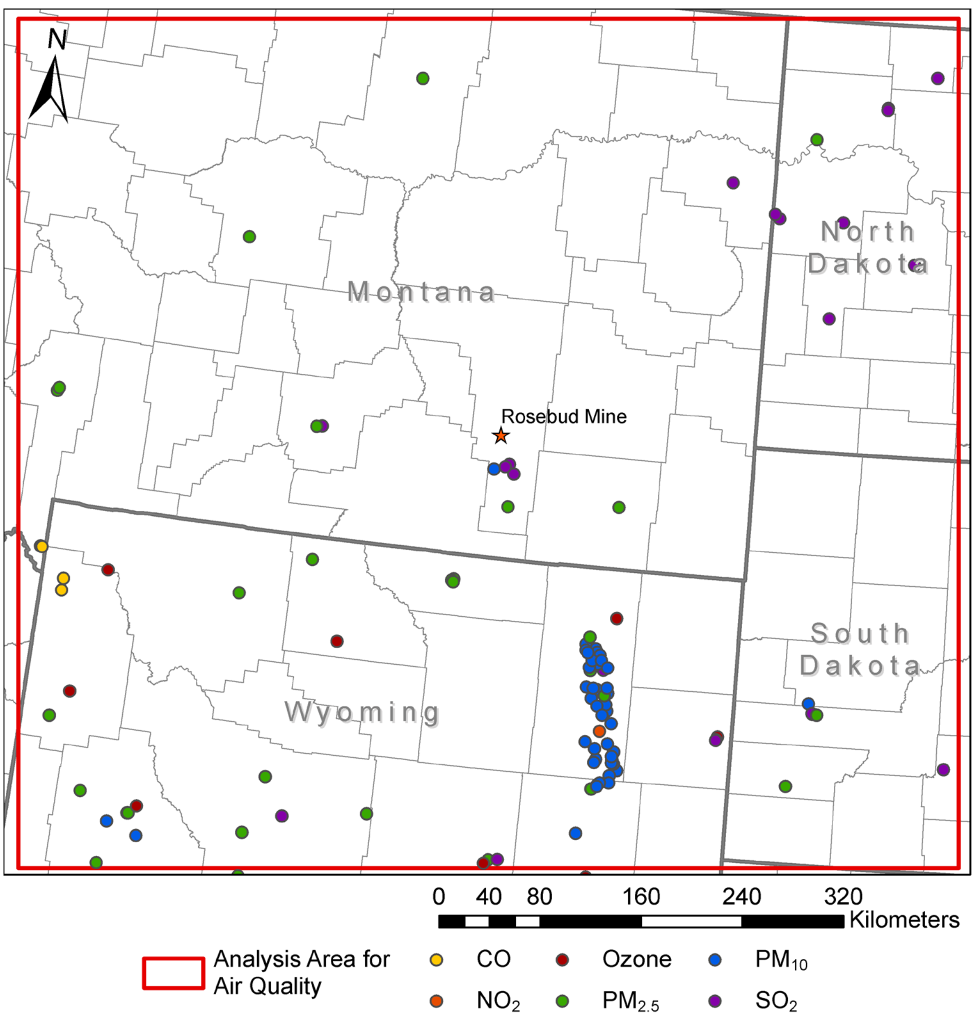

Figure 16. Criteria Air Pollutant Monitoring Sites within the Cumulative and Indirect Impacts Analysis Area.

All of the reported concentrations from monitoring sites in Montana are well below the respective NAAQS and MAAQS, and in the entire analysis area, only a single SO_2 monitor in Williams, North

Dakota (Appendix D-3, Table D-3-7, Site ID: 38-105-0105) reported values that exceeded the NAAQS. This monitoring site is more than 400 km from the project area. Therefore, the existing air quality in the region of the Proposed Action is generally clean with respect to the NAAQS.

Attainment Status

EPA utilizes CAP specific DVs calculated from ambient monitoring data to determine compliance of a geographic location with the NAAQS (**Table 15**). The calculated DVs are used to designate the status of each area as either attainment, nonattainment, or unclassifiable. Areas that were previously designated as nonattainment, but have been re-designated as attainment and have an EPA-approved maintenance plan are referred to as maintenance areas. Within the cumulative and indirect impacts analysis area for air quality, there are three areas that are designated as either nonattainment or maintenance in Montana (**Table 26**) and two nonattainment areas in Wyoming (**Table 27**). The closest nonattainment area to the project area is Lame Deer, MT; this is located in Rosebud County and was designated as a 'moderate' PM_{10} nonattainment area in 1990. Lame Deer is a federal nonattainment area and outside Montana jurisdiction. The other nonattainment areas in Montana within the cumulative and indirect impacts analysis area are Billings, MT and Laurel, MT. Billings was designated nonattainment for the 1-hour SO_2 standard in 2013, but was re-designated as maintenance as of June 2016. Laurel was designated nonattainment in 1978 for the 1971 24-hour SO_2 NAAQS, but DEQ is in the process of a re-designation request and maintenance plan. Designated nonattainment or maintenance areas are subject to the General Conformity Rule wherein federal actions should be shown to conform to the appropriate SIP.

Table 26. Nonattainment/Maintenance Areas in Montana within the Indirect/Cumulative Impacts Analysis Area.

Location	Pollutant	NAAQS Violated	Nonattainment Designation	Maintenance Designation
Laurel	SO_2	1971 (24-hr)	March 03, 1978	N.A.
Billings	SO_2	2010 (1-hr)	August 05, 2013	June 09, 2016
Lame Deer	PM_{10}	1987 (24-hour)	November 15, 1990	N.A.

Table 27. Nonattainment/Maintenance Areas in Wyoming within the Indirect/Cumulative Impacts Analysis Area.

Location	Pollutant	NAAQS Violated	Nonattainment Designation
Sheridan	PM_{10}	1971 (24-hr)	November 15, 1990
Upper Green River Basin	O_3	2008 (8-hr)	July 20, 2012

3.3.5.2 Visibility and Regional Haze

Regional haze is the impairment of visibility due to scattering and absorption of light by fine particles and gases in the atmosphere and is the cumulative impact of numerous sources over large geographical regions. Visibility in Federal Class I areas is protected in the CAA by the RHR (see discussion under **Regional Haze Rule** above), which requires states to develop goals for achieving reasonable progress toward visibility improvement on the 20 percent most impaired days while ensuring no degradation in visibility for the 20 percent least impaired days.

Visibility is often described using visual range, which is the greatest distance an observer can see a black object viewed against the horizon sky, or a light extinction coefficient, which is a measure of the reduction in light per distance traveled in the atmosphere. Of the two, only the light extinction coefficient can be directly related to the concentration of particles and gases in the atmosphere, but neither visual range nor the light extinction coefficient are linearly related to a perceived change in haze. For this reason, visibility is described by the RHR using the deciview haze index (dv) for which an incremental change in dv corresponds to a uniform change in visibility perception for the entire range of visibility conditions.

The RHR requires states to develop a monitoring plan to measure and characterize regional haze visibility impairment; this is often met through participation in the IMPROVE network (IMPROVE 2017). There are 15 IMPROVE monitoring sites located within the cumulative and indirect impacts analysis area for air quality; these are listed in **Table 28** and presented in **Figure 17**.

Table 28. IMPROVE Monitoring Sites in the Indirect/Cumulative Impacts Analysis Area for Air Quality.

State	Station Name/Area	Site Code	AQS Site ID	Start Date
Montana	Fort Peck	FOPE1	30-085-9000	06/2002
Montana	Gates of the Mountains	GAMO1	30-049-9000	07/2000
Montana	Medicine Lake	MELA1	30-091-9000	12/1999
Montana	Northern Cheyenne	NOCH1	30-087-0762	06/2002
Montana	UL Bend	ULBE1	30-027-9000	01/2000
North Dakota	Lostwood	LOST1	38-013-0004	12/1999
North Dakota	Theodore Roosevelt	THRO1	38-007-0002	12/1999
South Dakota	Badlands National Park	BADL1	46-071-0001	03/1988
South Dakota	Wind Cave	WICA1	46-033-0132	12/1999
Wyoming	Boulder Lake	BOLA1	56-035-9001	07/2009
Wyoming	Bridger Wilderness	BRID1	56-035-9000	03/1988
Wyoming	Cloud Peak	CLPE1	56-019-9000	06/2002
Wyoming	North Absaroka	NOAB1	56-029-9002	01/2000
Wyoming	Thunder Basin	THBA1	56-005-0123	06/2002
Wyoming	Yellowstone National Park #2	YELL2	56-039-9000	07/1996

Source: IMPROVE 2017.

The Northern Cheyenne IMPROVE site is the closest to the project area. The trend in visibility extinction for the 20 percent haziest and 20 percent clearest days at the Northern Cheyenne (NOCH1) site is shown in **Figure 18** along with the natural conditions for each. Overall, there is no apparent positive or negative trend in visibility since monitoring began in 2003. The visibility on the clearest days is relatively constant among years and ranges between approximately 1-3 dv over natural conditions, while the visibility on the haziest days shows larger interannual variability ranging from approximately 3 to 12 dv over natural conditions on the haziest days. The monitored visibility trends for the other IMPROVE sites in the analysis air for air quality are provided in Appendix D-4.

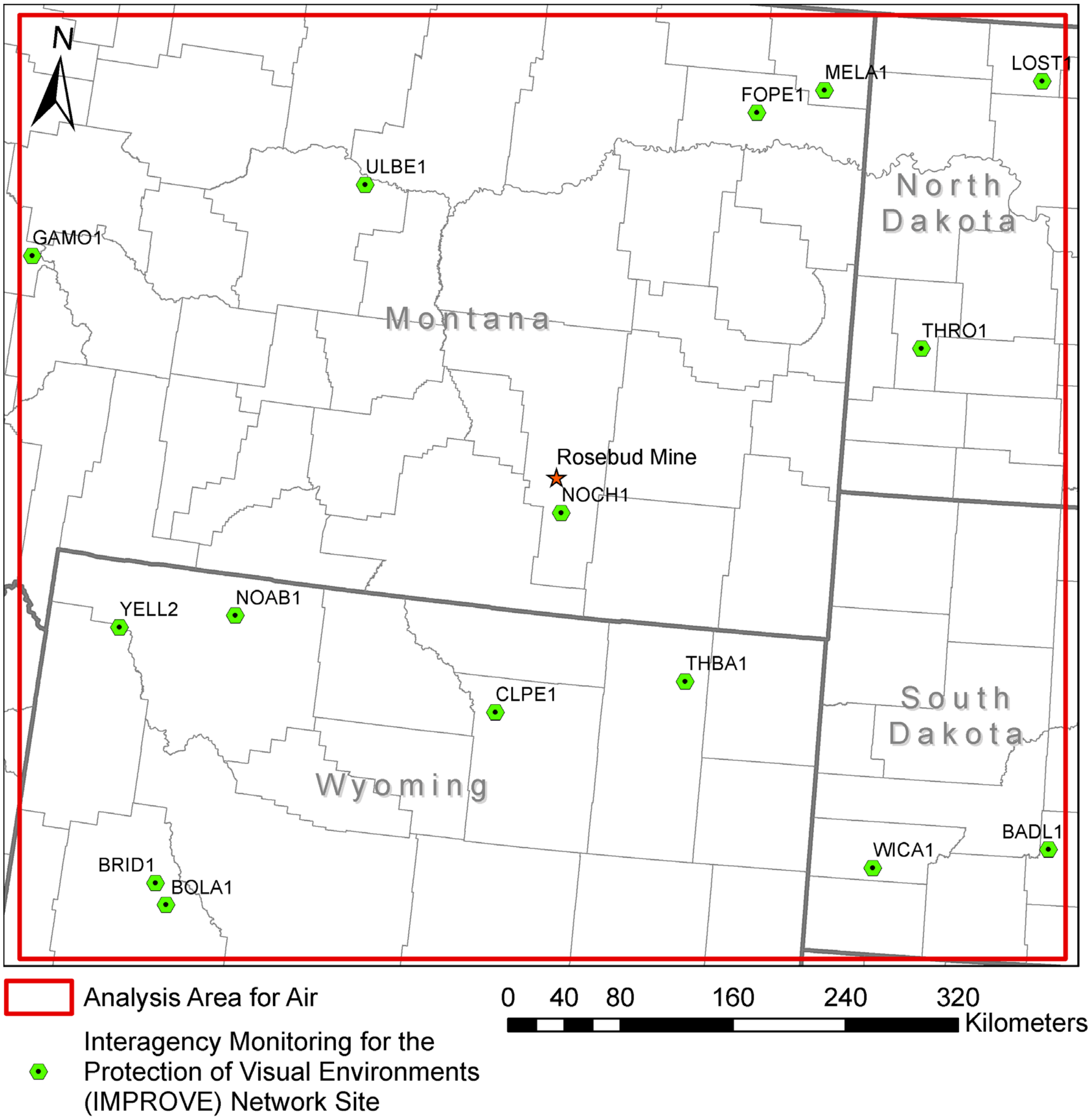

Figure 17. IMPROVE Network Sites within the Cumulative and Indirect Impacts Analysis Area.

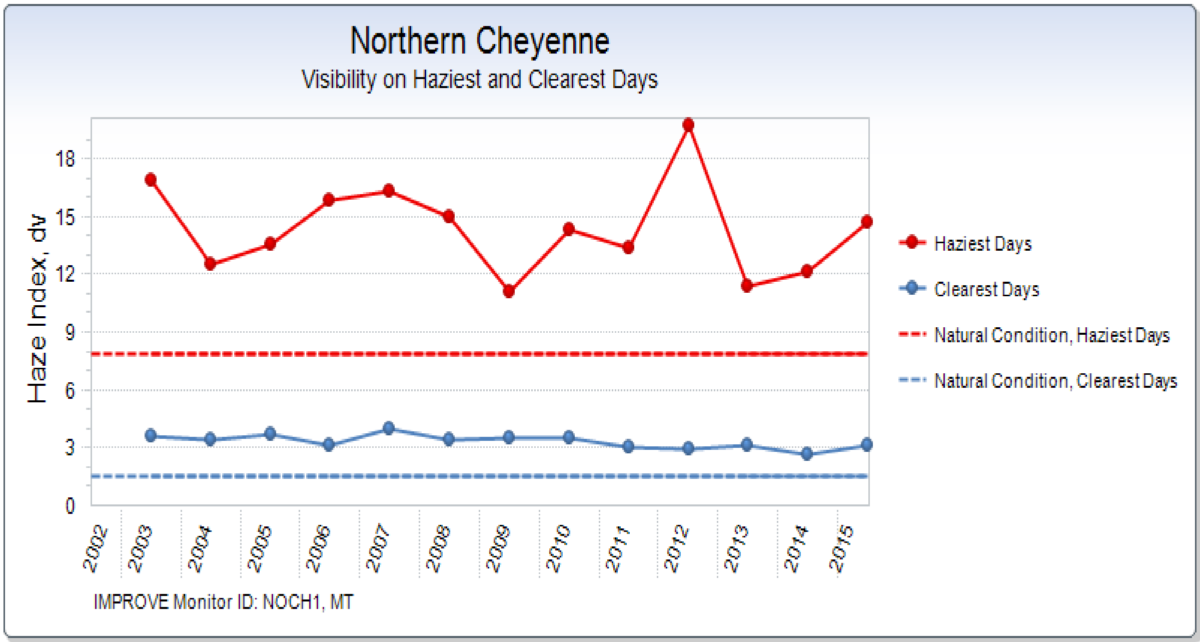

Figure 18. Visibility Extinction on Northern Cheyenne Indian Reservation.

Source: IMPROVE 2017.
dv = deciviews.

3.3.5.3 Atmospheric Deposition

Atmospheric deposition is the transfer of pollutants such as nitrogen and sulfur compounds, and mercury (Hg) from the atmosphere to surfaces such as waterbodies, vegetation, and buildings. Deposition occurs both in the presence and absence of precipitation (referred to as wet deposition and dry deposition, respectively) and can negatively affect ecosystems. The effects of these processes are widespread with potential impacts occurring in rural and remote ecosystems far from sources of pollution.

Acid rain refers to both wet and dry deposition with higher than normal concentration of acidic components, of which NO_x and SO_2 emissions from fossil fuel combustion are some of the key man-made precursors (EPA 2017a). These gases react in the atmosphere to form sulfuric and nitric acids that can lead to acidification of sensitive soils and waterbodies through deposition. In addition to acid rain, deposition can lead to other negative impacts such as the over-enrichment of soils and waterbodies from the nitrogen compounds such as ammonia (NH_3). This can result in oxygen depleted zones in water bodies (eutrophication) and alteration of terrestrial ecosystems (Fenn et al. 2003). For mercury, deposition is often an important contributor to loading in waterbodies resulting in bioaccumulation in fish that can potentially cause harm in humans when consumed.

The NADP began in 1978 to quantify wet deposition and better understand the trends and distribution of precipitation chemistry with a focus on acids, nutrients, and base cations (NADP 2017a). This monitoring network is now known as the NTN and is only one of the networks currently managed under the NADP. The NADP also includes the Mercury Deposition Network (MDN).

CASTNET is another long-term monitoring network that quantifies deposition. CASTNET was established in 1991 and is managed and operated by EPA in cooperation with the National Park Service (NPS), BLM Wyoming State Office, and other federal, state, and local agencies (EPA 2017b). The network measures ambient concentrations of sulfur and nitrogen species along with rural ozone concentrations. Additionally, it provides long-term estimates and trends of acidic dry deposition that complement the NADP's NTN.

The NADP and CASTNET monitoring sites within the cumulative and indirect impacts analysis area for air quality are listed in **Table 29** and shown in **Figure 19**.

Table 29. NADP and CASTNET Monitoring Sites in the Indirect/Cumulative Impacts Analysis Area.

Network	State	Site Name	SITE ID	Monitoring Start Date
NTN	Montana	Little Bighorn Battlefield National Monument	MT00	7/13/1984
NTN	Montana	Havre - Northern Agricultural Research Center	MT98	7/30/1985
NTN	Montana	Poplar River	MT96	12/21/1999
NTN	North Dakota	Theodore Roosevelt National Park-Painted Canyon	ND00	1/30/2001
NTN	South Dakota	Cottonwood	SD08	10/11/1983
NTN	South Dakota	Wind Cave National Park-Elk Mountain	SD04	11/5/2002
NTN	Wyoming	Sinks Canyon	WY02	8/21/1984
NTN	Wyoming	Pinedale	WY06	1/26/1982
NTN	Wyoming	Gypsum Creek	WY98	12/26/1984
NTN	Wyoming	Newcastle	WY99	8/11/1981
NTN	Wyoming	Yellowstone National Park-Tower Falls	WY08	6/5/1980
NTN	Wyoming	Grand Tetons National Park	WY94	9/27/2011
MDN	Montana	Badger Peak	MT95	11/2/2010
MDN	North Dakota	Lostwood National Wildlife Refuge	ND01	11/25/2003
MDN	Wyoming	Yellowstone National Park-Tower Falls	WY08	10/21/2004
MDN	Wyoming	Roundtop Mountain	WY26	12/20/2011
CASTNET	North Dakota	Theodore Roosevelt National Park	THR422	8/1/1998
CASTNET	South Dakota	Wind Cave National Park	WNC429	11/1/2003
CASTNET	Wyoming	Pinedale	PND165	10/21/1988
CASTNET	Wyoming	Yellowstone National Park	YEL408	6/1/1996
CASTNET	Wyoming	Fortification Creek	FOR605	5/21/2013
CASTNET	Wyoming	Newcastle	NEC602	11/7/2012
CASTNET	Wyoming	Basin	BAS601	11/6/2012
CASTNET	Wyoming	Buffalo	BUF603	11/6/2012
CASTNET	Wyoming	Sheridan	SHE604	11/6/2012

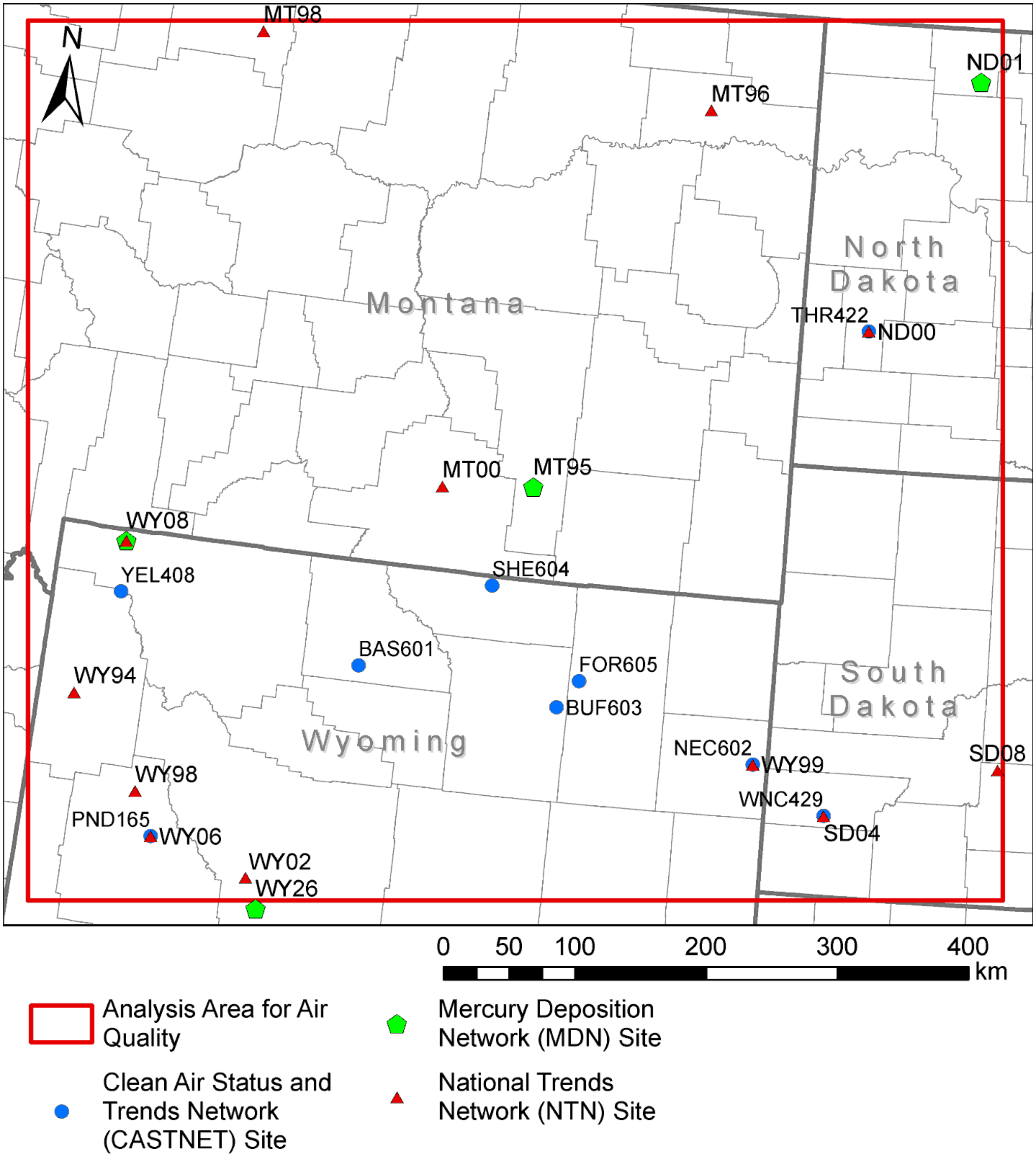

Figure 19. CASTNET, MDN, and NTN Monitoring Sites in the Indirect/Cumulative Impacts Analysis Area.

Annual wet deposition data from the NTN sites in the cumulative and indirect impacts analysis area for air quality is presented in Table D-5-1 of Appendix D-5 for period 2000 to 2015. The Little Bighorn Battlefield National Monument (Little Bighorn NM) NTN site is the closest to the project area; the historical deposition rates at this site are shown in **Figure 20**. There is no clear positive or negative trend in the deposition rates of any of the measured species for the period shown. However, the overall wet deposition rates in the cumulative and indirect impacts analysis area are small relative to deposition rates nationally. **Figure 21** presents spatial plots of total sulfur and nitrogen wet deposition for the years 1985, 2000, and 2015 (NADP 2017a). While sulfur and nitrogen wet deposition has fallen dramatically in the eastern U.S., the wet deposition of these compounds in the cumulative and indirect impacts analysis area continues to be generally lower than wet deposition in the eastern U.S.

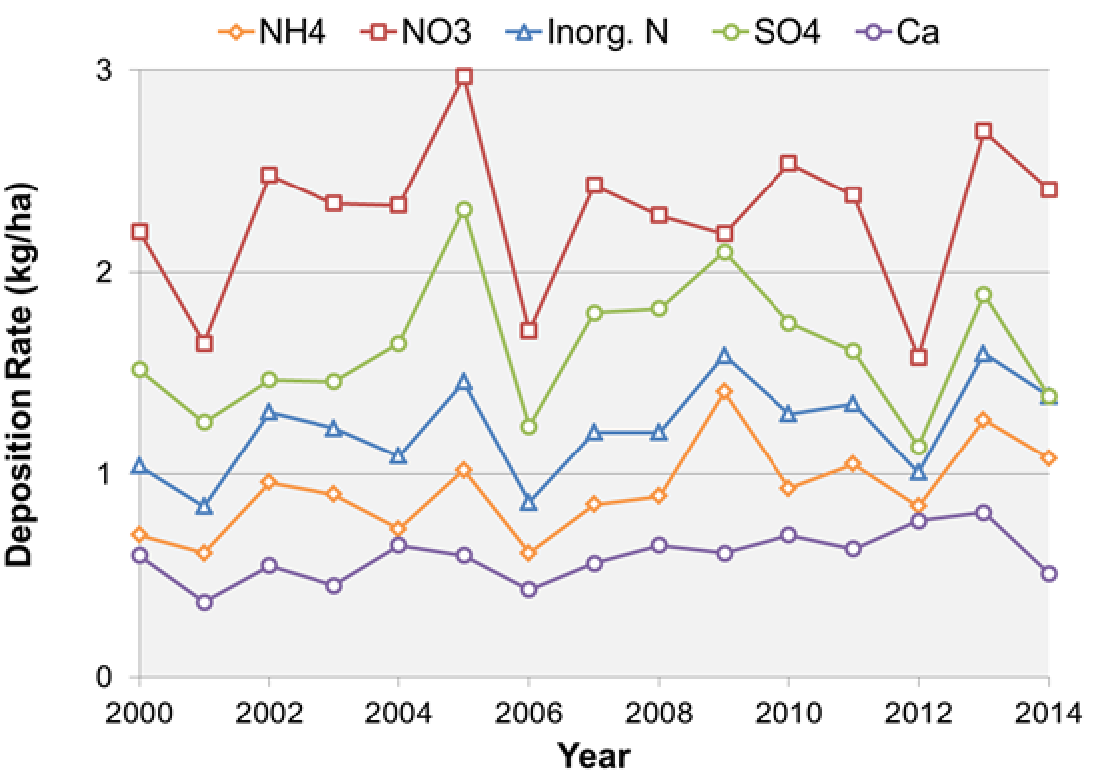

Figure 20. Historic NTN Wet Deposition Rates at Little Bighorn National Monument (site id: MT00).

Source: adapted from NADP 2017a.
kg/ha = kilogram per hectare.

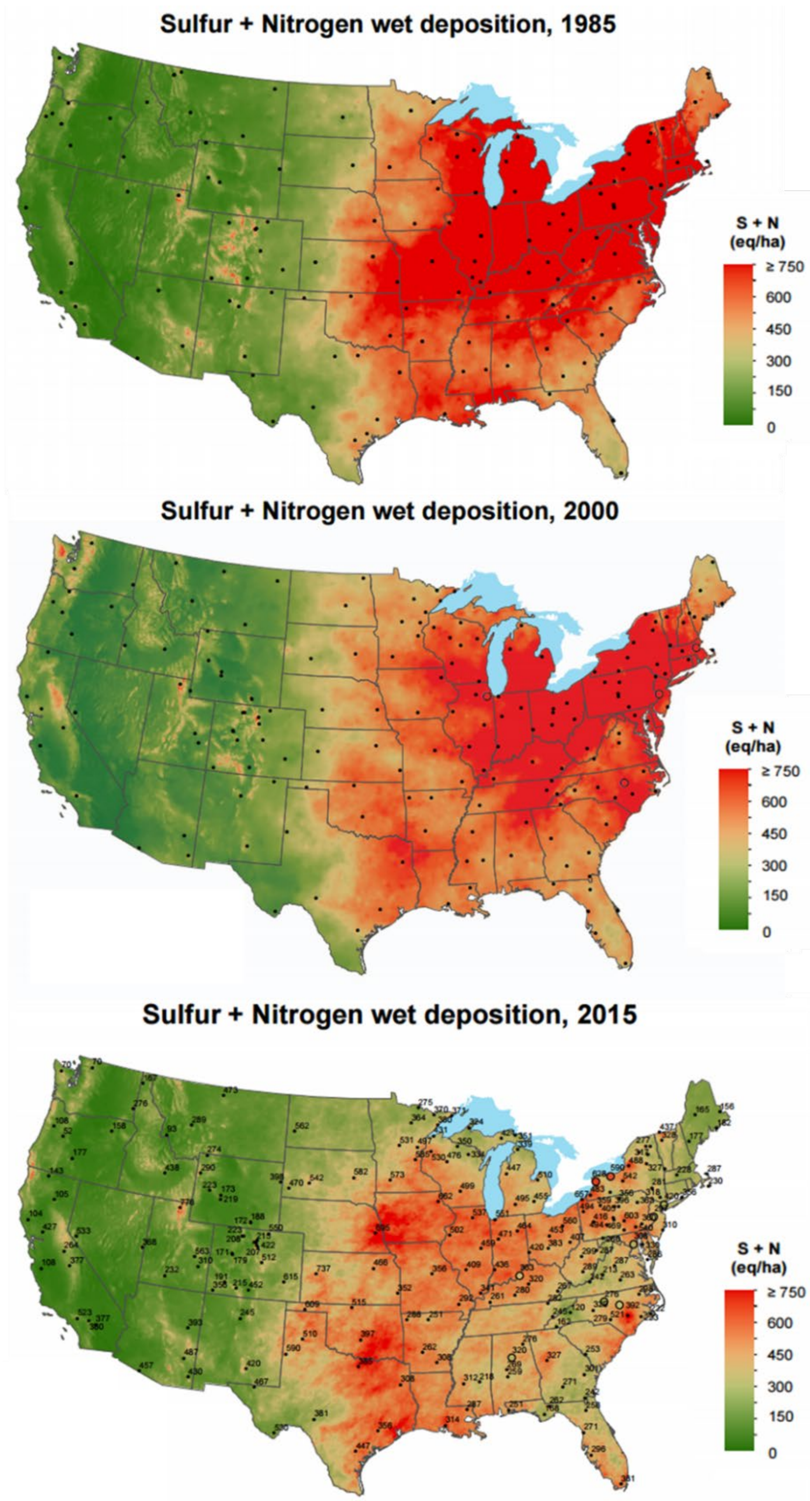

Figure 21. Total Sulfur and Nitrate Wet Deposition in 1985, 2000, and 2015.

Source: adapted from NADP 2017a.
eq/ha = equivalents per hectare.

Four MDN sites are in the cumulative and indirect impacts analysis area for air quality. Of these, the annual mercury deposition data from the Badger Peak (MT95), Lostwood National Wildlife Refuge

(ND01), and Yellowstone National Park – Tower Falls (WY08) MDN sites are presented in and **Table 30** and **Figure 22**. The Roundtop Mountain MDN site (WY26) in Wyoming has not produced data that meets the data completeness requirements since it began operation in 2011 and thus is not shown. There is no clear trend in mercury wet deposition at the station closest to the Rosebud Mine, MT95, on the Northern Cheyenne Indian Reservation. The mercury deposition rates in southeastern Montana are typically small relative to rest of the U.S. (**Figure 23**).

Table 30. Historic Mercury Deposition at MDN Sites in the Indirect/Cumulative Impacts Analysis Area.

Year	Precipitation (cm)			Mercury Wet Deposition (μg/m²)		
	MT95	ND01	WY08	MT95	ND01	WY08
2004	—	35.6	—	—	4.2	—
2005	—	36.2	39.8	—	3.7	4.9
2006	—	32.1	36.7	—	5.0	4.4
2007	—	32.1	33.5	—	4.8	3.7
2008	—	33.4	34.0	—	3.8	3.0
2009	—	—	48.3	—	—	5.1
2010	—	—	43.6	—	—	5.3
2011	63.0	—	44.7	6.6	—	3.6
2012	22.9	—	46.9	—	—	6.3
2013	47.7	—	38.7	—	—	6.6
2014	41.0	—	55.6	4.5	—	6.6
2015	39.0	—	42.9	6.0	—	4.8

Source: NADP 2017a.
Note: only valid data that meets all completeness requirements are shown.
cm = centimeter(s).
μg/m² = micrograms per square meter.
MT95 = Badger Peak MDN Site.
ND01 = Lostwood National Wildlife Refuge MDN Site.
WY08 = Yellowstone National Park-Tower Falls MDN Site.

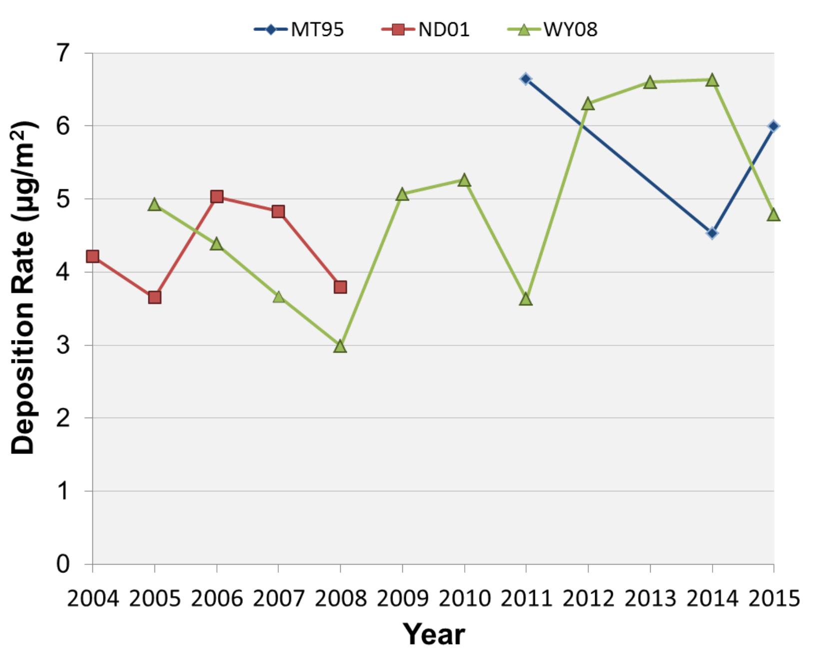

Figure 22. Trend in Mercury Deposition at Mercury Deposition Network Sites in the Analysis Area.

Source: adapted from NADP 2017a.
µg/m^2 = micrograms per square meter.

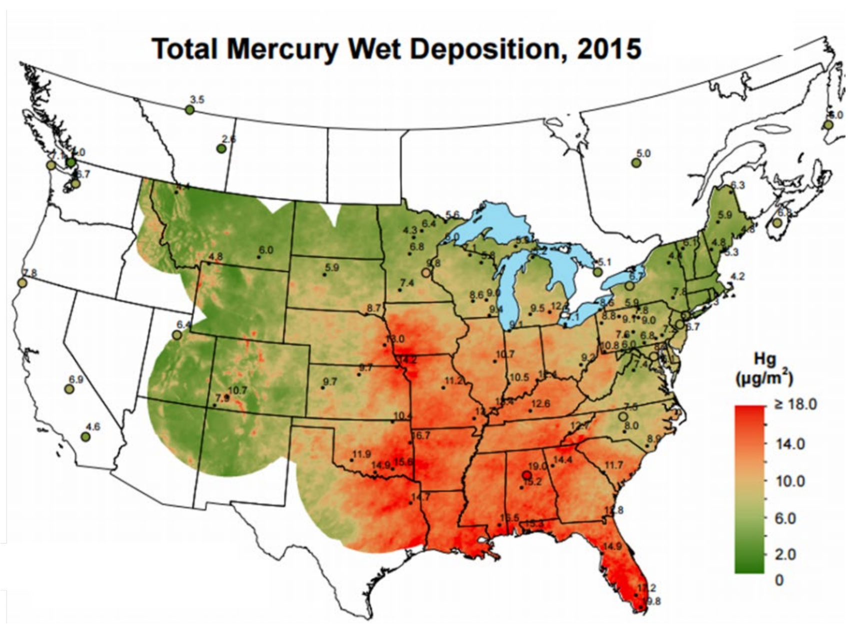

Figure 23. Spatial Distribution of Mercury Deposition in the United States in 2015.

Source: adapted from NADP 2017a.
µg/m^2 = micrograms per square meter.

3.4 CLIMATE AND CLIMATE CHANGE

3.4.1 Introduction

The purpose of this introduction is to provide a foundation for what is currently known about climate change and the role of human activities in the current warming trend. Subsequent sections describe the affected environment related to climate and climate change including the governing regulatory framework, trends in emissions, and global, national, and regional climate trends and current status. The analysis area for climate change is defined below in **Section 3.4.1.2, Direct and Indirect Effects Analysis Area**.

Climate change refers to any measurable deviation in climate that lasts for an extended period—several decades or longer—and includes recordable changes in temperature, precipitation, or wind patterns. Changes in climate can result from both human and natural factors, including changes in the sun's intensity, natural processes within the climate system such as changes in ocean circulation, and human activities that change the land surface or the composition of the atmosphere (Corbin et al. 2015). Although the terms climate change and global warming are often used interchangeably, global warming represents only one aspect of climate change (EPA 2017c). Global warming refers to the recent and ongoing rise in global average temperature near Earth's surface.

Over the past century, human activities have released large amounts of greenhouse gases (GHGs) into the atmosphere. The main GHGs are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), water vapor, hydrofluorocarbons (HFCs), perfluorocarbons, and sulfur hexafluoride. GHGs occur naturally because of volcanic eruptions, forest fires, and biological processes such as enteric fermentation (the process in which livestock produce methane via digestion) and aerobic decomposition. They are also emitted by fuel combustion, industrial processes, agricultural operations, waste management, and land-use changes such as conversion of farmland and forests to urbanization. GHGs absorb short-wave radiation emitted by the earth, which warms the atmosphere by trapping energy that would have otherwise been released into space. This phenomenon is called the greenhouse effect and is necessary to support life on Earth; however, excessive buildup of GHGs can change Earth's climate and result in undesirable effects on ecosystems, which affect human health and welfare (EPA 2017d). Seemingly small changes in the average temperature of the planet can translate to large and potentially hazardous shifts in climate and weather. Climate change leads to variation in rainfall amounts and distribution that can result in flooding, droughts, or more frequent and severe heat waves. Also, oceans are warming and becoming more acidic, polar ice caps are melting, glaciers are receding, and sea levels are rising due to thermal expansion and ice loss. As climate change progresses in the coming decades, it will likely present challenges to society and the environment.

The Intergovernmental Panel on Climate Change (IPCC), an international organization established to assess the science of climate change and related environmental and socioeconomic impacts, is the leading international scientific advisory group on climate change and global warming. IPCC reports that changes in many physical and biological systems such as increases in global temperatures, more frequent heat waves, rising sea levels, coastal flooding, loss of wildlife habitat, spread of infectious disease, and other potential environmental impacts are linked to changes in the climate system, and some changes might be irreversible (IPCC 2007). In its Fifth Assessment Report (AR5) of the science of climate change (IPCC 2014), IPCC states that each of the last three decades has been successively warmer at Earth's surface than any preceding decade since 1850 (IPCC 2014). IPCC further stated that warming of Earth's climate is unequivocal, and that scientists are more certain than ever that the majority of warming since 1950 has been caused by human activity (primarily by burning fossil fuels including coal, oil, and gas).

3.4.1.1 Regulatory Framework

Federal Requirements

Federal regulations that provide thresholds for GHG emissions or require monitoring and reporting for stationary sources are listed below. While these regulations do not currently apply to the Rosebud Mine, they provide a framework for existing and evolving rules and regulations. Some of these regulations apply to the Colstrip and Rosebud Power Plants as discussed below.

Mandatory Reporting of Greenhouse Gases (40 CFR Part 98, Subpart C)

EPA requires reporting of GHGs from listed facilities and facilities with stationary sources that emit 25,000 metric tons or more of CO_2 equivalent (CO_2e) per year in the United States. (CO_2e includes all GHGs except water vapor.) In addition, if the maximum rated heat input for all stationary fuel combustion sources at a facility is less than 30 million British thermal units (BTUs) per hour, the facility falls below the reporting threshold. The Mandatory Reporting Rule (40 CFR Part 98, Subpart C) facilitates collection of accurate and comprehensive emissions data to provide a basis for future EPA policy decisions and regulatory initiatives. Surface coal mines are not listed as mandatory sources for reporting purposes, and the Rosebud Mine is not required to report under this rule. The Colstrip and Rosebud Power Plants are required to report under this rule.

Greenhouse Gas Tailoring Rule (40 CFR Parts 51, 52, 70, et al.)

The GHG Tailoring Rule (40 CFR Parts 51, 52, 70, et al.) applies to stationary sources that (1) emit greater than 100,000 tons CO_2e per year or (2) are already major sources and modify their facility with a resulting emission increase greater than 75,000 tons CO_2e per year. This rule sets thresholds for GHG emissions that define when permits are required for new and existing industrial facilities under the Prevention of Significant Deterioration – New Source Review (PSD-NSR) and Title V Operating Permit CAA programs. Potential GHG emissions for the project area are primarily fugitive/mobile-source related and do not trigger PSD-NSR, so the project area is not currently subject to these regulations. The Supreme Court of the United States, in its *Utility Air Regulatory Group v. USEPA* decision on June 23, 2014 (134 S. Ct. 2427), ruled that EPA may not treat GHGs as an air pollutant for purposes of determining whether a source is a major source required to obtain a PSD or Title V permit. The court also ruled that PSD permits that are otherwise required (based on emissions of other pollutants) may continue to require limitations on GHG emissions to comply with BACT (EPA 2017e).

EPA Region 8 Climate Adaptation Implementation Plan

The EPA Region 8 Climate Adaptation Implementation Plan proposes measures to address climate change vulnerabilities in the states of MT, Colorado, South Dakota, Utah, and Wyoming (EPA 2014a). The Region 8 Draft Climate Change Strategic Plan provides details of the 2007 GHG emissions inventories in these states (EPA 2008a). The inventories are based on consumption of electricity within the region and do not include electricity that is produced for export outside the region. A key objective of the strategic and adaptation implementation plans is mitigation, which includes identifying and implementing goals and prioritized activities that have the highest potential to reduce GHG emissions. In particular, GHG-emitting projects subject to NEPA should disclose relevant information about the project's GHG emissions to support the plan. In addition, Region 8 goals include conserving natural resources and energy by managing materials more efficiently. This includes increasing the recycling of coal combustion products in Region 8 and reducing GHG emissions.

Clean Power Plan and Carbon Pollution Standards Rule

On August 3, 2015, EPA announced the Clean Power Plan that sets carbon emission standards for existing power plants and customized goals for states to cut carbon pollution. EPA also issued final Carbon Pollution Standards for new, modified, and reconstructed power plants and proposed a Federal Plan and model rule to assist states in implementing the Clean Power Plan (EPA 2015a). On August 31, 2018, EPA published a draft rule in the *Federal Register*, called the Affordable Clean Energy Rule, to regulate carbon pollution from existing fossil-fueled power plants. This rule is designed to replace the Clean Power Plan. EPA is taking comments on the proposed rule until October 30, 2018, after which a final rule is expected in the future.

State Requirements

Existing state plans and initiatives provide guidance for GHG emissions as described below.

Montana Climate Change Action Plan

In December 2005, DEQ established a Climate Change Advisory Committee (CCAC) to identify ways in which the state could reduce its collective GHG emissions while saving money, conserving energy, and bolstering the economy (DEQ 2007). On November 9, 2007, Governor Brian Schweitzer received the final Climate Change Action Plan from the CCAC, which includes 54 recommended policy and mitigation options for reducing the state's GHG emissions to 1990 levels by 2020. These include research and development for energy storage and advanced fossil fuel technologies, incentives for clean coal and for carbon capture and storage, and the use of natural gas in place of coal or oil.

Montana Greenhouse Gas Inventory and Reference Case Projections 1990–2020

As part of its work to develop the Climate Change Action Plan, CCAC completed an inventory and projections of GHG emissions for 1990 to 2020, which was released in September 2007. The inventory found that gross GHG emissions are rising at about the same rate in MT as in the nation as a whole. Some data gaps exist in this analysis, particularly for the reference-case projections. Key tasks include developing a better understanding of electricity-generation sources currently used to meet MT loads, and review and revision of the major emissions drivers (electricity, fossil-fuel production, and growth rates for transportation fuel use) that will determine MT's future GHG emissions.

Local Requirements

There are no local regulations applicable to climate change within or near the vicinity of the Rosebud Mine or the Colstrip and Rosebud Power Plants.

3.4.1.2 Direct and Indirect Effects Analysis Area

For the purpose of the climate change analysis, the analysis area extends to areas where potential direct or indirect effects of GHG emissions from any of the alternatives could occur. GHGs have the potential to remain in the atmosphere for long periods of time (from tens to hundreds of years) and to travel long distances. Their effects are thus widely distributed rather than localized to the mine permit area or coal combustion facilities and need to be placed in the context of emissions on a much larger spatial scale. Thus, the analysis area for climate and climate change is the world with focus on the United States and MT. GHG emissions sources and trends are described below on global, national, state, and regional scales. In particular, the analysis area for air quality was used for identifying major regional sources of GHGs.

3.4.2 Climate Conditions

3.4.2.1 Atmospheric Composition

Air is a mixture of constituent gases, and its composition varies slightly with location and altitude. The permanent gases for which the percentages of the air do not change from day to day are nitrogen (78 percent), oxygen (21 percent), and argon (0.9 percent). CO_2, N_2O, CH_4, and ozone are among the trace gases that together account for the remaining 0.1 percent.

Water vapor is the largest contributor to the natural greenhouse effect and is unique in that its concentration varies from 0 to 4 percent of the atmosphere depending on location and time of the day (EPA 2016c). GHGs, the percentages of which vary daily, seasonally, and annually, have physical and chemical properties that cause them to interact with solar radiation and infrared light (heat) emitted from Earth to affect the energy balance of the globe. Therefore, although GHGs like CO_2 and CH_4 account for a small fraction of Earth's atmosphere, they can strongly affect the global energy balance and temperature over time, leading to potentially long-term changes in climate.

3.4.2.2 Greenhouse Gases

The most common GHG produced from human activity (fuel combustion) is CO_2, followed by CH_4 and N_2O (EPA 2017d). These are also the primary GHGs that would be emitted from the project area and Colstrip and Rosebud Power Plants and thus are the focus of the following discussion. Larger GHG emissions lead to higher concentrations of GHGs in the atmosphere. GHG concentrations are measured in parts per million (ppm), parts per billion (ppb), and parts per trillion (ppt). Emissions are measured as metric tons of CO_2e, a unit of measure that takes into account the Global Warming Potential (GWP) of each of the emitted GHGs in terms of CO_2e.[5]

Carbon Dioxide

CO_2 is naturally present in the atmosphere as part of Earth's carbon cycle—the natural circulation of carbon among the atmosphere, oceans, soil, plants, and animals. It enters the atmosphere through burning fossil fuels (coal, natural gas, and petroleum products); decomposition of solid waste, trees, and wood products; fermentation; and certain chemical reactions such as cement manufacturing. It is removed from the atmosphere (sequestered) when it is absorbed by plants as part of the biologic carbon cycle.

Human activities are altering the carbon cycle—both by adding CO_2 to the atmosphere and by influencing the ability of natural sinks, such as forests, to remove CO_2 from the atmosphere (EPA 2017d). In 2013, CO_2 accounted for about 82 percent of all U.S. GHG emissions from human activities. CO_2 concentrations in the atmosphere have increased from about 280 ppm in preindustrial times to about 390 ppm. IPCC noted that "this concentration has not been exceeded during the past 420,000 years, and likely not during the past 20 million years" (IPCC 2001) and that "the rate of increase over the past century is unprecedented, at least during the past 20,000 years." The main sources of CO_2 emissions in the United States are electricity (the combustion of fossil fuels to generate electricity), transportation (the combustion

[5] According to EPA, emissions of GHGs are typically expressed in a common metric so that their impacts can be directly compared, as some gases are more potent (have a higher GWP) than others. Gases with a higher GWP absorb more energy (and thus contribute more to warming the earth) than gases with a lower GWP. The international standard practice is to express GHGs in CO_2 equivalents, or CO_2e. Emissions of gases other than CO_2 are translated into CO_2e using GWPs. A GWP is calculated over a specific time interval, commonly 20, 50, or 100 years. IPCC recommends using 100-year potentials (EPA 2017l).

of fossil fuels to transport people and goods), and industry (the combustion of fossil fuels and chemical reactions) (EPA 2017d).

The GWP coefficient of CO_2 is defined as 1.0. The lifetime of CO_2 in the atmosphere cannot be accurately represented by a single value, as some fraction of emitted CO_2 is quickly absorbed by the ocean and vegetation, some fraction slowly decreases over a period of years, and a small fraction can remain in the atmosphere for centuries or longer (EPA 2017f).

Methane

CH_4 is primarily produced by anaerobic (without oxygen) decomposition of organic matter in biological systems including livestock, by other agricultural practices, and by the decay of organic waste in municipal solid-waste landfills. It is also emitted during the production and transport of coal, natural gas, and oil (EPA 2016c). CH_4 is the second-most prevalent GHG emitted in the United States as a result of human activities, but it persists in the atmosphere for a much shorter time than CO_2 (12.4 years). However, it is more efficient at trapping radiation than CO_2, having a 100-year GWP of 28 (IPCC 2014).

Nitrous Oxide

N_2O is naturally present in the atmosphere as part of Earth's nitrogen cycle and is emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste (EPA 2016c). IPCC's AR5 reports a GWP coefficient for N_2O of 265, and its persistence in the atmosphere is estimated to be 121 years (IPCC 2014).

3.4.2.3 Climate and Emissions Trends

Global Climate and Emissions Trends

According to IPCC, many of the observed changes to the earth's climate system since the mid-20th century are "unprecedented over decades to millennia." **Figure 24** presents a number of observed long-term changes in indicators of Earth's climate system including surface temperature, precipitation, sea level, and sea ice. The average temperature of Earth's land and ocean surface increased by about 1.5 degrees Fahrenheit (°F) or 0.85 degrees Celsius (°C) between 1880 and 2012, and the 30-year period from 1983 to 2012 was very likely the warmest in 800 years (IPCC 2014). The ten warmest years on record have occurred since 1998 (EPA 2016c). Between 1971 and 2010, warming of the ocean has accounted for more than 90 percent of the energy stored in the climate system with the ocean surface warming 0.2 °F (0.11 °C) per decade. Global precipitation has increased at an average rate of about 0.08 inches per decade since 1901 (EPA 2016c). The annual mean extent of Arctic sea ice has decreased 3.5 to 4.1 percent per decade since satellite observations began in 1979, and snow cover in the Northern Hemisphere has fallen by 1.6 percent per decade since the mid-20th century (IPCC 2014). Glaciers have receded and lost significant mass since the 1970s with the rate of ice loss in Greenland and Antarctic ice sheets likely being larger between 2002 and 2011 than between 1992 and 2001 (IPCC 2014). The global mean sea level rose by about 7.5 inches (0.19 m) between 1901 and 2010 with reduction in glacial mass and ocean thermal expansion from warming accounting for about 75 percent of the rise since the early 1970s. In addition, ocean acidity has increased by 26 percent since the beginning of the industrial era due to the uptake of CO_2 (IPCC 2014).

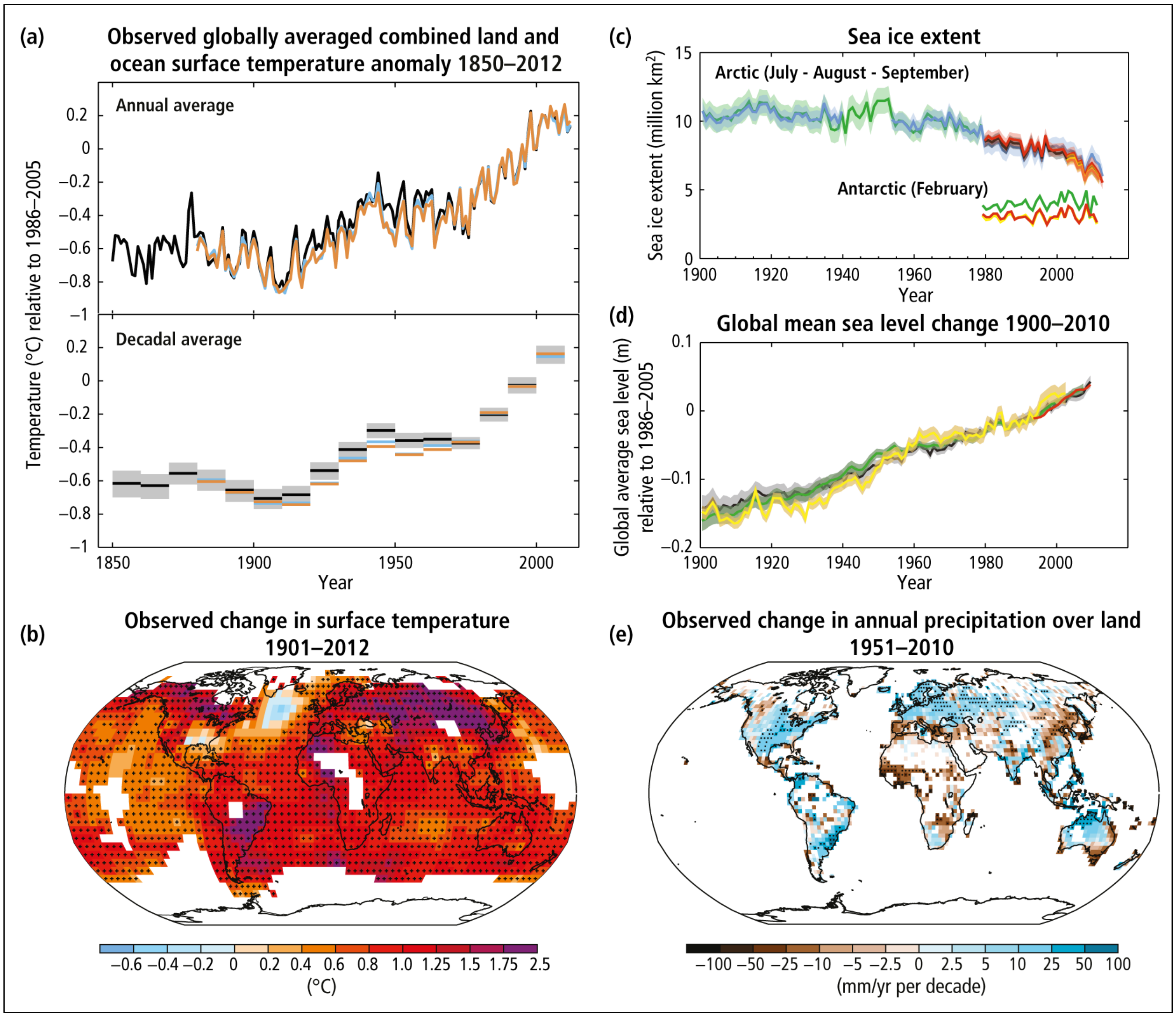

Figure 24. Historical Changes in Observed Indicators of the Global Climate System Including Surface Temperature (a, b), the Extent of Sea Ice (c), Sea Level (d), and Annual Precipitation (e).

Source: IPCC 2014.

The anthropogenic contribution to atmosphere GHG concentrations has been significant and increasing since the beginning of the industrial revolution largely as a result of the burning of fossil fuels and clearing of forests (EPA 2016c). **Figure 25** presents the global average concentrations of CO_2, CH_4, and N_2O since 1750. Current atmospheric concentrations of GHGs are at levels that are higher than any time in the past 800,000 years, and atmospheric concentrations of CO_2, CH_4, and N_2O have increased by 40 percent, 150 percent, and 20 percent since 1750, respectively (IPCC 2014). Half of the cumulative anthropogenic CO_2 emissions since 1750 have occurred in the last 40 years, and about 40 percent of the total anthropogenic CO_2 emissions since 1750 are still in the atmosphere (IPCC 2014).

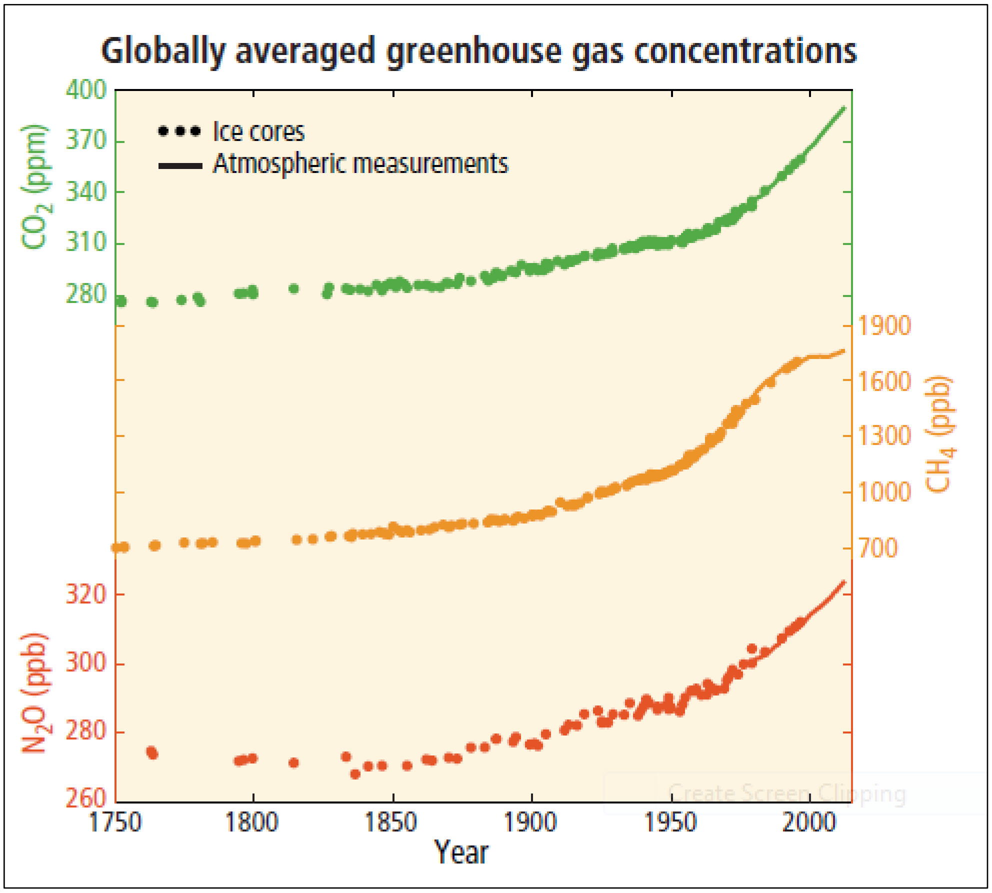

Figure 25. Observed Concentrations of CO_2, CH_4, and NO_2 since 1750 Based on Atmospheric Measurements and Ice Cores.

Concentrations are reported in parts per million (ppm) or parts per billion (ppb).
Source: IPCC 2014.

Total anthropogenic GHG emissions from 2000 to 2010 were the highest in human history, reaching 52 gigatonnes (Gt) of CO_2e in 2010 (based on GWP from AR5). Anthropogenic GHG emissions increased by 2.2 percent per year during this period with energy, industry, transport, and building sectors accounting for 47 percent, 30 percent, 11 percent, and 3 percent of the growth in emissions (IPCC 2014). CO_2 is the primary anthropogenic GHG, comprising 76 percent of total anthropogenic emissions in 2010. Cumulative CO_2 emissions from fossil fuel combustion, cement production, and flaring have tripled since 1970, and cumulative CO_2 emissions from forestry and other land uses have increased by about 40 percent during the same period (**Figure 26**). CO_2 emissions from Asia, the United States, and Europe accounted for 88 percent of total global emissions in 2012 (EPA 2016c).

The increased concentration of GHGs in the atmosphere since 1750 has led to an uptake in energy by the climate system, and human influence is extremely likely to have been the dominant cause of recent observed warming since the mid-20th century (IPCC 2014). **Figure 27** presents the observed warming that occurred between 1951 and 2010 along with the estimated anthropogenic and natural forcing contributions to surface warming during this period. According to IPCC, it is extremely likely that the anthropogenic increases in GHG concentrations and other anthropogenic forcings contribute more than half of the increase in global surface temperatures.

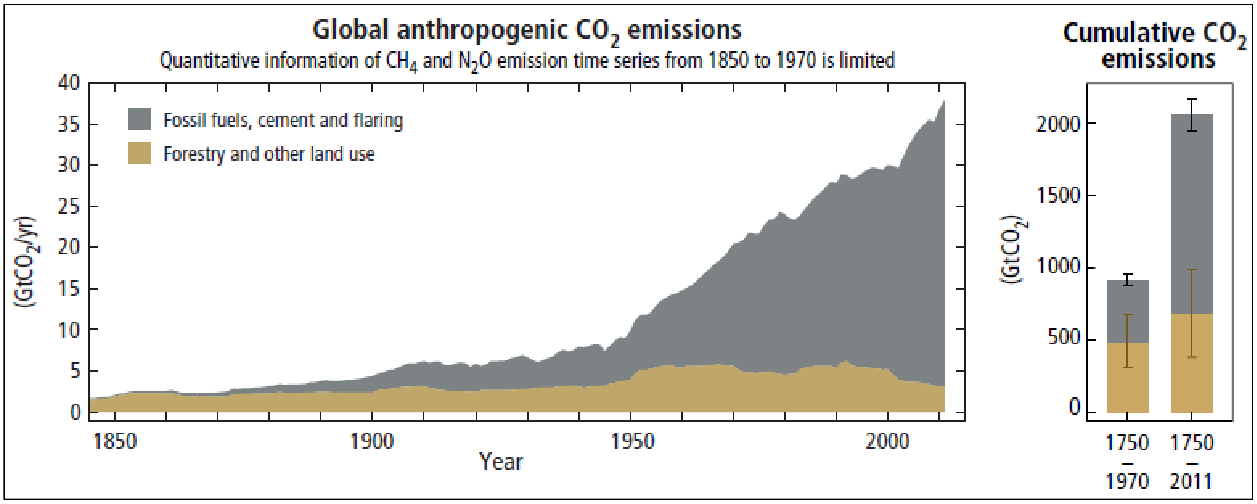

Figure 26. Historic Annual and Cumulative Global Anthropogenic CO_2 Emissions in Gigatonnes of CO_2e per Year from Fossil Fuel Combustion, Cement Production, Flaring, and Forestry and Other Land Use.

Source: IPCC 2014.

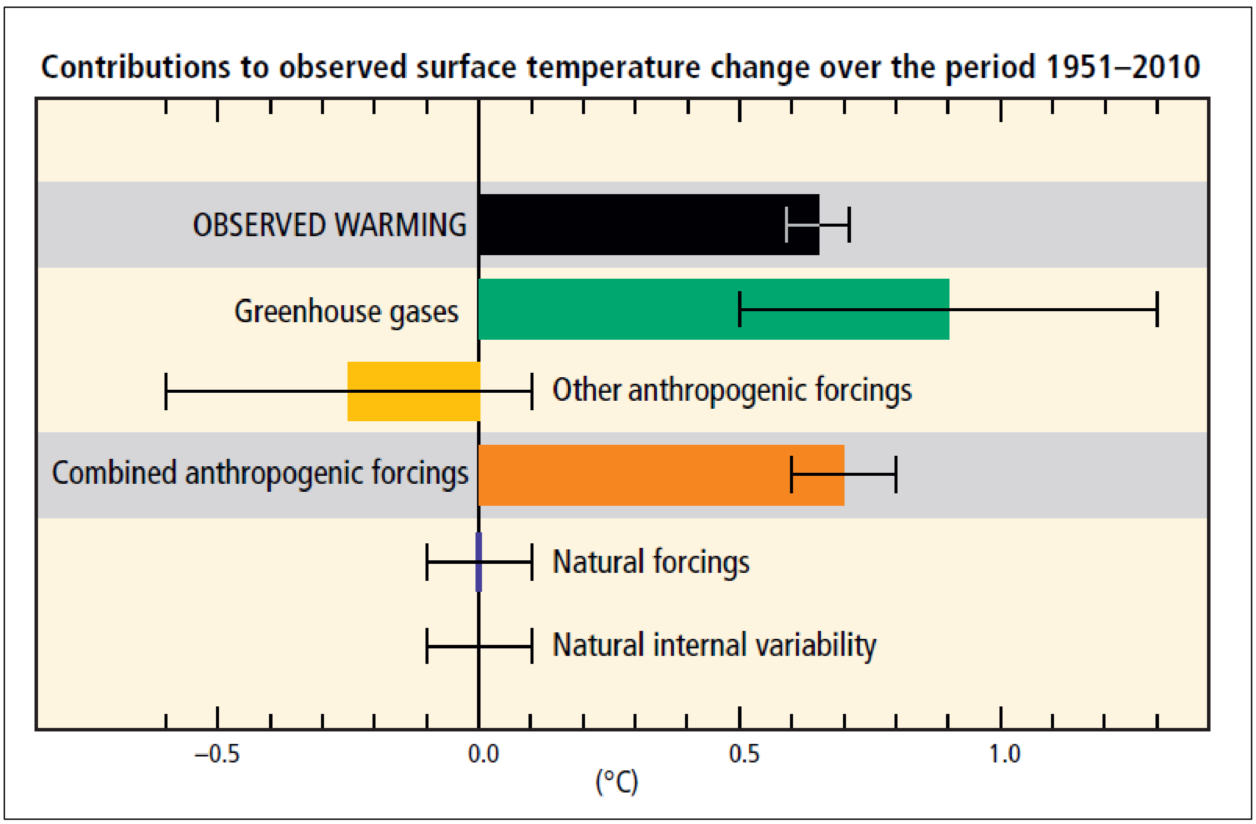

Figure 27. Observed Warming and Estimated Contributions of Anthropogenic and Natural Forcing to Observed Surface Temperature Change from 1951 to 2010.

Source: IPCC 2014.

National Climate and Emissions Trends

Since 1901, the average surface temperature across the contiguous United States has risen by 0.14 °F per decade, which is consistent with the global trend (0.15 °F per decade), but U.S. temperatures have increased faster than the global rate since 1979 with increases of 0.29 °F to 0.46 °F per decade (EPA 2016c). The observed warming is not evenly distributed across the United States with some areas warming more rapidly than others (**Figure 28**). The largest observed increases in warming during this period occurred in the North, the West, and Alaska, while some parts of Southeast experienced little change. Total average precipitation has increased over the land areas of the United States during this period, which is consistent with global trends, but some areas such as the Southwest have seen precipitation decrease (**Figure 28**). In addition, the occurrence of extreme single-day precipitation events has increased significantly with 9 of the top 10 years for extreme one-day precipitation events from 1910 to 2015 occurring since 1990 (EPA 2016c).

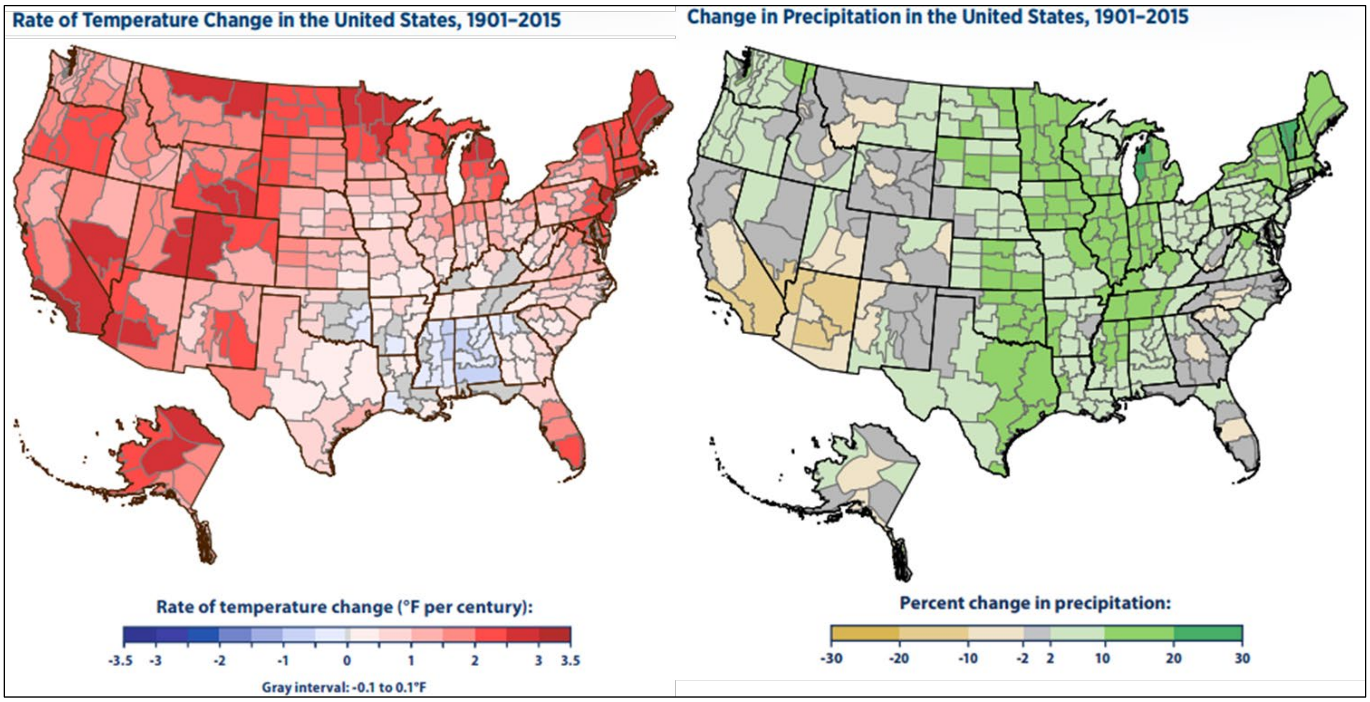

Figure 28. Rate of Observed Temperature Change and Change in Precipitation in Each of the Climate Divisions of the United States from 1901 to 2015.

Source: EPA 2016c.

EPA tracks and publishes total U.S. annual emissions in the Inventory of U.S. Greenhouse Gases and Sinks; this report estimates the total national GHG emissions and removals associated with human activities in all 50 states (EPA 2017f). In 2015, total U.S. GHG emissions were 6,586.7 million metric tons (MMT) CO_2e, which is a 2.3-percent decrease since 2014 and a 3.5-percent increase since 1990 (**Figure 29**; EPA 2017f). According to the World Resources Institute (WRI), the United States is the second largest global source of GHGs, contributing about 13 percent of global GHG emissions as of 2013 (WRI 2017). The primary economic sectors contributing to GHG emissions in the United States in 2015 were electricity production (29 percent), transportation (27 percent), industry (21 percent), commercial and residential (12 percent), and agriculture (9 percent) (EPA 2017f).

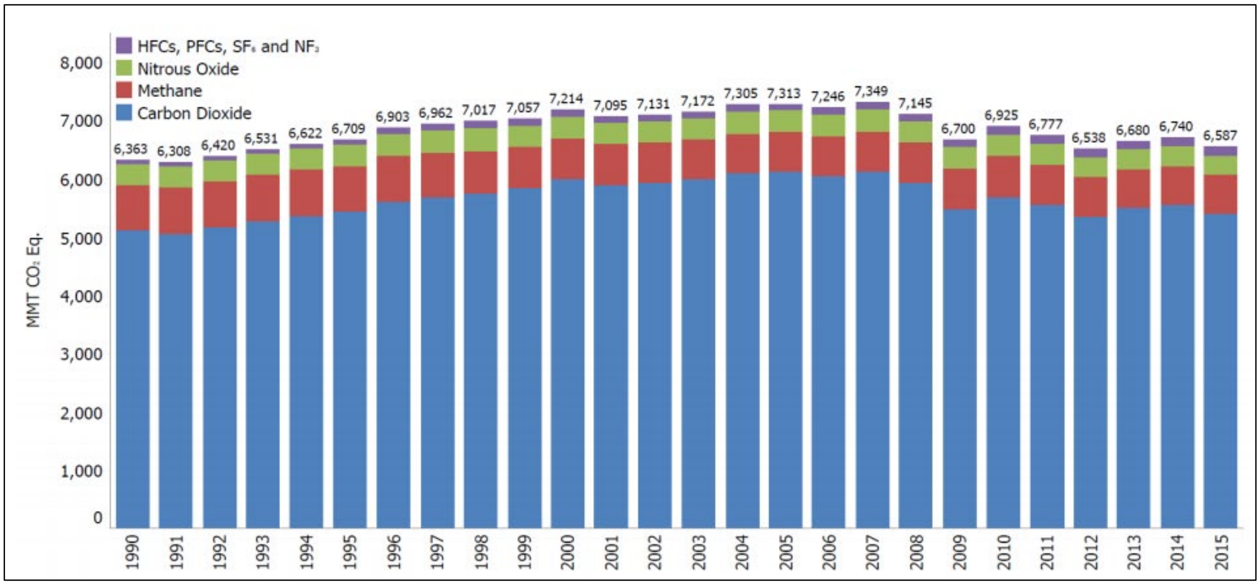

Figure 29. Gross U.S. GHG Emissions by Gas in Million Metric Tons (MMT) CO_2e from 1990 to 2015.

Source: EPA 2017f.

Between 1990 and 2015, CO_2 emissions in the United States increased by 5.6 percent, while total N_2O and CH_4 emissions in CO_2e decreased by 6.9 percent and 16.0 percent, respectively (EPA 2017f). The sector with the largest growth in GHG emissions over the same period was industrial process and product use (10.4 percent), followed by agriculture (5.5 percent) and energy (4.1 percent). Net carbon sequestration for the land use, land-use change, and forestry sectors decreased by 7.4 percent between 1990 and 2015.

Regional and State Climate and Emissions Trends

The U.S. Global Change Research Program, which is mandated by the Global Change Research Act of 1990, publishes National Climate Assessment (NCA) reports every four years that evaluate changes and the current status of climate in the United States. The third report was released in 2014 (Melillo et al. 2014). The Rosebud Mine falls within the Great Plains climate region of the NCA, which also includes Wyoming, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, and Texas (Shafer et al. 2014). In this region, summers are long and hot in the south and winters are long and severe in the north, with average annual temperatures ranging from 70 °F in South Texas to 40 °F in the mountains of MT and Wyoming (**Figure 30**). Average rainfall in the region is less than 30 inches; some areas, including some of MT, receive less than 15 inches of rainfall per year (**Figure 31**). The Great Plains region has seen heavier and more frequent rainfall and has seen a 16 percent increase in the rainfall from heavy precipitation events since 1958 (**Figure 32**). A description of precipitation and climate change is provided in the context of surface water in **Section 3.7.2, Climate**. Rising temperatures are leading to increased demand for water and energy, and changes in crop growth cycles due to warming winters and changes in rainfall have been observed (Shafer et al. 2014).

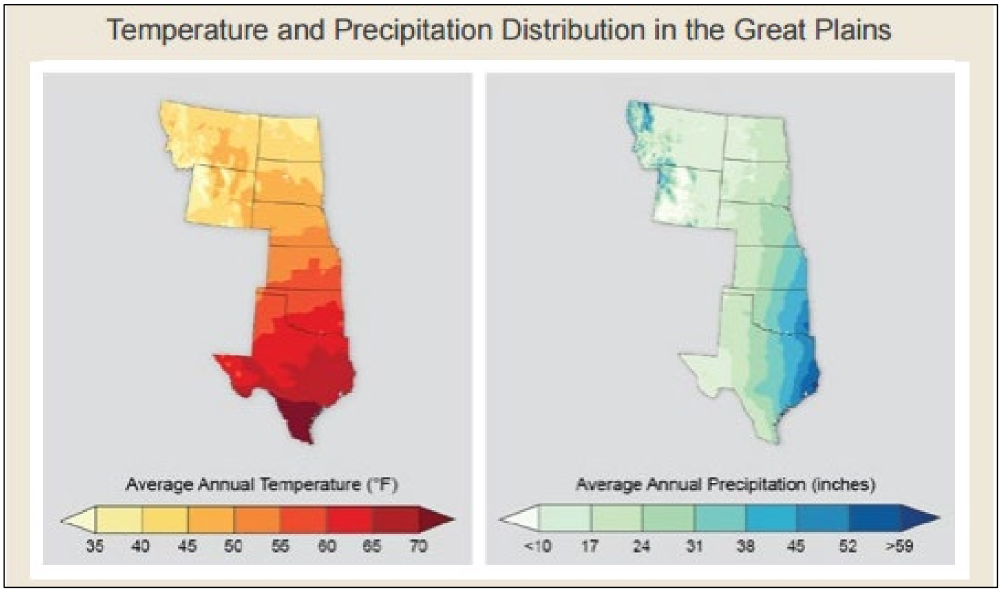

Figure 30. Average Annual Temperature and Precipitation in the Great Plains Region from 1981 to 2010.

Source: Melillo et al. 2014.

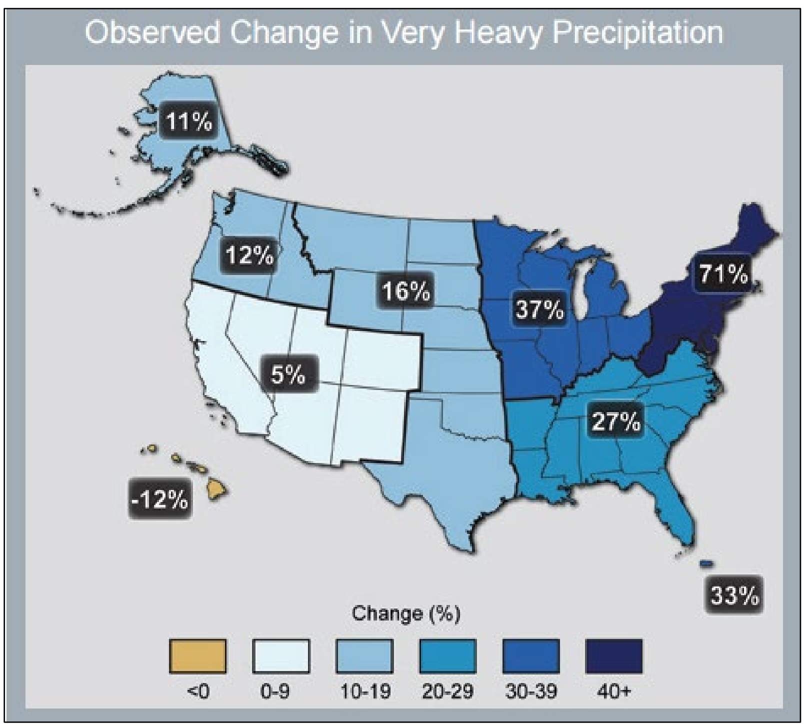

Figure 31. Observed Change in the Amount of Rainfall Falling in Heavy Precipitation Events (Heaviest 1 Percent of All Daily Events) from 1958 to 2012.

Source: Melillo et al. 2014.

In MT, temperatures have increased by 0.4 °F per decade since 1950, resulting in a total increase of 2.7 °F during this period. The largest increase in temperature occurred during the winter, and the annual maximum and minimum temperatures in MT have increased by more than 3 °F (Whitlock et al. 2017). The trend in annual mean temperature in MT since 1895 is presented in **Figure 32**. Unlike temperature, average annual precipitation has not changed significantly since 1950. However, precipitation in southeastern MT has increased by about 0.3 inches in the same period.

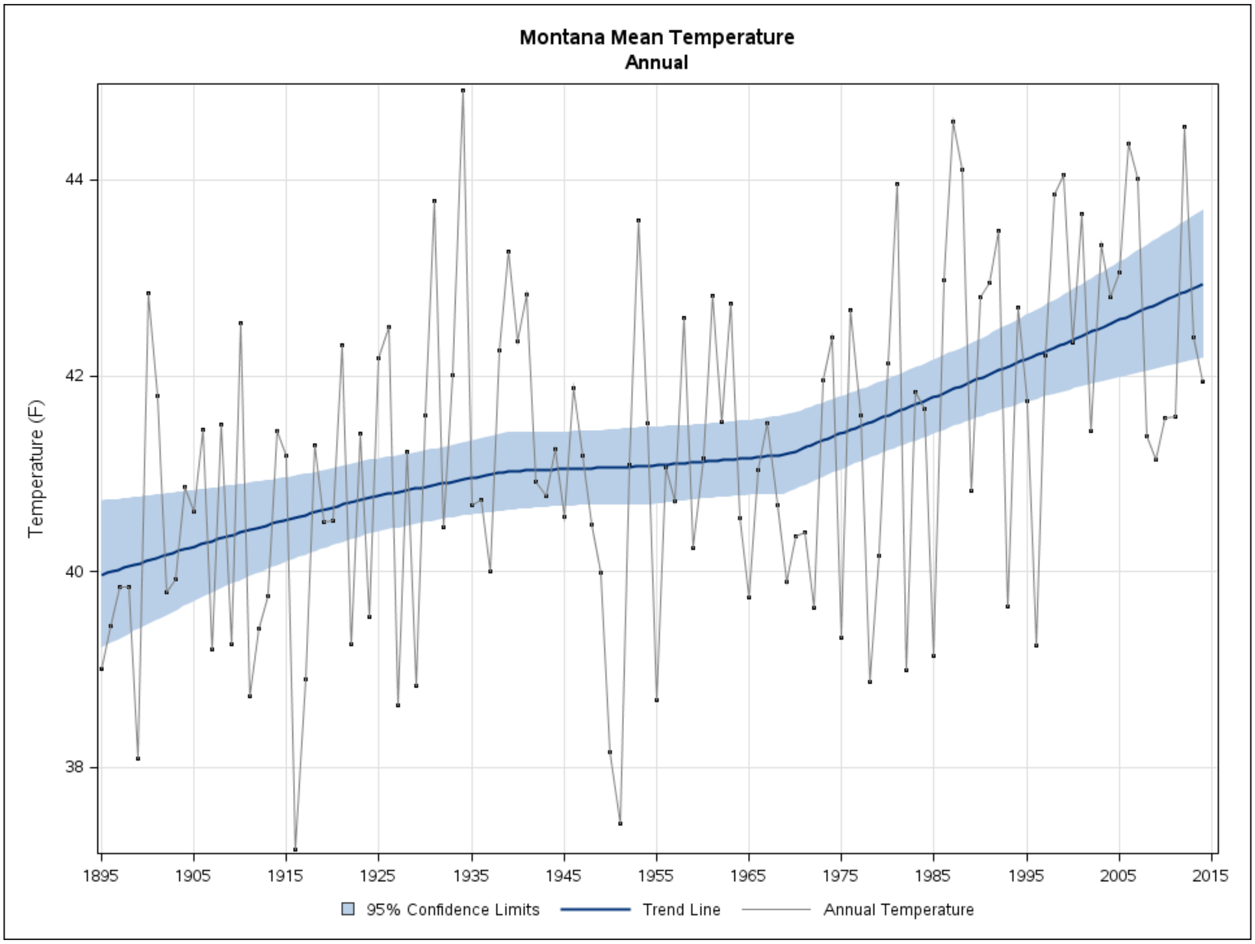

Figure 32. Historic Trend in Mean Annual Temperature in Montana from 1895 to 2015.
Source: NOAA 2017b.

As described under **Section 3.4.1.1, Regulatory Framework**, EPA's Region 8 Climate Change Strategic Plan (EPA 2008a) provides details of the 2007 GHG emissions inventories in MT, Colorado, South Dakota, Utah, and Wyoming. The inventories are based on the region's consumption of electricity and do not include electricity that is produced for export outside the region. Based on these inventories, EPA determined that:

- the states in EPA Region 8 were responsible for 5.3 percent of the nation's GHG emissions in 2005 totaling 362.39 million metric tons of CO_2e ($MMtCO_2e$)
- the principal sources of emissions in the region vary by state but include energy use, transportation, the fossil fuel industry, and agriculture

In 2005, MT's electricity generation, heating needs, commerce, agricultural practices, and transportation needs accounted for 37 $MMtCO_2e$ gross emissions, or 0.6 percent of the GHG emissions in the United

States. A 14-percent increase in GHG emissions from 1990 to 2005 moved MT from a net carbon sink to a net carbon emitter (EPA 2008b). By 2007 the state averaged net emissions (which include the effects of land use and forestry) of about 12 $MMtCO_2e$ per year. MT also has a per-capita rate of GHG emissions that is nearly double the national average. The reasons for this include the state's large fossil-fuel production industry, substantial agricultural industry, long distances for transportation, cooler climate, and low population base (DEQ 2007). However, MT is a large net exporter of electricity, and the CO_2 emissions produced from electricity production are attributed to MT's per-capita rate of GHG emissions even though the exported electricity is not consumed by residents of the state. Electricity use, agriculture, and transportation are the state's principal GHG emissions sources. Together, the combustion of fossil fuels for electricity generation used in-state and in the transportation sector account for about 46 percent of MT's gross GHG emissions (EPA 2008b).

MT's forests, cropland, and rangeland provide a vast terrestrial carbon sink that helps balance the state's emissions. Based on data from 1989 to 2004, MT's forests are estimated to account for a GHG emissions sink of -23.1 $MMtCO_2$. In addition, agricultural soil is estimated to sequester 2.3 $MMtCO_2$ (EPA 2008b).

More recent GHG emissions data were acquired for regional sources and MT from EPA's Facility Level Information on Greenhouse Gases Tool (FLIGHT) for 2015 (https://ghgdata.epa.gov/). FLIGHT is part of the required Greenhouse Gas Reporting Program, which requires all facilities that emit more than 25,000 metric tons of CO_2e per year to report annual GHG emissions to EPA. The total CO_2e emissions from MT in 2015 are shown in **Table 31** along with source category–specific emissions. GHG emissions from power plants comprise more than 81 percent of the total emissions from major facilities in MT.

Table 31. Reported 2015 GHG Emissions from Major Source Categories in Montana.[1]

Sector	2015 GHG Emissions[2] (MT CO_2e)
Power plants	18,799,567
Refineries	1,830,621
Minerals	998,216
Chemicals	652,464
Waste	315,164
Other[3]	192,208
Petroleum and natural gas systems	186,617
Metals	42,897
Total	**23,017,754**

Source: EPA 2017g.
[1]GHG emissions are from EPA's Facility Level Information Greenhouse Gases Tool (FLIGHT), which includes facilities that emit above 25,000 metric tons of CO_2e.
[2]CO_2e are calculated using GWP from IPCC's AR4 report.
[3]Other includes food processing, ethanol production, other manufacturing, military, universities, and any other industry not including in other sectors.
MT CO_2e = metric tons CO_2 equivalent.

GHG emissions data from large sources were also obtained from FLIGHT. In 2015, there were 119 facilities within 300 km of the Colstrip Power Plant area that reported to FLIGHT; the total GHG emissions from these facilities were about 42 $MMtCO_2e$. The 20 largest sources are shown in **Table 32.** The major sources of GHGs are power plants and refineries. The FLIGHT data shown here for GHG emissions, including those for the Colstrip and Rosebud Power Plants, are based on the GWP from AR4. Historic GHG emissions from the Colstrip and Rosebud Power Plants are discussed in more detail in **Section 3.4.2.5**.

Table 32. 20 Largest GHG Emission Sources within 300 km of the Rosebud Mine.

Facility	2015 GHG Emissions (MT CO_2e)[1]
Colstrip Power Plant	15,972,993
Dave Johnston	5,558,885
Dry Fork Station	3,123,225
Wyodak	3,114,905
Yellowstone Energy Limited Partnership	906,819
Wygen I	872,061
Phillips 66 Billings Refinery	837,699
Wygen III	828,737
Wygen II	770,723
ExxonMobil Refining and Supply Billings Refinery	766,725
Neil Simpson II	761,209
CHS Inc. Laurel Refinery	747,231
Hardin Generating Station	615,245
GCC Dacotah	592,051
Rosebud Power Plant	476,129
Graymont Western - U.S. Inc. Indian Creek	342,287
Pete Lien & Sons Inc.	334,913
Bison Treating Facility	329,161
Trident	304,320
Lewis & Clark	300,808

Source: EPA 2017g.
[1]MT CO_2e = Metric Tons CO_2 equivalent.

Coal Production

The sources and emissions of GHG from U.S. and MT coal production are discussed in this section to provide context for the GHG emissions from the coal-mining operations that would occur from the project area operations. Coal production in the United States reached a record level in 2008 of 1.17 billion short tons, according to the Energy Information Administration (EIA 2011). In 2013, the total fell below one billion for the first time since 1993, with 984.8 million short tons produced (EIA 2015). In 2014, the trend was shortly reversed after a 1.5 percent increase in U.S. coal production before dropping 10.3 percent to below 900 million short tons in 2015 (EIA 2016a, 2016b). In 2014, MT was eighth in the nation in terms of coal production, producing 37,916,366 tons (from both surface and underground sources), which accounted for 3.85 percent of the total U.S. production (OSMRE 2015). CH_4 emissions from U.S. coal mining account for about 1 percent of overall U.S. GHG emissions and about 9 percent of total U.S. CH_4 emissions (EPA 2017f). There were 834 mines in operation in the U.S. in 2015, the majority of which were surface mines (63 percent).

Three potential sources of fugitive CH_4 are associated with surface coal mining:

- emissions from the coal excavated and processed during mining activities
- emissions from the coal and other gas-bearing strata in the overburden or underburden exposed by mining activities
- emissions from the overburden coal excavated and stored on-site in waste piles (EPA 2014b)

Despite the fact that 63 percent of U.S. coal comes from surface mines, CH_4 emissions from surface mines constitute only 14 percent of total U.S. coal-mine methane emissions from active mines (EPA

2017f).[6] This is a result of the relatively low gas content of the coals from surface mines (EPA 2014c). The low gas content of these coal beds is likely related to the shallow depth of burial and the fact that some contain lower-rank coal (i.e., lignite and subbituminous coal) with proportionally lower gas-adsorption capacity. The gas content values used in estimating emissions from surface mines are based on a variety of studies. Average *in situ* gas content values are assigned on a basin-specific basis and range from 5.6 to 74.5 cubic feet per short ton (cf/t) (EPA 2008c).

3.4.2.4 Rosebud Mine GHG Emissions

In terms of production, the Rosebud Mine is the 16th-largest surface coal mine in the United States and the 2nd-largest surface coal mine in MT (EIA 2013). The primary sources of GHG emissions from the mine are fugitive CH_4 emissions from exposed coal, and exhaust from mobile and stationary engines used at the mine. Mobile sources of GHG include gasoline and diesel-powered loaders, coal-haul trucks, coal and overburden drills, hydraulic excavators, support vehicles, maintenance equipment, other materials-handling equipment (e.g., graders, dozers, dump trucks, reclamation tractors), and explosive detonation. The dominant fuel used for mobile sources at the Rosebud Mine is diesel, with a calculated GHG content of 22.4 pounds per gallon CO_2e.

Existing GHG emissions from Areas A, B, C, D, and E were estimated for 2010 to 2015 using activity data provided by Western Energy as an estimate of historic GHG emissions from the Rosebud Mine. To estimate emissions from off-road diesel and gasoline mobile sources, CO_2, CH_4, and N_2O emission factors for diesel and gasoline fuel combustion[7] were applied to the annual reported fuel usage rates. Annual stationary diesel equipment emissions were calculated based on the stationary diesel usage rate for Areas A, B, C, D, and E, along with stationary diesel equipment emission factors.[8] Emissions from the hauling of waste coal to the Rosebud Power Plant were estimated for 2013 (about midway between 2010 and 2015) using EPA's Motor Vehicle Emissions Simulator (MOVES) model with data provided by Western Energy, and were assumed to be representative of annual emissions from 2010–2015 (see Supplemental Information for data used in calculations). Surface methane emissions were calculated based on an emission rate of 33.1 standard cubic feet per ton (scf/ton) (EPA 2005a). None of the basins with available methane production rates were located in MT; therefore, the value for Green River Basin (Wyoming) was selected.

The resulting annual GHG emission rates for the Rosebud Mine are provided in **Table 33** for 2010 to 2015.

Table 33. Historic GHG Emissions Summary from the Rosebud Mine.

Year	Coal Production (MT/year)	Greenhouse Gas Emissions (MT/year)			
		CO_2	CH_4	N_2O	CO_2e
2010	11,095,174	47,333	8,211	1.19	277,550
2011	7,969,457	39,554	5,898	1.00	204,959
2012	7,273,891	40,268	5,383	1.01	191,271
2013	7,482,397	42,188	5,538	1.06	197,526
2014	8,181,408	39,085	6,055	0.98	208,877
2015	8,732,547	45,887	6,463	1.16	227,151

MT/year = metric tons per year.

[6] Inactive or abandoned mines continue to release CH_4 for years following closure. However, abandoned mine methane (AMM) emissions are not quantified or included in U.S. inventory estimates, in part because IPCC has not provided guidance on how to quantify emissions from abandoned mines (USEPA 2004).

[7] The Climate Registry. 2016 Default Emission Factors. Tables 13.1 and 13.7. https://www.theclimateregistry.org/wp-content/uploads/2014/11/2016-Climate-Registry-Default-Emission-Factors.pdf.

[8] 40 CFR Part 98, Appendix Tables C-1 and C-2. https://www.law.cornell.edu/cfr/text/40/part-98/subpart-C.

3.4.2.5 Colstrip and Rosebud Power Plants Stationary Source GHG Emissions

The subbituminous coal produced in Rosebud Mine is conveyed to and combusted at the Colstrip Power Plant in Units 1 to 4, while the waste coal is trucked to and used in the Rosebud Power Plant. Historic GHG emissions from these two power plants were acquired from EPA's FLIGHT, which uses GWP from IPCC's AR4. Reported CO_2e was revised for CH_4 and N_2O using the GWP from IPCC's AR5. The resulting annual GHG emissions from 2010 to 2015 are presented in **Table 34**.

Table 34. Historic GHG Emissions Summary from the Colstrip and Rosebud Power Plants.

Year	Greenhouse Gas Emissions (MT/year)			
	CO_2	CH_4	N_2O	CO_2e
Colstrip Units 1 to 4				
2010	16,994,687	1,902	277	17,121,274
2011	13,991,414	1,535	223	14,093,594
2012	13,395,792	1,455	212	13,492,605
2013	13,577,421	1,491	217	13,676,663
2014	14,796,150	1,627	237	14,904,402
2015	15,854,041	1,740	253	15,969,860
Rosebud Power Plant				
2010	415,871	51	7	419,297
2011	371,211	39	6	373,832
2012	427,247	45	7	430,267
2013	439,555	50	7	442,812
2014	418,448	48	7	421,612
2015	472,857	48	7	476,043

MT/year = metric tons per year.

Under Alternative 2 - Proposed Action, the average annual coal production at the Rosebud Mine would not be expected to increase above the current level of annual production, and the rate of coal combustion at the Colstrip Power Plant is not expected to increase beyond the current rate. Therefore, it is not expected that the annual rate of indirect GHG emissions produced from combustion of Area F coal at the Colstrip Power Plant would increase as a result of the Proposed Action. If the Proposed Action were to be approved, the life of the Rosebud Mine would be extended by 8 years, meaning potential GHG emissions-related impacts from combustion of Area F coal would not increase but would continue to occur at current levels for an additional 8 years when compared to Alternative 1 - No Action.

3.5 PUBLIC HEALTH AND SAFETY

3.5.1 Introduction

Public health is concerned with the health of entire populations, as well as disparities in quality and accessibility of health care and wellness. Public health is related to incidences and death rates for infectious and chronic diseases or other health conditions, including mental health. It can be affected by environmental conditions as well as demographics (such as poverty and minority status), the availability of infrastructure and services, and the prevalence of behavioral and social problems (see **Section 3.15, Socioeconomics** and **Section 3.16, Environmental Justice**).

This section describes the overall public health of populations within and surrounding the Rosebud Mine. It describes environmental conditions and public health resources within the proximity of the Rosebud Mine and the Colstrip and Rosebud Power Plants, including the area downwind. Relevant topics include environmental quality with respect to direct impacts of mining to surface and ground water quality; PM in the air and deposited on soils and water; a community's socioeconomic conditions with respect to access to and availability of public health resources; and demographics with respect to sensitive populations, community health, and land use.

Public safety addresses the risks of direct public exposure to operational activities (e.g., blasting with potential noise and vibration effects), hazards associated with transportation of hazardous materials, and railway and transportation safety. Evaluation of worker safety is not within the scope of this EA, but some EPA standards are applicable to public safety, particularly residences located in proximity to active mining.

3.5.1.1 Regulatory Framework

Federal Requirements

Federal Mine Safety Act and Health Act of 1977

The Federal Mine Safety and Health Act requires the U.S. Department of Labor's MSHA to ensure safe and healthy work environments for miners. All mines are inspected on multiple occasions each year for compliance with MSHA's regulations. In addition to setting safety and health standards for preventing hazardous and unhealthy conditions, MSHA's regulations require mine operators to provide the following:

- Immediate notification by the mine operator of accidents, injuries, and illnesses at the mine;
- Training programs that meet the requirements of the Mine Act;
- Obtaining approval for certain equipment used in gassy underground mines; and
- Requirements for the use of personal protective equipment (PPE).

Occupational Safety and Health Act (29 USC 651 et seq.)

The Occupational Safety and Health Act requires the Occupational Safety and Health Administration (OSHA) to issue and enforce workplace health and safety regulations. These include limits on chemical exposure, employee access to information, requirements for the use of personal protective equipment (PPE), and requirements for safety procedures. The employees working at the Rosebud Mine and performing maintenance of transmission lines are covered under OSHA, while mine workers are covered under MSHA.

EPA Noise Control Act of 1972

The EPA Noise Control Act of 1972 advises that a 24-hour equivalent level of less than 70 decibels on the A-weighted scale (decibel [dBA]) prevents hearing loss; and that a level below 55 dBA, in general, does not constitute a major impact. **Table 35** details the workplace protection measures provided per OSHA guidance against the effects of noise exposure. Regulation 30 CFR Part 816.67, enforced by OSMRE, regulates blasting activity in terms of noise and vibration resources (see **Section 3.22, Noise**).

Table 35. OSHA Workplace Permissible Noise Exposures.

Duration per Day (hours)	Sound Level (dBA)
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
0.5	110
0.25 or less	115

Source: OSHA 1974.
dBA = decibels on the A-weighted scale.

Hazardous and Solid Waste

All operations at mine and the power plants are required to be in compliance with the regulations promulgated under or by the Resource Conservation and Recovery Act (RCRA), the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Federal Water Pollution Control Act (Clean Water Act), Safe Drinking Water Act, Toxic Substances Control Act, MSHA, U.S. Department of Transportation, and the CAA (see **Section 3.21, Solid and Hazardous Waste**).

Air Quality

The CAA, with amendments and standards that apply to public health, is discussed in **Section 3.3, Air Quality**. Applicable regulatory standards for public health include the NAAQS that provide limits for CAPs; MATS (also known as NESHAP) that provide limits for HAPs, mercury, and acid gases; and the 2016 Consent Decree for the Colstrip Power Plant (see **Section 1.2.2.1, Colstrip Power Plant**).

Water Quality

Federal surface water quantity and quality regulations applicable to the analysis area include the Clean Water Act of 1972 and Clean Water Act Amendments of 1977, which require federal agencies to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." SMCRA requires that surface coal mining and reclamation operations protect surface and ground water quality in compliance with all applicable state and federal water quality laws and regulations and with the effluent limitations for coal mining operations. For a full discussion of these standards, see **Section 3.7, Water Resources - Surface Water** and **Section 3.7, Water Resources—Ground Water**.

Executive Order 12898 – Environmental Justice

Executive Order 12898, Environmental Justice, requires federal agencies to identify and address, as appropriate, disproportionately high and adverse public health or environmental effects on minority and low-income populations when implementing their respective programs, including American Indian programs. OSMRE's analysis of environmental justice follows the CEQ and EPA guidance on environmental justice (CEQ 1997; EPA 1998), and the U.S. Department of the Interior's Environmental Justice Strategic Plan 2012–2017 (OEPC 2012). For a full discussion of environmental justice populations, see **Section 3.16, Environmental Justice.**

State Requirements

Public Safety

Under MSUMRA, ARM 17.24.623(1-2) regulates the use of explosives, which includes notifying the public ahead of blasting including nearby residences where noise and vibrations may be experienced.

Air Quality

Under the CAA, individual states can adopt more stringent standards for CAPs and/or establish air quality standards for other COPCs than the federal standards. The MAAQS are presented along with the NAAQS in **Table 1**, and a full discussion of these standards is in **Section 3.3, Air Quality**.

The Montana Settleable PM standard (see **Section 3.3, Air Quality**) was designed for much larger particles than those covered under the federal NAAQS for PM_{10} and $PM_{2.5}$. MT utilizes a number of measures through permitting and enforcement that serve to provide reasonable precautions against excess PM generation. A full discussion of this standard is in **Section 3.3, Air Quality**.

Water Quality

Under the Clean Water Act, individual states can adopt more stringent standards for water quality than the federal standards. DEQ is responsible for administering the Montana Water Quality Act, which prevents degradation of surface and ground waters due to discharges of mine wastewater and storm water. For a full discussion, see **Section 3.7, Water Resources – Surface Water** and **Section 3.8, Water Resources – Ground Water**.

The rules implementing MSUMRA provide requirements to protect water quality and quantity, including water quality performance standards, and the use of best technology currently available (BTCA) to protect water resources. For a full discussion, see **Section 3.7, Water Resources – Surface Water**.

Local Requirements

There are no local requirements related to public health and safety within or near the analysis area.

3.5.1.2 Analysis Area

Public Health

The direct effects analysis area includes the project area and any residences and waterbodies where recreation or fishing may occur, that fall within the vicinity of the project area (see **Section 3.18, Recreation**, and **Section 3.25, Land Use**). The direct effects analysis area includes the county roads used for accessing the mine, where both general traffic and mine traffic occur. The air quality model identifies the direct effects analysis area as the project area, and notes that air concentrations and deposition of COPCs found in coal dust PM and DPM due to proposed project activities would drop off to below air quality standard levels at the boundary of the project area (see **Section 3.3, Air Quality; Section 4.3, Air Quality;** and **Appendix D-8**).

The population within the direct effects analysis area is sparse, and there may be scattered residences. The health and safety of on-site Rosebud Mine employees and contractors are covered under regulations as required by MSHA; as such, this evaluation focuses on off-site human receptors.

The indirect effects analysis area includes local communities and populations within Rosebud, Bighorn, and Treasure Counties, including the city of Colstrip, as well as the Northern Cheyenne Indian Reservation, the Crow Reservation, and the town of Lame Deer. The population density throughout the analysis area is sparse, with denser population centers located in or near Colstrip and Lame Deer. See **Section 3.15, Socioeconomics** and **Section 3.16, Environmental Justice** for descriptions of the demographics within the analysis areas. See **Section 3.18, Recreation** and **Section 3.25, Land Use** for descriptions of recreational and opportunities and other land use activities within the area.

The cumulative effects analysis area for the public health analysis encompasses the direct and indirect effects analysis areas for the Proposed Action and alternatives.

Public Safety

The public safety analysis areas for noise impacts are the same as for the noise analysis areas, which is the project area and a buffer that includes the city of Colstrip and the nearest residences to the project area in all directions. The indirect effects analysis area includes the residences that are within 1,000 to 3,500 feet away from the Rosebud Power Plant; and the residences in the city of Colstrip. The Colstrip residences are as close as 1,500 feet from the nearest cooling tower of the Colstrip Power Plant.

The public safety analysis areas for hazardous and solid waste impacts are the same as for the solid or hazardous waste analysis area (see **Figure 64** and **Section 3.21**). The direct effects analysis area includes the Rosebud Mine, including the project area. The indirect effects analysis area includes the entire Rosebud Mine, the sites of the Colstrip and Rosebud Power Plants, and the off-site CCR storage area associated with the Colstrip Power Plant.

3.5.2 Environmental Health

3.5.2.1 Public Health Environment

The NRC outlines four areas to consider for when describing a community's public health environment: environment, economy, demographics, and social characteristics (NRC 2011). Relevant topics to consider under each of these areas include:

- Chronic Disease: Noncommunicable health conditions that persist for periods longer than 3 months, such as heart disease, cancer, or asthma.
- Infectious Disease: Associated with viral, bacterial, or microbial infections that are commonly communicated from person to person through direct contact, such as influenza or malaria.
- Injury: Unintentional or accidental injury or trauma, such as a car accident or fall.
- Nutrition: Impacts on health (positive or negative) associated with diet.
- Well-Being Effects: Social, cultural, and psychological health of the affected populations.

The public health affected environment includes topics that are relevant to the alternatives, which are summarized in Table 36.

Table 36. Relevant Areas and Topics for Public Health Analysis.

Potentially Affected Areas	Possible Sources	POSSIBLE PATHWAYS FOR EXPOSURE AND RELEVANT ISSUES				
		Chronic Disease	Infectious Disease	Injury	Nutrition	Well-being
Environment						
Air	Fugitive dust and diesel emissions from vehicle traffic and machinery	Inhalation or ingestion of criteria pollutants, COPCs, and HAPs	Exacerbation and increased susceptibility for sensitive populations through inhalation or ingestion of criteria pollutants, COPCs, and HAPs	None	Uptake of hazardous pollutants through consumption and incidental ingestion of soils with criteria pollutants, COPCs, and HAPs content	Inhalation or ingestion of criteria pollutants, COPCs, and HAPs
	Stack emissions from existing plant operations; secondary emissions and fugitive dust from plant and ash disposal area; fugitive dust and diesel emissions from vehicle traffic	Inhalation or ingestion of criteria pollutants, COPCs, and HAPs	Exacerbation and increased susceptibility for sensitive populations through inhalation or ingestion of criteria pollutants, COPCs, and HAPs	None	Uptake of hazardous pollutants through consumption and/or incidental ingestion of soils, produce, agricultural products, or livestock	Inhalation or ingestion of criteria pollutants, COPCs, and HAPs
Surface Water and Ground Water	Changes in surface and ground water quality due to mining, as well as deposition of stack emissions in surface water	Direct contact with criteria pollutants, HAPs, and COPCs	Exacerbation and increased susceptibility for sensitive populations through direct contact with criteria pollutants, HAPs, and COPCs	None	Uptake of COPCs and criteria pollutants through consumption and incidental ingestion of water	Direct contact with criteria pollutants, COPCs and HAPs
Demographic						
Sensitive Populations	Potential effects on sensitive sub-populations (minority populations, low-income populations, populations with compromised health)	Inhalation or ingestion of criteria pollutants, COPCs, and HAPs	Exacerbation and increased susceptibility for sensitive populations through inhalation or ingestion of criteria pollutants, COPCs, and HAPs	None	Uptake of criteria pollutants, COPCs, and HAPs through consumption and incidental ingestion	Inhalation or ingestion of criteria pollutants, COPCs, and HAPs

Table 36. Relevant Areas and Topics for Public Health Analysis.

Potentially Affected Areas	Possible Sources	POSSIBLE PATHWAYS FOR EXPOSURE AND RELEVANT ISSUES				
		Chronic Disease	**Infectious Disease**	**Injury**	**Nutrition**	**Well-being**
Other Populations	Potential effects on the broader population, including those that recreate, garden, work, and live in the area	Inhalation or ingestion of criteria pollutants, COPCs, and HAPs	Exacerbation and increased susceptibility for sensitive populations through inhalation or ingestion of criteria pollutants, COPCs, and HAPs	None	Uptake of hazardous pollutants through consumption and incidental ingestion of criteria pollutants, COPCs, and HAPs	Inhalation or ingestion of criteria pollutants, COPCs, and HAPs
Economic						
Income and employment	Local employment and income including members of the Northern Cheyenne Tribe	Increased access to health care and preventative social services	Increased access to health care and preventative social services	None	Increased access to healthy foods	Job opportunities and income, access to health insurance and care
Revenue or expense to local, state, or tribal government (support for or drain on services, infrastructure)	Funds to county, state, and federal governments through extension of lease and coal royalties	Support for infrastructure and social services, response, and prevention of chronic disease	Support for infrastructure and social services, response, and prevention of infectious disease	Support for infrastructure and social services, response, and prevention of injury	Support for infrastructure and social services, response, and prevention of nutrition-related health issues	Support for infrastructure and social services, response, and prevention of behavioral and social health issues
Social						
Social Services	Schools, hospitals, health care providers, libraries, police and fire response	• Limited access to health and social services • Response, treatment, and prevention of chronic disease	• Limited access to health and social services • Response, treatment, and prevention of infectious disease	• Limited access to health and social services • Response, treatment, and prevention of injury	• Limited access to health and social services • Response, treatment, and prevention of nutrition-related health issues	• Limited access to health and social services • Response, treatment, and prevention of behavioral and social health issues
Community Health	• Potential effects on overall community health (e.g., exacerbation of asthma, impacts on lung/heart disease rates) • Insured population	Inhalation or ingestion of criteria pollutants, COPCs, and HAPs	Exacerbation and increased susceptibility for sensitive populations through inhalation or ingestion of criteria pollutants, COPCs, and HAPs	None	Uptake of hazardous pollutants through consumption and incidental ingestion of criteria pollutants, COPCs, and HAPs	Inhalation or ingestion of criteria pollutants, COPCs, and HAPs

Table 36. Relevant Areas and Topics for Public Health Analysis.

Potentially Affected Areas	Possible Sources	POSSIBLE PATHWAYS FOR EXPOSURE AND RELEVANT ISSUES				
		Chronic Disease	Infectious Disease	Injury	Nutrition	Well-being
Land use patterns (residential, recreational, or tribal use patterns)	• Potential impacts on lands used for livestock grazing • Disturbance of cultural resources that might affect traditional tribal ways of life • Noise and vibration disturbances during mine blasting	None	None	None	Effects on livestock, fish, and/or garden/home grown foods	• Psychological effects due to changes in traditional landscape and practices • Effects to traditional tribal cultural identity • Psychological effects due to noise and vibration

Source: Table 3-1 in NRC 2011.

3.5.2.2 Primary Contaminants and Exposure Pathways

Environmental media that are relevant to evaluate for public health include air, soil, surface and ground water. Public health concern is evaluated by considering if there would potentially be public exposure through these media that could result in health concerns. Possible exposure pathways to environmental contaminants include inhalation of PM, volatile organic compounds (VOCs), and fugitive dust; incidental ingestion of soil and dermal exposure from contact with soil; drinking water; recreation; and consuming fish, home-grown produce, and livestock.

The primary relevant public health risk concern in the direct effects analysis area would be health effects related to:

1) DPM, which consists of PM less than 2.5 micrograms per meter (μm) in diameter and is found in diesel exhaust at the mine. Inhalation of DPM can cause both carcinogenic and noncarcinogenic adverse health effects.
2) Metals found in coal dust (e.g., arsenic, cadmium, chromium, copper, lead, mercury, and selenium). Metals in coal particulate dust may contribute to both cancer risk and non-cancer acute or chronic hazard (represented by hazard index (HI)), through both inhalation of PM and non-inhalation pathways due to exposure to metals deposited on the surface of soil and waterbodies.

The primary relevant human health risk concern within the indirect effects analysis area would likely be health effects from:

1) Non-metal and metal contaminants emitted from the Colstrip and Rosebud Power Plants that can result in cancer risk and chronic non-cancer hazard due to human exposures.
2) Inhalation of chemicals of potential concern (COPCs) that have non-cancer acute health effects (e.g., sulfur dioxide (SO_2) and nitrogen dioxide (NO_2)).

The air quality model provides data to quantitatively address only inhalation exposure to DPM within the direct affects analysis area. Other primary contaminants and exposure pathways will be discussed qualitatively and within the limits of existing data. Deposition of COPCs and HAPs from air emissions on surface water and soil are assumed to be secondary results of air quality and are therefore not treated as separate topics.

3.5.2.3 Air Quality

Section 3.3, Air Quality, provides a detailed discussion of the current air quality conditions within the affected environment, including summaries of the existing emissions from the Rosebud Mine, the Colstrip and Rosebud Power Plants, and other regional air pollutant sources. Air quality has been monitored at the mine since 1990 and within the indirect effects analysis area since 2010 (Western Energy 2013; Western Energy 2017a; EPA 2016a; see **Appendix D-8**).

Existing sources of air pollution in the affected environment include the existing permitted areas of the Rosebud Mine, the Colstrip and Rosebud Power Plants, and a number of mines and industrial operations (see **Section 3.3.4.3, Existing Emissions from Other Regional Sources** and **Table 25).**

With respect to the existing emissions from the Rosebud Mine, emphasis will be on health impacts from PM. Characteristics and potential sources of PM are discussed below.

Historic and recent PM air concentrations detected at the Rosebud Mine and the indirect effects analysis area have been within the NAAQS standards (Western Energy 2017a). As noted in **Section 3.3.4.1,**

Existing Conditions from Rosebud Mine, the total CAP emissions are almost entirely from low-level and dispersed sources with the largest sources being fugitive dust emissions from wind erosion of exposed areas, and vehicle traffic on haul and access roads.

The primary sources of HAPs at the mine are fugitive coal dust and diesel exhaust. Raw coal contains a number of HAPs and the generation of coal dust at the mine suspends these compounds in the air where they can potentially impact human health via inhalation and deposition on soils and water bodies. The exhaust from diesel equipment also releases DPM, which is comprised of toxic gases and PM. DPM is considered a carcinogenic air toxin, but is not currently regulated by the EPA (EPA 2002).

Particulate Matter (PM)

PM emissions may be composed of a number of substances, including acids, organic chemicals, metals, and soil or dust particles (EPA 2009). Sources may include construction sites, unpaved roads, power plants, motor vehicles, mining operations, biomass combustion (e.g., forest fires and burning of wood), power plants, mines, and vehicle emissions (Stanek et al. 2011; EPA 2009).

Following inhalation, deposition and retention of particles in the respiratory tract is dependent upon the size of the particles. Larger particles are deposited higher in the respiratory tract (nose, throat), while smaller particles are deposited lower (lungs). The EPA regulates PM_{10} and $PM_{2.5}$, which have aerodynamic diameters <10 µm and <2.5 µm respectively, and are considered the most likely to cause adverse health effects. Both have the potential to penetrate to the terminal bronchioles and the alveoli within the lungs, and $PM_{2.5}$ is considered especially harmful to respiratory health (Hinds 1999; EPA 2009).

Exposure to $PM_{2.5}$ and PM_{10} has been linked with worsening adverse effects in populations with asthma. There is a potential link between exposure and worsening existing cardiopulmonary problems for those with diabetes (EPA 2009). Recent studies indicate there may be a causal link between particulate inhalation and an increased incidence of asthma (American Academy of Pediatrics 2004; Guarnieri and Balmes 2014; Patel and Miller 2009; EPA 2009). There is evidence that populations with asthma and compromised respiratory systems also may be more susceptible to viral and bacterial respiratory infections during and after increases in air pollution events (Kelly and Fussell 2011; EPA 2009).

Although it is possible that some cases of cardiovascular problems, respiratory problems, lung cancer, and diabetes may be related to, result from, or be worsened by $PM_{2.5}$, most cases of these health problems are associated with and compounded by other variables, including lifestyle factors such as diet, inactivity, and adult smoking rates). These variables are present at relatively high rates within the analysis area (University of Wisconsin Population Health Institute (UWPHI) 2017).

The average daily concentrations of $PM_{2.5}$ in µm/m^3 are 7.1 in Big Horn County, 7.4 in Rosebud County, and 6.2 in Treasure County, compared to 6.2 in MT. While lower than the U.S. average for $PM_{2.5}$ (6.7 in the 10th percentile), Rosebud County has one of the highest concentrations in MT (University of Wisconsin Population Health Institute (UWPHI) 2017). The aforementioned concentrations are well below the NAAQS. Lame Deer is designated a federal moderate non-attainment area for PM_{10}, the primary source of which is fugitive dust from unpaved roads (DEQ 2017a).

Diesel Exhaust Emissions

Diesel engine exhaust is primarily composed of CO_2 and water vapor, and contains smaller amounts of DPM and various gaseous substances (International Agency for Research on Cancer 2014; EPA 2002). DPM is primarily composed of $PM_{2.5}$. A variety of health effects have been linked to elevated DPM exposures, including acute irritant effects (e.g., eye, throat, or bronchial irritation), respiratory symptoms (e.g., cough, phlegm, and wheezing), immunologic effects (e.g., exacerbation of asthma and allergenic responses), lung inflammatory effects, cardiovascular health responses (e.g., clotting or other blood flow restrictions), and cancer (e.g., lung cancer) (Hesterberg et al. 2010; Ghio et al. 2012).

Most of the research on health effects from DPM examines exposure to exhaust from older diesel engines. Advances in diesel engine technology have resulted in the development of modern diesel engines that emit less DPM with lower concentrations of HAPs and COPCs than older engines, and comply with more stringent national and state emissions standards; therefore, an analysis based on the available data and assumptions is limited in its applicability to situations where newer diesel engine technology is used. The limited research about the health effects from exposure to exhaust from modern diesel engines suggests that adverse effects may be reduced compared with older engines (Hesterberg et al. 2010; Mills et al. 2011).

Coal Dust

Coal dust is created when coal is handled and transported. Its toxicity depends on chemical composition and the size of the dust particles. The health risks from coal dust exposure depend on particle size, where particles are deposited and/or transported, and where and to what extent they are absorbed; and on the composition of the coal dust. In general, about half of the coal dust emissions particles would be in the PM_{10} size range, and only about 15 percent would be in the $PM_{2.5}$ size range (EPA 1995a). Particle size and shape also play a role in how far coal dust travels, how long it stays suspended in air, and where it is deposited on soils and surface water.

Chemical components potentially toxic to humans include silica, polycyclic aromatic hydrocarbon compounds, and trace metals, such as arsenic, lead, copper, iron, mercury, and selenium. Metals concentrations in coal dust are typically low. The Montana Bureau of Mines and Geology recently analyzed coal samples from the Otter Creek coal bed in MT and reported concentrations of various metal elements mostly in the range of a thousandth of a percentage or less by mass (U.S. Department of Transportation 2015). Metals and polycyclic aromatic hydrocarbon compounds are found in a similar concentration range in coal samples collected at the Rosebud Mine (**Appendix D-8**).

Most research on the potential health effects of coal dust exposure has focused on occupational settings, specifically those of coal miners exposed to dust in above-surface or underground coal mines, where exposure is typically at concentrations that are orders of magnitude greater than the highest airborne dust concentrations that would be expected in non-occupational settings (National Institute for Occupational Safety and Health (NIOSH) 2011) (see **Section 3.25, Resources Considered but Dismissed**). Studies indicate that individuals and communities located near coal mines do not have increased incidence of asthma (Pless-Mulloli et al. 2000; Pless-Mulloli et al. 2001) but may be at a greater risk for cancer and other chronic illnesses (Jenkins et al. 2013; Hendryx and Ahern 2008).

3.5.2.4 Surface and Ground Water Quality

Section 3.5, Water Resources – Surface Water and **Section 3.6, Water Resources—Ground Water**, provides a detailed discussion of the current water quality conditions within the affected environment. **Table 37** provides the maximum concentrations for metals in project area streams, ponds and springs compared to the Montana Surface Water Quality Standards. **Table 38** compares the maximum concentrations for metals in ground water compared to the Montana Numeric Ground Water Quality Standards and livestock consumption water quality recommendations. The quality of most surface waters in the project area complies with human health standards. Arsenic concentrations exceeding the human health standard have been found in ponds and springs, lead concentrations exceeding the human health standard have been found in some ponds and streams and selenium concentrations exceeding the human health standard have been found in some streams and springs. **Tables 42** through **54** and **59** through **63** summarize the water quality within the direct effects analysis area. Atmospheric deposition of COPCs from the Rosebud Mine and Colstrip and Rosebud Power Plants on surface water is considered part of the air quality analysis and is not addressed here.

While some surface water sources exceed human health standards, the analysis area does not have documented drinking water violations (UWPHI 2017). Municipal water for the town of Colstrip is sourced from Castle Rock Lake, which is filled by water piped from the Yellowstone River and from a few domestic water wells. Exposure to COPCs from surface water occurs primarily from recreational contact with water (e.g., fishing and swimming at Castle Rock Lake within the indirect effects analysis area). DEQ classifies surface water in the direct and indirect effects analysis areas as suitable for bathing, swimming, and recreation, and growth and propagation of non-salmonid fish and associated aquatic life, waterfowl, and furbearers (see **below** and **Section 3.5, Water Resources – Surface Water**). Castle Rock Lake has fish consumption advisory for mercury, however there is no water quality data for the lake. Mercury concentrations in nearby streams and creeks do not exceed water quality standards (see **Section 3.5, Water Resources – Surface Water**).

Both boron and arsenic are present in low concentrations in the McKay and Sub-McKay aquifer in the project area; it is likely that these analytes occur naturally and are not the result of the mining operations at the Rosebud Mine. Both boron and arsenic are present in surface waters and ground water at levels well below the lowest water quality standard or recommended concentration for livestock (see **Tables 42** through **54** in **Section 3.7, Surface Water Resources** and **Tables 59** through **63** in **Section 3.8, Ground Water Resources**). The lowest water quality standard concentration for boron is 30 mg/L. Boron in ground water in the McKay Coal aquifer ranges between 0.10 and 0.81 mg/L. Boron in the Sub-McKay aquifer ranges between 0.18 and 1.3 mg/L. The lowest water quality standard for arsenic is 0.01 mg/L. Arsenic in the Sub-McKay aquifer ranges between 0.00007 and 0.003 mg/L. Arsenic in ground water in the Sub-McKay aquifer ranges between <0.00007 and 0.015 mg/L. At these concentrations, risk to human health is not likely. While there have been exceedances for arsenic in overburden areas, ground water concentrations overall remain within acceptable limits.

Table 37. Montana Surface Water Quality Standards and Surface Water Quality in the Direct Effects Analysis Area.

Parameter	Human Health Standard (mg/L)	Maximum Concentration in Ponds (mg/L)	Maximum Concentration in Streams (mg/L)	Maximum Concentration in Springs (mg/L)
Arsenic – C	0.01	**0.019**	0.009	**0.013**
Cadmium – T	0.005	0.001	0.00097	0.0025
Chromium – T	0.1	0.036	0.0238	0.0014
Copper – T	1.3	0.055	0.0335	0.0355
Fluoride – T	4.0	2.5	0.9	3.92
Lead – T	0.015	**0.038**	**0.0217**	0.0038
Mercury – T, BCF>300	0.00005	**<0.0002**	—	—
Nickel – T	0.1	0.044	0.0002	0.0135
Nitrate+nitrite, as N – T	10	4.2	0.0286	6.8
Selenium – T	0.05	0.023	**1.7**	**0.17**
Zinc – T	2.0	0.176	0.105	0.029

Source: Circular DEQ-7, Montana Numeric Water Quality Standards (DEQ 2017c); Circular DEQ-12A (DEQ 2014); ARM 17.30.629.
Concentrations in bold exceed Montana Surface Water Quality Standards. See **Section 3.6, Water Resources—Surface Water**.
T = toxic; C = carcinogen; H = harmful (aquatic life).

Table 38. Montana Numeric Ground Water Quality Standards, Livestock Consumption Water Quality Recommendations, and Maximum Ground Water Concentrations within the Analysis Area.

Parameter	Montana Numeric Ground Water Quality Standard (mg/L)	Lowest Water Quality Standard or Recommended Concentration for Livestock (mg/L)	Maximum Concentration in Project Area Alluvium (mg/L)	Maximum Concentration in Project Area Overburden (mg/L)	Maximum Concentration in Rosebud Coal in Project Area (mg/L)	Maximum Concentration in McKay Coal in Project Area (mg/L)	Maximum Concentration in Sub-McKay in Project Area (mg/L)
Arsenic – C	0.01	0.01	0.003	**0.0194**	0.0052	0.0052	**0.015**
Cadmium – T	0.005	0.005	0.0016	0.0016	0.001	0.001	0.0016
Copper – T	1.3	0.5	0.041	0.28	0.011	0.011	0.0083
Fluoride – T	4	2	**4.84**	**14.8**	1.62	1.62	**2.5**
Lead – T	0.015	0.015	0.0009	**8.1**	**0.018**	**0.018**	0.003
Nickel – T	0.1	0.1	0.009	**1.22**	0.033	0.033	0.0163
Selenium – T	0.05	0.05	0.048	**21.3**	0.014	0.014	**0.207**
Zinc[5]– T	2	2	0.073	0.128	0.38	0.38	0.26

Source: Circular DEQ-7, Montana Numeric Water Quality Standards (DEQ 2017c); Circular DEQ-12A (DEQ 2014); ARM 17.30.629.
Concentrations in bold exceed Montana numeric ground water quality standards or recommended concentrations for livestock (see Section 3.7, Water Resources –Surface Water and Section 3.8, Water Resources—Ground Water).
T = toxic; C = carcinogen; H = harmful (aquatic life).

3.5.3 Socioeconomic Environment and Health

3.5.3.1 Demographics

Detailed population and demographic characteristics are found in **Sections 3.15, Socioeconomics** and **3.16, Environmental Justice**. The human populations within the direct and indirect effects analysis areas potentially include the following: residents, resident farmers, trespassers, and recreation users (recreation fishers and swimmers/waders).

Sensitive Populations

Minority race and low-income populations are present within the analysis area. These populations are discussed in depth in **3.16, Environmental Justice**. American Indians, primarily Northern Cheyenne and Crow, are the largest minority race group within the area. Low income populations are present within all three counties and on the Crow and Northern Cheyenne Reservations.

3.5.3.2 Economics

Economic impacts may have indirect impacts on public health because the financial resources available to the local population or local government will affect the quality and quantity of health-related services, including treatment and prevention of chronic and infectious diseases. **Section 3.18** discusses the economic environment within the analysis area, including markets, employment and economic sectors, income, and revenue.

3.5.3.3 Social Characteristics

Social Services

Social services are discussed in **Section 3.15, Socioeconomics**, including health care facilities, schools, libraries, and other services. The analysis area has been identified as being underserved by health services (Montana Department of Health and Human Services (MDHHS) 2011). All three counties have lower ratios of primary health care providers, dentists, and mental health care professionals, and higher rates of uninsured individuals than the state (UWPHI 2017). Health care costs are about $2,000 per year higher in Rosebud County and Big Horn County than in the rest of MT, while costs are slightly lower in Treasure County (UWPHI 2017). The rates of insured individuals within Rosebud and Big Horn Counties lag behind MT's insured rate. In 2015, an estimated 85 percent of Montanans had health insurance, compared to 59 percent in Big Horn County and 76 percent in Rosebud County. Treasure County's insured rate is 91 percent, while the Crow and Northern Cheyenne insured rates were 54 percent and 53 percent, respectively. The national rate for insurance coverage in 2015 was 87 percent (U.S. Census Bureau 2016).

Community Health

Relevant community health issues include those related to particulate inhalation, which is the most significant exposure pathways associated with the alternatives. Most general community health data in the vicinity of the study area is available at the county or regional level. Treasure and Rosebud Counties are in Region 1 and Big Horn County is in Region 2. Data include the reservations' populations that reside within the counties and regions. Limited community health information is available for American Indians living within the analysis area, including the Crow and Northern Cheyenne Reservations (American Indian Health Profile 2008a, 2008b; CDC 2015).[9]

As described below, health in the analysis area communities is poorer than most of other MT communities. The socioeconomic patterns in these counties could be partially responsible for these discrepancies in health outcomes, as poverty rates and income inequality are higher in these counties than the state and other regional counties. Income inequality and behavioral risk factors that may contribute to poor community health are more common among communities with lower socioeconomic status, such as those within analysis area (UWPHI 2017).

Chronic Disease

Most chronic disease information in the analysis area is limited to regional data, which aggregates several counties together. Limited data is available for Rosebud and Big Horn Counties. Rosebud County data, when available, will be emphasized because greater exposure to public health factors from the alternatives would be experienced there.

In MT, chronic diseases account for over 60 percent of the leading causes of death (MDHHS 2013). Cardiovascular disease and cancer combined account for nearly half the deaths on an annual basis, while respiratory disease accounts for 7 percent of deaths. Within Regions 1 and 3 (which includes Rosebud, Treasure, and Big Horn Counties, among other counties, as well as the Crow and Northern Cheyenne Reservations), cancer rates exceed state rates. The incidence of asthma in the larger analysis area (8.6 percent in both regions) is comparable to that of Montanans as a whole (8.7 percent statewide). The incidence of asthma in Rosebud County, however, is 10.1 percent. Lung cancer rates in the analysis area are slightly higher than the state, at 68.2 per 100,000 in Region 1 and 67.2 per 100,000 in Region 2, compared to 64.7 per 100,000 in the state (MDHHS 2011). The prevalence of diabetes is slightly higher in the regions (7.7 percent in Region 1, 6.9 percent in Region 3, and 8.7 percent in Rosebud County), compared to MT (6.2 percent). The causal factors for the relatively high rates of chronic disease in the project area are unknown but may be linked in part to nutrition and wellbeing factors as well as exposure to environmental pollution from coal plant emissions (see the **Nutrition** and **Wellbeing** discussions below) (Clean Air Task Force 2010; Institute for Health Metrics and Evaluation 2016).

Infectious Diseases

Incidence rates for infectious diseases within the analysis area are not remarkably different from the state's rates, with the exception of sexually transmitted diseases and salmonellosis incidence. All three counties in the analysis area have substantially higher infection rates for these than the state, while the overall regions are slightly higher but comparable (MDHHS 2011; UWPHI 2017).

Injury

Deaths by injury are higher in Rosebud County and Big Horn County than in the state. No data are available for Treasure County (UWPHI 2017). In MT, 91 deaths per 100,000 are attributed to injuries,

[9] The most current publically available data on community health for the Northern Cheyenne Tribe and the Crow Tribe is from the 2008 American Indian Health Profile, compiled by the Kids Count Foundation and available through the MT Legislature website (American Indian Health Profile 2008a and 2008b). This data is not directly comparable to the county and regional data, and does not include the same level of detail as the 2011 reports cited in this section. General community health characteristics for American Indians within the U.S. are available through the CDC. In 2014, lower proportions of the U.S. American Indian population reported having excellent, very good, and good health; and higher proportions reported having fair and poor health, compared to the U.S. population reported as a whole, and to any other minority race group (CDC 2015).

compared to 115 in Rosebud County and 157 in Big Horn County. Deaths per 100,000 from motor vehicle crashes in Big Horn County and Rosebud County were 76 and 51, respectively, compared to 20 in MT. Firearm fatalities in Big Horn County and Rosebud County are 23 and 21 per 100,000, respectively, compared to 18 per 100,000 in MT.

Nutrition

The University of Wisconsin Healthy County Index compiles data from multiple sources to range quality of life. County food environments are evaluated based on access to healthy foods and food insecurity on a scale of 1 (worst) to 10 (best). MT's food environment index is 7.2, while Rosebud County's is 6.9, Big Horn County's is 4.5, and Treasure County's is 4.0. The best performing counties in the U.S. score above 8.0 on the scale. The analysis area has a relatively poor food environment compared to both MT and the U.S., indicating that nutritional health of the communities is poor, and access to healthy food is limited. Nineteen percent of Big Horn County and 14 percent of Rosebud and Treasure County populations are food insecure, compared to 14 percent of Montanans. In Big Horn County, where the Crow and Northern Cheyenne Reservations are located, nearly a quarter of the population has limited access to food. Ten percent of the population in Rosebud County and 40 percent in Treasure County have limited access to food. Nine percent of Montanans overall have limited access to food (UWPHI 2017).

Well-Being

Of the 56 MT counties, Healthy County Index ranks Rosebud and Big Horn Counties 39 and 44, respectively, for quality of life (Treasure County is not ranked) (UWPHI 2017). Higher rates of poor or fair health and self-reported poor physical and mental health days exceed the state values all three counties. In Big Horn and Rosebud Counties, the rates for premature deaths are nearly twice that of MT as a whole. Rosebud and Bighorn Counties have relatively high adult smoking rates (22 percent and 27 percent respectively) and obesity rates (36 percent and 39 percent, respectively). In MT, 19 percent of adult smoke and 25 percent are obese. Treasure County has similar smoking and obesity rates as the state. Physical inactivity rates are higher within all three counties (26 percent in Bighorn County, 24 percent in Rosebud County, and 31 percent in Treasure County) than in the state as a whole (20 percent) (UWPHI 2017).

Land Use

Section 3.23, Land Use provides a detailed discussion of the current land use patterns within the analysis area. **Section 3.18**, **Recreation** provides a detailed discussion of recreational uses of land in the area. To summarize, the surface ownership of land in the analysis area is mostly private. The incorporated city of Colstrip is 12 miles to the east of the project area. Federal, state, Tribal, and local government agencies all manage land in Southeast MT, which is primarily private land (73 percent). About 19 percent of the analysis area is public land, with an additional 9 percent of the land managed by Tribes (FWP 2014). Southeast MT has two Tribal Nations and their associated lands—the Crow and Northern Cheyenne. The land uses within the three-county area primarily include agricultural production, grasslands, forest/grazing, open grazed sparse woods, and irrigated land. Farming, ranching, mining, hunting, fishing, and recreating take place on private and public lands within the area. The region is considered rural, and supports a "small town lifestyle" environment. While water bodies within the project area are considered to be suitable for recreation, no known public recreation occurs in waters within the project area. The Castle Rock Lake, located near Colstrip within the indirect effects analysis area, provides water-based and land-based recreation opportunities and is used by the public. Other surface water bodies within the indirect effects analysis area, such as the East Fork Armells Creek, may also provide recreation opportunities (see **Section 3.3, Water Resources—Surface Water** and **Section 3.18, Recreation**).

3.5.4 Public Safety

3.5.4.1 Noise

Section 3.22, Noise provides a detailed discussion of the affected environment as it relates to noise from the Rosebud Mine and the power plants, including the number, density, and location of residences within the direct and indirect effects analysis areas (see **Section 3.22.2, Existing Noise Sources, Figure 65,** and **Table 89**). To summarize, there are seven residences outside of the city of Colstrip that are between 2.2 and 8 miles from the project area; and between 0.7 and 12 miles from the existing mine area. The city of Colstrip is 12 miles from the project area, and adjacent to the existing mine area.

Existing noise sources included excavation, hauling, conveyors system operations, use of heavy machinery, coal blasting, and overburden blasting. Coal blasting occurs 1 to 3 times per week, and overburden blasting occurs 4 to 6 times per month. Blasting overpressure levels of about 120 dB occur at a distance of 450 feet from the blast for a duration of 1 or 2 seconds (Marcus 2014). OSMRE recommends keeping overpressure noise levels from a blast below 120 dB to minimize human annoyance and complaints. The U.S. Bureau of Mines considering 134 dB to be safe for residential structures (USDI 1987).

3.5.4.2 Hazardous or Solid Waste

Rosebud Mine

Section 3.21.2.1, Existing Rosebud Mine Operations provides a detailed discussion of the affected environment as it relates to waste production and disposal at the Rosebud Mine and power plants. The Rosebud Mine is considered a Large Quantity Generator (LQG) of solid or hazardous waste, but often produces less waste than the 2,200 pound per month LQG threshold (see **Figure 64**). Non-hazardous waste is produced at Rosebud Mine is collected in dumpsters and disposed of at the Rosebud County Landfill. Hazardous waste generated at the mine, including contaminated soils are contained transported to either the hazardous waste storage area located in Area A. Weekly inspections of the storage area and any other accumulation area are conducted. Within 90 days, hazardous waste must be shipped to a treatment, storage, and disposal facility (TSDF) for final destruction or disposal.

Power Plants

Section 3.21.2.4 and **Section 3.21.2.5** describe the production, storage, and transportation of solid and hazardous waste produced at the Colstrip Power Plant and the Rosebud Power Plant, respectively. **Tables 86** and **87** outline the content and amount of Toxic Release Inventory (TRI) chemicals reported to EPA by the for land-disposal releases. Coal from the Rosebud Mine is transported to the power plants by haul truck via county and state roads.

Most CCR generated at the Colstrip Power Plant is initially stored and treated within a series of on-site ponds. It is then transferred via pipeline to a stage two evaporation pond (STEP) located about three miles from Colstrip; or via haul trucks to a holding pond (EHP) area about 3 miles east of Colstrip for disposal.

The CCR generated at the Rosebud Power Plant is conveyed pneumatically to an ash silo for temporary storage, then periodically transferred into a plant-ash truck and transported to an on-site ash monofill disposal area where it is hydrated with industrial wastewater from the plant to consolidate and solidify the ash.

3.6 GEOLOGY

3.6.1 Introduction

The Rosebud Mine is located in the northwestern Powder River Basin where surface coal-mining has occurred since 1924. The sections below provide an overview of the geology within the analysis area and the regulatory authorities governing it. The analysis area for geology is defined below in **Section 3.6.1.2, Analysis Area**.

3.6.1.1 Regulatory Framework

Federal Requirements

SMCRA outlines the minimum federal coal-mining requirements to restore land to a condition capable of supporting preexisting uses or to higher or better uses. Under 30 CFR 780.22, Geologic Information, detail is provided on the specific information needed in a surface-mining permit application to assist in determining the probable hydrologic consequences, all potential acid- and toxic-forming strata, whether the reclamation can be accomplished, and whether the proposed operation has been designed to prevent material damage to the hydrologic balance outside the permit area.

State Requirements

DEQ regulates permitting and operation of surface coal mines on federal lands within MT under the authority of MSUMRA (Section 82-4-221 et seq., MCA) and its implementing rules (ARM 17.24.301-1309). Under ARM 17.24.322, Geologic Information and Coal Conservation Plan, detail is provided on the specific geologic information needed in a surface-mine permit application as well as the requirement that the application include a coal conservation plan.

Local Requirements

There are no applicable local regulations for geologic resources within or near the analysis area.

3.6.1.2 Analysis Area

Direct Effects Analysis Area

The analysis area for direct effects on geology is the project area (see **Figure 33**).

Indirect Effects Analysis Area

The analysis area for indirect effects on geology includes the project area and adds to it the watersheds of the streams in and downstream of the project area.

3.6.2 Analysis Area Geology

Figure 33 presents the surface geology of the direct effects analysis area; **Figure 34** presents a generalized column of the local stratigraphy. In the Colstrip area, the Fort Union Formation is approximately 445 feet thick and thickens to the south to a maximum of 2,125 feet (PAP). Unconsolidated Quaternary-age alluvium and colluvium, 16 to 31 feet thick, overlie the Tongue River

Member locally, mostly along drainageways. Within the analysis area, relatively thin deposits of clay and gravelly sand comprise the quaternary alluvial fill occurring within portions of Donley Creek and Black Hank Creek (**Figure 33**). Unmapped unconsolidated alluvial deposits are also present in the upper portion of the Donley Creek drainage and in the Robbie Creek drainage (PAP). Sandstone, claystone, interbedded claystone and sandstone, and sub-bituminous coal beds of the Tongue River Member comprise the remainder of the stratigraphic sequence within the analysis area. Two inferred normal faults are located within the analysis area (**Figure 34**).

The sandstone in the analysis area is a fine- to very-fine-grained silty unit and is gray to light gray in color and light yellow-brown where exposed. The sandstone is frequently massive and sometimes contains stacked, cross-bedded channel sequences encompassing disseminated pyrite along with pyrite and hematite concretions. The claystone is predominantly gray to dark gray and silty to sandy with a sparse to moderate carbonaceous content. It commonly includes dark to very dark carbonaceous-rich clay intervals containing pyrite. According to Western Energy's PAP, there is no evidence that significant or unique geologic formations or sites are present in the project area.

Coal targeted for removal in the project area is within the Tongue River Member of the Fort Union Formation. The project area would include 6,746 permitted acres, of which 4,260 acres would be disturbed by mining and associated activities to remove an estimated total recoverable reserve of 70.8 million tons of coal.

The highest coal bed in the analysis area stratigraphic sequence is the Rosebud Coal bed. This bed averages 18.6 feet thick with a maximum thickness of 26.0 feet. Typically the first 1-foot layer of the Rosebud deposit is high in sulfur content, generally represented by pyrite and marcasite. The upper portion of the Rosebud Coal bed sometimes splits into three thin coal benches ranging in total thickness from near 0 in the southeast to about 15 feet in the northwest where the thickness of the partings between the benches increases. Each of the three coal benches is approximately 6 feet thick with the partings ranging from near 0 to more than 9 feet. The coal splits from the main Rosebud Coal bed are not recovered during the mining process. The lower 0.8-foot portion of the Rosebud Coal bed also has a high sulfur content represented by the occurrence of pyrite.

During the coal-extraction process in other permit areas of the Rosebud Mine, the high-sulfur zone occurring in the upper portions of the Rosebud Coal is removed and recovered. This material is trucked to the nearby Rosebud Power Plant which is designed to burn waste coal in its boilers. The main portion of the Rosebud Coal bed is burned in Colstrip Units 1–4. The higher-sulfur zone present near the base of the bed is not recovered. A similar coal-extraction process would be used for Area F as described in **Section 2.2.2, General Sequence of Operations**.

Natural or spontaneous combustion of the Rosebud Coal bed has locally metamorphosed the overlying rock units, creating reddish bands of thermally-altered rock locally called scoria (clinker). The clinker beds define the northern extent of the project area Rosebud Coal bed and range in thickness from 10 to 300 feet (Vuke et al. 2001). Clinker is mined in other permit areas of the Rosebud Mine and used as a road-surfacing material.

Within the project area, the average Rosebud Coal bed overburden thickness averages approximately 79 feet and ranges from 0 to 240 feet in thickness. All overburden material removed during the mining process would be backfilled into the pit as spoil to reconstruct the postmining topography as described in **Section 2.4.4.5, Postmining Topography and Drainage Basin Design**.

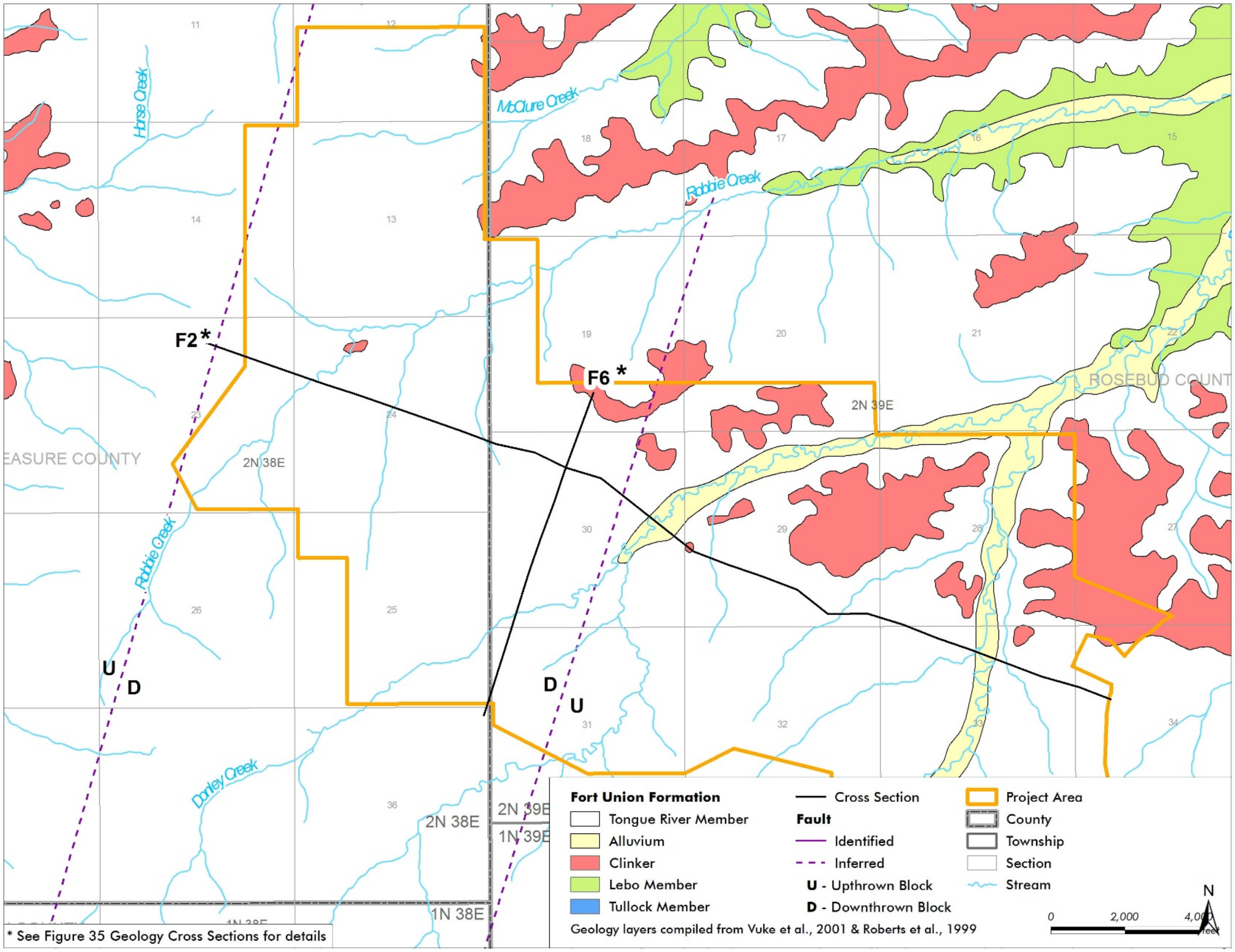

Figure 33. Surface Geology in the Direct Effects Analysis Area.

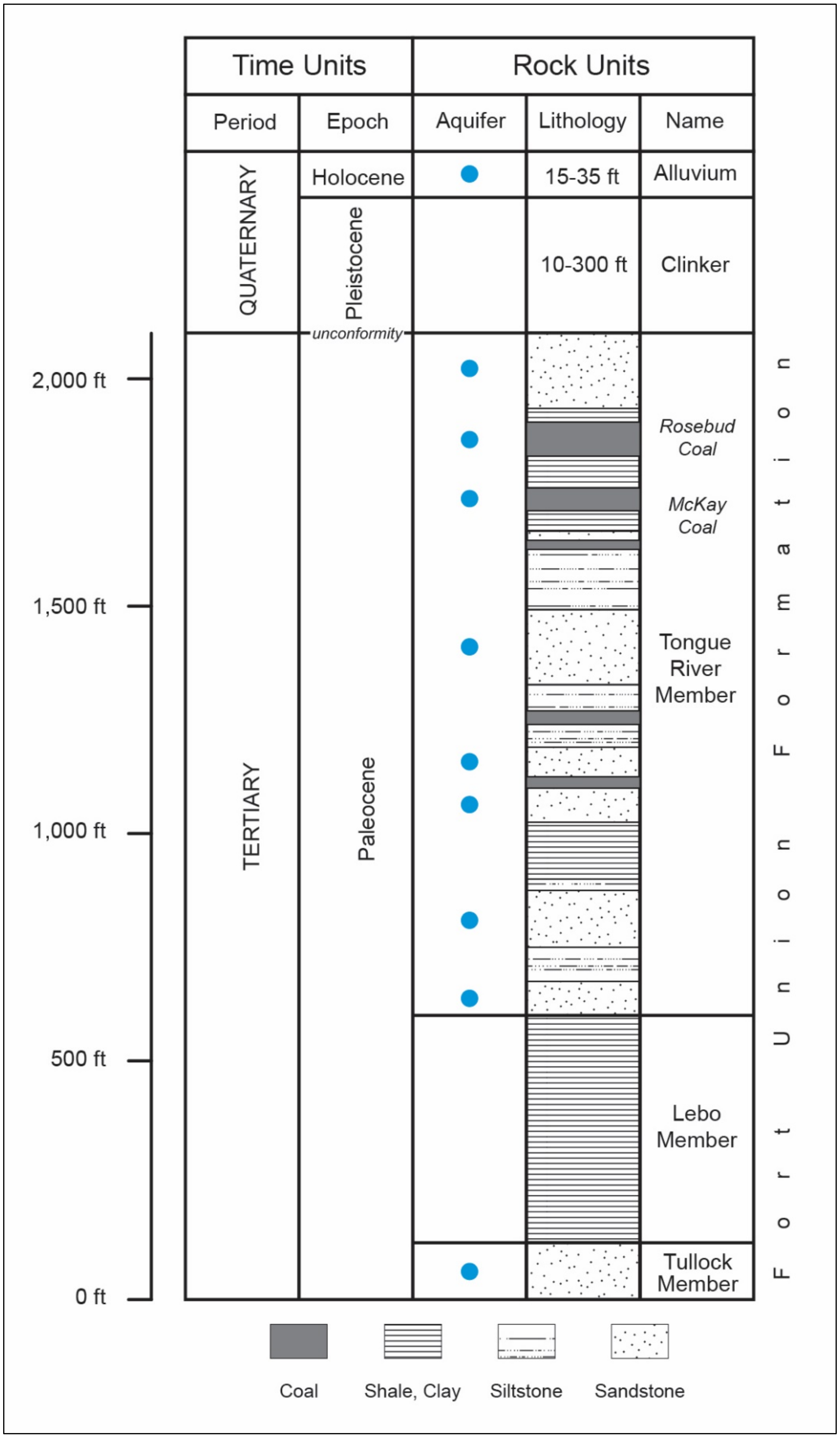

Figure 34. Generalized Column of the Local Stratigraphy.

Y-axis represents thickness of Fort Union Formation.
Source: KC Harvey 2012.

Figure 35 provides geologic cross-sections through the project area. Occurring approximately 67 feet below the Rosebud Coal bed, the McKay Coal bed ranges between 7 and 13 feet thick and averages 9 feet thick. The interburden material between the coal beds consists of sandstone and claystone and ranges in thickness from a few feet to more than 100 feet, averaging 78 feet thick. The underburden includes the remainder of the Tongue River Member below the McKay Coal. The lithologies of this group are similar to the overburden, with the exception of what may be more laterally continuous sandstones.

The average coal quality (as-received basis) of the Rosebud Coal bed in the project area is 8,590 British thermal units (Btus) per pound, 0.63 percent sulfur, 26.29 percent moisture, and 8.49 percent ash, with a sodium-in-ash content of 1.25 percent as sodium oxide (PAP). The coal quality of the McKay Coal bed is inferior to the Rosebud Coal bed due to a higher sulfur content and higher iron and sodium content in the ash. Because of these quality issues, the Board of Natural Resources and Conservation of the State of MT on June 4, 1979 prohibited the use of the McKay Coal, either as an exclusive fuel or in combination with the Rosebud Coal, in Colstrip Generating Units 1 and 2.

The suitability of overburden to be used as backfill was determined by Western Energy based on data collected from 31 core-hole samples between 2004 and 2007 and included in the PAP, Appendix D. Overburden material in the project area is deemed suitable based on the following parameters: pH between 5.5 and 8.5, electrical conductivity less than or equal to 8.0 deci-Siemens/meter, saturation percentage between 25 and 90 percent, sodium adsorption ratio (SAR) less than or equal to 20, boron less than or equal to 5 parts per million (ppm), molybdenum less than or equal to 1.0 ppm, nitrate-nitrogen less than or equal to 130 ppm, and selenium less than or equal to 0.1 ppm. The core-hole data indicates that more than 94 percent of the total overburden thickness is deemed suitable for backfill (PAP, Appendix D). Of the 31 cores analyzed, 11 had exceedances of 1 or more of the suitability levels within 19 different sampled intervals. The intervals determined to be unsuitable ranged in thickness between 1.4 and 28.4 feet and averaged 10 feet. The parameters exceeded included the following: saturation percentage (less than 25 percent), selenium, nitrate, molybdenum, pH (greater than 8.5), and electrical conductivity. Western Energy reasons that the 6 percent of unsuitable overburden material identified would be blended with suitable material as part of the mining process (PAP, Appendix D). Backfill suitability-sampling would not be required unless areas of suspect overburden or coal evident at the surface are found (PAP, Appendix D). However, a Spoil Monitoring Plan would be implemented and would require a sampling intensity of one sample per 1,000 feet for graded spoil. Under this plan, each sample would be tested for a list of parameters that includes the following: pH, saturation percentage, electrical conductivity, sodium absorption ratio, moisture, and texture (PAP).

Acid mine drainage and large concentrations of iron and other metals generally do not occur in coal-mine overburden spoil in the area because the natural buffering capacity of the overburden will generally prevent acid drainage (Canon 1984). Acid- or toxic-forming materials have not been identified in the overburden (PAP).

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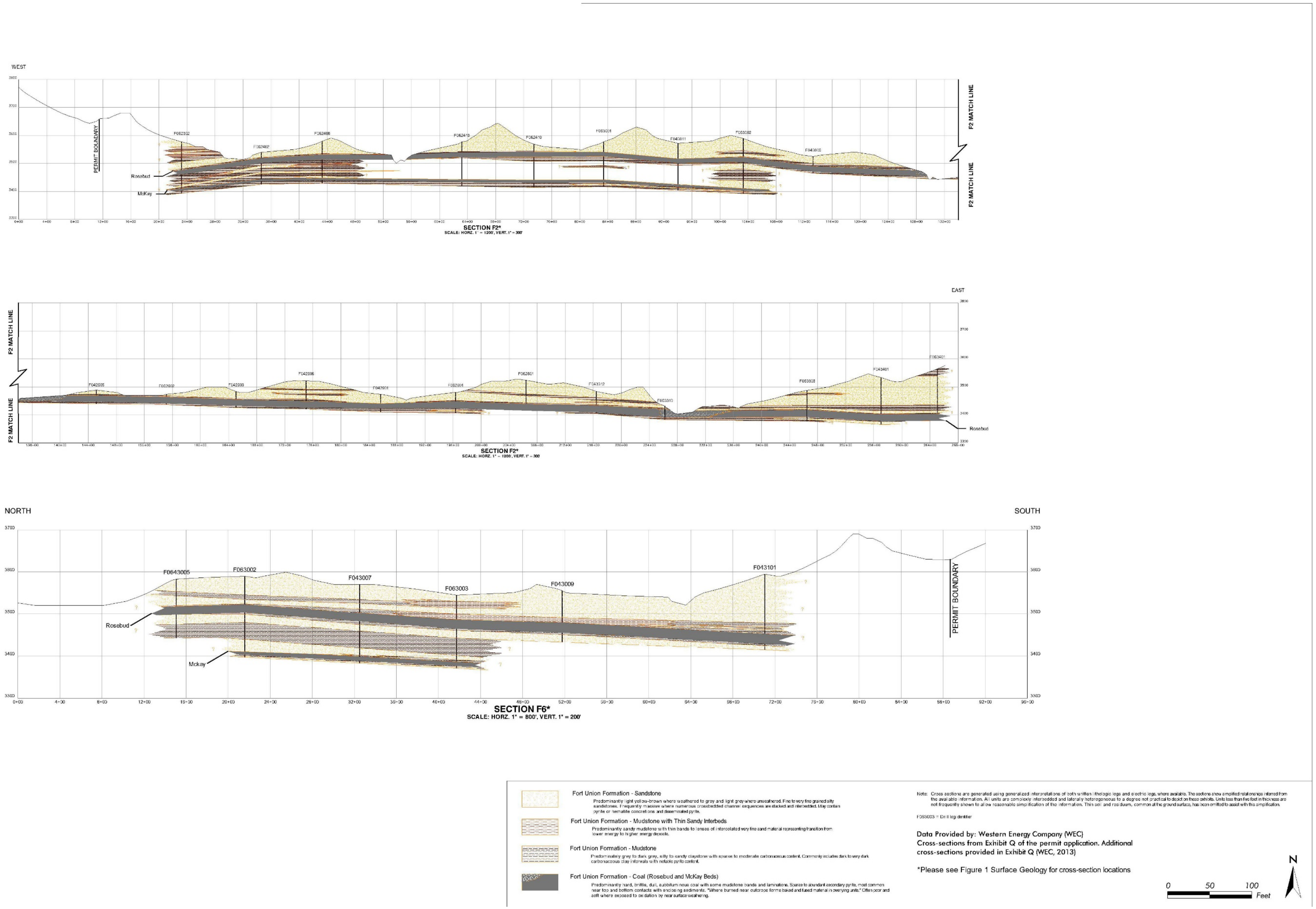

Figure 35. Geologic Cross Sections (F2 and F6).

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3.6.3 Regional Geology

The Rosebud Mine is located in the northwestern portion of the Powder River structural basin, a broad northeast-trending synclinal structural basin in eastern Wyoming and southeastern MT bound on three sides by mountain uplifts (Mapel and Swanson 1977). The Powder River Basin is bounded on the west by the Bighorn Mountains, on the southwest by the Casper Arch, and on the south by the north end of the Laramie Mountains and by the Hartville uplifts. It is bounded on the east by the Black Hills and on the northeast and northwest by the Miles City Arch and Ashland Syncline, respectively (USGS 1962).

The Powder River Basin is about 230 miles long and 100 miles wide and represents an asymmetrical syncline whose trough is on the western side of the basin and parallels the Bighorn Mountains (USGS 1962). The western limb of the syncline contains steeply dipping strata and the eastern limb contains gently dipping strata. During the Paleozoic and Mesozoic Eras, the Powder River Basin was part of a relatively stable interior platform that was at times flooded by epicontinental seas, resulting in the accumulation of thick marine sediments (USGS 1962). Overlying the thick Paleozoic and Mesozoic sediments are relatively thin accumulations of late-Cretaceous and Cenozoic sediments derived principally from continental source areas. The basin was formed through compressional deformation associated with the Laramide orogeny, which occurred from late-Cretaceous through early-Tertiary eras.

The Paleocene Fort Union Formation is the predominant bedrock unit in the vicinity of the Rosebud Mine and consists of gently dipping (less than a few degrees) sedimentary rocks. The Fort Union Formation is composed of sandstone, siltstone, mudstone, claystone, and coal beds (Mapel and Swanson 1977; Roberts et al. 1999). The formation was deposited during Paleocene time from sediments accumulating during a tropical to subtropical climate in a vast area of shifting floodplains, sloughs, swamps, and lakes that occupied the central part of the United States (Mapel and Swanson 1977). As a result of the depositional setting, at a regional scale changes occur within the rock deposits with channel sandstones laterally changing into siltstones and shales and coal beds pinching out laterally or abruptly stopping. In descending order, members of the Fort Union Formation are the Tongue River, Lebo, and Tullock with only exposures of the Tongue River Member occurring in the project area (**Figure 33**). The Lebo Shale Member underlies the Tongue River Member, ranging in thickness between 95 and 200 feet in the area of the Rosebud Mine. The Lebo Shale Member consists of gray smectitic shale and mudstone with lenses of gray and yellow and very fine to medium-grained sandstone with a few thin coal beds (Vuke et al. 2001). Northeasterly trending high-angle normal faults locally modify and steepen the dip of the sedimentary sequence (Roberts et al. 1999).

3.7 WATER RESOURCES – SURFACE WATER

3.7.1 Introduction

This section describes surface water resources that occur within the analysis area, including a description of floodplains, stream flow, spring flow, and ponds; the analysis area is defined below in **Section 3.7.1.2, Analysis Area**. This section also describes surface water quality in the analysis area and includes the regulatory requirements to protect surface water (floodplains, quantity, and quality).

3.7.1.1 Regulatory Framework

Federal Requirements

Federal surface water quantity and quality regulations applicable to the analysis area include the Clean Water Act of 1972 and Clean Water Act Amendments of 1977, which require federal agencies to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." SMCRA, which requires minimization of the disturbance to the hydrologic balance and to the quality and quantity of water in surface and ground water systems both during and after surface coal mining operations and during reclamation, is also applicable. Authority to administer SMCRA in the state has been delegated by OSMRE to DEQ (see **Section 1.4.1.1, Office of Surface Mining Reclamation and Enforcement**), and DEQ administers several sections of the federal Clean Water Act pursuant to an agreement between the state and EPA. Both the Clean Water Act and SMCRA are discussed in more detail below.

Surface Water Quantity

SMCRA requires that surface coal mining and reclamation operations protect surface and ground water resources, including the hydrologic balance on-site and off-site, natural watercourses on-site and off-site, watersheds, springs, seeps, aquifers (Sections 510, 515, 516, 517, and 522), water supply, and water rights (Sections 403, 406, 407, 411, and 522). The Environmental Protection Performance Standards (Section 515 of SMCRA) require that surface coal mining and reclamation operations "minimize disturbances to the prevailing hydrologic balance at the mine site and in associated off-site areas and to the quality and quantity of water in surface and ground water systems both during and after surface coal mining operations and during reclamation."

Surface Water Quality

SMCRA requires that surface coal mining and reclamation operations protect surface and ground water quality in compliance with all applicable state and federal water quality laws and regulations and with the effluent limitations for coal mining operations. DEQ is responsible for enforcing compliance with most water quality laws on all lands in the state, excluding tribal lands (see **State Requirements** below).

For industrial sources, national effluent limit guidelines (ELGs) have been developed for specific categories of industrial facilities and represent technology-based effluent limits. The analysis area is in an industrial category that is specifically identified and included in the ELGs at 40 CFR 434, Coal Mining. The federal ELGs that apply to discharges from the project area are for alkaline mine drainage (Subpart D), western alkaline coal mining (Subpart H), and precipitation discharge events (Subpart F). ELGs after application of the best practicable control technology currently available are provided in **Table 39** for new coal facilities. Alkaline mine drainage is defined as having a pH equal to or greater than 6.0, a total iron concentration of less than 10 mg/L, and a net alkalinity greater than zero prior to any treatment.

Table 39. Effluent Limit Guidelines for New Coal Mine Point Source Discharges.

Parameter	1-Day Maximum	30-Day Average
Iron, total (mg/L)	6.0	3.0
Total suspended sediments (mg/L)	70.0	35.0
pH (s.u.)	6.0–9.0	6.0–9.0
Settleable solids[1] (mL/event)	0.5	NA

Source: 40 CFR 434, Subparts D and F.
mg/L = milligrams per liter; s.u. = standard units; mL = milliliters.
[1] Settleable solids limits are for discharges caused by precipitation events less than or equal to the 10-year, 24-hour precipitation event.

Subpart H is applicable to alkaline mine drainage at western coal mining operations from reclamation areas, brushing and grubbing areas, topsoil stockpiling areas, and graded areas. Subpart H requires submittal of a site-specific Sediment Control Plan designed to prevent an increase in the average annual sediment yield from current, undisturbed conditions. The Sediment Control Plan must identify Best Management Practices (BMPs) and also must describe design specifications, construction specifications, maintenance schedules, and criteria for inspection, as well as expected performance and longevity of the BMPs. BMPs must be designed, implemented, and maintained as specified in the approved Sediment Control Plan.

EPA has delegated authority to the state, through DEQ, for administering non-point source pollution prevention programs, the National Pollutant Discharge Elimination System (NPDES) program for point sources, and water quality standards. The Montana Water Quality Act provides a regulatory framework for protecting, maintaining, and improving the quality of water for beneficial uses.

State Requirements

State surface water quantity and quality regulations applicable to the analysis area include MSUMRA, which contains reclamation requirements to protect the hydrologic balance and achieve postmine land use performance standards. Hydrologic balance is defined as the relationship between the quality and quantity of water inflow to, water outflow from, and water storage in a hydrologic unit such as a drainage basin, aquifer, soil zone, lake, or reservoir, and encompasses the dynamic relationships among precipitation, runoff, evaporation, and changes in ground water and surface water storage per 82-4-203(24), MCA. The Montana Water Quality Act, which prevents degradation of surface and ground waters due to discharges of mine wastewater and storm water, is also applicable. Both MSUMRA and the Montana Water Quality Act are discussed in more detail below. State water rights requirements are described in **Section 3.9.1.1**.

MSUMRA conditions approval of an application for a coal mine operating permit on demonstration by the applicant that "the assessment of the probable cumulative impact of all anticipated mining in the area on the hydrologic balance has been made by the department [DEQ] and the proposed operation of the mining operation has been designed to prevent material damage to the hydrologic balance outside the permit area" under 82-4-227(3)(a), MCA, and ARM 17.24.405(6)(c). MSUMRA defines "material damage" as follows: "with respect to protection of the hydrologic balance, degradation or reduction by coal mining and reclamation operations of the quality or quantity of water outside of the permit area in a manner or to an extent that land uses or beneficial uses of water are adversely affected, water quality standards are violated, or water rights are impacted. Violation of a water quality standard, whether or not an existing water use is affected, is material damage." The permit application must contain a detailed description of the "measures to be taken during and after mining activities to minimize disturbance to the hydrologic balance on and off the mine permit area, and prevent material damage to the hydrologic balance outside the permit area" under ARM 17.24.314(1). Material damage criteria are established for the evaluation of both surface and ground water quality and quantity, and are used to determine whether water quality or quantity outside the permit area will be impacted to the extent that land uses or beneficial uses of water are adversely affected, water quality standards outside the permit area will be violated, or water rights outside the permit area will be impacted by the proposed mine operations. An approved application for a coal mine operating permit allows adverse effects on water quality and quantity within the permit boundary as long as the proposed mining includes measures to minimize disturbance on and off the mine plan area and to prevent material damage to the hydrologic balance outside the permit area (ARM 17.24.314(1)).

Surface Water Quantity and Quality

The rules implementing MSUMRA (ARM 17.24.301 through 1309) provide requirements to protect water quality and quantity, including water quality performance standards and the use of best technology currently available (BTCA) to protect water resources. The regulations limit or prevent stream-channel disturbances within 100 feet of a perennial or intermittent stream or a stream reach with a biological community (as defined by ARM 17.24.651(3)) and to the stream itself. Disturbances within 100 feet may be approved providing requirements are met for reclaiming drainage basins to restore the original stream function and prevent, during and after mining, adverse effects on water quantity and quality and other environmental resources of the stream and lands within 100 feet of the stream. The regulations provide requirements for the design, construction, stabilization, and maintenance of water diversions, sediment ponds, and other treatment facilities (i.e., discharge structures and acid- and toxic-forming spoil impoundments). The regulations also require surface water monitoring and reporting. ARM 17.24.301 provides definitions for ephemeral drainageways and intermittent and perennial streams:

- An “Ephemeral drainageway” is defined in 82-4-203, MCA, as “a drainageway that flows only in response to precipitation in the immediate watershed or in response to the melting of a cover of snow or ice and is always above the local water table.” See ARM 17.24.301(39).

“Intermittent stream” means a stream or reach of a stream that is below the local water table for at least some part of the water year and obtains its flow from both surface runoff and ground water discharge. See ARM 17.24.301(61)."Perennial stream" means a stream or reach of a stream that flows continuously during all of the water year as a result of ground water discharge or surface runoff. The term does not include intermittent streams or ephemeral streams. See ARM 17.24.301(84).DEQ is responsible for administering the Montana Water Quality Act, which prevents degradation of surface and ground waters due to discharges of mine wastewater and storm water (implementing rules: ARM 17.30 Subchapters 11, 12, and 13). MT’s nondegradation rule applies to any human activity resulting in a new or increased source that may cause degradation of high-quality waters. The analysis area would be considered a new source. High-quality waters include all state surface waters except those not capable of supporting any of their designated uses or those that have zero flow for more than 270 days during most years. For all state waters, existing and anticipated uses and the water quality necessary to protect those uses must be maintained. For high-quality waters outside the permit boundary, degradation may be authorized by DEQ following procedures described in ARM 17.30.708, or it may be determined that the changes in existing water quality are nonsignificant as described in ARM 17.30.715 or 17.30.716. The nondegradation rules do not apply to nonpoint sources of pollution to water resources within (or outside) the permit boundary.

DEQ also administers several sections of the Clean Water Act pursuant to an agreement between the state and EPA. DEQ developed water quality classifications and standards, as well as a permit system to control discharges into state waters. Mining operations must comply with state’s regulations and standards for surface water and ground water. Montana Pollutant Discharge Elimination System (MPDES) permits are required for point discharges of wastewater to state surface water. MPDES permits regulate discharges of wastewater by establishing effluent limitations based on, when applicable, technology-based effluent limits, state surface water quality standards including numeric and narrative requirements, and nondegradation criteria.

Section 303(d) of the Clean Water Act requires states to assess the condition of state waters to determine where water quality is impaired (does not fully support uses identified in the stream classification or does not meet all water quality standards) or threatened (is likely to become impaired in the near future). The result of this review is the compilation of a 303(d) list, which states must submit to EPA biannually. Section 303(d) also requires states to prioritize and target water bodies on their list for development of water quality improvement strategies, and to develop such strategies for impaired and threatened waters such as Total Maximum Daily Loads (TMDLs). A TMDL, as defined by EPA, is a pollution budget that includes a calculation of the maximum amount of a pollutant that can occur in a waterbody, and allocates the necessary reductions to one or more pollutant sources. A TMDL serves as a planning tool and potential starting point for restoration or protection activities with the ultimate goal of attaining or maintaining water quality standards).

Part of the indirect effects analysis area is in the Sarpy Creek watershed. Sarpy Creek is on the current MT 303(d) list (DEQ 2016d) as impaired for aquatic life due to elevated nitrate+nitrite, total nitrogen, and total phosphorus concentrations with grazing and non-irrigated crop production identified as probable sources. TMDLs have not been developed for Sarpy Creek.

Other streams near the Rosebud Mine that are on the current 303(d) list are Rosebud Creek, which is listed for loss of riparian habitat due to physical substrate habitat alterations, and effects on the creek due to dam construction for flood control. The East Fork Armells Creek from Colstrip to its confluence with the West Fork Armells Creek is listed for nitrate + nitrite and total nitrogen due to agriculture, and total dissolved solids and specific conductance due to the transfer of water from another watershed (the Yellowstone River). The East Fork Armells Creek upstream of Colstrip is listed for alteration in streamside or littoral vegetative cover due to agriculture. Both sections of the East Fork Armells Creek are listed as not fully supporting aquatic life.

Classification and Standards

DEQ defines surface waters as any waters on Earth's surface including but not limited to streams, lakes, ponds, and reservoirs, as well as irrigation and drainage systems, but not water bodies used solely for treating, transporting, or impounding pollutants per ARM 17.30.602(31). DEQ classifies surface water in the analysis area as C-3 (ARM 17.30.611). Class C-3 waters are to be maintained suitable for bathing, swimming, and recreation, and growth and propagation of non-salmonid fish and associated aquatic life, waterfowl, and furbearers. The quality of C-3 waters is naturally marginal for drinking, culinary, food-processing, agricultural, and industrial water supply. MT surface water quality standards for inorganic pollutants applicable to perennial and intermittent streams, ponds, and springs in the project area are provided in **Table 40** (DEQ 2017c).In a recent opinion issued by Judge Kathy Seeley of the First Judicial District Court, Lewis and Clark County, the Court indicated that surface waters that are classified as C-3 waters under MT's water use classification system may not be treated as ephemeral streams for purposes of determining the applicable water quality standards, without complying with the procedures set forth in ARM 17.30.615(2) for reclassifying a specific water body in MT. Although Judge Seeley's opinion is not final and may be appealed to the Montana Supreme Court, DEQ has applied the water quality standards applicable to non-ephemeral C-3 waters to all surface water bodies that are classified as C-3 waters, regardless of whether the surface waters meet the definition of ephemeral stream. A narrative standard for all C-3 streams states that no increases are allowed above naturally occurring concentrations of sediment or suspended sediment, settleable solids, oils, or floating solids that might create a nuisance or render the waters harmful to public health, recreation, safety, welfare, livestock, or aquatic or terrestrial wildlife. Should Judge Seeley's opinion be overturned, the standards listed in **Table 40** presumably would only apply to perennial and intermittent streams, ponds, and springs in the analysis area. Discharges to ephemeral streams would be subject to general treatment standards (ARM 17.30.635), general operation standards (ARM 16.30.636), and general prohibitions (ARM 17.30.637), but would not be subject to the water quality standards listed in **Table 40**.

DEQ has developed numeric standards for total phosphorus and total nitrogen for wadeable streams in Montana Ecoregions (DEQ 2014). Wadeable streams are perennial or intermittent streams in which most of the wetted channel is safely wadeable by a person during low flow conditions; this includes streams with perennial or intermittent flow in the analysis area. The analysis area is in the Northwestern Great Plains Ecoregion, where the July 1 to September 30 total phosphorus standard is 150 micrograms per liter (µg/L) and total nitrogen standard is 1,300 µg/L.

Primary pre-mining land uses in and downslope of the analysis area are grazing land, pastureland, cropland, and fish and wildlife habitat. The Montana State University Extension Water Quality Program (MSU 2014a, 2015) has recommended water quality limits for livestock, which may be appropriate for other ruminants such as deer, elk, and pronghorn (**Table 41**). The state and EPA have not established ambient water quality criteria for wildlife. The EPA lists a chloride chronic limit of 230 milligrams per liter (mg/L) and an acute limit of 860 mg/L for protection of fresh water aquatic life. Recent studies on a small subset of macroinvertebrate species has indicated that toxicity can be caused by sulfate and/or chloride (Elphick et al. 2011; Iowa DNR 2009; Soucek et al. 2011). The toxicity of sulfate and chloride are interdependent, and are also dependent on hardness. In southeast MT, ambient surface water concentrations of sodium, sulfate, and total dissolved solids (TDS) often exceed recommended concentrations for these parameters, particularly in stock ponds. Cattle will adapt to higher dissolved solids concentrations, and wildlife also will likely adapt to higher TDS concentrations, but sulfate in particular can affect animal weight gain and health (MSU 2014b). Aquatic life data collected by DEQ in streams in southeast MT, including the East and West Fork Armells Creek (DEQ 2017b), indicate that these streams support a diverse assemblage of species that are tolerant of sodium, sulfate, and TDS concentrations that exceed the recommended concentrations. In most situations, the naturally occurring minerals in water do not result in acute toxicosis, but lead to chronic conditions of poor animal performance or increased health problems (National Research Council 2005). TDS toxicity in animals is dependent upon the type and combination of ions in solution (Timpano et al. 2010). TDS concentrations exceeding 500 to 1,000 mg/L may be harmful to sensitive crops in southeast MT, and 3,150 mg/L is about the maximum TDS concentration tolerated by most plants (Ferriera 1984).

Table 40. MT Surface Water Quality Standards for C-3 Waters.

Parameter – Category[1]	Human Health Standard	Aquatic Life Standard[2]	
		Acute	Chronic
Temperature (°F) – H	—	• 3ºF max increase for naturally occurring range of 32º to 77ºF • In range of 77° to 79.5°F, no increase to above 80ºF • 0.5ºF max increase for naturally occurring 79.5ºF or greater • 2ºF per hour maximum decrease for naturally occurring temperatures above 55ºF; 2ºF maximum decrease for naturally occurring range of 32º to 55ºF	
pH (s.u.)[3]	—	—	—

Table 40. MT Surface Water Quality Standards for C-3 Waters.

Parameter – Category[1]	Human Health Standard	Aquatic Life Standard[2]	
		Acute	**Chronic**
Dissolved Oxygen[4] – T	—	• 5.0 (early life) • 3.0 (other life stages)	• 6.0 (7-day mean, early life) • 4.0 (7-day mean minimum, other life stages) • 5.5 (30-day mean, other life stages)
Escherichia coli	**April 1–October 31:** geometric mean may not exceed 126 colony-forming units per 100 milliliters, and 10 percent of the total samples may not exceed 252 colony-forming units per 100 milliliters during any 30-day period **November 1–March 31:** geometric mean may not exceed 630 colony-forming units per 100 milliliters, and 10 percent of the total samples may not exceed 1,260 colony-forming units per 100 milliliters during any 30-day period	—	—
Turbidity (NTU)[8] – H	—	Increase above ambient no more than 10 NTUs	Increase above ambient no more than 10 NTUs
Nitrate+nitrite, as N – T	10	No excessive amounts that would produce undesirable aquatic life	
Ammonia, as N – T	—	Calculated based on stream pH	Calculated based on stream pH and temperature
Total Nitrogen	—	1.3 (applies from 7/1 to 9/30)	
Total Phosphorus	—	0.15 (applies from 7/1 to 9/30)	
Aluminum[5] – T	—	0.75	0.087
Antimony[5]– T	0.0056	—	—
Arsenic[5] – C	0.01	0.34	0.15
Barium[5] – T	1.0	—	—
Beryllium[5] – C	0.004	—	—
Cadmium[5] – T	0.005	0.0074	0.0024
Chromium[5] – T	0.1	5.61/0.016[6]	0.27/0.011[6]
Copper[5] – T	1.3	0.052	0.031
Fluoride[5] – T	4.0	—	—
Iron[5] – H	—	—	1.0
Lead[5] – T	0.015	0.477	0.019
Mercury[5] – T, BCF>300[7]	0.00005	0.0017	0.0009
Nickel[5] – T	0.1	1.52	0.169
Selenium[5] – T	0.05	0.020	0.005
Silver[5] – T	0.1	0.044	—
Zinc[5] – T	2.0	0.388	0.388

Source: Circular DEQ-7, Montana Numeric Water Quality Standards (DEQ 2017c); Circular DEQ-12A (DEQ 2014); ARM 17.30.629.
All units are in milligrams per liter (mg/L) unless otherwise indicated.
[1] T = toxic; C = carcinogen; H = harmful (aquatic life).

[2] Many metals standards are hardness-dependent; for this table, values presented are based on a hardness of 400 mg/L. Hardness concentrations in surface water are greater than 400 mg/L, but DEQ-7 states that 400 mg/L is to be used to calculate hardness-dependent metals standards when hardness is greater than or equal to 400 mg/L.
[3] s.u. = standard units. Per ARM 17.30.629(2)(c), induced variation in pH within a range of 6.5 to 9.0 must be less than 0.5 pH unit; natural pH outside this range must not change; natural pH above 7.0 must be maintained above 7.0.
[4] Dissolved oxygen standards are water column concentrations; see DEQ-7 for other notes.
[5] All metals standards except aluminum are based on total recoverable concentrations. Aluminum standards are based on dissolved aluminum concentrations and are valid only in a pH range of 6.5 to 9.0.
[6] Aquatic life chromium standards are for trivalent/hexavalent forms.
[7] Mercury has a bioconcentration factor of greater than 300 (developed by EPA).
[8] NTU = nephelometric turbidity units.
mg/L = milligrams/liter; "—" = No applicable standard.

Table 41. Montana State University Recommended Water Quality Concentration Limits for Livestock.

Parameter	Threshold limit/Upper limit (mg/L)
Aluminum	5/10
Arsenic	0.2/0.2
Bicarbonate	—/<1,000
Boron	5/30
Cadmium	0.01/0.05
Calcium	100/150
Chloride	100/300
Chromium	1/1
Cobalt	1/1
Copper	0.2/0.5
Fluoride	2/2
Lead	0.05/0.1
Magnesium	50/100
Manganese	0.05/0.5
Mercury	0.01/0.01
Molybdenum	—/0.3
Nickel	0.25/1
Selenium	0.05/0.10
Vanadium	0.05/0.10
Zinc	25/50
Nitrate	10/20
Nitrite	—/10.0
Alkalinity	—/1,000
Sodium	50/300
Sulfate	1,500/2,500
Total Dissolved Solids	3,000/4,999
Cyanobacteria	Large blooms severely toxic

Source: MSU 2014a, 2015.
Note: Metal limits are for both dissolved and total metals.

Local Requirements

Anyone planning new development within a designated Special Flood Hazard Area (SFHA) including excavation, placement of fill, storage of equipment or materials, roads, culverts, bridges, etc., must obtain a permit for such development from the local floodplain administrator. This administrator is designated by the city or county government. The purpose of the Floodplain Development Permit is to review and permit appropriate uses within SFHAs that will not be seriously damaged or present a hazard to life if flooded, thereby limiting the expenditure of public tax dollars for emergency operations and disaster relief.

Anyone planning to do work on or near a waterway in MT must submit a 310 Joint Application Form 270 for Proposed Work in Montana's Streams, Wetlands, Floodplains and Other Water Bodies to the conservation district in which the activity will take place. Projects must be designed and constructed to minimize adverse impacts on the stream and stream banks. The project must be reviewed to determine the effects of soil erosion and sedimentation, the effects of stream alteration, the effects on stream flow, turbidity and water quality, the effects on fish and aquatic habitat, whether there are modifications or alternatives that would reduce disturbance to the stream and its environment, and whether the project would create harmful flooding or erosion problems.

3.7.1.2 Analysis Area

Direct Effects Analysis Area

The direct effects analysis area for surface water quantity and quality includes streams that may be impacted by mining in the project area by changes in flow and/or changes in water quality. The area includes where mining and related disturbances would occur (4,260-acre disturbance area) and the watersheds of the streams in and downstream of the project area that flow through the disturbance area or receive water from the disturbance area. This includes the West Fork Armells Creek, but does not include the East Fork Armells Creek (**Figure 36**). Tributaries to the West Fork Armells Creek in the analysis area are, from north to south: Trail, McClure, Robbie, Donley, and Black Hank Creeks. A small portion of the analysis area flows to Horse Creek, a tributary to Sarpy Creek. Measurable direct effects are not expected to extend beyond the watersheds of Trail Creek, McClure Creek, Robbie Creek, Donley Creek, and Black Hank Creek.

Indirect Effects Analysis Area

Project area coal would be burned in the nearby Colstrip Power Plant Units 3 and 4, located about 12 miles east of the project area, and in the Rosebud Power Plant, located 6 miles north of Colstrip. Trace metal deposition modeling due to coal combustion at the power plants was conducted to determine the indirect effects analysis area for special status species and is described in **Section 4.3, Air Quality**. Using a conservative analysis, the deposition model identified a 32-km circular analysis area for mercury. The analysis area for selenium was substantially smaller, and for the other five metals modeled was within the Plant site area of the Colstrip Power Plant (see **Section 4.3 Air Quality**). The deposition analysis area is based on soil concentrations that are deposition thresholds for plants and animals. As a result of various pathways including wind, precipitation, runoff, and erosion of soil to surface water, as well as direct deposition onto surface water bodies, mercury that is deposited from the atmosphere may reach surface water in and downstream of the 32-km circular area. The indirect effects analysis area includes all of the Armells Creek watershed, and parts of the Sarpy Creek and Rosebud Creek watersheds within and downstream of the 32-km circular area (**Figure 37**). The uppermost parts of the Sarpy and Rosebud Creek watersheds are not in the analysis area because they are outside of the 32-km circular analysis area. Because less than 3 percent of the Tongue River watershed (139 square miles of a total 5,400 square miles) is in the 32-km circular area, it is not included in the analysis area for surface water effects. Mercury water quality data for streams in the indirect effects analysis area, discussed in **Section 3.7.1.2**, support the indirect effects analysis area as being adequately large to evaluate the effects of coal combustion from the two power plants.

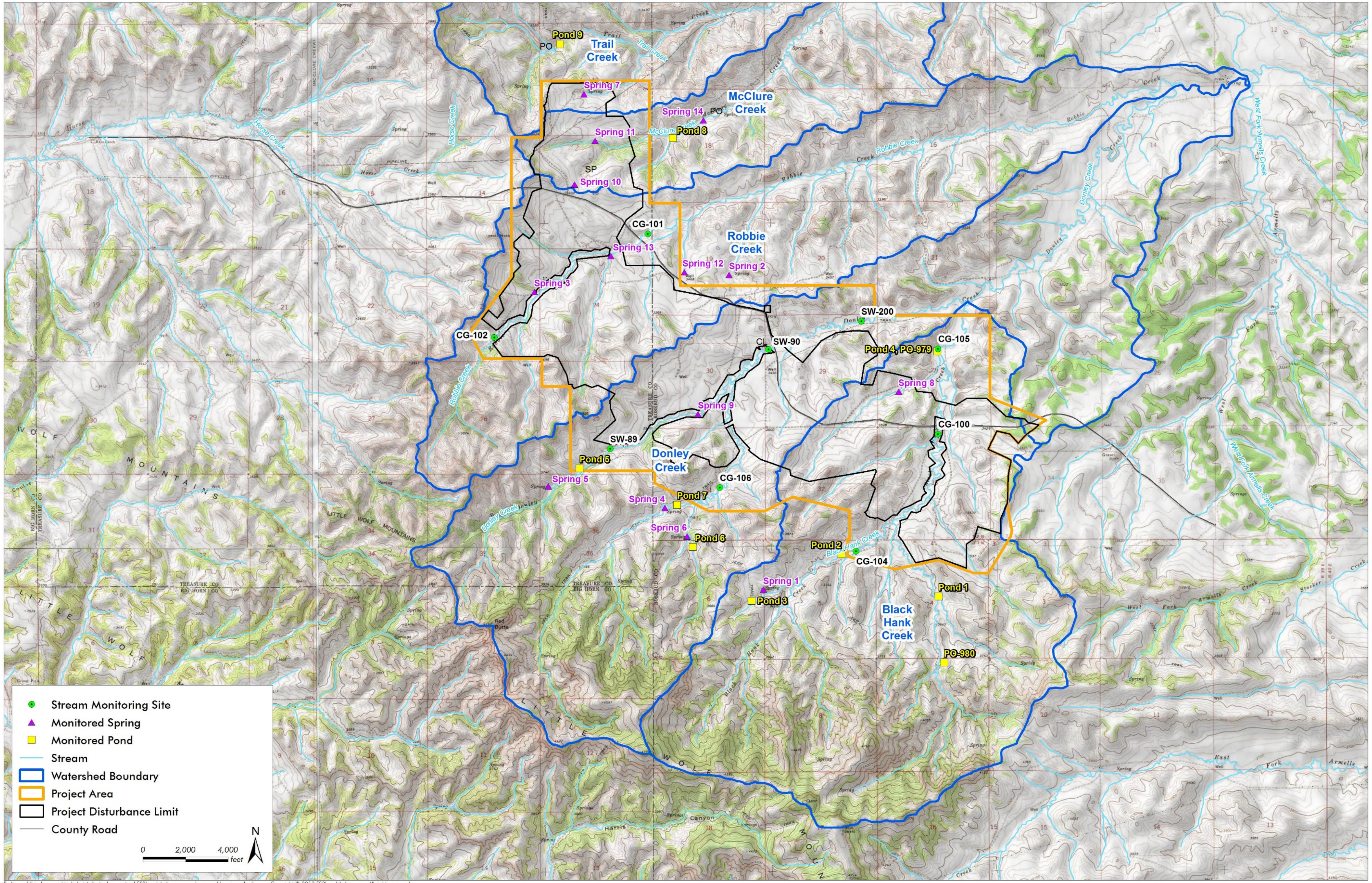

Figure 36. Surface Water Direct Effects Analysis Area.

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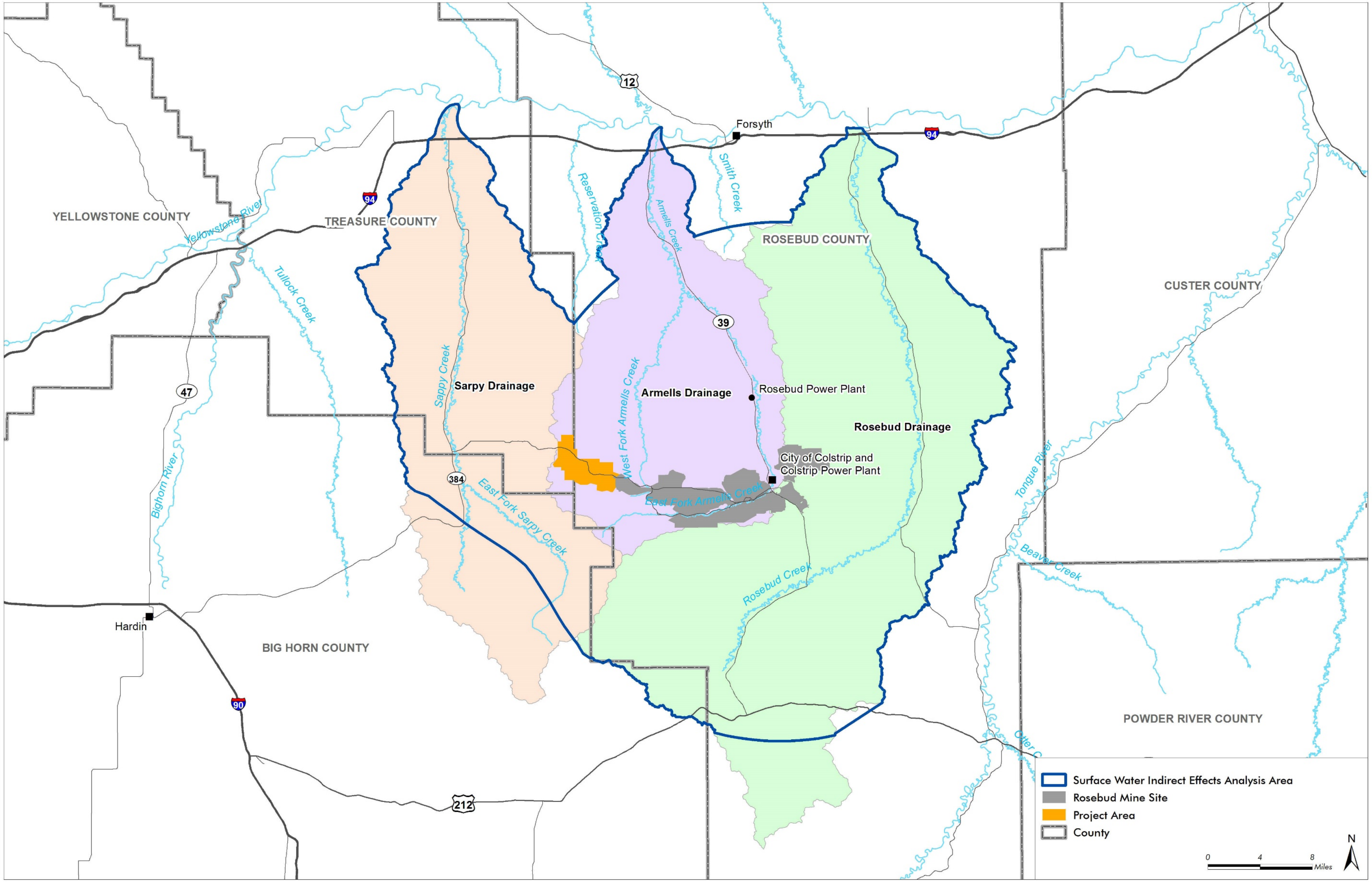

Figure 37. Surface Water Indirect Effects Analysis Area.

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3.7.2 Climate

The analysis area is in the Northwest Great Plains Ecoregion, which encompasses the Missouri Plateau section of the Great Plains. The region has a semiarid climate and flat to rolling topography of shale and sandstone punctuated by occasional buttes. Native grasslands, replaced on about 500 acres in the analysis area by non-irrigated cropland (small grains), persist in rangeland areas. Daily precipitation and other climate data are recorded in Colstrip (NOAA 2017a). Precipitation is variable, ranging from 5 to nearly 24 inches per year (over the past 40 years) and averaging 15 inches. The wettest months are May and June, and the driest are November through February. Large precipitation events of 1 to 3 inches in a day occur fairly frequently, and monthly precipitation totals of 4 to 10 inches have been recorded in April through September. Large multi-day events occurred on May 21 to 23, 2011 when 4.8 inches of precipitation fell, and on May 19 to May 31, 2013 when 7.6 inches of precipitation fell (with 5.5 inches falling on the last two days). The wettest year during the past 40 years occurred in 2011 (23.9 inches), and the second-wettest was in 2016. The second driest year in 40 years occurred in 2012 (8 inches). 2014 was slightly wetter than average, and 2015 was slightly drier than average.

Average annual snowfall is about 35 inches and the snowiest month is January, averaging 6.9 inches. December, February, and March are nearly as snowy, averaging about 6 inches of snow. From 2011 through 2016, the snowiest months were January and February 2011 (17 and 17.5 inches of snow, respectively), and March 2014, with 15.5 inches of snow. The snowiest month on record was March 2003, with 28.5 inches of snow, and the snowiest year on record was 2003, with a total of 77.6 inches of snow. The project area monitoring period of 2011 to 2016 contained three fairly snowy years (2011, 2013, and 2014), with 46 to nearly 52 inches of snow; two fairly average years (2015, with 31 inches of snow, and 2016, with 33 inches of snow); and one low snow year (2012, with 6.8 inches of snow).

3.7.3 Floodplains

The Federal Emergency Management Agency (FEMA) has mapped the floodplains in the analysis area as Special Flood Hazard Areas (Zone A), which are areas subject to inundation by the 1 percent annual chance flood event (a 100-year flood). Detailed hydraulic analyses have not been performed for Special Flood Hazard Areas, so no base flood elevations or flood depths have been estimated. In general, the floodplains mapped along the creeks in the analysis area are about 300 feet wide (FEMA 2015).

3.7.4 Hydrologic Balance

Precipitation as rain and snow, described in **Section 3.7.2**, is the source of water to the hydrologic system in the project area. A majority of the precipitation is returned to the atmosphere by evaporation from water bodies, plants, and the ground surface, as well as transpiration from plants. Evapotranspiration was calculated using the Blaney Criddle formula to average nearly 28 inches at Colstrip (PAP, Appendix B, Table B-2), and using measured pan evaporation at the Rosebud Mine to average 59 inches per year (PAP, Appendix B, Table B-3). In either case, average evapotranspiration exceeds the average annual precipitation of 15 inches per year, but on a monthly basis is less on average than precipitation during November through April. The loss of moisture by evapotranspiration is a major factor in the water balance for this semiarid area. Sublimation, the direct conversion of ice or snow to water vapor, occurs during the winter months, and in the Colstrip area has been estimated to transfer about half of the winter precipitation, or about 2.5 inches, back into the atmosphere. Interception loss of precipitation occurs as a result of vegetative cover absorbing the water or evaporation from the vegetation, and is estimated to range from about 0.5 to 1.8 inches per year (PAP, Appendix B, Table B-1). Infiltration is the movement of water into and through the soil. Based on soil type, the average infiltration rate in the project area is 2.3

inches per hour (PAP, Appendix B, Table B-4). This substantially reduces runoff because most precipitation events in the area have intensities of less than 2 inches per hour. When the rainfall or snowmelt rate exceeds the infiltration rate, water flows overland to drainage channels. Soil can absorb significant quantities of water infiltrating in the subsurface. Soil in the project area has the capacity to hold water that averages 0.1 inch per inch (PAP, Appendix B, Table B-4). Soil moisture content is typically highest in the spring and early summer, and driest in late summer. Soil can be a major factor in water storage, where it can be evaporated to the atmosphere or taken up by plants. Ground water recharge, discharge and storage are also parts of the hydrologic balance in the project area, and are discussed in **Section 3.8, Water Resources – Ground Water**. When a land surface is disturbed by human activities, there may be changes in vegetative cover, soil cover, and topography, resulting in changes to the hydrologic balance.

3.7.5 Surface Water Hydrology

3.7.5.1 Springs

Numerous springs occur in the analysis area. Western Energy inventoried springs in the analysis area and documented the locations of 53 springs (PAP, Appendix B, Table B-31). Until 2015, nine springs were monitored by Western Energy adjacent to tributaries or the mainstem of Trail, McClure, Robbie, Donley, and Black Hank Creeks (**Figure 36**). Beginning in 2015, five additional springs were monitored by Western Energy in the McClure and Robbie Creek watersheds. Some of the 14 monitored springs are used for livestock watering and have permitted diversion volumes of 30 gallons per day per animal. Only one (Spring 3 on a tributary of Robbie Creek) is developed and has a decreed maximum diversion rate, which is 8 gallons per minute. The springs, except for Spring 1 and Spring 8 on Black Hank Creek, are water sources for wetlands. Springs or seeps in the analysis area support wetlands flow all or nearly all the time. The majority of the wetlands in the project area are typical of the Great Plains region, with most occurring in drainage bottoms and a few along upland seeps. The wetlands extend several to hundreds of feet from the ground water surface discharge point before percolating into the soil or evaporating.

The monitored springs in the analysis area, which are listed in **Section 3.8.2.3, Springs**, are typically located along or near drainages and some of them maintain perennial or intermittent reaches of streams. The sources of these springs also are described in **Section 3.8.2.3**. From 2011 to 2016 when the springs were monitored, most springs were nearly always flowing. Quantifiable flow was observed at Springs 1 through 5, 7, 10, and 11, and other monitored springs exhibited dispersed seepage over a broad area (PAP, Appendix B). The highest flow of 9 gallons per minute (gpm) occurred in Spring 4.

3.7.5.2 Streams

The direct effects analysis area contains portions of the headwaters of Trail, McClure, Robbie, Donley, and Black Hank Creeks (**Figure 36**), all of which flow in an easterly or northeasterly direction to West Fork Armells Creek, then to Armells Creek, a tributary to the Yellowstone River (**Figure 37**). A small portion of the analysis area contains the headwaters for Horse Creek, which flows west into Sarpy Creek, a tributary to the Yellowstone River.

Surveyed pre-mine channel cross-sections and geomorphic characteristics of the five watersheds in the analysis area have been measured and were provided by Western Energy in the PAP (PAP, Appendix J). Exhibit J-1 contains the channel cross-sections, and Table J-2 in Appendix J to the PAP provides drainage area, slope, length, relief, stream length, channel sinuosity, and other information for Trail, McClure, Robbie, Donley, and Black Hank Creeks and their minor tributaries within the project area.

The sections below describe flow conditions in analysis area streams. When the ground water table is always below the channel bottom, ground water discharge is not a source of water to a creek, and ephemeral flow occurs only during and after snowmelt runoff or rainfall events. When the ground water table is above the channel during part of the year, a stream is intermittent and flows not only when surface runoff enters the channel, but also when ground water discharges to the stream surface as baseflow (82-4-203, MCA). Baseflow is the contribution of near channel alluvial ground water and deeper bedrock ground water to a stream channel. A perennial stream flows continuously, either because it has a constant source of surface runoff (such as from springs) and/or the ground water table is above the channel bottom for much or all of the year, providing baseflow.

Trail Creek

Stream flows and alluvial ground water levels have not been monitored in the project area in Trail Creek. Spring 7 is located on upper Trail Creek above Wetland B, which is described in the Rosebud Mine Wetland Delineation, Area F Report (Wetland Delineation Report; PAP, Appendix E). When measured in the summer of 2013, the wetland in the swale bottom was about 1,200 feet long. Spring 7 was flowing in every month of the year when measured from 2011 to 2016, indicating that flow within Trail Creek is perennial. Water flows above the ground surface in the channel for up to about 1,200 feet downstream of Spring 7. Below the wetland, Trail Creek may flow intermittently or ephemerally.

McClure Creek

Stream flows and alluvial ground water levels have not been monitored in the project area in McClure Creek. The Wetland Delineation Report found two wetlands on McClure Creek that were both supported by springs or seeps. At Wetland C (see **Figure 47** in **Section 3.11, Wetlands and Riparian Zones**), the wetland was observed to occur within the drainage bottom below a spring and extended 1,000 feet downstream. Observed "hydrology characteristics included soil saturation to the surface or flowing water in most locations along the thalweg [creek bottom]" (PAP, Appendix E). In August 2015, the measured wetted area of Wetland C was nearly 3,600 square feet (PAP, Appendix B, Attachment B-P). At Wetland F028 (see **Figure 47** in **Section 3.11, Wetlands and Riparian Zones**), the wetland was measured to be about 1,350 long in the main channel and 280 feet long in a side channel. The report states that "hydrology characteristics included apparent perennial seepage, ponded surface water, and soil saturation to the surface in most locations along the drainage" (PAP, Appendix E). In August 2015, the measured wetted area of Wetland F028 was slightly more than 12,000 square feet (PAP, Appendix B). The 2015 aquatic life survey identified more than two dozen aquatic species at both wetlands (PAP, Appendix B, Attachment B-P). In the areas of the springs and wetlands, flow in McClure Creek is perennial, but downstream of the wetlands McClure Creek may flow intermittently or ephemerally.

Robbie Creek

In Robbie Creek, surface water depth has generally been monitored monthly, and flow was calculated since 2013 at CG-101, located near the eastern proposed Area F permit boundary. The creek was flowing at CG-101 nearly always in 2013 to mid-2015, and then was nearly always dry from August 2015 through June 2016. The highest flow was estimated at 28 cfs, which occurred in early March 2014 during a period of snowmelt runoff. Western Energy began monitoring Robbie Creek at CG-102 at the upper end of Robbie Creek within the project area in April 2016; there was no flow at that gage in April through June 2016. Upstream of CG-101, Wetland D (see **Figure 47** in **Section 3.11, Wetlands and Riparian Zones**) is located where "it appears that a subterranean rock formation may be responsible for forcing alluvial water to the surface and causing the seeps" (PAP, Appendix E). Open water and small fish were observed in 2013 up to 2,000 feet downstream from the seeps. Observed "hydrology characteristics included ponded and flowing surface water and soil saturation to the surface in most locations along the drainage"

(PAP, Appendix E). In August 2015, the measured wetted area of Wetland D was 27,640 square feet, and the aquatic life survey identified 30 species at Wetland D (PAP, Appendix B). Upstream of Wetland D, Spring 3 flows perennially into a tank, and there are several other springs and seeps. At alluvial well WA-222 (see **Figure 42** in **Section 3.8, Water Resources – Ground Water**) located at the downstream end of Robbie Creek in the project area, the depth to water ranged from above ground surface to about 6 feet below ground surface in 2012 to 2016, indicating intermittent flow at this location. In the areas of the springs and wetlands, and in the stream adjacent to WA-222, flow in Robbie Creek is perennial or intermittent, but the creek may be ephemeral at other locations in the analysis area.

Donley Creek

Stream flow has been measured on Donley Creek at one location (SW-90) since November 2011 and a second, upstream location (SW-89) since November 2013 (**Figure 36**). Donley Creek has frequently been dry at both locations. At SW-89, located near the west edge of the project area, there were 22 flow events through June 2016, most of which occurred in winter or spring and were recorded for 1 to 2 days. The longest measured continuous flow periods were in March 2014 when there were 12 days of stream flow, in October to November 2014 when there were 26 days of flow, and in March 2015 when there were 11 days of flow. The highest flow measured at SW-89 was 3.5 cfs, which occurred in May 2016. Many of the flows at SW-89 do not appear to be directly related to large precipitation events (recorded in Colstrip and at weather station RL-5 in the project area) (PAP, Appendix C). SW-89 is located within Wetland F049 and downstream of Pond 5, a large stock pond. Leakage from the dam may be the source of smaller, longer-term flow at SW-89, and Pond 5 also reduces flows from the upper watershed at SW-89. Wetland F049 is located downstream of Pond 5 and water was observed in 2013 to flow for 2,400 feet downstream. In August 2015, the measured wetted area of Wetland F049 was 7,790 square feet and the aquatic life survey identified 21 species at Wetland F049 (PAP, Appendix B). At SW-90, located downstream of SW-89 (**Figure 36)**, much higher flows have been recorded, with the highest being 360 cfs measured for 2 days in May 2013 and 446 cfs measured in March 2014. There were 23 flow events between November 2011 and June 2016, most of which occurred in winter and spring and were recorded for 1 to 2 days. The longest flow events measured at SW-90 occurred for 12 days in May to June 2013, and for 11 days in June 2014. The May–June 2013 flow event occurred as a result of two large precipitation events totaling about 7.5 inches. The reason for the extended flow in June 2014 is less certain, as the total precipitation during that period was much less (about 1 inch), but it may have been due to the slow release of bank storage water and/or slow release of water stored in sandstones in the overburden upstream of SW-90. The large flow measured in early March 2014 was likely due to snowmelt runoff; Colstrip received a great deal of snow in late February and early March that year, and on March 5 the air temperature reached nearly 50 degrees F (NOAA 2017b). Large precipitation events have not always resulted in large stream flow increases. For example, in late August 2014 precipitation totaling more than 4 inches occurred, but flow at SW-90 reached a daily maximum of only 0.04 cfs, indicating that little runoff to streams resulted from this late summer event.

Wetland F is located between SW-89 and SW-90 where ground water seeps from a sandstone outcrop along the drainage (see **Figure 47** in **Section 3.11, Wetlands and Riparian Zones**). The seeps appear to be perennial or nearly perennial (PAP, Appendix E). In 2013, water was observed for a distance of 2,500 feet downstream of the seeps. Observed "hydrology characteristics included apparent perennial seepage, ponded surface water, and soil saturation to the surface in most locations along the drainage" (PAP, Appendix E). In August 2015, the measured wetted area of Wetland F was nearly 20,000 square feet and the aquatic life survey identified 26 species at Wetland F (PAP, Appendix B). At alluvial wells WA-224 and WA-225 on Donley Creek, measured in 2012 to 2015, and in alluvial well WA-220 on Donley Creek, measured from 2005 to 2015, ground water levels ranged from 8 to more than 30 feet below ground surface, indicating that stream flow at these locations is ephemeral. In the main southern tributary to Donley Creek, there are two wetlands (see **Figure 47** in **Section 3.11, Wetlands and Riparian Zones**).

At Wetland F058, there is a spring that supports the wetland, which in 2013 was observed for 1,100 feet in the creek channel. Observed "hydrologic characteristics included ponded surface water and soil saturation to the surface in most locations along the drainage" (PAP, Appendix E). In August 2015, the measured wetted area of Wetland F058 was more than 32,290 square feet, and the aquatic life survey identified 26 species at Wetland F058 (PAP, Appendix B). At Wetland F061, a high ground water table and ponded surface water were observed in 2013. The depth to the ground water table at alluvial well WA-226 located upstream of Wetland F061 was about 13.5 feet in 2012 to 2016, indicating that the stream is ephemeral at that location. It appears that much of Donley Creek in the project area is ephemeral except at the wetland locations, where flow is perennial.

Black Hank Creek

In Black Hank Creek, water depth has been monitored approximately monthly since 2013 at CG-100, and since April 2016 at CG-103 and CG-104 (**Figure 36**). Water was measured in the creek during 15 of 46 monitoring events, including several consecutive 3-month periods, and was 1 to 2 feet deep on several occasions. The maximum flow at CG-100 was 59 cfs measured in early March 2014 during a period of snowmelt runoff. Black Hank Creek was dry at all three gage locations when they were monitored in April through June 2016. No springs or wetlands have been mapped along the main channel of Black Hank Creek, but Spring 8 is located on a tributary to Black Hank Creek. At alluvial wells WA-219 and WA-227 on Black Hank Creek, the first measured from 2005 to 2016, and the second measured in 2012 to 2016, ground water levels ranged from 7 to 22 feet below ground surface, indicating that stream flow at these locations is ephemeral. It appears that much or all of Black Hank Creek in the analysis area is ephemeral.

Horse Creek

Horse Creek, located within the analysis area, has not been monitored. The USGS McClure Creek and Minnehaha Creek 7.5-minute topographic maps show several springs on Horse Creek, so some sections of the creek may have intermittent or perennial flows.

Streams near the Project Area in the Indirect Effects Analysis Area

Other streams located in the general vicinity of the project area within the indirect effects analysis area have been measured for longer periods than those in the project area (**Figure 37**). The closest continuously monitored stream is Rosebud Creek near Colstrip, where the USGS measured flow from 1974 to 2006. The creek was dry only 10 percent of all days, typically in late summer or fall. In Armells Creek, located east of the analysis area, and into which nearly all streams in the project area flow, stream flow was measured by the USGS near its confluence with the Yellowstone River from 1974 to 1995; there was measurable flow more than 90 percent of the time. In Sarpy Creek, located west of the project area and into which Horse Creek flows, USGS measured flows near its confluence with the Yellowstone River for 12 years between 1973 and 1984. Flow was measured during about 33 percent of all days. These streams, with watersheds much larger than the streams in the project area, all flowed intermittently and exhibited similar annual hydrograph patterns, with highest flows generally occurring from about mid-winter to early to mid-summer, and lowest flows occurring in the fall and early winter.

3.7.5.3 Ponds

Nine monitored dam diversions, shown as man-made livestock ponds (Pond 1 to Pond 9), are located within or close to the direct effects analysis area adjacent to or on Trail Creek, McClure Creek, Donley Creek, or Black Hank Creek (**Figure 36**). There are more than two dozen ponds located within or near the project area, but water level and water quality data are not available for the other ponds. Some are instream ponds and some are spring fed ponds. Ponds 1 to 9 have year-round water rights diversion volumes of 30 gallons per day per animal. During the 2011 to 2016 monitoring period when the ponds were monitored monthly, pond depths ranged from dry to 15 feet deep.

Ponds 1, 2, 3, and 4

Ponds 1 and 3, located in the upper Black Hank Creek watershed, contained water for much of 2011 to mid-2015, with depths of a few inches to 3 feet, and then were dry from August 2015 to June 2016. Pond 2, located downstream of Pond 3 on Black Hank Creek, was often dry but was from 9 to 15 feet deep from June to August 2011. Pond 4 is located on lower Black Hank Creek and was also often dry. The water depth in Pond 4 was up to 3 feet. These four ponds do not appear to be spring fed and are likely supplied by surface runoff.

Ponds 5, 6, and 7

Ponds 5, 6, and 7 are located in the Donley Creek watershed and nearly always contained water when monitored, except for Pond 6, which was dry from August 2015 to April 2016. Ponds 5 and 7 are spring fed. The source of water to Pond 6 may primarily be surface runoff, but because it nearly always contained at least a few inches of water in 2011 to mid-2015, there may be ground water seepage into the pond. Measured water depths in Ponds 5, 6, and 7 were a few inches to 10 feet.

Ponds 8 and 9

There is little depth information for Ponds 8 and 9, which were added to the monitoring program in 2015. Pond 8, located on McClure Creek downstream of the project area, was 3 feet deep when measured in November 2015. Pond 9, located on Trail Creek north of the project area, was 5 feet deep when measured in November 2015.

3.7.6 Surface Water Quality

The sections below describe the water quality of surface water resources in the direct and indirect effects analysis areas. The water quality of surface water resources in the direct effects analysis area, specifically within the project area, represents largely natural conditions that have been minimally affected by man-made disturbances within or upstream of the project area. The largest existing water quality effect is stock watering. Water quality is variable in the project area primarily due to the dominance of either direct runoff from snowmelt or rainfall or ground water discharge to surface water during various times of the year. Direct runoff has much lower dissolved solids concentrations (such as calcium, magnesium, sodium, bicarbonate, sulfate, and chloride) than ground water. Differences between drainages are more subtle than the effect of seasonal flow variability and are due to the presence or absence of baseflow from ground water discharges, lithology, soil types, and land use practices (Slagle et al. 1983). Other factors affecting surface water quality are evaporation and transpiration, reactions of water with sediment, aquatic biota, and impoundments and diversions for agricultural purposes.

The existing water quality of streams in the indirect effects analysis area is described below in the context of coal combustion from the Colstrip and Rosebud Power Plants, specifically, for the following constituents: mercury, selenium, copper, and nitrogen. Water quality data were collected by DEQ, the Northern Cheyenne Tribe, and Montana PPL Corporation for Sarpy Creek, Armells Creek, Rosebud Creek, Pony Creek, and Spring Creek, the last two of which are tributaries to Rosebud Creek east of Colstrip.

3.7.6.1 Water Quality in the Direct Effects Analysis Area

Streams in the Project Area

Water quality data collected during 13 sampling events from April 2013 to May 2015 in Robbie Creek (CG-101) are provided in **Table 42**; the monitoring location is shown on **Figure 36**. This location represents surface water quality at a location where the creek was flowing nearly always in 2013 to mid-2015 and then was nearly always dry from August 2015 through June 2016. Some of the sampling events occurred during runoff periods when elevated total metal concentrations were associated with elevated total suspended solid concentrations, indicating the total metals were associated with the suspended solids in the water.

At CG-101, stream water quality varied during the monitoring period. Calcium, magnesium, manganese, sulfate, and sodium concentrations sometimes exceeded recommended livestock concentrations, and aluminum and iron concentrations each once exceeded the standard. The water was always basic, with a median pH of 8.2. Nitrate+nitrite concentrations were well below the standard. Total nitrogen and total phosphorus concentrations standards, which apply from July 1 through September 30, were not exceeded. Water quality at CG-101 was similar to the water quality of the alluvium (see **Section 3.8.5**, **Ground Water Quality**). A few elevated total suspended sediment concentrations indicate that some of the sampling occurred during or immediately after a storm event. Elevated total metal concentrations such as the high total iron concentration that exceeded the standard are associated with elevated suspended sediment concentrations. When water quality samples were collected, stream flow was often low, ranging from 0.08 to 3 cfs, but on two occasions the flow was higher (12.5 and 28 cfs).

Water quality data collected during 16 sampling events from August 2011 to October 2014 are provided in **Table 43**; the monitoring locations are shown in **Figure 36**. These sites on Donley Creek and Black Hank Creek (CG-100, SW-89, and SW-90) represent surface water quality during runoff events and ephemeral flow as a result of large precipitation or snowmelt events. When water quality samples were collected, stream flows were sometimes low, ranging from less than 1 to 5 cfs, and sometimes higher, ranging from 17 to 265 cfs. In nearly every sample, total suspended solid concentrations and turbidity were high. Elevated metal and nutrient concentrations also were measured in many of the samples. There were standard exceedances for dissolved aluminum, total chromium (exceeded Cr IV but not Cr III standard), total copper, total mercury, total selenium, total iron, and total lead. There were exceedances of recommended livestock limits for total aluminum, total manganese, calcium, magnesium, total dissolved solids, sodium, and sulfate. Nitrate+nitrite concentrations were below the standard; the total nitrogen standard was exceeded once, and the total phosphorus concentration was exceeded three times.

Table 42. Water Quality of Surface Water at CG-101 in the Project Area.

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard[1] or Recommended Concentration for Livestock[2]
Acidity (mg/L)	10	0	<1	<1	<1	<5	<5	NS
Aluminum, diss (mg/L)	9	8	<0.004	<0.005	0.03	0.03	**0.09**	0.087
Aluminum, total (mg/L)	10	10	0.014	0.023	0.042	0.092	0.39	10
Ammonia, as N (mg/L)[3]	10	5	<0.04	<0.05	<0.06	0.18	0.28	2.43
Arsenic, diss (mg/L)	10	10	0.0009	0.001	0.001	0.001	0.001	0.2
Arsenic, total (mg/L)	10	10	0.001	0.001	0.001	0.001	0.002	0.01
Bicarbonate Alkalinity (mg/L)	10	10	104	506	556	597	612	999
Boron, diss (mg/L)	10	10	0.12	0.40	0.53	0.59	0.66	30
Boron, total (mg/L)	10	10	0.17	0.45	0.60	0.63	0.64	30
Cadmium, diss (mg/L)	10	2	<0.00007	<0.00008	<0.00008	<0.00008	0.0005	0.005
Cadmium, total (mg/L)[4]	10	1	<0.00008	<0.00008	<0.0001	<0.0001	0.0005	0.0024
Calcium, diss (mg/L)	10	10	42	**182**	**209**	**218**	**300**	150
Carbonate Alkalinity (mg/L)	10	2	1	1	5	5	35	NS
Chloride (mg/L)[5]	10	10	7.1	26.4	31.4	36.1	41.5	300
Chromium, diss (mg/L)	6	3	<0.00025	<0.0003	<0.00038	0.00058	0.0017	1
Chromium, total (mg/L)	6	6	0.0005	0.0006	0.0014	0.0019	0.0021	0.011
Copper, diss (mg/L)	10	10	0.001	0.001	0.002	0.002	0.003	0.5
Copper, total (mg/)	9	9	0.0008	0.002	0.002	0.002	0.003	0.0305
Fluoride (mg/L)	8	4	<0.004	<0.1	<0.3	0.4	0.9	2
Iron, diss (mg/L)	6	6	0.02	0.02	0.02	0.05	0.1	NS
Iron, total (mg/L)	10	10	0.03	0.15	0.33	0.43	**2.11**	1
Laboratory Conductivity (µS/cm)	10	10	787	3,475	3,880	3,960	4,250	NS
Laboratory pH (s.u.)	10	10	7.0	7.9	8.2	8.3	8.4	NS
Lead, diss (mg/L)	10	2	<0.000004	<0.00001	<0.00005	<0.0001	0.0003	0.1
Lead, total (mg/L)	10	3	<0.00002	<0.0001	<0.0001	0.0003	0.0006	0.015
Magnesium, diss (mg/L)	10	10	62	**382**	**428**	**448**	**568**	100
Manganese, diss (mg/L)	10	10	0.04	0.13	0.26	**0.68**	**2.1**	0.5
Manganese, total (mg/L)	10	10	0.05	0.17	0.47	**0.72**	**2.2**	0.5
Mercury, diss (mg/L)	6	1	<0.00003	<0.00003	<0.00003	<0.00003	0.002	0.01
Mercury, total (mg/L)	6	0	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	0.00005
Nickel, diss (mg/L)	10	8	<0.0006	0.002	0.0025	0.0029	0.003	1

Table 42. Water Quality of Surface Water at CG-101 in the Project Area.

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard[1] or Recommended Concentration for Livestock[2]
Nickel, total (mg/L)	10	10	0.0020	0.0025	0.0029	0.0030	0.0072	0.1
Nitrate+nitrite (mg/L)	9	5	<0.003	<0.005	0.01	0.01	0.032	10
Potassium, diss (mg/L)	10	8	10.2	12.4	13.0	15.2	31.6	NS
Selenium, diss (mg/L)	10	4	<0.0004	<0.0005	<0.0005	0.001	0.001	0.1
Selenium, total (mg/L)	10	3	<0.0005	<0.0005	<0.0006	0.001	0.002	0.005
Sodium, diss (mg/L)	10	10	29	195	223	225	257	300
Sulfate (mg/L)	10	10	279	1,813	2,010	2,235	**2,670**	2,500
Total Alkalinity (mg/L)	10	10	104	514	557	606	634	1,000
Total Dissolved Solids (mg/L)	10	10	536	3,305	3,600	3,913	4,550	4,999
Total Hardness (mg/L)	10	10	361	2,033	2,305	2,363	3,090	NS
Total Nitrogen	6	6	0.589	0.723	0.817	1.03	1.41	1.3 [6]
Total Phosphate (mg/L)	10	10	0.020	0.025	0.028	0.068	0.19	0.15 [6]
Total Suspended Sediments (mg/L)	12	11	<1.6	3.8	12	43	196	NS
Turbidity (NTU)	6	6	0.30	1.87	2.81	3.79	32.9	NS
Vanadium, diss (mg/L)	9	8	<0.00005	0.0002	0.01	0.01	0.01	0.1
Vanadium, total (mg/L)	9	7	<0.00030	<0.00032	0.00033	0.01	0.01	0.1
Zinc, diss (mg/L)	10	2	<0.00086	<0.00086	<0.0030	<0.005	0.008	50
Zinc, total (mg/L)	10	6	<0.0018	<0.0052	0.0101	0.011	0.014	0.388

Data collected at CG-101 from April 2013 to May 2015.
NS = no numeric standard or recommended concentration.
diss = dissolved; μS/cm = micro Siemens/centimeter; s.u. = standard units; NTU = nephelometric turbidity units.
[1] Many metals standards are hardness dependent; standards for hardness of 400 mg/L are provided in **Table 40**.
[2] Dissolved metal recommended concentrations are for livestock.
[3] Ammonia standard is temperature and pH dependent. Standard provided assumes temperature of 10°C and pH of 8.0, with fish early-life state present.
[4] Total cadmium detection limit greater than chronic aquatic life standard.
[5] EPA lists a chloride chronic limit of 230 mg/L and acute limit of 860 mg/L, but DEQ does not have a numeric chloride limit.
[6] Total nitrogen and total phosphorus standards are applicable from July 1 through September 30; no exceedances of these standards occurred in July through September.
Note: For less than detection limit concentrations, detection limit used to calculate percentile concentrations. Concentrations shown with less than (<) symbols indicate some or all measured concentrations were less than the detection limit.
Concentrations in bold exceed surface water quality standards (**Table 40**), or recommended concentration limits for livestock (**Table 41**).

Table 43. Water Quality of Surface Water at CG-100, SW-89, and SW-90 in the Project Area.

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard[1] or Recommended Concentration for Livestock[2]
Acidity (mg/L)	16	0	<1	<1	<5	<5	<5	NS
Aluminum, diss (mg/L)	16	16	0.0047	0.0082	0.0210	0.0832	**0.782**	0.087
Aluminum, total (mg/L)	16	16	0.112	0.873	1.31	3.75	14.4	10
Ammonia, as N (mg/L)[3]	13	10	<0.04	<0.05	0.13	0.67	1.7	2.43
Arsenic, diss (mg/L)	13	13	0.0007	0.001	0.001	0.001	0.002	0.2
Arsenic, total (mg/L)	13	13	0.0014	0.0021	0.0024	0.0036	0.009	0.01
Bicarbonate Alkalinity (mg/L)	16	16	44.2	134.5	218.5	355	401	999
Boron, diss (mg/L)	16	16	0.019	0.172	0.335	0.560	1.1	30
Boron, total (mg/L)	16	16	0.014	0.190	0.340	0.663	1.0	30
Cadmium, diss (mg/L)	16	3	<0.00008	<0.00008	<0.00008	<0.00008	0.0005	0.005
Cadmium, total (mg/L)[4]	18	8	<0.00008	<0.00008	<0.00012	0.0005	0.00097	0.0024
Calcium, diss (mg/L)	16	16	12.6	88.2	**188.5**	**267**	**319**	150
Carbonate Alkalinity (mg/L)	16	4	<1	<5	<5	6.5	46.1	NS
Chloride (mg/L)[5]	14	14	1	6.3	11.7	16.3	32.5	300
Chromium, diss (mg/L)	10	5	<0.00025	<0.00025	0.00038	0.00066	0.00199	1
Chromium, total (mg/L)	10	10	0.00088	0.00221	0.00306	0.0055	**0.0238**	0.011
Copper, diss (mg/L)	16	16	0.0014	0.0020	0.0023	0.0028	0.005	0.5
Copper, total (mg/)	16	16	0.0024	0.0042	0.0051	0.0083	**0.0335**	0.0305
Fluoride (mg/L)	11	3	<0.004	<0.004	0.147	0.251	0.5	2
Iron, diss (mg/L)	16	9	<0.02	<0.04	<0.05	0.09	0.46	NS
Iron, total (mg/L)	16	16	0.24	**1.27**	**2.19**	**6.05**	**25.9**	1
Laboratory Conductivity (µS/cm)	16	16	136	1,538	2,825	5,478	7,280	NS
Laboratory pH (s.u.)	16	16	7.6	8.1	8.3	8.4	**8.7**	NS
Lead, diss (mg/L)	16	10	<0.00001	<0.0001	0.0003	0.0003	0.0005	0.1
Lead, total (mg/L)	16	16	0.0003	0.0011	0.0016	0.0049	**0.0217**	0.015
Magnesium, diss (mg/L)	16	16	4.8	**109**	**226**	**441**	**850**	100
Manganese, diss (mg/L)	16	16	0.0045	0.0114	0.025	0.0755	0.38	0.5
Manganese, total (mg/L)	16	16	0.017	0.062	0.141	0.183	**0.669**	0.5
Mercury, diss (mg/L)	10	0	<0.00003	<0.00003	<0.00003	<0.0002	<0.0002	0.01
Mercury, total (mg/L)	10	1	<0.00003	<0.00003	<0.00003	<0.0002	**0.0002**	0.00005
Nickel, diss (mg/L)	13	13	0.0012	0.002	0.002	0.0024	0.0026	1

Table 43. Water Quality of Surface Water at CG-100, SW-89, and SW-90 in the Project Area.

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard[1] or Recommended Concentration for Livestock[2]
Nickel, total (mg/L)	13	13	0.002	0.0036	0.0051	0.0094	0.0286	0.1
Nitrate+nitrite (mg/L)	16	10	<0.0046	<0.0046	0.035	0.208	1.7	10
Potassium, diss (mg/L)	15	15	6.8	15.2	19.6	23.2	32.2	NS
Selenium, diss (mg/L)	16	13	<0.000367	0.00078	0.00194	0.00322	0.013	0.1
Selenium, total (mg/L)	16	14	<0.0005	0.0010	0.0022	0.0035	**0.015**	0.005
Sodium, diss (mg/L)	16	15	<5	109	229	**601**	**758**	300
Sulfate (mg/L)	16	16	19	738	1,520	**3,225**	**4,300**	2,500
Total Alkalinity (mg/L)	16	16	44	146	219	358	416	1,000
Total Dissolved Solids (mg/L)	16	16	116	1,203	2,215	**5,760**	**7,680**	4,999
Total Hardness (mg/L)	16	16	59	734	1,400	2,583	4,090	NS
Total Nitrogen (mg/L)	7	7	0.68	1.04	1.5	3.29	4.31	1.3 [6]
Total Phosphate (mg/L)	13	13	0.028	0.100	0.200	0.444	1.6	0.15 [6]
Total Suspended Sediments (mg/L)	16	16	14	41	103	238	1,240	NA
Vanadium, diss (mg/L)	16	16	0.00038	0.00094	0.00175	0.01	0.01	0.1
Vanadium, total (mg/L)	16	16	0.0016	0.0034	0.01	0.01	0.034	0.1
Zinc, diss (mg/L)	16	2	<0.00086	<0.00086	<0.005	<0.005	0.0055	50
Zinc, total (mg/L)	15	14	<0.005	0.0076	0.0089	0.0278	0.105	0.388

Data collected at CG-100 from May to October 2013, at SW-89 from June 2013 to October 2014, and at SW-90 from August 2011 to March 2014.
NS = no numeric standard or recommended concentration.
diss = dissolved; μS/cm = micro Siemens/centimeter; s.u. = standard units; NTU = nephelometric turbidity units.
[1] Many metals standards are hardness dependent; standards for hardness of 400 mg/L are provided in **Table 40**.
[2] Dissolved metal recommended concentrations are for livestock.
[3] Ammonia standard is temperature and pH dependent. Standard provided assumes temperature of 10°C and pH of 8.0, with fish early-life state present.
[4] Total cadmium detection limit greater than chronic aquatic life standard.
[5] EPA lists a chloride chronic limit of 230 mg/L and acute limit of 860 mg/L, but DEQ does not have a numeric chloride limit.
[6] Total nitrogen and total phosphorus standards are applicable from July 1 through September 30; one exceedance of the total nitrogen standard and three exceedances of the total phosphorus standard occurred in July through September.
Note: For less than detection limit concentrations, detection limit used to calculate percentile concentrations. Concentrations shown with less than (<) symbols indicate some or all measured concentrations were less than the detection limit.
Concentrations in bold exceed surface water quality standards (**Table 40**), or recommended concentration limits for livestock (**Table 41**).

Ponds in the Project Area

Water quality data collected from 2011 to 2016 in Ponds 1 through 9 in or near the project area are provided in **Table 44**. In 2011 to 2013, ponds were generally sampled monthly, and in 2014 to 2016 were sampled one to four times per year. The quality of the ponds was variable during the monitoring period. There were water quality standard exceedances (particularly for cadmium, iron, and selenium) and recommended livestock or aquatic life concentration exceedances for numerous parameters. Calcium, magnesium, sodium, sulfate, and TDS concentrations typically exceeded upper limit recommendations for livestock. Cation and anion concentrations were generally highest in ponds after the end of the summer season when evaporation was greatest. The highest total metal concentrations were associated with high suspended solids in the water, indicating that some of the sampling occurred during or immediately after a storm event. The water is basic, with a median pH of about 8, and extremely hard. Nitrate+nitrite concentrations were typically (but not always) well below the standard. Total phosphate concentrations sometimes exceeded the standard. Phosphorus concentrations were sometimes high enough to create conditions that might produce undesirable aquatic life. Excess algae have been observed in at least one pond (Pond 8).

Table 44. Water Quality of Ponds in and near the Project Area.

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard[1] or Recommended Concentration for Livestock
Acidity (mg/L)	75	0	<1	<1	<5	<5	<5	NS
Aluminum, diss (mg/L)	74	61	<0.004	0.0048	0.0081	0.03	**0.14**	0.087
Aluminum, total (mg/L)	77	75	<0.012	<0.049	0.16	0.50	**17.8**	10
Ammonia, as N (mg/L)[3]	48	29	<0.04	<0.05	0.08	0.46	**1.8**	1.52
Arsenic, diss (mg/L)	47	46	<0.0005	0.0013	0.0018	0.0033	0.0082	0.2
Arsenic, total (mg/L)	45	45	0.0005	0.0019	0.0031	0.0042	**0.019**	0.01
Bicarbonate Alkalinity (mg/L)	74	74	30	179	366	470	704	999
Boron, diss (mg/L)	75	75	0.10	0.36	0.68	0.89	2.10	30
Boron, total (mg/L)	75	75	0.11	0.39	0.69	0.86	2.40	30
Cadmium, diss (mg/L)	75	11	<0.00001	<0.0001	<0.0001	0.0001	0.001	0.005
Cadmium, total (mg/L)[4]	71	8	<0.00008	<0.0001	<0.0001	<0.0001	0.001	0.0024
Calcium, diss (mg/L)	75	75	33	**159**	**248**	**294**	**724**	150
Carbonate Alkalinity (mg/L)	75	30	<1	<5	<5	17	284	NS
Chloride (mg/L)[6]	70	70	3	12	19	24	118	300
Chromium, diss (mg/L)	48	26	<0.00025	<0.00039	0.00051	0.0007	0.0017	1
Chromium, total (mg/L)	45	30	<0.0004	<0.00055	<0.001	0.003	**0.036**	0.011
Copper, diss (mg/L)	74	72	<0.00002	0.0015	0.002	0.0025	0.0078	0.5
Copper, total (mg/)	75	67	<0.00009	0.002	0.003	0.005	**0.055**	0.0305
Fluoride (mg/L)	63	35	<0.01	<0.20	<0.36	<0.55	**2.5**	2
Hydroxide Alkalinity	75	1	<1	<1	<5	<5	<5	NS
Iron, diss (mg/L)	74	21	<0.0005	<0.05	<0.05	<0.05	0.2	NS
Iron, total (mg/L)	69	69	0.022	0.14	0.33	0.87	**41.2**	1
Field pH	156	156	**6.1**	7.6	8.0	8.3	**10.9**	6.5 – 8.5
Laboratory Conductivity (µS/cm)	75	75	646	3,420	5,160	6,105	22,400	NS
Laboratory pH (s.u.)	75	75	7.5	8.1	8.2	8.5	**9.4**	NS
Lead, diss (mg/L)	75	26	<0.000004	<0.0001	<0.0001	<0.0002	0.0018	0.1
Lead, total (mg/L)	74	52	<0.000018	<0.0001	<0.0003	0.001	**0.038**	0.015
Magnesium, diss (mg/L)	75	75	25	**324**	**496**	**593**	**2,190**	100
Manganese, diss (mg/L)	75	75	0.0009	0.012	0.027	0.09	**1.14**	0.5
Manganese, total (mg/L)	75	75	0.0019	0.027	0.075	0.19	**1.72**	0.5
Mercury, diss (mg/L)[3]	49	5	<0.000008	<0.00003	<0.0002	<0.0002	0.0002	0.01

Table 44. Water Quality of Ponds in and near the Project Area.

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard[1] or Recommended Concentration for Livestock
Mercury, total (mg/L)[3]	49	0	<0.00003	<0.00003	**<0.0002**	**<0.0002**	**<0.0002**	0.00005
Nickel, diss (mg/L)	48	34	<0.00061	0.00071	0.002	0.003	0.005	1
Nickel, total (mg/L)	48	32	<0.00072	<0.0009	0.003	0.005	0.044	0.1
Nitrate+Nitrite (mg/L)	72	46	<0.003	<0.01	<0.01	0.15	4.2	10
Orthophosphate as P (mg/L)	30	24	0.001	0.0025	0.004	0.007	0.022	NS
Total Phosphate as P (mg/L)	47	47	0.007	0.032	0.053	0.13	1.7	0.15 [7]
Potassium, diss (mg/L)	74	74	4.4	13.1	17.2	19.9	53.4	NS
Selenium, diss (mg/L)	74	65	<0.00018	0.0011	0.0020	0.0037	0.027	0.1
Selenium, total (mg/L)	69	64	<0.00046	0.0014	0.0022	0.004	**0.023**	0.005
Sodium, diss (mg/L)	75	75	40	**307**	**491**	**722**	**3,730**	300
Sulfate (mg/L)	75	75	252	1,915	**3,020**	**3,925**	**16,400**	2,500
Total Alkalinity (mg/L)	75	75	38	195	369	470	797	1,000
Total Dissolved Solids (mg/L)	75	75	430	3,550	**5,600**	**6,400**	**27,900**	4,999
Total Hardness (mg/L)	75	75	11	1,545	2,550	3,220	10,700	NS
Total Suspended Sediments (mg/L)	75	73	<0.01	6	11	38	1,470 [5]	NS
Turbidity (NTU)	47	47	1	4	7	15	890 [5]	NS
Vanadium, diss (mg/L)	71	70	0.00005	0.00038	0.0008	0.01	0.01	0.1
Vanadium, total (mg/L)	69	68	0.00024	0.00085	0.0018	0.01	0.05	0.1
Zinc, diss (mg/L)	73	9	<0.00086	<0.001	<0.005	<0.005	0.023	50
Zinc, total (mg/L)	67	27	<0.001	<0.005	<0.005	0.013	0.176	0.388

Data collected as follows:
Pond 1: June 2011 to May 2015
Pond 2: June 2011 to September 2013
Pond 3: March 2011 to May 2015
Pond 4: June 2011 to February 2014
Pond 5: March 2011 to April 2015
Pond 6: March 2011 to May 2015
Pond 7: March 2011 to October 2015
Pond 8: November 2015 to April 2016
Pond 9: November 2015 to April 2016.
NS = no numeric standard or recommended concentration.
diss = dissolved; µS/cm = micro Siemens/centimeter; s.u. = standard units; NTU = nephelometric turbidity units.
[1] Many metals standards are hardness dependent; standards for hardness of 400 mg/L are provided in **Table 40**.
[2] Dissolved metal recommended concentrations are for livestock.
[3] Ammonia standard is temperature and pH dependent. Standard provided assumes temperature of 10°C and pH of 8.3, with fish early-life state present. Ammonia standard was not exceeded in Pond 2 when concentration was 1.1 mg/L on May 28, 2013 or 1.8 mg/L on September 16, 2013 based on measured pH and water

temperatures. Chronic ammonia standard was exceeded in Pond 5 when concentration was 1.3 mg/L on April 12, 2016 based on measured pH of 8.5 s.u. and water temperature of 15.4 ºC.
[4] Total cadmium detection limit often greater than chronic aquatic life standard. Mercury detection limit greater than surface water quality standard.
[5] High total metal concentrations were associated with high suspended sediments (1,470 mg/L)/ high turbidity (890 NTU) measured in Pond 7 on March 21, 2014.
Note: For less than detection limit concentrations, detection limit used to calculate percentile concentrations. Concentrations shown with less than (<) symbols indicate some or all measured concentrations were less than the detection limit.
[6] EPA lists a chloride chronic limit of 230 mg/L and acute limit of 860 mg/L, but DEQ does not have a numeric chloride limit.
Concentrations in bold exceed surface water quality standards (**Table 40**), or recommended concentration limits for livestock (**Table 41**).
[7] Total phosphorus standard is applicable from July 1 through September 30; three exceedances of the total phosphorus standard occurred in July through September.

Springs in the Project Area

Water quality data collected from 2011 to 2016 in Springs 1 through 9 in or near the project area are provided in **Table 45** through **Table 53**. Water quality data collected in 2015 and 2016 in Springs 10 to 14 in and near the project area in the Robbie and McClure Creek watersheds is provided in **Table 54**. The likely source of water to these springs is listed in **Section 3.8.2.3, Springs**. Springs sourced in overburden or primarily in overburden have generally poor water quality with calcium, magnesium, manganese, and sodium concentrations that exceeded recommended concentrations for livestock. Springs 5 and 6, located west of the project area, had the poorest water quality. Spring 5 had nitrate+nitrite concentrations that nearly always exceeded the standard, and were as high as 90 mg/L. The water quality of Spring 1 is better than other overburden springs, probably because it is near the top of the watershed and there is a short flow path from where precipitation infiltrates through the overburden to where the spring discharges. Spring 2 has water quality better than Spring 1 and is also located near the top of a watershed (a tributary to Robbie Creek east of the project area). Spring 3, located in the project area along McClure Creek, is listed as having overburden as its source, but had relatively good water quality, comparable to springs whose source is Rosebud Coal such as Spring 7. Spring 8 is listed as a Rosebud Coal spring, with clinker as another possible source; its water quality was poorer than Springs 3 and 7. Spring 9, located along Donley Creek, and whose source is listed as overburden, had relatively good water quality similar to, but slightly poorer than Springs 3 and 7. Springs 10 to 14 were sampled from one to four times in 2015 and 2016; all are located in or near the northern part of the project area in the McClure and Robbie Creek watersheds. The water quality of these springs, based on limited data, appears to be relatively good with the exception of Spring 12, which had poor water quality when sampled in 2015.

Table 45. Water Quality of Spring 1 (Upper Black Hank Creek above the Project Area).

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard[1] or Recommended Concentration for Livestock[2]
Acidity (mg/L)	15	0	<1	<1	<3	<5	<5	NS
Aluminum (mg/L)	15	13	<0.004	0.0085	0.015	0.03	0.034	0.087
Ammonia, as N (mg/L)[3]	12	6	<0.0448	<0.0448	<0.056	0.194	0.32	5.39
Arsenic (mg/L)	12	11	<0.00007	0.001	0.002	0.003	0.004	0.2
Bicarbonate Alkalinity (mg/L)	15	15	438	518	5721	627	852	999
Boron (mg/L)	15	15	0.26	0.28	0.36	0.50	0.66	30
Cadmium (mg/L)	15	4	<0.00005	<0.0001	<0.0003	<0.0004	0.0025	0.005
Calcium (mg/L)	15	15	54	85	97	105	**164**	150
Carbonate Alkalinity (mg/L)	15	7	<1	<5	5	37	75	NS
Chloride (mg/L)[4]	15	15	10	13	16	22	37	300
Chromium (mg/L)	3	2	<0.0005	<0.0005	<0.0005	0.0010	0.0014	1
Copper (mg/L)	15	13	<0.00002	0.0013	0.002	0.002	0.007	0.5
Fluoride (mg/L)	14	13	<0.004	0.35	0.50	0.55	1	2
Hydroxide Alkalinity (mg/L)	15	0	<1	<1	<1	<5	<5	NS
Iron (mg/L)	9	9	0.021	0.024	0.028	0.120	0.387	NS
Laboratory Conductivity (µS/cm)	15	15	1,740	2,070	2,260	2,420	3,940	NS
Laboratory pH (s.u.)	15	15	7.2	8.1	8.2	8.4	8.5	NS
Lead (mg/L)	15	5	<0.000004	<0.00001	<0.0001	0.0002	0.0038	0.1
Magnesium (mg/L)	15	15	75	90	97	**108**	**235**	100
Manganese (mg/L)	15	15	0.01	0.04	0.12	0.22	**1.14**	0.5
Nickel (mg/L)	12	12	0.0015	0.0020	0.0023	0.0032	0.0073	1
Nitrate+Nitrite (mg/L)	14	14	0.01	0.56	1.02	1.75	2.50	10
Orthophosphate as P (mg/L)	3	3	0.0086	0.0087	0.0087	0.0149	0.021	NS
Potassium (mg/L)	15	15	5.7	7.8	8.8	10.4	15.0	NS
Selenium (mg/L)	15	14	<0.0005	0.0014	0.0025	0.0040	0.016	0.1
Sodium (mg/L)	15	15	212	248	**328**	**404**	**649**	300
Sulfate (mg/L)	15	15	434	582	697	820	1,950	2,000
Total Alkalinity (mg/L)	15	15	438	541	588	628	852	1,000
Total Dissolved Solids (mg/L)	15	15	1,280	1,500	1,720	1,760	3,350	4,999
Total Hardness (mg/L)	15	15	450	577	647	706	1,380	NS

Table 45. Water Quality of Spring 1 (Upper Black Hank Creek above the Project Area).

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard[1] or Recommended Concentration for Livestock[2]
Vanadium (mg/L)	15	14	<0.000043	0.001	0.004	0.01	0.01	0.1
Zinc (mg/L)	15	2	<0.00086	<0.001	<0.003	<0.005	0.006	50

Data collected between May 2011 and April 2016.
NS = no numeric standard or recommended concentration. µS/cm = micro Siemens/centimeter; s.u. = standard units.
All metals are dissolved.
[1] Many metals standards are hardness dependent; standards for hardness of 400 mg/L are provided in **Table 40**.
[2] Dissolved metal recommended concentrations are for livestock.
[3] Ammonia standard is temperature and pH dependent. Standard provided assumes temperature of 10 °C and pH of 7.2, with fish early life state present.
[4] EPA lists a chloride chronic limit of 230 mg/L and acute limit of 860 mg/L, but DEQ does not have a numeric chloride limit.
Note: For less than detection limit concentrations, detection limit used to calculate percentile concentrations. Concentrations shown with less than (<) symbols indicate some or all measured concentrations were less than the detection limit.
Concentrations in bold exceed surface water quality standards (**Table 40**), or recommended concentration limits for livestock (**Table 41**).

Table 46. Water Quality of Spring 2 (Robbie Creek Tributary below the Project Area).

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard[1] or Recommended Concentration for Livestock[2]
Acidity (mg/L)	18	0	<1	<1	<5	<5	<5	NS
Aluminum (mg/L)	18	13	<0.004	<0.004	0.02	0.03	**0.17**	0.087
Ammonia, as N (mg/L)[3]	14	11	<0.0448	0.08	0.24	0.43	0.62	5.39
Arsenic (mg/L)	14	10	<0.0005	<0.0005	0.001	0.001	0.006	0.2
Bicarbonate Alkalinity (mg/L)	18	18	407	431	452	485	899	999
Boron (mg/L)	18	18	0.6	0.72	0.78	0.95	1.1	30
Cadmium (mg/L)	18	6	<0.00007	<0.00008	0.0001	0.0005	0.0005	0.005
Calcium (mg/L)	18	18	107	**188**	**198**	**204**	**235**	150
Carbonate Alkalinity (mg/L)	18	1	<1	<1	<5	<5	25	NS
Chloride (mg/L)[4]	18	18	7.2	11	15.2	18.1	53	300
Chromium (mg/L)	4	4	0.00052	0.00060	0.00065	0.00071	0.00078	1
Copper (mg/L)	18	16	<0.0005	0.0006	0.0015	0.002	0.002	0.5
Fluoride (mg/L)	14	5	<0.004	<0.065	<0.2	0.25	**3.54**	2
Hydroxide Alkalinity (mg/L)	18	0	<1	<1	<5	<5	<5	NS
Iron (mg/L)	9	9	0.02	0.02	0.028	0.045	0.38	NS
Laboratory Conductivity (µS/cm)	18	18	2,030	2,695	3,000	3,153	3,830	NS
Laboratory pH (s.u.)	18	18	7.3	7.6	8.0	8.1	8.4	NS
Lead (mg/L)	18	9	<0.000004	<0.0001	0.0001	0.0003	0.0007	0.1
Magnesium (mg/L)	18	18	**207**	**307**	**351**	**402**	**518**	100
Manganese (mg/L)	18	17	<0.0025	0.020	0.033	0.054	0.19	0.5
Nickel (mg/L)	14	13	0.0006	0.001	0.002	0.002	0.01	1
Nitrate+Nitrite (mg/L)	18	18	0.42	3.7	4.6	6.2	6.8	10
Orthophosphate as P (mg/L)	4	4	0.0021	0.0044	0.0081	0.012	0.016	NS
Potassium (mg/L)	18	18	4.2	5.5	6.8	7.2	44.5	NS
Selenium (mg/L)	18	18	0.0032	0.012	0.026	0.038	0.066	0.1
Sodium (mg/L)	18	18	42	65	84	110	146	300
Sulfate (mg/L)	18	18	979	1,325	1,660	1,795	2,480	2,500
Total Alkalinity (mg/L)	18	18	407	431	459	485	899	1,000
Total Dissolved Solids (mg/L)	18	18	1,840	2,468	2,835	3,058	3,620	4,999
Total Hardness (mg/L)	18	18	1,120	1,763	1,910	2,148	2,540	NS

Table 46. Water Quality of Spring 2 (Robbie Creek Tributary below the Project Area).

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard[1] or Recommended Concentration for Livestock[2]
Vanadium (mg/L)	18	18	0.00013	0.0006	0.0031	0.01	0.01	0.1
Zinc (mg/L)	18	3	<0.00086	<0.0011	<0.005	0.01	0.01	50

Data collected between May 2011 and April 2016.
NS = no numeric standard or recommended concentration. µS/cm = micro Siemens/centimeter; s.u. = standard units.
All metals are dissolved.
[1] Many metals standards are hardness dependent; standards for hardness of 400 mg/L are provided in **Table 40**.
[2] Dissolved metal recommended concentrations are for livestock.
[3] Ammonia standard is temperature and pH dependent. Standard provided assumes temperature of 10 °C and pH of 7.2, with fish early life state present.
[4] EPA lists a chloride chronic limit of 230 mg/L and acute limit of 860 mg/L, but DEQ does not have a numeric chloride limit.
Note: For less than detection limit concentrations, detection limit used to calculate percentile concentrations. Concentrations shown with less than (<) symbols indicate some or all measured concentrations were less than the detection limit.
Concentrations in bold exceed surface water quality standards (**Table 40**), or recommended concentration limits for livestock (**Table 41**).

Table 47. Water Quality of Spring 3 (Robbie Creek in the Project Area).

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard[1] or Recommended Concentration for Livestock[2]
Acidity (mg/L)	21	0	<1	<1	<5	<5	<5	NS
Aluminum (mg/L)	21	12	<0.004	<0.004	0.0085	0.03	0.03	0.087
Ammonia, as N (mg/L)[3]	16	14	<0.045	<0.095	0.144	0.207	0.424	5.39
Arsenic (mg/L)	16	15	<0.0005	0.0009	0.001	0.001	0.002	0.2
Bicarbonate Alkalinity (mg/L)	21	21	515	577	594	624	681	999
Boron (mg/L)	21	21	0.11	0.14	0.17	0.19	0.23	30
Cadmium (mg/L)	21	5	<0.00007	<0.00008	<0.00008	<0.00008	0.00073	0.005
Calcium (mg/L)	21	21	96	105	113	121	146	150
Carbonate Alkalinity (mg/L)	21	0	<1	<1	<5	<5	<5	NS
Chloride (mg/L)[4]	21	21	3	4	5	5.9	8.5	300
Chromium (mg/L)	5	3	<0.0005	<0.0005	0.00055	0.00055	0.00058	1
Copper (mg/L)	21	14	<0.00002	<0.0005	0.0007	0.002	0.002	0.5
Fluoride (mg/L)	21	16	<0.004	0.23	0.31	0.41	1.3	2
Hydroxide Alkalinity (mg/L)	21	0	<1	<1	<5	<5	<5	NS
Iron (mg/L)	21	11	<0.04	<0.05	0.34	2.9	3.6	NS
Laboratory Conductivity (µS/cm)	21	21	1,870	2,050	2,180	2,300	2,580	NS
Laboratory pH (s.u.)	21	21	7.0	7.2	7.4	8.1	8.3	NS
Lead (mg/L)	21	3	<0.000004	<0.00001	<0.0001	<0.0001	0.0015	0.1
Magnesium (mg/L)	21	21	**161**	**181**	**193**	**206**	**257**	100
Manganese (mg/L)	21	21	0.08	0.14	0.18	0.22	0.34	0.5
Nickel (mg/L)	16	14	<0.00061	<0.0013	0.002	0.002	0.003	1
Nitrate+Nitrite (mg/L)	20	4	<0.003	<0.004	<0.01	<0.01	0.03	10
Orthophosphate as P (mg/L)	5	5	<0.0016	0.0018	0.002	0.002	0.003	NS
Potassium (mg/L)	21	21	4.5	5.2	6.1	6.5	8.8	NS
Selenium (mg/L)	21	4	<0.00026	<0.0004	0.001	0.001	0.004	0.1
Sodium (mg/L)	21	21	117	125	133	159	172	300
Sulfate (mg/L)	201	21	563	660	738	875	1,160	2,500
Total Alkalinity (mg/L)	21	21	515	577	594	624	681	1,000
Total Dissolved Solids (mg/L)	21	21	1,500	1,540	1,660	1,870	2,220	4,999
Total Hardness (mg/L)	21	21	902	999	1,070	1,160	1,420	NS

Table 47. Water Quality of Spring 3 (Robbie Creek in the Project Area).

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard[1] or Recommended Concentration for Livestock[2]
Vanadium (mg/L)	21	11	<0.0001	<0.0001	0.0003	0.01	0.01	0.1
Zinc (mg/L)	21	12	<0.00086	<0.0011	0.0055	0.008	0.028	50

Data collected between May 2011 and April 2016.
NS = no numeric standard or recommended concentration. µS/cm = micro Siemens/centimeter; s.u. = standard units.
All metals are dissolved.
[1] Many metals standards are hardness dependent; standards for hardness of 400 mg/L are provided in **Table 40**.
[2] Dissolved metal recommended concentrations are for livestock.
[3] Ammonia standard is temperature and pH dependent. Standard provided assumes temperature of 10 °C and pH of 7.2, with fish early life state present.
[4] EPA lists a chloride chronic limit of 230 mg/L and acute limit of 860 mg/L, but DEQ does not have a numeric chloride limit.
Note: For less than detection limit concentrations, detection limit used to calculate percentile concentrations. Concentrations shown with less than (<) symbols indicate some or all measured concentrations were less than the detection limit.
Concentrations in bold exceed surface water quality standards (**Table 40**), or recommended concentration limits for livestock (**Table 41**).

Table 48. Water Quality of Spring 4 (Upper Donley Creek Tributary above the Project Area).

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard[1] or Recommended Concentration for Livestock[2]
Acidity (mg/L)	21	0	<1	<1	<5	<5	<5	NS
Aluminum (mg/L)	20	14	<0.004	<0.005	<0.019	0.054	**0.096**	0.087
Ammonia, as N (mg/L)[3]	16	11	<0.05	<0.05	0.15	0.34	1.09	5.39
Arsenic (mg/L)	16	13	<0.0005	0.0005	0.001	0.001	0.001	0.2
Bicarbonate Alkalinity (mg/L)	21	21	458	514	545	575	621	999
Boron (mg/L)	21	21	0.59	0.75	0.77	0.84	0.97	30
Cadmium (mg/L)	21	10	<0.00008	<0.00008	<0.00008	0.0005	0.0016	0.005
Calcium (mg/L)	21	21	**228**	**276**	**302**	**309**	**372**	150
Carbonate Alkalinity (mg/L)	21	0	<1	<1	<5	<5	<5	NS
Chloride (mg/L)[4]	21	21	11.8	15.6	16.2	17.7	47.1	300
Chromium (mg/L)	4	4	0.0006	0.001	0.001	0.001	0.001	1
Copper (mg/L)	21	21	0.0005	0.0009	0.001	0.002	0.002	0.5
Fluoride (mg/L)	18	14	<0.004	0.28	0.43	0.78	**3.92**	2
Hydroxide Alkalinity (mg/L)	21	0	<1	<1	<5	<5	<5	NS
Iron (mg/L)	9	9	0.02	0.02	0.02	0.03	0.42	NS
Laboratory Conductivity (µS/cm)	21	21	3,870	5,200	5,410	5,540	5,730	NS
Laboratory pH (s.u.)	21	21	7.4	7.5	7.8	8.1	8.2	NS
Lead (mg/L)	21	5	<0.000004	0.00001	0.0001	0.0002	0.0015	0.1
Magnesium (mg/L)	21	21	**397**	**527**	**548**	**557**	**625**	100
Manganese (mg/L)	21	21	<0.0002	0.0043	0.0052	0.009	0.023	0.5
Nickel (mg/L)	16	6	<0.0005	<0.0006	<0.0007	0.0007	0.002	1
Nitrate+Nitrite (mg/L)	21	21	0.2	1.0	1.2	1.5	2.5	10
Orthophosphate as P (mg/L)	5	3	<0.001	<0.003	0.003	0.006	0.009	NS
Potassium (mg/L)	21	21	14.8	17.1	17.8	21.2	37.5	NS
Selenium (mg/L)	21	21	0.0031	0.0072	0.0089	0.0114	0.033	0.1
Sodium (mg/L)	21	21	**405**	**433**	**444**	**476**	**535**	300
Sulfate (mg/L)	21	21	2,400	**2,930**	**3,180**	**3,340**	**3,560**	2,500
Total Alkalinity (mg/L)	21	21	458	514	545	575	621	1,000
Total Dissolved Solids (mg/L)	21	21	4,120	**5,510**	**5,560**	**5,780**	**6,070**	4,999
Total Hardness (mg/L)	21	21	2,200	2,900	3,010	3,060	3,430	NS

Table 48. Water Quality of Spring 4 (Upper Donley Creek Tributary above the Project Area).

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard[1] or Recommended Concentration for Livestock[2]
Vanadium (mg/L)	21	19	<0.00004	0.00025	0.0003	0.01	0.01	0.1
Zinc (mg/L)	11	1	<0.00086	<0.00086	<0.00108	<0.0011	0.0099	50

Data collected between May 2011 and April 2016.
NS = no numeric standard or recommended concentration. µS/cm = micro Siemens/centimeter; s.u. = standard units.
All metals are dissolved.
[1] Many metals standards are hardness dependent; standards for hardness of 400 mg/L are provided in **Table 40**.
[2] Dissolved metal recommended concentrations are for livestock.
[3] Ammonia standard is temperature and pH dependent. Standard provided assumes temperature of 10 °C and pH of 7.2, with fish early life state present.
[4] EPA lists a chloride chronic limit of 230 mg/L and acute limit of 860 mg/L, but DEQ does not have a numeric chloride limit.
Note: For less than detection limit concentrations, detection limit used to calculate percentile concentrations. Concentrations shown with less than (<) symbols indicate some or all measured concentrations were less than the detection limit.
Concentrations in bold exceed surface water quality standards (**Table 40**), or recommended concentration limits for livestock (**Table 41**).

Table 49. Water Quality of Spring 5 (Upper Donley Creek above the Project Area).

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard[1] or Recommended Concentration for Livestock[2]
Acidity (mg/L)	18	0	<1	<1	<3	<5	<5	NS
Aluminum (mg/L)	16	14	<0.004	0.006	0.048	**0.091**	**0.16**	0.087
Ammonia, as N (mg/L)[3]	14	11	<0.05	0.07	0.27	0.57	2.39	5.39
Arsenic (mg/L)	14	11	<0.00007	<0.001	<0.001	0.002	0.005	0.2
Bicarbonate Alkalinity (mg/L)	18	18	449	598	641	727	799	999
Boron (mg/L)	18	18	1	1.5	2	2	3.2	30
Cadmium (mg/L)	16	9	<0.00008	<0.00008	0.0004	0.0005	0.0016	0.005
Calcium (mg/L)	18	18	**192**	**332**	**358**	**408**	**474**	150
Carbonate Alkalinity (mg/L)	18	3	<1	<1	<5	<5	42.2	NS
Chloride (mg/L)[4]	18	18	12	23	28	33	41	300
Chromium (mg/L)	4	4	0.00061	0.00063	0.00064	0.00066	0.00068	1
Copper (mg/L)	18	16	<0.000018	0.0023	0.0027	0.0036	0.0109	0.5
Fluoride (mg/L)	14	9	<0.004	<0.005	0.575	1.55	**2.45**	2
Hydroxide Alkalinity (mg/L)	18	0	<1	<1	<3	<5	<5	NS
Iron (mg/L)	9	6	<0.0005	<0.0008	0.02	0.03	0.05	NS
Laboratory Conductivity (µS/cm)	18	18	5,690	8,228	9,885	10,200	11,700	NA
Laboratory pH (s.u.)	18	18	7.9	8.1	8.2	8.2	8.4	NS
Lead (mg/L)	11	4	<0.000004	<0.000005	<0.00001	<0.00023	0.0014	0.1
Magnesium (mg/L)	18	18	**391**	**684**	**838**	**935**	**1,130**	100
Manganese (mg/L)	18	18	0.0010	0.009	0.028	0.039	0.24	0.5
Nickel (mg/L)	14	8	<0.00061	<0.00071	0.002	0.003	0.012	1
Nitrate+Nitrite (mg/L)	18	17	<0.0046	**15.2**	**26.7**	**51.9**	**89.8**	10
Orthophosphate as P (mg/L)	4	3	<0.001	0.002	0.004	0.008	0.012	NS
Potassium (mg/L)	17	17	7.8	11.5	15	16.8	21.8	NS
Selenium (mg/L)	18	18	0.034	0.049	0.058	0.073	**0.17**	0.1
Sodium (mg/L)	18	18	**814**	**1,355**	**1,500**	**1,625**	**1,760**	300
Sulfate (mg/L)	18	18	**3,210**	**5,773**	**6,500**	**7,050**	**7,470**	2,500
Total Alkalinity (mg/L)	18	18	465	598	641	727	828	1,000
Total Dissolved Solids (mg/L)	18	18	**5,220**	**9,203**	**11,350**	**12,100**	**12,800**	4,999
Total Hardness (mg/L)	18	18	2,090	3,653	4,340	4,938	5,840	NS

Table 49. Water Quality of Spring 5 (Upper Donley Creek above the Project Area).

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard[1] or Recommended Concentration for Livestock[2]
Vanadium (mg/L)	18	13	<0.000043	<0.0001	0.0007	0.0016	0.01	0.1
Zinc (mg/L)	15	0	<0.00086	<0.00086	<0.001	<0.005	<0.005	50

Data collected between May 2011 and April 2016.
NS = no numeric standard or recommended concentration. µS/cm = micro Siemens/centimeter; s.u. = standard units.
All metals are dissolved.
[1] Many metals standards are hardness dependent; standards for hardness of 400 mg/L are provided in **Table 40**.
[2] Dissolved metal recommended concentrations are for livestock.
[3] Ammonia standard is temperature and pH dependent. Standard provided assumes temperature of 10 °C and pH of 7.2, with fish early life state present.
[4] EPA lists a chloride chronic limit of 230 mg/L and acute limit of 860 mg/L, but DEQ does not have a numeric chloride limit.
Note: For less than detection limit concentrations, detection limit used to calculate percentile concentrations. Concentrations shown with less than (<) symbols indicate some or all measured concentrations were less than the detection limit.
Concentrations in bold exceed surface water quality standards (**Table 40**), or recommended concentration limits for livestock (**Table 41**).

Table 50. Water Quality of Spring 6 (Upper Donley Creek Tributary above the Project Area).

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard[1] or Recommended Concentration for Livestock[2]
Acidity (mg/L)	21	0	<1	<1	<5	<5	<5	NS
Aluminum (mg/L)	19	14	<0.004	0.005	0.037	0.099	**0.17**	0.087
Ammonia, as N (mg/L)[3]	16	10	<0.05	0.07	0.35	0.65	4.55	5.39
Arsenic (mg/L)	16	15	<0.00012	0.0017	0.0029	0.0041	0.0094	0.2
Bicarbonate Alkalinity (mg/L)	21	21	428	516	679	742	**1,210**	999
Boron (mg/L)	21	21	0.4	1.0	1.3	1.8	3.3	30
Cadmium (mg/L)	19	5	<0.000005	<0.00008	<0.00008	<0.00033	0.0019	0.005
Calcium (mg/L)	21	21	**280**	**387**	**425**	**459**	**628**	150
Carbonate Alkalinity (mg/L)	21	0	<1	<1	<5	<5	<5	NS
Chloride (mg/L)[4]	21	21	14	30	36	44	59	300
Chromium (mg/L)	5	4	<0.0005	0.00052	0.00066	0.00076	0.00094	1
Copper (mg/L)	19	17	<0.000018	<0.0005	0.0016	0.002	0.013	0.5
Fluoride (mg/L)	13	6	<0.004	<0.004	<0.008	0.44	1.92	2
Hydroxide Alkalinity (mg/L)	21	0	<1	<1	<5	<5	<5	NS
Iron (mg/L)	11	11	0.02	0.04	0.07	0.11	0.16	NS
Laboratory Conductivity (µS/cm)	21	21	6,770	8,730	9,460	10,100	13,400	NS
Laboratory pH (s.u.)	21	21	7.6	7.9	8.1	8.2	8.3	NS
Lead (mg/L)	13	5	<0.000004	<0.000004	<0.000007	0.0003	0.0023	0.1
Magnesium (mg/L)	21	21	**494**	**762**	**842**	**926**	**1,500**	100
Manganese (mg/L)	21	21	0.0096	0.057	0.12	0.44	**2.53**	0.5
Nickel (mg/L)	16	8	<0.00061	<0.00071	0.0016	0.0037	0.0066	1
Nitrate+Nitrite (mg/L)	17	11	<0.003	<0.005	0.01	0.01	0.03	10
Orthophosphate as P (mg/L)	5	5	0.0017	0.0022	0.003	0.0045	0.0049	NS
Potassium (mg/L)	21	20	7.9	11.2	13.5	20	26.2	NS
Selenium (mg/L)	18	12	<0.00037	<0.0005	0.001	0.001	0.014	0.1
Sodium (mg/L)	21	21	**919**	**1,220**	**1,400**	**1,610**	**2,090**	300
Sulfate (mg/L)	21	21	**3,620**	**5,650**	**6,190**	**7,720**	**9,830**	2,500
Total Alkalinity (mg/L)	21	21	428	516	679	742	**1,210**	1,000
Total Dissolved Solids (mg/L)	21	21	**6,760**	**9,780**	**10,800**	**12,000**	**16,400**	4,999
Total Hardness (mg/L)	21	21	2,730	4,110	4,530	4,830	7,330	NS

Table 50. Water Quality of Spring 6 (Upper Donley Creek Tributary above the Project Area).

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard[1] or Recommended Concentration for Livestock[2]
Vanadium (mg/L)	97	15	<0.000043	0.00019	0.00025	0.01	0.01	0.1
Zinc (mg/L)	18	3	<0.00086	<0.001	<0.005	<0.005	0.014	50

Data collected between May 2011 and April 2016.
NS = no numeric standard or recommended concentration. µS/cm = micro Siemens/centimeter; s.u. = standard units.
All metals are dissolved.
[1] Many metals standards are hardness dependent; standards for hardness of 400 mg/L are provided in **Table 40**.
[2] Dissolved metal recommended concentrations are for livestock.
[3] Ammonia standard is temperature and pH dependent. Standard provided assumes temperature of 10 °C and pH of 7.2, with fish early life state present.
[4] EPA lists a chloride chronic limit of 230 mg/L and acute limit of 860 mg/L, but DEQ does not have a numeric chloride limit.
Note: For less than detection limit concentrations, detection limit used to calculate percentile concentrations. Concentrations shown with less than (<) symbols indicate some or all measured concentrations were less than the detection limit.
Concentrations in bold exceed surface water quality standards (**Table 40**), or recommended concentration limits for livestock (**Table 41**).

Table 51. Water Quality of Spring 7 (Trail Creek Tributary in the Project Area).

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard[1] or Recommended Concentration for Livestock[2]
Acidity (mg/L)	21	0	<1	<1	<5	<5	<5	NS
Aluminum (mg/L)	21	15	<0.004	<0.004	0.011	0.03	0.036	0.087
Ammonia, as N (mg/L)[3]	16	9	<0.045	<0.05	0.07	0.15	0.54	5.39
Arsenic (mg/L)	16	15	<0.0005	0.001	0.001	0.002	0.004	0.2
Bicarbonate Alkalinity (mg/L)	21	21	482	565	621	682	773	999
Boron (mg/L)	21	21	0.044	0.069	0.086	0.1	0.11	30
Cadmium (mg/L)	21	2	<0.000005	<0.00007	<0.00008	<0.00008	0.001	0.005
Calcium (mg/L)	21	21	62	80	82	95	124	150
Carbonate Alkalinity (mg/L)	21	7	<1	<5	<5	25	79	NS
Chloride (mg/L)[4]	21	21	2.1	4.5	8.0	9.8	19.1	300
Chromium (mg/L)	5	4	<0.0005	0.00054	0.00065	0.00066	0.00093	1
Copper (mg/L)	21	12	<0.000018	<0.0005	0.0008	0.002	0.002	0.5
Fluoride (mg/L)	12	7	<0.004	<0.004	<0.16	0.26	1.1	2
Hydroxide Alkalinity (mg/L)	21	0	<1	<1	<5	<5	<5	NS
Iron (mg/L)	11	11	0.02	0.026	0.040	0.049	0.13	NS
Laboratory Conductivity (µS/cm)	21	21	1,280	1,540	1,770	2,050	5,870	NS
Laboratory pH (s.u.)	21	21	7.2	8.1	8.2	8.4	**8.6**	NS
Lead (mg/L)	11	2	<0.000004	<0.000004	0.00001	0.00001	0.003	0.1
Magnesium (mg/L)	21	21	**133**	**165**	**202**	**235**	**292**	100
Manganese (mg/L)	21	20	<0.0025	0.013	0.023	0.064	0.239	0.5
Nickel (mg/L)	16	11	<0.0005	<0.0007	0.0012	0.002	0.002	1
Nitrate+Nitrite (mg/L)	16	11	<0.003	0.005	0.01	0.02	0.24	10
Orthophosphate as P (mg/L)	5	5	0.0038	0.0041	0.011	0.012	0.019	NS
Potassium (mg/L)	20	20	2.2	4.6	5.6	8.6	11.3	NS
Selenium (mg/L)	21	15	<0.00018	<0.0005	<0.00005	<0.0012	**0.108**	0.1
Sodium (mg/L)	21	21	26.6	32.2	51.6	57.2	95.4	300
Sulfate (mg/L)	21	21	203	285	434	610	1,220	2,500
Total Alkalinity (mg/L)	21	21	482	587	621	682	815	1,000
Total Dissolved Solids (mg/L)	21	21	856	1,100	1,260	1,600	2,290	4,999
Total Hardness (mg/L)	21	21	705	876	1,040	1,200	1,510	NS

Table 51. Water Quality of Spring 7 (Trail Creek Tributary in the Project Area).

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard[1] or Recommended Concentration for Livestock[2]
Vanadium (mg/L)	21	19	<0.000043	0.00048	0.0007	0.01	0.01	0.1
Zinc (mg/L)	12	2	<0.00086	<0.00086	<0.0011	<0.0011	0.029	50

Data collected between May 2011 and April 2016.
NS = no numeric standard or recommended concentration. µS/cm = micro Siemens/centimeter; s.u. = standard units.
All metals are dissolved.
[1] Many metals standards are hardness dependent; standards for hardness of 400 mg/L are provided in **Table 40**.
[2] Dissolved metal recommended concentrations are for livestock.
[3] Ammonia standard is temperature and pH dependent. Standard provided assumes temperature of 10 °C and pH of 7.2, with fish early life state present.
[4] EPA lists a chloride chronic limit of 230 mg/L and acute limit of 860 mg/L, but DEQ does not have a numeric chloride limit.
Note: For less than detection limit concentrations, detection limit used to calculate percentile concentrations. Concentrations shown with less than (<) symbols indicate some or all measured concentrations were less than the detection limit.
Concentrations in bold exceed surface water quality standards (**Table 40**), or recommended concentration limits for livestock (**Table 41**).

Table 52. Water Quality of Spring 8 (Black Hank Creek Tributary in the Project Area).

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard[1] or Recommended Concentration for Livestock[2]
Acidity (mg/L)	19	0	<1	<1	<5	<5	<5	NS
Aluminum (mg/L)	19	14	<0.004	0.0049	0.03	0.03	**0.6**	0.087
Ammonia, as N (mg/L)[3]	14	8	<0.0448	<0.05	0.13	0.31	1.22	5.39
Arsenic (mg/L)	14	13	<0.00007	0.001	0.0011	0.0018	0.0052	0.2
Bicarbonate Alkalinity (mg/L)	19	19	385	431	464	548	594	999
Boron (mg/L)	19	19	0.24	0.62	0.76	0.9	1.3	30
Cadmium (mg/L)	19	5	<0.00007	<0.00008	<0.0001	0.0002	0.0016	0.005
Calcium (mg/L)	19	19	**183**	**295**	**302**	**326**	**444**	150
Carbonate Alkalinity (mg/L)	19	1	<1	<1	<5	<5	13.5	NS
Chloride (mg/L)[4]	19	19	11.7	23.5	28.3	33.5	50.5	300
Chromium (mg/L)	5	0	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	1
Copper (mg/L)	16	14	<0.000018	0.0008	0.00093	0.002	0.002	0.5
Fluoride (mg/L)	19	15	<0.004	0.31	0.43	0.55	1.55	2
Hydroxide Alkalinity (mg/L)	19	0	<1	<1	<5	<5	<5	NS
Iron (mg/L)	11	10	<0.0005	0.06	3.5	5.1	19.4	NS
Laboratory Conductivity (µS/cm)	19	19	2,240	3,385	3,680	3,815	4,820	NS
Laboratory pH (s.u.)	19	19	7.2	7.3	7.7	8.0	8.3	NS
Lead (mg/L)	19	4	<0.000004	<0.000007	<0.0001	<0.0001	0.0018	0.1
Magnesium (mg/L)	19	19	**217**	**341**	**367**	**390**	**592**	100
Manganese (mg/L)	19	19	0.01	**1.6**	**2.3**	**3.1**	**5.6**	0.5
Nickel (mg/L)	14	13	<0.00071	0.0021	0.0030	0.0036	0.0068	1
Nitrate+Nitrite (mg/L)	19	10	<0.005	<0.01	0.02	0.19	2.17	10
Orthophosphate as P (mg/L)	5	5	0.0011	0.0016	0.0029	0.0037	0.0057	NS
Potassium (mg/L)	19	19	5.4	8.9	10.0	13.9	24.4	NS
Selenium (mg/L)	19	8	<0.00037	<0.0005	<0.0005	0.0057	0.035	0.1
Sodium (mg/L)	19	19	67	113	127	138	180	300
Sulfate (mg/L)	19	19	1,040	2,025	2,200	2,360	**2,910**	2,500
Total Alkalinity (mg/L)	19	19	399	431	464	548	594	1,000
Total Dissolved Solids (mg/L)	19	19	1,960	3,310	3,540	3,890	**5,040**	4,999
Total Hardness (mg/L)	19	19	1,350	2,140	2,260	2,430	3,550	NS

Table 52. Water Quality of Spring 8 (Black Hank Creek Tributary in the Project Area).

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard[1] or Recommended Concentration for Livestock[2]
Vanadium (mg/L)	18	10	<0.000043	<0.0001	0.0002	0.01	0.01	0.1
Zinc (mg/L)	9	3	<0.00086	<0.00086	<0.00108	0.008	0.0089	50

Data collected between May 2011 and October 2015.
NS = no numeric standard or recommended concentration. µS/cm = micro Siemens/centimeter; s.u. = standard units.
All metals are dissolved.
[1] Many metals standards are hardness dependent; standards for hardness of 400 mg/L are provided in **Table 40**.
[2] Dissolved metal recommended concentrations are for livestock.
[3] Ammonia standard is temperature and pH dependent. Standard provided assumes temperature of 10 °C and pH of 7.2, with fish early life state present.
[4] EPA lists a chloride chronic limit of 230 mg/L and acute limit of 860 mg/L, but DEQ does not have a numeric chloride limit.
Note: For less than detection limit concentrations, detection limit used to calculate percentile concentrations. Concentrations shown with less than (<) symbols indicate some or all measured concentrations were less than the detection limit.
Concentrations in bold exceed surface water quality standards (**Table 40**), or recommended concentration limits for livestock (**Table 41**).

Table 53. Water Quality of Spring 9 (Donley Creek in the Project Area).

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard[1] or Recommended Concentration for Livestock[2]
Acidity (mg/L)	20	0	<1	<1	<5	<5	<5	NS
Aluminum (mg/L)	20	17	<0.004	0.005	0.007	0.030	0.032	0.087
Ammonia, as N (mg/L)[3]	15	10	<0.0448	<0.050	0.124	0.42	2.4	5.39
Arsenic (mg/L)	15	15	0.00077	0.0015	0.0024	0.0061	0.013	0.2
Bicarbonate Alkalinity (mg/L)	20	20	315	433	503	545	748	999
Boron (mg/L)	20	20	0.15	0.31	0.37	0.43	0.62	30
Cadmium (mg/L)	20	4	<0.00005	<0.00008	<0.00008	<0.00008	0.00055	0.005
Calcium (mg/L)	20	20	58	110	126	139	**209**	150
Carbonate Alkalinity (mg/L)	20	4	<1	<4	<5	<5	29.9	NS
Chloride (mg/L)[4]	18	17	<0.18	4.8	7.2	10.1	28.3	300
Chromium (mg/L)	5	3	<0.0005	<0.0005	<0.0005	0.00073	0.00091	1
Copper (mg/L)	20	11	<0.000018	<0.0005	<0.0007	0.002	0.0028	0.5
Fluoride (mg/L)	12	7	<0.004	<0.004	0.22	0.45	**3.4**	2
Hydroxide Alkalinity (mg/L)	20	0	<1	<1	<5	<5	<5	NS
Iron (mg/L)	14	14	0.03	0.10	0.15	0.19	2.82	NS
Laboratory Conductivity (µS/cm)	20	20	1,470	2,403	2,665	2,953	3,540	NS
Laboratory pH (s.u.)	20	20	7.2	7.6	7.9	8.3	8.4	NS
Lead (mg/L)	15	10	<0.000004	0.000007	0.00016	0.0003	0.0022	0.1
Magnesium (mg/L)	20	20	**107**	**177**	**200**	**226**	**274**	100
Manganese (mg/L)	20	20	0.06	0.24	0.45	**0.64**	**2.24**	0.5
Nickel (mg/L)	15	15	0.00082	0.0020	0.0026	0.0034	0.0097	1
Nitrate+Nitrite (mg/L)	18	10	<0.003	<0,005	0.01	0.01	0.04	10
Orthophosphate as P (mg/L)	5	5	0.0029	0.0053	0.0068	0.0075	0.038	NS
Potassium (mg/L)	19	19	5.9	7.5	9.7	14.4	31.7	NS
Selenium (mg/L)	19	5	<0.00037	<0.0005	<0.0005	0.0008	0.001	0.1
Sodium (mg/L)	19	19	111	236	259	**304**	**361**	300
Sulfate (mg/L)	19	19	490	1,055	1,180	1,385	1,770	2,500
Total Alkalinity (mg/L)	20	20	28	433	502	545	748	1,000
Total Dissolved Solids (mg/L)	20	20	1,000	2,073	2,260	2,565	3,020	4,999
Total Hardness (mg/L)	19	19	634	1,015	1,110	1,305	1,620	NS

Table 53. Water Quality of Spring 9 (Donley Creek in the Project Area).

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard[1] or Recommended Concentration for Livestock[2]
Vanadium (mg/L)	20	20	0.00011	0.00033	0.0012	0.01	0.01	0.1
Zinc (mg/L)	9	1	<0.00086	<0.00086	<0.00086	<0.0011	0.0053	50

Data collected between May 2011 and April 2016.
NS = no numeric standard or recommended concentration. µS/cm = micro Siemens/centimeter; s.u. = standard units.
All metals are dissolved.
[1] Many metals standards are hardness dependent; standards for hardness of 400 mg/L are provided in **Table 40**.
[2] Dissolved metal recommended concentrations are for livestock.
[3] Ammonia standard is temperature and pH dependent. Standard provided assumes temperature of 10 °C and pH of 7.2, with fish early life state present.
[4] EPA lists a chloride chronic limit of 230 mg/L and acute limit of 860 mg/L, but DEQ does not have a numeric chloride limit.
Note: For less than detection limit concentrations, detection limit used to calculate percentile concentrations. Concentrations shown with less than (<) symbols indicate some or all measured concentrations were less than the detection limit.
Concentrations in bold exceed surface water quality standards (**Table 40**), or recommended concentration limits for livestock (**Table 41**).

Table 54. Water Quality of Springs 10, 11, 12, 13, and 14 (Robbie and McClure Creek Watersheds in and below the Project Area).

Parameter	Spring 10		Spring 11		Spring 12		Spring 13	Spring 14		Lowest Water Quality Standard[1] or Recommended Concentration for Livestock[2]
	Minimum	**Maximum**	**Minimum**	**Maximum**	**Minimum**	**Maximum**	**1 sample**	**Minimum**	**Maximum**	
Acidity (mg/L)	<1	<1	<1	<1	<1	<1	<1	<1	<1	NS
Aluminum (mg/L)	0.0125	0.03	0.0141	0.03	0.0357	**0.122**	0.03	0.0155	0.03	0.087
Ammonia, as N (mg/L)[3]	<0.0448	0.157	0.0788	0.192	0.687	3.68	0.0953	0.131	0.406	5.39
Arsenic (mg/L)	0.001	0.00159	0.001	0.00114	0.0016	0.0103	0.00187	0.001	0.001	0.2
Bicarbonate Alkalinity (mg/L)	423	470	473	552	501	666	762	646	667	999
Boron (mg/L)	0.0548	0.0946	0.152	0.21	0.628	1.78	0.533	0.393	0.468	30
Cadmium (mg/L)	<0.00007	0.0005	<0.000005	<0.00007	<0.00007	0.00138	<0.00007	<0.000005	0.0005	0.005
Calcium (mg/L)	65.2	73.9	87.1	87.6	**236**	**584**	135	132	147	150
Carbonate Alkalinity (mg/L)	<1	23.8	<1	15.7	<1	9.14	<1	<1	<1	NS
Chloride (mg/L)[4]	14.5	17.6	9.62	11.1	34.7	294	13.7	11.4	13.3	300
Copper (mg/L)	<0.000018	0.002	0.002	0.002	<0.000018	0.0355	<0.000018	0.002	0.002	0.5
Fluoride (mg/L)	0.157	0.477	0.258	0.438	<0.008	0.536	0.791	0.344	0.897	2
Hydroxide Alkalinity (mg/L)	<1	<1	<1	<1	<1	<1	<1	<1	<1	NS
Iron (mg/L)	0.0309	0.131	0.0753	0.427	0.073	0.731	1.75	0.02	0.0348	NS
Laboratory Conductivity (µS/cm)	1,240	1,460	1,410	1,430	4,410	10,400	2,430	2,440	2,730	NS
Laboratory pH (s.u.)	7.94	8.43	8.22	8.35	7.84	8.32	8.23	7.98	8.25	NS
Lead (mg/L)	<0.000004	<0.000004	0.0003	0.0003	0.0003	0.00152	0.0003	<0.000004	<0.000004	0.1
Magnesium (mg/L)	**142**	**150**	**152**	**160**	**657**	**4,880**	**320**	**264**	**290**	100
Manganese (mg/L)	0.0199	0.137	0.113	0.271	**1.06**	**2.85**	**0.877**	0.0505	0.0601	0.5
Nickel (mg/L)	<0.000705	0.0022	0.002	0.00241	0.002	0.0135	0.00511	<0.000705	0.002	1

Table 54. Water Quality of Springs 10, 11, 12, 13, and 14 (Robbie and McClure Creek Watersheds in and below the Project Area).

Parameter	Spring 10		Spring 11		Spring 12		Spring 13	Spring 14		Lowest Water Quality Standard[1] or Recommended Concentration for Livestock[2]
	Minimum	**Maximum**	**Minimum**	**Maximum**	**Minimum**	**Maximum**	**1 sample**	**Minimum**	**Maximum**	
Nitrate+Nitrite (mg/L)	<0.003	<0.003	<0.003	<0.003	0.041	0.221	0.01	<0.003	0.034	10
Potassium (mg/L)	4.57	6.74	6.53	6.97	11.6	123	9.68	8.53	9.31	NS
Selenium (mg/L)	<0.000182	0.00762	0.001	0.001	0.001	0.0154	0.001	<00026	<0.000394	0.1
Sodium (mg/L)	46.6	51.5	49.4	56.1	191	**1,300**	100	155	164	300
Sulfate (mg/L)	346	382	393	395	**2,780**	**21,600**	967	1,080	1,120	2,500
Total Alkalinity (mg/L)	443	470	473	568	510	666	762	646	667	1,000
Total Dissolved Solids (mg/L)	958	1,101	1,060	1,130	5,170	**29,600**	2,210	2,210	2,320	4,999
Total Hardness (mg/L)	758	794	845	877	3,310	21,500	1,650	1,410	1,470	NS
Vanadium (mg/L)	<0.000048	0.01	<0.000048	0.01	<0.000048	0.01	0.01	0.01	0.01	0.1
Zinc (mg/L)	<0.00108	0.008	<0.00108	<0.00108	<0.00108	<0.00108	<0.00108	<0.00108	<0.00108	50

Data collected as follows:
Spring 10: 5 times, April 2015 to April 2016
Spring 11: 2 times, April 2015 and April 2016
Spring 12: 4 times, April 2015 to October 2015
Spring 13: 1 time, April 2015
Spring 14: 3 times, November 2015 to April 2016
NS = no numeric standard or recommended concentration. µS/cm = micro Siemens/centimeter; s.u. = standard units.
All metals are dissolved.
[1] Many metals standards are hardness dependent; standards for hardness of 400 mg/L are provided in **Table 40**.
[2] Dissolved metal recommended concentrations are for livestock.
[3] Ammonia standard is temperature and pH dependent. Standard provided assumes temperature of 10 °C and pH of 7.2, with fish early life state present.
[4] EPA lists a chloride chronic limit of 230 mg/L and acute limit of 860 mg/L, but DEQ does not have a numeric chloride limit.
Note: For less than detection limit concentrations, detection limit used to calculate percentile concentrations. Concentrations shown with less than (<) symbols indicate some or all measured concentrations were less than the detection limit.
Concentrations in bold exceed surface water quality standards (**Table 40**), or recommended concentration limits for livestock (**Table 41**).

3.7.6.2 Water Quality in the Indirect Effects Analysis Area

Castle Rock Lake is a reservoir located in Colstrip (**Figure 37**). It was constructed to provide water for the Colstrip Power Plant and was filled in 1978. The source of the water is the Yellowstone River, piped 30 miles to Castle Rock Lake. The city of Colstrip also uses the lake for its municipal water supply. Montana Fish Wildlife and Parks has a fish consumption advisory related to mercury for Castle Rock Lake (DEQ 2016e). No mercury or other water quality data are available for Castle Rock Lake. There are mercury data collected from the Yellowstone River at Forsyth (near the point of diversion for the Colstrip pipeline) during four sampling events in 2013; all results were below the laboratory detection limit and well below mercury standards.

A summary of water quality data for mercury, selenium, copper, and nitrogen are provided in **Table 55** that were collected by DEQ or the Northern Cheyenne Tribe between 2000 and 2016. An analysis of effects on stream water quality from deposition was limited to mercury and selenium, for which the most stream water quality data were available in the analysis area, and copper, which was predicted by the air-quality modeling to have the greatest deposition rate of all the modeled metals. Other metals were not evaluated because the deposition areas for antimony, arsenic, cadmium, chromium, and lead were predicted to be very small (within the Colstrip Power Plant site area). No water quality data are available for other streams in the analysis area during this time period. The standards for mercury, selenium, and copper are provided in **Table 40** and the lowest standard is shown in **Table 41**. Alkalinity of indirect effects analysis area streams has nearly always been greater than 100 mg/L, and often has been several hundred mg/L, and pH averaged 8 standard units from 2000 through 2016 (EPA 2017h).

Table 55. Summary of Mercury, Selenium, and Copper Water Quality Data for Indirect Effects Analysis Area Streams.

Stream	Mercury (mg/L)	Selenium (mg/L)	Copper (mg/L)	Nitrate + Nitrite (mg/L)	Total Nitrogen (mg/L)
Sarpy Creek, SW of project area to mouth)	2005 only <0.00005 – 0.0001	No data	2005 only 0.001–0.008	2005 only <0.0006-0.4	2005 only 1.1-1.4
Armells Creek, East and West forks	All below detection limit and below standards	<0.0005–0.06	2005 only <0.001–0.002	<0.005-3.55	No data 7/1-9/30 <0.03-1 (10/1-6/30)
Rosebud Creek, from Lame Deer to mouth	All below detection limits since 2005	<0.0005–0.008	<0.001–0.02, one at 0.77 at mouth in 2004	<0.004 – 0.32	<0.01 – 1.04 (7/1-9/30) <0.01 – 1.67 (10/1-6/30)
Pony Creek (above confluence with Rosebud Creek, east of Colstrip)	No data	2015–2016 all <0.001	2015–2016 < 0.001–0.004	<0.005 – 0.07	0.62 (1 sample 7/1-9/30) 0.26 – 1.13 (10/1-6/30)
Spring Creek (about confluence with Rosebud Creek, NE of Colstrip)	No data	2015–2016 <0.001–0.003	2015–2016 <0.001–0.012	<0.005 – 0.14	1.22 (1 sample 7/1-9/30) 0.34 – 1.22 (10/1-6/30)
Lowest water quality standard	0.00005	0.005	0.031	10	1.3 (7/1 – 9/30) No standard 10/1 – 6/30

Source: EPA 2017h.

An analysis of the data shows the following:

- For mercury, water quality data are limited except in Armells and Rosebud Creeks. Most results were below laboratory detection limits; there was one exceedance of the standard in 2005 in Sarpy Creek.
- For selenium, in Armells Creek results were often below laboratory detection limits. There were seven exceedances of the standard between 2000 and 2007, and two exceedances of the standard in 2011 at a site on the East Fork Armells Creek just north of Colstrip. In Rosebud Creek, there was one exceedance of the standard near Lame Deer in 2004.
- For copper, nearly all results were well below copper standards. There was one exceedance of the standard in Rosebud Creek in 2004, at the mouth.
- For nitrate + nitrite, all results were well below the standard.
- For total nitrogen, which has a standard during the months of July through September, the only standard exceedance occurred in 2005 in Sarpy Creek. There were some concentrations near the standard in Rosebud Creek and Spring Creek.
- Within the last 5 years, mercury, selenium, and copper concentrations in the streams where data have been collected have nearly all been low in streams within the indirect effects analysis area. Most results were well below standards except for selenium in the East Fork Armells Creek in Colstrip, and in Spring Creek, where a few concentrations were 0.002 to 0.004 mg/L, approaching the standard of 0.005 mg/L.
- Within the last 5 years, nitrate+nitrite and total nitrogen concentrations in the streams where data have been collected have nearly all been low in streams within the indirect effects analysis areas. There were total nitrogen concentrations approaching the standard in Rosebud Creek upstream of Pony Creek in July 2016 (1.04 mg/L) and in Spring Creek near the mouth in July 2015 (1.22 mg/L).

3.8 WATER RESOURCES – GROUND WATER

3.8.1 Introduction

This section describes ground water resources that occur within the analysis area; the analysis area is defined below in **Section 3.8.1.2, Analysis Area**. This section includes regulatory requirements to protect ground water (quantity and quality), a description of aquifers in the analysis area, and descriptions of ground water movement, flow direction, ground water depths, and ground water recharge in the analysis area. This section also describes ground water quality in the analysis area.

3.8.1.1 Regulatory Framework

Federal Requirements

SMCRA requires that surface coal mining and reclamation operations protect surface and ground water resources, including the hydrologic balance on-site and off-site, natural watercourses on-site and off-site, watersheds, springs, seeps, aquifers (Sections 510, 515, 516, 517, and 522); and water supply, and water rights (Sections 403, 406, 407, 411, and 522). The Environmental Protection Performance Standards (Section 515 of SMCRA) require that surface coal mining and reclamation operations "minimize the disturbances to the prevailing hydrologic balance at the mine site and in associated offsite areas and to the quality and quantity of water in surface and ground water systems both during and after surface coal mining operations and during reclamation…" Postmining, SMCRA requires that reclamation restore "recharge capacity" to approximate pre-mine conditions, and throughout the mining process (mining and reclamation) maintain the "essential hydrologic function of alluvial valley floors." As described in **Section 1.4.1.1, Office of Surface Mining Reclamation and Enforcement, Surface Mining Control and Reclamation Act**, DEQ operates an approved state program under SMCRA and, therefore, has primary jurisdiction over the regulation of surface coal mining and reclamation operations on non-federal and non-Indian lands within the state.

State Requirements

DEQ regulates permitting and operation of surface coal mines on federal lands within Montana under the authority of MSUMRA (Section 82-4-221 et seq., MCA) and its implementing rules (ARM 17.24.301-1309). Subchapter 6, ARM 17.24.605, 631, 632, 635, 641, 643, 644, and 645 provide specific requirements to protect the quantity and quality of ground water. These requirements cover ground water levels, ground water recharge, protection of ground water rights, and ground water quality. The regulations require control of mine drainages to protect ground water and placement of backfill materials to minimize adverse effects on ground water flow and quantity. The regulations state that disturbed areas must be reclaimed to restore the approximate pre-mine recharge capacity to support the approved postmining land use (ARM 17.24.644), and disturbances to the prevailing hydrologic balance in the mine area and adjacent areas must be minimized (ARM 17.24.605, 631, and 645). ARM 17.24.314 requires submittal of a plan for protection of the hydrologic balance, including water quantity and quality, and water rights. In addition, the regulations describe required ground water monitoring (ARM 17.24.645). State water rights requirements are described in **Section 3.9, Water Rights.**

MSUMRA conditions approval of an application for a coal mine operating permit on demonstration by the applicant that "the assessment of the probable cumulative impact of all anticipated mining in the area on the hydrologic balance has been made by the department [DEQ] and the proposed operation of the mining operation has been designed to prevent material damage to the hydrologic balance outside the permit area" under (82-4-227(3)(a), MCA, and ARM 17.24.405(6)(c). MSUMRA defines "material damage" as follows: *"with respect to protection of the hydrologic balance, degradation or reduction by coal mining and reclamation operations of the quality or quantity of water outside of the permit area in a manner or to an extent that land uses or beneficial uses of water are adversely affected, water quality standards are violated, or water rights are impacted. Violation of a water quality standard, whether or not an existing water use is affected, is material damage."* The permit application must contain a detailed description of the "measures to be taken during and after mining activities to minimize disturbance to the hydrologic balance on and off the mine permit area, and prevent material damage to the hydrologic balance outside the permit area" under ARM 17.24.314(1). Material damage criteria are established for the evaluation of both surface and ground water quality and quantity, and are used to determine whether water quality or quantity outside the permit area will be impacted to the extent that land uses or beneficial uses of water are adversely affected, water quality standards outside the permit area will be violated, or water rights outside the permit area will be impacted by the proposed mine operations.

Local Requirements

There are no applicable local regulations for ground water resources within or near the analysis area.

Ground Water Quality

State Classification and Standards

DEQ classifies ground water in the analysis area as Class I, II, or III based on natural specific conductance (ARM 17.30.1006). Class I ground water has a specific conductance less than or equal to 1,000 micro Siemens/centimeter (µS/cm). The quality of Class I ground water must be maintained for the following beneficial uses with little or no treatment: public and private water supply, culinary and food processing, irrigation, drinking water for livestock and wildlife, and commercial and industrial purposes. Class II ground water has a natural specific conductance greater than 1,000 µS/cm and less than or equal to 2,500 µS/cm. The quality of Class II ground water must be maintained so that such waters are at least marginally suitable for the following beneficial uses: public and private water supply, culinary and food processing, irrigation of some agricultural crops, drinking water for livestock and wildlife, and most commercial and industrial purposes. Class III ground water has a natural specific conductance greater than 2,500 µS/cm and less than or equal to 15,000 µS/cm. The quality of Class III ground water must be maintained so that such waters are at least marginally suitable for the following beneficial uses: drinking, culinary, and food processing (where the specific conductance is less than 7,000 µS/cm) irrigation of some salt tolerant crops, some commercial and industrial purposes, and drinking water for some livestock and wildlife. Class I and II ground water is considered high quality water in MT. The Montana Water Quality Act prohibits degradation of high quality waters unless DEQ issues an authorization to degrade.

Montana numeric ground water quality standards for inorganic pollutants applicable to the project are shown in **Table 56**. Montana's ground water rules contain narrative standards that cover a number of parameters, such as alkalinity, chloride, hardness, sediment, sulfate, and TDS for which sufficient information does not yet exist to develop specific numeric standards. These narrative standards are designed to protect beneficial uses from adverse effects and supplement the existing numeric standards. The narrative standards prohibit any increase in a parameter to a level that renders the water harmful, detrimental, or injurious to the beneficial uses listed for the class.

Table 56. Montana Numeric Ground Water Quality Standards.

Parameter	Montana Numeric Ground Water Quality Standard (milligrams per liter [mg/L])
Nitrate + nitrite, as N	10/50[1]
Nitrite, as N	1.0
Antimony	0.006
Arsenic	0.01
Barium	1.0
Beryllium	0.004
Cadmium	0.005
Chromium	0.1
Copper	1.3
Fluoride	4.0
Lead	0.015
Mercury	0.002
Nickel	0.1
Selenium	0.05
Silver	0.1
Zinc	2.0

Source: Circular DEQ-7, Montana Numeric Water Quality Standards, DEQ 2017c.
[1] Nitrate + nitrite as N standard is 10 (mg/L for Class I and II ground water, and also for Class III ground water except when specific conductance is equal to or greater than 7,000 µS/cm; then the standard is 50 mg/L (ARM 17.30.1006).

The Montana USDA Natural Resources Conservation Service (NRCS) and Montana State University Extension Water Quality Program have recommended water quality criteria for livestock that are provided in **Table 41** in **Section 3.7, Water Resources – Surface Water.** These criteria are also relevant to well water used for livestock. The criteria are not enforceable standards, but are used as guidance in evaluating the suitability of water quality for optimal livestock performance.

3.8.1.2 Analysis Area

Direct Effects Analysis Area

The analysis area for direct effects on ground water hydrology and quality is the project area, which includes 4,260 acres to be disturbed during mining, and the area outside of the permit boundary where direct effects on ground water are predicted to occur. Within the project area, the Rosebud Coal would be removed, except beneath the major drainages where ground water drawdown within the remaining Rosebud Coal is expected to occur, as predicted by the ground water model. Outside of the permit boundary, the analysis area includes areas where ground water drawdown is predicted by the model to be greater than 5 feet as a result of the Proposed Action. The proposed Area F permit boundary (project area) is shown on all figures in this section.

Indirect Effects Analysis Area

The analysis area for indirect effects on ground water is within the property boundary of the Colstrip Power Plant (owned by PPL Montana LLC, WPP LLC, and Colstrip Comm Serv LLC), because the Colstrip Power Plant boundary includes all ground water impacted by operations at the plant (Hydrometrics 2015). Indirect effects from the storage of coal combustion products on ground water at both the Rosebud and Colstrip Power Plants were analyzed (see **Section 4.8, Water Resources – Ground Water**). With respect to existing conditions, the analysis area for indirect effects has similar geology and ground water hydrology to the project area. An extensive ground water monitoring network exists in the indirect effects analysis areas related to site characterization studies and ongoing site ground water remediation (Hydrometrics 2015).

3.8.2 Site Hydrogeology

3.8.2.1 Geologic Framework

The proposed project would be within the Tongue River Member of the Fort Union Formation. The Paleocene Tongue River Member consists of massive to cross-bedded sandstone, fine-grained siltstone, light to dark colored mudstone, claystone, and numerous coal seams, including economically minable seams such as the Rosebud Coal. With the exception of the coal seams, individual beds or layers are not typically laterally continuous. In addition to the depositional units, areas of baked sedimentary rock (clinker) have developed where coal seams exposed at or near the surface have burned. As discussed below, the characteristics of the clinker influence local ground water recharge and movement. A low permeability clay layer immediately underlies many of the coal seams and is typically laterally continuous, unlike most of the other non-coal lithologies.

The Lebo Shale Member underlies the Tongue River Member, ranging in thickness between 95 and 200 feet in the area of the Rosebud Mine. The Lebo Shale Member consists of gray smectitic shale and mudstone with lenses of gray and yellow, very fine to medium-grained sandstone with a few thin coal beads (Vuke et al. 2001).

Unconsolidated Quaternary age alluvium and colluvium, 15 to 35 feet thick, overlie the Tongue River Member locally, mostly along drainageways. For additional discussion of geology in the area, see **Section 3.6, Geology**.

3.8.2.2 Ground Water Conditions

Western Energy combined the various lithologic units into the following hydrostratigraphic units, which were used in the Western Energy numerical model of the project area (PAP, Appendix B):

- Alluvium
- Overburden (all lithologies that overlie the Rosebud Coal, including clinker)
- Rosebud Coal
- Interburden (Tongue River Member between the Rosebud and McKay Coals)
- McKay Coal
- Sub-McKay (Tongue River Member below the McKay Coal).

Alluvium

Of the depositional units, alluvium represents the most permeable lithology in the current mine area with respect to ground water. Alluvium along East Fork Armells Creek adjacent to the Rosebud Mine has a saturated thickness up to 30 feet, a mean hydraulic conductivity (K) of about 56 feet/day, and a reported high K value of 333 feet/day (PAP, Appendix B). In the project area, saturated thickness in the alluvium varies from 0 to 16 feet (PAP, Appendix B). The alluvium in Area F is typically 20 feet thick in areas where the alluvial monitoring wells were installed, and ranges from 16 to 31 feet thick. The hydraulic conductivity of the alluvium, based on testing performed at three locations in the project area, ranges from 2.2 to 470 feet/day (PAP, Appendix B).

Overburden

Ground water occurs in various low to moderately permeable sandstones as perched zones of saturation overlying very low permeability mudstones or claystones. The areal extent of the saturated sandstones is limited by the discontinuous nature of the general stratigraphy. Nicklin (2016) reports a wide range of transmissivity values from Area C (1.7 to 602 $feet^2$/day) for overburden, but does not differentiate between the various lithologies included as overburden. In the project area, aquifer testing was performed at one location with a resulting transmissivity of 44 $feet^2$/day and a hydraulic conductivity of 2.2 feet/day (PAP, Appendix B).

Clinker is included in overburden because of its typical stratigraphic position. Clinker is reported to occur in thicknesses ranging from 10 to 300 feet (Vuke et al. 2001). Because the clinker results from the baking of overlying sedimentary rock and subsequent collapse into the space once occupied by the burned coal, its permeability is generally very high, particularly compared with other water bearing lithologies in the area. Because clinker is typically exposed at or near the surface and is highly permeable, clinker exposures represent localized areas of high recharge rates from precipitation. At least during periods of high precipitation or snow melt, clinker is a source of water to deeper units and/or nearby alluvium.

Depth to water in the overburden varies considerably because of the nature of the stratigraphy and common perched conditions. In the project area, the depth to water in monitoring wells varies from about 30 feet to nearly 150 feet.

Rosebud Coal

The Rosebud Coal averages 18.6 feet thick with a maximum thickness of 26.0 feet and typically contains ground water under confined to semiconfined conditions in much of the proposed mine area; it is unconfined where it is at or near the surface. In the Rosebud mine area, the mean hydraulic conductivity of the Rosebud Coal is 2.8 feet/day, but ranges from 0.02 to 68 feet/day (PAP, Appendix B). Van Voast et al. (1977) reports that the higher hydraulic conductivities in the Rosebud Coal are typically associated with fault or fracture zones. The Rosebud Coal is the source of ground water to springs located near the outcrop of the coal. In the project area, the depth to water in monitoring wells screened in the Rosebud Coal varies from about 50 to 150 feet. The regional Rosebud ground water flow direction is from southwest to northeast (**Figure 38**). Aquifer testing was performed at two locations in the project area with resulting transmissivities of 2 and 28 $feet^2$/day and hydraulic conductivities of 1.1 and 0.18 feet/day (PAP, Appendix B).

Interburden

The interburden is the stratigraphic sequence between the two major coal beds and is composed of similar lithologies to the overburden, with the exception that it does not contain clinker. The thickness of the interburden ranges from a few feet to more than 100 feet (PAP, Appendix B) with an average thickness of 78 feet. Hydrologically, the interburden behaves like the overburden and generally has low permeability.

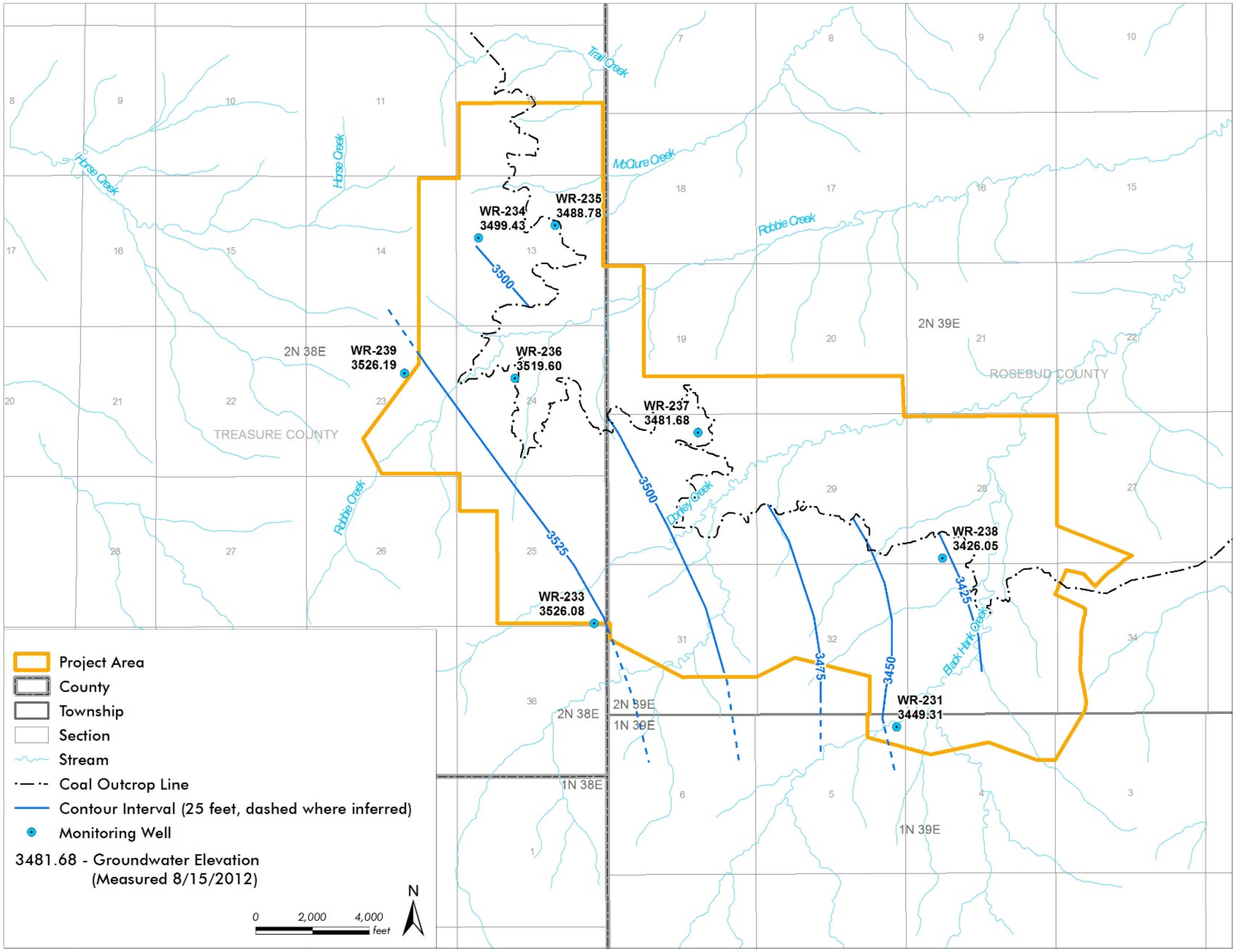

Figure 38. Potentiometric Surface in the Rosebud Coal.

McKay Coal

The McKay Coal is similar in nature to the Rosebud Coal. The McKay Coal has an average thickness of 9 feet and provides water to springs and seeps where the coal is at or near the surface. The hydraulic conductivity of the coal in the Rosebud mine area ranges from 0.01 to 7.5 feet/day with a mean of about 2 feet/day. In the project area, the depth to water measured in monitoring wells screened across the McKay Coal varies from about 90 feet to more than 200 feet. Ground water in the McKay Coal also flows from southwest to northeast (**Figure 39**). Aquifer testing in the project area at four locations resulted in transmissivity values ranging from 0.13 to 6.2 $feet^2$/day and hydraulic conductivity values ranging from 0.016 to 0.31 feet/day (PAP, Appendix B).

Sub-McKay (or Underburden)

This stratigraphic sequence includes the remainder of the Tongue River Member below the McKay Coal. The lithologies of this group are similar to the overburden, with the exception of what may be more laterally continuous sandstones. Overall permeability of this unit is low, but the sandstones yield water to wells at a rate of 3.5 to 35 gallons per minute (gpm). The PAP, Appendix B, reports a range of transmissivity values from 12 to 428 $feet^2$/day with a mean of 115 $feet^2$/day in the Rosebud Mine area. These values are not converted to hydraulic conductivity because of the lack of saturated thickness data. The limited water level data from the Sub-McKay units indicate ground water flows from southwest to northeast, or possibly from west to east (**Figure 40**).

3.8.2.3 Springs

Numerous springs have been identified in the vicinity of the project area (**Figure 41)**. Fourteen of the springs are numbered and have been periodically monitored by Western Energy. Springs are typically located along or near drainages, and some maintain perennial or intermittent reaches of streams. **Table 57** provides a summary of the likely ground water source to each spring.

Table 57. Source of Ground Water to Monitored Springs.

Spring	Ground Water Source	Spring	Ground Water Source
1	Overburden	8	Rosebud Coal (possibly clinker)
2	Unknown	9	Overburden
3	Overburden	10	Overburden (possibly Rosebud Coal)
4	Overburden	11	Rosebud/clinker
5	Overburden	12	Unknown
6	Overburden	13	McKay Coal
7	Rosebud Coal	14	Sub-McKay

Source: PAP, Appendix J, Attachment B-J.

Springs 2 and 12 are located stratigraphically below the outcrop of the Rosebud Coal and could be receiving water from interburden sandstones or possibly the McKay Coal, such as nearby Spring 13. Spring 3 is located stratigraphically above the outcrop of the Rosebud Coal so that it could be receiving water from sandstone in the overburden and/or the Rosebud Coal.

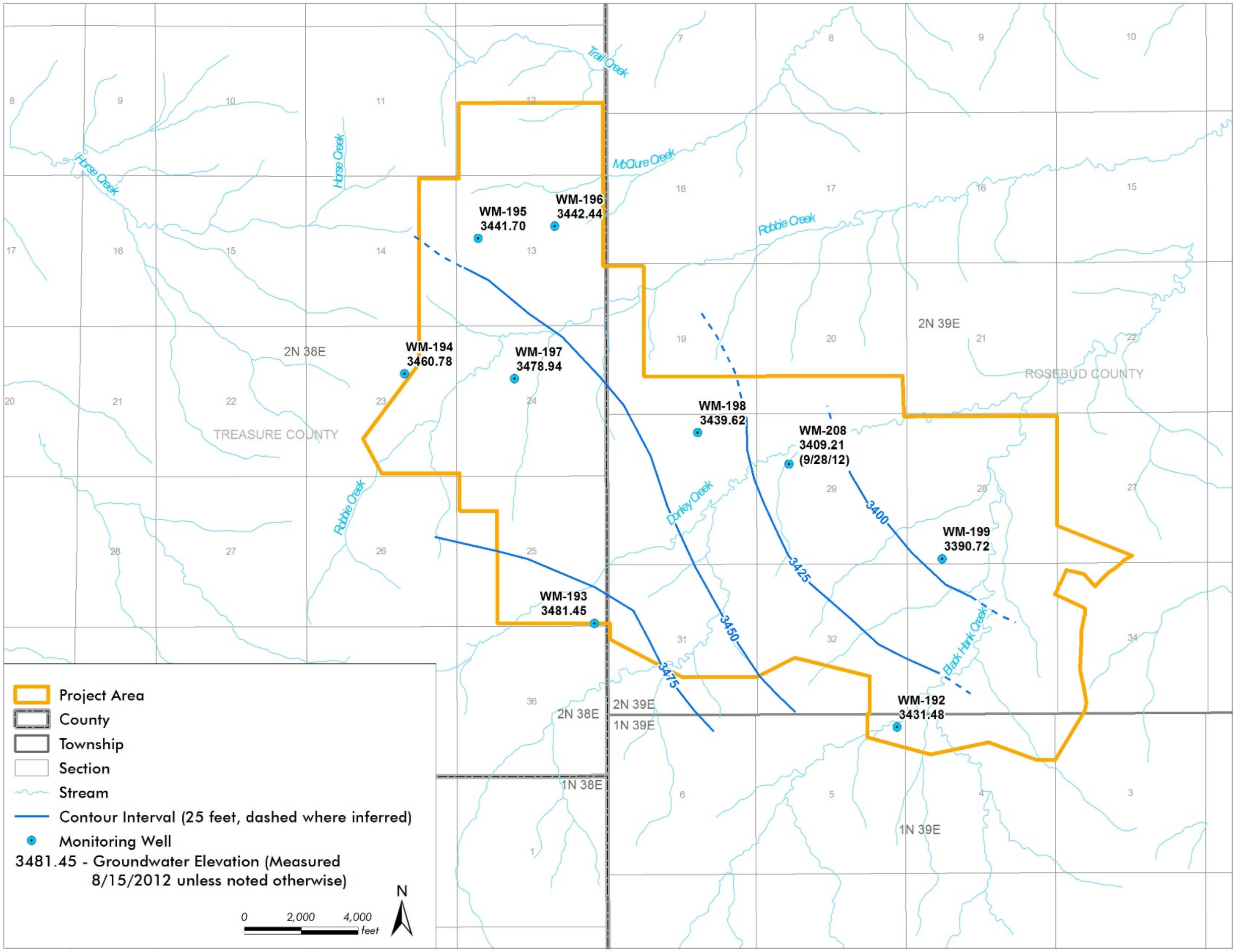

Figure 39. Potentiometric Surface in the McKay Coal.

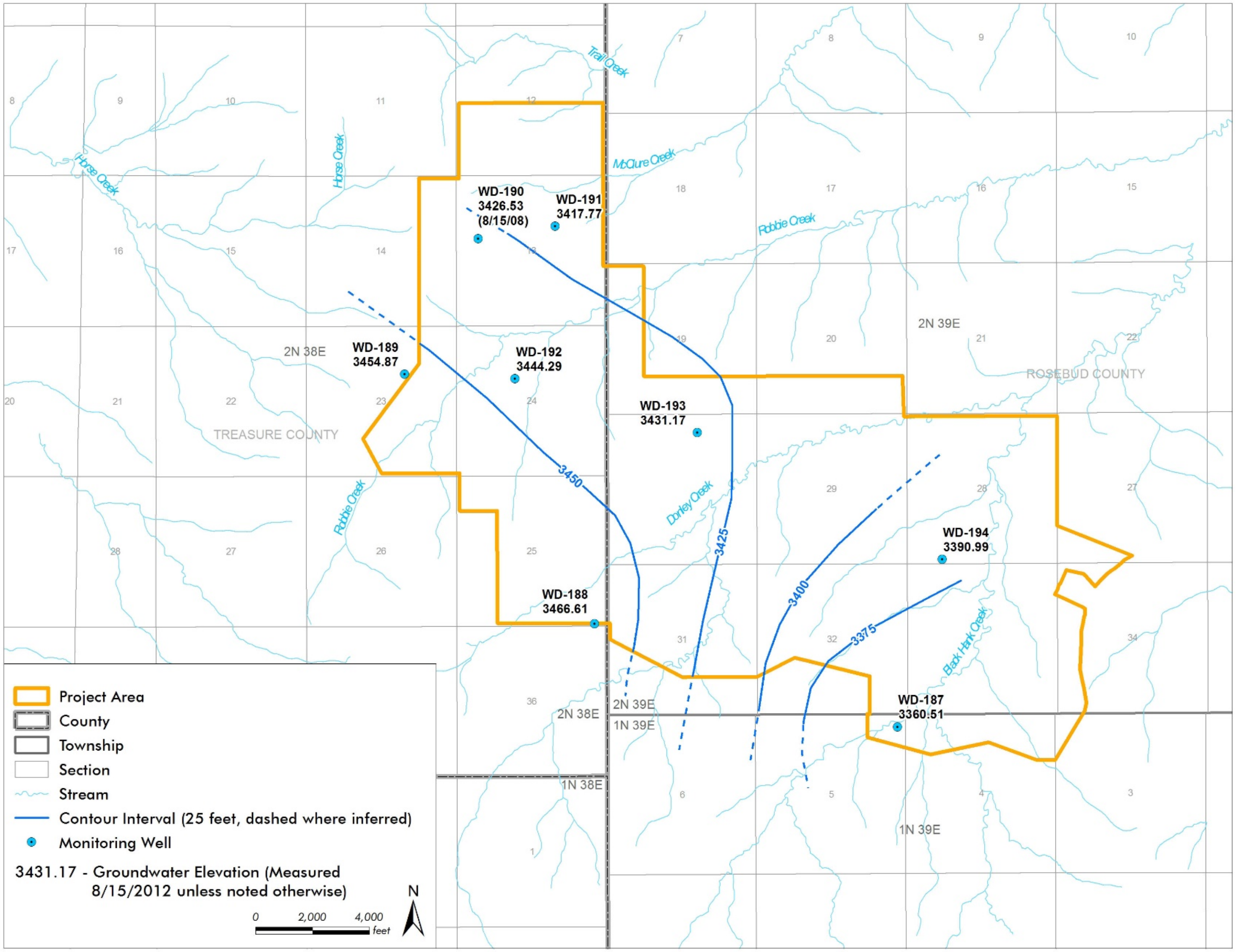

Figure 40. Potentiometric Surface in the Sub-McKay.

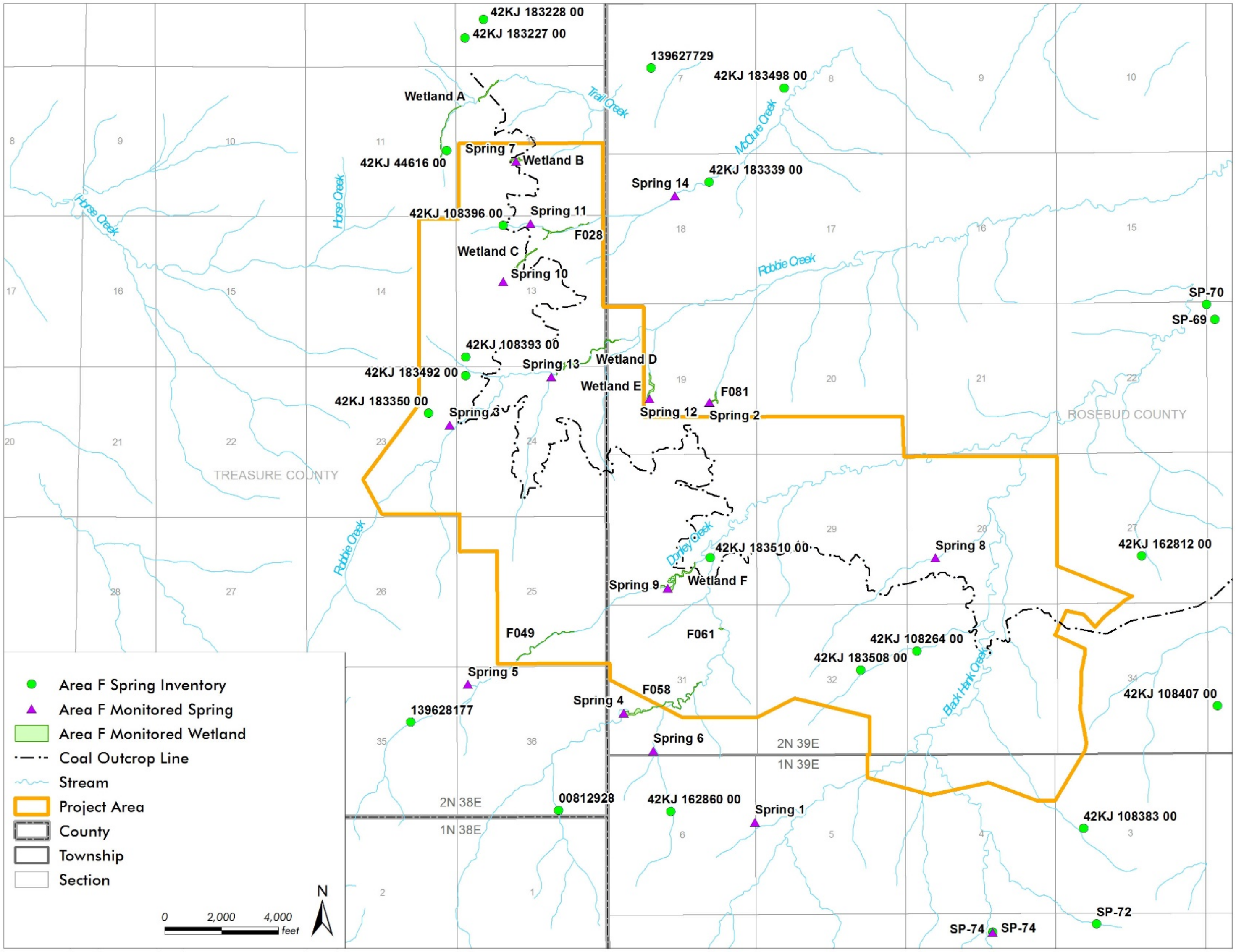

Figure 41. Project Area Spring Inventory.

3.8.3 Conceptual Hydrogeological Model

The geologic framework, specifically the complex stratigraphy, and the regional climate are key factors in the occurrence and movement of ground water in the region. Most of the Tongue River Member sedimentary units are saturated, but few of the lithologies have high enough hydraulic conductivity to yield water in sufficient quantities to be considered aquifers. Because of low annual precipitation and high evaporation rates, net infiltration rates to bedrock units are generally low in the area of the project area, with the exception of areas with clinker outcrops. Water level contour maps of the Rosebud and McKay Coals (**Figure 38** and **Figure 39**) show a ground water flow direction from southwest to northeast, indicating that at least the deeper units of the Tongue River Member receive recharge in the upland areas to the southwest where precipitation rates are likely higher. The consistency of the water level data from monitoring wells screened in the coals suggest there is reasonably good horizontal hydraulic connection within the coals across the region, as compared with the overburden. Based on the available data, this also appears to be true for the Sub-McKay sandstones (**Figure 40**).

There are not consistent water level data from the overburden to construct a water level contour map. Exposures of sandstones within the overburden may also receive recharge to the southwest, but because of the discontinuous nature of the Tongue River Member's stratigraphy, ground water may discharge to various drainages as it flows northeastward. In the region around the project area, the overburden appears to receive limited recharge from infiltration of precipitation. The intervening low permeability mudstone and claystone units perch ground water within the lenticular sandstones as ground water percolates downward. Areas of clinker exposure represent an exception to the low infiltration rates. The very permeable nature of the clinker probably results in much higher rates of infiltration and temporary storage of ground water. Ground water stored in the clinker is available to recharge deeper sandstones and/or to discharge to shallow alluvium.

Ground water in perched areas of the overburden and in the more continuous and permeable coals discharges as springs and underflow to alluvium where these units either crop out or subcrop. Ground water in the Rosebud and McKay Coals discharges to the surface as springs and/or directly to alluvium along the major creeks that drain the project area. Both coals end within the project area where they are exposed at the surface or subcrop below other geologic units, such as alluvium. Therefore, all ground water that is flowing to the northeast within the coals discharges and ultimately becomes part of the shallow alluvial ground water/surface water system. The total ground water flow or flux through the Rosebud Coal within the project area along a strike length of about 7 miles is estimated to range from about 10 to 15 gpm (PAP, Appendix O, Addendum to PHC). The ground water flux is relatively low due to both the flat hydraulic gradient (0.009) and the generally low overall hydraulic conductivity. It is likely that the ground water flux through the Rosebud Coal is not uniform over the entire strike length, but rather is concentrated in areas of fracturing and faulting and/or along drainages. The total ground water flux through the McKay Coal was not directly calculated, but because the McKay Coal is much thinner than the Rosebud Coal, the flux would be expected to be less than half of that of the Rosebud Coal. The total ground water discharge from the two coals becomes part of the shallow alluvial system that drains the project area.

Water level data collected from Rosebud Coal monitoring wells since January 2005 indicate that the Rosebud Coal may also receive vertical recharge through the overburden in some locations. These areas may be related to faulting, clinker, and/or other higher vertical permeability materials. The ground water levels in many of the Rosebud Coal monitoring wells appear to respond rapidly to periods of high precipitation, such as the spring of 2011, when water levels increased by several feet. Areas of vertical recharge via the overburden may explain the large observed variability in water quality in the Rosebud Coal discussed below in **Section 3.8.5, Ground Water Quality**.

3.8.4 Ground Water Use

Ground water in the area around the project area is used for both stock and rural domestic water needs. Water from springs is used for stock watering. Although discharges from springs may vary seasonally, they are reported to be reliable sources of water, except during periods of extended drought (Van Voast et al. 1977). In addition, many wells have been drilled in the region, most of which are less than 200 feet deep (Van Voast et al. 1977). Well yields are generally low (less than 10 gpm), but adequate for the intended use, which is stock watering. Ground water wells produce water from the various sandstone units of the Tongue River Member and the thicker coals, such as the Rosebud and McKay Coals. See **Section 3.9, Water Resources – Water Rights**, for additional discussion of ground water use.

3.8.5 Ground Water Quality

Limited pre-mining ground water quality data were collected in July or August 1923 by the U.S. Geological Survey (Van Voast et al. 1977). At that time, the city of Colstrip did not exist, ground water was less extensively developed in the area, but was being used for stock watering, and the Northern Pacific Railway was building a rail line to the Rosebud Mine, which began operating in 1924. Water quality data from 10 wells ranging from 48 to 340 feet deep, a 40-foot coal shaft, and two test holes installed by the Northern Pacific Railway Company are provided in **Table 58**. Limited information is available on the water bearing formations of the 10 wells; however, the data indicate ground water conditions similar to the present, with less mineralized water in some coal beds and poorer quality water in nearby inorganic geologic materials such as the overburden (Van Voast et al. 1977).

Table 58. Ground Water Quality in the Colstrip Area in 1923.

Parameter	Minimum	Maximum
Carbonate Alkalinity (mg/L)	0	36
Bicarbonate Alkalinity (mg/L)	63	1,210
Total Dissolved Solids (mg/L)	334	3,266
Sulfate (mg/L)	2.8	1,749
Chloride (mg/L)	3	35
Nitrate (mg/L)	"trace"	8.13
Calcium (mg/L)	4.4	194
Iron (mg/L)	"trace"	8
Magnesium (mg/L)	2.4	238
Sodium + Potassium (mg/L)	16	380
Hardness (mg/L)	21	1,261

Source: Van Voast et al. 1977.
All metals are dissolved.
Averages for nitrate and iron do not include several "trace" results.

Ground water monitoring locations in the project area are shown on **Figure 42**. **Table 59**, **Table 60**, **Table 61**, and **Table 62** provide baseline water quality data for the alluvium, overburden, Rosebud Coal, and McKay Coal hydrostratigraphic units in the project area. These data represent ground water quality conditions prior to any mining in the project area. There may be existing minor effects on ground water quality in the project area from ongoing ground water use (stock and domestic), ground water recharge from areas with livestock, and nearby mining in the western part of Area C. Based on the measured conductivity of ground water in the alluvium and overburden, these waters are classified as Class III ground water. The conductivity in the Rosebud and McKay Coal ground water is within a range that places the ground water within the Class I, Class II, and Class III classifications.

The water quality of springs monitored in and near the project area is provided in **Section 3.7.6.1**.

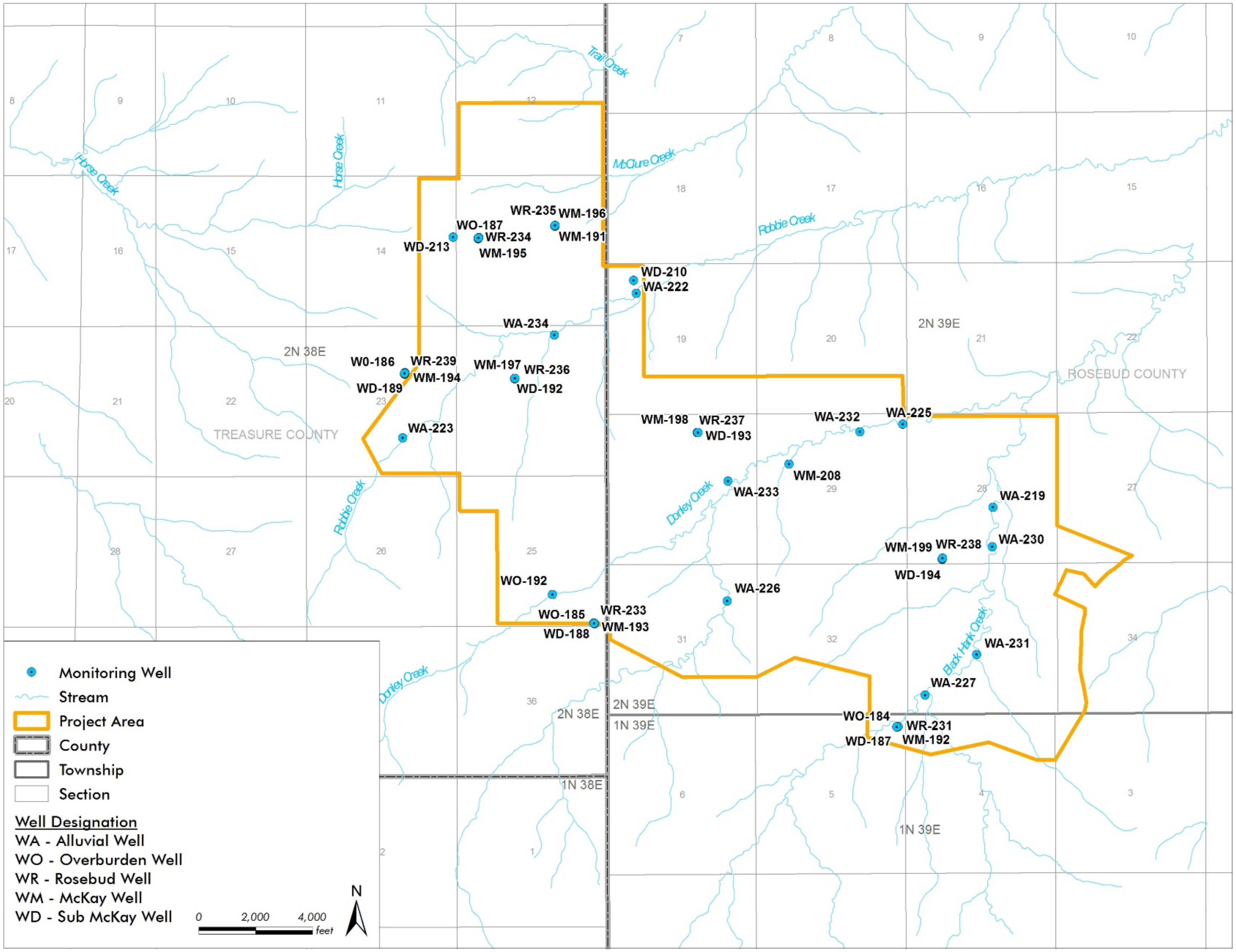

Figure 42. Ground Water Monitoring Locations.

3.8.5.1 Alluvium

Bicarbonate, calcium, magnesium, manganese, sodium, sulfate, and TDS concentrations were sometimes high in the alluvial wells monitored on Robbie, Donley and Black Hank Creeks (**Table 59**). In WA-227, the fluoride concentration was above the standard once in 2016, and was above the recommended limit for livestock twice in 2016. Nutrient concentrations were usually low (less than 0.2 mg/L for ammonia, less than 1 mg/L for nitrate+nitrite, and less than 0.1 mg/L for total phosphate) except for nitrate+nitrite in WA-225, which had concentrations as high as 4.5 mg/L (below the standard) when sampled, and in WA-227, in which nitrate+nitrite was between 1.6 and 2.8 mg/L (below the standard) when sampled. In general, alluvial ground water quality is better than ground water in the underlying overburden, but is poorer than ground water in the coal beds.

Table 59. Ground Water Quality in the Alluvium in the Project Area.

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard or Recommended Concentration for Livestock
Acidity (mg/L)	77	0	<1	<1	<1	<5	<5	NS
Aluminum (mg/L)	79	70	<0.004	0.007	0.03	0.048	0.198	10
Ammonia (mg/L)	77	49	<0.045	<0.05	0.103	0.23	0.70	NS
Arsenic (mg/L)	82	59	<0.000082	<0.0005	0.001	0.0016	0.0030	0.01
Bicarbonate Alkalinity (mg/L)	84	84	290	366	409	518	696	999
Boron (mg/L)	82	82	0.28	0.35	0.49	0.59	0.85	30
Cadmium (mg/L)	80	31	<0.00005	<0.00008	<0.00008	0.0005	0.0016	0.005
Calcium (mg/L)	81	81	134	**177**	**211**	**251**	**308**	150
Carbonate Alkalinity (mg/L)	79	1	<0.5	<1	<1	<5	8.7	NS
Chloride (mg/L)	83	83	8	9.7	14.5	18.1	39.4	300
Copper (mg/L)	77	65	<0.000018	<0.00082	0.002	0.002	0.041	0.5
Fluoride (mg/L)	76	65	<0.004	0.19	0.34	0.79	**4.84**	2
Hydroxide Alkalinity (mg/L)	78	0	<1	<1	<1	<5	<5	NS
Iron (mg/L)	67	67	0.02	0.021	0.051	0.88	1.23	NS
Laboratory Conductivity (µS/cm)	84	84	2,480	3,015	3,445	3,960	5,220	NS
Laboratory pH (s.u.)	84	84	7.1	7.3	8.0	8.1	8.4	NS
Lead (mg/L)	52	23	<0.000004	<0.000004	0.00001	0.0003	0.0009	0.015
Magnesium (mg/L)	81	81	**162**	**230**	**275**	**420**	**493**	100
Manganese (mg/L)	84	82	<0.000174	0.006	0.03	0.07	**1.32**	0.5
Nickel (mg/L)	77	48	<0.0005	<0.00062	0.002	0.002	0.009	0.1
Nitrate+Nitrite (mg/L)	72	52	<0.003	0.005	0.16	1.6	4.5	10
Potassium (mg/L)	71	71	8.4	11.4	13.1	15.3	22.2	NS
Selenium (mg/L)	77	54	<0.00018	<0.0005	0.0051	0.0096	0.048	0.05
Sodium (mg/L)	81	81	154	206	224	**378**	**613**	300
Sulfate (mg/L)	84	84	1,180	1,628	1,765	2,335	**2,910**	2,500
Total Alkalinity (mg/L)	84	84	290	366	407	518	696	1,000
Total Dissolved Solids (mg/L)	82	82	1,370	2,835	3,120	3,828	**5,190**	4,999
Total Hardness (mg/L)	84	84	999	1,368	1,570	2,328	2,740	NS
Total Phosphate (mg/L)	6	6	0.02	0.03	0.05	0.13	0.23	NS

Table 59. Ground Water Quality in the Alluvium in the Project Area.

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard or Recommended Concentration for Livestock
Vanadium (mg/L)	65	54	<0.000043	0.00015	0.01	0.01	0.01	0.1
Zinc (mg/L)	56	14	<0.00086	<0.00086	<0.00108	0.002	0.073	2

Sampled wells in 2005 to 2016 included WA-219 (Black Hank Creek), WA-222 (Robbie Creek), WA-225 (Donley Creek), WA-226 (Donley Creek), and WA-227 (Black Hank Creek).
All metals are dissolved.
NS = no numeric standard or recommended concentration. µS/cm = micro Siemens/centimeter; s.u. = standard units.
For less than detection limit concentrations, detection limits are used to calculate percentile concentrations. Concentrations shown with less than symbols indicate some or all measured concentrations were less than the detection limit.
Concentrations in bold exceed Montana numeric ground water quality standards (**Table 56**) or recommended concentrations for livestock (see **Section 3.7, Water Resources –Surface Water**).

3.8.5.2 Overburden

In general, ground water quality is poorest in the overburden. The ground water has high bicarbonate alkalinity, calcium, magnesium, manganese, sodium, and sulfate concentrations (**Table 60**). There are no numeric standards for these parameters, but there are recommended limits for livestock for all that were exceeded. There was one exceedance of the arsenic standard and there were five exceedances of the selenium standard. Dissolved iron concentrations were as high as 5.26 mg/L, and fluoride concentrations were sometimes high, sometimes exceeding the numeric standard and recommended limit for livestock. Other metal concentrations were generally well below standards or recommended livestock limits. Nitrogen concentrations were usually well below standards, except for nitrate+nitrite in WO-184, which was almost always greater than 2 mg/L, with a maximum concentration of 5.6 mg/L (below the standard) when sampled. Total phosphate concentrations were sometimes high, exceeding 1 mg/L and as high as 4 mg/L. The generally poor water quality in the overburden is the result of the mineralogy of the sedimentary material, limited recharge, and as a result, low ground water flow through the water bearing lithologies. Water quality is spatially variable due to the discontinuous nature of the various lithologies.

Table 60. Ground Water Quality in the Overburden in the Project Area.

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard or Recommended Concentration for Livestock
Acidity (mg/L)	80	0	<1	<1	<1	<5	<5	NS
Aluminum (mg/L)	99	89	<0.004	0.009	0.03	0.048	0.26	10
Ammonia (mg/L)	80	64	<0.045	0.108	0.31	0.56	1.03	NS
Arsenic (mg/L)	87	42	<0.00007	<0.0005	<0.0005	0.001	**0.0194**	0.01
Bicarbonate Alkalinity (mg/L)	108	108	331	444	609	784	**1,880**	999
Boron (mg/L)	100	100	0.20	0.28	0.38	0.46	1.1	30
Cadmium (mg/L)	98	45	<0.000005	<0.00008	<0.000081	0.0005	0.0016	0.005
Calcium (mg/L)	94	94	**165**	**229**	**271**	**321**	**419**	150
Carbonate Alkalinity (mg/L)	90	0	<0.5	<1	<1	<5	<5	NS
Chloride (mg/L)	106	106	5.3	8.3	9.3	18	**397**	300
Copper (mg/L)	77	74	<0.000018	0.0016	0.0031	0.0031	0.28	0.5
Fluoride (mg/L)	75	45	<0.004	<0.008	0.15	0.32	**14.8**	2
Hardness (mg/L)	108	108	1,530	1,935	2,070	2,320	4,000	NS
Hydroxide Alkalinity (mg/L)	86	0	<1	<1	<1	<5	<5	NS
Iron (mg/L)	93	90	<0.0005	0.082	0.54	1.1	5.26	NS
Laboratory Conductivity (µS/cm)	108	108	2,850	3,515	4,395	4,750	7,810	NS
Laboratory pH (s.u.)	108	108	6.6	7.0	7.3	7.9	8.1	NS
Lead (mg/L)	62	35	<0.000004	<0.000004	0.00014	0.0003	0.00096	0.015
Magnesium (mg/L)	94	94	**238**	**318**	**360**	**396**	**733**	100
Manganese (mg/L)	108	105	<0.00017	0.006	0.028	0.075	**1.22**	0.5
Nickel (mg/L)	80	64	<0.0005	<0.0009	0.002	0.003	0.043	0.1
Nitrate+Nitrite (mg/L)	101	80	<0.003	0.01	0.08	0.29	5.6	10
Potassium (mg/L)	87	87	7.6	10.0	11.8	13.8	21.3	NS
Selenium (mg/L)	80	52	<0.00018	<0.0005	0.0020	0.026	**0.24**	0.05
Sodium (mg/L)	94	94	159	292	**453**	**453**	**722**	300
Sulfate (mg/L)	108	108	1,400	1,820	2,165	**2,868**	**5,090**	2,500
Total Alkalinity (mg/L)	108	108	331	431	607	718	**1,880**	1,000
Total Dissolved Solids (mg/L)	100	100	2,900	3,285	4,150	4,873	**8,300**	4,999
Total Phosphate	27	27	0.01	0.05	0.08	0.27	3.96	NS

Table 60. Ground Water Quality in the Overburden in the Project Area.

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard or Recommended Concentration for Livestock
Vanadium (mg/L)	67	56	<0.000043	0.00017	0.01	0.01	0.01	0.1
Zinc (mg/L)	96	75	<0.00086	0.006	0.01	0.02	0.128	2

Sampled wells in 2005 to 2016 included WO-184, WO-185, WO-186, WO-187, and WO-192.
All metals are dissolved.
NS = no numeric standard or recommended concentration. µS/cm = micro Siemens/centimeter; s.u. = standard units.
For less than detection limit concentrations, detection limits are used to calculate percentile concentrations. Concentrations shown with less than symbols indicate some or all measured concentrations were less than the detection limit.
Concentrations in bold exceed Montana numeric ground water quality standards (**Table 56**) or recommended concentrations for livestock (see **Section 3.7, Water Resources –Surface Water**).

3.8.5.3 Rosebud Coal

Ground water in the Rosebud Coal is of better quality than alluvial and overburden water quality and similar to ground water quality in the McKay Coal. The lowest TDS and sulfate concentrations were measured in the Rosebud Coal wells (**Table 61**). The water has high bicarbonate, calcium, magnesium, manganese and sodium concentrations. There are no numeric standards for these parameters, but there are recommended limits for livestock for all of them that were reached or exceeded. Other metal concentrations were generally well below standards, but there was one exceedance of the dissolved lead standard. Nutrient concentrations were usually well below standards. Total phosphate concentrations were very high once each in WR-233, WR-235, WR-236, and WR-237, between 4 and 7.6 mg/L. The better water quality observed in the Rosebud Coal indicates the coal bed receives little, if any, vertical recharge via the overburden. Most of the ground water in the Rosebud Coal likely results from direct infiltration in areas of clinker and upland areas to the southwest. However, areas in the Rosebud Coal have TDS concentrations that are similar to those observed in the overburden (at Rosebud wells WR-231 and WR-233), indicating it is possible there are areas of higher vertical recharge, possibly near faults.

Table 61. Ground Water Quality in the Rosebud Coal in the Project Area.

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard or Recommended Concentration for Livestock
Acidity (mg/L)	113	0	<1	<1	<1	<5	<5	NS
Aluminum (mg/L)	147	135	<0.0004	0.0082	0.030	0.040	2.77	10
Ammonia (mg/L)	113	94	<0.045	0.15	0.33	0.48	1.37	NS
Arsenic (mg/L)	143	58	<0.00007	<0.0005	0.0005	0.001	0.0052	0.01
Bicarbonate Alkalinity (mg/L)	158	158	280	379	447	525	910	999
Boron (mg/L)	148	148	0.05	0.35	0.43	0.52	1.3	30
Cadmium (mg/L)	151	55	<0.000005	<0.00008	<0.00008	0.00050	0.001	0.005
Calcium (mg/L)	140	140	48	82	157	**212**	**261**	150
Carbonate Alkalinity (mg/L)	141	9	<0.26	<1	<5	<5	17.9	NS
Chloride (mg/L)	152	152	1.4	3.1	4.7	8.4	15.8	300
Copper (mg/L)	101	95	<0.000018	0.002	0.002	0.002	0.011	0.5
Fluoride (mg/L)	105	68	<0.004	<0.008	0.13	0.35	1.62	2
Hydroxide Alkalinity (mg/L)	123	0	<1	<1	<5	<5	<5	NS
Iron (mg/L)	127	127	0.02	0.066	0.13	0.44	2.02	NS
Laboratory Conductivity (µS/cm)	158	158	770	989	2,750	3,355	5,110	NS
Laboratory pH (s.u.)	158	158	6.6	7.2	7.7	8.0	8.5	NS
Lead (mg/L)	95	60	<0.000004	<0.000007	0.00017	0.0003	**0.018**	0.015
Magnesium (mg/L)	140	140	28	66	**113**	**223**	**324**	100
Manganese (mg/L)	157	157	0.005	0.041	0.073	0.133	**1.76**	0.5
Nickel (mg/L)	113	77	<0.0005	<0.00065	0.002	0.0024	0.033	0.1
Nitrate+Nitrite (mg/L)	144	102	<0.003	<0.005	0.02	0.06	0.48	10
Potassium (mg/L)	121	121	2.6	3.7	7.8	10.1	15.3	NS
Selenium (mg/L)	113	32	<0.00018	<0.00039	0.001	0.001	0.014	0.05
Sodium (mg/L)	140	140	8.5	16	186	**330**	**1,010**	300
Sulfate (mg/L)	158	158	56	186	1,210	1,450	**2,520**	2,500
Total Alkalinity (mg/L)	158	158	280	376	433	519	763	1,000
Total Dissolved Solids (mg/L)	158	158	85	656	2,345	2,965	**10,600**	4,999
Total Hardness (mg/L)	158	158	86	468	877	1,485	2,270	NS

Table 61. Ground Water Quality in the Rosebud Coal in the Project Area.

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard or Recommended Concentration for Livestock
Total Phosphate (mg/L)	45	45	0.023	0.043	0.07	0.13	7.6	NS
Vanadium (mg/L)	112	79	<0.00004	<0.0001	0.0100	0.01	0.021	0.1
Zinc (mg/L)	124	93	<0.00086	0.0040	0.0100	0.0160	0.380	2

Sampled wells in 2005 to 2016 included WR-231, WR-233, WR-234, WR-235, WR-236, WR-237, WR-238, and WR-239.
All metals are dissolved.
NS = no numeric standard or recommended concentration. μS/cm = micro Siemens/centimeter; s.u. = standard units.
For less than detection limit concentrations, detection limits are used to calculate percentile concentrations. Concentrations shown with less than symbols indicate some or all measured concentrations were less than the detection limit.
Concentrations in bold exceed Montana numeric ground water quality standards (**Table 56**) or recommended concentrations for livestock (see **Section 3.7, Water Resources –Surface Water**).

3.8.5.4 McKay Coal

Ground water quality in the McKay Coal is similar to or slightly better than in the Rosebud Coal in the project area. The water sometimes has high bicarbonate, calcium, magnesium, and sodium concentrations (**Table 62**). There are no numeric standards for these parameters, but there are recommended limits for livestock for all that were reached or exceeded. The fluoride standard was exceeded once, and the recommended fluoride limit for livestock was exceeded three times. The selenium standard was exceeded twice, and the recommended selenium limit for livestock was exceeded once. Other metal concentrations were generally well below standards. Nitrate+nitrite concentrations were usually well below standards. Total phosphate concentrations sometimes exceeded 1 mg/L in four of the wells, ranging up to 5.4 mg/L.

The source of ground water in the McKay Coal is likely from vertical recharge in upland areas to the southwest. As indicated by the observed water quality of McKay Coal, it does not receive significant recharge vertically via the overburden or interburden. As with the Rosebud Coal, there are areas of high TDS concentrations (such as at WM-192 and WM-193), indicating some vertical recharge from overlying units may be occurring, possibly in areas of faulting.

Table 62. Ground Water Quality in the McKay Coal in the Project Area.

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard or Recommended Concentration for Livestock
Acidity (mg/L)	145	0	<1	<1	<1	<5	<5	NS
Aluminum (mg/L)	197	181	<0.0004	0.013	0.034	0.083	0.977	10
Ammonia (mg/L)	145	132	<0.045	0.22	0.39	0.57	1.22	NS
Arsenic (mg/L)	185	72	<0.00007	<0.0005	<0.0005	0.001	0.003	0.01
Bicarbonate Alkalinity (mg/L)	210	210	197	336	380	430	935	999
Boron (mg/L)	192	192	0.10	0.29	0.33	0.44	0.81	30
Cadmium (mg/L)	203	67	<0.00001	<0.00008	<0.00008	0.00050	0.0015	0.005
Calcium (mg/L)	178	178	21.1	28.4	56.8	**171**	**306**	150
Carbonate Alkalinity (mg/L)	183	31	<0.26	<1	<5	<5	22.9	NS
Chloride (mg/L)	204	204	1.6	3.0	4.9	8.8	81.4	300
Copper (mg/L)	137	129	<0.000018	0.0012	0.002	0.002	0.025	0.5
Fluoride (mg/L)	170	144	<0.004	0.13	0.26	0.48	**4.74**	2
Hydroxide Alkalinity (mg/L)	158	0	<1	<1	<5	<5	<5	NS
Iron (mg/L)	172	172	0.02	0.05	0.13	0.34	2.85	NS
Laboratory Conductivity (µS/cm)	209	209	585	981	2,320	3,200	5,590	NS
Laboratory pH (s.u.)	210	210	6.8	7.4	8.0	8.2	8.5	NS
Lead (mg/L)	135	91	<0.000004	<0.000007	0.00020	0.0003	0.001	0.015
Magnesium (mg/L)	178	178	7	9	34	**149**	**465**	100
Manganese (mg/L)	208	208	0.003	0.022	0.03	0.051	0.2	0.5
Nickel (mg/L)	145	105	<0.0005	<0.00071	0.0020	0.002	0.049	0.1
Nitrate+Nitrite (mg/L)	196	153	<0.003	0.01	0.04	0.15	2.4	10
Potassium (mg/L)	153	153	4	6.1	7.2	8.4	19.4	NS
Selenium (mg/L)	145	58	<0.00018	<0.0004	<0.0005	0.0027	**0.22**	0.05
Sodium (mg/L)	178	178	82	126	**474**	**602**	**796**	300
Sulfate (mg/L)	210	210	17	146	947	1,360	**3,640**	2,500
Total Alkalinity (mg/L)	210	210	197	330	378	414	945	1,000
Total Dissolved Solids (mg/L)	210	210	459	630	1,670	2,288	**5,980**	4,999
Total Phosphate (mg/L)	64	64	0.004	0.05	0.10	0.53	5.4	NS

Table 62. Ground Water Quality in the McKay Coal in the Project Area.

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard or Recommended Concentration for Livestock
Vanadium (mg/L)	124	106	<0.000043	0.0002	0.01	0.01	0.01	0.1
Zinc (mg/L)	119	101	<0.0005	0.0011	0.008	0.010	0.087	2

Sampled wells in 2005 to 2016 included WA-220, WM-192, WM-193, WM-194, WM-195, WM-196, WM-197, WM-198, WM-199, WM-208, FDF4Q15, and FDF1Q15.
All metals are dissolved.
NS = no numeric standard or recommended concentration. µS/cm = micro Siemens/centimeter; s.u. = standard units.
For less than detection limit concentrations, detection limits are used to calculate percentile concentrations. Concentrations shown with less than symbols indicate some or all measured concentrations were less than the detection limit.
Concentrations in bold exceed Montana numeric ground water quality standards (**Table 56**) or recommended concentrations for livestock (see **Section 3.7, Water Resources –Surface Water**).

3.8.5.5 Sub-McKay

Ground water quality in the Sub-McKay is similar to that in the Rosebud and McKay Coals except that sodium concentrations are much lower in the Sub-McKay (**Table 63**). Calcium and magnesium concentrations were high in WD-189 and WD-201 located in the Robbie Creek drainage. There are no numeric standards for these parameters, but there are recommended limits for livestock that were exceeded. Other metal concentrations were generally well below standards, and nutrient concentrations were usually well below standards. There was one exceedance each of the arsenic and fluoride standard. There were two exceedances of the selenium standard, and a few exceedances of recommended concentrations for livestock for sulfate and TDS. The source of ground water in the Sub-McKay is likely from vertical recharge in upland areas to the southwest. As indicated by the observed water quality of the Sub-McKay, it does not receive significant recharge vertically via the overburden or interburden.

Table 63. Ground Water Quality in the Sub-McKay in the Project Area.

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard or Recommended Concentration for Livestock
Acidity (mg/L)	108	0	<1	<1	<1	<5	<5	NS
Aluminum (mg/L)	165	141	<0.004	0.017	0.030	0.055	0.3	10
Ammonia (mg/L)	108	87	<0.045	0.096	0.382	0.610	0.991	NS
Arsenic (mg/L)	165	63	<0.00007	<0.0005	<0.0005	0.001	0.015	0.01
Bicarbonate Alkalinity (mg/L)	166	166	238	329	395	518	955	999
Boron (mg/L)	149	149	0.18	0.22	0.27	0.46	1.3	30
Cadmium (mg/L)	165	42	<0.00004	<0.00008	<0.00008	0.0002	0.0016	0.005
Calcium (mg/L)	137	137	5.8	23.8	49.2	**207**	**329**	150
Carbonate Alkalinity (mg/L)	142	37	<0.52	<3.5	<5	<5	38.8	NS
Chloride (mg/L)	166	162	1.3	3.0	5.9	10.4	25	300
Copper (mg/L)	108	95	<0.000018	<0.0008	<0.002	<0.002	0.0083	0.5
Fluoride (mg/L)	165	116	<0.004	0.18	0.32	0.56	**2.5**	2
Hydroxide Alkalinity (mg/L)	119	0	<1	<1	<5	<5	<5	NS
Iron (mg/L)	165	125	<0.01	<0.05	0.10	0.51	5.24	NS
Laboratory Conductivity (µS/cm)	166	166	1,360	1,843	2,510	3,105	5,780	NS
Laboratory pH (s.u.)	166	166	6.7	7.4	8.0	8.2	8.6	NS
Lead (mg/L)	165	68	<0.000004	<0.0001	0.0001	0.0003	0.003	0.015
Magnesium (mg/L)	137	135	1.7	9.3	24.8	**178**	**391**	100
Manganese (mg/L)	166	166	0.001	0.015	0.027	0.045	0.54	0.5
Nickel (mg/L)	108	69	<0.0005	<0.0006	0.0008	0.002	0.0163	0.1
Nitrate+Nitrite (mg/L)	166	109	<0.003	0.01	0.04	0.13	0.81	10
Potassium (mg/L)	115	111	<2.5	4.4	6.4	9.9	15.1	NS

Table 63. Ground Water Quality in the Sub-McKay in the Project Area.

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard or Recommended Concentration for Livestock
Selenium (mg/L)	108	30	<0.0002	<0.0004	<0.0005	0.001	**0.207**	0.05
Sodium (mg/L)	166	166	0.2	5.1	11.0	25.6	36.5	300
Sulfate (mg/L)	166	166	300	618	1,030	1,318	**3,050**	2,500
Total Alkalinity (mg/L)	166	166	238	322	396	506	955	1,000
Total Dissolved Solids (mg/L)	165	165	603	1,300	1,890	2,330	**5,190**	4,999
Total Hardness (mg/L)	166	166	21	95	222	1,155	2,700	NS
Total Phosphate (mg/L)	57	57	0.013	0.036	0.057	0.09	1.45	NS
Vanadium (mg/L)	108	71	<0.00004	<0.0001	0.0003	0.01	0.01	0.1
Zinc (mg/L)	166	79	<0.0005	<0.005	0.008	0.01	0.26	2

Sampled wells in 2005 to 2015 included WD-187, WD-188, WD-189, WD-190, WD-191, WD-192, WD-193, WD-194, and WD-210.
All metals are dissolved.
NS = no numeric standard or recommended concentration. μS/cm = micro Siemens/centimeter; s.u. = standard units.
For less than detection limit concentrations, detection limits are used to calculate percentile concentrations. Concentrations shown with less than symbols indicate some or all measured concentrations were less than the detection limit.
Concentrations in bold exceed Montana numeric ground water quality standards (**Table 56**) or recommended concentrations for livestock (see **Section 3.7, Water Resources –Surface Water**).

3.9 WATER RESOURCES – WATER RIGHTS

3.9.1 Introduction

This section describes surface water and ground water rights that occur in and near the analysis area and that may be affected by mine operations in the project area; the analysis area is defined below in **Section 3.9.1.2 Analysis Area**. This section includes regulatory requirements to protect water rights. A list and description of surface water and ground water rights in the analysis area is provided in **Appendix E**.

3.9.1.1 Regulatory Framework

Federal Requirements

SMCRA requires that surface coal mining and reclamation operations protect surface and ground water resources, including water rights. As described in **Section 1.4.1.1, Office of Surface Mining Reclamation and Enforcement, Surface Mining Control and Reclamation Act**, DEQ operates an approved state program under SMCRA and, therefore, has primary jurisdiction over the regulation of surface coal mining and reclamation operations on non-federal and non-Indian lands within the state.

State Requirements

The Montana Water Use Act requires that any person, agency, or government entity intending to acquire new or additional water rights or to change an existing water right in the state obtain a beneficial water use permit or change authorization before commencing to construct a new or additional diversion, withdrawal, impoundment, or water distribution works for appropriations of ground water or surface water. The Montana Water Use Act gives authority to administer water rights in the state of Montana to the Montana Department of Natural Resources and Conservation, Water Resources Division, Montana Water Rights Bureau (Water Rights Bureau). The Water Rights Bureau assures the orderly appropriation and beneficial use of Montana's waters. The Water Rights Bureau administers the Montana Water Use Act and assists the Water Court with the adjudication of water rights.

An application for a Beneficial Water Use Permit requires proof that there is water physically and legally available at the proposed point of diversion in the amount requested (ARM 36.12.1702 and 36.12.1705). Senior water rights have an earlier priority date, and claimants who hold them have a higher priority to divert water from a stream or water body than those with more junior rights. If a senior water user would be adversely affected by a new use, the application would be denied unless a mitigation plan with specific conditions that would eliminate or mitigate potential adverse effects on senior water rights holders. These conditions must also be acceptable to the new water user. For example, a new water user may be required to divert or pump water only at certain times when adequate water is available for all users, or to find water from another source to replace water appropriated by the new user.

The Montana Water Use Act provides a specific exception from water right permitting for small ground water wells. This exception from the law allows rural domestic or agricultural water users the opportunity to drill a small well without obtaining a permit. This was intended for small dispersed uses of water with little potential to impact existing rights. All new water rights filed after July 1, 1973 require a permit from the state except individual wells pumping no more than 35 gpm and no more than 10 acre-feet per year. An exempt well requires only a filing of a "Notice of Completion of Ground Water Development" and payment of a fee for approval. While senior water rights users may legally make a call against more junior exempt wells, significant practical and legal challenges are associated with implementing and enforcing the call, especially if the call is made against a well that is exempt from the permitting process (Kolman 2012).

Under the Montana Water Use Act, dewatering a mine is not a beneficial use of water and a beneficial water use permit would not be required. The Water Use Act requires that a person cannot waste water, use water unlawfully, or prevent water from moving to another person having a prior right to use the water. However, the disposal of ground water (without further beneficial use) that must be withdrawn as part of the mine dewatering process may not be construed as wasting water (MCA 85-2-505[c]).

DEQ regulates permitting and operation of surface coal mines on federal lands within Montana under the authority of MSUMRA (Section 82-4-221 et seq., MCA) and its implementing rules (ARM 17.24.301-1309). ARM 17.24.648 requires that Western Energy replace the water supply of any owner of interest in real property who obtains all or part of his water supply for domestic, agricultural, or other uses from surface or ground water if such supply has been affected by contamination, diminution, or interruption proximately resulting from mine operations.

Pursuant to ARM 17.24.648, MSUMRA unconditionally requires Western Energy to provide replacement water. Section 82-4-222(1)(m), MCA, requires the applicant to submit a determination of the PHC, which includes findings on whether the proposed mining may proximately result in the diminution or interruption of a water supply that is used for domestic, agricultural, industrial, or other beneficial use. Section 82-4-222(1)(n) further requires an applicant to provide a plan for monitoring the availability and suitability of both ground and surface waters for current and approved postmining land uses. ARM 17.24.304 requires that an application for an underground coal mining permit include (among other things): a description of alternative water supplies, not to be disturbed by mining, that could be developed to replace water supplies diminished or otherwise adversely impacted in quality or quantity by mining activities so as not to be suitable for the approved postmining land uses (see ARM 17.24.304(1)(f)(iii)). ARM 17.24.648 (part of MSUMRA) requires that Western Energy replace the water supply of any owner of interest in real property who obtains all or part of his water supply for domestic, agricultural, or other uses from surface or ground water if such supply has been affected by contamination, diminution, or interruption proximately resulting from mine operations. The specific steps for water supply replacement are set out in 82-4-253(3)(d), MCA, which requires in pertinent part that an operator shall be ordered (in compliance with MCA Chapter 2, Title 85) to replace lost water supplies on both an interim basis (to supply needed water) and a permanent basis with a supply of water in like quantity, quality and duration. Under MSUMRA, as noted, the obligation to provide permanent-basis replacement of any lost, diminished, or otherwise adversely impacted water supply with a supply of water in like quantity, quality, and duration is unconditional.

The Montana DNRC (and not DEQ) is the state agency charged with issuing new water use permits and determining, inter alia, whether water is "legally available." See Section 85-2-311, MCA; *Confederated Salish & Kootenai Tribes v. Clinch*, 2007 MT 63, P35, 336 Mont. 302, 318 (2007); see also *Confederated Salish & Kootenai Tribes v. Clinch*, 1999 MT 342, P14-P15, 297 Mont. 448, 453-454 (1999). In the context of the federal SMCRA (30 USC § 1201 et seq.), the federal (DOI) Interior Board of Land Use Appeals (IBLA) has explained that OSMRE, when issuing a permit under SMCRA, does not have the authority to determine water rights. As that board explained, "[t]o hold otherwise would be to require OSMRE to become the adjudicator of water rights claims, a role which it is neither authorized nor qualified to assume." See *Peabody Coal Co. v. OSMRE*, 123 IBLA 195; 1992 IBLA LEXIS 55, 123 IBLA 195; and 1992 IBLA LEXIS 55 at [2]. Like OSMRE, DEQ is neither authorized nor qualified to determine water rights within the context of MSUMRA, and MSUMRA does not require DEQ to determine the "legal availability" of replacement water sources. Accordingly, by its plain language, ARM 17.24.304(1)(f)(iii) does not (and as a matter of law, could not) require DEQ to make a determination as to legal availability of replacement water sources. ARM 17.24.304(1)(f)(iii) instead requires DEQ to identify sources that "could" be used for replacement purposes. "Could" is defined in the dictionary alternately as simple past tense of "can" or as an auxiliary verb to express possibility, conditional possibility, or ability. The latter definition applies with respect to ARM 17.24.304(1)(f)(iii), which addresses a future contingent event in terms of conditional probability. The question before DEQ, which DEQ has both the jurisdiction and the expertise to answer, is whether, from a hydrologic perspective, there are alternative water supplies, not to be disturbed by mining, that could be developed to replace water supplies diminished or otherwise adversely impacted in quality or quantity by mining activities (ARM 17.24.304(1)(f)(iii)). MSUMRA's requirement that such replacement water must be provided "in compliance with" the Montana Water Use Act (Section 82-4-253(3)(d), MCA) does not otherwise serve to vest DEQ with the jurisdiction to decide, on an advisory basis or otherwise, whether a replacement water source can be provided consistent with the Montana Water Use Act. Such matters are purely within the expertise and jurisdiction of DNRC, and nothing in the Montana Water Use Act could serve to relieve Western Energy of its unconditional obligation (by whatever means required and permissible) to provide replacement water.

With respect to the laws administered by DNRC, if a water supply needed to be replaced, the water rights owner would need to complete one of the following (Elison, pers. comm. 2018):

- If the well would continue to pump water from the same aquifer, but the well needed to be deepened to increase its yield, the appropriator would need to file a well replacement form with the Water Rights Bureau.
- If ground water needed to be acquired from a different aquifer, such as a change from the Rosebud Coal aquifer to the Sub-McKay aquifer, the water rights owner would need to file a change of appropriation form with the Water Rights Bureau.
- If a surface water right needed to be replaced by ground water, such as from the Sub-McKay aquifer, a new water rights permit would need to be acquired from the Water Rights Bureau. For replacement of a surface stock water supply, water could be pumped to a stock tank or pond, then allowed to flow downstream for stock use.

DEQ would require Western Energy to pay any costs for water replacement in perpetuity, such as administrative costs, the costs for electricity, installation of pumping equipment, and operation and maintenance of a pumping system.

Local Requirements

Water rights are regulated and protected at the state and federal level. There are no local water rights requirements.

3.9.1.2 Analysis Area

Direct Effects Analysis Area

The analysis area for direct impacts on surface water rights and ground water rights includes the project area (where mining and related disturbance would occur) as well as the surrounding area that may be affected by mining in the project area. The analysis area is shown on **Figure 43**, which depicts surface water rights, and **Figure 44**, which depicts ground water rights.

Indirect Effects Analysis Area

The indirect effects analysis area for surface water rights is the same as that described for surface water in **Section 3.7, Water Resources – Surface Water**, and shown on **Figure 2** in that section. The indirect effects analysis area for ground water rights is the same as that described for ground water in **Section 3.8, Water Resources – Ground Water**.

3.9.2 Existing Water Rights

Surface water and ground water rights have been compiled for T2N R38E in the southeast corner of Treasure County and for T2N R39E in Rosebud County. The direct effects analysis area is within this area. **Appendix E** provides a list of the 122 surface water and ground water rights on record with the Water Rights Bureau that are within the direct effects analysis areas well as downgradient water rights that may be affected by mine operations. Some water rights are listed more than once because there is more than one point of diversion. Nearly all of the 122 rights are for stock water use, and a few are for domestic use. Forty percent of the rights are for ground water diversions. Thirty percent of the rights are for spring water diversions. Some of the surface rights are for on-stream reservoirs for stock watering. Stock water rights are located on Black Hank, Donley, McClure, Robbie, and Trail Creeks, and on tributaries to Black Hank, Donley, and Trail Creeks. Forty-eight percent of the water rights are owned by Booth Land & Livestock Company most of which are for stock use. Western Energy owns 11 water rights in this area; 2 are for domestic use and the remaining 9 are for stock use. Existing surface water rights in and near the direct effects analysis area, which includes both direct diversion and storage rights, are shown on **Figure 43,** and existing ground water rights in and near the direct effects analysis area are shown on **Figure 44**.

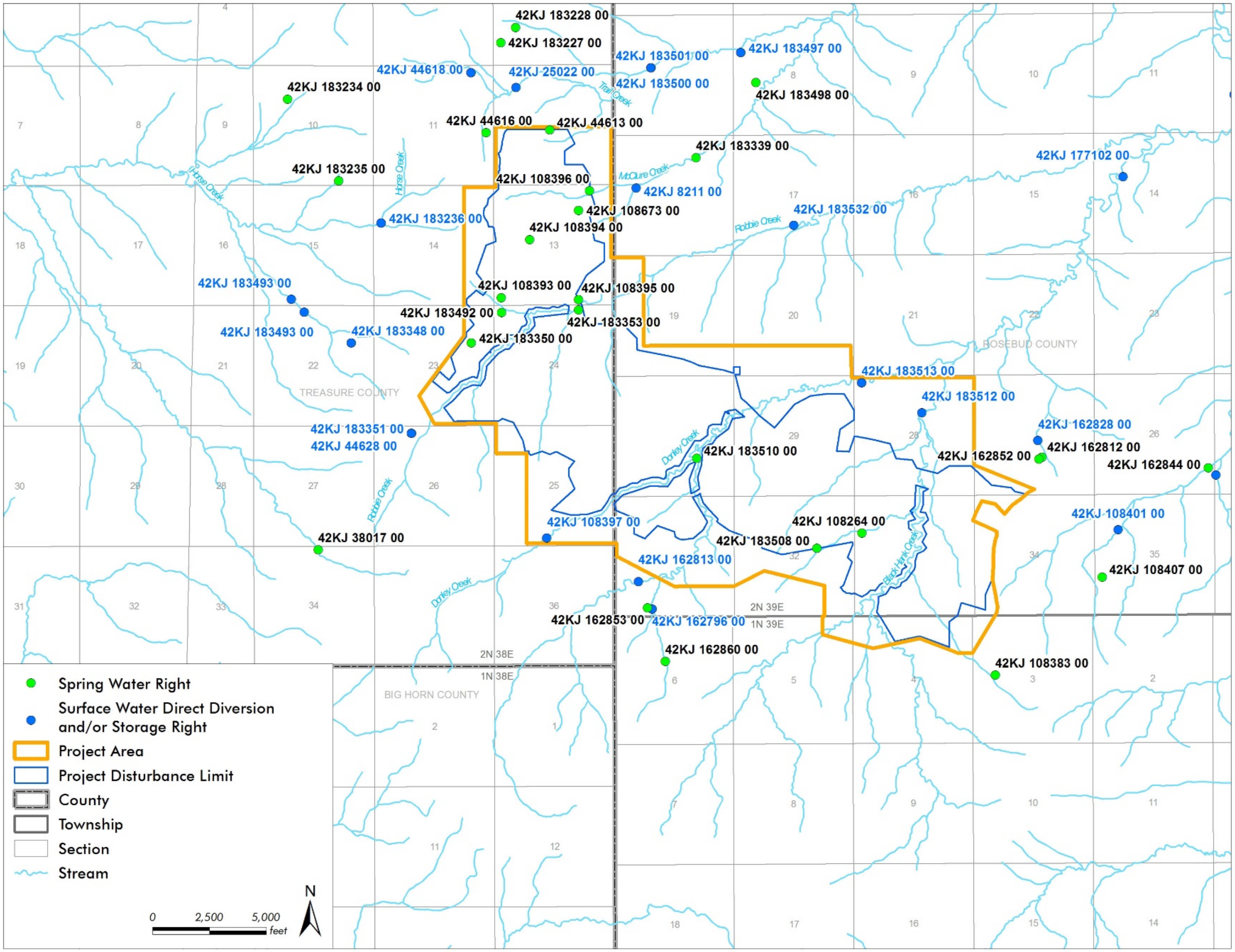

Figure 43. Surface Water Rights in and near the Direct Effects Analysis Area.

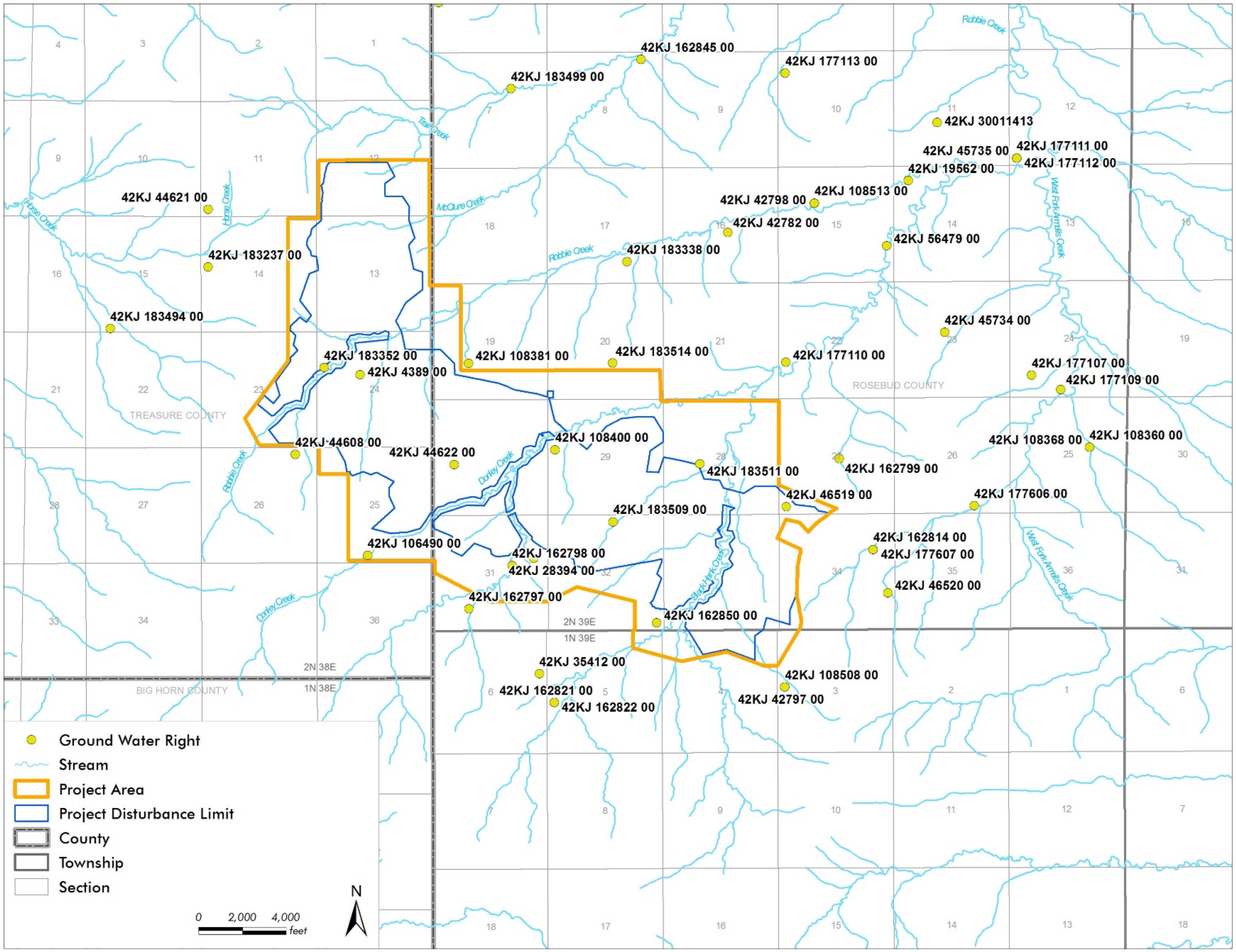

Figure 44. Ground Water Rights in and near the Direct Effects Analysis Area.

3.10 VEGETATION

3.10.1 Introduction

This section describes vegetation resources that occur within the analysis area and the regulatory requirements to protect these resources. The analysis area for vegetation resources is defined below in **Section 3.10.1.2, Analysis Area**. The types of vegetation assessed include upland and riparian vegetation communities and noxious weeds. Vegetation provides wildlife habitat, protects soil, supports agricultural operations, and provides other ecosystem functions. The regulatory requirements to protect vegetation resources are discussed in the following section.

3.10.1.1 Regulatory Framework

Federal Requirements

Vegetation resources in general are not regulated by federal agencies. Federally listed Threatened and Endangered (T&E) plant species are protected under the ESA, as amended under 16 USC 1531–1543 (Supp. 1996). See **Section 3.13, Special Status Species** for a discussion of federally listed plant species.

State Requirements

MSUMRA (82-4-233 and 82-4-235, MCA) and its implementing rules (Subchapters 3, 5, 6, 7, 8, and 11 of the ARM) include regulations applicable to vegetation including requirements for baseline investigations, requirements for reclamation and revegetation, protection of federally T&E species, and conditions for bond release. **Table 64** summarizes the applicable regulations.

Table 64. Applicable Vegetation and Reclamation Rules and Regulations.

Applicable Rules and Regulations under the Administrative Rules of Montana	
Subchapter	**Summary of Requirement**
3	Contains requirements of the surface-mine permit application, including gathering vegetation baseline information (ARM 17.24.304 and ARM 17.24.305), requirements of the reclamation plan (ARM 17.24.313), special application requirements for prime farmlands (ARM 17.24.324), and special-use requirements for coal-mining operations on or adjacent to areas including alluvial valley floors (ARM 17.24.325)
5	Contains backfilling and grading requirements suitable for revegetation
6	Lists requirements for road and railroad construction (ARM 17.24.601), hydrologic impact of roads and railroads (ARM 17.24.605), general hydrology requirements (ARM 17.24.631), performance standards for drainage reclamation (ARM 17.24.634), and sediment-control measures (ARM 17.24.638)
7	Includes requirements for establishment of vegetation (ARM 17.24.711), timing of seeding and planting (ARM 17.24.713), methods of revegetation (ARM 17.24.716), planting of trees and shrubs (ARM 17.24.717), monitoring (ARM 17.24.723), revegetation success criteria (ARM 17.24.724), normalized difference (ND) vegetation measurements (ARM 17.24.726), Threatened and Endangered species/designated critical habitat (ARM 17.24.751), and cropland reclamation (ARM 17.24.764)
8	Contains requirements for preservation of essential hydrologic functions (ARM 17.24.801), protection of farming (ARM 17.24.802), alluvial valley floor monitoring (ARM 17.24.804), significance determination (ARM 17.24.805), and prime farmland revegetation (ARM 17.24.815)
11	Contains requirements for bond release

Table 64. Applicable Vegetation and Reclamation Rules and Regulations.

Applicable Rules and Regulations under Montana Strip and Underground Mine Reclamation Act	
82-4-2, MCA Subpart	**Summary of Requirement**
233	Contains requirements for planting of vegetation following grading of disturbed area
235	Determination of successful revegetation – final bond release

See **Section 3.13, Special Status Species** for information on state Species of Concern.

Noxious weeds are managed under the Montana County Weed Control Act, as implemented under MSUMRA (ARM 17.24.308). The act states, "It is unlawful for any person to permit any noxious weed to propagate or go to seed on the person's land, except that any person who adheres to the noxious weed management program of the person's weed management district or who has entered into and is in compliance with a noxious weed management agreement is considered to be in compliance with this section" (MDA [Montana Department of Agriculture] 2011). MDA maintains lists of noxious weeds categorized by the severity of potential impacts and other factors and, depending on the category, may require management or eradication of the species to prevent the negative impacts of noxious weeds on the economic and environmental values of MT (MDA 2015).

Local Requirements

There are no applicable local regulations for vegetation resources within or near the analysis area.

3.10.1.2 Analysis Area

Direct Effects Analysis Area

The direct effects analysis area for vegetation is the project area boundary (see **Figure 45**). Surveys of pre-mining vegetation within the project area were conducted between 2005 and 2007 to provide a baseline assessment of impacts and reference for reclamation (Cedar Creek Associates, Inc. 2009). These surveys were updated in 2014 (PAP, Appendix E). Baseline vegetation conditions were evaluated to determine species composition, ground cover, annual herbaceous production, and woody-plant density (Cedar Creek Associates, Inc. 2014). Assessment methods follow ARM 17.24.304 (Baseline Information, Environmental Resources) and DEQ Vegetation Guidelines (DEQ 2000). Surveys for sensitive plant populations potentially occurring in the analysis area were also conducted (Cedar Creek Associates, Inc. 2014).

Indirect Effects Analysis Area

The indirect effects analysis area for vegetation consists of the operational boundaries of the Colstrip and Rosebud Power Plants plus a 32-km area around each of the power plants. This analysis area was determined as a result of trace metal deposition modeling for special status species that utilized soil trace metal background concentrations from a USGS background study (Smith et al. 2013) and air-quality modeling (using 1 percent of the 95 percent upper confidence limit [95-percent UCL] of background) (see **Section 4.3, Air Quality** for discussion of modeling methods and results). The 32-km analysis area was defined as the largest spatial extent for indirect effects on special status species where trace metals exceeded 1 percent of the current soil concentrations over the 19-year operation period of the project. Of the eight trace metals modeled, mercury had the greatest deposition distance (about 32 km) inside which there could be potential impacts on special status species. This analysis area was also used as the basis for the vegetation indirect effects analysis area. **Figure 46** shows the vegetation communities within the analysis area for indirect effects**.**

3.10.2 Vegetation Communities

3.10.2.1 Vegetation Communities in Direct Effects Analysis Area

The project area, which is also the direct effects analysis area for vegetation, is located on the Missouri Plateau, an unglaciated section of the Great Plains with generally rolling to steep slopes and occasional bluffs rising above the plains. The direct effects analysis area ranges in elevation from 3,300 feet above sea level (asl) to more than 3,930 feet asl. Both the direct and indirect effects analysis areas have limited human disturbance, but some vegetation communities have been affected by livestock grazing, agriculture, roads, utility corridors, and wildfire. Six major vegetation communities were identified in the direct effects analysis area: grassland, conifer (Ponderosa pine)/sumac, sagebrush, pastureland, mixed shrubland, and woody draw (**Figure 45**). The plant communities were segregated by dominant plant species, influence of soil type, topography, elevation, and other related factors (PAP, Appendix E). In addition, several vegetation communities are associated with different land types: agricultural fields (cropland), ranch yards and county roads, scoria pit, cliff, and sandstone rock (**Figure 45**). Wetland plant communities are described in more detail in **Section 3.11, Wetlands and Riparian Zones**. Ponds also support riparian, wetland, and rooted aquatic vegetation.

The grassland, conifer/sumac, and sagebrush plant communities dominate the land-surface cover of the direct effects analysis area, comprising more than 77 percent of the total area (**Table 65**). Pastureland and agricultural fields each occupy 8 percent of the land base, while all other community and land-use types occupy less than 5 percent. Field assessments documented the presence of 50 grass, 151 forb, 9 tree, 20 shrub, 4 sub-shrub, and 4 succulent plant species (PAP, Appendix E).

Table 65. Project Area Acreage Summary by Plant Community Type.

Vegetation Community and Land Types Supporting Vegetation	Acres in Project Area	Percentage of Total
LOWLAND		
Grassland	0.4	0
Deciduous tree/shrub	61	0.9
UPLAND		
Grassland	2,381	35.29
Shrub grasslands		
• Big sagebrush	443	6.56
• Silver sagebrush	643	9.53
• Skunkbush sumac	394	5.84
• Deciduous tree/shrub	159	2.35
Mixed shrub	184	2.72
Conifer	1,373	20.35
OTHER		
Pastureland	537	7.96
Agricultural fields	511	7.57
Ranch yards/county roads	41	0.61
Wet meadows	7	0.10
Scoria pit	5	0.07
Sandstone features		
• Sandstone rock	4	0.06
• Cliff	2	0.03
Ponds	1	0.01
Total	**6,746**	**100.00**

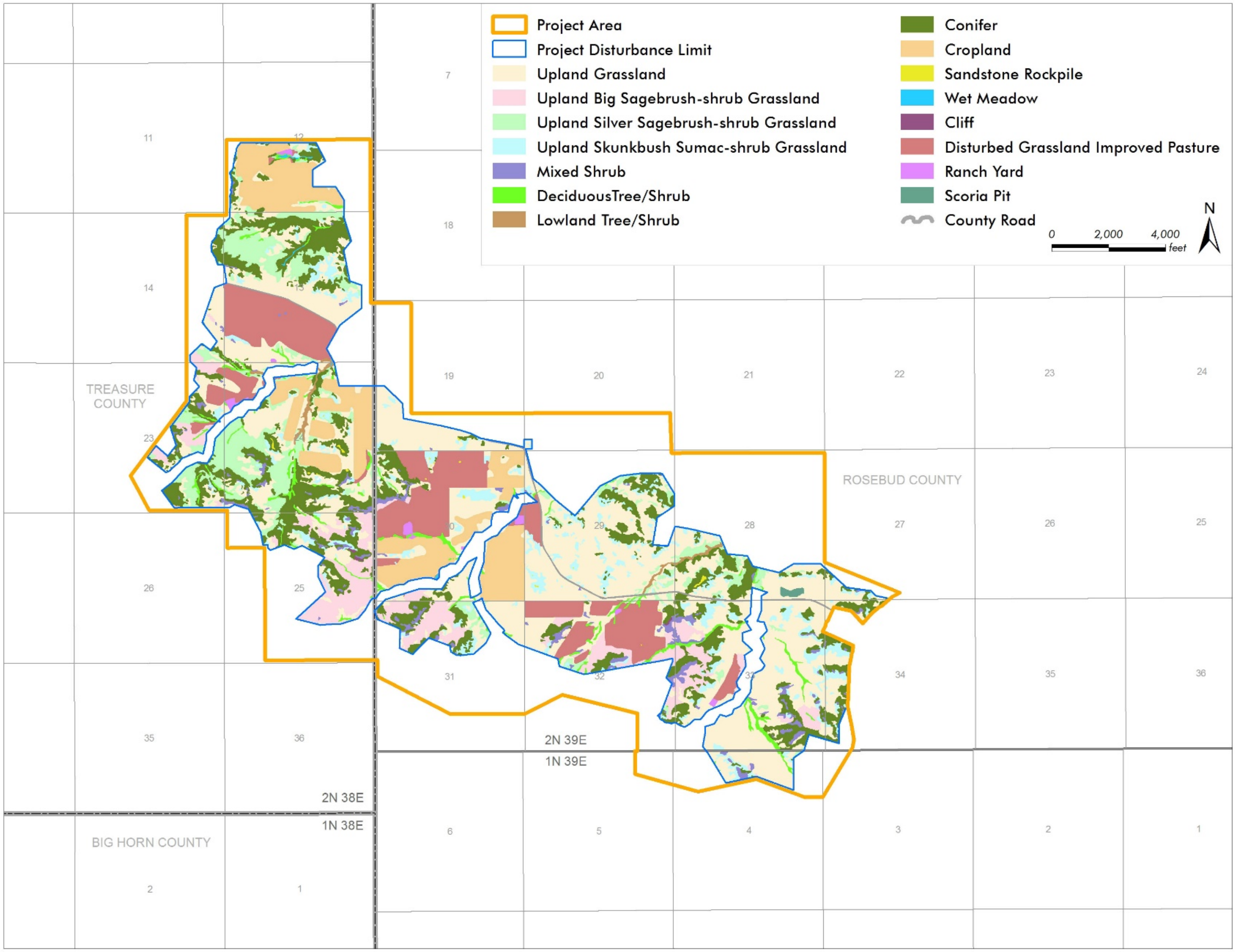

Figure 45. Vegetative Communities in the Project Area.

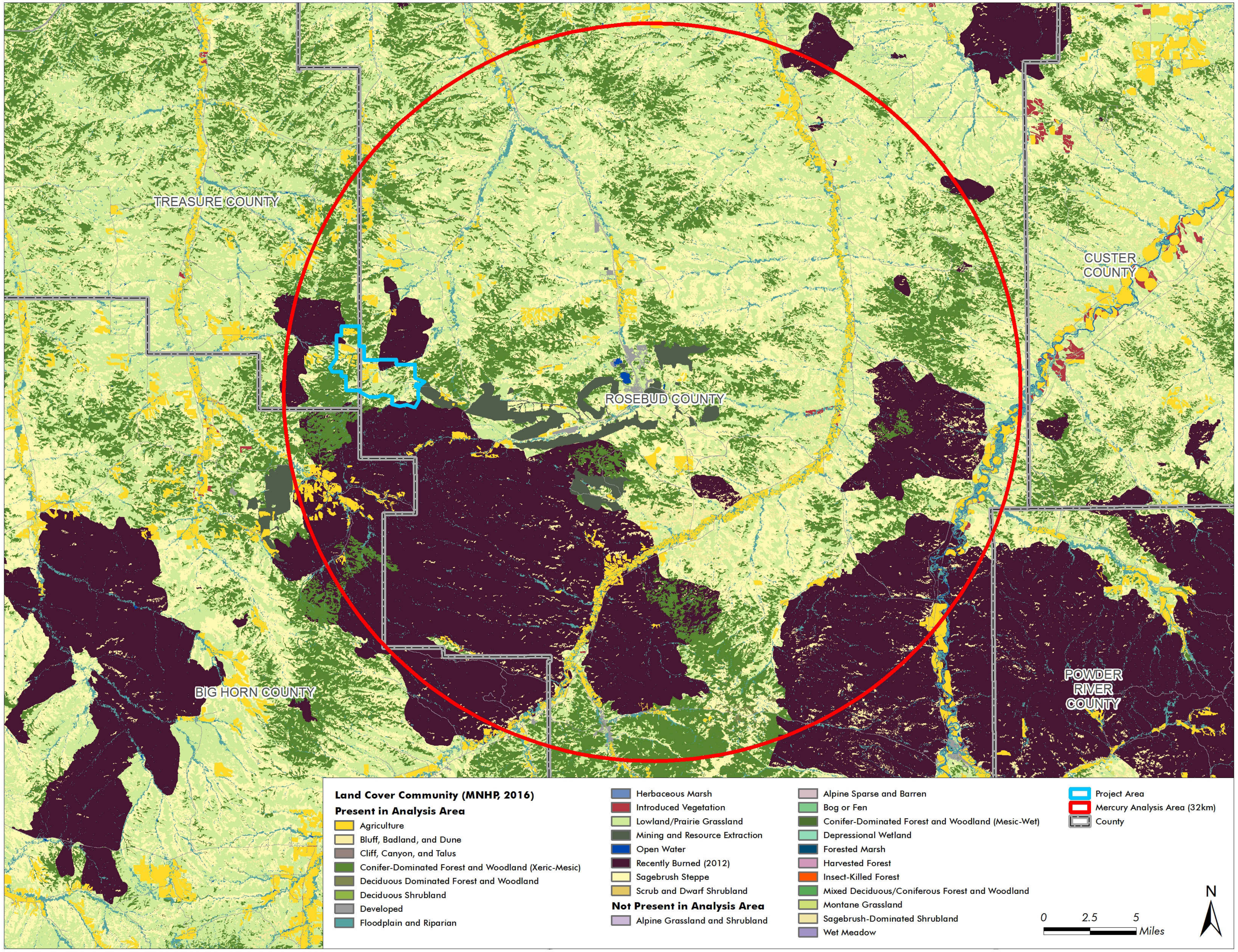

Figure 46. Vegetative Communities in the Indirect Effects Analysis Area.

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3.10.2.2 Grassland Community

The grassland plant community is the dominant vegetation type in the direct effects analysis area, occupying 35 percent of the land cover (**Table 65**). Grasslands occur on deep soil of flat valley bottoms to gently sloping hillsides and occasionally on hilltops surrounded by conifers. While the community is dominated by grasses, scattered sagebrush is also present.

The grasslands of eastern MT are recognized as mixed-grass prairies containing a blend of tallgrass and shortgrass prairie species. The baseline vegetative assessment recorded 111 plant species in the grassland community (PAP, Appendix E). The average grassland vegetative ground cover was 52 percent. The dominant herbaceous species (11 percent ground cover) was Japanese brome (*Bromus japonicus*), an introduced nonnative species. Co-dominants include the following native species: needle-and-thread (*Stipa comata*), prairie junegrass (*Koeleria cristata*), western wheatgrass (*Agropyron smithii*), and blue grama (*Bouteloua gracilis*). Seventy-two species of forbs were observed, each with an average ground cover of less than 1 percent. Woody shrub species are present in the grasslands, but no tree species were recorded. The most common woody species are silver sagebrush (*Artemisia cana*) and winterfat (*Ceratoides lanata*) (PAP, Appendix E).

3.10.2.3 Conifer/Sumac Communities

The conifer/sumac communities are widespread in eastern MT at elevations below 4,800 feet asl and are the driest forest types in MT with a historically frequent fire interval. The conifer/sumac plant communities are found on moderately deep soil of sedimentary parent material. This soil is deeper than that where mixed shrub communities are found but shallower than that where grassland and shrubland communities are found.

The conifer/sumac communities cover 26 percent of the land in the direct effects analysis area (**Table 65**). A total of 126 plant species were recorded in this community (PAP, Appendix E). Ponderosa pine (*Pinus ponderosa*) and skunkbush sumac (*Rhus trilobata*) dominate the overstory. Woody and herbaceous plant species characterize the understory vegetation. Creeping juniper (*Juniperus horizontalis*) and snowberry (*Symphoricarpos occidentalis*) account for 2.7 percent and 1.9 percent of the ground cover. Other dominant ground-cover shrub species include silver sagebrush and Arkansas rose (*Rosa arkansana*). The herbaceous understory consists mostly of grasses. Dominant grasses include bluebunch wheatgrass (*Agropyron spicatum*), Kentucky bluegrass (*Poa pratensis*), and prairie junegrass. Fifty-three species of forbs occur in the analysis area, with common yarrow (*Achillea millefolium*) and prairie sage (*Artemisia ludoviciana*) the most common.

3.10.2.4 Sagebrush Communities

The sagebrush communities are the third-most-common plant community in the direct effects analysis area, occupying 16 percent of the land cover (**Table 65**). These communities are present on moderate to deep nonsaline soil. The sagebrush communities support 104 plant species (PAP, Appendix E). Two sagebrush species dominate the sagebrush communities: big sagebrush (*Artemisia tridentata*) and silver sagebrush. Big sagebrush occurs on moderately sloping hillsides, in open areas surrounded by conifers, and along drainage bottoms. Silver sagebrush is more common along slopes near drainage bottoms and in upland meadows. The composition of the two sagebrush species can vary from one species dominating to near-equal mixes of the two. Other shrub species contribute to the total shrub ground cover with snowberry having the greatest cover. Dominant grass species are Japanese brome, Kentucky bluegrass, western wheatgrass, and needle-and-thread. Seventy forb species comprise 4.6 percent of the total ground cover.

3.10.2.5 Pastureland Community

The pastureland (also referred to as Improved Pasture) community makes up about 8 percent of the land cover in the direct effects analysis area (**Table 65**). This community generally occurs near ranch operations and access roads in the valley bottoms where slopes are gentle and soil is deep. Improved Pasture is defined as native grasslands that have been interseeded with introduced "improved" grass cultivars to increase overall production. The improved grass communities were likely seeded in the early to middle 20th century by homesteaders and ranchers. The introduced grass species continue to persist today.

Unlike agricultural field monocultures, the pastureland community has relatively diverse species richness, with 81 species documented in this community (PAP, Appendix E). Dominant grass species include native thickspike wheatgrass (*Agropyron dasystachyum*), introduced crested wheatgrass (*Agropyron cristatum*), and Japanese brome. Crested wheatgrass was seeded to improve the pasture, while Japanese brome is an aggressive introduced invader. The dominant seeded forb is alfalfa (*Medicago sativa*). Shrub species are present as a minor component. The noxious weed field bindweed (*Convolvulus arvensis*) is also present.

3.10.2.6 Mixed Shrubland Community

The mixed shrubland community makes up only 2 percent of the land cover in the direct effects analysis area (**Table 65**), occurring on ridgeline saddles and steep slopes below ridgelines on all aspects. Mixed shrubland communities have shallow soil with little to no topsoil present, making them prone to erosion and resulting in a high percentage of bare ground (43 percent). The mixed shrubland community type transitions to sandstone cliff areas where the associated vegetative cover decreases as slope angle increases. Where slope angle decreases, soil becomes deeper, and this community transitions into the sagebrush, conifer/sumac, or grassland plant community types.

The mixed shrubland community is diverse with 115 species observed (PAP, Appendix E). The dominant shrub species include skunkbush sumac, yucca (*Yucca glauca*), and snakeweed (*Gutierrezia sarothrae*). Bluebunch wheatgrass and few-flowered buckwheat (*Eriogonum pauciflorum*) dominate the herbaceous cover.

3.10.2.7 Woody Draw Community

Woody draw communities make up less than 4 percent of the land cover in the direct effects analysis area (**Table 65**). Woody draws are linear, moist riparian corridors and basins along drainage channels and areas associated with the lowland tree/shrub community on **Figure 45**. They develop where moisture is trapped or concentrated and where intermittent streams and springs are present. Depending on the size of the drainage, soil can be deep to shallow, and slopes have gentle to steep banks. Woody draw corridors provide important wildlife habitat for cover, forage, and movement.

The woody draw community is relatively diverse with 116 species recorded during the baseline assessment. The dominant tree and shrub species in the woody draw community are snowberry, chokecherry (*Prunus virginiana*), and skunkbush sumac. Other prominent species present include American plum (*Prunus americana*), Arkansas rose, silver sagebrush, box elder (*Acer negundo*), and fleshy hawthorn (*Crataegus succulenta*). Dominant herbaceous species include Kentucky bluegrass, Japanese brome, western wheatgrass, and Canada thistle (*Cirsium arvense*). Woody draws have greater resource availability (e.g., water and nutrients) for plant growth. They are also areas where wildlife and livestock travel and congregate, leading to increased disturbances and seed dispersal. Subsequently, these factors increase the likelihood for weed-species invasion in woody draws. Two noxious weeds, Canada thistle and houndstongue (*Cynoglossum officinale*), as well as one state-regulated plant, Russian olive (*Elaeagnus angustifolia*), occur in the woody draw community.

3.10.2.8 Minor Vegetative Communities

Several minor vegetation communities occur within the direct effects analysis area including those found in agricultural fields, wetlands, ranch yards and county roads, scoria pits, cliffs, sandstone rock, and ponds. The agricultural fields comprise 8 percent of the land cover in the direct effects analysis area (**Table 65**). The crops produced can vary by site and by year; however, the most common crops grown are dryland wheat (*Triticum* spp.) and alfalfa.

Ranch buildings, yards, and livestock pens were combined with county roads because they are all long-term disturbed areas that lack permanent vegetation or are too small in size for vegetation sampling. Together these lands occupy 41 acres. A 5-acre scoria road and gravel storage pit area are located in the analysis area, with some annual and perennial vegetation observed in less compacted areas of the pit. Cliffs (2 acres) and sandstone rock outcrops (4 acres) occur along ridges and as geologic monolith features in the valley bottoms. Cliffs and outcrops have varied erosion rates and little to no soil and vegetation. These features are a minor community type but are important for some wildlife species. Human-made stock ponds scattered throughout the analysis area total 1 acre. These ponds are seasonal and dependent on annual precipitation patterns, and they may support wetlands or rooted aquatic vegetation.

3.10.3 Vegetation Communities in Indirect Effects Analysis Area

The 32-km indirect effects analysis area is dominated by communities similar to those found within the project area (**Section 3.10.2.1**). Based on MNHP mapping, the indirect effects analysis area is dominated by grassland, sagebrush steppe, and conifer-dominated forests and woodland communities (**Table 66; Figure 46**) (MNHP 2017). Some wetland and riparian areas occur along drainages. The indirect effects analysis area is focused around the city of Colstrip and, therefore, does have some areas that have been disturbed by humans for resource extraction or agricultural use. In addition, a large portion (27 percent) of the indirect effects analysis area has been recently disturbed by fire.

Table 66. Indirect Effects Analysis Area, Acreage Summary by Plant Community Type.

Vegetation Community and Land Types Supporting Vegetation	Acres in Analysis Area	Percentage of Total
Agriculture	25,741.62	3.24
Bluff, badland, and dune	21,285.78	2.68
Cliff, canyon, and talus	8.24	0.00
Conifer-dominated forest and woodland (xeric-mesic)	134,456.25	16.91
Deciduous-dominated forest and woodland	2,292.62	0.29
Deciduous shrubland	44.53	0.01
Developed	7,130.31	0.90
Floodplain and riparian	23,590.03	2.97
Herbaceous marsh	8.24	0.00
Introduced vegetation	388.50	0.05
Lowland/prairie grassland	197,640.67	24.86
Mining and resource extraction	13,575.16	1.71
Open water	701.62	0.09
Recently burned	215,890.50	27.16
Sagebrush steppe	152,188.44	19.14
Scrub and dwarf shrubland	52.76	0.01
Total	**794,995.27**	**100.00**

3.10.4 Noxious Weeds

Three noxious weed species on list Priority 2B of the State of Montana Noxious Weed list (MDA 2015)—Canada thistle (*Cirsium arvense*), houndstongue (*Cynoglossum officinale*), and field bindweed (*Convolvulus arvensis*)—were documented in the direct effects analysis area during the baseline assessment (PAP, Appendix E). List Priority 2B weed species are abundant in MT and widespread in many counties, requiring management by local weed districts. Canada thistle and houndstongue were found in woody draw areas, while bindweed was found in the pastureland community. All of the noxious weeds were low in density, with their combined ground cover comprising less than 1 percent. Russian olive, a Priority 3 species, was also found in the woody draw areas. Priority 3 species are not listed as noxious weeds but are listed as regulated plants that have the potential for significant negative impacts. Rosebud County lists other noxious weed species not on the Montana Noxious Weed list; however, none of the county species were observed in the direct effects analysis area during the baseline assessment in 2005–2007. It is likely some noxious weeds occur within the indirect effects analysis area, especially near areas that have been disturbed by human activities.

3.11 WETLANDS AND RIPARIAN ZONES

3.11.1 Introduction

This section describes wetlands and riparian zones that occur within the analysis area. The analysis area is defined below in **Section 3.11.1.2, Analysis Area**. The regulatory requirements to protect wetlands and other waters of the U.S. are also discussed in the section directly below.

A wetland is an area of land that is saturated or inundated with water either permanently or seasonally, allowing it to support vegetation that is adapted for life in saturated soil conditions. Wetlands are typically present along streams, ponds, and lakes on the gradient between upland areas and aquatic areas. Wetlands play an important role in the ecosystem by providing vegetative diversity and wildlife habitat, improving water quality, providing ground water discharge, and retaining sediment and nutrients, among other values. Streams, ponds, springs, and other waters of the U.S. provide aquatic habitat, nutrient and sediment removal, and other functions.

3.11.1.1 Regulatory Framework

Federal Requirements

Waters of the U.S. are defined broadly in the U.S. Army Corps of Engineers (Corps) regulations to include a variety of waters and wetlands. Water bodies covered under this definition include streams (perennial, intermittent, and ephemeral), ponds, and lakes per 33 CFR 328.3(a). Habitats included under this definition are deep-water habitats (non-wetland) and special aquatic sites, which include wetlands (Environmental Laboratory 1987). The Corps defines “wetlands” as those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas per 33 CFR 328.3(b).

Waters tributary to navigable and interstate waters are considered waters of the U.S. and are subject to the Corps’ jurisdiction. Wetlands subject to the Corps’ jurisdiction (jurisdictional wetlands) meet the Corps’ definition of wetlands and are adjacent, neighboring, or have a surface tributary connection to interstate or navigable waters of the U.S. The Corps determines a water to be jurisdictional if the water body is a traditionally navigable water, relatively permanent water, or a wetland that directly abuts a traditionally navigable or relatively permanent water body, or, in combination with all wetlands adjacent to that water body, has a significant nexus with traditionally navigable waters (Corps and EPA 2007). The Corps determines whether a wetland or water is a water of the U.S. and subject to the Corps’ regulatory authority (jurisdictional) based on data received when a jurisdictional determination is requested.

The Corps defines springs as “any location where there is ground water flow emanating from a distinct point. Springs do not include seeps or other ground water discharge areas where there is no distinct point source” (Corps 2012). The Corps requires preconstruction notifications for any regulated activities located within 100 feet of a jurisdictional spring.

Federal and state agencies have the responsibility to avoid, minimize, and mitigate unavoidable effects on wetlands and waters of the U.S. under Section 404(b)(1) of the Clean Water Act (CWA). All activities that result in the discharge of fill material into wetlands or waters of the U.S. are regulated by the Corps. Based on a Supreme Court 2001 ruling, wetlands that are isolated from other waters of the U.S., and whose only connection to interstate commerce is use by migratory birds, are not jurisdictional. Such wetlands are “isolated” or “nonjurisdictional,” and these terms are used synonymously.

Projects subject to the Corps’ jurisdiction also must comply with the 404(b)(1) Guidelines (Guidelines) for discharge of dredged and fill material into wetlands and waters of the U.S. (40 CFR 230). The Guidelines specify “no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse effect on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences.” An alternative is considered practicable if “it is capable of being done after taking into consideration cost, existing technology, and logistics in the light of overall project purposes.” Practicable alternatives under the Guidelines assume that “alternatives that do not involve special aquatic sites are available, unless clearly demonstrated otherwise.” The Guidelines also assume that “all practicable alternatives to the proposed discharge which do not involve a discharge into a special aquatic site are presumed to have less adverse effect on the aquatic ecosystem, unless clearly demonstrated otherwise” (40 CFR 230).

Federal agencies have responsibilities to avoid, minimize, and mitigate unavoidable impacts on wetlands under Executive Order 11990—Protection of Wetlands. Executive Order 11990 requires federal agencies to “consider factors relevant to a proposal’s effect on the survival and quality of the wetlands” (42 FR 26961). Federal agencies must find that there is no practicable alternative to new construction located in wetlands and that the Proposed Action includes all practicable measures to minimize harm to wetlands. Agencies may take into account economic, environmental, and other pertinent factors in making this finding.

The Corps Regulatory Program in Montana has a stream mitigation procedure to quantify the adverse impacts and acceptable compensatory mitigation in relation to a project that would result in more than minimal adverse impacts on a stream (Corps 2013).

OSMRE, the Corps, EPA, and USFWS developed a Memorandum of Understanding (MOU) to improve coordination and information sharing among the agencies responsible for reviewing and processing SMCRA and CWA Section 404 permits (Corps et al. 2005). The purpose of the MOU is to provide a framework for establishing more coordinated procedures to improve the decision-making process for surface coal-mining permit applications received pursuant to SMCRA and CWA Section 404. The MOU encourages development of joint procedures between Corps districts and SMCRA regulatory agencies to facilitate concurrent and coordinated review and processing of surface coal mining permit applications.

State Requirements

Montana has an overarching goal to have no net loss of the state’s remaining wetland resource base (as of 1989) and to overall increase the quality and quantity of wetlands in Montana (Montana Wetland Council 2013). DEQ is the lead state agency for wetland protection and works with the Montana Wetland Council to help implement the Strategic Framework for Wetland and Riparian Area Conservation and Restoration in Montana 2013-2017, which is considered the state plan for wetland and riparian areas (Montana Wetland Council 2013). Wetlands, including those determined to be nonjurisdictional by the Corps, are waters of the state. Under MSUMRA, these resources are considered important as part of the hydrologic balance and wildlife habitat. ARM 17.24.751 requires surface mine operating permit applicants to restore or avoid disturbance to wetlands.

In Montana, state waters are defined as a body of water, irrigation system, or drainage system, either surface or underground, with the exception of (a) ponds or lagoons used solely for treating, transporting, or impounding pollutants; or (b) irrigation waters or land application disposal waters when the water is being used up with the irrigation or disposal system and the water is not returned to state waters (75-5-103 [34], MCA).

Under MSUMRA (ARM 17.24.312), surface mine operating permit applicants also are required to prepare a fish and wildlife plan that explains how the applicant will utilize impact control measures, management techniques, and annual monitoring methods to protect or enhance habitat for fish and wildlife, including wetlands and riparian areas. In addition, no land within 100 feet of a perennial or intermittent stream or a stream reach with a biological community may be disturbed by strip or underground mining operations, nor may the stream itself be disturbed, unless DEQ determines the original stream function will be restored and the water quality and quantity and other environmental resources of the stream and its adjacent lands will not be adversely affected during or after mining (ARM 17.24.651). The applicant is also required to include a site reclamation plan that includes a postmine land uses section (ARM 17.24.313 and ARM 17.24.762). This land uses section should include a description of the locations and designs of drainages, and can include descriptions of wetlands. The reclamation of drainage basins must establish or restore habitats that are consistent with postmining land use, and restore, enhance where practicable, or maintain natural riparian vegetation (ARM 17.24.634).

Local Requirements

There are no applicable local regulations for wetlands and riparian resources within or near the analysis area.

3.11.1.2 Analysis Area

The analysis area includes locations where potential direct or indirect effects on wetlands by any of the alternatives would occur.

Direct Effects Analysis Area

For direct effects, baseline inventories of wetlands conducted in 2006 and 2013 by Cedar Creek Associates, Inc. (PAP, Appendix E) were used to develop the analysis area. The delineations occurred within the project area and also included areas within 500 feet of the proposed permit boundary to accommodate potential adjustments to the project area or downstream impacts (PAP, Appendix E). Based on the wetland delineations, the analysis area for direct effects includes the project area plus a 500-foot buffer (see **Figure 47** and **Figure 48**).

Indirect Effects Analysis Area

The indirect effects analysis area for wetlands includes all of the Armells Creek watershed, and parts of the Sarpy Creek and Rosebud Creek watersheds as shown on **Figure 49.** This analysis area is within and downstream of a 32-km circular area around the Colstrip and Rosebud Power Plants that was determined as a result of trace-metal deposition modeling for special status species. Deposition modeling utilized soil trace-metal background concentrations from a USGS background study (Smith et al. 2013) and air-quality modeling (using 1 percent of the 95-percent upper confidence level (95-percent UCL) of background) (see **Section 4.3, Air Quality** for discussion of modeling methods and results). The 32-km analysis area was defined as the largest spatial extent for indirect effects on special status species where trace metals exceeded 1 percent of the current soil concentrations over the 19-year operations period of the project. Of the eight trace metals modeled, mercury had the greatest deposition distance (approximately 32 km) inside which there could be potential impacts on special status species. To analyze indirect effects on wetlands, this 32-km area was expanded to include the Armells Creek watershed and parts of the Sarpy Creek and Rosebud Creek watersheds. This analysis area is appropriate for analyzing wetlands because mercury that is deposited from the atmosphere may reach wetlands in and downstream of the 32-km circular area. The uppermost parts of the Sarpy and Rosebud Creek watersheds are not in the analysis area because they are outside of the 32-km circular analysis area. Because less than 3 percent of the Tongue River watershed (139 square miles of a total 5,400 square miles) is in the 32-km circular area, it is not included in the analysis area for wetland effects.

3.11.2 Wetlands in the Direct Effects Analysis Area

The direct effects analysis area supports few wetlands because of its location near the top of the watershed and the semiarid climate; however, more wetlands are present within the project area than in other Rosebud Mine permit areas. The Rosebud Mine is adjacent to a watershed divide, with a majority of the mine occurring in the West Fork Armells Creek watershed, and a slight portion (42 acres) occurring in the Upper Sarpy Creek watershed. The watershed divide is formed by the Little Wolf mountain range at the upper end of the watershed. Surface water drains and infiltrates quickly as a result of rugged topography and relatively porous soil. The project area is located on the western end of the Rosebud Mine (**Figures 1** and **2** in **Chapter 1**). The direct effects analysis area contains several small headwater creeks, but does not contain major river channels or associated floodplain riparian wetlands.

3.11.2.1 Location and Classification of Wetlands in the Direct Effects Analysis Area

Eleven wetland areas were identified in the direct effects analysis area, primarily along several small drainages (PAP, Appendix E). The wetlands are located in drainage bottoms where ground water discharges and surface flows accumulate. Discharge from springs and seeps and runoff from snowmelt and rainfall result in soil saturation or inundation primarily during spring and early summer. Springs or seeps in the analysis area that support wetlands flow all or nearly all the time. The majority of the wetlands in the analysis area are typical of Great Plains region wetlands, with most occurring in drainage bottoms and a few along upland seeps. Wetlands typically extend several to hundreds of feet from the ground water surface discharge point before the water percolates into the soil or evaporates. The eleven wetland areas (Wetland A through Wetland F081) comprise 12.21 acres, of which 7.65 acres are within the analysis area. Wetlands occupy 0.11 percent of the analysis area. **Table 67** shows the size, classification, description, and water source for each wetland. **Figure 47** shows the wetlands in the analysis area.

Table 67. Wetland Size, Classification, and Water Source in the Direct Effects Analysis Area.

Wetland Identification	Size (acres)	Classification of Wetland Type[1]	Description	Water Source
A	1.22	PEMB	Wetland in drainage above and below stock pond outside of the project area	Spring
B	1.19	PEMB	Wetland in drainage within the project area	Seep
C	0.80	PEMB	Wetland in drainage within the project area	Spring
D	1.64	PEMB	Wetland in drainage within the project area	Seep
E	1.23	PEMB	Wetland in drainage outside of the project area	Seep
F	2.38	PEMC	Wetland in drainage within the project area	Seep
F028	0.60	PEMB	Wetland in drainage downstream from Wetland C within the project area	Seep
F049	0.46	PEMB	Wetland in drainage within the project area	Leakage below stock pond
F058	2.01	PEMB	Impoundment and wetland in drainage inside and outside of the project area	Spring
F061	0.13	PEMC	Ponded area within drainage within the project area	Surface flow
F081	0.54	PEMB	Wetland in drainage outside of the project area	Surface flow
Total area	**12.21**			

[1]Classification of wetland habitats according to Cowardin et al. 1979.
PEMB: Palustrine (P), Emergent (EM), Saturated (B).
PEMC: Palustrine (P), Emergent (EM), Seasonally Flooded (C).

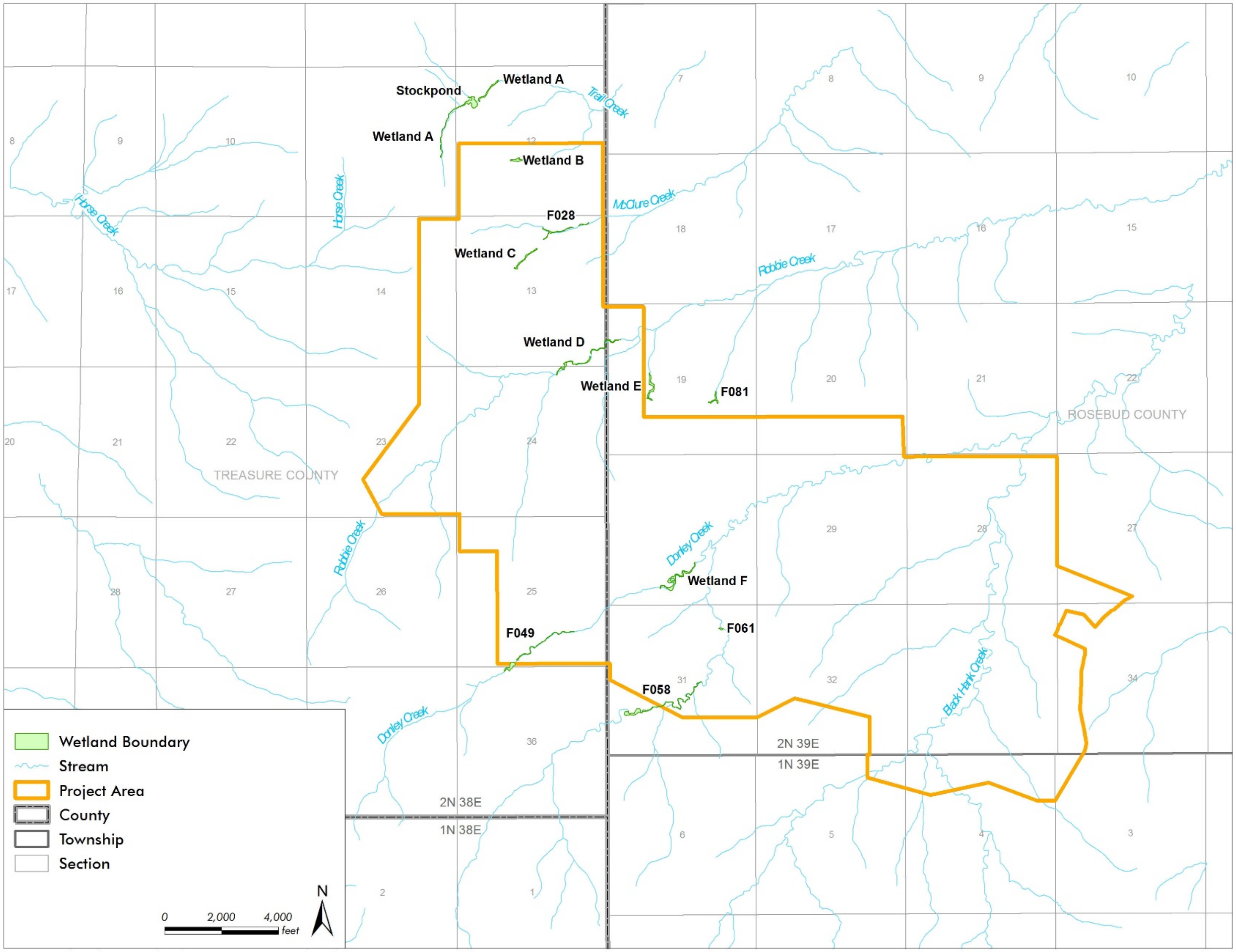

Figure 47. Project Area Wetlands.

All 11 wetlands in the direct effects analysis area are located in the headwaters of tributaries to West Fork Armells Creek (Trail, McClure, Robbie, and Donley Creeks; there are none in the headwaters of Black Hank Creek). The wetlands are classified as palustrine emergent wetlands that are either saturated or seasonally flooded (Cowardin et al. 1979). Palustrine emergent wetlands are characterized by erect, rooted herbaceous hydrophytes with the vegetation being present for most of the growing season and are usually dominated by perennial plants (Cowardin et al. 1979). The dominant vegetation in the wetlands includes Nebraska sedge (*Carex nebrascensis*), meadow barley (*Hordeum brachyantherum*) and other sedge species (*Carex* spp.), threesquare bulrush (*Schoenoplectus pungens*), hardstem bulrush (*Schoenoplectus acutus*), broad-leaved cattail (*Typha latifolia*), and Kentucky bluegrass (*Poa pratensis*) (PAP, Appendix E). The wetlands are supported by hydric soil and are generally saturated or inundated.

3.11.2.2 Functional Assessment

Western Energy evaluated the functions of wetlands that would be impacted by mine operations in July and August 2016 (PAP, Appendix N). Western Energy used the MDT's 2008 Montana Wetland Assessment Method (MWAM) (Berglund and McEldowney 2008) to assess the wetlands. **Table 68** provides a summary of the scores assigned to each wetland that was evaluated. All of the wetlands scored as Category III wetlands (PAP, Appendix N). Category III wetlands are more common, generally less diverse, and often smaller and more isolated than those in Categories I and II, which are higher quality wetland categories. The wetlands showed some capacity for flood attenuation and sediment, nutrient, or toxicant retention and removal. The wetlands had low to moderate quality habitat for wildlife partly due to the heavy livestock use in the area.

Table 68. Functional Category and Units for Potentially Impacted Wetlands in the Analysis Area.

Wetland	Watershed	Functional Category	Functional Units
B	Trail Creek	III	4.8
C	Trail Creek	III	3.8
D	Robbie Creek	III	9.3
E	Robbie Creek	III	5.8
F	Robbie Creek	III	11.0
F028	Trail Creek	III	2.4
F081	Robbie Creek	III	1.9
Total Functional Units			39.0

3.11.2.3 Jurisdictional Determination

The 2013 wetland delineation for the analysis area (PAP, Appendix E) was submitted to the Corps in December 2013. The Corps prepared an approved jurisdictional determination based on the 2013 wetland delineation report and determined all 11 wetlands are isolated and therefore not jurisdictional waters of the U.S. under the authority of Section 404 of the CWA (Corps File No. NWO-2012-01315-MTB) (Corps 2014).

3.11.3 Other Waters of the U.S. in the Direct Effects Analysis Area

Several named drainages occur in the direct effects analysis area, including five tributaries of West Fork Armells Creek (Trail Creek, McClure Creek, Robbie Creek, Donley Creek, and Black Hank Creek and their unnamed tributaries). Within the analysis area, these drainages do not have sufficient flow to develop a defined bed and bank or other characteristics of waters of the U.S. and support upland vegetation (PAP, Appendix E). Additional descriptions of these drainages are provided in **Section 3.7, Water Resources – Surface Water**. **Figure 47** shows the named drainages in the direct effects analysis area.

Two stock ponds in the analysis area were identified as potential waters of the U.S. (PAP, Appendix E). These two stock ponds (near Wetland A and Stock Pond F043) hold water on a perennial basis and have a defined bed and bank. The two stock ponds are the only other potential waters of the U.S. identified during the wetland survey outside of the 11 wetland sites identified.

3.11.3.1 Jurisdictional Determination

Based on the 2013 wetland delineation report, the Corps determined that Trail Creek, McClure Creek, Robbie Creek, and Donley Creek are not waters of the U.S. (Corps 2014) because no defined bed and bank were observed within these drainages. The only two potential waters of the U.S. (Stock Pond F043 and stock pond near Wetland A) were determined by the Corps to be isolated and nonjurisdictional (Corps 2014).

3.11.4 Springs and Seeps in the Direct Effects Analysis Area

Numerous springs and seeps are located in the direct effects analysis area. Springs are associated with Wetlands A, C, and F058. Seeps are associated with Wetlands B, D, E, F, and F028. Seeps and springs are typically located at the upstream ends of the wetlands and supply the water source for the wetlands. The spring types and locations are described in **Section 3.7, Water Resources – Surface Water**. Springs and seeps in the project area are shown in **Figure 48**.

3.11.4.1 Jurisdictional Determination

The seeps and springs associated with the wetlands in the analysis area were determined to not be jurisdictional waters of the U.S. under the authority of Section 404 of the CWA (Corps 2014).

3.11.5 Wetlands in the Indirect Effects Analysis Area

Wetlands occurring in the indirect effects analysis area are shown on **Figure 49**. Approximately 3,003 acres of wetlands have been mapped within the indirect effects analysis area (USFWS 2017b). A majority of the wetlands in the indirect effects analysis area are mapped as freshwater emergent wetlands, with some forested or scrub-shrub wetlands present (**Table 69**). Most of the wetlands occur along drainages or ponds. Although not described in detail in this EIS, general indirect effects on those wetlands are described in **Section 4.11, Wetlands and Riparian Zones**.

Table 69. Wetlands in the Indirect Effects Analysis Area.

Wetland Type	Acres
Freshwater Emergent Wetland	2,781.75
Freshwater Forested/Shrub Wetland	221.62
Total	**3,003.37**

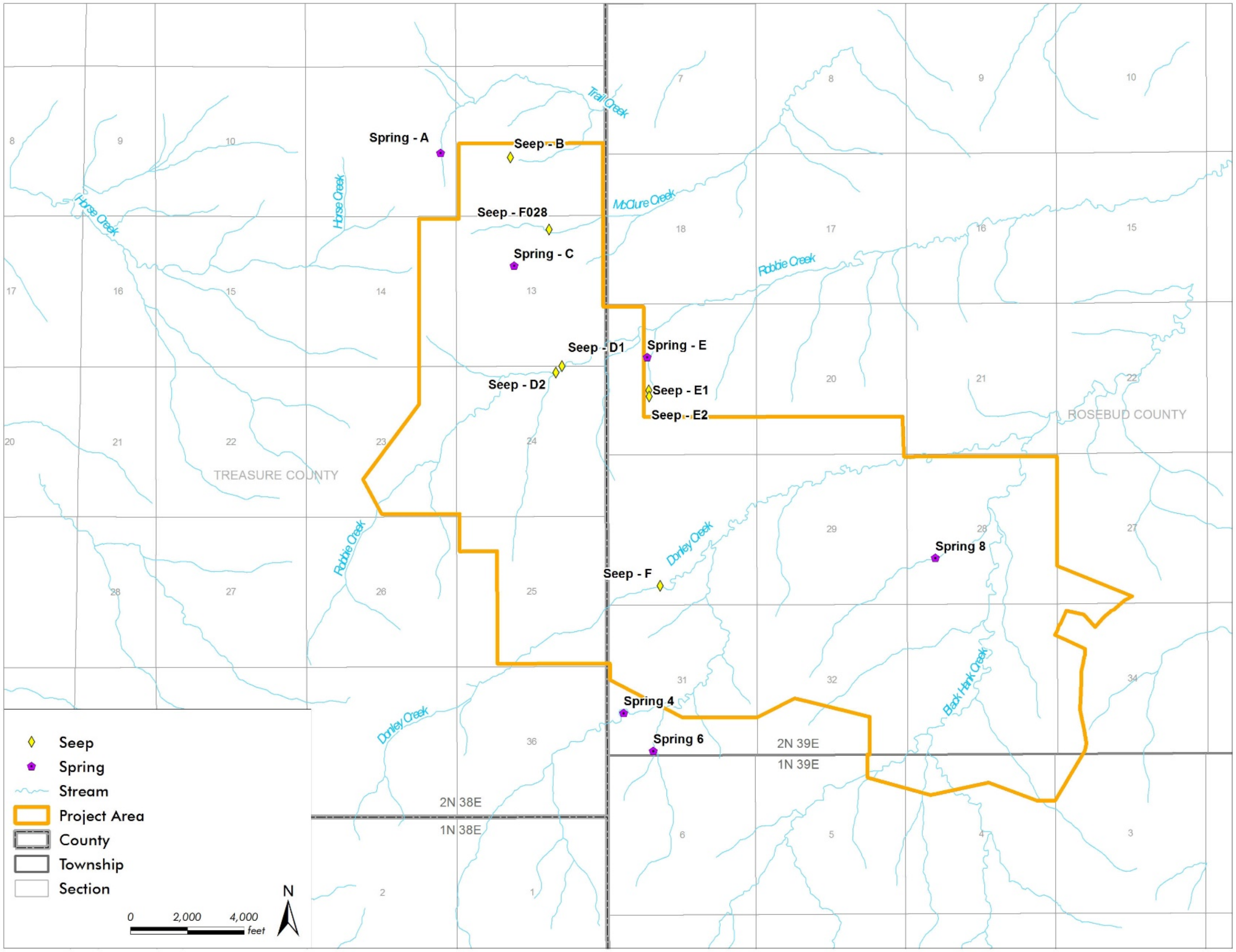

Figure 48. Project Area Seeps and Springs.

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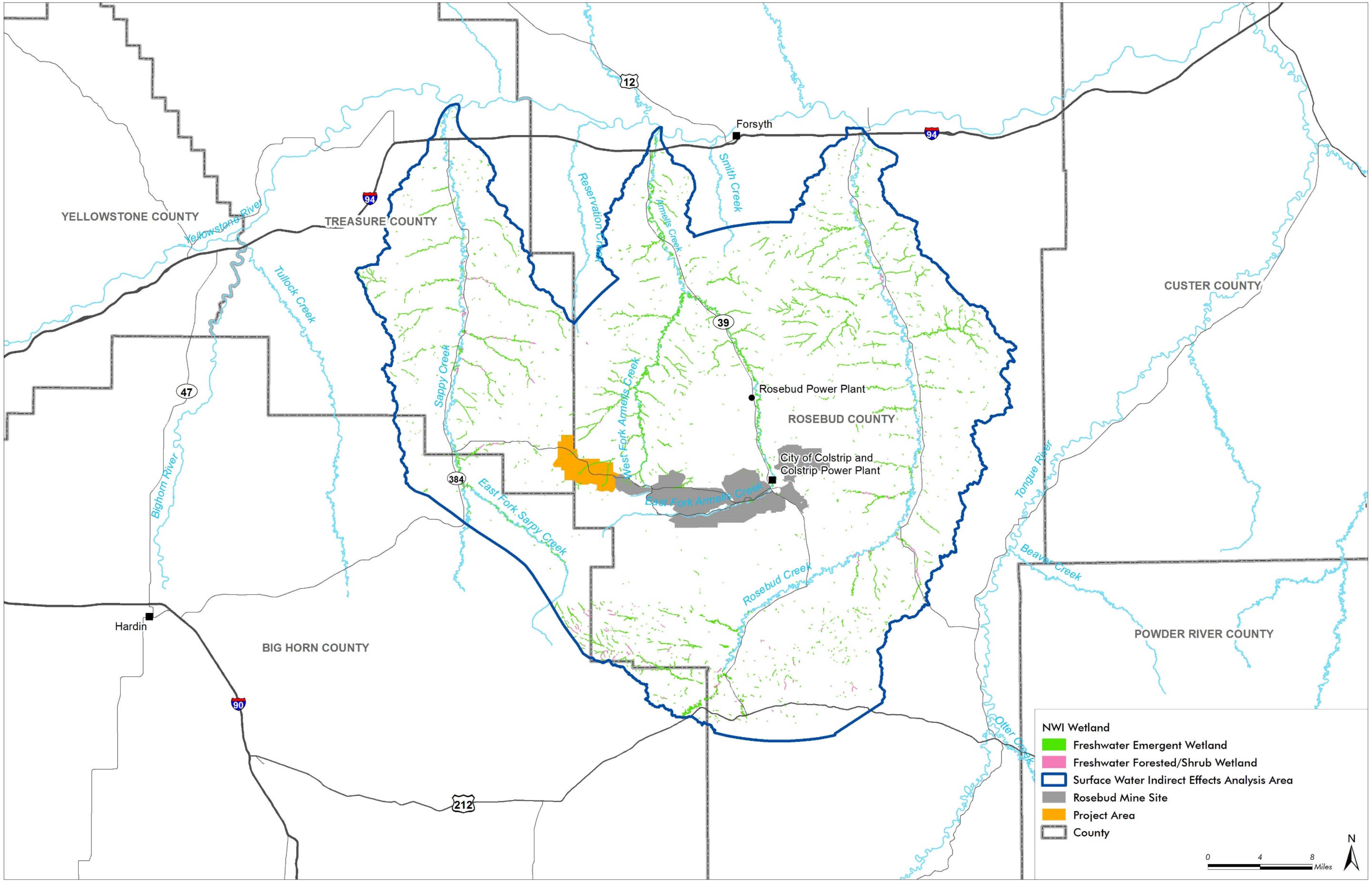

Figure 49. Wetlands in the Indirect Effects Analysis Area.

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3.12 FISH AND WILDLIFE RESOURCES

3.12.1 Introduction

This section describes fish and wildlife resources that occur within the analysis area. Fish and wildlife resources consist of a variety of big game species, upland game birds, migratory birds, small mammals, amphibians, reptiles, and aquatic species. The analysis area for fish and wildlife resources is defined below in **Section 3.12.1.2, Analysis Area.** The regulatory requirements that protect fish and wildlife are also discussed directly below. Information specific to special status species can be found in **Section 3.13, Special Status Species.**

3.12.1.1 Regulatory Framework

Federal Requirements

The Bald and Golden Eagle Protection Act of 1940 (16 USC 668–668c) prohibits taking eagles, their eggs, eagle parts, or their nests without a permit issued by USFWS. A "take" is defined as any of the following actions: to pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb eagles. A recently clarified definition (72 FR 31132) explicitly defines disturbance and protects eagles from impacts of human-initiated activities primarily around active, alternate, and historic nest sites. The definition of "disturb" includes any activity that will cause, or is likely to cause, based on the best scientific information available (1) injury to an eagle; (2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior; or (3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior.

Migratory birds (including raptors) and active nests are protected under the Migratory Bird Treaty Act (MBTA) (16 USC 703–712). Under the MBTA, it is illegal to take any migratory bird, its eggs, its parts, or any bird nest except as permitted (such as waterfowl hunting licenses, falconry licenses, or bird banding permits) by USFWS. The definition of take under the act includes any attempts or acts of pursuing, hunting, shooting, wounding, killing, trapping, capturing, possessing, or collecting. Removal of active nests resulting in the loss of eggs or young is also prohibited (16 USC 703–712). In addition, EO 13186 directs federal agencies to develop a Memorandum of Understanding with USFWS to further implement the MBTA and promote the conservation of migratory bird populations.

Information on federal and state regulatory requirements for special status species can be found in **Section 3.13, Special Status Species.**

State Requirements

Under MSUMRA, Subchapter 7 of the ARM includes regulations on topsoiling, revegetation, and protection of wildlife and air resources. ARM 17.24.751(1) prohibits mining operations that may jeopardize continued existence of federally listed Threatened or Endangered species, result in adverse modification of critical habitat, or result in unlawful take of bald or golden eagles including active nests or eggs. ARM 17.24.751(2)(a–g) requires avoidance and minimization measures as well as BMPs for siting and construction of electric power lines, roads, and fencing that minimize adverse impacts on wildlife habitat. MSUMRA and the associated administrative rules require submittal of pre-mine wildlife surveys, preparation of a fish and wildlife plan, periodic monitoring and reporting during operations, and reclamation of wildlife habitats.

FWP regulates fish and wildlife under the state Fish, Wildlife, and Parks Commission (87-1-301, MCA) and designates state species of concern (SOC) in conjunction with the Montana Natural Heritage Program (MNHP). For more information on SOC and MNHP, see **Section 3.13, Special Status Species**.

Local Requirements

There are no applicable local regulations for fish and wildlife resources within or near the analysis area.

3.12.1.2 Analysis Area

Direct Effects Analysis Area

The direct effects analysis area for fish and wildlife resources is the project area plus a 1-mile buffer outside of the project area" (**Figure 50**). This analysis area includes the 4,260 acres of direct habitat disturbance within the project area. It also includes a 1-mile perimeter buffer because wildlife are mobile and can be affected by disturbance outside the project area also. Wildlife in the analysis area were assessed by reviewing data provided by ICF International (2011, 2013, 2014, 2016), FWP, MNHP, and USFWS. Data includes baseline surveys and annual and long-term monitoring reports for the Rosebud Mine completed by ICF, and species occurrence data provided by FWP, MNHP, and USFWS. Baseline and annual surveys conducted by ICF International also include the 1-mile perimeter buffer around the project area, defined as the direct effects analysis area. Special status species have been documented on the Rosebud Mine in previous years using a 15-mile perimeter around the project area established by KC Harvey Environmental, LLC (KC Harvey Environmental) in conjunction with Western Energy. Special status species are discussed under **Section 3.13, Special Status Species.**

Indirect Effects Analysis Area

The indirect effects analysis area for fish and wildlife resources consists of the operational boundaries of the Colstrip and Rosebud Power Plants plus a 32-km area around each of the power plants (see **Section 3.10, Vegetation** for a figure showing the indirect effects analysis area and the vegetation communities within in it). This analysis area was determined as a result of trace-metal deposition modeling for special status species that utilized soil trace-metal background concentrations from a USGS background study (Smith et al. 2013) and air-quality modeling (using 1 percent of the 95-percent upper confidence level (95-percent UCL) of background) (see **Section 4.3, Air Quality** for discussion of modeling methods and results). The 32-km analysis area was defined as the largest spatial extent for indirect effects on special status species where trace metals exceeded 1 percent of the current soil concentrations over the 19-year project operations period. Of the eight trace metals modeled, mercury had the greatest deposition distance (about 32 km) inside which there could be potential impacts on special status species. This analysis area was also used as the basis for the fish and wildlife indirect effects analysis area.

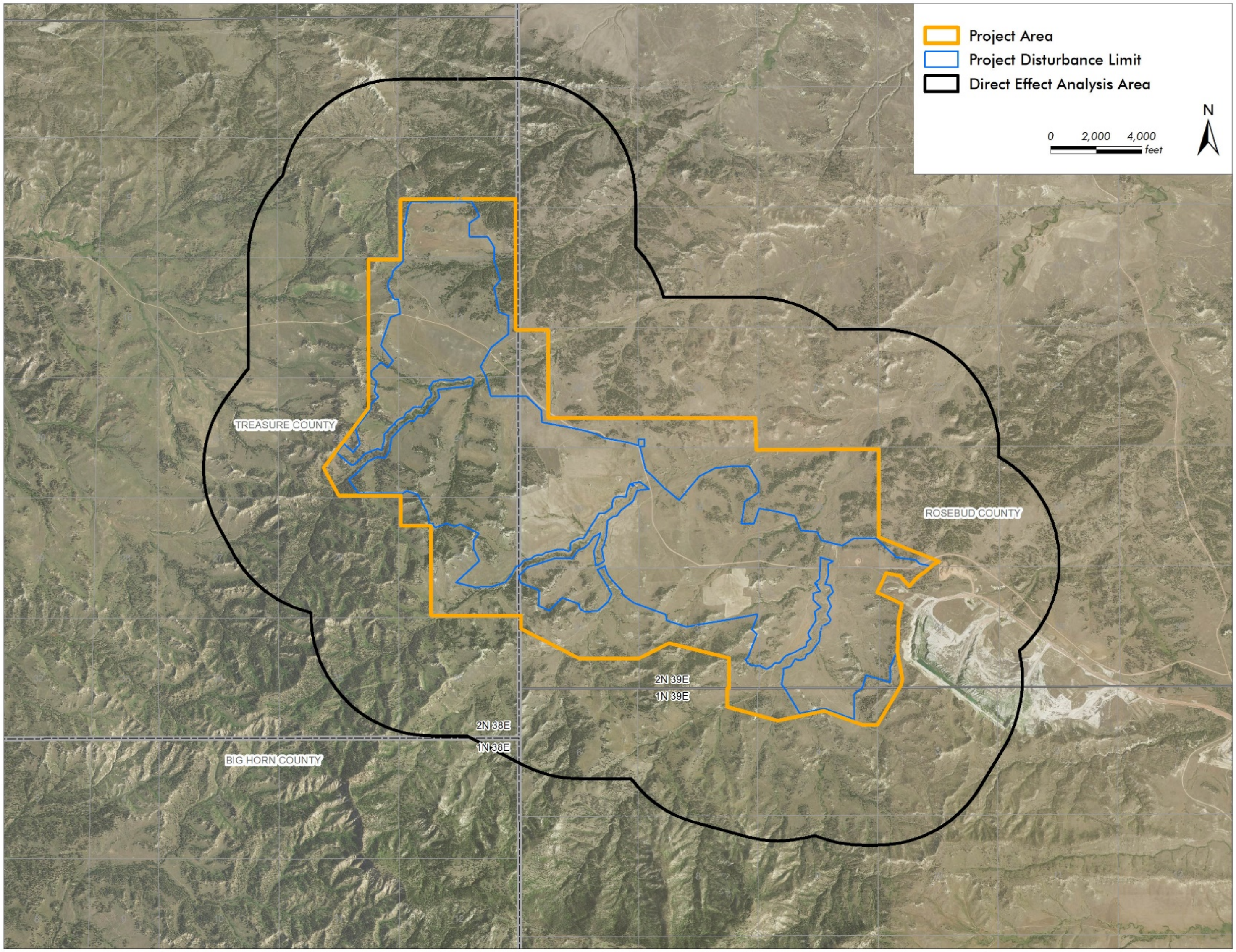

Figure 50. Fish and Wildlife Direct Effects Analysis Area.

3.12.1.3 Fish and Wildlife Habitat Characteristics

Wildlife habitat types in the direct effects analysis area were grouped into seven categories: lowlands (woody draws, wetlands, and ponds); grasslands; upland shrublands (sagebrush and mixed shrubland); conifer/sumac woodlands (conifer/sumac); agricultural lands (improved pastures and croplands); disturbed/developed lands (scoria pits, ranch yards, and county roads); and sandstone piles/cliffs (see **Section 3.10, Vegetation** for a detailed description of these categories). The analysis area consists primarily of grasslands, conifer/sumac woodlands, and upland shrublands, which together encompass about 80 percent (5,385 acres). Agricultural lands and pasture comprise about 15 percent (1,048 acres), and interspersed patches of lowlands, sandstone piles/cliffs, and disturbed/developed lands comprise the remaining 5 percent (313 acres).

Upland shrublands and grasslands encompass about 51 percent of the analysis area, and provide habitat for a variety of species. These species include small animals such as desert cottontail and their predators, rodent species (e.g., voles, mice, ground squirrels, and woodrats), red fox, and badger. Common ground-nesting birds such as meadowlark and lark sparrow are also found. Larger mammals such as mule deer and pronghorn are found in areas dominated by grassland and shrub species. Reptiles such as bullsnake and eastern yellow-bellied racer, and amphibians such as plains spadefoot and Woodhouse's toad are found in moist and dry habitats. SOC including red bats, fringed myotis, sage thrasher, and northern sagebrush lizards also use upland grassland and shrubland habitats (see **Section 3.12, Special Status Species** for information on SOC in the analysis area).

Conifer/sumac woodlands encompass about 26 percent of the analysis area. These areas are dominated primarily by ponderosa pine, skunkbush sumac, snowberry, creeping juniper, blue grama, and green needlegrass. Common wildlife species in wooded areas include mule deer, elk, North American porcupine, least chipmunk, and squirrels. Avian species include nuthatches, hairy woodpecker, black-capped chickadee, and warblers (ICF 2011).

Aquatic habitat is limited within the direct effects analysis area. Seven springs and nine manmade stock ponds occur within or very near the project area boundary (**Figure 20, Section 3.7 Water Resources – Surface Water**). Additionally, portions of Trail, McClure, Robbie, Donley, and Black Hank Creeks occur within the project area boundary (**Figure 20, Section 3.7 Water Resources – Surface Water**). Several of the springs in the area form the headwaters to the creeks named above. Some contain permanent water and wetlands that extend a few hundred feet from the discharge point before percolating into the soil or evaporating. Ponds are mostly manmade and often contain standing water during the spring and summer seasons. The creeks listed above are intermittent or ephemeral. **Section 3.7, Water Resources – Surface Water** contains a detailed description of aquatic habitat in the analysis area.

Lowland areas, especially those containing riparian and wetland habitat, provide shelter and foraging for numerous amphibians, reptiles, birds, small and large mammals, and invertebrates. Common species in these areas include boreal chorus frogs, Woodhouse's toad, plains garter snake, red-winged blackbird, North American porcupine, various small mammal species (e.g., mice, voles, shrews), and big game including mule deer. A variety of ducks and shorebirds (e.g., sandpipers) also use this habitat. Numerous SOC including several bat species, northern leopard frog, and plains spadefoot toad use wet areas for foraging and breeding.

Wildlife species associated with agricultural and disturbed/developed lands consist mostly of generalist species that inhabit a variety of habitats. Barn swallow, black-billed magpie, mourning dove, house and deer mouse, and desert cottontail are common. Predators common in these areas include raccoon, coyote, and red fox.

Sandstone pile/cliff areas occur along ridges and geologic monolith features in the valley bottoms. Cliffs and outcrops have varied erosion rates and little to no soil or vegetation. Ridges and monolith features are a minor community type but provide important nesting habitat for some species such as golden eagle and prairie falcon. Sandstone pile/cliff areas also provide thermal cover/hibernacula for many reptiles and amphibians as well as roosting habitat for bats.

Fish and wildlife habitat in the indirect effects analysis area is dominated by communities similar to those found within the project area. See **Section 3.13** for more information.

2012 Wildland Fires

In 2012 two wildland fires burned 221 acres in the southern portion of the project area (**Figure 54**, **Figure 55**, and **Figure 56** show the fire boundaries). The fires burned through mixed shrub, conifer/sumac, and grassland habitats. Based on studies outlined in the General Technical Report prepared by the U.S. Forest Service (Smith 2000), it is anticipated that grassland communities will recover quickly from the fires, while shrub and forest communities will likely return to pre-fire conditions more slowly.

Based on post-fire 2013 wildlife monitoring, it is not clear how the fires may have changed wildlife activity patterns such as migration, nesting, or foraging within these habitats (ICF 2014). However, while the scope of the most recent wildlife monitoring study is short-term, it indicates that large-game observations between 2012 and 2013 have not changed substantially following the fire. No large-game surveys were conducted in 2015. Similarly, most raptor nests on the burned area that were intact in 2012 remained intact in 2013. Nesting success was lower in 2013, but increased in 2014 and 2015 (see **Section 3.12.4.4** below).

3.12.2 Mammals

3.12.2.1 Small Mammals

About 20 small-mammal species (excluding bats) have been documented on the Rosebud Mine since 1972. Rodents recorded on the Rosebud Mine include yellow-bellied marmot, red squirrel, least chipmunk, thirteen-lined ground squirrel, northern pocket gopher, western harvest mouse, deer mouse, Wyoming pocket mouse, bushy-tailed woodrat, prairie vole, house mouse, porcupine, beaver, and muskrat. Masked shrew and at least three rabbit species (white-tailed jackrabbit, desert cottontail, and other cottontail) have also been documented on the mine (ICF 2014).

Generalist species including deer mouse, house mouse, red squirrel, and cottontail rabbits likely occur in all habitat types within the analysis area. Grassland, shrubland, and agricultural land within the analysis area provides habitat for other small mammals including desert cottontail rabbit, western harvest mouse, and northern pocket gopher. Other small mammals likely to occur in association with grassland and agricultural areas include thirteen-lined ground squirrel and Wyoming pocket mouse. Wetlands and riparian areas in lowland areas provide potential habitat for a variety of mammals such as raccoon, prairie and meadow vole, and western harvest mouse.

Many of the species listed above also occur within the 32-km indirect effects analysis area. Most of these species, including the least chipmunk, bushy-tailed woodrat, deer mouse, meadow vole, prairie vole, and raccoon, are wide-ranging in Montana (MT). Species such as the yellow-bellied marmot and red squirrel are more common in western and southern MT (MNHP and FWP 2017).

3.12.2.2 Bats

Several bat species have been documented in the direct effects analysis area. Between 2011 and 2013 bat surveys were conducted for the direct effects analysis area, which followed a two-step process (ICF 2011). The first step involved surveys characterizing potential roosting and foraging habitat. The second step involved acoustic surveys of bat echolocation calls conducted during summer nighttime hours in 2011.

Habitat surveys of the direct effects analysis area identified 10 distinct sites for acoustic surveys (Tigner 2011). These were typically adjacent to water impoundments, rock ridgelines and cliffs, creek channels, and mature pine stands. Higher levels of bat activity were documented nearer to surface water. Echolocation survey analysis identified 10 of the 15 bat species known to occur in MT in the direct effects analysis area (Foresman 2001). Nearly 11,000 call recordings indicate a substantial level of bat activity.

For information on MNHP bat SOCs, see **Section 3.13, Special Status Species**

Bat species recorded in the direct effects analysis area include western small-footed myotis, long-eared myotis, big brown bat, silver-haired bat, red bat, and long-legged myotis. Deciduous trees in riparian areas provide roosting sites for bats such as red bats, silver-haired bats, and long-eared myotis. Pinion-juniper woodlands and shrublands provide roosting habitat for species such as long-legged myotis. The western small-footed myotis appears to inhabit dry, rocky areas and the big brown bat is a habitat generalist that ranges throughout the continental U.S. (Fitzgerald 1994). No bat hibernacula were identified during the 2011 and 2013 bat surveys.

Most MT bat species are likely to occur within the 32-km indirect effects analysis area. Common species such as the big brown bat, long-eared myotis, long-legged myotis, and western small-footed myotis occur throughout the entire state (MNHP and FWP 2017). SOC likely to occur in the 32-km analysis area are described in detail in **Section 3.13, Special Status Species**.

3.12.2.3 Carnivores

Between 1972 and 2015, a total of 10 carnivores—coyote, red fox, raccoon, long-tailed weasel, American badger, striped skunk, bobcat, mountain lion, mink, and black bear—have been documented on the Rosebud Mine (ICF 2014). The raccoon, striped skunk, bobcat, mountain lion, and mink have not been documented within the past 10 years, although surveys for carnivores have not been conducted. Most recent carnivore records are results of incidental sightings. Common species such as red fox and coyote likely occur in all habitat types within the direct effects analysis area. Other carnivores that have been documented in the direct effects analysis area include American badger, long-tailed weasel, and black bear (ICF 2011; 2016).

Most carnivore species that occur within the state of MT potentially occur within the 32-km indirect effects analysis area. All of the 10 carnivore species listed above have a broad geographic range throughout the state, and likely occur throughout the entire 32-km analysis area (MNHP and FWP 2017).

3.12.3 Big Game Animals

Game animals are considered economically important species in MT, particularly big game species such as elk and deer. Big game mammals found within the analysis area include elk, mule deer, and pronghorn. Important upland game birds include introduced species such as wild turkey, ring-necked pheasant, and gray partridge, and native species including sharp-tailed grouse. Most of the analysis area also provides potential habitat for small game mammals such as cottontail rabbit.

In 2006, 2011, 2012, and 2013, aerial and ground surveys for big game were conducted in the analysis area. Long-term monitoring for big game has been ongoing at the Rosebud Mine since 1974 (Fritzen 1995). Mule deer, elk, and pronghorn were all observed during the 2006, 2011, 2012, and 2013 ground surveys. Winter aerial surveys conducted in January 2011 detected only mule deer (ICF 2011). A follow-up survey in February 2011 detected all three big game species. The low numbers observed during the January 2011 aerial survey were attributed to a large snowstorm that occurred immediately prior to the survey date. No big game surveys were conducted in 2015. Big game surveys were scheduled for 2016 (results are not yet available) and are planned every three years thereafter.

3.12.3.1 Mule Deer

Mule deer occupy all ecosystems from grasslands to alpine tundra and are found throughout the western two-thirds of the U.S. They generally migrate seasonally, spending summer months at higher altitudes and moving to lower elevations during winter. Snow depth often influences mule deer migration between summer and winter range.

A study done by Fritzen (1995) indicated that mule deer populations on the Rosebud Mine increased between 1974 and 1994. The deer distribution patterns have also shifted from outlying portions of the mine to reclaimed areas. According to the MNHP database, the direct effects analysis area is considered year-round mule deer range (winter and summer). Mule deer likely migrate locally throughout the wildlife analysis area and occur in nearly every habitat on the Rosebud Mine, although previous studies indicate that they favor reclaimed areas and avoid mixed-shrub areas (Fritzen 1995). Fall 2011 surveys detected mule deer in every habitat type in the direct effects analysis area, whereas winter surveys conducted in 2012 and 2013 indicated that the deer seemed to favor ponderosa pine and grassland areas (ICF 2011, 2013, 2014).

Mule deer observations have fluctuated at the Rosebud Mine since 1974 and have been steadily increasing since 1994 (Fritzen 1995; ICF 2011, 2013, 2014). Mule deer appear to migrate in and out of the analysis area and also likely occur throughout the 32-km indirect effects analysis area. Winter 2011 aerial surveys conducted in the direct effects analysis area detected 40 mule deer, whereas fall 2011 flights detected 54 mule deer. Winter flight surveys conducted in 2012 and 2013, recorded 172 and 268 mule deer, respectively. The most recent surveys indicate a minimum population estimate of 1.7 deer per square mile (ICF 2014), which is up from previous minimum population estimates of 1.4 and 1.0 deer per square mile recorded in 2011 and 2012, respectively. Productivity and survivability within the Rosebud Mine remain high with a fawn to female ratio of 95:100. The 34-year average ratio of males to females on the Rosebud Mine is 32:35. **Table 70** summarizes mule deer survey numbers and habitat associations between 2011 and 2013.

Table 70. Mule Deer Observation and Habitat Associations on the Rosebud Mine between 2011 and 2013.

Year	Individual Mule Deer Observed	Density (Deer/mi^2)	Habitat Association (Individual Deer Observed)					
			LL/BO	UG/G	C/PP	AP/D	US/S	RG
January 21, 2011	2	0.1	0	0	2	0	0	n/a
February 8, 2011	38	1.0	5	26	69	0	0	n/a
October 14, 2011	54	1.4	44	4	37	9	6	n/a
January 24, 2012	68	0.7	0	0	43	0	7	50
February 13, 2012	104	1.0	5	20	5	6	4	60
February 19, 2013	97	1.0	0	10	33	n/a	22	32
February 27, 2013	171	1.7	3	60	17	n/a	12	79

Source: ICF 2011, 2012, 2014.

2011 Categories: LL = lowland; C = conifer; UG = upland grassland; US = upland shrubland; AP = agricultural/pasture.

2012 Categories: BO = bottomland; D = disturbed; G = grassland; PP = ponderosa pine; RG = reclaimed grassland; S = sagebrush shrublands.

2013 Categories: BO = bottomland; G = grassland; PP = ponderosa pine; RG = reclaimed grassland; S = sagebrush shrublands.

3.12.3.2 Elk

Elk are generalists and occur in a variety of habitats. They are adapted to the transitional habitat that occurs within the direct effects analysis area and likely occur throughout the 32-km indirect effects analysis area. Typically, elk inhabit forested areas that provide shelter and breeding habitat, but will migrate to lower-elevation grasslands and shrublands to forage and/or during periods of heavy snow in higher-elevation forests. Winter range is often located in transitional areas that commonly occur in foothills with a southern or western exposure. Elk occur throughout the Rosebud Mine and the direct effects analysis area, with an affinity for conifer/sumac woodland habitat, and likely migrate locally within the analysis area. The direct effects analysis area is considered year-round elk range (winter and summer) (MNHP and FWP 2013).

Elk observations have increased on the Rosebud Mine since monitoring began in 1974. During 2011 winter aerial surveys for the direct effects analysis area, elk were detected in upland grassland and conifer woodlands, whereas during the fall 2011 surveys, elk were only detected in conifer woodland habitat. Survey flights conducted during winter 2011 detected 113 elk, whereas fall 2011 surveys detected 64. During 2012 winter surveys, only two elk were detected in an open grassland area surrounded by conifer woodland habitat (ICF 2013). In 2013, 32 elk were observed in conifer woodland habitat during aerial winter surveys and 9 cow elk were observed in grassland habitat during ground surveys in the spring (ICF 2014).

Fall and winter densities within the direct effects analysis area have ranged from 1.7 to 3.0 individuals per square mile in 2011 (ICF 2011). Two large herds in the direct effects analysis area contained 28 and 53 animals in 2011. According to the 2011 wildlife baseline survey report, productivity appeared to be high throughout the Rosebud Mine with a calf to cow ratio of 37:100 observed during the fall of 2011 (ICF 2011). **Table 71** summarizes elk survey numbers and habitat associations between 2011 and 2013.

Table 71. Elk Observations and Habitat Associations on the Rosebud Mine between 2011 and 2013.

Year	Individual Elk Observed	Density (Elk/mi^2)	Habitat Association (Individual Elk Observed)					
			LL/BO	UG/G	C/PP	AP/D	US/S	RG
February 8, 2011	113	3. 0	0	4	108	0	0	0
October 14, 2011	64	1.7	0	0	64	0	0	0
February 13, 2012	2	n/a	0	2	0	0	0	0
February 19, 2013	29	n/a	0	0	29	0	0	0
May 2, 2013	9	n/a	0	0	0	0	9	0

Source: ICF 2011, 2012; 2014.
2011 Categories: LL = lowland; C = conifer; UG = upland grassland; US = upland shrubland; AP = agricultural/pasture.
2012 Categories: BO = bottomland; D = disturbed; G = grassland; PP = ponderosa pine; RG = reclaimed grassland; S = sagebrush shrublands.
2013 Categories: BO = bottomland; G = grassland; PP = ponderosa pine; RG = reclaimed grassland; S = sagebrush shrublands.
n/a – not applicable due to lack of data.

3.12.3.3 Pronghorn

American pronghorn inhabit grasslands and semi-desert shrublands on rolling topography that provides good visibility (FWP 2011). Pronghorn tend to favor vast, open areas and are typically sensitive to human presence including residential, commercial, and industrial development (Sawyer et al. 2005). According to the MNHP database, the direct effects analysis area is considered year-round pronghorn range, although local migrations within the analysis area are likely.

Pronghorn observations on the Rosebud Mine have fluctuated over the past three years. Fall 2011 aerial surveys detected only one pronghorn, and no pronghorn were detected during the winter months (ICF 2011). During the 2012 surveys, 18 pronghorn were observed in grassland and agricultural habitat and in 2013, 61 pronghorn were observed in both native and reclaimed grassland and shrublands.

The minimum population estimates for the entire Rosebud Mine in 2013 were 0.6 pronghorn per square mile, which is lower than the long-term average of 1.6 pronghorn per square mile (1974 through 2013). Additionally, several individuals were observed during ground surveys in upland grassland and shrubland habitat on both the Rosebud Mine and the direct effects analysis area during all seasons. **Table 72** summarizes pronghorn survey numbers and habitat associations between 2011 and 2013.

Table 72. Pronghorn Observations and Habitat Associations on the Rosebud Mine between 2011 and 2013.

Year	Individual Pronghorn Observed	Density (Pronghorn/mi^2)	Habitat Association (Individual Pronghorn Observed)					
			LL/BO	UG/G	C/PP	AP/D	US/S	RG
October 14, 2011	1	n/a	0	1	0	0	6	0
February 13, 2012	18	0.2	0	11	0	7	0	0
February 27, 2013	61	0.6	0	10	0	0	22	29

Source: ICF 2011, 2012, 2014.
2011 Categories - LL = lowland; C = conifer; UG = upland grassland; US = upland shrubland; AP = agricultural/pasture.
2012 Categories - BO = bottomland; D = disturbed; G = grassland; PP = ponderosa pine; RG = reclaimed grassland; S = sagebrush shrublands.
2013 Categories - BO = bottomland; G = grassland; PP = ponderosa pine; RG = reclaimed grassland; S = sagebrush shrublands.

Pronghorn occur throughout the majority of MT and likely occur throughout the majority of the 32-km indirect effects analysis area (MNHP and FWP 2017).

3.12.3.4 Other Big Game Species

Other ungulates with the potential to be present in the direct effects analysis area are white-tailed deer, moose, and bighorn sheep. White-tailed deer occur throughout MT and are present in the Colstrip area where they mainly use creek-bottom habitats (MDSL 1977). Moose prefer heavily wooded, riparian habitats of willows and aspens, which are not common in eastern MT or the direct effects analysis area. One moose was observed in the Area C portion of the Rosebud Mine in 2014 (Yde 2014). Prior to this recent observation, the last reported sighting of a moose in Rosebud County near Colstrip was 15–20 years ago (MNHP and FWP 2013). Bighorn sheep occur in a variety of habitats in MT, from alpine to grasslands. An important component of any bighorn sheep habitat is rough, rocky terrain used to escape from predators (Foresman 2001). Escape habitat is largely absent from the direct effects analysis area and the general region. Bighorn sheep have been reported in Rosebud County in the last 10–15 years (MNHP and FWP 2013) and may represent individuals moving through the area on breeding dispersals instead of resident animals (Forbs and Hogg 1999).

Big game species including bighorn sheep and white-tailed deer likely occur within the entire 32-km indirect effects analysis area where appropriate habitat for these species exists. Moose generally occur within western portions of MT and populations of this species are less likely to be widespread throughout the indirect effects analysis area (MNHP and FWP 2017).

3.12.4 Birds

3.12.4.1 Upland Game Bird Species

Upland game birds (e.g., sharp-tailed grouse, wild turkeys, ring-necked pheasants, gray partridge, and mourning dove) have close association with various habitats in the analysis area and forage in various habitats including mixed tree and shrub grasslands, agricultural lands, and upland shrublands within the area.

Sharp-tailed grouse typically inhabit pockets of open grassland that contain interspersed shrubs and brush and some trees (MNHP 2014a). Breeding grounds (leks) for sharp-tailed grouse usually occur in open grassland pockets surrounded by shrubs. Nesting usually occurs within about ½ mile of a lek in habitat containing more cover. Foraging typically occurs within both grassland and shrubland habitat, and young typically forage within ½ mile of nests (MNHP 2014a).

A total of 57 sharp-tailed grouse leks have been documented on the entire Rosebud Mine survey area (including the project area and areas adjacent [between 0.5 and 2.5 miles] from the mine boundary). A total of 28 active leks were observed on the Rosebud Mine in 2015, which is up from the 18 active leks recorded in 2013. One potential new site was observed in an alfalfa field within the vicinity of Area C (ICF 2016). Of the 18 leks, 10 were found in reclaimed habitat in 2013 and were also documented in currently permitted areas (Areas A–E) and the project area. The collective counts for male sharp-tailed grouse in 2013 totaled 205. Lek sizes varied from 1 to 29 males, an average of 11.4 males per lek. Peak active lek averages ranged from 5.8 to 18.5 males between 1973 and 2013. Individual grouse numbers have also fluctuated during the same period, ranging from 37 individuals in 2003 to 318 observed in 1980 (ICF 2014). **Figure 51**, **Figure 52**, and **Figure 53** show sharp-tailed grouse lek locations identified on the Rosebud Mine.

Ring-necked pheasants and mourning dove have also been detected in upland grassland, lowland riparian habitat, and agricultural lands in the direct effects analysis area. Additionally, wild turkeys have been observed in lowland grassland and woodland habitat associated with Black Hank Creek in the southeastern portion of the project area.

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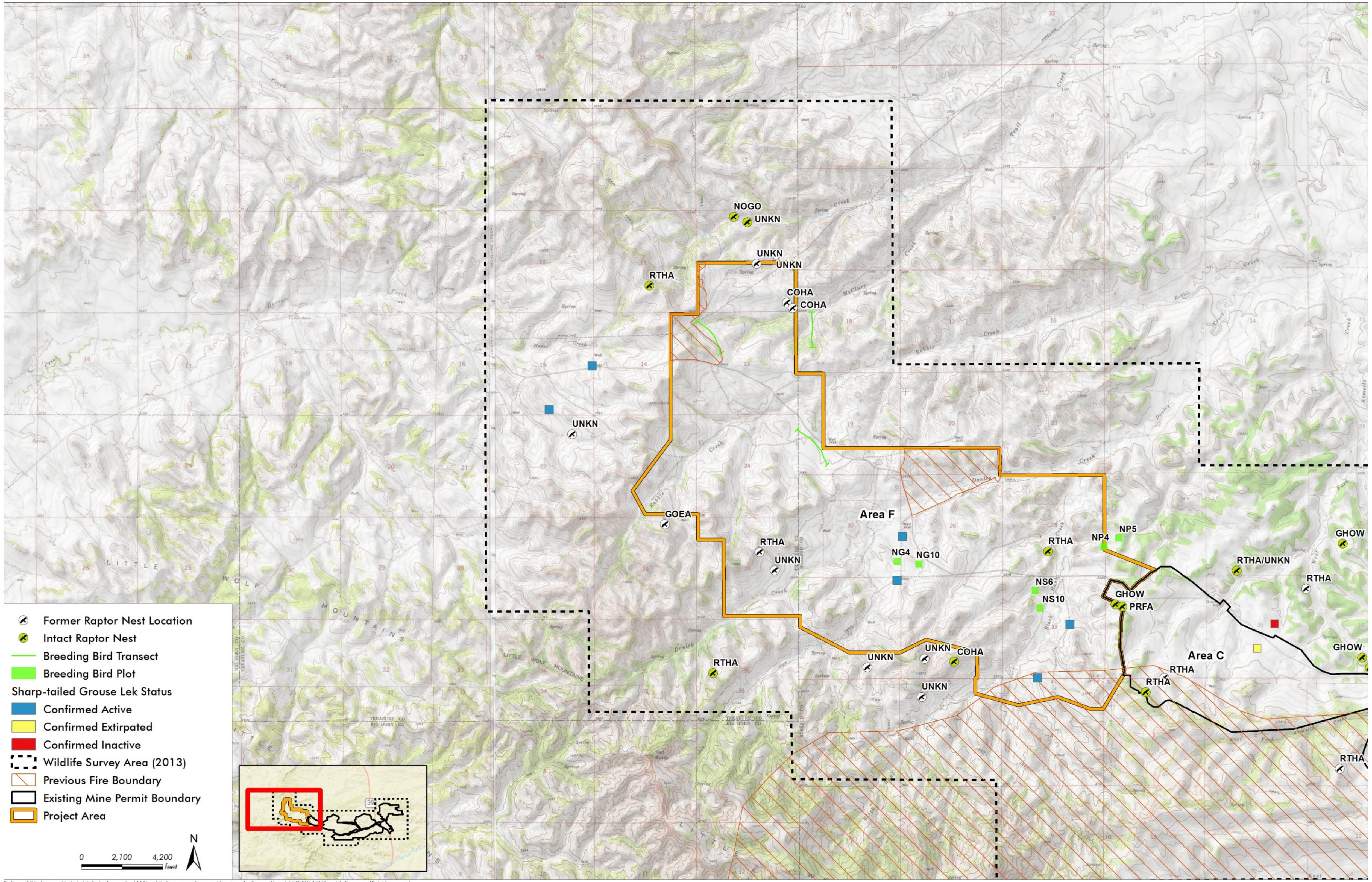

Figure 51. Sharp-Tailed Grouse Leks and Raptor Nests on the Rosebud Mine, Western Section.

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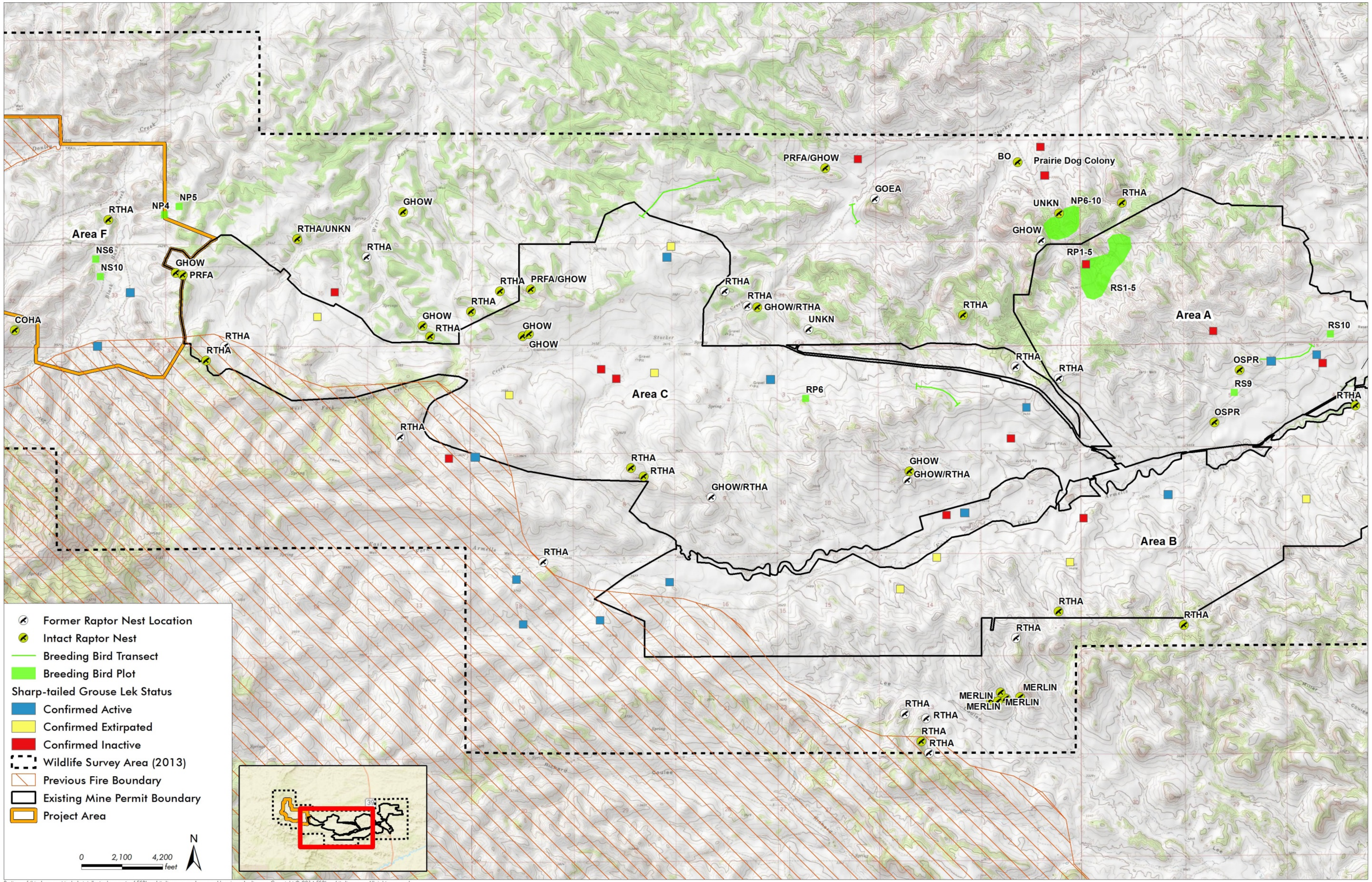

Figure 52. Sharp-Tailed Grouse Leks and Raptor Nests on the Rosebud Mine, Central Section.

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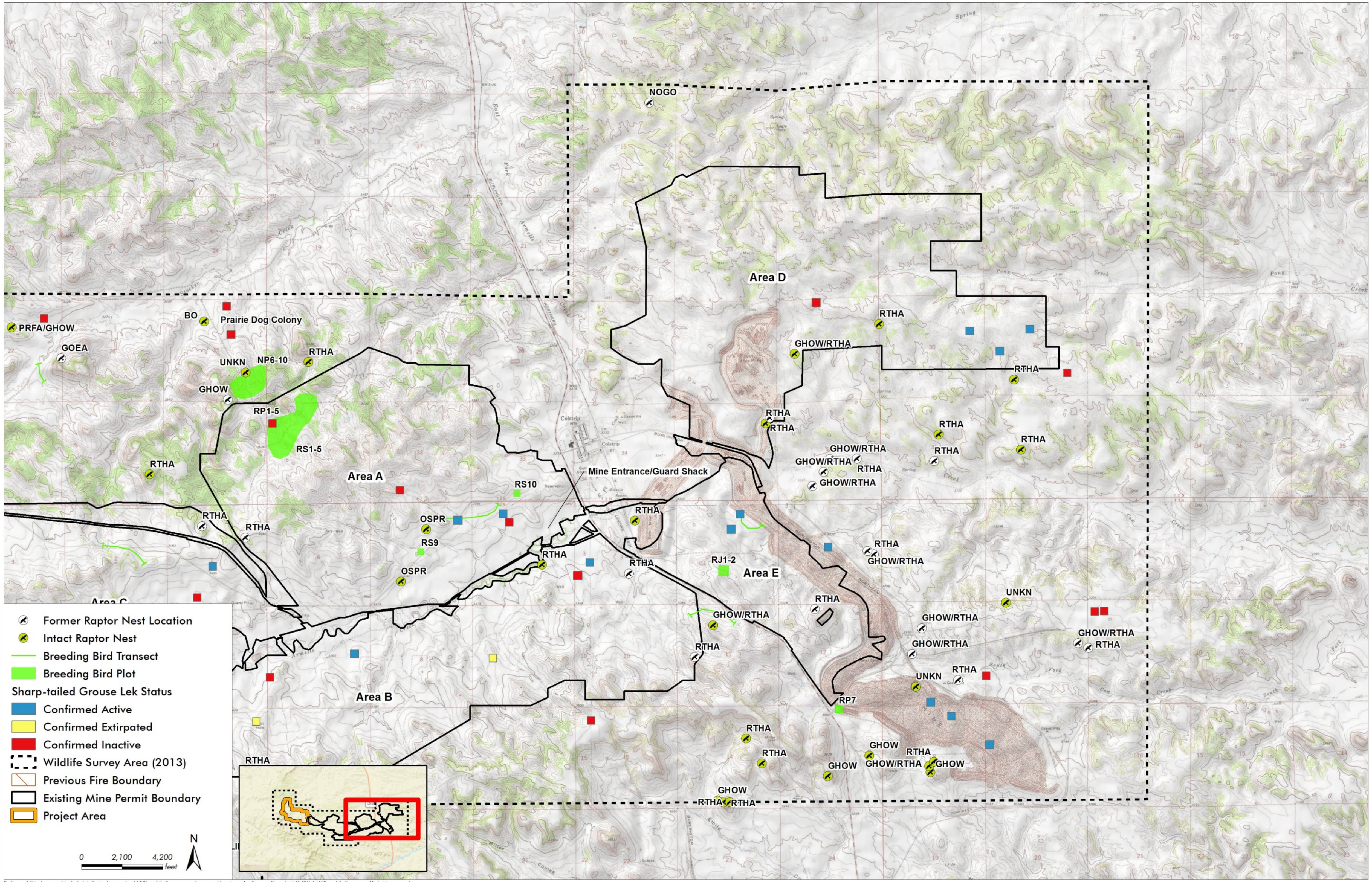

Figure 53. Sharp-Tailed Grouse Leks and Raptor Nests on the Rosebud Mine, Eastern Section.

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Native game birds including Mourning dove and sharp-tailed grouse likely occur throughout the entire 32-km indirect effects analysis area as these species have a rather widespread range throughout MT. Non-native game birds including gray partridge, ring-necked pheasant, and wild turkey also are likely to occur throughout the 32-km analysis area (MNHP and FWP 2017). The 32-km analysis area is also within the overall range of the greater sage grouse which is discussed in more detail in **Sections 3.13** and **4.13, Special Status Species.**

3.12.4.2 Migratory Birds

Bird species use different habitat types in the analysis area for shelter, breeding, wintering, and foraging at various times of the year. The entire analysis area contains habitat for migratory birds. Baseline assessments conducted between 1972 and 2013 identified 175 avian species migrating through, breeding, or residing in some portion of the Rosebud Mine. Transect surveys conducted in 2011 documented 53 avian species in the direct effects analysis area. Songbird surveys were not conducted in 2012 or 2013.

The most common songbirds documented in the direct effects analysis area during baseline assessments in 2011 were western meadowlark, American robin, yellow warbler, and lark sparrow (ICF 2011). Of the 53 avian species documented during the 2011 baseline assessments, 7 were documented in all habitat types in the analysis area. Species found in each habitat type are western meadowlark, American robin, lark sparrow, brown-headed cowbird, chipping sparrow, western kingbird, and Say's phoebe. Although songbird surveys were not conducted in 2012 or 2013, incidental observations in 2012 recorded common poorwill, Cassin's kingbird, and plumbeous vireo.

Common smaller songbirds present in upland areas dominated by grasslands and shrublands include western meadowlark, lark sparrow, vesper sparrow, and Brewer's blackbird (ICF 2011). For information on MNHP songbird SOCs, see **Section 3.13, Special Status Species**.

Species likely to nest among trees in grassland or agricultural habitats in the direct effects analysis area include mourning dove, eastern kingbird, western kingbird, and barn swallows. Species documented in lowland riparian areas or conifer/sumac woodlands during the 2006 and 2011 baseline inventories include yellow warbler, Bullock's oriole, black-capped chickadee, brown thrasher, and black-headed grosbeak (ICF 2011).

The species listed above all occur within the 32-km indirect effect analysis area. Most of the species listed above, including the western meadowlark, Brewer's blackbird, Bullock's oriole, black-capped chickadee, brown thrasher, black-headed grosbeak, American robin, yellow warbler, and lark sparrow are wide-ranging species in MT that occur within the entire 32-km analysis area (MNHP and FWP 2017).

3.12.4.3 Shorebirds and Waterfowl

Shorebirds and waterfowl documented in the direct effects analysis area include spotted sandpiper, American wigeon, green-winged teal, northern shoveler, cinnamon teal, blue-winged teal, mallard, Canada goose, and solitary sandpiper. Most of the shorebirds and waterfowl listed above have wide distributions in MT and potentially occur within the 32-km indirect effects analysis area where habitat is available (MNHP and FWP 2017). For information on MNHP shorebirds and waterfowl SOCs, see **Section 3.13, Special Status Species**.

3.12.4.4 Raptors

Raptors frequently return to the same nest each year or build two or more alternate nest sites that are used in different years. Raptors also may build new nests and abandon existing nests over time.

Monitoring efforts between 2003 and 2015 have documented 117 known raptor nests on the entire Rosebud Mine including the proposed Area F permit boundary. At the end of 2015 it was determined that 63 raptor nests remained intact (although not necessarily active) throughout the Rosebud Mine. This includes 7 additional intact nests that were documented in 2015 on the Rosebud Mine (ICF 2016). Species observed nesting during the 2015 wildlife survey consisted of nine red-tailed hawks and five great horned owls mine-wide. Additionally, one osprey pair attempted to nest on a mitigation platform that was constructed on the mine, although the nest failed (ICF 2016).

Nesting success has varied between 2003 and 2015. In 2015 the raptor productivity average was 2.4 young per active nest. In 2013 raptor productivity was the lowest ever recorded—0.2 young per active nest (ICF 2016). Apparent severe weather conditions during the spring of 2013 may have contributed to the lower success rate.

Raptor species documented nesting at the Rosebud Mine (not including the project area) include red-tailed hawks, great horned owl, merlin, Cooper's hawk, prairie falcon, osprey, and other unknown species. Raptor species that have been documented nesting in the project area include red-tailed hawk, prairie falcon, Coopers hawk, and great horned owl (**Figure 51**, **Figure 52**, and **Figure 53**). The prairie falcon and Cooper's hawk nests in the direct effects analysis area were not active in 2012, 2013, or 2015 (ICF 2016). Other species that could nest in the direct effects analysis area include northern harrier, American Kestrel, and merlin. One northern goshawk, a state SOC was documented just north of the project area which is discussed in **Section 3.13, Special Status Species**.

Most raptors that occur within the state of MT have potential to occur throughout the 32-km indirect effects analysis area (MNHP and FWP 2017).

3.12.5 Reptiles and Amphibians

For information on reptile and amphibian SOCs, see **Section 3.13, Special Status Species**.

3.12.5.1 Reptiles

Four species of reptiles have been observed within the direct effects analysis area. Seven additional species have been observed in other areas of the Rosebud Mine. Reptile assessments in the direct effects analysis area included meander surveys and incidental observations during other surveys. Literature, range maps, and other resource references assisted with an understanding of reptiles potentially present in the direct effects analysis area. Reptiles documented in other areas of the Rosebud Mine are also assumed to occur in the direct effects analysis area.

Species documented in the direct effects analysis area include western painted turtle, eastern yellowbelly racer, western plains garter snake, and sagebrush lizard. Additional species observed in other areas of the Rosebud Mine, and that potentially occur in the direct effects analysis area, include bullsnake, prairie rattlesnake, and milksnake.

The western painted turtle occurs in larger waterbodies including ponds and impoundments, and nests in adjacent uplands. The western plains garter snake is the most common snake in the direct effects analysis area. This is due to its biology as a habitat and prey generalist, tolerance for cold temperature extremes, and widespread hibernacula availability. Eastern yellowbelly racers occur in grassland, shrubland, and agricultural habitats.

Snakes and lizards such as the eastern yellowbelly racer, bullsnake, common gartersnake, western terrestrial garter snake, and sagebrush lizard potentially occur throughout the 32-km indirect effects analysis area. Additionally, turtles including the western painted turtle, snapping turtle, and spiny softshell potentially occur throughout the 32-km indirect effects analysis area (MNHP and FWP 2017).

3.12.5.2 Amphibians

Species including tiger salamander, boreal chorus frog, and Woodhouse's toad, have been documented on the Rosebud Mine. Tiger salamanders have not been observed in the Rosebud Mine since 2002 (ICF 2014).

Call surveys conducted in 2011 in the direct effects analysis area recorded detections of boreal chorus frog and Woodhouse's toad (**Figure 60**). The boreal chorus frog and Woodhouse's toad are the most abundant amphibians in the direct effects analysis area. Boreal chorus frogs were commonly found at water impoundments with temporary standing water. Woodhouse's toads were found near areas where permanent water was present.

Amphibians including the western tiger salamander, boreal chorus frog, and Woodhouse's toad also likely occur throughout the 32-km indirect effects analysis area (MNHP and FWP 2017)

For information on MNHP SOC, see **Section 3.13, Special Status Species**.

3.12.5.3 Invertebrates

The majority of common invertebrates that occur within the direct and indirect effects analysis area consist of insects, arthropods, worms, and mollusks (snails). It is unknown as to what individual species occur within the direct effects analysis area. Soil invertebrates such as earthworms and burrowing arthropods and insects likely occur throughout the entire direct and indirect effects analysis area.

3.12.6 Aquatic Species

3.12.6.1 Aquatic Macroinvertebrates

An aquatic survey was conducted in the project area from August 12 through 15, 2015 (PAP, Appendix R). Isolated wetland areas and wetlands along streams (McClure Creek, Robbie Creek, Donley Creek, and associated tributaries) were surveyed for aquatic life. The survey identified 33 different taxa of macroinvertebrate species. The most predominant taxonomic groups identified were aquatic worms, snails, amphipods, mayflies, damselflies, caddisflies, beetles, midges, and fly larvae.

3.12.6.2 Fish

No fish were identified during the Area F aquatic survey conducted from August 12 through 15, 2015 (ERM 2015). Fish habitat extent and quality is poor within and immediately adjacent to the project area. The stock ponds in the project area may periodically harbor notropids (minnows and chubs) that become established under favorable conditions through bird dispersion. This occurrence is rare and ephemeral due to winter kill or high temperatures/low oxygen during summer. West Fork Armells Creek which drains to Armells Creek, and eventually the Yellowstone River downstream of the direct effects analysis area, contains permanent fish communities. However, aquatic species habitat is limited in the direct effects analysis area due to the ephemeral or intermittent nature of drainages and isolated stock ponds. The nearest permanent fish communities occur in the watershed areas east of the project area in Rosebud Creek and west in the Sarpy Creek drainage.

Aquatic systems within the 32-km indirect effects analysis area include Castle Rock Lake, Rosebud Creek, Sarpy Creek, and Armells Creek, which contain fish and macroinvertebrate habitat.

3.13 SPECIAL STATUS SPECIES

3.13.1 Introduction

This section describes special status wildlife and plant species within the analysis area. Special status species include federally-listed Threatened, Endangered, and Candidate species and other sensitive wildlife and plant species (e.g., state SOC). The analysis area for special status species is defined below in **Section 3.11.1.2, Analysis Area**. The regulatory requirements to protect special status species are also discussed in the following section.

3.13.1.1 Regulatory Framework

Federal Requirements

Federally listed Threatened and Endangered species are protected under the Endangered Species Act (ESA) of 1973 under 16 USC 1531–1543 (Supp. 1996)), as amended, and implemented by the U.S. Fish and Wildlife Service (USFWS) and National Oceanic and Atmospheric Administration (NOAA). The ESA defines an Endangered species as "a species in danger of becoming extinct throughout all or a portion of its range" and a Threatened species as "a species likely to become Endangered in the foreseeable future" (50 CFR 17.3). Candidate species are plants and animals for which there is sufficient information on their biological vulnerability to support federal listing as Threatened or Endangered (63 Federal Register [FR] 13347), but listing is precluded by other higher-priority listing activities. Potential effects on a federally listed species or its habitat resulting from a project with a federal action require consultation with the USFWS under Section 7 of the ESA. MSUMRA requires this consultation for state permitting of coal mines (implemented by DEQ). Adverse modification of designated critical habitat for a federally listed species also requires consultation with the USFWS.

Information on the Bald and Golden Eagle Protection Act of 1940 and MBTA can be found in **Section 3.12, Fish and Wildlife Resources.**

State Requirements

FWP regulates wildlife and fish under the state Fish, Wildlife, and Parks Commission (87-1-301, MCA). MNHP is operated by the University of Montana and contains the Montana State Library's Natural Resource Information System. MNHP and FWP designate the state SOC. MNHP maintains the list of state SOC and uses the international Natural Heritage Program's species ranking system ranging from 1 (highest risk, imperiled) to 5 (relatively stable). Designation of state SOC is not a statutory or regulatory classification; it aids in species conservation needs, data collection priorities, and agency management guidance. State SOC are native plant and animal species that are considered rare or at risk of becoming Endangered or extirpated in Montana.

DEQ regulations prohibit surface or underground mining operations which are likely to jeopardize the continued existence of any listed endangered or threatened species or which are likely to result in the destruction or adverse modification of designated critical habitat of such species in violation of the ESA. DEQ regulations also prohibit surface or underground mining operations which would result in the unlawful taking of a bald or golden eagle, its nest, or any of its eggs as a result of the mining operations outlined in ARM 17.24.751(1).

Local Requirements

There are no applicable local regulations for special status species within or near the analysis area.

3.13.1.2 Analysis Area

Direct Effects Analysis Area

The direct effects analysis area for special status species is the project area (6,746-acre proposed Area F permit area) plus a 15-mile buffer outside of the proposed Area F permit boundary (**Figure 54** and **Figure 55**). This analysis area includes the 4,260 acres of direct habitat disturbance within the proposed Area F permit boundary. It also includes a 15-mile perimeter around the proposed Area F permit boundary, established by KC Harvey Environmental in conjunction with Western Energy. The 15-mile perimeter includes portions of Rosebud and Treasure Counties. Therefore, special status species potentially occurring in both counties were assessed for direct effects. Special status species in the analysis area were assessed by reviewing data provided by ICF International (2011, 2013, 2014), DEQ, FWP, MNHP, and USFWS. This includes baseline surveys and annual and long-term monitoring reports for the Rosebud Mine and species occurrence data provided by MNHP. No known federally listed Threatened or Endangered species are known to occur within the direct effects analysis area. General fish and wildlife species and a description of wildlife monitoring on the mine are discussed in **Section 3.12, Fish and Wildlife Resources.**

Indirect Effects Analysis Area

The indirect effects analysis area for special status species consists of the operational boundaries of the Colstrip and Rosebud Power Plants plus a 32-km buffer around each of the power plants (**Figure 56**; see **Section 3.10, Vegetation** for a figure showing the indirect effects analysis area and the vegetation communities within in it). This analysis area was determined as a result of trace-metal deposition modeling completed for special status species that utilized soil trace-metal background concentrations from a USGS background study and air-quality modeling (Smith et al. 2013); see **Section 4.3, Air Quality**, for discussion of modeling methods and results. Of the eight trace metals modeled, mercury had the greatest deposition distance, about 32 km, inside which there could be potential impacts on soil and vegetation (and therefore on special status species habitat). The 32-km buffer includes portions of Rosebud, Treasure, Big Horn, and Powder River Counties. Therefore, special status species that potentially occur in the three counties were assessed for indirect effects.

3.13.1.3 Wildlife Habitat Characteristics

For information on wildlife habitat characteristics in the analysis area, see **Section 3.12, Fish and Wildlife Resources**.

3.13.2 Federally Listed Threatened, Endangered, and Candidate Species

According to the USFWS Information, Planning, and Conservation System (IPAC), a total of four federally Endangered species may be found in Rosebud, Treasure, Big Horn, and Powder River Counties, specifically within the direct and indirect effects analysis areas (**Table 73**). The IPAC is consistent with the USFWS Ecological Services Montana Field Office’s county list of Threatened and Endangered species.

Table 73. Federally Endangered Species Potentially Occurring in Rosebud, Treasure, Big Horn, and Powder River Counties.

Common Name	Scientific Name	Status* Federal/State	General Habitat Affinity	Habitat in Analysis Area
Birds				
Whooping crane	*Grus americana*	E	Wet meadows, marshes	None
Mammals				
Black-footed ferret	*Mustela nigripes*	E	Active prairie dog towns or complex > 80 acres in size	None
Northern long-eared bat	*Myotis septentrionalis*	T	Rock cavities and crevices, behind bark in trees, dead hardwood trees	None
Fish				
Pallid sturgeon	*Scaphirhynchus albus*	E	Slow-moving, large rivers	None

Source: USFWS 2017a.
*E = Endangered; T = Threatened.

3.13.2.1 Whooping Crane

The whooping crane was listed as an Endangered species in 1967 when the population was down to less than 100 individuals. The whooping crane is the tallest bird in North America and can reach nearly 1.5 meters (4.9 feet) in height (USFWS 2012). Adults are white with a patch of black feathering on the nape and red or crimson feathers extending down across the throat. Whooping cranes can be confused with sandhill cranes although sandhill cranes are generally dominated by grey plumage. Whooping cranes have been known to forage in croplands and along wetlands where they feed on a variety of small insects, fish, and berries (MNHP 2017).

The whooping crane is endemic to North America and historically ranged from the Arctic Sea to Central Mexico and from Utah to the eastern seaboard. Currently there are three wild populations remaining. Only one wild population is self-sustaining, which is the population that migrates between Aransas, Texas and Wood Buffalo National Park in Canada (USFWS 2012). Experimental re-introductions have been attempted in the Rocky Mountain region without success. The whooping crane is a passing migrant and has occasionally been observed in eastern MT during the spring and fall migrations between northern Canada and southern Texas. No breeding of this species has been documented in MT and observations are generally incidental near the project area.

3.13.2.2 Black-footed Ferret

The ferret was listed as Endangered in 1967 under a precursor to the ESA of 1973. The USFWS has not designated any critical habitat for the ferret. In Montana, all known black-footed ferret populations are those that have been re-introduced. The black-footed ferret historically inhabited areas of the Great Plains and intermountain west. With the exception of re-introduced populations, the black-footed ferret has been extirpated from the majority of its range. This species is dependent on prairie dogs (*Cynomys* sp.) for food and uses prairie dog burrows for shelter. Over the past century, prairie dog distribution has been substantially reduced due to habitat loss, plague, and prairie dog control efforts (USFWS 1993).

Black-footed ferrets feed almost exclusively on prairie dogs, although other small animals may be eaten opportunistically. This species feeds on its prey underground and has been known to drag prey more than 1,000 feet during the winter (MNHP 2014b). Black-footed ferrets do not inhabit single burrows but are nomadic and travel from burrow to burrow (MNHP 2014b).

In Montana, ferret populations are those that have been re-introduced and are monitored (MNHP 2017). Known black-footed ferrets coincide with black-tailed prairie dog (*C. ludovicianus*) colonies. Black-tailed prairie dogs occur throughout eastern Montana and are considered a SOC due to their value to prairie ecosystems. USFWS encourages conservation of black-tailed prairie dog colonies because of their value to prairie ecosystems and potential for black-footed ferret reintroductions. No black-tailed prairie dog colonies suitable for black-footed ferrets (over 80 acres in size) are present in the direct effects analysis area. Additionally, no black-footed ferrets have been re-introduced into the direct effects analysis area or the 32-km indirect effects analysis area (FWP and MNHP 2017). The nearest black-footed ferret reintroduction site is on the Crow Indian Reservation 66 km (about 41 miles) southwest of the project area. Since the black-footed ferret is unlikely to occur within the analysis area, this species will not be discussed further in this document.

3.13.2.3 Northern Long-eared Bat

The northern long-eared bat (also referred to as northern myotis or NLEB) has long ears and a dark brown pelage color. This species was listed as threatened species in 2015, mainly due to significant population declines from the effects of white-nose syndrome. This species roosts in caves, cavities, or crevices, and behind peeling bark in trees during the daytime hours (MNHP 2017). The species inhabits riparian areas with relatively close proximity to water.

The northern long-eared bat ranges from the southeast U.S. to northwest Canada. Montana is on the edge of NLEB range. One hibernating individual was discovered in 1978 and two active individuals were documented in 2016 in northeastern Montana (Richland and Roosevelt Counties), about 190 miles north of the project area (MNHP 2017). Potential habitat for this species has been identified in Powder River County, although the species has never been documented in southeastern Montana.

3.13.2.4 Pallid Sturgeon

The pallid sturgeon is listed as Endangered throughout all of its known range. This species formerly inhabited the Missouri and Mississippi river systems from Montana to Louisiana. Its decline is due to habitat loss from damming of the Missouri River.

This species is a large fish characterized by its pale grey-whitish color and bony scutes (bony plate) on its back, head, and sides (MNHP 2014c). It inhabits large, slow, turbid waters with sandy bottoms. In Montana, this species is known to occur in the Missouri and Yellowstone Rivers. The diet of the pallid sturgeon is thought to consist of aquatic insects and small fish (MNHP 2014c).

The nearest known occurrences of this species to the Rosebud Mine including the project area, is 60 miles away along lower reaches of the Yellowstone River, northeast of Miles City, which it may inhabit during the summer months. Sturgeons utilize the Missouri River below the confluence of the Yellowstone River during the spring, winter, and fall (MNHP 2014c). No habitat (large turbid rivers) for pallid sturgeon exists within the direct or indirect effects analysis area. Since the pallid sturgeon is unlikely to occur within the direct or indirect effects analysis areas, this species will not be discussed further in this document.

3.13.3 MNHP Species of Concern

According to MNHP and FWP, 42 SOC potentially occur within Rosebud, Treasure, Big Horn or Powder River Counties (MNHP and FWP 2014). SOC in these counties consist of 7 mammal, 21 bird, 6 reptile, 6 fish, and 2 amphibian species.

Table 74 identifies MNHP SOC and their preferred habitats that have been documented in the Rosebud Mine 15-mile wildlife survey area (same as the direct effects analysis area) since 1973. Eight species of concern (northern leopard frog, plains spadefoot toad, golden eagle, northern goshawk, great blue heron, long-billed curlew, McCown's longspur, and hoary bat) have been documented in the direct effects analysis area.

Figure 54 shows bird and mammal SOC, and **Figure 55** shows reptile and amphibian SOC at locations documented by MNHP within the direct effects analysis area.

Figure 56 shows special status species documented within the indirect effects analysis area.

Table 74. MNHP Species of Concern Documented within Direct Effects Analysis Area.[1]

Common Name	Scientific Name	Status	General Habitat Affinity	Likely to Occur in Analysis Area? (Y/N)
Amphibians				
Great plains toad	*Anaraxus cognatus*	S3	Grasslands, and shrublands with nearby water sources including wetlands, stock tanks, streams, springs, and stock ponds	N
Northern leopard frog	*Lithobates (Rana) pipiens*	S1, S4[1]	Wetlands, stock tanks, streams, springs, stock ponds	Y
Plains spadefoot toad	*Spea bombifrons*	S3	Grasslands, and shrublands with nearby water sources including wetlands, stock tanks, streams, springs, and stock ponds	Y
Birds[2]				
American bittern	*Botaurus lentiginosus*	S3; B	Large freshwater wetlands composed of cattails and bulrushes	N
Black-billed cuckoo	*Coccyzus erythropthalmus*	S3; B	Riparian woodlands	Y
Burrowing owl	*Athene cunicularia*	S3; B	Open grasslands with abandoned burrows dug by mammals	N
Black tern	*Childonias niger*	S3; B	Wetlands, marshes, prairie potholes, and small ponds with emergent vegetation	N
Brewer's sparrow	*Spizella breweri*	S3; B	Sagebrush shrublands	Y
Caspian tern	*Hydroprogne caspia*	S2; B	Large rivers, lakes, and reservoirs	N
Clark's nutcracker	*Nucifraga columgiana*	S3	Conifer forests	Y
Common loon	*Gavia immer*	S3; B	Mountain lakes with emergent vegetation	N
Common tern	*Sterna hirundo*	S3; B	Large rivers, lakes, and reservoirs	N
Ferruginous hawk	*Buteo regalis*	S3; B	Shrub-grasslands, mixed grass prairie, sagebrush grasslands and sagebrush steppe	Y
Forster's tern	*Sterna forsteri*	S3; B	Wetlands	N
Franklin's gull	*Larus pipixcan*	S3; B	Wetlands	N

Table 74. MNHP Species of Concern Documented within Direct Effects Analysis Area.[1]

Common Name	Scientific Name	Status	General Habitat Affinity	Likely to Occur in Analysis Area? (Y/N)
Greater sage grouse	*Centrocercus urophasianus*	S2	Shrub-grasslands, mixed grass prairie, sagebrush grasslands and sagebrush steppe	N
Golden eagle	*Aquila chrysaetos*	S3; BGEPA	Canyons, cliffs, and bluffs	Y
Gray-crowned finch	*Leucosticte tephrocotis*	S2; B, S5	Alpine cliffs, glaciers and snowfields above timberline.	N
Great blue heron	*Ardea herodias*	S3	Riparian areas along major rivers and lakes	Y[3]
Horned grebe	*Podiceps auritus*	S3; B	Wetlands, freshwater ponds, and marshes	N
Lewis' woodpecker	*Melanerpes lewis*	S2; B	Riparian woodlands	Y
Loggerhead shrike	*Lanius ludovicianus*	S3, B	Upland shrublands	Y
Long-billed curlew	*Numenius americanus*	S3, B	Mixed-grass prairie and moist meadows	Y
McCown's longspur	*Calcarius mccownii*	S3; B	Rangeland and shortgrass prairie	Y
Northern goshawk	*Accipiter gentilis*	S3; B	Mature or old growth, coniferous, or mixed conifer/aspen forests with relatively open understories	Y
Peregrine falcon	*Falco peregrinus*	S3	Cliffs and canyons	Y
Pinyon jay	*Gymnorhinus cyanocephalus*	S3	Low-elevation ponderosa pine limber pine-juniper woodlands	Y
Red-headed woodpecker	*Melanerpes erythrocephalus*	S2; B	Riparian woodlands	Y
Sage thrasher	*Oreoscoptes montanus*	S3; B	Upland shrublands	Y
Sprague's pipit	*Anthus spragueii*	S3; B	Mixed-grass grasslands	N
Trumpeter swan	*Cygnus buccinator*	S3	Lakes, ponds, and reservoirs	N
Mammals				
Black-tailed prairie dog	*Cynomys ludovicianus*	S3	Shortgrass prairie, grasslands	N
Fringed myotis	*Myotis thysanodes*	S3	Riparian areas within coniferous woodlands, caves; typically roosts in rock crevices, caves, abandoned buildings	Y
Hoary bat	*Lasiurus cinereus*	S3	Deciduous and occasional coniferous woodlands; typically roost in trees	Y
Little brown myotis	*Myotis lucifugus*	S3	Variety of habitats including buildings, woodlands, caves and mines; forages over water.	Y
Merriam's shrew	*Sorex merriami*	S3	Shrublands, grasslands and agricultural lands dominated by pasture grasses	Y
Pallid bat	*Antrozous pallidus*	S3	Woodlands, including ponderosa forests and shrublands	Y

Table 74. MNHP Species of Concern Documented within Direct Effects Analysis Area.[1]

Common Name	Scientific Name	Status	General Habitat Affinity	Likely to Occur in Analysis Area? (Y/N)
Townsend's big-eared bat	*Corynorhinus townsendii*	S3	Woodlands, rocky outcrops, caves, tunnels, and abandoned mines; occasionally roosts in tree cavities	Y
Reptiles				
Plains hognose snake	*Heterodon nasicus*	S2	Sagebrush-grasslands and gravely and sandy soil	Y
Short-horned lizard	*Phyrnosoma herandesi*	S3	Sandy gravely soil	Y
Snapping turtle	*Chelydra serpentine*	S3	Prairie rivers and streams	N
Western Milksnake	*Lapmpropeltis triangulum*	S2	Rocky outcrops; shrublands; grasslands	Y
Western smooth greensnake	*Opheodrys vernalis*	S2	Wetlands; forested areas with open meadows	Y

Source: Adams and Hayes 2000; Barrett 1998; ICF 2014; MNHP and FWP 2014.
S1: Very high risk of extirpation in the state due to very restricted range, steep declines, severe threats and other factors.
S2: At high risk of extinction or extirpation in the state due to very limited and/or declining numbers, range, and/or habitat or extirpation in the state.
S3: At risk of extinction or extirpation in the state due to very limited and/or declining numbers, range, and/or habitat, even though it may be abundant in some areas.
S4: At a fairly low risk of extirpation in the state due to an extensive range and/or many populations or occurrences but with possible cause for some concern.
B: Protected under the Migratory Bird Treaty Act (MBTA).
BGEPA: Protected under the Bald and Golden Eagle Protection Act.
[1] Critically imperiled in mountain areas in western Montana; apparently secure on the Great Plains in eastern Montana.
[2] Note: Red Knot (*Calidris canutus*) was discussed in Section 7 consultation documents sent to the USFWS; however, MNHP now ranks its status as "SNA," indicating that "a conservation status rank is not applicable because the species or ecosystem is not a suitable target for conservation activities as a result of being: 1) not confidently present in the state; 2) exotic or introduced; 3) a long distance migrant with accidental or irregular stopovers; or 4) a hybrid without conservation value."
[3] Seen flying over analysis area.

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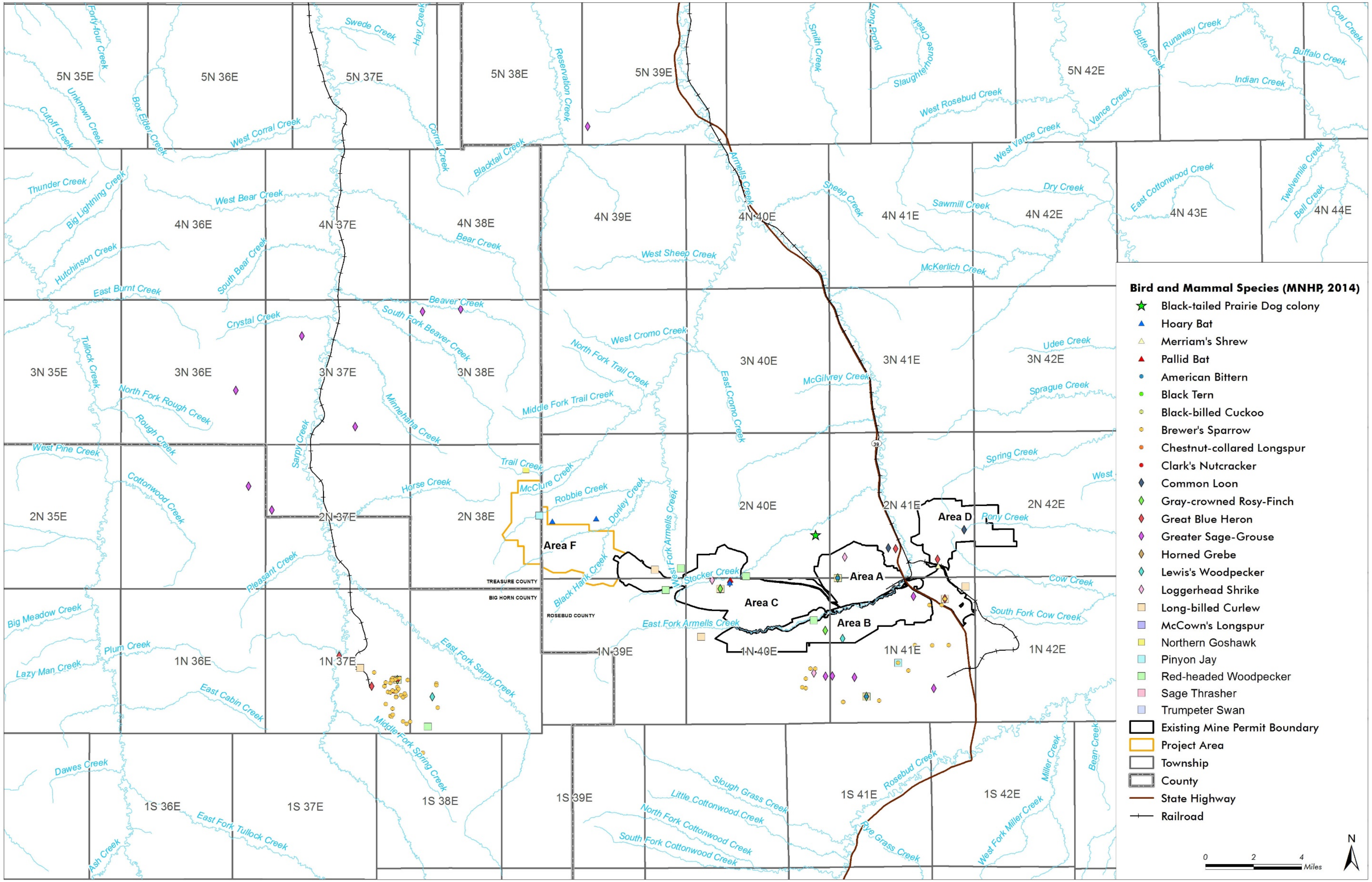

Figure 54. Bird and Mammal Species of Concern, Locations within the Direct Effects Analysis Area.

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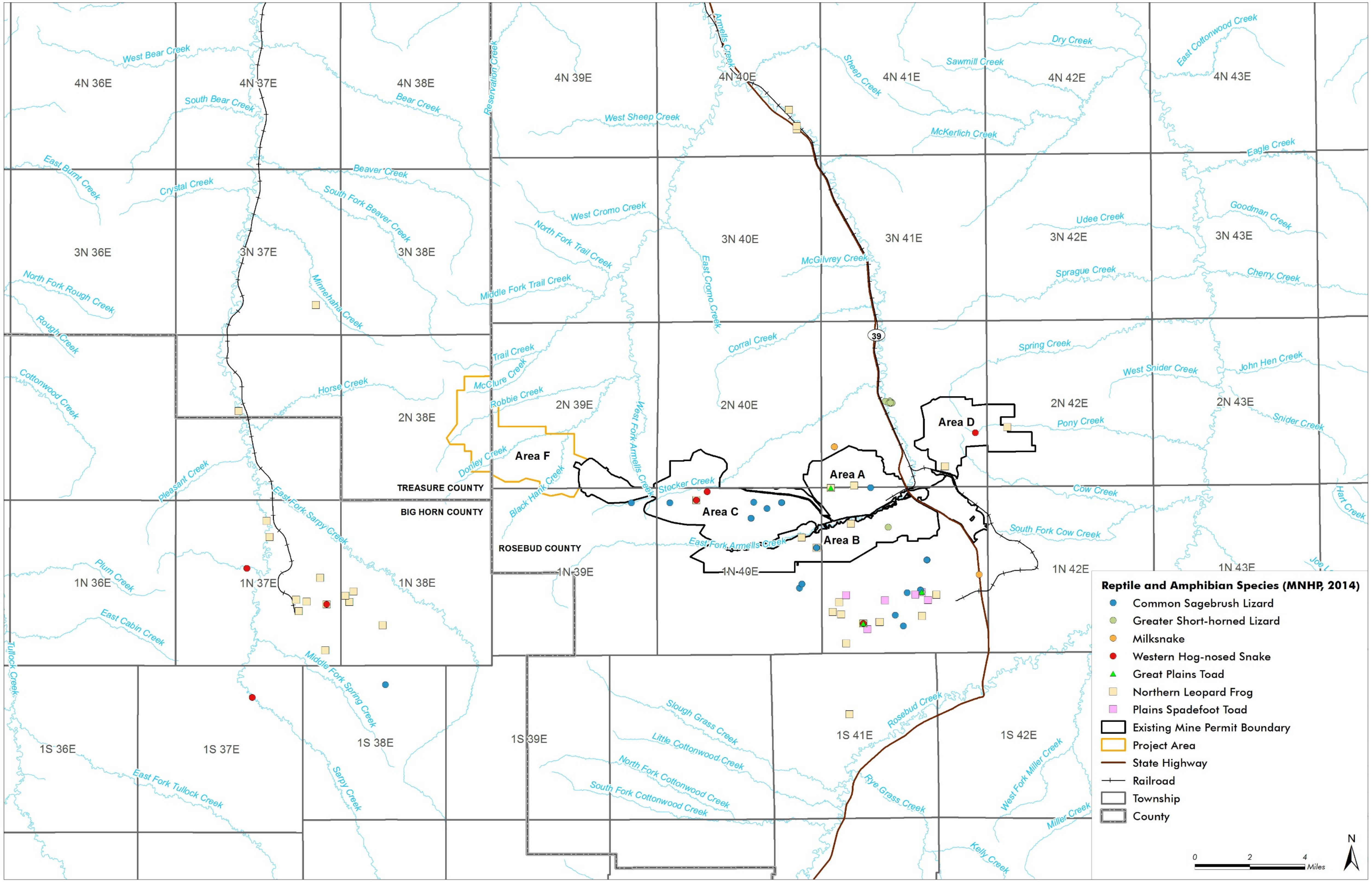

Figure 55. Reptile and Amphibian Species of Concern, Locations within the Direct Effects Analysis Area.

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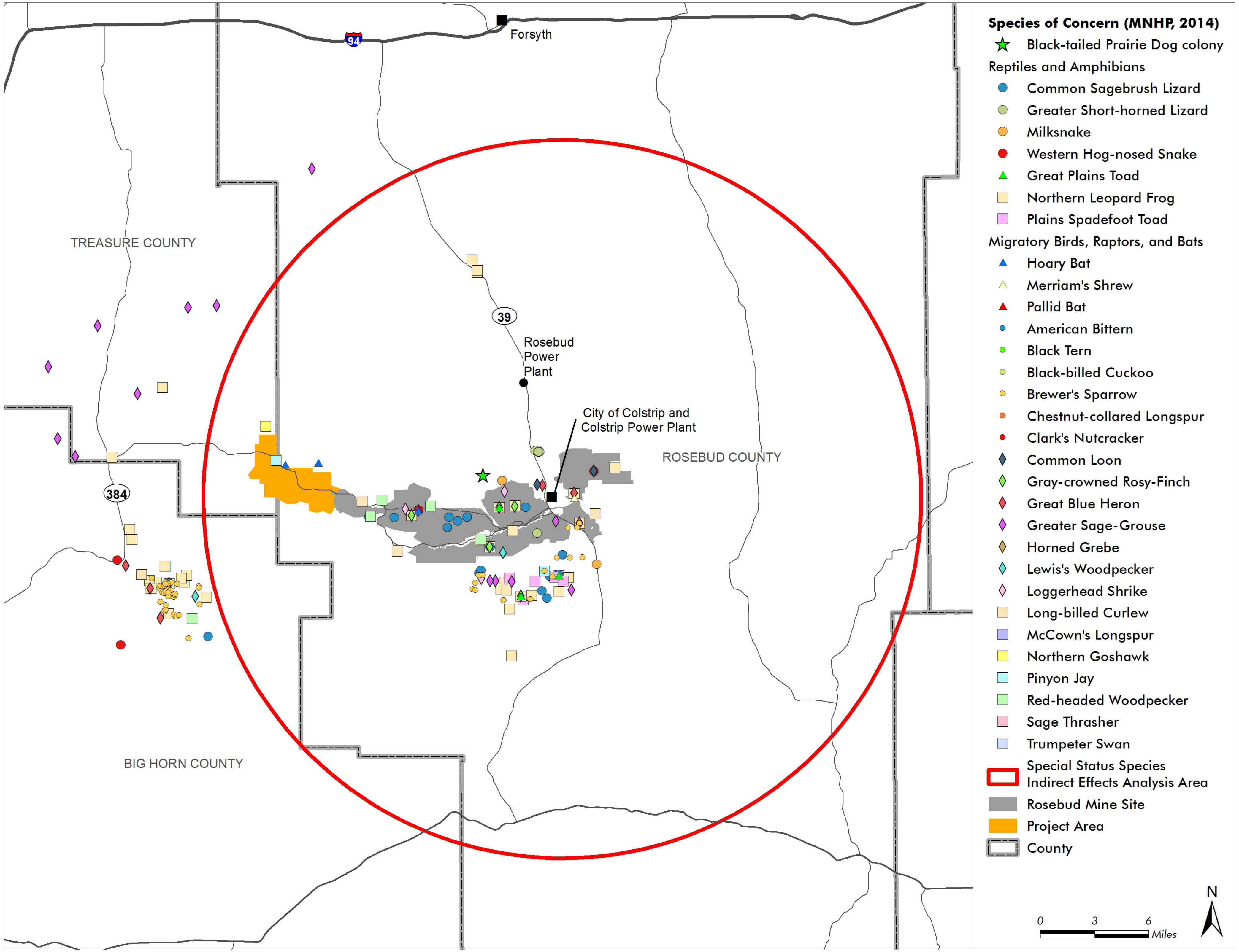

Figure 56. Special Status Species Documented within the Indirect Effects Analysis Area.

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3.13.3.1 Mammals

Two mammalian SOC have been documented in the direct effects analysis area and are likely to occur throughout the 32-km indirect effects analysis area (MNHP and FWP 2017). Merriam's shrew and the black-tailed prairie dog occur throughout the southern and eastern portions of Montana and have been documented in portions of the Rosebud Mine (ICF 2014; MNHP and FWP 2017). The two species listed above are also likely to occur throughout the 32-km indirect effects analysis area where habitat is available (MNHP and FWP 2017).

Bats

Five bat species documented in the direct effects analysis area are MNHP SOC and are listed above in **Table 74**: Townsend's big-eared bat, little brown myotis, hoary bat, pallid bat, and fringed myotis (**Figure 57**; see also **Section 3.12, Fish and Wildlife Resources**). Townsend's big-eared bat, which roosts in underground mines, tunnels, caves, and rock outcrops, could occur in existing rocky outcrops within the project area. The little brown myotis is found in a variety of habitats including buildings, woodlands, caves and underground mines and typically forage over water and may be found foraging near water sources in the project area. The hoary bat is found in deciduous and occasional coniferous woodlands and typically roosts in trees. The pallid bat is found in woodlands, including ponderosa forests and shrublands. The fringed myotis is found in riparian areas within coniferous woodlands or in caves and typically roosts in rock crevices, caves, and abandoned buildings.

Figure 57. Fringed Myotis.
Source: Montana Field Guide, Kristi DuBois

According to MNHP data, two hoary bats have been documented near the project area boundary between Robbie and Donley Creeks (**Figure 56**) (MNHP 2014d). Additionally, during surveys conducted in the direct effects analysis area between June and September of 2013, hoary bat and little brown myotis were detected. Pallid, silver-haired, and hoary bats, and little brown myotis have been documented in Area C of the Rosebud Mine (**Figure 56**) (MNHP 2014d).

Most Montana bat species are likely to occur within the 32-km indirect effects analysis area. Species of concern likely to occur in the 32-km analysis area include Townsend's big-eared bat, little brown myotis, hoary bat, and fringed myotis. The pallid bat could occur within the southern portion of the indirect effects analysis area (MNHP and FWP 2017). General bat species are described in more detail under **Section 3.12, Fish and Wildlife Resources**.

3.13.3.2 Upland and Other Game Birds

Greater Sage-Grouse

The greater sage-grouse is listed as a Montana Species of Concern (**Figure 58**). The species was federally listed as a Candidate species. However, in 2015 the USFWS determined that the listing was "not warranted" and that the greater sage-grouse remains relatively abundant throughout its range (USFWS 2015). The greater sage-grouse potentially occurs in Rosebud and Treasure Counties. It is the largest grouse species in North America and occurs throughout the northern portions of the intermountain west. Greater sage-grouse depend on a range of habitats within sagebrush shrublands throughout the west but require large, continuous tracts of open sagebrush for breeding, nesting, brood-rearing, and winter habitat. Each spring sage-grouse perform elaborate mating displays in areas that are known as leks. Leks usually consist of a clearing surrounded by sagebrush habitat (MSGWG 2005). Nesting season occurs from April until July.

Figure 58. Greater Sage-Grouse.
Source: freebeekeeper.com

No sage-grouse leks have been observed or documented within the direct effects analysis area. According to FWP, greater sage-grouse have been documented west, northwest, and southeast of the proposed mine site; however, long-term monitoring for greater sage-grouse has been ongoing within the Rosebud Mine area since 1973, and no sage-grouse leks have been observed or documented within the analysis area (Atwood 2014). In 1984 and 1985, two male sage-grouse were observed in a sharp-tailed grouse lek near the mine; no others have been reported since that time (ICF 2014).

On September 9, 2014, Montana Governor Steve Bullock signed Executive Order 10-2014 (EO 10-2014), creating the Montana Sage-Grouse Oversight Team and the Montana Sage-Grouse Habitat Conservation Program. EO 10-2014 provides specific guidelines that outline certain conservation and management measures that may be implemented to conserve sage-grouse populations in Montana, including adoption of the Final Management Plan and Conservation Strategies for Sage-Grouse in Montana (plan) (MSGWG 2005). The plan outlines conservation measures that include a balance between energy development and minimization of impacts on sage-grouse habitat. With regard to mining operations, the plan and EO recommend:

- working cooperatively with agencies, municipalities, and other landowners
- baseline assessments to identify important sage-grouse habitat and prioritize areas in greatest need for protection
- incremental development in order to stagger land disturbance
- provision of technical assistance and education to private landowners
- use of off-site mitigation through habitat creation or conservation easements to offset habitat loss
- removal of facilities and reclamation of lands following creation

The direct effects analysis area contains sagebrush habitat fragmented by forest and grassland, but lacks large areas of contiguous sagebrush/grassland habitat that would provide suitable cover and that are preferred by sage-grouse. Additionally, Attachment A to EO 10-2014 outlines sage-grouse conservation areas in Montana. Conservation areas include sage-grouse core areas and connectivity areas. The direct and indirect effects analysis areas are located within the overall range of the sage-grouse but not in a designated core area or connectivity areas. Additionally, the direct and indirect analysis areas are not located within any priority habitat management areas identified in the BLM Miles City Resource Management Plan. The nearest core area is located north of Forsyth in Rosebud County (Montana DNRC 2017).

3.13.3.3 Migratory Birds

Figure 59. Red-Headed Woodpecker.
Source: Audubon Society

MNHP songbird SOC were documented in varying habitats during the 2011, 2012, and 2013 surveys (ICF 2011, 2013, 2014). McCown's longspur and sage thrasher were documented in upland grassland and shrublands in 2011. In 2006, 2011, and 2012, a red-headed woodpecker (**Figure 59**) was documented in a forested area and in 2013, a loggerhead shrike was observed foraging between a power line and yucca plants.

Each of the songbird SOC listed above potentially occurs in the indirect effects analysis area where habitat is present (MNHP and FWP 2017).

Shorebirds and Waterfowl

In 2012 a great blue heron was observed flying over the reclamation area of the Rosebud Mine, and in 2013 a long-billed curlew was observed along a gravel road near the project area. Great blue herons have been documented in Areas B, C, and D of the Rosebud Mine in previous years (MNHP 2014d). Because aquatic habitat is limited in the direct effects analysis area, herons, cranes, egrets, and other waterfowl have not been documented nesting in the area.

Raptors

Three SOC have been documented on the Rosebud Mine: golden eagle, northern goshawk, and burrowing owl. Both the golden eagle and northern goshawk potentially occur statewide. The burrowing owl occurs in the eastern two-thirds of the state. All three species potentially occur within the direct and indirect effects analysis area (ICF 2014; MNHP and FWP 2017).

3.13.3.4 Reptiles

Three reptile SOC—the western milksnake, western hognose snake, and short-horned lizard—have been documented in upland grassland and shrubland habitat adjacent to the project area on or adjacent to portions of the Rosebud Mine. The three reptile species occur throughout the western two-thirds of the state and potentially occur within the direct and indirect effects analysis areas, where suitable habitat exists (MNHP and FWP 2017).

3.13.3.5 Amphibians

The northern leopard frog, Great Plains toad, and plains spadefoot toad have been documented on or near the mine. The plains spadefoot toad was found at a streamside pool following a period of rain in 2011 (ICF 2011). Great Plains toads have not been documented on the mine since 2003 (ICF 2014). The three amphibian species, similar to the reptile SOC, occur throughout the western two-thirds of the state and potentially occur within the direct and indirect effects analysis areas, where suitable habitat exists (MNHP and FWP 2017).

Figure 60. Northern Leopard Frog.

Source: U.S. Fish and Wildlife Service

Call surveys conducted in 2011 in the direct effects analysis area recorded detections of plains spadefoot toad and a single northern leopard frog (**Figure 60**). The plains spadefoot toad was found at a streamside pool following a period of rain. The northern leopard frog is a species historically known to be present on the Rosebud Mine (ICF 2014). The species is considered at high risk due to limited and rapidly declining population numbers, range, and habitat. The northern leopard frog is a habitat generalist in Montana and occurs in low-elevation ponds, stock reservoirs, lakes, creeks, pools in intermittent streams, warm-water springs, potholes, and marshes. This species' life cycle requires a mosaic of wetlands adjacent to short-grass uplands (MNHP and FWP 2013).

3.13.4 Special Status Plant Species

3.13.4.1 Sensitive Plant Species

Federally Listed Threatened, Endangered, and Candidate Species

Three plant species are listed as federally threatened in Montana including the Spalding's catchfly (*Silene spaldingii*), Ute ladies'-tresses orchid (*Spiranthes diluvialis*), and water howellia (*Howellia aquatilis*). The whitebark pine (*Pinus albicaulis*) is listed as a federal Candidate species in Montana (**Table 75;** USFWS 2015). None of these federally Threatened or Candidate vegetation species are listed as potentially occurring in Rosebud, Treasure, Big Horn, or Powder River Counties (USFWS 2015). No federally listed plant species were documented in the project area during the field surveys in 2005–2007 (PAP, Appendix E).

MNHP Species of Concern

Thirteen vegetation SOC potentially occur in Rosebud, Treasure, and Big Horn Counties (**Table 75**, MNHP 2015). The project area contains suitable habitat for nine SOC; however, a January 2015 MNHP data request identified no vegetation SOC occurrences within the project. None of the SOC were documented in the project area during the field assessments in 2005–2007. Six vegetation SOC occur in Treasure and Rosebud Counties beyond a 12-mile radius of the project area (MNHP 2017). Each of the plant species of concern that potentially occur in project area also potentially occur in the 32-km indirect effects analysis area (MNHP and FWP 2017).

Table 75. MNHP Plant Species of Concern in Rosebud, Treasure, Big Horn, and Powder River Counties, and Montana's Federally Listed Plant Species.

Common Name	Scientific Name	Status	General Habitat Affinity	Suitable Habitat Present in the Project Area?
Alderleaf mountain-mahogany	*Cercocarpus montanus*	S2/S3	Open slopes and breaks on the plains	No
Barr's milkvetch	*Astragalus barrii*	S3	Sparsely vegetated knobs and buttes; often along rivers or streams	Yes
Bractless blazingstar	*Mentzelia nuda*	S1/S2	Sandy or gravelly soil of open hills and roadsides on the plains	No
Bush morning-glory	*Ipomoea leptophylla*	S1/S2	Open prairie habitats in sandy or gravelly soil	Yes
Heavy sedge	*Carex gravida*	S3	Green ash ravines and woody draws	No
Lead plant	*Amorpha canescens*	SH	Grasslands and woodlands; often in sandy soil	Yes
Lichen	*Psora rubiformis*	S1/S2	On soil and in fissures of rock in alpine areas	No
Little Indian breadroot	*Pediomelum hypogaeum*	S3/S4	Sandy soil of grasslands and open pine woodlands	Yes
Narrowleaf milkweed	*Asclepias stenophylla*	S2	Sandy soil of prairies and open pine woodland	Yes
Nuttall desert-parsley	*Lomatium nuttallii*	S2	Open pine woodlands 3,400 to 7,200 feet in elevation	Yes
Persistent-sepal yellow-cress	*Rorippa calycina*	SH	Moist sandy to muddy banks of streams, stock ponds, and reservoirs	Yes
Plains phlox	*Phlox andicola*	S3/S4	Sparsely vegetated outcrops; sandy soil in grasslands and pine woodlands	Yes
Spalding's catchfly	*Silene spaldingii*	S2, FT	Open mesic grasslands in valleys and foothills in northwest Montana	No
Ute ladies'-tresses	*Spiranthes diluvialis*	S1/S2, FT	Alkaline wetlands, swales, and old meander channels on the edge of wetlands	No
Water howellia	*Howellia aquatilis*	S3, FT	Small depressional wetlands in Swan Valley	No
Whitebark pine	*Pinus albicaulis*	S3, FC	Subalpine and krummholtz habitats	No
Woolly twinpod	*Physaria didymocarpa* var. *lanata*	S2/S3	Sandy, often calcareous soil of open grassland or shrubland slopes	Yes

Source: MNHP 2017.
S1: At very high risk of extinction or extirpation in the state due to extremely limited and/or rapidly declining numbers, range, and/or habitat, or extirpation in the state.
S2: At high risk of extinction or extirpation in the state due to very limited and/or declining numbers, range, and/or habitat, or extirpation in the state.
S3: At risk of extinction or extirpation in the state due to limited and/or declining numbers, range, and/or habitat, even though it may be abundant in some areas.
SH: Historical, known only from records usually 40 or more years old; may be rediscovered.
FT: Federally Threatened.
FC: Federal Candidate.

3.14 CULTURAL AND HISTORIC RESOURCES

3.14.1 Introduction

Cultural resources are aspects of the human environment that include buildings, structures, objects, historic and prehistoric archeological sites, and districts. Districts are groups of buildings, structures, or sites that are associated by shared cultural significance such as mining or homesteading and are further related both in time and space. Sites are typically meant to include historic or prehistoric archeological sites. Traditional cultural properties (TCPs) include "traditions, beliefs, practices, lifeways, arts, crafts, and social institutions of any community, be it an Indian tribe, a local ethnic group, or the people of the nation as a whole" (National Park Service 1998).

The sections below provide an overview of cultural and historic resources in the analysis area and the regulatory authorities governing them; the analysis area for cultural and historic resources is defined below in **Section 3.14.1.2, Analysis Area**. The locations of most cultural resources are exempt from public disclosure under Public Laws 96-95 and 89-665 to protect resources from potential vandalism and to retain confidentiality of those resources culturally significant to American Indian tribes. Thus, specific cultural resource locations are not included in the discussion.

3.14.1.1 Regulatory Framework

Federal Requirements

Section 106 of the National Historic Preservation Act (NHPA) of 1966 as amended and its implementing regulations under 36 CFR 800 require all federal agencies to consider effects of federal actions on cultural resources eligible for or listed in the National Register of Historic Places (NRHP). Both listed and potentially eligible properties (collectively referred to as historic properties) are considered during Section 106 review, as are cultural resources that have not yet been evaluated for the NRHP. Effects on historic properties are considered during the Section 106 review within the area of potential effect (APE). The APE is defined as "the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if any such properties exist" (36 CFR 800.16). The APE is the proposed Area F permit boundary (project area) defined in consultation between OSMRE, SHPO, BLM, and DEQ. Class III cultural-resource surveys were completed specifically for the project area in 2010 (PAP, Appendix A-1) and 2012 (PAP, Appendix A-2) to identify potential effects to historic properties from the proposed undertaking; see **Section 1.1.1.2, Analysis Area**, and **Figure 61** below.

Section 106 mandates that consultation occur among the State Historic Preservation Officer (SHPO), the Advisory Council on Historic Preservation (ACHP), Native American tribes traditionally associated with the affected land, and other "interested parties" to consider effects on historic properties from the undertaking (see **Section 106 Consultation** below).

The project area includes a federal coal lease (see **Section 2.4.1, Permit and Disturbance Areas**). The federal approval to mine the federal coal lease (see **Chapter 1**) must comply with Section 106 of the NHPA and its implementing regulations under 36 CFR 800. OSMRE is the lead federal agency responsible for compliance and consultation under the NHPA.

Section 106 Consultation

OSMRE is responsible for consultation with SHPO and for NHPA compliance, which requires consulting with ACHP and interested parties including Native American tribes who claim cultural affiliation with the affected lands in order to maintain government-to-government consultation responsibilities. As part of Section 106 consultation, OSMRE would disclose potential effects on historic properties on lands with federal minerals.

OSMRE has initiated Section 106 consultation and has provided SHPO with a report that includes recommendations of NRHP eligibility for each cultural resource affected by the first 5 years (60 months) of project operations. Project effects determined in consultation with SHPO are defined under 36 CFR 800.4 of the NHPA (either a determination of "no historic properties affected" or "historic properties affected"). If a cultural resource is found to be eligible for listing in the NRHP (i.e., a historic property), OSMRE (and BLM for federal minerals) determines whether historic properties would be adversely affected by mining and associated operations.

Resolution of Adverse Effects

Historic properties that cannot be avoided during project implementation would be considered adversely affected and would require mitigation to resolve adverse effects. In order to mitigate adverse effects on historic properties, a treatment plan would be developed that outlines the methods and schedule; this plan would be appended to an existing programmatic agreement (PA) entered into by Western Energy, SHPO, DEQ, BLM, and OSMRE. The PA is in **Appendix H** of this EIS. The PA supersedes and adopts the terms of an existing memorandum of agreement that resolves adverse effects on historic properties affected by the first five years of mining operations. The PA provides for continuing compliance with Section 106 of the NHPA over the life of mining operations because mining operations beyond the first five years would be phased and future effects on historic properties remain unknown. The PA also includes stipulations to treat unanticipated discoveries during mining operations.

State Requirements

DEQ is the state permitting and regulating agency for the proposed project, which includes both private and federal coal leases. MSUMRA and its implementing rules require compliance with Section 106 of the NHPA. Rules applicable to cultural resources are summarized in **Table 76**.

Additionally, under MSUMRA, DEQ may not approve an application for strip mining when the area of land described in the application includes land which has special, exceptional, critical or unique characteristics (including archaeologic or cultural significance) or where mining on such land would adversely affect the use, enjoyment or fundamental character of neighboring land with special, exceptional, critical or unique archaeological or cultural significance, with particular attention being paid to the preservation of Plains Indian history and culture (82-4-227(2) MCA). An application for a strip mine permit must include a listing, location and description of the archaeological, cultural and other values of the area of land to be affected by the proposed mining operation (ARM 17.24.1807(8))."

Table 76. Administrative Rules of Montana Applicable to Cultural Resources under MSUMRA and Other State Regulations.

Administrative Rules of Montana (ARM)	Summary of Requirement
17.24.304(1)(b)	Includes the requirements for baseline information in the permit application; specifically, it must include a listing, location, and description of all archeological, historical, ethnological, and cultural resources and values of the proposed mine plan and adjacent area. Sites listed on, eligible for, or potentially eligible for the NRHP must be so identified.
17.24.305(1)(h)	Contains mapping requirements for the permit application; the application must contain locations of any cultural or historical resources listed or eligible for listing in the NRHP.
17.24.318	Contains requirements for the permit application; specifically, the application must contain information on the protection of public parks and historic places and the inclusion of plans to minimize or prevent impacts on these resources.
17.24.1131	Contains requirements that prohibit from use for surface or underground mining parks, historic sites, and places listed on the national register of historic places unless approved jointly by the department and the federal, state, or local agency with jurisdiction over the park or historic site.
17.24.1132(1)(e)	Prohibits coal-mining from impacting a “community or institutional building…that functions as an educational, cultural, historic, religious, scientific…facility.”
2.65.101-401	Establishes a burial preservation board that ensures that burials discovered on state and private lands are accorded equal treatment, establishes procedures for the protection of burial discoveries, and establishes repatriation procedures.

Local Requirements

There are no local requirements related to cultural and historic resources that would apply to the analysis area.

3.14.1.2 Analysis Area

The direct effects analysis area for cultural resources is the same as the APE, which as noted above is the proposed project area (**Figure 61**). The proposed project area was surveyed for cultural resources in 2010 (PAP, Appendix A-1) and 2012 (PAP, Appendix A-2); the total area surveyed was 8,280 acres and extended beyond the project area as shown on **Figure 61**. A small portion of the project area (adjacent to Area C) was surveyed in 1979 as part of the permitting process for Area C (Fredlund 1980). See also **Section 4.14.1, Analysis Methods**.

The indirect effects of coal combustion on historic properties have no practical boundary outside of the area of direct effect from mining and have no quantifiable measure. Therefore, both direct and indirect effects are limited to ground-disturbing activities, and the analysis area used for both is the APE.

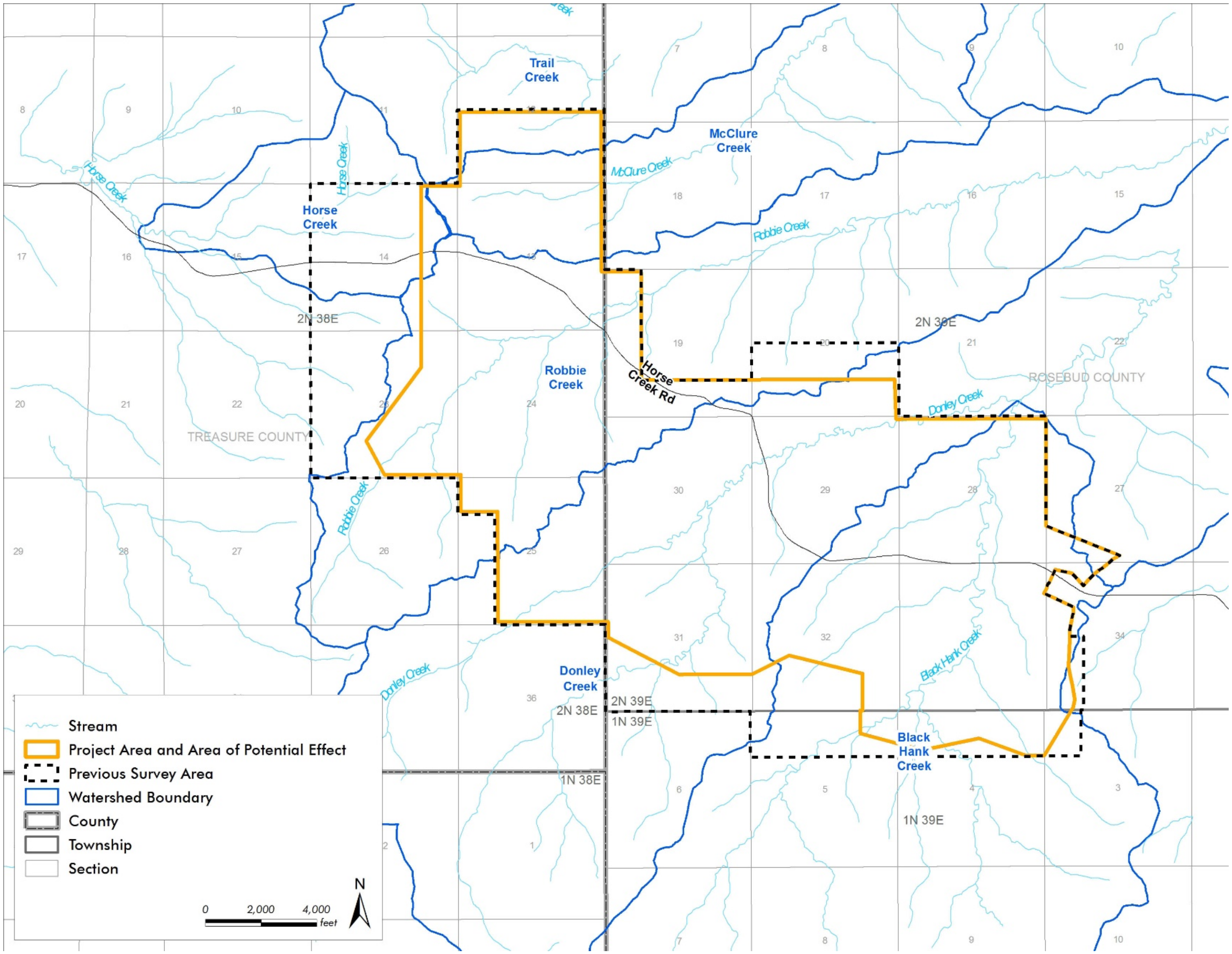

Figure 61. APE/Cultural Resources Analysis Area.

3.14.2 Cultural Context

The cultural context that follows is provided for a better understanding of the cultural and historical context of the analysis area. A summary of the cultural history of eastern Montana is also provided by Aaberg and others (Aaberg et al. 2006).

Occupation of the Pine Breaks area, which encompasses the analysis area, began during the Paleo-Indian period (12000 to 8500 BP [before present]/10000 to 6500 BC). This period is characterized by the use of large, well-made lanceolate spear points and the hunting of large mammals including now-extinct bison and mammoth species. By the end of this period, subsistence strategies had changed to a broad-spectrum hunting and plant-gathering economy. No Paleo-Indian components have been found in the vicinity of the analysis area (Kornfeld et al. 2010).

The Archaic stage (8500 to 1500 BP/6500 BC to AD 500) is divided into three periods, marked by changes in settlement strategies and material culture. Few sites are known in the Pine Breaks and adjacent areas that date to the Early Archaic, which is characterized primarily by a change in projectile-point style and increased emphasis on plant gathering (Kornfeld et al. 2010). As the climate stabilized around 3500 BC, the McKean complex became the dominant archeological manifestation of the Middle Archaic period characterized by the co-occurrence of several projectile-point types and an increase in ground-stone technology. The number of archeological sites increased dramatically during the Late Archaic period. The dominant material culture change was a shift to larger corner-notched projectile points and by the end of this period, bow-and-arrow and ceramic technology was introduced. Of the 105 documented cultural resources (refer to **Section 3.14.3, Documented Cultural Resources**, below), 5 are suspected to contain Archaic-stage components.

The Late Prehistoric period (AD 500 to 1600) is associated with the common use of the bow and arrow and the full adoption of ceramic technology. The population continued to increase during this time. Characteristic material culture included the shift from small corner-notched arrow points to small side-notched forms, and stylistic changes in pottery traditions (Kornfeld et al. 2010). Ethnohistoric information suggests the presence of several modern tribes in the area by this period including the Shoshone, Crow, Northern Cheyenne, Kiowa, and Kiowa-Apache (Reher 1979). Of the 111 documented cultural resources (see **Section 3.14.3, Documented Cultural Resources** below), 3 are suspected to contain Late Prehistoric-period components; however, the vast majority of prehistoric archeological sites documented within the APE could not be assigned to a cultural-historical period.

The first well-documented Euroamericans in the region were members of the Lewis and Clark Expedition of 1804–1806. However, the effects of horses, firearms, and disease were felt long before Euroamericans established a permanent presence. Disease had a significant effect on Native American populations in the region. Major tribes that occupied the region during the Historic period included the Crow, Shoshone, Lakota (western, or Teton Sioux), Nakota (central, or Yanktonai Sioux), Cheyenne, Blackfeet, Gros Ventre, Arapaho, and Kiowa, among others (Waldman 1985; Kooistra et al. 1993).

During the first three-quarters of the 19th century, small numbers of Euroamericans passed through the region including fur traders, government explorers, military expeditions, hunting parties, and cattle drives. The first heavily traveled routes were in Wyoming along the south and west edges of the Powder River Basin. Starting in the 1840s, westbound emigrants used the Oregon-California Trail to the south, along the North Platte River (Larson 1978). By the 1860s, the Bozeman Trail ran along the eastern edge of the Big Horn Mountains. In 1876, the U.S. government terminated all Native American claims to the Powder River country, which opened the region to large-scale Euroamerican settlement (Larson 1978).

Following the Civil War, homesteading associated primarily with the cattle industry expanded into the region, facilitated by the concomitant expansion of the railroad that enabled the movement of goods and products to market (Fletcher 1960). Homesteading, regardless of the economic driver, was boom and bust, affected by climate and precipitation patterns.

The presence of coal in the region was recognized very early. Small-scale coal mining began as private enterprise, but slowly expanded to industry. The Northern Pacific Railway Company attempted to develop the coal deposits at the head of Keogh Flat, a few miles north of Miles City, and even built the small community of Lignite near the mine. However, the coal was not suitable for use in locomotives, and the mine and village were abandoned.

In 1913 the Northern Pacific Railroad surveyed coal resources near its lines and made an extensive study of the Rosebud Field in the present-day Colstrip area. Construction of a branch line and opening of the field at Colstrip marked the beginning of the first large-scale coal operation in the Yellowstone Valley area. The Foley Brothers Company of Minnesota began construction on the mine in 1924; by 1930, the mine was producing 40 percent of Montana's coal. The mine's output peaked during World War II when it reached 2.5 million tons (over half the entire state's total) in 1943 (Chadwick 1973). The Colstrip mine was the first completely electrified coal surface mine in the country. The original city of Colstrip was also constructed at this time.

3.14.3 Documented Cultural Resources

A total of 105 cultural resources were documented within the APE (see **Section 4.14.1, Analysis Methods**), including 2 historic districts, 76 prehistoric archeological sites, 21 historic-period archeological sites, and 5 multicomponent (both prehistoric and historic) archeological sites (Fredlund 1980; Meyer 2010; Meyer and Ferguson 2012). Prehistoric site types include lithic scatters, lithic source locations, camps, and rock-art locations, which total 76 of the 105 identified sites. Lithic scatters and sources refer to sites where stone-tool manufacturing primarily took place, whereas camps refer to sites where habitation took place. The historic-period sites include the remains of homesteads, cabins, rock art/graffiti, a trash dump, and a possible grave. Additionally, 5 multicomponent historic and prehistoric period sites are within the analysis area, which include primarily rock art/graffiti locations that generally date to both periods and historic homesteads with underlying prehistoric components. A total of 93 isolated finds were also documented. Generally, isolated finds are not eligible for inclusion on the NRHP and are dismissed from further consideration. Evaluative testing occurred at 46 cultural resource sites (Meyer and Ferguson 2012).

The majority of the sites (81) have been evaluated as not eligible for listing on the NRHP. Sixteen sites are recommended eligible for listing on the NRHP, primarily under Criterion D, for their potential to provide information significant to history or prehistory. The eligible sites include 14 prehistoric archeological sites and 2 multicomponent historic/prehistoric sites. Six sites remain unevaluated due to inconclusive results from the magnetic gradient survey and evaluative testing. These sites include five prehistoric archeological sites and one multicomponent historic/prehistoric archeological site. Additional work at these sites to determine NRHP eligibility may be required.

In addition, two historic districts intersect the APE—the Castle Rock (24TE119/24RB2090) and Lee Historic Districts (24RB2053). The historic districts have been recommended eligible for the NRHP under Criterion A for their association with the development of homesteading in the region. Both of these districts are communities of homesteads founded in the early 20th century and share common historical developments and a bounded geographic area. Individual historic sites are evaluated for their NRHP significance as well as to determine whether they contribute to the period of significance and are located within the geographic boundary that defines these districts. Five homesteading sites (24RB957, 24RB958, 24RB959, 24RB2443, and 24RB2444) contribute to the Castle Rock Historic District. The prehistoric components of sites 24RB958 and 24RB959 are eligible for listing on the NRHP. None of the historic sites within the analysis area contribute to the Lee Historic District, despite its boundaries extending into the analysis area.

3.14.4 Tribal Consultation

OSMRE has initiated tribal consultation with the Northern Cheyenne, Fort Peck Assiniboine and Sioux tribes, and Crow tribes regarding the identification and effects on TCPs and archeological sites of significance to the tribes. OSMRE provided these tribes an opportunity to identify sites of religious or cultural significance and for additional comment on the Section 106 process, including resolution of adverse effects. OSMRE also initiated consultation on June 6, 2018, with additional tribes identified during public comment. These tribes include the Apache, Blackfeet Nation, Eastern Shoshone, Kiowa, and Oglala Sioux. TCPs are protected under Section 106 of the NHPA as historic properties, and when applicable, have additional protections under the American Indian Religious Freedom Act of 1978 and the Native American Grave Protection and Repatriation Act of 1990. A TCP may be eligible for listing in the NRHP because of its association with cultural practices or beliefs of a living community that are (a) rooted in the history of the community or tribe, and, (b) important in maintaining the continuing cultural identity of the community or tribe (see **Section 6.1.3, Tribal Consultation Process**). Examples of TCPs include, but are not limited to, locations where Native Americans have performed ceremonies, traditional locations for resource gathering, and rural community land use patterns such as farming and ranching.

No TCPs have been identified to date; however, continued tribal consultation may identify such properties (see **Section 6.1.3, Tribal Consultation Process**).

3.15 SOCIOECONOMIC CONDITIONS

3.15.1 Introduction

Socioeconomics describes a combination of the economic and social level of a specific population of people based on income, education, demographics, and occupation. The economic and social position of an individual or family, in relation to others, is taken into account when describing socioeconomics. This section discusses the current socioeconomic conditions within and near the analysis area, as well as the regulatory framework. The analysis area for socioeconomic conditions is defined below in **Section 3.15.1.2, Analysis Area**.

3.15.1.1 Regulatory Framework

Federal Requirements

Mineral Leasing Act

Under the Mineral Leasing Act of 1920, as amended, the federal government collects royalties on every ton of coal that is mined on federal lands or to which the federal government holds title. The Department of the Interior's Office of Natural Resources Revenue subsequently forwards approximately half of these royalty revenues to states, which in turn distribute the money toward road construction, schools, universities, communities affected by energy development, and general funds.

Coal Excise Tax

Section 4121 of the Internal Revenue Code imposes an excise tax on domestically produced coal. The taxes collected on the sales of coal are deposited to the Black Lung Disability Trust Fund to finance payments of benefits to afflicted miners.

Producers of coal in the United States are liable for the tax upon the first sale or use of the coal. The producer is the entity who has vested interest in the coal immediately after its severance from the ground without regard to the existence of any contractual arrangements for the sale or other disposition of the coal or the payment of any royalties between the producer and third parties.

The tax imposed for surface mines is the lower of 55 cents per ton or 4.4 percent of the sales price. Therefore, project area coal would be taxed at the 4.4 percent rate if the selling price is less than $12.50 per ton for surface coal.

Federal Abandoned Mine Reclamation Fund

SMCRA requires that active coal mines reclaim their land and that mines not cause water-pollution discharges for an indefinite period of time. Many coal mines that have not been reclaimed pre-date SMCRA; these mines are typically called "abandoned mine lands" (AMLs). Title IV of SMCRA addresses the reclamation of pre-1977 AMLs through the establishment of the Abandoned Mine Reclamation Fund (AMRF).

The AMRF is the most significant source of funding to remediate AMLs. This funding is generated by a federal per-ton tax on every ton of mined coal. These funds are then allocated to state environmental agencies to spend on reclamation projects. From 1977 through 2007, fees were set at 35 cents per ton for surface-mined coal and 15 cents per ton for deep-mined coal. When the AMRF was reauthorized in 2006, these fees were lowered. In fiscal year (FY) 08–12, fees were 31.5 and 13.5 cents per ton, respectively. In FY13–21, the fees decreased again to 28 and 12 cents per ton, respectively.

In Montana, the AML Section is responsible for administering abandoned mine-reclamation projects that are funded by federal grants derived from a tax on coal under SMCRA. In 1989, Montana certified to OSMRE that the state had addressed all of its high-priority coal-related reclamation problems that were eligible for funding under SMCRA. Montana was then approved to use SMCRA funding for reclamation of mines other than coal mines.

State Requirements

Federal Mineral Royalties

Twenty-five percent of the revenue received by the state for federal mineral royalties is given to local governments. It is distributed based on mineral production in each county (17-3-240, MCA).

State of Montana Coal Severance Tax

Coal mines in Montana pay a severance tax based on the value of coal produced (15-35-103, MCA). The tax rate on coal varies with the heat content of the coal and the type of mine (open-pit or underground).

The value of coal represents the contract sales price, which is either the price of the severed coal or the price of coal as computed by the Montana Department of Revenue. The contract sales price includes royalties paid on the production of the coal and is reduced to 15 cents per ton only when royalties are paid to the federal government, the state, or a federally-recognized Tribe. Each producer is exempt from tax on 20,000 tons per year, and mines producing less than 50,000 tons per year are exempt from the tax.

Coal severance taxes are distributed to several funds. Through FY 2016, 26.79 percent of the tax will be distributed to the General Fund[10]—$14.75 million was distributed in 2015 and $16.61 million is projected in 2017 (Montana Legislative Fiscal Division 2015). The General Fund receives a residual allocation after revenue has been allocated to all other funds which include: Coal Tax Trust Fund (50 percent); Long Range Building Program Account (12 percent); Local Impacts (5.46 percent); Oil, Gas, and Coal Natural Resource Account (2.9 percent); Parks Trust Fund (1.27 percent); Renewable Resource Loan Debt Service Fund (0.95 percent); and Capitol Art Protection Trust Fund (0.63 percent). In addition, $250,000 each fiscal year is appropriated to the Coal and Uranium Program.

State of Montana Coal Gross Proceeds Tax

While no actual property tax is levied on coal real property in Montana, the coal gross proceeds tax is implemented in lieu. The coal gross proceeds tax is equal to 5 percent of the coal's value (15-23-703, MCA). The value of coal is determined by considering the contract sales price, which represents either the price of coal when extracted or a price imposed by the Montana Department of Revenue. The price may be imposed by the Montana Department of Revenue if any of the following apply:

- the extracted coal is used by the operator in a manufacturing process
- the coal is refined to improve quality through either drying, cleaning, or additional processing

[10] The state General Fund accounts for all state governmental financial resources except those required to be accounted for in another fund. The major sources of revenue to the state general fund are individual income taxes (about 43 percent), corporation tax, coal severance tax, oil severance tax, interest on investments, long-range bond excess, coal trust-fund interest, insurance premium tax, and other taxes and reimbursements.

- the coal is sold through a contract and that contract is not an arm's-length agreement
- the gross yield statement for a mine is not filed

The local county treasurer collects the tax. The revenue is proportionally distributed to the appropriate taxing jurisdictions in which production occurred based on the total number of mills levied in FY 1990. No tax is levied on reserve coal property in Montana.

Business Equipment Tax

Coal-related personal property (business equipment) owned by coal companies in Montana such as machinery, fixtures, and equipment is classified as Class 8 property. The first $100,000 of market value is exempt. From $100,000 to $6 million of market value, Class 8 property is taxed at 1.5 percent. Above $6 million, Class 8 property is taxed at 3 percent.

State of Montana Coal Board Grants

The governing body of a city, town, county, or school district; any other local or state governmental unit or agency; or the governing body of a federally recognized Tribe may apply for a grant to enable it to provide governmental services that are needed as a direct consequence of an increase or decrease in coal development or of an increase or decrease in the consumption of coal by a coal-using energy complex (90-6-208, MCA).

Local Requirements

There are no local requirements that apply to the socioeconomic environment as it relates to the alternatives.

3.15.1.2 Analysis Area

The analysis area for direct and indirect socioeconomic effects is Rosebud, Treasure, and Big Horn Counties (**Figure 62**). Affected incorporated municipalities in the analysis area include Colstrip, Forsyth, Hysham, and Hardin.

The socioeconomic analysis area is based on various factors that may influence the location and magnitude of potential socioeconomic impacts. These factors include:

- the location of and access to the proposed permit area
- the likely residence area for people working at the mine (existing residents and/or any in-migrating project employees)
- the rate and magnitude of population and employee turnover, if any (including student population turnover in schools, employee turnover at the mine, and employee turnover from existing jobs to employment with Western Energy)
- the availability and location of existing housing and potential housing, and the capacity and condition of existing local services and facilities
- the people directly/indirectly affected economically by the proposed mining operation (e.g., from wages and taxes)
- the willingness and ability of community residents and local government personnel to deal with change

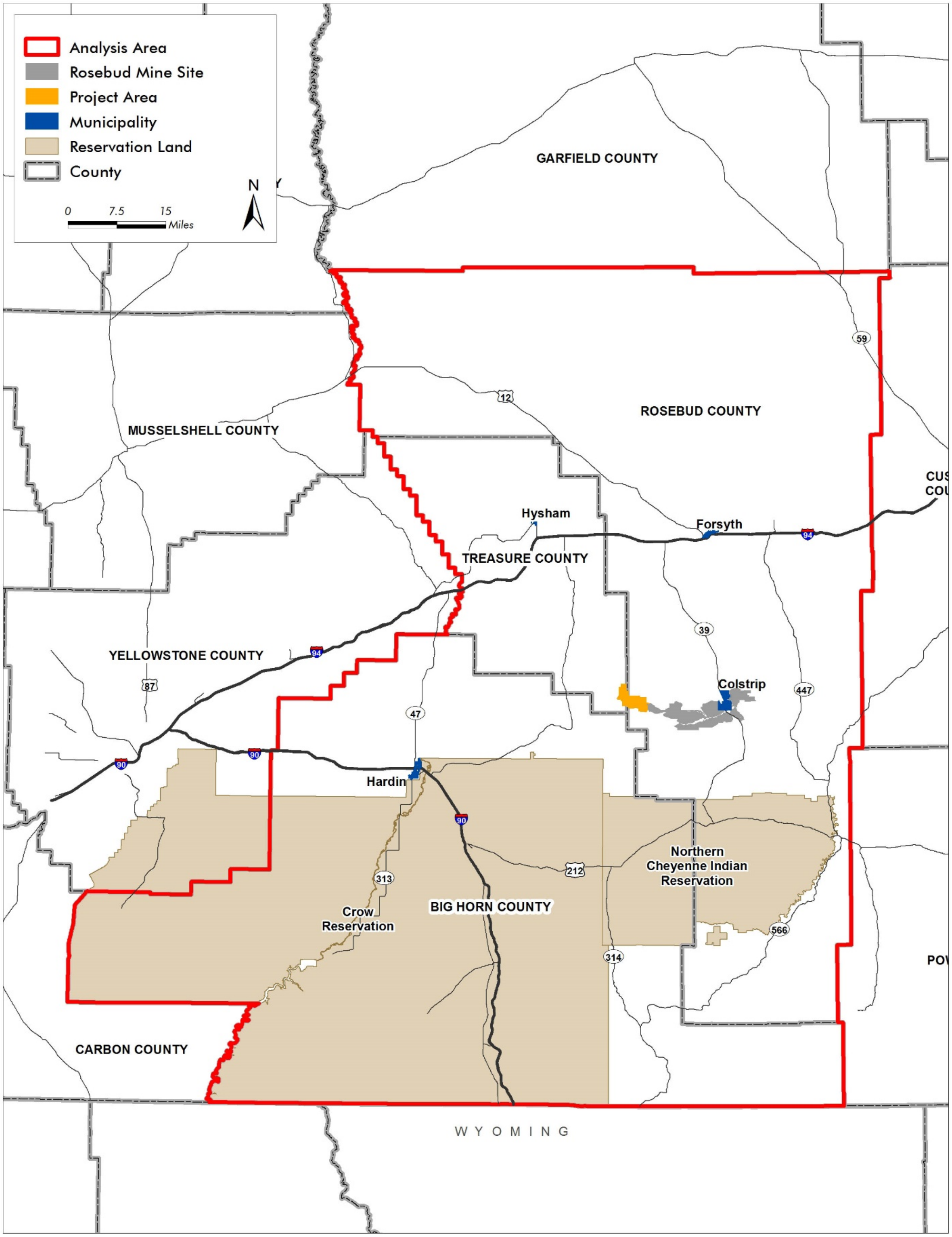

Figure 62. Socioeconomic Analysis Area.

3.15.2 Population and Demographics

3.15.2.1 Historical Population Trends and Characteristics

The analysis area's population numbers from 1970 to 2015 are shown in **Table 77**. Between 1970 and 2010, the population fluctuated in Rosebud County, steadily declined in Treasure County, and grew in Big Horn County. Between 2000 and 2010, Rosebud and Treasure Counties and communities all experienced a decline in population, while Bighorn County experienced minor to moderate growth. Population estimates for 2010 to 2015 show a moderate population increase in all of the counties, as well as in Montana. Montana's overall population has steadily increased between 1950 and 2015 (USCB 2016).

The median age was 36.9 years in Rosebud County, 49 years in Treasure County, and 29.8 years in Big Horn County, compared to 39.7 years in Montana as a whole (USCB 2016). While Treasure County has an aging workforce and experienced a negative population trend between 1980 and 2010, its population actually increased between 2010 and 2015 and its median age decreased.

Table 77. Rosebud, Treasure, and Big Horn Counties Population (1970–2015).

Jurisdiction	1970	1980	1990	2000	2010	2015
Rosebud County	6,032	9,899	10,505	9,383	9,233	9,352
% change	—	64.1	6.1	-10.7	-1.6	1.3
Forsyth	1,873	2,553	2,178	1,944	1,777	1,874
% change	—	36.3	-14.7	-10.1	-8.6	5.5
Colstrip	—	—	—[1]	2,346	2,214	2,289
% change	—	—	—	-22.7	-5.6	3.4
Treasure County	1,069	981	874	861	718	812
% change	—	-8.2	-10.9	-1.5	-16.6	13.1
Hysham	373	449	361	330	312	363
% change	—	20.3	-19.6	-8.6	-5.5	16.3
Big Horn County	10,057	11,096	11,337	12,671	12,865	13,341
% change	—	10.3	2.2	11.8	1.5	3.5
Hardin	2,733	3,300	2,940	3,384	3,668	3,754
% change	—	20.8	-10.9	15.1	8.4	2.3
Montana	694,409	786,690	799,065	902,125	989,415	1,014,699
% change	—	13.3	1.6	12.9	9.7	2.6

Source: Montana Department of Commerce 2012a, 2012b, and 2012c; USCB 2016.
[1] Colstrip was incorporated in 1998.

3.15.3 Incorporated Population Centers

The population characteristics of the counties' incorporated towns are shown in **Table 77**. In Rosebud County, Colstrip has about 24 percent of the population and Forsyth has about 20 percent of the population. A population boom occurred in Colstrip in the 1970s and 1980s during the construction of the coal-fired electric power plants (see **Section 1.2.2, Coal Combustion**). Since then, Colstrip steadily decreased in population. In Treasure County, 45 percent of the population lives in Hysham. In Big Horn County, 29 percent of the population lives in Hardin, the county seat. By 2010, Forsyth, Colstrip, and Hysham had experienced a population decrease of 5 percent or more from their 2000 populations, while

Hardin experienced a population increase of over 8 percent. All the incorporated areas have grown between 2010 and 2015.

3.15.3.1 Population Projections

Population projections for the counties and the incorporated municipalities are shown in **Table 78**. The populations of Rosebud and Big Horn Counties are projected to increase steadily from 2015 to 2030. Treasure County's population is expected to decrease between 2015 and 2030. Population projections for municipalities within the analysis area shown in **Table 78** were obtained by applying county population projected growth rates from 2020 to 2030 to the municipalities. The population in Colstrip is expected to increase by 315 people between 2015 and 2030. Forsyth's population is expected to increase by 217 people, Hysham's population is expected to decrease by 114 people, and Hardin's population is expected to increase by 1,275 people (NPA Data Services, Inc. 2008; USCB 2016).

Table 78. Rosebud, Treasure, and Big Horn Counties Population Projections (2020–2030).

Jurisdiction	Current (2015)	2020	2025	2030
Rosebud County % change	9,352 -	10,120 3.4	10,480 3.6	10,860 3.6
Forsyth	1,874	1,948	2,018	2,091
Colstrip	2,289	2,427	2,514	2,604
Treasure County % change	812 -	560 -9.7	580 3.6	570 -1.7
Hysham	363	244	253	249
Big Horn County % change	13,341 -	13,550 2.0	13,920 2.7	14,310 2.8
Hardin	3,754	4,764	4,892	5,029
Montana % change	1,014,699 -	1,078,460 4.5	1,128,460 4.6	1,182,440 4.8

Source: NPA Data Services, Inc. 2008; USCB 2016.

Minority and Disabled Populations

Minority populations in the analysis area are described in **Section 3.16, Environmental Justice**.

Disabled populations and individuals are those with serious difficulty in four basic areas of function: hearing, vision, cognition, and ambulation. Persons with disabilities account for 10.7 percent of Big Horn County's population compared to 15.1 percent of Rosebud County and 14.8 percent of Treasure County. Montana's disabled population represents 13.3 percent of the total (USCB 2016).

3.15.3.2 Employment

Employment conditions in the analysis area are presented in terms of historical employment trends, current types of employment, and baseline employment projections by county.

Rosebud County

Rosebud County's traditional major industries of coal-mining, the railroad, and agriculture remain the driving forces of the area's economy. Rosebud County has experienced a declining economy within the last several decades. Primary businesses in the county have downsized and a small U.S. Air Force base closed. Ongoing drought conditions in southeastern Montana have also impacted the county's agricultural sector. The Tongue River Lumber Mill (a major employer of Native Americans) closed but has attempted to reopen numerous times in the last 10 years.

The top 10 private employers for Rosebud County during the second quarter of 2015, listed in alphabetical order, were: Colstrip Electric, Lame Deer Trading Post, North American Energy Services, PP&L of Montana, Prince Inc., Rosebud Community Hospital, St. Labre Indian School, Town Pump, True Oil Company, and Western Energy (Montana Department of Labor & Industry 2016).

Western Energy employs approximately 400 workers per year. In 2015, Western Energy had 323 union and 87 salaried employees with a total payroll of approximately $30.3 million at the Rosebud Mine. The current economic effects of the Rosebud Mine were modeled for this EIS using the IMPLAN regional economic modeling system (BBC 2017); the BBC 2017 report is included in **Appendix G** of this EIS. Please see **Section 4.15, Socioeconomics** for a summary of the analysis methods and a discussion of current economic effects.

As described in **Section 1.2.2.1, Colstrip Power Plant**, Montana Power finished construction of its first two Colstrip plants (Units 1 and 2) in 1976 and two more (Units 3 and 4) in 1986 (collectively called the Colstrip Power Plant). The power plant, which is now operated by Talen Energy, currently employs about 400 workers and currently supports about $934 million in total annual economic output across the analysis area (BBC 2017). The coal mined from the Rosebud Mine by Western Energy is the primary fuel for the Colstrip Power Plant.

In 1996, the city of Colstrip experienced a population decrease due to downsizing by Montana Power at the Colstrip Power Plant and lost coal contracts as a result. Approximately 500 jobs were lost. The majority of the laid-off workforce found jobs elsewhere, with a few families staying to find local employment or to start their own service businesses. Local businesses include two banks, a credit union, two hardware stores, two motels, a bowling alley, a grocery store, casinos, a floral shop, a post office, a clothing store, a library, restaurants, and convenience stores. These businesses are supported by income from the Colstrip Power Plant, the Rosebud Power Plant, and the Rosebud Mine, as well as the agricultural production in the area surrounding Colstrip, including the Crow Reservation and the Northern Cheyenne Indian Reservation.

The incorporated city of Forsyth is the largest commercial district in Rosebud County with a post office, two banks, several motels, numerous retail stores, restaurants, and services. The primary employers are the railroad, agriculture, government, the hospital and nursing home, the school district, and retail and service businesses, with some residents traveling 36 miles south to Colstrip to work at the coal mine or the power plants.

The top employment sectors by industry with the number of employees are shown in **Table 79**. The labor force in Rosebud County, defined as persons working or seeking work, decreased by 3.5 percent. During the same period, Montana's labor force increased by 3.1 percent (Montana Department of Labor & Industry 2016).

In Rosebud County, the unemployment rate—defined as the number of unemployed persons as a percentage of the labor force—decreased from 7.0 percent in 2010 to 5.6 percent in 2015. This was somewhat higher than the overall unemployment rate in Montana, which was 4.7 percent during 2015 (Montana Department of Labor & Industry 2016).

Table 79. Rosebud County Employment by Industry 2011–2015 (5-year estimates).

Industry	Number	Percent
Agriculture, forestry, fishing and hunting, and mining	801	20.0
Construction	243	6.1
Manufacturing	44	1.1
Wholesale trade	6	0.1
Retail trade	216	5.4
Transportation and warehousing; Utilities	473	11.8
Information	90	2.2
Finance and insurance; Real estate/rental/leasing	188	4.7
Professional, scientific, management, and administrative	110	2.7
Educational services; Health care and social assistance	1,073	26.8
Arts, entertainment, and recreation; Accommodation and food services	363	9.1
Other services, except public administration	76	1.9
Public administration	319	8.0
Total	**4,002**	**100.0**

Source: Missouri Census Data Center 2016.

Treasure County

Treasure County's principal industries are farming and ranching. Crops include sugar beets, corn, wheat, barley, and beans. Hysham is the county seat with a small business district that has two restaurants, a hardware store, a bank, a few service businesses, and two convenience stores. A motel and a bed-and-breakfast provide places to stay for hunters and tourists. A veterinarian clinic, farm-implement dealer, and Simplot Elevator services are additional businesses in town.

The top employment sectors by industry with the number of employees are shown in **Table 80**. The labor force in Treasure County decreased by 11.3 percent between 2010 and 2015. During the same period, Montana's labor force increased by 3.1 percent (Montana Department of Labor & Industry 2016).

In Treasure County, the unemployment rate decreased from 5.3 percent in 2010 to 4 percent in 2015. This was below the overall unemployment rate in Montana, which was 4.7 percent in 2015 (Montana Department of Labor & Industry 2016).

Table 80. Treasure County Employment by Industry 2011–2015 (5-year estimates).

Industry	Number	Percent
Agriculture, forestry, fishing and hunting, and mining	163	43.0
Construction	18	4.7
Manufacturing	5	1.3
Wholesale trade	6	1.6
Retail trade	25	6.6
Transportation and warehousing; Utilities	46	12.1
Information	3	0.8
Finance and insurance; Real estate/rental/leasing	7	1.8
Professional, scientific, management, and administrative	9	2.4
Educational services; Health care and social assistance	56	14.8
Arts, entertainment, and recreation; Accommodation and food services	10	2.6
Other services, except public administration	10	2.6
Public administration	21	5.5
Total	**379**	**100.0**

Source: Missouri Census Data Center 2016.

Big Horn County

Big Horn County is Montana's 14th-most-populous county; Hardin, the county seat, is the state's 22nd-largest city. The majority of Big Horn County lies within the Crow Reservation and the Northern Cheyenne Indian Reservation. Coal-mining and agriculture both play major roles in Big Horn County's economy. Farms and ranches in the county produce mainly beef cattle, sugar beets, alfalfa, and small grains.

The top employment sectors by industry with the number of employees are shown in **Table 81**. The labor force in Big Horn County, defined as persons working or seeking work, increased by 2.2 percent between 2010 and 2015. During the same period, Montana's labor force increased by 3.1 percent (Montana Department of Labor & Industry 2016).

In Big Horn County, the unemployment rate decreased from 11 percent in 2010 to 10 percent in 2015. This was more than twice the overall unemployment rate in Montana, which was 4.7 percent in 2015 (Montana Department of Labor & Industry 2016).

Table 81. Big Horn County Employment by Industry 2010–2015 (5-year estimates).

Industry	Number	Percent
Agriculture, forestry, fishing and hunting, and mining	163	43.0
Construction	18	4.7
Manufacturing	5	1.3
Wholesale trade	6	1.6
Retail trade	25	6.6
Transportation and warehousing; Utilities	46	12.1
Information	3	0.8
Finance and insurance; Real estate/rental/leasing	7	1.8
Professional, scientific, management, and administrative	9	2.4
Educational services; Health care and social assistance	56	14.8
Arts, entertainment, and recreation; Accommodation and food services	10	2.6
Other services, except public administration	10	2.6
Public administration	21	5.5
Total	**379**	**100.0**

Source: Missouri Census Data Center 2016.

3.15.3.3 Income

Median household income (MHI), per-capita income (PCI), and persons below the poverty line (poverty rate) are variables used to understand income (**Table 82**). All three counties have lower PCI when compared to the state. Big Horn and Treasure Counties have lower MHIs compared to the state. Rosebud County has a higher MHI and PCI, and a slightly lower poverty rate compared to the other counties. Big Horn County has a substantially lower PCI and a higher rate of persons below the poverty line than the state and the other counties. PCI can be relatively low when a disproportionate number of nonworking residents (children, the elderly, and the disabled) are included in the population, which is the case for Treasure County. All three counties in the analysis area have a higher percentage of people living below the poverty line than the state.

Table 82. Household Income.

Parameter	Rosebud County	Treasure County	Big Horn County	Montana
Median household income	$51,159	$41,103	$41,622	$47,169
Per-capita income	$23,238	$20,758	$16,244	$26,381
Percentage of persons below poverty line	20.6%	21.9%	29.2%	15.2%

Source: Missouri Census Data Center 2016.

3.15.3.4 Housing

All three of the counties have a housing surplus, with between 19 and 24 percent of housing units vacant. Rosebud County had 4,105 housing units, while Treasure County had 437 and Big Horn County had 4,677. Overall, the percentage of owner-occupied housing units in the analysis area (about 69 percent in Rosebud County, 64 percent in Treasure County, and 61 percent in Big Horn County) was comparable to the state's 67 percent (Missouri Census Data Center 2016).

3.15.4 Public Services and Infrastructure

3.15.4.1 Schools

Colstrip. The Colstrip Public School System has an elementary, middle, and high school. Pine Butte Elementary School houses kindergarten through grade 5, Frank Brattin Middle School houses grades 6 through 8, and Colstrip High School houses grades 9 through 12. The school district has approximately 700 students. When local populations decreased in the 1990s, a second elementary school was closed.

Forsyth. Forsyth Public Schools has an elementary and high school. Forsyth Elementary School serves kindergarten through grade 6, while Forsyth High School serves grades 7 through 12. The school district has approximately 400 students.

Hysham. Hysham Public Schools has an elementary, middle, and high school. Hysham Elementary School serves pre-kindergarten through grade 6, Hysham Middle School serves grades 7 and 8, while Hysham High School serves grades 9 through 12. The school district has approximately 100 students.

Hardin. Hardin Public Schools are home to about 1,900 students who attend classes in 7 schools. There are two elementary schools that serve kindergarten through grade 5—the Crow Agency School and Fort Smith School. In addition to a kindergarten readiness center, the Hardin Primary School serves kindergarten through grade 3; the Hardin Intermediate School serves grades 3 through 5; the Hardin Middle School serves grades 6 through 8; and the Hardin High School serves grades 9 through 12.

3.15.4.2 Law Enforcement

Colstrip. Initiated in 2004, the Colstrip Police Department provides safety, protection, code enforcement, animal control, and operates a seven-bed jail holding facility. The department currently has six full-time officers, two reserve officers, and five 911 dispatchers.

Forsyth. Forsyth contracts with Rosebud County for law enforcement services. The Rosebud County Sheriff's Office located in Forsyth was established in 1901. The office has seven officers, four dispatchers, and additional detention staff. The Rosebud County Detention Center holds up to 26 inmates. Dispatch for the Rosebud County Sheriff's Office also works with local Montana Highway Patrol officers and Montana Fish, Wildlife and Parks game wardens. The Rosebud County Sheriff's Office is also responsible for paging Disaster and Emergency Services, Forsyth Ambulances, and Rural County Fire Departments.

Hysham. There is no city police department in Hysham. Under a cooperative agreement with Hysham, the Treasure County Sheriff Department provides police services to both the city and county. Treasure County uses Rosebud County's dispatch and detention services. Montana Highway Patrol Officers also provide law enforcement services.

Hardin. There is no city police department in Hardin. The Big Horn County Sheriff Department provides police services to both the city and county.

3.15.4.3 Fire Protection

Colstrip. The Colstrip Volunteer Fire Department serves the city and surrounding community. The fire department follows the policies and procedures of the city of Colstrip and state law (7-33-4104 through 4133, MCA) relevant to municipal fire departments. The 26 volunteer firefighters train regularly and are required to complete 30 hours of basic firefighting training.

Forsyth. Forsyth has two fire stations and two fire departments—the Forsyth Fire Department and Rosebud County Fire.

Hysham. The Hysham Volunteer Fire Department, located in the center of town, has 20 volunteers and no paid staff.

Hardin. The Hardin Volunteer Fire Department has about 20 volunteers and no paid staff.

3.15.4.4 Health Care Facilities

Colstrip. The Colstrip Medical Center serves the community and surrounding areas as a primary-care facility. Staffing includes two full-time family physicians, two full-time physician assistants, several nurses, a physical therapy program, diagnostic center, and a health and wellness program. The nearest hospital is Rosebud Community Hospital located 30 miles north in Forsyth. Colstrip has an ambulance service that operates within an approximate 30-mile radius around Colstrip and is dispatched through the local police department.

Forsyth. Forsyth has a fully-staffed hospital and nursing home with three physicians on staff and two medical clinics in town, and serves all of Rosebud County. The county owns the hospital buildings and land. Operating revenues and private donations support all other expenses. Recently, a task force worked to build an assisted-living facility in Forsyth.

Hysham. The Hysham Community Health Clinic and Treasure County Health Department are combined as the public healthcare provider for Hysham. The facility is staffed by a physician one day a week to provide general clinic services. There are no nursing homes or elderly-care facilities in Hysham. However, the Treasure County Senior Citizens Center provides meals and a social meeting space. Local ambulance service is dispatched through the county.

Hardin. In 1959, Hardin opened its present hospital, Big Horn County Memorial Hospital. In 1974, a 34-bed nursing home was constructed by Big Horn County and attached to the existing hospital. In 1982, Heritage Acres Nursing Home complex was built with 36 long-term care beds and 20 independent-living apartments. The Big Horn Hospital Association constructed a new clinic to house five physicians and staff an outpatient rehabilitation facility. Big Horn County Memorial Hospital is a critical access hospital with approximately 60 beds.

3.15.4.5 Water Supply

Colstrip. The public water supply is sourced from the Yellowstone River 6 miles west of Forsyth to a storage impoundment (Castle Rock Lake) immediately west of Colstrip. Stored water is then treated at the Colstrip Water Treatment Plant for potable use. Potable water is distributed from the plant through six high-service pumps entering into three separate pressure zones over 26 miles of distribution lines servicing Colstrip. Three separate reservoirs totaling 3.15 million gallons of water maintain the pressure zones.

Forsyth. The Forsyth City Water Works Department *provides municipal potable water treatment.* The water-treatment plant is located near the source intake on the Yellowstone River. Treated potable water is piped to municipal users through a pressurized distribution network.

Hysham. Hysham provides municipal potable water. The municipal water-treatment plant is located near the source intake on the Yellowstone River. Treated potable water is piped to municipal users through a pressurized distribution network.

Hardin. Hardin water treatment consists of a surface water plant that treats water pumped from the Big Horn River with a capacity of 2 million gallons a day and two 500,000-gallon storage reservoirs.

3.15.4.6 Wastewater Treatment

Colstrip. Wastewater is collected from the city of Colstrip through two sanitary collection systems into a water-treatment plant designed to treat the sewage to water-quality standards set by EPA. Effluent is discharged to a holding pond for use as reclaimed water on the local Pine Butte Golf Course. Sludge is disposed in a storage lagoon. The wastewater-treatment plant currently operates at approximately 200,000 gallons per day, but is designed for a larger population with average daily flows of 600,000 gallons.

Forsyth. Wastewater in Forsyth is collected through a sewer network for treatment at the municipal wastewater-treatment plant. The wastewater-treatment plant’s maximum design volume is 1 million gallons per day, but it is presently treating an average 300,000 gallons per day.

Hysham. Wastewater in Hysham is collected through a sewer network for treatment at the municipal wastewater-treatment plant. The wastewater-treatment plant’s maximum design volume is 864,000 gallons per day. Presently the plant is treating 250,000 to 300,000 gallons per day in the summer and 35,000 to 50,000 gallons in the winter.

Hardin. Wastewater in Hardin is collected through a sewer network for treatment. The sewer treatment plant’s current effluent flow is 750,000 to 900,000 gallons per day. The plant has a capacity of 1.1 million gallons per day and uses aerobic digestion and oxidation systems.

3.16 ENVIRONMENTAL JUSTICE

3.16.1 Introduction

Environmental justice refers to actions that unequally impact a given segment of society as a result of physical location, perception, design, noise, pollution, or other factors. This section describes minority and low-income populations in the analysis area and the applicable regulatory framework. The analysis area for environmental justice is defined below in **Section 3.16.1.2, Analysis Area**.

3.16.1.1 Regulatory Framework

Federal Requirements

Executive Order 12898 Environmental Justice

Executive Order 12898, Environmental Justice, requires federal agencies to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects on minority and low-income populations when implementing their respective programs, including American Indian programs. OSMRE's analysis of environmental justice follows the CEQ and EPA guidance on environmental justice (CEQ 1997; EPA 1998), and the U.S. Department of the Interior's Environmental Justice Strategic Plan 2012–2017 (OEPC 2012). These documents suggest a step-wise evaluation of environmental justice: identification of minority and low-income populations, assessment of effects, determination of whether the effects would be disproportionately high and adverse, and determination of whether mitigation is needed. An effect on a minority or a low-income population is disproportionately high and adverse if the adverse effect is appreciably more severe or greater in magnitude than the adverse effect that would be suffered by the non-minority population and/or non-low-income population.

Northern Cheyenne v. Lujan Settlement Agreement

Western Energy has a 1991 settlement agreement with the Northern Cheyenne Tribe pertaining to the case, Northern Cheyenne Tribe, Plaintiff, *v*. Lujan, et al., Defendants, Cause No. CV-82-116-BLG-JFB (Lujan Settlement). The Lujan Settlement includes provisions for employment of Northern Cheyenne Tribe members at the Rosebud Mine. Western Energy agreed to increase the number of qualified persons with Northern Cheyenne affiliation employed at the Rosebud Mine, specifically agreeing to "make reasonable efforts to hire 50 percent of all New Employees in Colstrip Operations from Tribal Referrals" (Lujan Settlement 1991). This agreement pertains to positions related to "administration, pre-mining and exploration activity, mining, coal processing, coal beneficiation, coal drying, coal conveying, coal loadout, environmental activities, postmining and reclamation activities and related construction; and security, clerical, janitorial, warehouse, and technical support services."

State Requirements

There are no state requirements or regulatory guidance pertaining to environmental justice.

Local Requirements

There are no local requirements or regulatory guidance pertaining to environmental justice.

3.16.1.2 Analysis Area

The analysis area for environmental justice direct and indirect social and economic effects is the same as that used for the socioeconomic analysis and includes Rosebud, Treasure, and Big Horn Counties (see **Section 3.15, Socioeconomic Conditions**). The Crow Reservation overlies Big Horn County and the Northern Cheyenne Indian Reservation overlies Big Horn and Treasure Counties. Both reservations are included in the analysis area. The State of Montana and the U.S. are used when appropriate to provide context and comparison. All data for minority populations and low-income populations are from the most recent U.S. Census Bureau (USCB) American Community Survey (ACS) 5-year estimates for 2011 to 2015 ("ACS estimates") (USCB 2016). The analysis area for direct and indirect human health and safety effects on environmental justice includes the air quality analysis, as described in **Section 3.5, Human Health and Safety**. The direct impacts analysis area is defined as the project disturbance limits and the access roads where mine traffic may travel. Because public health and demographic data is often available at the county and regional level, the indirect affects analysis discussion extends beyond the air quality analysis area to the region, which includes the three counties and the Northern Cheyenne Indian Reservation and the Crow Reservation.

3.16.2 Minority Populations

The presence of minority race and minority ethnic populations was determined by comparing the ACS-estimated proportion of the minority population within the analysis area to the proportion of the population in Montana. If the analysis area had a disproportionate population of minorities when compared to the state population, it was considered to have an environmental justice population. For this analysis, disproportionate minority populations were considered present when the proportion of minorities was greater than twice the state's population proportion. If Montana's minority race, ethnicity, or total minority population is substantially different than the U.S. population proportion, both were taken into consideration when determining if a disproportionate environmental justice population is present. Minority populations are summarized in **Table 83** in **Section 3.16.2.3, Total Minority Populations**, below.

3.16.2.1 Minority Race Populations

The ACS estimates that minority race populations comprise 39 percent of the total Rosebud County population, 10.2 percent of the total Treasure County population, and 66.7 percent of the total Big Horn County population. In Montana, minority race populations comprise 10.8 percent of the population. Treasure County's American Indian or Alaska Native population proportion is 2.8 percent, while Rosebud County and Big Horn County have a proportion of 36.9 percent and 64.9 percent, respectively (USCB 2016). The Northern Cheyenne Indian Reservation is in the southern part of Rosebud County and accounts for the high percentage of American Indian residents.

The Crow and Northern Cheyenne Indian Reservations and off-reservation trust lands overlap with substantial portions of Bighorn and Treasure Counties (**Section 3.15, Socioeconomic Conditions**). The ACS estimates that American Indian or Alaska Natives account for 78.5 percent of the population on the Crow Reservation, and 91.7 percent of the population on the Northern Cheyenne Indian Reservation. Montana's American Indian or Alaska Native population proportion is 8.1 percent (USCB 2016). The overall minority race population on the Crow Reservation and the Northern Cheyenne Indian Reservation are 79.5 percent and 92.6 percent, respectively (USCB 2016).

Based on these proportions, minority race environmental justice populations are present within Big Horn and Rosebud Counties and on the Northern Cheyenne Indian and Crow Reservations. These populations are predominantly Native American or Alaska Native populations. The Northern Cheyenne Indian and

Crow Reservations intersect with the human health and safety indirect effects analysis area (**Section 3.5, Human Health and Safety**).

3.16.2.2 Latino and Hispanic Populations

The ACS estimates that Latino or Hispanic individuals of all races, comprise 5.2 percent of Big Horn County, 4.2 percent of Rosebud County, and 6.9 percent of Treasure County. The Latino or Hispanic population in Montana as a whole is about 3.3 percent of the population. While the counties have higher proportions of the population that are ethnic minorities, these are substantially lower than the national proportion, which is 17.1 percent. The Latino or Hispanic population on the Northern Cheyenne Indian and Crow Reservations are 3.1 percent and 3.3 percent, respectively, which are comparable to the state's proportion (USCB 2016). Based on these proportions, there are no significant minority ethnic populations within the analysis area. While Big Horn and Treasure Counties have relatively high Hispanic and Latino population proportions compared to Montana, these are notably lower than the U.S. population proportion.

3.16.2.3 Total Minority Populations

ACS estimates that the total minority population, defined as those identifying as both non-White and/or Hispanic, comprises 70.5 percent of Big Horn County, 41.3 percent of Rosebud County, and 10.8 percent of Treasure County. Montana's minority population is 13 percent. Total minority populations on the Northern Cheyenne Indian and Crow Indian Reservations are 82.2 and 93.2 percent, respectively. Based on these proportions, there are significant total minority populations within the analysis area, which is comprised of individuals that are non-white and/or Hispanic or Latino.

Table 83. Minority Race, Hispanic and Latino, and Total Minority Populations within the Analysis Area.

Population/ Geography	U.S.	Montana	Big Horn County	Rosebud County	Treasure County	Northern Cheyenne Indian Reservation	Crow Reservation
All minority race	26.4	10.8	66.7	39.0	10.2	92.6	79.5
American Indian	1.5	7.9	64.9	36.4	2.8	91.7	78.5
Hispanic or Latino	17.1	3.3	5.2	4.2	6.9	3.3	3.1
Total minority population	33.7	13.0	70.5	41.3	10.8	93.2	82.2

Source: USCB 2016.

3.16.3 Low-Income Populations

Low-income environmental justice populations are present if the proportion of the ACS-estimated population living below the poverty line is disproportionate to state and national levels. For this analysis, disproportionate poverty rates were considered to be greater than 20 percent of the overall population, based on the poverty rates for Montana and for the U.S. Montana's poverty rate (15.2 percent) is comparable to the national rate (15.5 percent). **Table 84** summarizes poverty rates within the analysis area.

ACS estimates that Big Horn, Treasure, and Rosebud Counties have family poverty rates of 29.2 percent, 21.9 percent, and 20.6 percent, respectively. The family poverty rates on the Northern Cheyenne Indian and Crow Reservations are 24.4 percent and 37.4 percent, respectively. All three counties and both the Northern Cheyenne Indian and Crow Reservations have higher family poverty rates than Montana overall

(15.2 percent), which is comparable to the U.S. as a whole (15.5 percent) (Missouri Census Data Center 2016; USCB 2016).

As discussed above, American Indians are the largest minority race population within the project area. ACS estimated poverty rates for American Indians are 41 percent in Big Horn County and 47.5 percent in Treasure County. These rates are higher than for American Indians in Montana and the U.S., and far exceed the overall poverty rates within any of the counties, the state, and the nation. Likewise, poverty rates for American Indians living on the Northern Cheyenne Indian and Crow Reservations exceed those of the overall population.

Table 84. Individual Poverty Rates within the Analysis Area.

Population/ Geography	U.S.	Montana	Big Horn County	Rosebud County	Treasure County	Northern Cheyenne Indian Reservation	Crow Reservation
Poverty Rate (percent)	15.5	15.2	29.2	21.9	20.6	24.4	37.4
American Indian Poverty Rate (percent)	28.3	38.2	41.0	47.5	0	36.5	49.8

Source: USCB 2016.

Based on these proportions, low-income environmental justice populations are present within all three counties and on the Northern Cheyenne Indian and Crow Reservations, and within the public health indirect effects analysis area (**Section 3.5, Public Health**). American Indian populations within the analysis area have higher rates of poverty than the overall population.

3.17 VISUAL RESOURCES

3.17.1 Introduction

This section describes the visual character within and near the project area and the regulatory authorities governing visual resources. The analysis area for visual resources is defined below in **Section 3.17.1.2, Analysis Area**.

3.17.1.1 Regulatory Framework

Federal Requirements

There are no federal regulations applicable for visual resources within or near the analysis area. BLM Visual Resource Management (VRM) definitions and terminology are referenced to describe the analysis area; however, a VRM analysis was not deemed necessary since there are no federally-owned surface lands in the analysis area.

The regulatory requirements applicable to regional haze are addressed in **Chapter 3** under **Air Quality**. Haze-causing criteria pollutants such as fine particulates, SO_2, and NO_x emitted from power plants, construction, car exhaust, and other manmade and natural sources can obscure the clarity, color, form and texture of what one sees. These criteria pollutants are regulated under the Clean Air Act and EPA's Federal Haze Rule and are discussed in **Section 3.3.1.1, Air Quality, Regulatory Framework**.

State Requirements

There are no state regulations applicable to visual resources within or near the analysis area.

Local Requirements

There are no local regulations applicable to visual resources within or near the analysis area.

3.17.1.2 Analysis Area

Direct Effects Analysis Area

The analysis area for direct effects is the viewshed of the proposed project, which is the landscape that can be directly seen under favorable atmospheric conditions from a given viewpoint. Therefore, the analysis area includes everything within the project area and lands surrounding the proposed mining operations (and associated infrastructure) with potential views of the proposed operations (see **Section 4.17, Visual Resources**). Observation points were identified within the analysis area to assess visual impacts of the Proposed Action and alternatives, as further discussed in **Chapter 4**.

Indirect Effects Analysis Area

The analysis area for indirect effects from regional haze and visibility is the same as that used for air quality: it consists of a large rectangular region that encompasses the entire Rosebud Mine and the area within a 300-km radius, including the Rosebud and Colstrip Power Plants (see analysis area figure in **Section 3.3, Air Quality**. It is derived from the distance within which criteria pollutants from the power plants may affect visibility, as discussed in **Section 3.3, Air Quality**. Regional haze and visibility rules are applicable to areas designated as Class I air quality areas, where visibility is monitored in national parks and wilderness areas, also addressed in **Section 3.3, Air Quality**. The closest Class I area is the Northern Cheyenne Reservation, located 21 km (about 13 miles) south of the analysis area just under 30 km away. Other Class I air-quality areas occurring within the 300-km analysis area include: North Absaroka Wilderness and Washakie Wilderness Area (Wyoming), Theodore Roosevelt National Park (North Dakota), UL Bend National Wildlife Refuge and Fort Peck Indian Reservation (Montana), and Yellowstone National Park (Montana and Wyoming).

3.17.2 Visual Character

The direct and indirect effects analysis areas occur in the Northwestern Great Plains ecoregion, an unglaciated, semi-arid rolling plain with occasional buttes, badlands, and ephemeral and intermittent streams (Woods et al. 2002). The analysis areas contain low-lying, long, rolling hills vegetated with predominantly native grasslands and scattered, small native woody shrubs (mostly sagebrush) with patches of conifer woodlands. Six major vegetation communities were identified in the analysis area: grassland, conifer (ponderosa pine)/sumac, sagebrush, pastureland, mixed shrubland, and woody draw (see **Section 3.10, Vegetation**). The grasslands are grama-needlegrass-wheatgrass mixed-grass prairie, interspersed with low-lying hills covered in scattered conifer (ponderosa pine)/sumac forests (Woods et al. 2002; Cedar Creek Associates, Inc. 2014). This region contains numerous small, open valleys with narrow ephemeral streams.

The direct effects analysis area is located 12 miles west of the city of Colstrip. The views in this area also include distant mountains such as Cone Butte, 14 miles west of Colstrip. The hills have highly visible rock outcrops interspersed with sparse conifer forests. Horse Creek Road passes through the project area roughly west-east. The terrain surrounding the road is consistent with the description above: low-lying, rolling hills of grass (green to yellow, depending on the season) with scattered woody shrubs and conifer woodlands. The proposed project would relocate the road about 1 mile northeast of its current alignment (see **Section 4.17, Visual Resources**).

From high viewpoints in the topography, the direct effects analysis area has unobstructed views for several miles in all directions. The rolling topography of the site, however, screens most views of ground disturbance in Permit Areas A, B, and C where active mining is occurring. Distant mountains are typically visible to the west and north, and large areas of the sky and changing weather conditions can be seen in all directions. The landscape has only subtle variations in color and texture, except occasional buttes and rock outcrops or when rolling grasslands transition to ponderosa forests. The surface within the analysis area has limited visible human disturbance, but some changes to vegetation are evident from livestock grazing, agriculture, roads, utility corridors, and wildfire.

The vegetation communities on the rolling hills around the city of Colstrip, Colstrip Power Plant, and Rosebud Power Plant, which are within the indirect effects analysis area, are predominantly mixed-grass prairie with ponderosa pine forests on knolls. The existing Rosebud Mine is located west, south, and east of the city of Colstrip. As expected, the existing mine operations look industrial, with large buildings, conveyors, coal piles, large equipment, draglines, evaporative ponds, and land scars of bare soil from the open pits, maintenance, and haul roads. Steam from cooling facilities and the smokestacks of the Colstrip Power Plant (built in 1975) are visible from most locations within the city of Colstrip including residential homes, local roads, commercial businesses, recreation and park facilities, and State Highway (SH) 39 north and south of Colstrip. Associated mine and power plant facilities such as the railroad tracks, a pipeline, and haul roads are also visible from the south side of Colstrip and from SH 39 as it passes through Colstrip. Although Colstrip residences are located directly east of active mining in Permit Area A, very little of the mining operation is visible from these residences because it is obscured by low rolling hills. The Rosebud Power Plant is only visible for a short time as travelers drive past it on SH 39, for two to three minutes. It is not visible from any of the other observation points.

3.18 RECREATION

3.18.1 Introduction

This section describes the affected environment for recreation within and near the analysis area and the regulatory authorities governing the project. The analysis area for recreation resources is defined below in **Section 3.18, Analysis Area**. Other land uses, as defined in MSUMRA (82-4-203, MCA), are discussed in **Section 3.23, Land Use**. Visual resources, which are closely related to recreation, are described in **Section 3.17, Visual Resources**.

3.18.1.1 Regulatory Framework

Federal Requirements

The Approved Resource Management Plan (ARMP) for the BLM Miles City Field Office (MCFO) provides a framework for the future management direction and appropriate use of the MCFO planning area, which covers 2.75 million acres of public land and 10.6 million acres of federal minerals in Carter, Custer, Daniels, Dawson, Fallon, Garfield, McCone, Powder River, Prairie, Richland, Roosevelt, Rosebud, Sheridan, Treasure, Wibaux, and portions of Big Horn and Valley Counties. The RMP provide goals, objectives, land-use allocations, and management direction for land uses (including recreation) for the BLM-administered surface and mineral estate based on multiple use and sustained yield, unless otherwise specified by law (Federal Land Policy and Management Act Section 102 [c], 43 United States Code [USC], Section 1701 et seq.). There are no BLM-administered lands in the analysis area; however, there are such lands within the indirect effects analysis area.

State Requirements

Recreation is defined in MSUMRA in 82-4-203(45), MCA, as “land used for public or private leisure-time activities, including developed recreation facilities such as parks, camps, and amusement areas, as well as areas for less-intensive uses such as hiking, canoeing, and other undeveloped recreational uses.” MSUMRA has requirements regarding postmine land uses, including recreation, which are quoted in the discussion under Land Use in **Section 3.23.1.1, Regulatory Framework**.

Montana Fish, Wildlife & Parks (FWP) manages wildlife populations and establishes limits on fishing and hunting activities statewide. FWP’s mission, through its Employees and Citizen Commission, provides for the stewardship of the fish, wildlife, parks, and recreation resources of Montana while contributing to the quality of life for present and future generations. FWP’s mission is not an enforceable standard.

Local Requirements

Rosebud and Treasure Counties, which are the two counties in the analysis area, do not have comprehensive recreation plans. The City of Colstrip Comprehensive Growth Policy conforms to the requirement of 77-1601, MCA. In terms of recreation facilities and services, this policy establishes the goal to “encourage recreation development” (City of Colstrip 2013).

3.18.1.2 Analysis Area

Direct Effects Analysis Area

The analysis area for direct effects includes the project area plus a 2,000-foot buffer (this is the same analysis area used for **Land Use;** see **Section 3.23.1.2, Analysis Area**).

Indirect Effects Analysis Area

There would be no indirect impacts on recreation other than potential regional haze as described in **Section 4.3, Air Quality**; the analysis area used for regional haze is described in that section.

3.18.2 Recreation Opportunities

Outdoor recreation is an important part of the lifestyle and economy throughout Montana. Recreation survey data presented in the Montana Statewide Outdoor Comprehensive Plan (SCORP) cited fishing, hunting, and backpacking to be among the top five outdoor recreation activities for Montana residents. Over the next 35 years, SCORP projected increases in developed and undeveloped skiing as well as challenge activities like mountain climbing, rock climbing, and motorized water activities. Activities that will see large decreases in per-capita participation include visiting primitive areas, hunting, and fishing (FWP 2014).

3.18.2.1 Rosebud Mine

The surface of the land within the analysis area is privately owned (see **2.4.1, Permit and Disturbance Areas)** and is primarily used for grazing land, pastureland, cropland and fish and wildlife habitat **(see Section 3.23.3 Primary Pre-Mining Land Uses).** It is used also for private recreational purposes, primarily hunting. Private leasing of hunting lands or contracting of guide services is ongoing in the area. There are no public easements, trails, or recreation facilities within the analysis area.

The Rosebud Mine, including the analysis area, is within FWP Hunting District 702, which is 1,793,846 acres in size. During hunting season for big game (mule deer, white-tail deer, pronghorn, and elk) and upland birds, Western Energy allows public access to inactive areas of the mine through FWP's Block Management Program. A cooperative program between private landowners and FWP, Block Management helps landowners manage hunting activities and provides the public with free hunting access to private land, and sometimes to adjacent or isolated public lands.

Based on data for 2008 through 2012, an average of 465 hunter days (all days hunted by all hunters) each year have been hunted on the mine site. Hunter success for all species was approximately 39 percent in 2012, but averaged around 20 percent over the prior 10 years. Mule deer and upland birds are the most common species harvested on the mine site (Peterson 2014b).

Hunting also occurs on public (state) and private land surrounding the mine and hunters likely reach these locations using the Horse Creek Road, which passes through the mine and is proposed to be relocated under the Proposed Action (see **Section 2.4.3, Mine Plan**).

3.18.2.2 Colstrip Park and Recreation District

Colstrip has a tax-supported county park district. In 1987, the Colstrip Park and Recreation District (CPRD) was formed with a 3-mill levy. Currently this district is funded by 15.9 mills and a portion of the

Coal Gross Proceeds Tax collected by Rosebud County. It is overseen by a 7-member, publicly-elected board (City of Colstrip 2013).

Facilities located in Colstrip include a 32,000-square-foot community center with basketball, handball, racquetball, and exercise areas including a weight room, cardio room, youth room, and an outdoor swimming pool with a 147-foot waterslide. The center also provides child care. In addition, CPRD has constructed and operates a 9-hole golf course with a clubhouse and golf professional. Parks include ball fields, tennis and basketball courts, a skate park, a BMX track, and 32 improved playgrounds. There are over 150 acres of dedicated open space, which CPRD oversees. CPRD also maintains a paved pedestrian/bike trail that stretches about 4.5 miles and serves both recreational and transportation needs (City of Colstrip 2013).

Castle Rock Lake sits on the edge of Colstrip and provides swimming, non-motorized boating, and warm-water fishing. Pedestrians and cyclists enjoy a well-maintained trail around the lake. Ice fishing is popular, so the lake is a year-round fishing destination (City of Colstrip 2013).

3.18.2.3 Regional

FWP (2014) identified six regions within the SCORP based on formal tourism regions established by state law and a Governor's Executive Order. The analysis area lies within the region designated as Southeast Montana. Southeast Montana is the largest of Montana's six SCORP regions. Federal, state, Tribal, and local government agencies all manage recreation resources in Southeast Montana, of which the majority is private land. About 19 percent is public land, with an additional 9 percent managed by Tribes (FWP 2014).

In total, the Southeast Montana region encompasses 5.8 million acres of public land. Of the public land, 47 percent is federal: BLM manages 37 percent and the USFS manages 9 percent, primarily on the Custer National Forest. About 21 percent of the public land is state land, with the majority managed through the Montana Department of Natural Resources and Conservation as State Trust Land.

The region offers an abundance of recreational activities, including but not limited to: hunting, fishing, boating, hiking, golfing, canoeing, bird-watching, rock-hounding, photography, and dinosaur fossil digging. A number of natural and cultural sites include the Bighorn River and Bighorn Canyon National Recreation Area, Custer National Forest, Makoshika State Park, Little Bighorn Battlefield National Monument, and Pompeys Pillar National Monument. Recreational opportunities are available to the public on all federally-administered (BLM, USFS, and NPS) lands in Southeast Montana that have legal access.

3.19 PALEONTOLOGY

3.19.1 Introduction

The Rosebud Mine is located in the northwestern Powder River Basin near Colstrip, where surface coal-mining has occurred since 1924. The sections below provide an overview of the paleontological resources within the analysis area and the regulatory authorities governing them. The analysis area for paleontology is defined below in **Section 3.19.1.2, Analysis Area**.

3.19.1.1 Regulatory Framework

Federal Requirements

Federal legislative protection for paleontological resources for this action stems from the Federal Land Policy and Management Act (43 USC Chapter 35) and NEPA [42 USC] Chapter 55). The federal laws that protect paleontological resources on public lands include the Antiquities Act of 1906 (16 USC 431-433) and the Paleontological Resources Preservation Act of 2009. Although not specifically stated, the Antiquities Act of 1906 protects resources of historic or scientific interest, which includes paleontological remains. The Paleontological Resources Preservation Act of 2009 requires the U.S. Department of Agriculture and the Department of the Interior to manage and protect paleontological resources on federal land using scientific principles and expertise.

State Requirements

The Montana State Antiquities Act and the Montana State Historic Preservation Office's (SHPO) Administrative Rules (ARM 10.121.901 through 10.121.916) provide protections for paleontological resources and address the responsibilities of SHPO and other state agencies on state-owned lands. The surface of the project area is privately owned and the subsurface is either privately or federally owned (see **Section 2.4.1, Permit and Disturbance Areas**). Because the project area does not include state-owned land, there are no applicable state regulations for paleontological resources within the project area.

Local Requirements

There are no applicable local regulations for paleontological resources within the project area.

3.19.1.2 Analysis Area

The analysis area for direct and indirect effects on paleontological resources is the project area.

3.19.2 Affected Environment

The Fort Union Formation contains 9 percent of currently-documented paleontological localities in BLM Montana records (BLM 2015). The Fort Union Formation contains abundant fossil vertebrates, invertebrates, and plants and displays an important time-interval during the early Paleogene evolution of mammals. As previously described (**Section 3.7, Geology**), the coal targeted for removal in the project area is within the Tongue River Member of the Fort Union Formation, which is stratigraphically above the Lebo Member of the Fort Union Formation (**Figure 34**).

BLM uses the Potential Fossil Yield Classification (PFYC) system to classify paleontological resource potential on public lands to assess possible resource impacts and mitigation needs for federal actions involving surface disturbance, land-tenure adjustments, and land-use planning (BLM 2016c). The PFYC system classifies geologic units based on the relative abundance of vertebrate fossils or scientifically significant invertebrate or plant fossils and their sensitivity to adverse impacts with a higher class number, indicating a higher potential.

These classification values are as follows (BLM 2016c):

- **Class 1 –** Very Low. Geologic units that are not likely to contain recognizable fossils. Management concern for paleontological resources in Class 1 units is usually negligible or not applicable and assessment or mitigation is usually unnecessary.
- **Class 2** – Low. Geologic units that are not likely to contain vertebrate fossils or scientifically significant nonvertebrate fossils. Management concern for paleontological resources is generally low and assessment or mitigation is only necessary where paleontological resources are known or found to exist.
- **Class 3 –** Moderate. Sedimentary geologic units where fossil content varies in significance, abundance, and predictable occurrence. Management concern for paleontological resources is moderate because the existence of significant paleontological resources is known to be low. Paleontological mitigation strategies would be proposed based on the nature of the proposed activity.
- **Class 4 –** High. Geologic units containing a high occurrence of significant fossils. Significant paleontological resources have been documented but may vary in occurrence and predictability. Surface-disturbing activities may adversely affect paleontological resources. Rare or uncommon fossils, including nonvertebrate or unusual plant fossils, may be present. Management concern for paleontological resources in Class 4 is moderate to high, depending on the proposed action. Paleontological mitigation strategies would depend on the nature of the proposed activity but field assessment by a qualified paleontologist would normally be needed to assess local conditions.
- **Class 5 –** Very High. Highly fossiliferous geologic units that consistently and predictably produce significant paleontological resources. Significant paleontological resources have been consistently documented and are highly susceptible to adverse impacts from surface-disturbing activities. Management concern for paleontological resources in Class 5 areas is high to very high. Paleontological mitigation strategies may be necessary before or during surface-disturbing activities and a field assessment by a qualified paleontologist to assess local conditions is almost always needed.
- **Class U** – Unknown Potential. Geologic units that cannot receive an informed PFYC assignment. Until a provisional assignment is made, geologic units that have an unknown potential have medium to high management concerns. Lacking other information, field surveys are normally necessary, especially prior to authorizing a ground-disturbing activity.
- **Class W** – Water. Includes any surface area that is mapped as water. Most bodies of water do not normally contain paleontological resources. However, shorelines should be carefully considered for uncovered or transported paleontological resources. Reservoirs are a special concern because important paleontological resources are often exposed during low water intervals. In karst areas sinkholes and cenotes may trap animals and contain paleontological resources. Dredging river systems may result in the disturbance of sediments that contain paleontological resources.
- **Class I** – Ice. Includes any area that is mapped as ice or snow. Receding glaciers, including exposed lateral and terminal moraines should be considered for their potential to reveal recently exposed paleontological resources. Other considerations include melting snow fields that may contain paleontological resources with possible soft-tissue preservation.

For the analysis area, BLM classifies the clinker with a PFYC rating of 2, the Quaternary Alluvium with a PFYC rating of 2, and all the members of the Fort Union Formation with a PFYC rating of 4 (BLM 2017). The PFYC is based on characteristics of the entire Fort Union Formation, and is not based on a specific bed, lithologic layer, or paleontological locality.

The Fort Union has a long history of scientific discovery and interest. In MT, the Fort Union conformably overlies the Cretaceous Hell Creek Formation, also a rock unit rich in fossils. At the approximate boundary between the Hell Creek and Fort Union Formations is the K-Pg boundary, or the boundary between the Cretaceous (K) and the Paleogene (Pg), which marks the end of the Mesozoic and the extinction of dinosaurs. After the extinction and removal of the dinosaurs as the dominant land animals, mammals, other animals, and plants underwent a dramatic period of evolution and diversification.

The lowest member of the Fort Union, the Tullock, and its relationship with the underlying Hell Creek have been extensively studied to understand the nature and tempo of dinosaur extinction and the subsequent ecological changes that took place. Numerous scientifically-important plants and animals have been described.[11] Early mammal groups such as primates,[12] pantodonts,[13] and other archaic mammal groups are represented.

All the other members of the Fort Union have also proven to be significantly fossiliferous. According to Brown (1962), “nearly every shale, clay, and sandstone contains well-preserved fossil plants, among which are mosses, ferns, cycads, conifers, palms, water-lilies, birches, hazels, hickories, oaks, viburnums, and many other dicotyledons.” The Lebo has produced several classic Paleocene localities as well.[14] As many as 57 mammal species were reported in the Crazy Mountain Basin alone[15] which includes primarily Lebo and Tongue River beds.

The Tongue River Member is a major surface-coal producer. Reports of fossils in the Tongue River Member include pollen;[16] plants;[17] trace fossils including footprints;[18] mollusks;[19] sharks, fishes, and amphibians;[20] and significant mammal fauna. Several classic mammal fauna come from this upper member, which includes the Scarritt Quarry, the Douglass Quarry, and several others. Many of these sites are typical localities for early mammal taxa.[21]

3.19.2.1 Analysis Area Paleontology Surveys

2012 Class III Cultural Resources and Paleontological Inventory

A Class III cultural resources and paleontological inventory was conducted in 2012, and no paleontological resources were noted in the analysis area (PAP, Appendix A-2). The inventory was conducted by archaeologists and contracted by Western Energy.

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11 Archibald 1977, 1982, 1987, 2000, 2002; Archibald et al. 1982; Archibald and Clemens 1982; Archibald et al. 2010; Brown 1962; Clemens 2011; Cope 1876; Dorf 1940; Douglass 1908; Gidley 1909, 1915, 1919, 1922, 1923; Jepsen 1930; Knowlton 1893; Moore et al. 2014; Simpson 1928, 1929, 1935, 1936, 1937; Wilson 2014a, 2014b; Zhang and Archibald 2007.
12 Sloan and Van Valen 1965
13 Simons 1960
14 Krause and Gingerich 1983; Roberts 1972; Simons 1960; Simpson 1937.
15 Simpson 1935.
16 Nichols 1999; Wilson and Webster 1946.
17 Kihm and Hartman 2004; Simpson 1937.
18 Belt et al. 2005; Peabody 1954.
19 Bickel 1977; Hanley and Flores 1987.
20 Estes 1976.
21 Gidley 1909, 1915; Gingerich et al. 1983; Krause and Gingerich 1983; Robinson and Honey 1987; Simpson 1928, 1929, 1935, 1936, 1937.

2015 Paleontology Resources Survey

During the initial stages of the EIS process, the lead agencies requested Western Energy to have a pre-disturbance paleontological resources survey done of the analysis area by a BLM-permitted professional paleontologist (this ensured the qualifications of the individual to conduct the survey were verified). A field paleontological assessment of the analysis area was completed by paleontologists in accordance with BLM guidelines and policies in 2015 (SWCA 2016). The objective of the survey was to complete thorough pedestrian examinations of surface fossils, exposures of potentially fossiliferous rock, and areas in which fossiliferous rock would be exposed or otherwise impacted during implementation of the project. Background research for the analysis area found that according to the BLM data set referenced, two geologic units, the Paleocene-age Tongue River Member of the Fort Union Formation (PFYC Class 4) and Quaternary-age alluvium (PFYC Class 2) underlie the analysis area.

The survey identified nine fossil localities (SWCA 2016) and found that the most common fossils in the analysis area are plant elements, including impressions of leaves, fruits, seeds, and stems, and fragmentary silicified wood. Invertebrate fossils documented at two of the localities include molds and casts of fresh-water snails. Trace fossils, *Ophiomorpha* burrows, were documented at one locality, indicating at least some marine influence in portions of the analysis area. Documented vertebrate fossils were limited to one turtle (*Trionychidae* indet.) shell fragment. The survey determined that based on specimens observed in the field, none of the nine fossil localities meet BLM's significance criteria. Although no significant fossils were documented during the field survey, it is possible that additional fossils may be exposed during mining within the project area. If these fossils are complete and well-preserved, they may be significant.

3.20 ACCESS AND TRANSPORTATION

3.20.1 Introduction

The transportation resource consists of a network of private haul roads owned by Western Energy and public roads owned and maintained by Rosebud and Treasure counties and the State of Montana that would be used during activities related to the development and mining of the project area. The sections below provide an overview of the transportation resource in the analysis area and the regulatory authorities governing it; the transportation analysis area is defined below in **Section 3.20.1.2, Analysis Area**.

3.20.1.1 Regulatory Framework

Federal Requirements

As described in **Section 1.4.1.1, Office of Surface Mining Reclamation and Enforcement, Surface Mining Control and Reclamation Act**, DEQ operates an approved state program under SMCRA and, therefore, has primary jurisdiction over the regulation of surface coal-mining and reclamation operations on non-federal and non-Indian lands within the state.

SMCRA prohibits mining within 100 feet on either side of the right-of-way of any public road unless the appropriate public road authority allows the road to be relocated or closed after public notice, an opportunity for a public hearing, and a finding that the interests of the affected public and landowners will be protected (30 CFR 761.11[d]).

State Requirements

DEQ regulates permitting and operation of surface coal mines on federal lands within Montana under the authority of MSUMRA (Section 82-4-221 et seq., MCA) and its implementing rules (ARM 17.24.301-1309).

Requirements under MSUMRA include:

- Provisions for the relocation of use of public roads (ARM 17.24.319). Each mine application must describe the measures to be used to ensure that the interests of the public and landowners affected are protected if the applicant is seeking approval of: (1) conducting the proposed mining activities within 100 feet of the right-of-way line of each public road, except where mine access or haul roads join that right-of-way; or (2) relocating or closure of a public road
- Requirements to develop a transportation facilities plan (ARM 17.24.321); each mine application must contain a description of each road, conveyor, and railroad loop to be constructed, used, or maintained within the proposed permit area
- General requirements for road and railroad loop construction (ARM 17.24.601)
- Requirements for the location of roads and railroad loops (ARM 17.24.602)
- Requirements for the location of roads and railroad loop embankments (ARM 17.24.603)
- Requirements to account and design for the hydrologic impact of roads and railroad loops (ARM 17.24.605)
- Requirements for the maintenance of roads and railroad loops (ARM 17.24.607)
- Provisions for permanent roads (ARM 17.24.610)

- Provisions for areas upon which coal mining is prohibited that address how to obtain permission to mine near public roads (ARM 17.24.1134); whenever a proposed mining operation is to be conducted within 100 feet measured horizontally to the outside right-of-way line of any public road (except where mine access roads or haul roads join such right-of-way), DEQ may permit mining to occur if the applicant
  - obtains the necessary approval of the authority with jurisdiction over the public road,
  - gives appropriate notice of a public hearing,
  - holds a public hearing with the purpose of determining whether the interests of the public and affected landowners will be protected, and
  - produces a written finding based on the information from the public hearing.
- Areas upon which coal-mining is prohibited that address the relocation or closure of a public road (ARM 17.24.1135); whenever any mine application proposes to relocate or close a public road to facilitate surface- or underground-mining operations, the road may not be relocated or closed until
  - the permit authorizing the operation is granted,
  - the applicant obtains the necessary approval from the authority with jurisdiction over the public road,
  - a notice of a public hearing in a newspaper of general circulation in the affected locale is provided at least two weeks before the hearing,
  - an opportunity for a public hearing at which any member of the public may participate is provided in the locality of the proposed mining operations for the purpose of determining whether the interests of the public and affected landowners will be protected, and
  - a written finding based upon information received at the public hearing is made within 30 days after completion of the hearing as to whether the interests of the public and affected landowners will be protected from the proposed mining operations.

Local Requirements

Provisions to mine near public roads or that address the relocation or closure of a public road would require approval from the authority with jurisdiction over the public road. The local regulatory framework is provided under MSUMRA, specifically in 82-4-227(7)(d), MCA, and in its implementing rules, ARM 17.24.1134 and ARM 17.24.1135.

3.20.1.2 Analysis Area

The analysis area for direct and indirect effects on access and transportation includes the project area, existing permit areas of the Rosebud Mine (which include the existing haul road and access roads), county roads (i.e., Castle Rock Road and Horse Creek Road), the section of State Highway (SH) 39 between the Rosebud Mine and the Rosebud Power Plant, and the Rosebud and Colstrip Power Plants plus an approximate 0.5-mile buffer area around the power plants (see **Figure 11**). The regional transportation network is generally described, and specifically the coal-transport routes to and from the Rosebud Mine and Rosebud Power Plant.

3.20.2 Mine Access and Internal Road System

3.20.2.1 Mine Access

The Rosebud Mine is primarily accessed from the east via Castle Rock Road, a Rosebud County road that runs west off of SH 39 about 1 mile south of Colstrip. Major mine facilities such as the mine office, maintenance shop, and the operations and maintenance complex are located on Castle Rock Road (see **Figure 11)**. The project area would be accessed beyond Area C by continuing west along the Castle Rock Road to the Horse Creek Road, a Rosebud County and Treasure County road.

The project area and the existing Rosebud Mine can also be accessed from the west off of Highway 384 via Horse Creek Road (**Figure 1**). Both Route 384 and Horse Creek Road are Treasure County roads. Route 384 ultimately connects west to Interstate 90 (I-90) just south of Hardin and north to Interstate 94 (I-94) east of Hysham. For the first several miles, Castle Rock Road has a paved surface until the alignment reaches the Rosebud Mine engineering office (about 10 miles). The remaining alignment has a gravel surface. Horse Creek Road has a gravel surface maintained by Rosebud and Treasure Counties' road departments.

3.20.2.2 Western Energy Road System

Western Energy's road system for the Rosebud Mine is comprised of four basic types of roads: access, haul, ramp, and service roads. Road materials for the road system primarily consist of pit run, which is crushed and/or screened scoria. The thickness of road base and finish typically vary by location since there are varying degrees of suitability of scoria on the mine, and road-bed materials vary (see also **Section 2.4.3.4**, **Roads** for further details regarding Western Energy's road system).

Access Roads

These road types provide access to the Rosebud Mine from public roadways. The access roads are typically 25 to 80 feet wide and are surfaced with road material for all-weather use. These roads include those described above under **Section 3.20.2.1, Mine Access**.

Haul Roads

Haul roads provide the main haul routes for the coal haulers and are used as the main source of ingress and egress to operational areas throughout the Rosebud Mine. There are no existing haul roads in the project area, but Western Energy proposes to extend the main haul road from Area C to serve the project area (see **Section 2.4.3.4**, **Roads** and **Figure 6**).

Ramp Roads

Ramp roads provide access into the Rosebud Mine pits. Ramp roads are constructed out of each pit to intercept the haul roads and are moved and/or advanced with each new pit development. There are no existing ramp roads in the project area, but new ones would be constructed in the project area to connect the active mining and reclamation area pits to the new project area haul road (see **Section 2.4.3.4**, **Roads** and **Figure 6**).

Service Roads

Service roads provide access to areas of the Rosebud Mine that are not accessible using the haul roads. Service roads include all other roads in the mine that are generally used for support functions. Service roads can be single-track to 80 feet wide and may or may not be surfaced with road material. The project area is traversed by several existing unimproved two-track roads used primarily for ranch access.

Road Materials

Western Energy uses pit run and crushed and/or screened scoria for road-construction materials. The materials used vary by location due to varying degrees of suitability of scoria on the Rosebud Mine site.

Fugitive Dust Control

Western Energy currently maintains a Fugitive Dust Control Plan in accordance with ARM 17.24.761 and the work-practice standards established within its current air quality permits (see **Section 3.3, Air Quality**). Western Energy proposes the ongoing maintenance and implementation of a dust-control plan for the project, which includes the Best Available Control Technology (BACT) for the control of fugitive particulate matter described in **Section 2.4.3.4**, **Roads**.

3.20.3 Regional Transportation System

3.20.3.1 Highways

No federal or state highways are located within the project area. SH 39 is a minor arterial connecting Colstrip with I-94 35 miles to the north. I-94 is a principal arterial for the region. The Rosebud mine hauls 300,000 tons of coal annually (via a fleet of five covered haul transports, though only three are used at a time) to the Rosebud Power Plant via the existing haul road and SH 39 (**Figure 11**). Three trucks operate daily, with each truck delivering approximately 6.5 loads daily (19.5 total loads daily).

Annual average daily traffic (AADT) obtained for the section of SH 39 from I-94 to southeast of Colstrip (**Table 85**) indicates typical volumes for a minor arterial. Peak volumes occur in Colstrip and near intersections in the center of town (i.e., Willow Avenue and Homestead Boulevard) representing local commuter traffic. For example, peak traffic near Castle Rock Lake Drive (Station 9-006) has about 1,000 additional vehicles per day over other station locations on SH 39 (**Table 85**). Mine employee and delivery traffic is inherently represented within the presented AADT.

Table 85. Annual Average Daily Traffic for Four Locations on State Highway 39 near Colstrip, Montana Over 20 Years.

Year	Annual Average Daily Traffic Data Collection Station on State Highway 39			
	Station 5-006 (1 mile south of I-94 intersection)	Station 7-001 (2 miles southeast of Colstrip)	Station 9-005 (Colstrip at Willow Avenue and Homestead Boulevard)	Station 9-006 (Colstrip near Castle Rock Lake Drive)
2015	935	770	1,408	2,240
2011	1,000	940	1,550	2,530
2006	950	1,080	1,320	2,470
2001	1,060	1,010	1,480	2,340
1996	880	1,010	1,880	2,460

Vehicle classification data provide additional perspective on traffic patterns (**Table 86**). Passenger cars and pickups were the most common vehicles using SH 39 near Colstrip and together accounted for 88.1 percent of the vehicles (**Table 86**). Total combined truck traffic accounted for 10.8 percent of the traffic (Montana Department of Transportation (MDT) Planning Division 2011, 2015).

Table 86. Vehicle Class Count Data for State Highway 39 in Rosebud County.[1]

Vehicle Type	Number on Road[2]	Percent on Road
Motorcycles (Type 1)	5	0.52
Passenger Car (Type 2)	407	42.05
Pickups (Type 3)	446	46.07
Buses (Type 4)	5	0.52
Small Trucks (Types 5–7)	31	3.20
Large Trucks (Types 8–13)	74	7.64
All Vehicles	**968**	**100.00**

[1] Data collected from Station 44-7-001 located 2 miles southeast of Colstrip, Montana.

[2] The number of vehicles on the road takes into account the ascending and descending combined traffic.

A MDT detailed crash list for 23 miles of SH 39 (Milepost [MP] 12 to MP 35) near Colstrip recorded 94 accidents from January 1, 2006 to December 31, 2015. Accidents were dispersed throughout this section with no concentrated clusters. No single contributing factor was apparent; the causes were dispersed and varied. The only accidents have not been related to the mine and the mine is not required to maintain an accident history on its roads.

3.20.3.2 Bus, Air, and Rail Transport

Colstrip is served by a number of freight carriers. As of 2013, there is no bus service available from Colstrip (City of Colstrip 2013). The nearest bus service is 35 miles away in Forsyth. The nearest commercial air transportation is 125 miles away in Billings, Montana. However, there is a small county-owned and operated airport 5 miles from the center of the community (between Rosebud Mine Permit Areas B and C) with an elevation of 3,426 feet (**Figure 11**). The runways have hard surfaces and the longest runway is 5,100 feet by 75 feet wide. An active Burlington Northern-Santa Fe branch line for freight connects Colstrip to the main east/west rail line that lies 30 miles to the north of Colstrip.

3.20.3.3 Local Access

A number of roads connect to SH 39 in the analysis area. Water Road and Snider Subdivision Road intersect SH 39 near the Rosebud Power Plant, Pinebutte Drive provides access to residential areas on the north side of Colstrip, and Power Road and Power Plant Road lead to the Colstrip Power Plant (**Figure 11**). A number of local or BLM roads provide the primary arterial and collector road systems for access to and through private and BLM lands in the region. Other informal or two-track roads traverse the analysis area, but generally do not account for a large amount of traffic.

3.21 SOLID AND HAZARDOUS WASTE

3.21.1 Introduction

This section describes the affected environment for solid and hazardous waste generation and storage in the analysis area related to mining operations; the analysis area is defined below in **Section 3.21.1.2, Analysis Area**. The regulatory framework that governs solid and hazardous waste generation and storage is also described. "A solid waste is a hazardous waste if it is specifically listed as a known hazardous waste or meets the characteristics of a hazardous waste. Characteristic wastes are wastes that exhibit any one or more of the following characteristic properties: ignitability, corrosivity, reactivity or toxicity." (EPA 2017i).

3.21.1.1 Regulatory Framework

Federal Requirements

A suite of federal laws governs the management and disposal of solid and hazardous waste. The Solid Waste Disposal Act of 1965 addresses the safe disposal of large volumes of municipal and industrial solid wastes and was the first federal effort covering solid-waste management. The Resource Recovery Act (RRA) of 1970 is an amendment to the Solid Waste Disposal Act and deals with management of solid waste by encouraging waste reduction and resource recovery; the RRA also establishes national disposal criteria for hazardous wastes. The Resource Conservation and Recovery Act (RCRA) of 1976 gives the EPA authority to manage non-hazardous wastes and the generation, transportation, treatment, storage, and disposal of hazardous waste from "cradle to grave." The Hazardous and Solid Waste Amendment of 1984 requires phasing out land disposal of hazardous waste and provides increased enforcement authority for EPA, more stringent hazardous-waste management standards, and a comprehensive underground-storage-tank program.

Regulation of solid and hazardous waste management is established under RCRA (40 CFR 239–282). RCRA sets national goals for the protection of human health and the environment from the potential hazards of waste disposal, conserving energy and natural resources, reducing the amount of waste generated, and ensuring that wastes are managed in an environmentally-sound manner. 40 CFR 239–259 contain the regulations for solid waste and 40 CFR 260–273 contain the regulations for hazardous waste. Regulations for managing used oil and standards for underground-storage tanks are contained in 40 CFR 279–282.

Effective October 19, 2015, EPA issued the Disposal of Coal Combustion Residuals from Electric Utilities rule (Rule) which regulates the disposal of coal-combustion residuals (CCR); including fly ash, bottom ash, boiler slag and flue gas desulfurization materials (FGDM) from coal-fired power plants. The Rule regulates CCR as a non-hazardous waste under subtitle D of RCRA contained in 40 CFR 257, Subpart D. The Rule sets design standards for CCR landfills and impoundments, requirements for conducting hazard-potential ratings for surface impoundments, methods and procedures for ground water monitoring, corrective actions if a leak is detected, closure and post-closure care, and implementation and notification requirements. Beneficial use of CCR in place of a natural resource—for example, in concrete as a partial replacement for aggregate, as sanding material on a road, or in manufactured drywall boards—is excluded from federal regulation under EPA's May 2000 regulatory determination that the Bevill amendment applies to such uses (EPA 2017j).

State Requirements

The Montana Hazardous Waste Act (75-10-401, MCA) and the Solid Waste Management Act (75-10-201–250, MCA) regulate the storage and disposal of solid and hazardous wastes. DEQ is responsible for implementing the Solid Waste Management Act under ARM 17.50.101 to 17.50.1405 and for implementing the Hazardous Waste Act under ARM 17.53.101 to 17.53.1502. CCR impoundments are regulated under MFSA, which governs the siting of energy-producing, converting, and transporting facilities in MT. DEQ is responsible for implementing the Major Facilities Siting Act under ARM 17.20.301. Coal mines in MT must also comply with MSUMRA (82-4-201 et seq., MCA). DEQ is responsible for MSUMRA under ARM 17.24.301. The storage and final disposal of solid waste is administered under ARM 17.24.507. The burial and treatment of waste materials generated is administered under ARM 17.24.505 and the use of bottom ash is administered under ARM 17.24.510. Monitoring of boron in bottom ash applied at the Rosebud Mine is administered under ARM 17.24.723.

Local Requirements

There are no applicable local solid and hazardous waste regulations within or near the analysis area.

3.21.1.2 Analysis Area

Direct Effects Analysis Area

The direct effects analysis area for solid and hazardous waste includes the entire Rosebud Mine site (**Figure 63**); this analysis area is appropriate because wastes generated from mining operations in the project area would be stored in other permit areas of the Rosebud Mine.

Indirect Effects Analysis Area

The indirect effects analysis area for solid and hazardous waste includes the entire Rosebud Mine, the sites of the Colstrip and Rosebud Power Plants, and the off-site CCR storage area associated with the Colstrip Power Plant. This analysis area is appropriate because CCR produced by the Colstrip and Rosebud Power Plants will result in part from the combustion of project area coal. In addition, some CCR from the Colstrip Power Plant may be applied to portions of other permit areas of the Rosebud Mine for beneficial uses such as culvert bedding or as sanding agent for ramp and haul roads. Note, however, that CCR will not be stored or used for any purpose in project area as described in **Section 2.4.3.4, Roads**.

3.21.2 Waste Disposal Practices

Currently no solid or hazardous waste is being generated in the project area, which as described in **Section 3.23, Land Use**, is primarily used for cropland, fish and wildlife habitat, grazing land, and pastureland. Wastes generated as part of active coal-mining within areas A, B, and C of the Rosebud Mine are handled under Western Energy's Waste Management Program, which consists of a Solid and Hazardous Waste Management Plan (SHWMP; Western Energy 2009), a Spill Prevention Control and Counter Measure Plan (SPCCMP), and a Contingency and Emergency Response Plan (CERP; Western Energy 2017b). Information summarized below was taken from the Western Energy's PAP and the SHWMP.

3.21.2.1 Existing Rosebud Mine Operations

The Rosebud Mine is a Large Quantity Generator (LQG), as defined under RCRA, due to its generation of greater than 2,200 pounds of waste per month. According to the SHWMP, the mine typically generates less than 2,200 pounds of waste per month; however, this volume fluctuates based on operations. **Figure 63** displays the Rosebud Mine and associated solid or hazardous waste features.

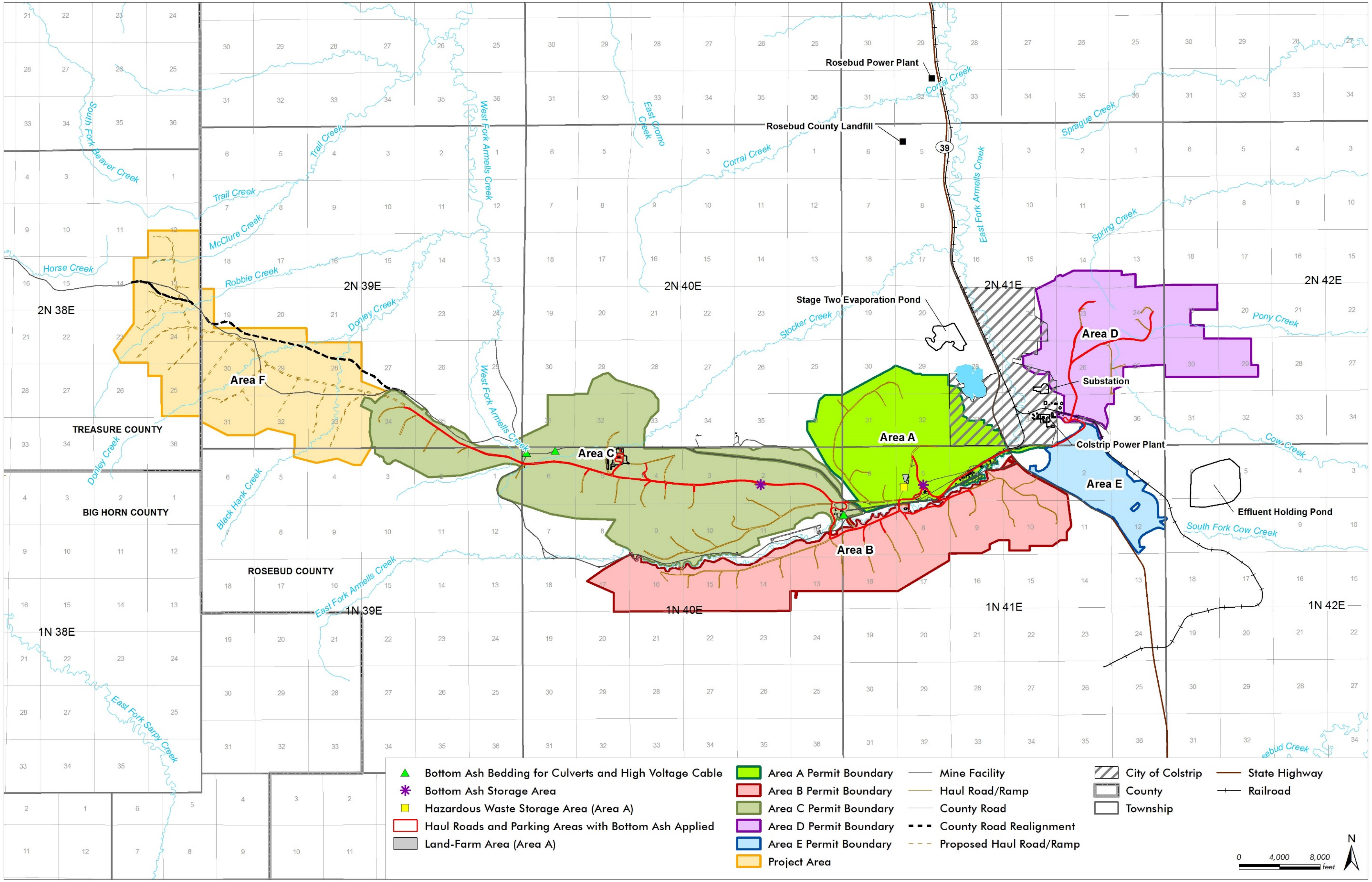

Figure 63. Solid and Hazardous Waste Features of the Rosebud Mine.

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3.21.2.2 Non-Hazardous Waste

Site-Generated Waste

Non-hazardous waste is collected in Dumpsters throughout the Rosebud Mine and transported to the Rosebud County Landfill (located about 4 miles north of Colstrip on Highway 39) by truck for final disposal. Mining-related non-hazardous waste such as non-treated wood, wooden pallets, concrete, and dragline cable and wooden cable spools can be placed in the mine pits in accordance with ARM 17.24.507. On a case-by-case basis, other non-hazardous construction, mining, or agricultural debris may also be placed within the mine pits if approved by DEQ. Paper and cardboard waste is collected throughout the mine office buildings and delivered to Western Energy's AB Warehouse where it is prepared for shipment to a recycler in Billings, MT.

Petroleum-contaminated soil generated by tank removals, spills, or sump cleanouts is hauled to Permit Area A, located directly to the north-northeast of the hazardous-waste storage area for treatment by land-farming (**Figure 63**). Land-farming is a process by which petroleum-contaminated soil are bioremediated above ground by stimulating aerobic microbial activity within the soil through aeration and/or the addition of minerals, nutrients, and moisture. It is a proven, effective technology for reducing concentrations of nearly all the constituents of petroleum products typically found at petroleum-contaminated sites (EPA 2016d). The land-farming practices used by Western Energy consist of regular tilling (weather permitting) and fertilization to accelerate the treatment process. The land-farm soil is sampled annually in late fall for heavy-fuel hydrocarbons, diesel, gasoline, benzene, ethylbenzene, toluene, and total xylenes to evaluate the effectiveness of remediation and to determine if treatment is complete and soil can be removed from the treatment area. The sampling data is summarized and reported annually to DEQ for review. Based on measured soil concentrations, soil-use classifications (Western Energy 2009) are assigned to treated soil. Final use of the treated soil is determined based on these classifications.

Off-Site Generated Waste

No CCRs are generated at the Rosebud Mine. However, dewatered bottom-ash waste generated from the Colstrip Power Plant is beneficially applied at the mine as tank- or culvert-bedding material, at parking facilities, and as a road-sanding material when needed (**Figure 63**). When used as tank bedding, the use is only for areas that would eventually be reclaimed. When used as culvert bedding, the use is only for areas that lead to sediment-control structures and not to a discharge point. The beneficial use of dewatered bottom ash at the mine is dependent on DEQ-required monitoring and reporting requirements. Reporting of bottom-ash usage and monitoring results is required as part of Western Energy's Annual Mining Reports. Bottom-ash usage prior to 2010 is unknown. Based on the 2015 Annual Report, bottom-ash storage was limited to the Area A storage pile for application use. No additional receipt of bottom ash has occurred since the 2011 deliveries. According to the 2011 Annual Mining Report, a total of 9,673 cubic yards of bottom ash was delivered to the mine in 2010 and 2011. DEQ requires that one sample of the bottom ash for every 10,000 cubic yards received be analyzed using the Toxicity Characteristic Leaching Procedure (TCLP). The bottom ash from the Area C ash pile was sampled for TCLP analysis in 2011 and the analysis detected no RCRA metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver).

3.21.2.3 Hazardous Waste

Hazardous wastes generated at the Rosebud Mine include greases, lubricants, paints, flammable liquids, solvents and any other material that meets the definition of a hazardous waste (40 CFR 261.3). These hazardous wastes are collected in 55-gallon drums at satellite accumulation points located throughout the mine (locations vary depending on mine activity and are not shown on **Figure 63**). Within three days of being filled, the waste drums are transported to the hazardous-waste storage area located in Area A (**Figure 63**) for shipment to a treatment, storage, and disposal facility (TSDF) for final destruction or disposal. Accumulation containers are securely closed at all times (except when waste is being added), with at least 2 to 3 inches of headspace to reduce the risk of leakage or seepage due to content expansion from temperature changes. Accumulation containers are labeled to indicate the type of waste contained and the point of generation. Acid or alkaline materials are accumulated in plastic drums or plastic-lined metal drums. Liquids are accumulated in closed-top drums, and solids are accumulated in open-top drums. Dented or leaking drums are transferred into undamaged drums or over-packed in a larger drum. Any spilled material is cleaned up in accordance with the SPCCMP and CERP and material generated as part of the cleanup process is placed in a drum for determination of its waste characteristics.

The Area A hazardous-waste storage area (**Figure 63**) is a square cement pad with no cover, secured by a barbed-wire fence and surrounded by a dirt berm on all sides to insure leachate and surface runoff associated with the storage will not degrade surface or ground water. Ramps on the east and west sides allow for vehicle access to the storage facility. Within the hazardous-waste storage area, drums are sorted into the following categories: used oil, used rags, used grease, waste solvent, miscellaneous waste streams, and empty drums. No poly-chlorinated biphenyls are currently used at the Rosebud Mine and no on-site solvent recycling is currently conducted. In accordance with LQG regulations, the waste for each regulated hazardous waste stream must be shipped to a TSDF within 90 days of the start of accumulation. Drums stored at the waste-storage area are consolidated as necessary and labeled in accordance with regulation guidelines. At least once per year, existing waste streams are re-evaluated to verify that the waste stream has not changed.

Western Energy subcontracts for services related to hazardous-waste disposal and transportation services. The waste streams are profiled and hazardous-waste manifests are generated and completed for shipment. Copies of all related paperwork are kept on-site for at least three years from the date the waste was shipped. Western Energy submits an annual hazardous waste report to DEQ no later than March 1 of each year, which documents the previous year’s generator activities.

Mine personnel working in the satellite accumulation areas are required to fill out a daily log of the work area, which includes inspection of accumulation drums. Weekly inspections of the draglines, which utilize parts cleaner containing 140 Solvent, are performed by the operator or oiler of each machine and documented in the Hazardous Materials Inspection Log. Inspection of satellite accumulation areas is performed quarterly by the Hazardous Waste Coordinator (HWC). The HWC inspects the hazardous-waste storage area weekly. Material Safety Data Sheets are stored in binders in the areas specific to their individual uses.

3.21.2.4 Colstrip Power Plant

Coal from Permit Areas A and B is used in Units 1 and 2 of the Colstrip Power Plant. Coal from all areas of the Rosebud Mine is allowed for use in Units 3 and 4, although currently only coal from Permit Area C is sent to Units 3 and 4 (DEQ 2015c). CCR is impounded in ponds at the plant site and at 2 separate locations about 3 miles east and northwest of Colstrip.

Table 87 summarizes the annual total Toxic Release Inventory (TRI) chemicals reported to EPA by the Colstrip Power Plant in the last 10 years for land-disposal releases. For the Colstrip Power Plant, this includes both on- and off-site land-disposal releases. TRI chemicals released to air are not included in **Table 87**.

Table 87. Colstrip Power Plant Reported Land Disposal Waste Release Totals from Toxic Release Inventory (Measured in Pounds).

Compound	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Antimony	11,900	12,500	12,900	11,600	9,800	8,000	7,850	8,250	9,240	9,930
Arsenic	29,800	31,300	32,200	26,100	30,500	24,800	24,100	22,200	25,200	27,800
Barium	8,090,000	8,384,000	8,711,000	7,300,000	10,400,000	8,340,000	7,710,000	8,450,000	8,970,000	9,200,000
Beryllium	6,800	7,100	7,400	6,000	9,900	8,000	7,850	7,910	8,900	9,610
Bromine	0	0	0	0	0	0	0	0	0	110
Chromium	64,500	67,000	69,500	56,400	97,300	78,900	76,800	75,100	84,500	91,500
Cobalt	30,800	32,200	33,200	27,000	28,800	23,400	22,700	22,900	25,700	27,800
Copper	152,400	159,400	164,600	133,600	165,900	135,600	130,000	133,700	148,400	158,600
Ethylene Glycol	19,400	43,400	35,300	12,600	12,700	41,000	7,200	12,100	5,000	6,000
Lead	53,000	55,400	57,200	46,400	98,200	79,300	76,100	77,300	85,900	92,100
Manganese	1,737,000	1,812,000	1,874,000	1,516,000	1,790,000	1,440,000	1,370,000	1,500,000	1,630,000	1,710,000
Mercury	860	910	940	920	1,410	1,160	1,130	1,050	1,180	1,290
Nickel	57,700	60,100	62,200	50,700	49,900	40,600	39,700	39,500	44,500	48,300
Selenium	13,500	14,000	14,500	12,100	13,800	11,700	11,300	11,100	12,400	13,400
Thallium	19,200	20,100	20,800	17,700	21,000	17,200	16,800	16,500	18,700	20,600
Vanadium	206,000	215,500	222,400	184,600	181,400	146,800	141,600	144,900	161,600	173,400
Zinc	171,000	179,200	184,700	149,400	98,400	79,400	75,000	70,000	77,400	83,700

Source: EPA 2017k.

CCR generated from Units 1 and 2 is sent to bottom-ash ponds and the B-pond associated with Units 1 and 2 located at the plant site. The Units 1 and 2 bottom-ash ponds receive bottom ash sluiced with water. Once settled, the water is sent to the Units 1 and 2 clearwell pond for reuse, and the bottom ash is loaded into haul trucks and transported about 3 miles east of Colstrip to the Units 3 and 4 effluent holding pond (EHP) area for disposal (**Figure 63**). The B-pond is used for storage of scrubber-return water from the stage two evaporation pond (STEP) and occasionally alternative storage of bottom and fly-ash slurry from other evaporation ponds. Fly ash and FGDM are sluiced with water and sent via pipeline to a paste plant at the STEP disposal area located about 3 miles northwest of Colstrip (**Figure 63**). At the paste plant, excess water is removed from the CCR prior to disposal in the storage ponds.

CCR generated from Units 3 and 4 is sent to bottom-ash ponds located at the plant site and at the Units 3 and 4 EHP area, which as noted above is located about 3 miles east of Colstrip. The Units 3 and 4 bottom-ash ponds receive bottom ash sluiced with water. Once settled, the water is sent to the Units 3 and 4 clearwell pond for reuse and the bottom ash is loaded into haul trucks and transported to the Unit 3 and 4 EHP area for disposal. Fly ash and FGDM are sluiced with water and sent via pipeline to a paste plant at the STEP disposal area located about 3 miles northwest of Colstrip. At the paste plant, excess water is removed from the CCR prior to disposal in the storage ponds.

An Administrative Order on Consent (AOC) with DEQ regarding the Colstrip Power Plant was administered related to seepage of wastewater from the CCR in 2012. Additional discussion regarding the AOC is provided in Section **1.2.2.1**, **Colstrip Power Plant** and **Section 3.8, Water Resources – Ground Water**.

3.21.2.5 Rosebud Power Plant

Rosebud Coal with higher sulfur content and low calorific value (the first 1-foot layer encountered and the lower 1-foot layer of the deposit) is trucked to the Rosebud Power Plant. The Rosebud Mine trucks 300,000 tons of coal annually (via a fleet of five covered haul trucks) to the Rosebud Power Plant (Spang 2013). Three of the five trucks operate daily, with each truck delivering about 6.5 loads, for a total of 19.5 loads daily. The Rosebud Power Plant uses a boiler designed to efficiently utilize low-Btu coal at lower temperatures to minimize NO_x formation while also allowing a high recovery of sulfur through the injection of limestone into the fluidized bed. The CCR generated is conveyed pneumatically to an ash silo for temporary storage, then periodically transferred into a plant-ash truck and transported to an on-site ash monofill disposal area where it is hydrated with industrial wastewater from the plant to consolidate and solidify the ash.

Table 88 summaries the annual total TRI chemicals reported to EPA by the Rosebud Power Plant in the last 10 years for land-disposal releases. For the Rosebud Power Plant, only on-site land disposal releases occurred. TRI chemicals released to air are not included in **Table 88**.

Table 88. Rosebud Power Plant Reported Land Disposal Waste Release Totals from Toxic Release Inventory (Measured in Pounds).

Compound	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Barium	367,895	407,829	421,102	421,136	78,146	66,326	547	31,435	18,045	82,694
Chromium	24,818	24,621	22,509	21,810	1,732	1,518	11	647	372	1,703
Copper	3,005	2,998	2,768	2,670	2,312	2,024	17	863	496	2,270
Lead	17,768	18,770	18,926	17,508	577	506	4	216	124	568
Manganese	11,596	24,011	36,689	37,770	43,044	53,100	0	0	0	0
Vanadium	2,870	2,992	2,959	2,761	2,560	2,402	14	790	453	2,077
Zinc	12,510	12,051	10,462	10,412	8,458	6,867	79	3,707	2,128	9,751

Source: EPA 2017k.

3.22 NOISE

3.22.1 Introduction

The sections below provide an overview of existing noise sources in the analysis area and the regulatory authorities governing noise. Definitions of noise and the measurements associated with it are also described. The analysis area for noise is defined below in **Section 3.22.1.2, Analysis Area**.

3.22.1.1 Regulatory Framework

Federal Requirements

Currently no federal regulations exist to regulate environmental noise levels within or near the project area. Under the Noise Control Act, EPA developed acceptable noise levels under various conditions that would protect public health and welfare with an adequate margin of safety. EPA identified outdoor day-night noise levels less than or equal to 55 decibels (L_{dn}, dBA) as sufficient to protect public health and welfare in residential areas and other places where quiet is a basis for use (EPA 1974). See **Section 3.22.1.3, Noise Terminology** below for an explanation of L_{dn} and dBA.

State Requirements

MSUMRA's implementing rules do not regulate noise per se but do include regulations related to the use of explosives. Specifically, ARM 17.24.623(1-2) states:

> "the operator shall publish a blasting schedule at least 10 days, but not more than 20 days, before beginning a blasting program in which blasts that use more than 5 pounds of explosive or blasting agent are detonated. The blasting schedule must be published once in a newspaper of general circulation in the locality of the blasting site. (2) copies of the schedule must be distributed by mail to local governments and public utilities and by mail or delivered to each residence within 1/2 mile of the permit area described in the schedule. For the purposes of this section, the permit area does not include haul or access roads, coal preparation and loading facilities, and transportation facilities between coal excavation areas and coal preparation or loading facilities, if blasting is not conducted in these areas. Copies sent to residences must be accompanied by information advising the owner or resident how to request a preblasting survey."

Local Requirements

There are no known local noise requirements applicable to this project.

3.22.1.2 Analysis Area

The analysis areas for direct and indirect noise impacts related to the project are shown in **Figure 64.**

Direct Effects Analysis Area

For direct effects, the analysis area includes the city of Colstrip, existing permit areas of the Rosebud Mine, the project area and a buffer area to the nearest residences (north, south, west, and east). The direct effects analysis area for noise was determined by identifying the nearest residences around the existing and proposed permit areas plus adding the city of Colstrip as it is the largest residential area in the vicinity of the project area (shown on **Figure 64**).

Indirect Effects Analysis Area

For indirect effects, the analysis area includes residences near the Rosebud and Colstrip Power Plants. Near the Rosebud Power Plant, this includes residences that are 1,000 to 3,500 feet away; for the Colstrip Power Plant, this includes residences in the city of Colstrip that are as close as 1,500 feet from the nearest cooling tower.

3.22.1.3 Noise Terminology

Sound or noise levels are most commonly reported in dB. The dB scale is logarithmic (a nonlinear scale used when there is a large range of quantities) and matches the way the ear and brain interpret sound pressures. The human auditory system is not equally sensitive to all frequencies; thus, for environmental noise, the A-weighted decibel (dBA) is used to measure sound the same way the ear "hears" it (Harris et al. 2011). Perceptible noise levels generally range from about 0 dBA (threshold of hearing) to about 140 dBA (painful) with a normal conversation being around 60 dBA and construction equipment being around 85 dBA at 50 feet away. **Table 89** shows typical average A-weighted sound levels for commonly encountered noises. With regard to the subjective response to changes in noise levels, humans can just perceive a difference in a noise level when it changes by 3 dB, most everyone can detect a 5 dB change, and a 10 dB change sounds like the noise level has doubled or has been cut in half. Because dBs are logarithmic, a change of 3 dB within an environment, such as that from a highway, would require the traffic volume to double for the noise level to increase by 3 dB.

Table 89. Typical Noise Levels.

Noise Source	Noise Level (dB)
Jet engine at takeoff	140
Emergency vehicle siren	115
Motorcycle (riding)	100
Passing diesel truck	85
Vacuum cleaner	75
Conversational speech	60
Light traffic	50
Babbling brook	40
Whisper	30
Rustling leaves	20
Threshold of hearing	0

Source: Noise Help 2015.

Environmental noise levels generally fluctuate with time as noise sources move and environmental factors change. Thus, environmental noise is reported as the equivalent noise level (L_{eq}), which is a measure of the exposure resulting from the accumulation of sound levels over a particular period of interest (e.g., an hour, an 8-hour work-day, nighttime, or a full 24-hour day). It is a way of assigning a single number to a time-varying sound level. Another noise metric is the day-night average noise level (L_{dn}), which reflects a 24-hour A-weighted noise dose. L_{dn} is equal to a 24-hour A-weighted L_{eq}, with one important adjustment: noise occurring at night (from 10 p.m. through 7 a.m.) is "factored up" by adding 10 dB to all nighttime noise contributions. This 10-dB adjustment accounts for our greater sensitivity to nighttime noise and the fact that noise events at night tend to be more intrusive due to lower ambient noise levels (Los Angeles World Airports 2011). Finally, low-frequency noise from blasting activities is called overpressure (or blast overpressure), and is assessed using flat-weighted decibels (dB) rather than dBA. This is because the primary concern with overpressure noise is the potential to cause structural damage from vibration, and dBA filters out most low frequencies.

3.22.2 Existing Noise Sources

The analysis area for noise includes the rural areas surrounding the Rosebud Mine to the north, south, and west, and residential areas to the east in Colstrip. As shown in **Figure 64**, the city of Colstrip is surrounded by Areas A through D of the Rosebud Mine; the project area would be 12 miles from Colstrip city limits. The nearest residences in Colstrip are anywhere from 1 to 2 miles away from active mining operations in Areas A, B, and C. However, coal conveyor systems from Areas A and C pass directly through Colstrip (**Figure 2**), and commuting workers, haul trucks, and supply trucks drive through Colstrip on Hwy 39 and associated mine access roads (see **Section 3.20, Access and Transportation**).Within the Colstrip city limits, noise sources include traffic on SH 39 and other local roads, the activities of residents, operation of the Colstrip and Rosebud Power Plants (the Rosebud Power Plant is about 6 miles to the north of Colstrip), and the coal conveyors. At night, local traffic is minimal with the exception of periods during shift changes at the mine. The nearest major highway (I-94) is more than 30 miles to the north and does not contribute to the noise. Noise occurring at night comes primarily from the Colstrip Power Plant, and therefore, noise levels at night primarily depend on the distance between the Colstrip Power Plant and the residences, which varies from about 0.5 to 1.5 miles. Existing outside nighttime noise levels are estimated to range from 30 to 60 dBA depending on proximity to the Colstrip Power Plant (Hankard 2012; Bradley 1985). Noise levels inside a typical residence with all windows and doors closed would be about 25 dBA lower (EPA 1978b).

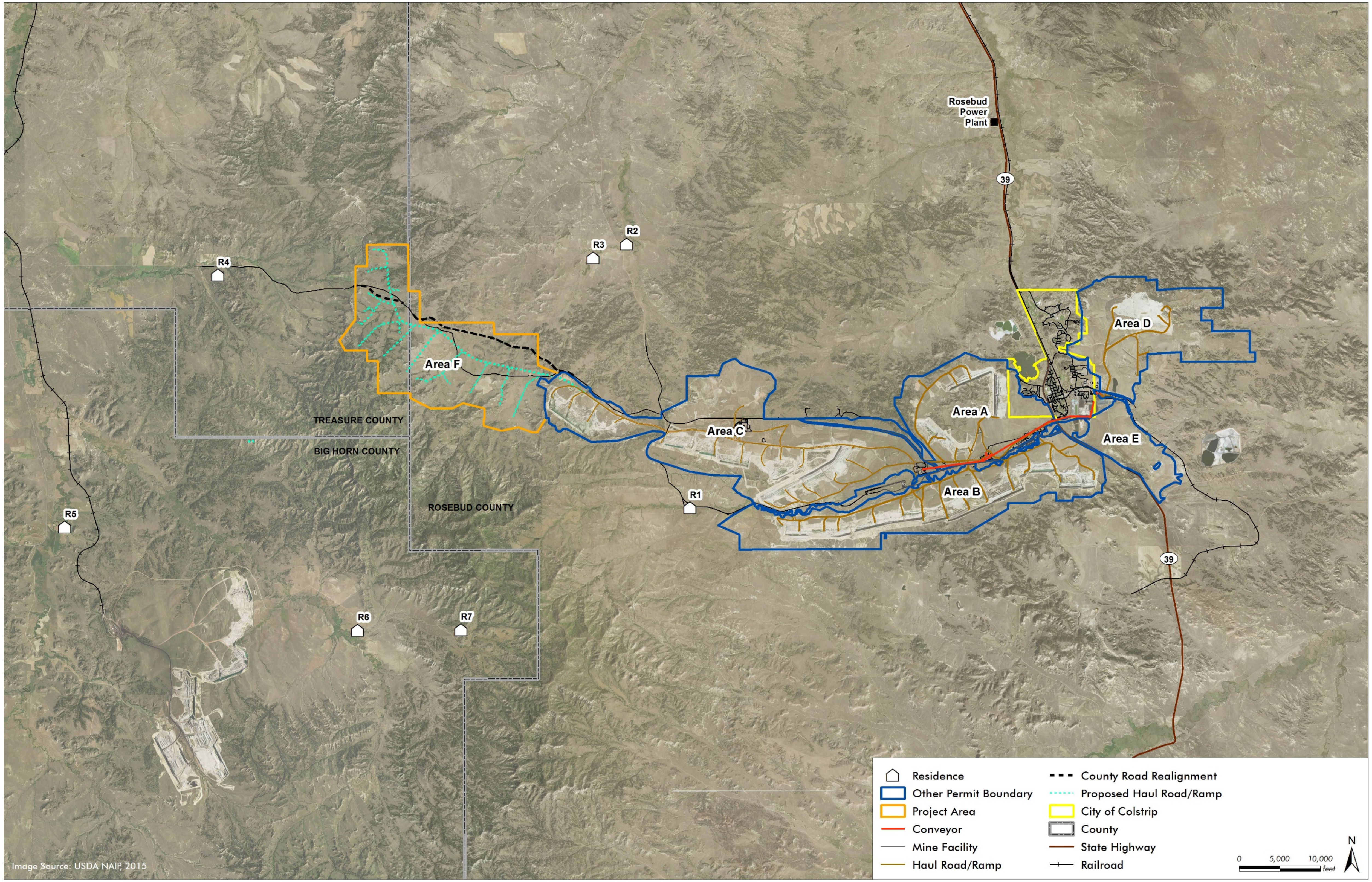

Figure 64. Location of Residences Analyzed for Noise Impacts Relative to Project Mining Operations. Image source: USDA NAIP 2015.

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Table 90 provides a list of non-Colstrip residences and a summary of each approximate distance from the project area. Distances were calculated using Google Earth™. The nearest non-Colstrip residences, R2 and R3 off Armells Creek Road (**Figure 64**), are located about 2.9 and 2.2 miles to the northeast of the project area, respectively. These same residences are located 3.3 and 2.8 miles north of Area C, which is the closest active mining site. The next closest residence to the project area is R4, which is 3.2 miles west off Horse Creek Road.

Table 90. Approximate Distances from Residences to Mining Areas.

Location	Description	Direction from Mine	Nearest Distance (miles)	
			Project Area	Existing Mine (Area ID)
R1	Airport Road	SE of the project area	4.0	0.7 (Area B)
R2	Armells Creek Road	NE of the project area	2.9	3.3 (Area C)
R3	Armells Creek Road	NE of the project area	2.2	2.8 (Area C)
R4	Horse Creek Road	W of the project area	3.2	7.8 (Area C)
R5	Highway 384	SW of the project area	8.0	11.7 (Area C)
R6	Unnamed Rural Road	S of the project area	5.5	6.6 (Area C)
R7	Unnamed Rural Road	S of the project area	4.7	5.2 (Area C)
Colstrip	Town of Colstrip	S of the project area	12.0	0.0 (Area A)

Currently, excavation and hauling of coal from the Rosebud Mine occurs within Areas A through C, with Area D in reclamation. Two existing conveyor systems that transport the coal from Areas A and C to the Colstrip Power Plant pass within 100 feet of residences on the south edge of Colstrip. The conveyor from Area C (4.2 miles long) would be used for project area coal transport as well. Typical heavy equipment that is used in Areas A through D would also be used in the project area including various trucks, haulers, tractors, loaders, drills, and one dragline.

Coal blasting generally occurs one to three days per week, with overburden blasting four to six times per month. No blasting occurs within 5,000 feet of any major structure outside the permit area. It is estimated that blasting overpressure levels of about 120 dB occur at a distance of 450 feet from the blast for a duration of 1 or 2 seconds (Marcus 2014). OSMRE recommends keeping overpressure noise levels from a blast below 120 dB to minimize human annoyance and complaints, with the U.S. Bureau of Mines considering 134 dB to be safe for residential structures (USDI 1987).

3.23 LAND USE

3.23.1 Introduction

The project area would include 6,746 permitted acres, of which 4,260 acres would be disturbed and require restoration to the approximate original pre-mine topography to facilitate postmine land uses. Land use is defined in MSUMRA (82-4-203, MCA) as specific uses or management-related activities, rather than the vegetative cover of the land. Land uses may be identified in combination when joint or seasonal uses occur and may include land used for support facilities that are an integral part of the land use. Land-use categories include cropland, developed water resources, fish and wildlife habitat, forestry, grazing land, industrial or commercial, pastureland, land occasionally cut for hay, recreation, or residential. This section describes existing land uses in the analysis area, as defined below in **Section 3.23.1.2, Analysis Area** (for a discussion of recreation see **Section 3.18, Recreation**).

3.23.1.1 Regulatory Framework

Federal Requirements

As described in **Section 1.4.1.1, Office of Surface Mining Reclamation and Enforcement, Surface Mining Control and Reclamation Act**, DEQ operates an approved state program under SMCRA and, therefore, has primary jurisdiction over the regulation of surface coal-mining and reclamation operations on non-federal and non-Indian lands within the state.

State Requirements

DEQ regulates permitting and operation of surface coal mines on federal lands within Montana under the authority of MSUMRA (Section 82-4-221 et seq., MCA) and its implementing rules (ARM 17.24.301-1309).

ARM 17.24.762 includes regulations on postmining land use, which are quoted below. "The postmining land use must satisfy 82-4-203(28) and 82-4-232(7), MCA. In applying 82-4-232(7), MCA, the following principles apply:

(a) The pre-mining uses of the land to which the postmining land use is compared are those that the land previously supported or could have supported if the land had not been mined and had been properly managed.
(b) The postmining land use for land that has been previously mined and not reclaimed must be judged on the basis of the land use that existed prior to any mining. If the land cannot be reclaimed to the use that existed prior to any mining because of the previously mined condition, the postmining land use must be judged on the basis of the highest and best use that can be achieved and is compatible with surrounding areas.
(c) The postmining land use for land that has received improper management must be judged on the basis of the pre-mining use of surrounding lands that have received proper management.
(d) If the pre-mining use of the land was changed within five years of the beginning of mining, the comparison of postmining use to pre-mining use must include a comparison with the use of the land prior to the change as well as its uses immediately preceding mining."

ARM 17.24.762(2) also states, "Alternative postmining land uses may be proposed and must be determined in accordance with 82-4-232(7) and (8), MCA, and ARM 17.24.821 and ARM 17.24.823. Certain pre-mining facilities may be replaced pursuant to 82-4-232(10), MCA."

Local Requirements

Rosebud County Planning and Grants Department oversees development of land and other resources within Rosebud County. The office staff administers the Montana Subdivision and Platting Act, Rosebud County Subdivision Regulation, and Rosebud County Flood Plain Regulation and assists governmental entities and nonprofit groups with project-funding administration. The Treasure County Comprehensive Development Plan/Growth Policy addresses issues related to growth for all areas of the county, except the town of Hysham.

Lease and Deed Agreements

Project area private surface and subsurface owners granted Western Energy exclusive rights to use and control their lands through lease and deed agreements dated from 1978 to 2009. These agreements may vary slightly from owner to owner. The agreements place restrictions, covenants, and/or transfers on property rights on the use by Western Energy. In general, the owners (sellers) have leased or deeded Western Energy all coal and coal deposits, together with the right of ingress and egress for the exploration for and development, production, or mining of coal. In addition, all interests of the sellers have been transferred to Western Energy including easements and other appurtenances on or attached to property fixtures including buildings, water rights, and crop production. In other cases, Western Energy has directly purchased lands with surface and mineral rights from other private owners. Western Energy provides ongoing management of these lands.

3.23.1.2 Analysis Area

Direct Effects Analysis Area

The analysis area for direct effects on land use includes the project area, plus a 2,000-foot buffer (**Figure 65** and **Figure 66**).

Indirect Effects Analysis Area

The analysis area for indirect effects includes the direct effects analysis area as well as the locations of the Colstrip and Rosebud Power Plants plus a 0.5-mile buffer (see **Figure 1** and **Figure 2**).

3.23.2 Land Ownership

3.23.2.1 Direct Effects Analysis Area

The project area encompasses 6,746 acres with three private surface owners (**Table 91**), including Western Energy Company (Western Energy), Great Northern Properties LP (GNP), and the Booth Land and Livestock Company (**Figure 65**). Formed in 1992, GNP acquired the surface, coal, and subsurface mineral (non-coal) related assets of Burlington Northern Railroad. Western Energy, the project proponent and mine operator, owns a small percentage of the surface lands within the project area. There is no federal or state surface ownership within the project area (**Figure 65**). Project area coal is either federal or owned by GNP. Western Energy holds leases for the federal (M82186) and private coal (G-002 and G-002-A). Subsurface mineral owners include GNP, Booth Land and Livestock Company, and ten private owners (**Figure 66**). These private owners include six companies/corporations and four individual families. Land-surface ownership within 2,000 feet of the project area includes state and private lands (**Figure 65**).

Table 91. Project Area Surface and Subsurface (Coal and Mineral) Ownership.

Ownership	ACRES PERMITTED		
	Surface	Subsurface (Coal)	Subsurface (Mineral)
Federal (BLM) Lands	0	3,267	0
State of Montana	0	0	0
Western Energy	309	0	0
GNP	2,703	3,479	3,479
Booth Land and Livestock Company	3,734	0	410
Private (10 owners)	0	0	2,857
Total	6,746	6,746	6,746

3.23.2.2 Indirect Effects Analysis Area

The incorporated city of Colstrip is 12 miles to the east of the project area. Federal, state, Tribal, and local government agencies all manage land in Southeast Montana, which is primarily private land (73 percent). About 19 percent of the land is public land, with an additional 9 percent of the land managed by Tribes (FWP 2014). Southeast Montana has two Tribal Nations and their associated lands—the Crow and Northern Cheyenne.

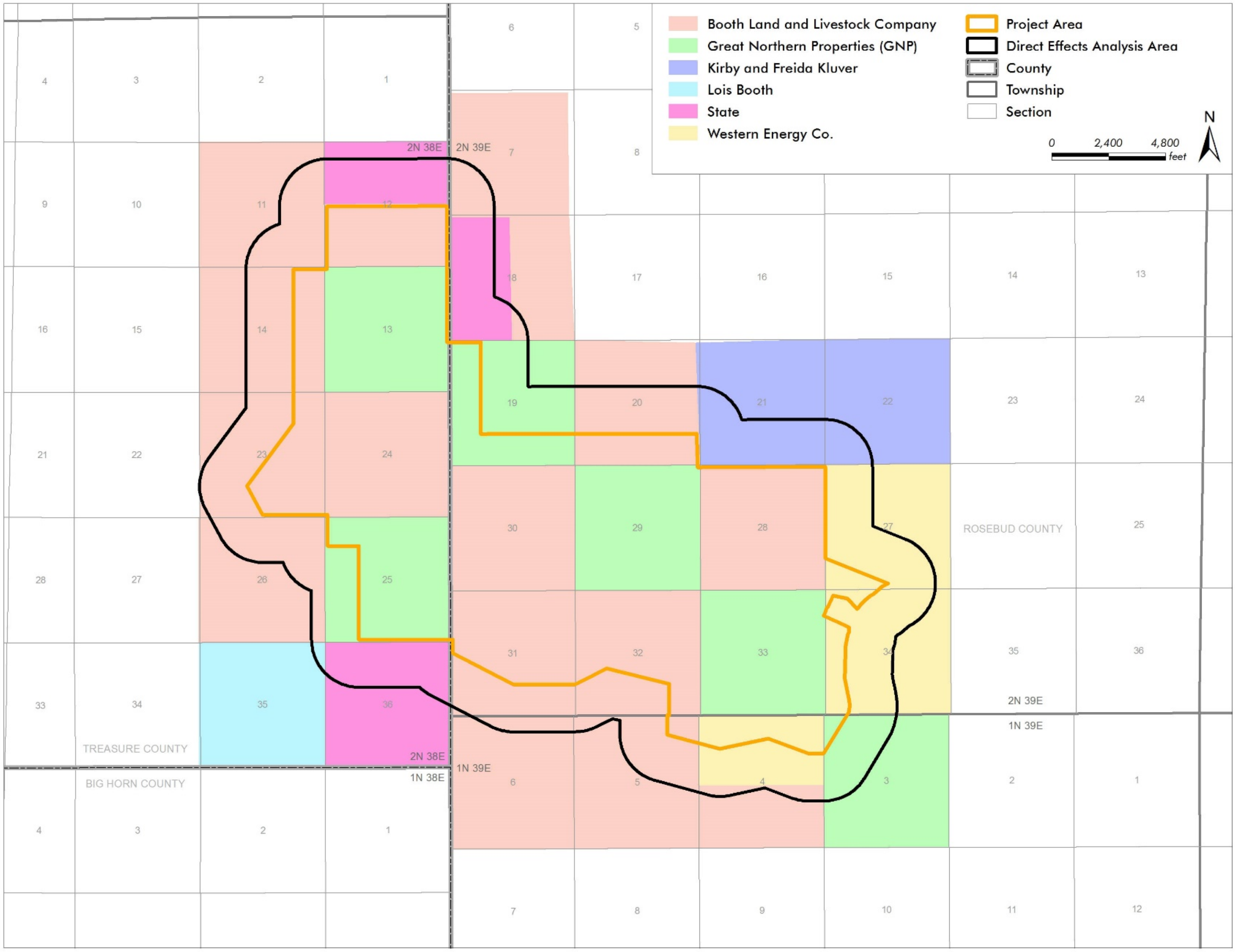

Figure 65. Project Area Surface Ownership.

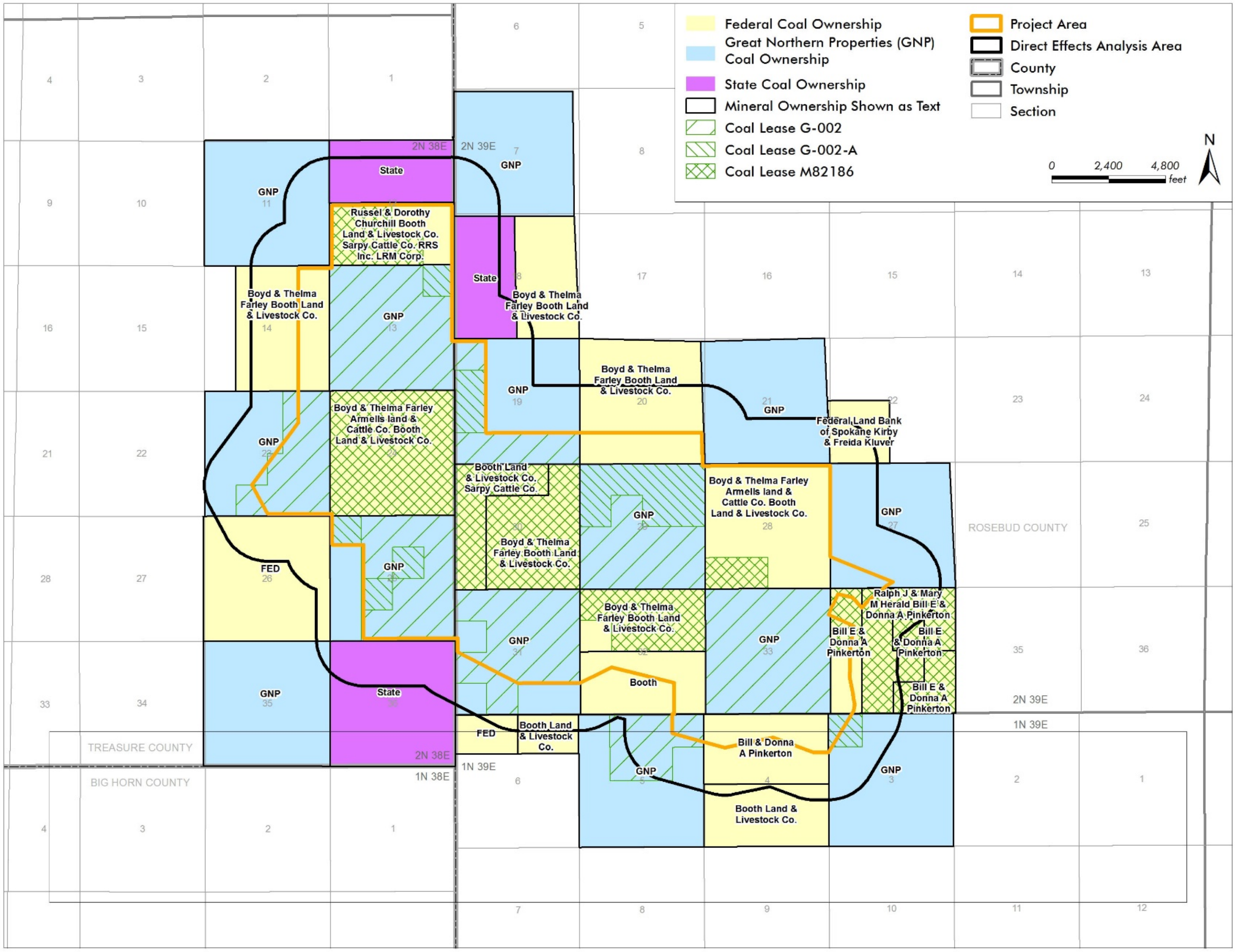

Figure 66. Project Area Coal Ownership.

3.23.3 Primary Pre-mining Land Uses (Direct Effects Analysis Area)

Primary pre-mining land uses within the direct effects analysis area are cropland, fish and wildlife habitat, grazing land, and pastureland. These land uses are described in the sections below.

3.23.3.1 Cropland

Cropland is defined in 82-4-203(13), MCA, as "land used for the production of adapted crops for harvest, alone or in rotation with grasses and legumes, that include row crops, small grain crops, hay crops, nursery crops, orchard crops, and other similar crops." Land that is used for facilities in support of cropland farming operations and is adjacent to, or an integral part of, these operations is also included in this category.

Cropland in the project area includes about 513 acres of nonirrigated area used for small grain production. Wheat is the primary crop with small acreages of barley and oats. There are no prime or unique farmlands in the project area.

3.23.3.2 Fish and Wildlife Habitat

Fish and wildlife habitat is defined in 82-4-203(20), MCA, as "land dedicated wholly or partially to the production, protection, or management of species of fish or wildlife." Fish and wildlife habitat is discussed in detail in **Section 3.12, Fish and Wildlife**.

3.23.3.3 Grazing Land

Grazing land is defined in 82-4-203(22), MCA, as "land used for grasslands and forest lands where the indigenous vegetation is actively managed for livestock grazing or browsing or occasional hay production."

The primary surface land use within the project area and the adjacent areas outside of the proposed permit boundary is livestock grazing. Livestock currently graze all vegetation types within the project area. Specific numbers of animals grazing the analysis area were only available for two lease areas: the North ½ Section 4, T1N R39E (54 animal unit months (AUM); currently 15 cow-calf pairs) and Section 27, T2N 39E (160 AUM). Both lease areas are owned by Western Energy.

Information on grazing numbers from other landowners in the analysis area was not available. Based on general descriptions of vegetative communities for the region, the estimated annual total production (grass, forbs, and shrubs) is between 500 and 2,200 pounds per acre with grassland stocking rates of 0.13 to 0.60 AUMs per acre (USDA-NRCS 2006). In 2006, the project area total production ranged from 368 to 1,188 pounds per acre, depending on the plant community. Therefore, estimates indicate that project area plant communities potentially support stocking rates ranging from 0.12 to 0.29 AUMs per acre. Production can vary from year to year based on precipitation.

3.23.3.4 Pastureland

Pastureland is defined in 82-4-203(38), MCA, as "land used primarily for the long-term production of adapted, domesticated forage plants to be grazed by livestock or occasionally cut and cured for livestock feed." Pastureland (also referred to as Improved Pasture) in the project area includes about 537 acres and occurs near ranch operations and access roads in the valley bottoms where slopes are gentle and soil is deep.

3.23.4 Other Pre-mining Land Uses (Direct Effects Analysis Area)

Other land uses defined in MSUMRA that may be found in the direct effects analysis area are described below.

3.23.4.1 Developed Water Resources

Developed water resources, as defined in 82-4-203(16), MCA, means "use of land for storing water for beneficial uses such as stock ponds, irrigation, fire protection, flood control, and water supply."

Seven dam diversions, shown as manmade livestock ponds, are located within or close to the project area adjacent to or on McClure, Robbie, Donley, or Black Hank Creeks (see **Figure 36, Section 3.7**, **Water Resources – Surface Water**). Some of the ponds are on-stream ponds and some are spring-fed ponds. All of the ponds have year-round water rights diversion volumes of 30 gallons per day per animal. During the 2011 to 2013 monitoring period, pond depths ranged from dry to nearly dry (a few inches deep) and up to 15 feet deep.

Nine springs are located within or near the project area adjacent to tributaries or the mainstem of McClure, Robbie, Donley, and Black Hank creeks. Another spring at the north end of the project area on a tributary to Trail Creek is located outside of the project area (see **Figure 36, Section 3.7**, **Water Resources – Surface Water**). All of the springs are used for livestock watering and have permitted diversion volumes of 30 gallons per day per animal. Only one spring (Spring 3 on a tributary of Robbie Creek) is developed and has a decreed maximum diversion rate, which is 8 gallons per minute. The livestock pond and spring rights are owned by Booth Land & Livestock, WPP LLC, or Western Energy.

3.23.4.2 Forestry

Forestry is defined in 82-4-203(21), MCA, as "land used or managed for the long-term production of wood, wood fiber, or wood-derived products." There are no lands used for forestry in the project area.

3.23.4.3 Industrial or Commercial

Industrial or commercial, as defined in 82-4-203(26), MCA, means "land used for: (a) extraction or transformation of materials for fabrication of products, wholesaling of products, or long-term storage of products. This includes all heavy and light manufacturing facilities, and (b) retail or trade of goods or services, including hotels, motels, stores, restaurants, and other commercial establishments."

Existing development on private land within the project area includes a scoria gravel storage area and some livestock facilities, which support existing livestock grazing. The Horse Creek Road (county road) bisects the proposed mine area, and utility corridors bisecting the project area include electric transmission lines and an underground natural gas pipeline. A 230-kilovolt (kV) transmission line bisects the southern portion of the project area on an east-west axis. This transmission line conveys power generated by the Colstrip Power Plant into Northwestern Energy's electric transmission grid. About 10 miles of 7.2-kV distribution lines are within the project area. Approximately 1.4 miles of a 4-inch natural gas transmission pipeline are collocated in the 7.2-kV transmission corridor (see **Figure 6**, **Chapter 2**).

3.23.4.4 Recreation

Recreation is defined in MSUMRA in 82-4-203(45), MCA as "land used for public or private leisure-time activities, including developed recreation facilities such as parks, camps, and amusement areas, as well as areas for less-intensive uses such as hiking, canoeing, and other undeveloped recreational uses." Recreation land uses are discussed in **Section 3.18, Recreation**.

3.23.4.5 Residential

Residential, as defined in 82-4-203(48), MCA, means "use of land for single- and multiple-family housing, mobile home parks, or other residential lodgings." Land that is used for facilities in support of residential operations and that is adjacent to, or an integral part of, these operations is also included. Support facilities include, but are not limited to, vehicle parking and open space that directly relate to the residential use. Abandoned ranch homesteads are used occasionally for site access or equipment storage. No private residences are within the project area.

3.23.5 Land Use in the Indirect Effects Analysis Area

Colstrip's zoning ordinance has 11 different land uses. Designated land use areas in and immediately surrounding Colstrip include: five residential districts, a general commercial district, a light-industrial district, a multiple-use district, an open-space district, a power-generation district, and a mining district (City of Colstrip 2013). Residential neighborhoods are geographically separated from industrial districts and the business centers. A business district is located in the original town site from the 1970s and another is located west of and adjacent to State Highway 39.

The power-generation complex is located on the south end of Colstrip. A light-industrial park is located on the north end of the community outside of the incorporated city limits, and identified as commercial through covenants. To avoid conflict, no development has been allowed near the power plants or under the transmission lines. Open space has been used to ensure the separation of incompatible development with the electric power facilities. Open space also has been used to effectively prevent development near fresh water and the wastewater treatment plants. Open space and some park and recreation development are located along the East Fork of Armells Creek to complement that stream corridor (City of Colstrip 2008).

The land uses surrounding Colstrip and in Southwest Montana primarily consist of agricultural crop production, grasslands, forest/grazing, open grazed sparse woods, and irrigated land. The landscape provides the region with natural resources and space to farm, ranch, mine, and hunt. With access to land for recreational opportunities, many people enjoy fishing, hunting, access to rivers, and small town lifestyle.

3.24 SOIL

3.24.1 Introduction

This section describes soil resources that occur within the direct effects analysis area and their suitability for use in reclamation and revegetation following mining operations. It also describes the soil resources that occur in the indirect analysis area in general terms. The analysis areas for soil are defined below in **Section 3.24.1.2, Analysis Area**. The regulatory authorities governing soil resources are also discussed in this section.

Soil varies in depth, texture, percent rock fragments, and chemical and physical properties. Soil resources are evaluated to determine the volume and suitability available to achieve reclamation success. A suite of chemical and physical parameters—particle size distribution (soil texture), rock content, percentage organic matter, soil pH, electrical conductivity (EC), saturation percentage, sodium adsorption ratio (SAR), selenium, boron, molybdenum, and slope—are used to determine soil suitability for mine and reclamation planning. Soil materials most likely to contribute to reclamation success are designated for salvage and use in reclamation.

3.24.1.1 Regulatory Framework

Federal Requirements

SMCRA outlines the minimum federal coal-mining requirements to restore land to a condition capable of supporting preexisting uses or to higher or better uses. Under Section 1273(c) of SMCRA, a state with a permanent regulatory program approved by the DOI Secretary, such as DEQ, can elect to enter into a cooperative agreement for state regulation of surface coal-mining and reclamation operations on federal lands within the state. OSMRE granted DEQ this authority, and DEQ regulates permitting and operation of surface coal mines on federal lands within Montana under the authority of MSUMRA, Section 82-4-221, MCA.

State Requirements

Surface-mining operations are required by MSUMRA (82-4-2.231 and 232, MCA) and its implementing rules (ARM 17.24.701 and 702) to remove all topsoil and subsoil suitable for reclamation, to immediately replace or temporarily store and protect the soil resource during mining, and to replace soil following mining to support revegetation. **Table 92** summarizes the applicable rules and regulations.

Table 92. Applicable Soil Rules and Regulations.

Applicable Rules and Regulations under the Administrative Rules of Montana	
ARM 17.24 Subchapter	**Summary of Requirement**
3	Contains requirements of the surface mine permit application, including gathering soil baseline information (ARM 17.24.304 and 306), requirements of the reclamation plan (ARM 17.24.313)
5	Contains backfilling and grading requirements
6	Lists performance standards for drainage reclamation (ARM 17.24.634) and sediment-control measures (ARM 17.24.638)
7	Includes the requirements of soil removal (ARM 17.24.701); soil stockpiling and redistribution (ARM 17.24.702); soil-stabilizing practices (ARM 17.24.714); use of soil amendments, management techniques, and land use practices (ARM 17.24.718); establishment of vegetation (ARM 17.24.711); soil/spoil monitoring plan (ARM 17.24.723); postmining land use (ARM 17.24.762); and cropland reclamation (ARM 17.24.764)
Applicable Rules and Regulations under Montana Strip and Underground Mine Reclamation Act	
MCA 82-4-2 Subpart	**Summary of Requirement**
222	Contains requirements of a mine permit application, which include a plan for the mining, reclamation, revegetation, and rehabilitation of land and water to be affected by the operation.
231	Requires submission of and action on reclamation plan and to include a plan of grading, backfilling, highwall reduction, topsoiling and reclamation for the area of land affected by the operation.
232	Contains specifications for soil removal, storage, replacement, and reconstruction on prime farmlands and non-prime farmlands.
233	Contains requirements for planting of vegetation following grading of disturbed area.

DEQ has outlined its procedures and methods to protect the soil resources that would be disturbed by coal-mining operations and to enhance the potential of achieving successful reclamation in its Soil, Overburden, and Re-graded Spoil Guidelines (DEQ 1998). These guidelines are based on the requirements and objectives of MSUMRA and its implementing ARMs (**Table 92**) and include soil-suitability criteria for determining salvage depths and volumes of suitable soil and soil materials for use as a plant-growth medium.

Local Requirements

There are no applicable local regulations for soil resources within or near the analysis area.

3.24.1.2 Analysis Area

Direct Effects Analysis Area

The analysis area for direct effects on soil is the proposed 4,260-acre mining disturbance area within the proposed Area F permit boundary (**Figure 68**). It includes all mining areas, stockpiles, scoria pits, haul roads, haul-road ramps, and buffer areas surrounding proposed disturbances.

Indirect Effects Analysis Area

The indirect effects analysis area for soil consists of the operational boundaries of the Colstrip and Rosebud Power Plants plus a 32-km irregular buffer around each of the power plants (**Figure 67**). The buffer is the result of trace metal deposition modeling, completed to develop the analysis area for special status species, that utilized soil trace metal background concentrations from a USGS background study (Smith et al. 2013); (see **Section 4.3, Air Quality**, for discussion of modeling methods and results). Of the eight trace metals modeled, mercury had the greatest deposition distance—about 32 km. This distance represents where mercury deposition from the power plants would reach one percent of the 95 percent

Upper Confidence Limit (95-percent UCL) of the USGS background samples over a 19-year period (the years project area coal would be combusted).

The area that represents one percent deposition (32-km buffer) was used instead of zero percent so the analysis area is more representative of the soils within the project area and to generate a reasonable area that sustains the soil resources. Mercury deposition versus distance is logarithmic, and zero percent deposition likely would be a few hundred km in radius, which would include soil of mountain environments and much wetter and drier environments than the project area. This same analysis area was also used for SO_2 and NO_2 emissions from the combustion of project area coal, because the modeling concentrations of these gases were shown to be well below NAAQS and MAAQS within the entire 32-km area (see **Section 4.3.3.2, Indirect Impacts of Coal Combustion**).

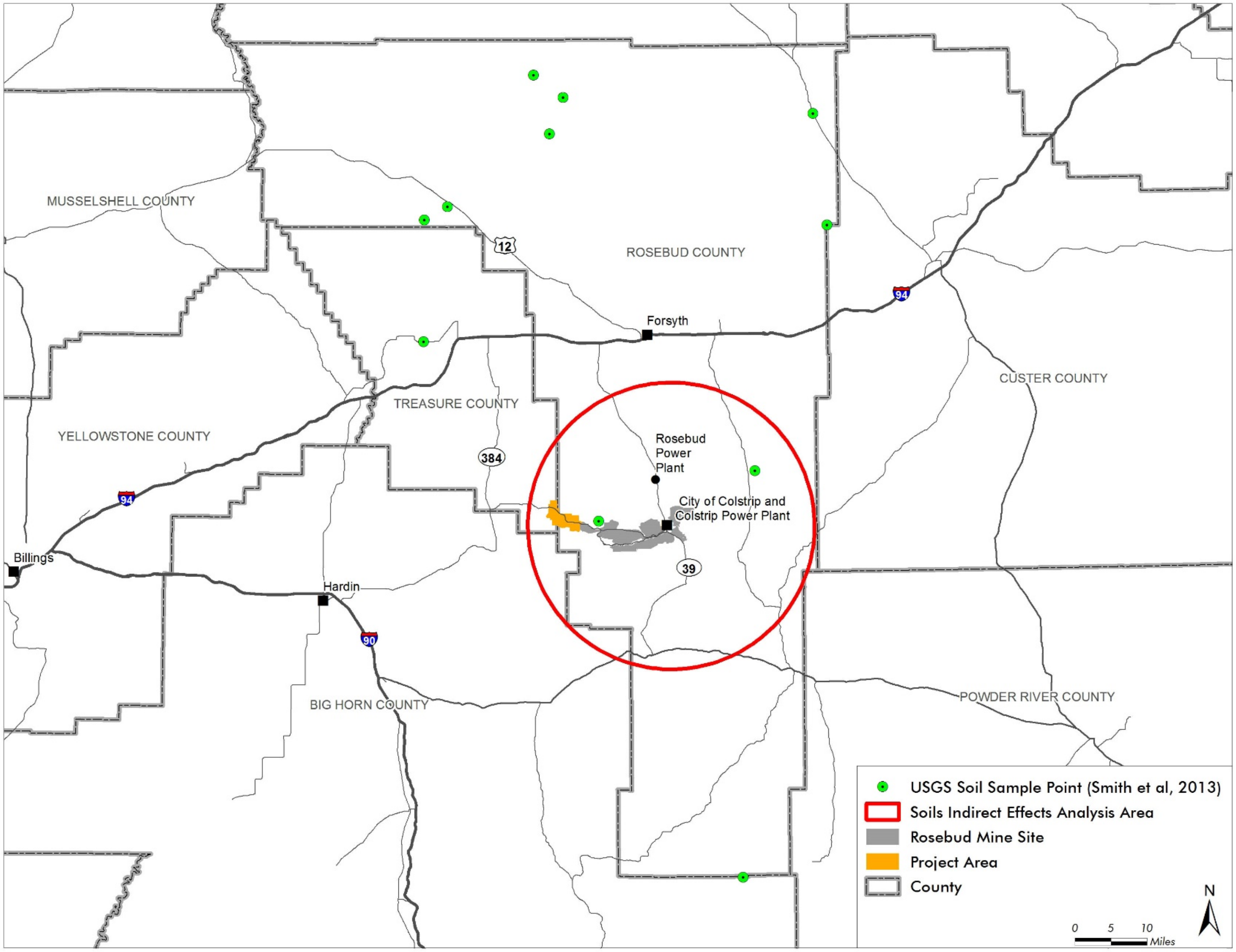

Figure 67. Indirect Effects Analysis Area and USGS Background Sample Locations.

3.24.2 Soil Map Units and Descriptions

3.24.2.1 Direct Effects Analysis Area

Soil Map Units in the Direct Effects Analysis Area

Soil investigations for the project area were conducted for Western Energy in 2007 and 2011 by James Nyenhuis (PAP, Appendix G), and the soil report was updated in 2015 (PAP, Appendix G). Thirty-four soil map units were identified and delineated within the project area during the soil baseline studies (PAP, Appendix G). The individual soil map units are grouped into five generalized soil map units based on soil depth, parent material, landscape position, and the soil's physical and chemical properties. The generalized map units (**Figure 68**) include: (1) shallow upland soil; (2) very deep, residual upland soil; (3) very deep, fine-textured soil of gently sloping uplands; (4) coarse-textured soil of rolling uplands; and (5) very deep, fine-textured drainage soil.

The project area encompasses 6,746 acres, of which 4,260 acres are expected to be disturbed by mining operations. The expected disturbance acreages of the generalized soil map units are listed in **Table 93**. Each of these soil map units is described below in **Section 3.24.2, Soil Map Units and Descriptions**, and the descriptions are taken from the baseline soil study (PAP, Appendix G) with minor modifications.

Table 93. Acreages of Generalized Soil Map Units.

Soil Map Unit Number	Generalized Soil Map Unit	Disturbance Acres
100	Shallow upland soil	666
200	Very deep, residual soil of uplands	146
300	Very deep, fine-textured soil of gently sloping uplands	2,675
400	Coarse-textured soil of rolling uplands	608
500	Very deep, fine-textured drainage soil	165
Total		**4,260**

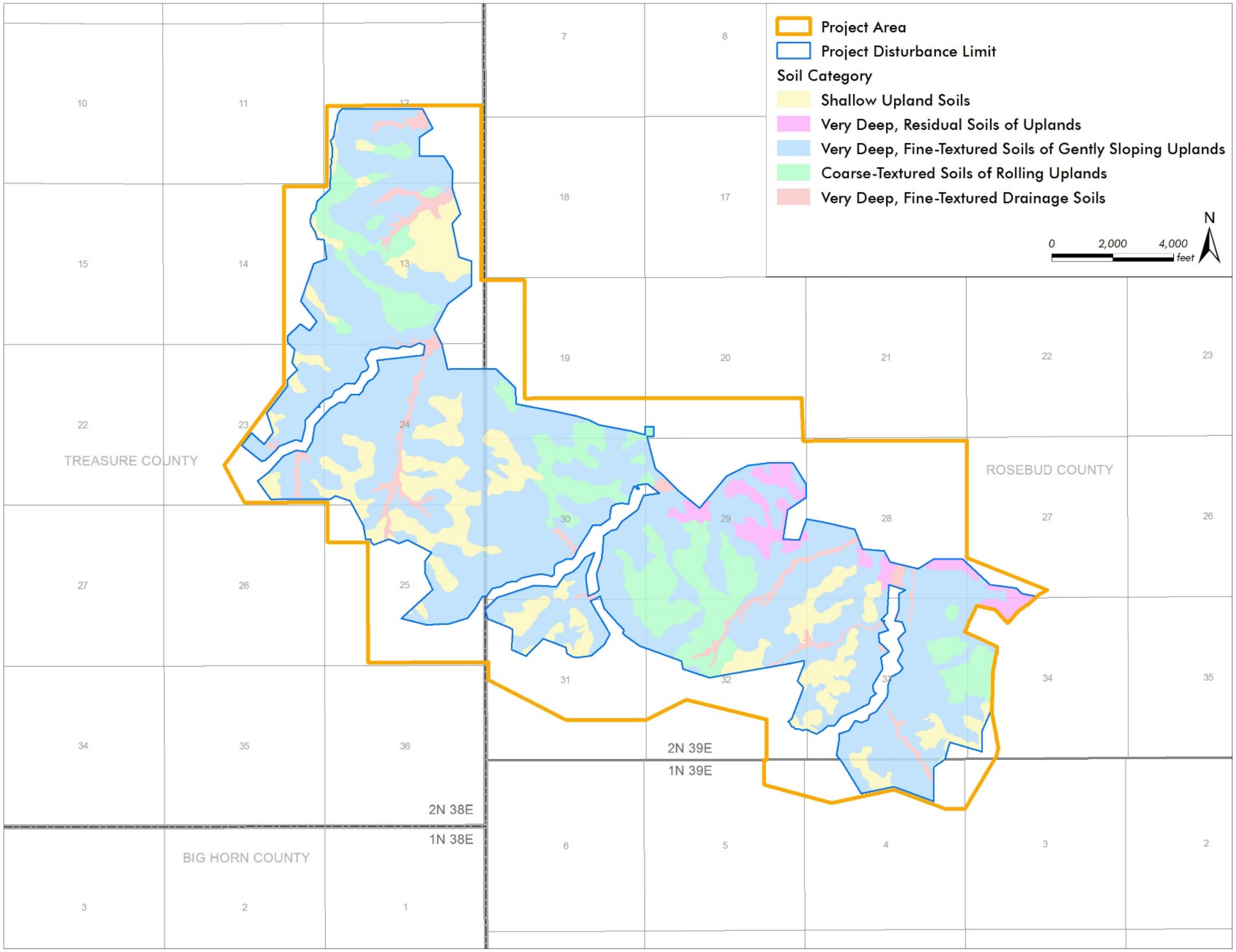

Figure 68. Generalized Soil.

Soil Map Unit Descriptions

Shallow Upland Soil (Soil Map Unit Number 100). Shallow upland soil is generally less than 20 inches to bedrock, although some deep soil (greater than 40 inches to bedrock) and moderately deep soil (20–40 inches to bedrock) are included in this soil map unit. Areas of rock outcrop are also included in the map unit. The soil is well-drained and developed predominantly in shallow residuum from sandstone, shale, or scoria on or adjacent to upland ridges with slopes ranging from 4–70 percent. The soil map units from the baseline soil study (PAP, Appendix G) that make up this generalized map unit include: 84D, 184F, 188E, 493D, 493E, 498E, and 741C (refer to the baseline soil study [PAP, Appendix G] for a description of these map units). This soil makes up about 16 percent of the analysis area (666 acres) and occur throughout this area.

The surface layers of this soil are thin and generally have fine-loamy textures with few rock fragments, medium to high organic-matter content, and low to high calcium carbonate levels. The soil is generally neutral to slightly alkaline, nonsaline, and nonsodic[22]. The subsoil is generally thin, moderately to strongly alkaline, nonsaline, and nonsodic; is has a fine-loamy texture with a high amount of rock fragments, low to medium organic-matter content, and a low to high calcium carbonate level.

This soil is generally suitable for salvage and replacement. Some soil on slopes greater than 50 percent may not be salvageable due to equipment operator safety concerns. Some subsoil may not be suitable for replacement due to excessive rock fragments unless used in areas selected for alternative substrates.

Very Deep, Residual Soil of Uplands (Soil Map Unit Number 200). This soil is very deep to bedrock (greater than 60 inches), well-drained, and developed predominantly in deep residuum and colluvium from sandstone, shale, or scoria on or adjacent to upland ridges. The slopes range from 4–70 percent. This soil is of limited extent, making up about 3 percent (146 acres) of the analysis area, and occur in the northeastern portion of the analysis area. The soil map units from the baseline soil study (PAP, Appendix G) that make up this generalized map unit include: 121E, 123E, 123F, and 422E.

The surface layers are generally thin, are neutral to moderately alkaline, have fine-loamy textures, and commonly have some rock fragments. The subsoil is generally slightly to strongly alkaline, contains a high calcium carbonate levels, has a fine-loamy texture, and is commonly very rocky.

This soil is generally suitable for salvage and replacement. Some soil on slopes greater than 50 percent may not be salvageable because of unsafe conditions for salvage operations. These slopes, however, are of limited extent within the analysis area. Some subsoil may not be suitable for replacement due to excessive rock fragments unless used in areas selected for shrub and tree plantings.

Very Deep, Fine-Textured Soil of Gently Sloping Uplands (Soil Map Unit Number 300). This soil is generally very deep to bedrock, well-drained, and developed in predominantly fine-textured slopewash alluvium, colluvium, or alluvial fan deposits from mixed sources. The soil occurs on gently sloping uplands with slopes ranging from 0–15 percent, and have significant calcium carbonate accumulations in the subsoil. This soil is dominant and makes up about 62 percent (2,675 acres) of the analysis area. The

[22] **Soil reaction (pH):** neutral (6.6–7.3), slightly alkaline (7.4–7.8), moderately alkaline (7.9–8.4), strongly alkaline (8.5–9.0). **EC:** nonsaline (0<2 millimhos [mmhos]/cm), very slightly saline (2<4 mmhos/cm), slightly saline (4<8 mmhos/cm), moderately saline (8<16), strongly saline (>16 mmhos/cm). **SAR:** nonsodic (0<2), slightly sodic (2<8), moderately sodic (8<15), highly sodic (15<30), very highly sodic (>30). **Organic matter content:** low (0.0–1.0 percent), medium (1.1–3.0), high (3.1–10 percent), very high (>10 percent). **Calcium carbonate levels:** low (<2.0 percent), medium (2–6 percent), high (>6 percent) (PAP, Appendix G).

soil map units from the baseline soil study (PAP, Appendix G) that make up this generalized map unit include: 16A, 16C, 21C, 23C, 27A, 27C, 37A, 37C, 42C, 49A, 49C, 49D, 59A, 59C, and 59D.

The surface layers of this soil are about 6 inches thick and have fine-loamy textures with few rock fragments, medium to high organic-matter content, and low calcium carbonate levels. The soil is neutral, nonsaline, and nonsodic. The underlying soil to a depth of about 17 inches is similar to the surface soil except that it has less organic content. The subsoil below 17 inches has high calcium carbonate levels, fine- and coarse-loamy textures with few rock fragments, and medium to low organic contents. This soil is moderately to strongly alkaline, nonsaline to slightly saline, and nonsodic to slightly sodic.

This soil is generally suitable for salvage and replacement. Below about 17 inches, however, the soil is less desirable as plant-growth medium due to high accumulations of calcium carbonate and poor soil structure (PAP, Appendix G).

Coarse-Textured Soil of Rolling Uplands (Soil Map Unit Number 400). This soil is moderately deep to very deep to bedrock, well-drained, and developed predominantly in coarse-textured alluvium and sandy eolian deposits on rolling uplands with slopes ranging from 2–25 percent. Rock outcrop is present in some areas. The soil commonly has significant calcium carbonate accumulations in the subsoil below about 16 inches. The soil map units from the baseline soil study (PAP, Appendix G) that make up this generalized map unit include: 13C, 13D, 131E, 132E, and 183E. This soil makes up about 14 percent (608 acres) of the analysis area.

The surface layers of this soil are about 5 inches thick and has a coarse-loamy texture with few rock fragments, medium to high organic-matter content, and low calcium carbonate levels. This soil is slightly to moderately alkaline, nonsaline, and nonsodic. The underlying soil to a depth of about 16 inches is similar to the surface layers but has slightly lower organic-matter content. The subsoil below 16 inches have high calcium carbonate levels, low organic-matter content, and coarse-loamy textures with few rock fragments. It is moderately to strongly alkaline, nonsaline, and nonsodic.

This soil is generally suitable for salvage and replacement. Below about 16 inches, however, the soil is less desirable as a plant-growth medium due to high accumulations of calcium carbonate and poor soil structure (PAP, Appendix G).

Very Deep, Fine-Textured Drainage Soil (Soil Map Unit Number 500). This soil is very deep to bedrock and well-drained. It is developed in alluvium on terraces and channels and in moderately fine-textured deposits in eroded areas adjacent to drainages. The soil map units from the baseline soil study (PAP, Appendix G) that make up this generalized map unit include 7E and 311. This soil is of limited extent and makes up about 4 percent (165 acres) of the analysis area. The soil generally occurs in narrow drainageways with slopes ranging from 0–35 percent. A few small, scattered inclusions of hydric soil (7.65 acres) are found within the project area, of which 3.09 acres are within proposed disturbances. Hydric soil typically supports wetlands. Wetlands within the project area are described in **Section 3.11, Wetlands and Riparian Zones**.

The surface layer of this soil is about 8 inches thick and has a fine-loamy texture with few rock fragments, medium to high organic-matter content, and low to high calcium carbonate levels. It is neutral to slightly alkaline, nonsaline, and nonsodic. The subsoil has a fine-loamy texture with few rock fragments, medium to low organic-matter content, and medium to high calcium carbonate level; is slightly to strongly alkaline; and is generally nonsaline and nonsodic.

This soil is generally suitable for salvage and replacement. It commonly has high calcium carbonate levels near the surface, and below about 18 inches has poor soil structure, which is less desirable as a plant-growth medium (PAP, Appendix G).

3.24.2.2 Indirect Effects Analysis Area

The indirect effects analysis area is over 3,000 square km and contains many soil map units (**Figure 67**). To summarize the soil map units over the indirect effects analysis area, soil was grouped into broad units, called soil associations. These associations were taken directly from the soil surveys of Rosebud County (USDA-SCS 1975), Big Horn County (USDA-SCS 1977), and Treasure County (USDA-SCS 1967) and are included in **Table 94**.

Table 94. Soil Associations within the Indirect Effects Analysis Area.

Rosebud County
Soil of the Floodplains
Nearly level to gently sloping, deep, well drained to somewhat poorly drained soil on floodplains. This association occurs along the major drainages within the indirect effects analysis area.
Soil of the Sandstone and Shale Uplands
Undulating to hilly, deep, well-drained soil of the sandstone uplands with steep sandstone rock outcrop. This association occurs in the eastern portion of the project area and at the Colstrip and Rosebud Power Plants.
Undulating to steep, shallow to deep, well-drained soil of the sandstone and shale uplands. This soil is commonly gravelly. This association occurs in the project area and north of the Colstrip Power Plant.
Gently rolling to steep, shallow and moderately deep, well-drained soil of the shale uplands. This association occurs north of the project area and the Colstrip and Rosebud Power Plants.
Soil of the Red and Brown Shale Hills
Undulating to very steep, deep to shallow, well-drained soil of the red and brown shale hills. This association occurs in the western portion and south of the project area and in the vicinity of the Colstrip Power Plant.
Gently rolling to very steep, deep to shallow, well-drained soil of the red and brown shale hills. Soil in this association is similar to those in the association above, except they are drier. This association occurs in and south of the project area and near the Colstrip Power Plant.
Big Horn County
Soil of Dissected Shale Hills
Moderately deep to shallow, undulating to hilly and gently sloping to very steep, well-drained soil on sedimentary uplands. This association occurs south of the project area and the extreme western portion of the indirect effects analysis area.
Shallow and moderately deep, gently undulating to hilly and strongly sloping to very steep, well-drained soil and shale outcrop on sedimentary uplands. This association occurs south of the project area and the extreme western portion of the indirect effects analysis area.
Treasure County
Soil of Rolling to Rough, Broken Uplands on Soft Shale
Moderately deep, dark colored sandy soil and moderately deep to shallow, light colored loamy soil on strongly rolling to hilly uplands. This association occurs in the extreme western portions of the project area and the indirect effects analysis area.
Moderately deep to shallow, light colored loams and clay loams on rolling to rough, broken uplands. This association occurs in the extreme western portion of the project area and the indirect effects analysis area.

3.24.3 Suitability for Reclamation

According to the baseline soil study, all the soil in the analysis area is suitable for use in reclamation and revegetation except as noted below. The soil is nonsaline, nonsodic, and has suitable values for soil pH, EC, SAR, saturation percentage, texture, rock fragments, boron, and molybdenum (PAP, Appendix G).

Selenium concentrations in all soil collected in 2007 from the project area averaged 0.27 milligrams per kilogram (mg/kg) throughout the soil profile and 0.23 mg/kg in the surface horizons. These levels exceed DEQ's suitability limit for soil used in reclamation. DEQ considers selenium concentrations greater than 0.1 mg/kg to be suspect or unsuitable, and suspect levels are to be used as a guide in evaluating the suitability of a soil material for reclamation.

These elevated selenium concentrations, as measured by Colorado State University in 2007, have not been found in any of the other Rosebud Mine area soil studies, and DEQ is in agreement that these elevated levels are not usual for the region (Calabrese, pers. comm. 2015). Considering the widespread distribution of the 2007 results and absence of such high selenium levels in other mine permit areas, the results were suspected to be incorrect due to a laboratory reporting error. Therefore, selenium was further investigated in 2016. Western Energy repeated sampling with 43 samples from 9 previously-sampled sites in 2007 to represent the same depths and soil horizons, and samples were collected from a range of soil conditions and are considered representative of project area soils. The samples were analyzed by Inter-Mountain Labs in Sheridan, Wyoming for hot water extractable selenium using standard methods.

A summary of the 2016 analytical results are in Addendum A in Appendix G of the PAP. All 43 samples had selenium values less than 0.02 mg/kg (the analytical detection limit), except for three samples. Those values (0.02, 0.06, and 0.08 mg/kg) were all less than DEQ's guideline for soil suitability for reclamation of 0.1 mg/kg. In addition, these three highest values did not correspond to the highest results in 2007, and the 2016 results are consistent with selenium levels found in other mine permit areas. The evidence supports that the high selenium values from 2007 are due to a laboratory recording error and, therefore, the 2007 selenium data has been rejected in favor of the 2016 data. Furthermore, no special management is necessary for the accepted selenium levels found in the project area.

Some subsoil is very rocky and exceed DEQ's guidelines for rock fragments. This subsoil can be redistributed in areas selected for shrub and tree plantings. Slopes greater than 50 percent may pose safety concerns for salvage operations.

Thicknesses of suitable soil for reclamation vary greatly across and within the five generalized soil map units. The mine plan currently has a balanced soil budget, and soil-salvage volumes are evaluated annually to ensure there is sufficient soil material to reclaim disturbed areas.

The suitable thicknesses presented below are generalized and although they are based on MT guidelines for soil suitability for reclamation (DEQ 1998), they do not represent the proposed stripping depths of the action alternatives. Instead, for the action alternatives all soil is grouped into three soil-salvage classes that have standard salvage depths. The three classes—trees, uplands, and lowlands—are described below.

Based on DEQ guidelines, soil map unit 100 has about 18 inches of salvageable soil for reclamation due to shallow bedrock, and soil map unit 200 generally has about 10 inches due to extreme rockiness in the subsoil. Thicknesses of salvageable soil in soil map units 300 and 400 vary greatly, but in general are at least 40 inches. Soil map unit 500 has about 60 inches of soil suitable for reclamation.

3.24.3.1 Soil Salvage Protocol

Three soil classes, which are shown on **Figure 69,** would be salvaged: lowland soil, upland soil, and tree soil. These classes, shown in **Table 95**, are based on suitable topsoil and subsoil thickness as well as soil texture and include the five generalized soil map units described above. Lowland soil corresponds to soil map unit 500 (very deep, fine-textured drainage soil). Upland soil corresponds to soil map units 300 (very deep, fine-textured soil on gently sloping uplands) and a portion of soil map unit 400 (coarse-textured soil of rolling uplands). Tree soil corresponds to soil map units 100 (shallow upland soil) and 200 (very deep residual soil of uplands), and a small portion of soil map unit 400 (coarse-textured soil of rolling uplands). The upland soil-salvage class makes up about 3,181 acres of the total disturbance, the lowland class makes up 165 acres, and the tree class makes up the remaining 914 acres.

Soil-salvage classes and salvage depths are shown in **Table 95**. Soil removal for lowland and upland soil would be done in two lifts: 12-inch topsoil and upper subsoil (lift 1), and 12-inch subsoil (lift 2). Tree soil would be removed in one 24-inch lift. Soil removal would be accomplished by scrapers, dozers or other excavators; and front-end loaders, loading shovels, and other loading equipment would load articulated dump-trucks that would transport and deposit the soil on graded areas or in soil-storage areas. Other mobile equipment including, but not limited to, trackhoes, blades, and haul equipment (bottom and/or end-dump) may also be used to assist in the operation (see **Section 2.4.3.2, [Equipment]**). To ensure that soil is salvaged to an appropriate depth, Western Energy would stake out small areas within the soil-salvage area and observe soil-salvage edges.

Table 95. Soil Salvage Classes and Depths.

Soil Salvage Class	Generalized Soil Map Units Included	Soil Salvage Depths Current Protocol – Proposed Action
Lowland Soil	• Very deep fine-textured drainage soil (Soil Map Unit 500)	Salvage depth = 12 inches in lift 1 (topsoil/upper subsoil); 12 inches in lift 2 (subsoil)
Upland Soil	• Very deep, fine-textured soil of gently sloping uplands (Soil Map Unit 300) • A portion of the coarse-textured soil of gently sloping uplands (Soil Map Unit 100)	Salvage depth = 12 inches in lift 1 (topsoil/upper subsoil); 12 inches in lift 2 (subsoil)
Tree Soil	• Shallow upland soil (Soil Map Unit 100) • Very deep residual soil of uplands (Soil Map Unit 200) • Most soil map units of the coarse-textured soil of gently sloping uplands (Soil Map Unit 400)	Salvage depth up to 24 inches in lift 1

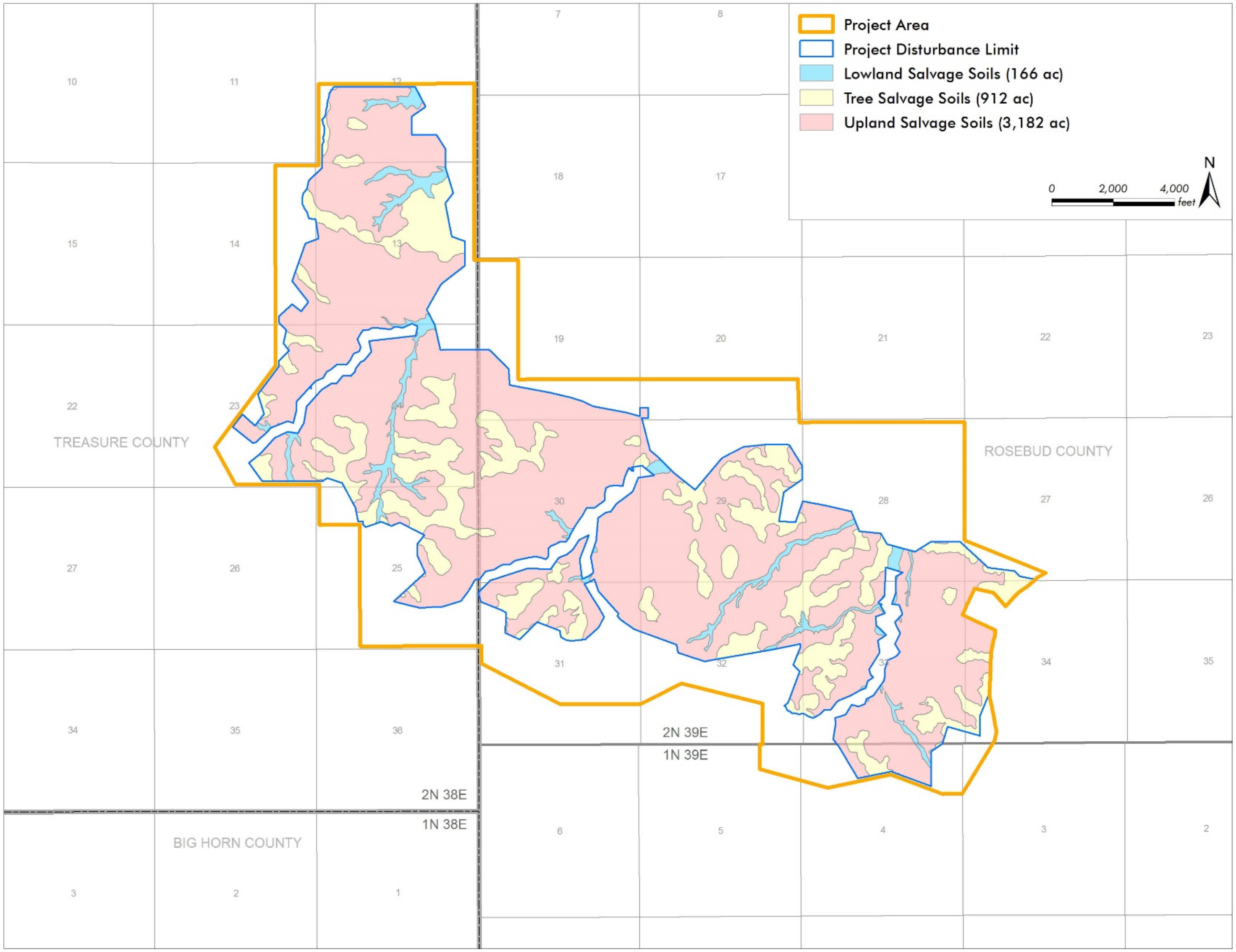

Figure 69. Soil Salvage Classes.

3.25 Resources Considered but Dismissed

As noted in the Chapter 3 introduction, the resources chosen for detailed analysis in this EIS were identified through internal agency scoping and comments received during public scoping. One resource, alluvial valley floors (AVF), was considered but was dismissed from detailed analysis following DEQ's AVF determination (DEQ 2016a). The following section includes key language from DEQ's AVF determination and identifies reasons for dismissal.

3.25.1 Alluvial Valley Floors Determination

3.25.1.1 Regulatory Framework

MSUMRA (Sections 82-4-201 through 82-4-254, MCA) and its implementing rules (ARM 17.24.301 through ARM 17.24.1309) set forth the process for identifying an AVF located in the arid and semi-arid lands of Montana (see specifically Section 82-4-227(3)(b)(i), MCA, and ARM 17.24.301, ARM 17.24.325, and ARM 17.24.805). Any mine proposal or mine-related disturbance within a valley holding a stream, or adjacent to and connected to a valley holding a stream, must have an AVF determination. MSUMRA requires protection of identified AVFs from impacts of coal-mining that are adverse to agricultural activities or farming.

An AVF determination consists of three separate evaluations (see ARM 17.24.325). The first evaluation determines the presence and extent or absence of AVFs based on defined criteria. The second evaluation determines the significance of the AVF for adversely affected agricultural or farming operations. The third evaluation determines the essential hydrologic functions of each agriculturally significant AVF. If the first evaluation determines that no AVF is present, then further evaluation is not warranted.

Both geologic and hydrologic criteria must be met to designate an AVF. The key to the existence of an AVF is the presence of both geomorphic characteristics and water availability for agricultural activities or farming (this concept is explained in detail in DEQ 2016a).

3.25.1.2 Definition of Alluvial Valley Floors

MSUMRA provides a definition of AVFs in Section 82-4-203(3)(a), MCA: "the unconsolidated stream-laid deposits holding streams where water availability is sufficient for subirrigation or flood irrigation agricultural activities." S

The definition of AVF is further clarified in MSUMRA's implementing rules as "unconsolidated stream-laid deposits holding streams" as "all flood plains and terraces located in the lower portions of valleys which contain perennial or other streams with channels" (ARM 17.24.301(132).

Finally stream valleys "adjacent" to proposed mining operations must be evaluated for the presence or absence of AVFs. "Adjacent" is also a defined term under MSUMRA and means in pertinent part, "the area outside the permit area where a resource or resources, determined in the context in which the term is used, are or could reasonably be expected to be adversely affected by proposed mining operations[.]" 82-4-203(2), MCA.

3.25.1.3 Reason for Dismissal

DEQ reviewed the geology, hydrology, and agricultural practices of the project area drainages with respect to AVFs and determined (DEQ 2016a) that there are no AVFs present in, or adjacent to, the project area. DEQ stated:

> An AVF is defined by having unconsolidated stream-laid deposits which are either flood or subirrigated. As described above, this is not evident within the Area F application area or on adjacent properties. This is based on the evidence below:
>
> - Unconsolidated deposits are confined to the active channels of primary drainages.
> - There is no current or historic evidence of flood irrigation.
> - There is no persistent or predictable surface water to support flood irrigation.
> - Subirrigation is confined to small wetland areas and does not enhance crop production in agriculture lands.

Based on DEQ's determination, the agencies concluded that no additional analysis was needed in the EIS and AVFs were dismissed from further consideration. This dismissal is in keeping with NEPA (40 CFR 1500.1(b)), which states that "NEPA documents must concentrate on the issues that are truly significant to the action in question, rather than amassing needless detail."

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CHAPTER 4. ENVIRONMENTAL CONSEQUENCES (DIRECT AND INDIRECT IMPACTS)

4.1 INTRODUCTION

This chapter discloses and analyzes the environmental effects that may result from selection and implementation of the Proposed Action and alternatives described in **Chapter 2** of this Environmental Impact Statement (EIS); these effects are presented in a summary table in **Section 2.7, Summary of Impacts and Identification of Preferred Alternative**. Cumulative impacts are discussed in **Chapter 5**. The Montana Environmental Policy Act (MEPA) and National Environmental Policy Act (NEPA) (described in Chapter 1) require state and federal agencies, respectively, to examine and disclose to the public the potential impacts on the human environment of proposed projects or activities that require state or federal approval.

Impacts were analyzed by considering the effect of an action on each of the 23 resources identified during public and agency scoping (see **Section 3.1, Introduction**). Overall, the Montana Department of Environmental Quality (DEQ) and Office of Surface Mining Reclamation and Enforcement (OSMRE) based these impact analyses and conclusions on the review of existing literature and studies, information provided by resource specialists and other agencies, professional judgment, agency staff insights, and public input; resource-specific analysis methodologies are provided in the introductions to each resource section.

In this EIS, an environmental impact or effect is any change from the present condition of any resource or issue that may result as a consequence of implementation of the No Action (Alternative 1), the Proposed Action (Alternative 2), or the Proposed Action Plus Environmental Protection Measures (Alternative 3) alternatives. The terms "effect" and "impact" are used interchangeably and synonymously in the EIS text. Definitions used to describe impacts/effects are listed below.

4.1.1 Definitions

The following terms were used in this EIS to describe the nature of impacts associated with each alternative. These definitions were formulated through the review of existing laws (such as MEPA and NEPA), policies, and guidelines, and with assistance from resource specialists. Although state and federal definitions are similar, MEPA definitions tend to be narrower in their scope than those used for NEPA. Because this is a joint EIS, the most inclusive definitions were used in the analyses.

Direct, Indirect, and Cumulative Impacts: Impacts can be direct, indirect, or cumulative.

Direct impacts are caused by an action and occur at the same time and place as the action; direct impacts are considered in this chapter.

Indirect impacts under NEPA are caused by the action and occur later in time or farther away in distance but are still reasonably foreseeable. Secondary impacts under MEPA are similar to indirect impacts under NEPA but are defined as "a further impact to the human environment that may be stimulated or induced by or otherwise result from a direct impact of the action" in ARM 17.4.603(18). Under MEPA, secondary impacts flow from a direct impact of an action, not from the action itself. For purposes of this joint EIS, the NEPA definition of indirect impacts was used. Indirect impacts also are considered in the analyses in this chapter.

Cumulative impacts under NEPA are the incremental impacts of the action when added to other past, present, and reasonably foreseeable future actions. Under MEPA, cumulative impacts are the "collective impacts on the human environment of the proposed action when considered in conjunction with other past and present actions related to the proposed action by location or generic type. Related future actions must also be considered when these actions are under concurrent consideration by any state agency through pre-impact statement studies, separate impact statement evaluation, or permit processing procedures per ARM 17.4.603(7). For purposes of this joint EIS, the NEPA definition of cumulative impacts was used. Cumulative impacts are disclosed in **Chapter 5**.

Duration: For this EIS, impact duration is described as short-term or long-term; generally, these are defined as follows (exceptions occur for Cultural and Historic Resources, Geology, and Paleontology):

- Short-term impact/effect – a change that within a short period would no longer be detectable as the resource is returned to its pre-mine condition, appearance, or use. In this EIS a "short period" is defined as the length of the Area F bond liability period (see **Chapter 1** for a description of the bond liability period).
- Long-term impact/effect – a change in a resource or its condition that does not immediately return the resource to pre-mine condition, appearance, or productivity; long-term impacts would apply to changes in condition that continue beyond the bond liability period but would be expected to eventually return to pre-mine condition, or would meet SMCRA or MSUMRA requirements.

Impact Intensity and Thresholds of Change: Intensity of impacts and the thresholds of change for the intensity of impacts vary by resource and are defined in a table at the beginning of each resource section. There may be no impact, adverse impacts, or beneficial impacts (defined below). In general, the intensity of adverse and beneficial impacts may be negligible, minor, moderate, or major. The thresholds of change for the intensity of impacts are also defined differently for each resource in this EIS. Before reading the effects analysis for a particular resource, please review the "Impact and Intensity Thresholds" table at the beginning of that resource section.

Type: Impacts can be beneficial or adverse. Beneficial impacts are those that create a positive change in the condition or appearance of the resource or a change that moves the resource toward a desired condition. Adverse impacts are those that move the resource away from a desired condition or detract from its appearance or condition.

4.1.2 Organization of This Chapter and Individual Resource Sections

As noted above, each of the 23 resource sections begins with a table of impact and intensity thresholds that provides resource-specific definitions for the analysis. The impact analysis is broken down by alternative (in numerical order), including direct and indirect impacts. The final section in this chapter provides an analysis of regulatory restrictions. MEPA, at 75-1-201(1)(b)(iv)(D), Montana Code Annotated (MCA), requires state agencies to evaluate any regulatory restrictions (e.g., extra costs to the proponent or a taking of private property) proposed to be imposed on private-property rights as part of a state action—in this case, a permit decision. The discussion of regulatory restrictions is limited to the conditions or mitigations that would be required of Western Energy if Alternative 3 is the agencies' selected alternative for implementation by Western Energy.

4.2 TOPOGRAPHY

This section discloses the direct and indirect effects on topography resulting from the No Action (Alternative 1), the Proposed Action (Alternative 2), and the Proposed Action Plus Environmental Protection Measures (Alternative 3); cumulative impacts are disclosed in **Chapter 5**. The analysis area is described in **Section 3. 2, Topography**. **Section 2.4.4, Reclamation Plan** describes how reclamation would be implemented for the Proposed Action; **Section 2.5.2.3, Reclamation** describes how reclamation would differ under Alternative 3.

4.2.1 Analysis Methods and Impact and Intensity Thresholds

4.2.1.1 Analysis Methods

Impacts on topography were determined based on the information contained in the PAP. The PAP provided details concerning reclamation activities and changes in topography related to proposed mining and reclamation actions.

4.2.1.2 Impact and Intensity Thresholds

The thresholds for assessment of impacts on topography are described in **Table 96**. Impacts are discussed in the sections below.

Table 96. Topography Impact and Intensity Thresholds.

Impact Intensity	Intensity Description
Negligible	The action would result in a change to topography, but the change would be so small that it would not be of any measurable or perceptible consequence.
Minor	The action would result in a change to topography, but the change would be small, localized, and of little consequence.
Moderate	The action would result in a noticeable change to topography; the change would be measurable and of consequence.
Major	The action would result in an extensive change to topography; the change would be measurable and result in a severe adverse impact.

Impacts are also defined as short-term, long-term, or both (see **Section 4.1.1, Definitions**).

4.2.2 Alternative 1 – No Action

Under the No Action alternative, Western Energy would not develop the project area. There would be no impact on topography (described in **Section 3.2**) because changes associated with development of the project would not occur.

The No Action alternative would not change the status of other areas of the Rosebud Mine that are currently permitted and being mined and/or reclaimed by Western Energy (see **Section 2.2, Existing Operations**) nor would it affect development of any other proposed Rosebud Mine areas currently in the permitting process (see **Section 5.2.2, Related Future Actions**).

4.2.3 Alternative 2 – Proposed Action

4.2.3.1 Direct Impacts

Under the Proposed Action, the postmine landscape of the analysis area would be restored following mining operations to the approximate original contour to facilitate postmine land uses. The postmine topography (PMT) that Western Energy proposes to meet at final bond release is shown in (**Figure 9**). The PMT shows the general topography (ridges, drainages, slopes, etc.) that would serve as Western Energy's grading template for matching the pre-mine topography, which is described in **Section 3.2, Topography** (**Figure 13**).

During operations, Western Energy would provide DEQ with an updated topographic map of all existing areas being graded. The topographic map would show the amount of pit advance and the actual graded contours. This map would be included in Western Energy's Annual Report for the project. During the final phases of spoil grading, surface drainages would be reconstructed to the approved approximate PMT. Cross-sections would be utilized to evaluate the blending of undisturbed terrain and disturbed ground to provide a smooth and stable transition in the topography.

Two postmine feature types, rock piles and cliffs, would be designed to mitigate the loss of sandstone outcrops and cliffs/bluffs that are common feature types on the pre-mine landscape. Highwall-reduction alternatives may be considered for replacement of bluff features that existed before mining. Sandstone cliff features may be created with DEQ approval in lieu of highwall reduction. Sandstone rock piles would be created and opportunistically placed on upland situations, ridges, hilltops, and sideslopes in the analysis area. With concurrence of DEQ, rocks and boulders may be placed on native areas within the permitted disturbance limits. Western Energy would demonstrate both slope stability and replacement of pre-mine features during the permitting process for each of these features.

Drainage-basin design would be based on pre-mine conditions. With the exception of haul-road crossings, Western Energy proposes to leave the main channels of Black Hank, Donley, McClure, and Robbie Creeks undisturbed. Reclaimed drainage basins—valleys, channels, streams (perennial, intermittent, ephemeral), and floodplains—would be constructed to meet approved PMT and approximate original contours, and to enable the drainage channels to remain in dynamic equilibrium with the drainage basin system. **Figure 13** presents the pre-mine topography with drainage divides. A pre-mine and postmine comparative analysis of geomorphic characteristics of the analysis area would be used to determine reclamation recontouring and drainage (see PAP, Appendix J, Table J-2). Aerial and ground surveys also would be utilized to evaluate other drainage characteristics, such as channel profiles, drainage patterns, and separation of flow between adjacent drainages. The pre-mine survey would also ensure that drainages and slope contours are designed and constructed consistent with the approved PMT.

During final grading, Western Energy may be able to incorporate additional drainage features to more closely approximate original contours and avoid geomorphic problems including long uniform slopes, inappropriate channel or slope profiles, or inadequate drainage density. Examples of some of the diversity features that Western Energy may be able to include during final grading include additional tributaries, over-steep slopes of various exposures in headwater locations, incised tributary or dry-wash areas, complex side slopes, small anomalies (i.e., hogbacks and knolls), and scoria pits. These features are not shown on **Figure 13**, but probable locations are shown on Exhibit B of the PAP. Impacts on topography would occur on 4,260 acres of previously undisturbed land within the analysis area. During operations, mining within Area F would lower the surface elevation resulting in a steep topographic gradient toward the open pit. Areas of soil and overburden piles would result in an increase in surface elevation where these piles were stored. The impacts on topography during mining would be noticeable within the analysis area and would result in short-term major adverse impacts on topography.

In the short term following reclamation, the impacts from erosion on topography would be minor, and the surface topography of the analysis area would resemble that of the PMT initially contoured following mining activities.

4.2.3.2 Indirect Impacts

The Proposed Action would mix geologically distinct layers into spoil consisting of fragments of sandstone, siltstone, mudstone, and claystone in the analysis area. The resulting fine-grained sediment generated due to the breakdown of these stones into fragments would result in a well-graded mixture of lithified and non-lithified material comprising the material used to backfill the analysis area. Indirect long-term minor adverse impacts on topography from differential erosion of the spoil would include the preferential erosion of the softer stone fragments and non-lithified sediment relative to the harder stone fragments. This would occur first within the created areas of drainage within the backfill and then extend out to the hillsides over time. The initial impact on topography would be the creation of a hummocky terrain with fragments of more resistant stone scattered throughout the analysis area. This topographic terrain would persist until the erosion of the backfilled material was complete.

Because drainage basins would not be mined, unaltered competent geologic layers of lithified material would be located in proximity to softer backfilled material in the areas where the coal was mined and backfilled with material softer in competency. Long-term differential erosion of these two dissimilar materials over an unknown geologic time would likely result in the topographic inversion of the area: the undisturbed drainage valleys would become buttes over time as the backfill would erode more easily. This would represent a long-term major adverse impact that would be measurable but would have a relatively minor impact on future users.

4.2.4 Alternative 3 – Proposed Action Plus Environmental Protection Measures

The effects of Alternative 3 on topography in the analysis area would be similar to Alternative 2; however, there would be some differences due to the Alternative 3 requirement to use a different methodology for PMT and drainage-basin design. Alternative 3 environmental protection measures include the following, which are described in **Section 2.5.2.3, Reclamation**: Western Energy would be required to use 5-foot contours to design the PMT for Area F instead of the 10-foot contours used under the Proposed Action.

Western Energy would submit drainage designs for drainages with estimated 2-year, 24-hour peak discharges greater than 5 cfs to DEQ for review and approval.

These changes would improve water management, resulting in the potential decrease in erosion rates in areas of the topography where drainages would develop. Tighter elevation control would help maximize rainfall infiltration and minimize surface water runoff and flow concentration, and thereby provide a more stable land surface. The drainage designs would provide stable channel characteristics in relation to the drainage basin such that over time channel features would be maintained. In the years immediately following reclamation, reduced impacts on topography would be realized with these protection measures relative to Alternative 2. In the long term, the impacts on topography would be the same for both Alternatives 2 and 3, as erosional forces would equilibrate with the new geologic conditions of Area F.

4.2.5 Irreversible and Irretrievable Commitment of Resources

Alteration of the previously undisturbed pre-mine topography would be an irreversible impact on the area topography. Although the postmine grading of the land surface would closely mimic the pre-mine topography, subtle variations would be noticeable when the pre-mine and postmine topographic maps are compared.

4.3 AIR QUALITY

This section addresses air quality effects from direct and indirect impacts from the Proposed Action and the other two alternatives. Direct impacts are the consequence of emissions from the mining, processing, and handling of project area coal as well as reclamation of the areas disturbed by these actions. Indirect impacts are the result of the combustion of project area coal. Air quality effects were examined for criteria air pollutants, nitrogen and sulfur deposition, visibility impairment, and hazardous air pollutants through a combination of using existing modeling databases and performing new modeling incorporating new information for the project area. Air quality impacts were assessed through comparison with air quality standards and thresholds from national and state regulations or other guidelines by analysis of modeling results and were subsequently classified as negligible, minor, moderate, or major in terms of intensity, short or long term in terms of temporal duration, and beneficial or adverse in terms of the direction of the resulted change.

As discussed below, the air quality impact analysis shows that the direct and indirect effects of the Proposed Action (Alternative 2) have only minor or negligible impacts on air quality and air quality related values, in terms of both direct and indirect impacts on air quality, compared to the relevant regulatory standards and thresholds or guidelines. Because only minor or negligible impacts would result from the Proposed Action and several control measures are already in place or will be implemented in permitting, no additional environmental protection measures are recommended for Alternative 3.

Details of the air quality impact analysis are provided below following a description of the analysis methods.

4.3.1 Analysis Methods and Impact and Intensity Thresholds

4.3.1.1 Analysis Methods

Modeling Approach

Criteria Air Pollutants

The Comprehensive Air Quality Model with Extensions (CAMx) (www.camx.com) was used for air resource impact analysis. CAMx is an advanced photochemical air quality model with a wide range of applications, including rulemaking by the United States Environmental Protection Agency (EPA) (e.g., 2015 ozone National Ambient Air Quality Standards (NAAQS) rulemaking and Cross-State Air Pollution Rule (CSAPR)), Environmental Impact Statements (EIS), State Implementation Plans (SIP), as well as in air quality research by academia. The model is state-of-the-science for air quality analysis and publicly available. In particular, the model is equipped with source attribution technologies, including the Ozone Source Apportionment Technology (OSAT) and the Particulate Source Apportionment Technology (PSAT). These source apportionment techniques in CAMx provide the ability to estimate air quality impacts from direct, indirect, and cumulative effects simultaneously. The CAMx source apportionment tools were used for efficient calculations of air quality impact contributions from different groups of emission sources representing these effects. Details on the CAMx inputs (other than those specified below) and the photochemical model configuration may be found in **Appendix D-7**.

CAMx modeling was conducted with version 6.2 of the model on two rectangular gridded geographical domains at 1 kilometer (km) and 4 km horizontal resolution, respectively. As shown in **Figure 70**, the 1 km resolution domain covers the Rosebud Mine and its vicinity and represents the analysis area for direct impacts on air quality. The focus of the direct effects analysis is the permit boundary and immediate vicinity; the rectangular domain is selected for ease of computer modeling. The 4-km resolution domain covers the larger analysis area for indirect and cumulative impacts (all areas within approximately 300 km of Colstrip Power Plant) (see **Section 3.1, Air Quality**). The rectangular 4 km domain is also selected for ease of modeling and such that Federal Class I areas that intersected the 300-km circle were included in their entirety. Impacts were estimated in these two modeling domains, and in particular, at Class I areas (**Figure 70**). The rationale for the two domains is to simultaneously provide adequate spatial coverage of the indirect/cumulative effects analysis area and relatively high spatial resolution (1 km) for the direct effects analysis area in and around the Rosebud Mine. These domains are within the modeling domain used in the photochemical grid-modeling study previously conducted for the Bureau of Land Management Montana/Dakotas (BLM-MT/DK) State Office (BLM 2016b). That study included an extensive performance evaluation and application with CAMx. This EIS used the same model configuration as the BLM-MT/DK CAMx modeling platform to allow for efficient data usage and ensure the quality of the modeling results. Specifically, meteorological and land-use input data, and initial and boundary conditions (i.e., background concentrations) were extracted from the BLM-MT/DK CAMx modeling. The emissions inventories used are discussed below in this chapter and in **Section 5.3.2, Air Quality**. The plume-in-grid option in CAMx was applied for better characterization of emissions in plumes from point sources in the modeling domains with oxides of nitrogen (NOx) emissions exceeding 1 ton/day. Other input data (photolysis rates, chemical parameters) were prepared using the same processing tools as those used for the BLM-MT/DK CAMx modeling (BLM 2016b).

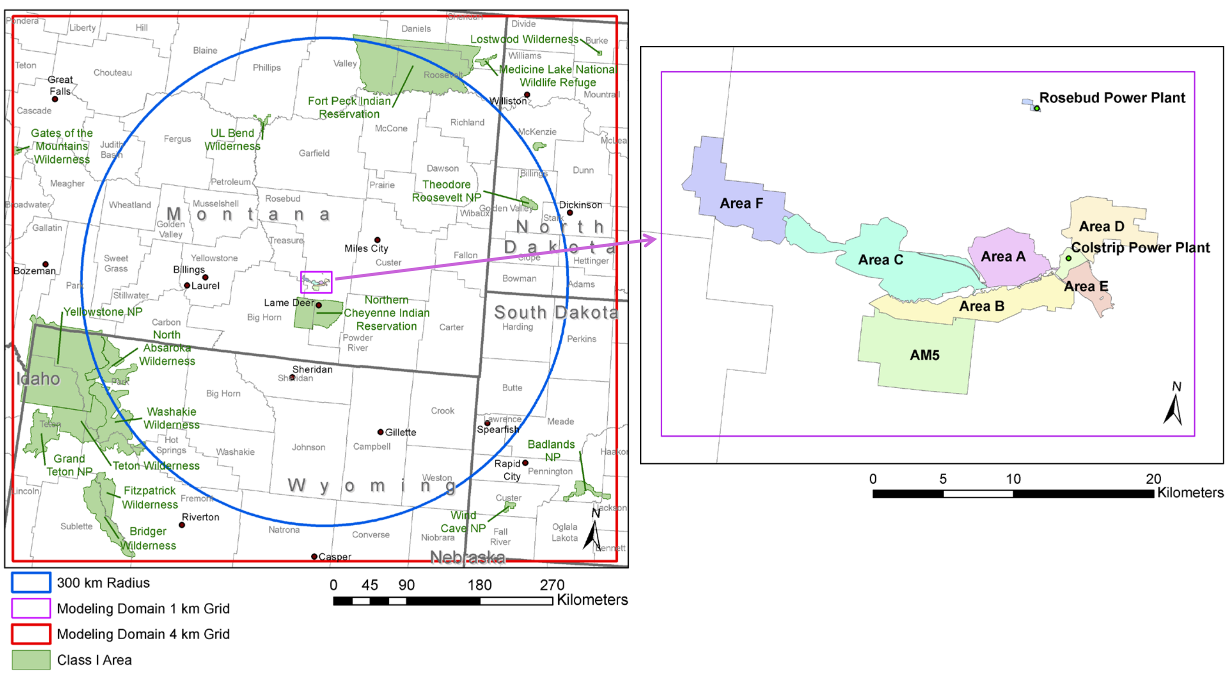


Figure 70. Maps of CAMx Modeling Domains at 4 km (Left) and 1 km (Right) Resolution and Class I Areas.

Table 97 lists the five source groups configured in the CAMx source apportionment modeling. The modeled pollutant concentrations for these five individual source groups and their combinations were used in conjunction with the total modeled values (air concentrations or deposition) to estimate impacts on the criteria air pollutants nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM) with diameter 10 microns or less (PM_{10}), fine PM with diameter 2.5 microns or less ($PM_{2.5}$), and sulfur dioxide (SO_2) and estimate air quality related values (acid deposition and visibility) at Federal and Tribal Class I areas.

Individual source group contributions were not calculated for carbon monoxide (CO) (only cumulative effects were calculated) because CO is not included in the OSAT/PSAT source apportionment technique. Modeling results show that the cumulative impacts for CO are well below the NAAQS and the Montana Ambient Air Quality Standards (MAAQS), as discussed in **Section 5.3.2, Air Quality**. Impacts for lead (Pb) are discussed under hazardous air pollutants.

Table 97. Definitions of Source Groups Used in CAMx Source Apportionment Modeling.

CAMx Source Groups	Definition
Direct	Area F (project area)
Indirect	Colstrip Units 3 and 4, and Rosebud Power Plant
Colstrip 1 and 2	Colstrip Units 1 and 2
AM5	The proposed south extension to Area B (AM5)
Other cumulative (regional) sources	All other cumulative sources in the analysis area including the existing areas of the mine

Hazardous Air Pollutants

The CAMx modeling platform discussed above was also applied to estimate the effects of emissions from the project area, AM5 and other existing mine areas on the concentration and deposition of hazardous air pollutants (HAPs) resulting from fugitive coal dust and concentrations of diesel particulate matter (DPM) exhaust from diesel equipment. Fugitive coal dust and DPM were treated as non-reactive compounds in this modeling. Estimates of HAP emissions from project area fugitive coal dust sources (coal drilling, coal blasting, coal removal, coal truck dump, coal crusher, and coal conveyors) and diesel equipment (haul/water trucks, graders, dozers, and waste coal haul trucks) that would operate in the project area are provided in **Table 101**, and the associated direct effects on air quality are discussed in **Section 4.3.3.1**.

To determine the potential air quality impacts of the indirect effects from hazardous air pollutants, the atmospheric dispersion and deposition of HAPs emitted from Colstrip Units 3 and 4, and Rosebud Power Plant were simulated with the EPA's AERMOD model. Version 16216 of AERMOD was used to model the dispersion and deposition of HAPs emitted from the Colstrip and Rosebud Power Plants from 2011 to 2015. AERMOD is the preferred air dispersion/deposition model recommended by EPA for source to receptor distances less than 50 km. It is the current regulatory near-field dispersion model capable of handling complex source configurations, deposition processes, emission units subject to plume downwash, and the scenarios when emission plumes interact with complex terrain (https://www3.epa.gov/ttn/scram/dispersion_prefrec.htm#aermod). Estimates of HAP emissions from these facilities are provided in **Table 107**, and the indirect effects on air quality are discussed in **Section 4.3.3.2**. A detailed discussion of the methodology and modeling process is provided in the **Supporting Information for Air Quality Impact Analysis for Rosebud Mine Area F DEIS** (**Appendix D-8**).

4.3.1.2 Impact and Intensity Thresholds

The thresholds of change for the intensity of an impact on air quality are defined in **Table 98** and are used to describe the impacts in the sections below.

Table 98. Air Quality Impact and Intensity.

Impact Intensity	Intensity Description
Negligible	Any effect on air quality would be slight or not perceptible.
Minor	The effects on air quality would be detectable. The effects would not cause an exceedance of air quality standards and the effects would change air quality in a relatively small portion of the analysis area.
Moderate	The effects would cause an exceedance of air quality standards but would be restricted to a relatively small portion of the analysis area.
Major	The effects would result in substantial impacts to air quality that would be readily apparent with exceedance of air quality standards over a large portion of the analysis area.

Impacts are also defined as short-term, long-term, or both. Also, as noted under **Section 4.1.1, Definitions**, impacts can be beneficial or adverse. Beneficial impacts are those that create a positive change in air quality or a change that moves air quality toward a desired condition. Adverse impacts are those that move air quality away from a desired condition or detract from its condition.

4.3.2 Alternative 1 – No Action

Under the No Action alternative, Western Energy would not develop the project area, and the conditions described in **Section 3.1, Air Quality** would continue into the foreseeable future. Selection of this alternative would not necessarily lead to mine closure. Areas A, B, and C are still actively mined (see **Section 2.2.2, Existing Operating Permits, Disturbance, and Reclamation**). In addition, Western Energy is currently in the process of applying to modify the Area B permit to include a 9,000-acre Area B South Extension (AM5). If approved, AM5 would be mined until 2043 (see **Section 5.2.2, Reasonably Foreseeable Future Actions**). The potential future emissions and impacts resulting from the existing areas of the mine and AM5 are discussed under **Section 5.3.2, Air Quality** conservatively accounting for the maximum projected annual coal production for each area. Numerous regional emission sources will continue to operate under the No Action alternative. The potential future emissions and impacts due to these sources are examined under **Other Regional Emissions** in **Section 5.3.2, Air Quality**.

The No Action alternative would not result in any change in emissions or air quality impacts in the analysis area. In the No Action alternative, it is assumed that the Colstrip and Rosebud Power Plants will continue to operate. The potential future emissions and impacts on ambient air concentrations, deposition, and visibility impairment resulting from Colstrip Units 3 and 4 and the Rosebud Power plant are discussed in **Section 4.3.3.2, Indirect Impacts of Coal Combustion**. The potential future emissions and impacts resulting from Colstrip Units 1 and 2 through their retirement in July 2022 are discussed in the context of other cumulative sources in **Section 5.3.2, Air Quality**. Potential visibility impairment is discussed in the context of the Proposed Action (see **Section 4.3.3.1, Visibility Impairment**).

4.3.3 Alternative 2 – Proposed Action

The direct impacts of the Proposed Action as well as indirect impacts due to coal combustion are disclosed below. As shown below, the direct and indirect components of the Proposed Action have only a minor or negligible impact on air quality and air quality related values.

4.3.3.1 Direct Impacts

If approved, the project area would extend the lifetime and total disturbance area of the Rosebud Mine but would not increase annual coal production. Instead project area coal would reduce the rate at which coal is mined in the existing mine permit areas (**Section 1.3, Purpose, Need, and Benefits** and **Section 2.4.1, Permit and Disturbance Areas**) and would utilize existing mine operations and support facilities

(**Section 2.2.1**). Inclusion of the project area would require a modification of the existing air quality permit for Area C (MAQP #1570-06); DEQ has issued a preliminary determination (PD) for the modification to include Area F (MAQP #1570-07). Additional emissions would result from the longer hauling distances between the project area and the coal processing facilities in Area C. Note that MAQP #1570-08 is the current permit for Area C, but does not include the project area. Under MAQP #1570-07, Western Energy would be limited to an annual coal production limit of 4 million tons per year for the project area and a total of 8 million tons per year in combined production for Area C and project area.

The direct air quality impacts of the Proposed Action would be a consequence of the emissions from the mining, processing, and handling of project area coal as well as reclamation of the areas disturbed by these actions. The sources of air pollution include fugitive dust sources (i.e., topsoil removal and unloading; overburden drilling, blasting, and removal; coal drilling, blasting, removal, loading, dumping, crushing, conveying; haul and access roads; and wind erosion of disturbed areas), mobile sources (i.e., haul/water trucks, graders, dozers, and waste coal hauling to the Rosebud Power Plant), portable/stationary engines, and explosive use for overburden and coal blasting.

The potential-to-emit (PTE) of each source from existing operations in Area C and the additional PTE for the additional hauling from the project area had been previously quantified (Bison Engineering 2013a, 2013b) by using the combined coal production limit of both areas and activity data from the year of highest coal production, 2008. The maximum additional haul road distance (approximately 5 miles or 8 km) was conservatively used in estimating the additional project area emissions from hauling. The existing PTE from Area C and additional PTE from the project area previously quantified are utilized below for estimating emissions of criteria and hazardous air pollutants attributable to the direct impacts of the Proposed Action.

Projections of future annual coal production from the project area and the other areas of the mine are shown in **Table 99**.

Table 99. Projected Annual Coal Production for Rosebud Mine by Area[1].

Year	Projected Annual Coal Production (tons / year)			
	Areas A + B[2]	Area C[3]	Area F	AM5
2018	2,466,100	3,483,050	4,000,000	--
2019	2,574,300	3,483,050	4,000,000	--
2020	2,468,700	2,786,440	4,000,000	1,393,220
2021	2,516,300	2,786,440	4,000,000	1,393,220
2022	1,217,300	1,741,525	4,000,000	1,741,525
2023	--	1,741,525	4,000,000	1,741,525
2024	--	1,741,525	4,000,000	1,741,525
2025	--	766,271	4,000,000	3,483,050
2026	--	--	4,000,000	4,876,270
2027	--	--	4,000,000	4,876,270
2028	--	--	4,000,000	4,876,270
2029	--	--	4,000,000	4,876,270
2030	--	--	3,250,000	4,876,270
2031	--	--	3,250,000	4,876,270

Source: Email communications from Western Energy Company on June 19, 2017.
[1]Coal production will continue beyond 2031 but annual production rates would be less than or equal to the production rates shown for 2031.
[2]Includes coal production from AM4, BX, and Area B BLM Lease Modification.
[3]Includes coal production from Area C BLM Lease Modification.

Project Area Criteria Air Pollutant Emissions

To estimate project area emissions, the existing source-specific PTE from Area C was apportioned using the ratio of the maximum projected annual coal production of the project area (4 million tons/year) to the coal production limit for both areas (8 million tons/year). The calculated fraction of existing PTE attributable to the project area was then added to the total additional emissions from hauling to estimate total air emissions associated with the direct effects of the Proposed Action. The estimated PTE does not include emissions from the hauling of waste coal to the Rosebud Power Plant. Therefore, these emissions were estimated using the EPA Motor Vehicle Emissions Simulator (MOVES) model (www.epa.gov/moves) with vehicle data provided by Western Energy (provided in the **Supporting Information for Air Quality Impact Analysis for Rosebud Mine Area F DEIS** in **Appendix D-8**). All of these emissions from waste coal hauling were attributed to the project area. Thus, in addition to emissions occurring within the geographic extent of the project area, other emissions occurring outside the project area that were due to the project area operations were also attributed to the Proposed Action. The resulting project area emission inventory is provided in **Table 100**.

Emissions were temporally allocated using source-specific operating times provided by Western Energy. For example, most of the active mining sources related to topsoil, overburden, and coal removal and handling were allocated to the operating hours of the mine (6:00 AM – 4:30 PM, 6:00 PM – 4:30 AM; 5 days per week; 12 months per year). Fugitive dust emissions were modeled with a flat temporal profile. Details on the temporal allocation of emission sources can be found in the **Supporting Information for Air Quality Impact Analysis for Rosebud Mine Area F DEIS** in **Appendix D-8**.

Project area sources were spatially allocated to the geographical extent of the areas in which the emissions could occur. For example, coal blasting emissions were allocated to the proposed mine passes in the project area while haul road emissions were allocated to the haul roads between the project area and the truck dump in Area C. Emissions that could occur throughout the disturbance boundary (e.g., wind erosion) were spatially allocated throughout the extent of the project area disturbance limit (Western Energy 2017). Details on the spatial allocation of emission sources can be found in the **Supporting Information for Air Quality Impact Analysis for Rosebud Mine Area F DEIS** in **Appendix D-8**.

Table 100. Estimated Emissions due to Project Area.

Emission Source(s)	PM_{10}	$PM_{2.5}$	NOx	CO	SO_2	VOC
	(tons / year)					
Topsoil Removal	18.73	1.87	--	--	--	--
Topsoil Dumping	0.68	0.10	--	--	--	--
Overburden Drilling	0.26	0.03	--	--	--	--
Overburden Blasting - Cast Blasting	28.85	1.66	--	--	--	--
Overburden Removal by Dragline	60.11	5.30	--	--	--	--
Overburden Handling by Truck/Shovel	94.08	2.37	--	--	--	--
Overburden Dumping	0.68	0.10	--	--	--	--
Overburden Handling by Dozer	9.28	5.13	--	--	--	--
Haul Roads – Travel	196.01	19.48	--	--	--	--
Access Roads – Unpaved	60.56	6.06	--	--	--	--
Coal Drilling	0.05	0.00	--	--	--	--
Coal Blasting	10.57	0.61	--	--	--	--
Coal Removal	0.06	0.01	--	--	--	--
Mobile Sources Diesel Exhaust - Haul/Water Trucks	9.12	9.12	235.56	56.78	0.29	14.97
Mobile Sources Diesel Exhaust – Grader	0.06	0.06	0.96	0.33	0.00	0.08
Mobile Sources Diesel Exhaust – Dozers	3.53	3.41	78.99	22.91	0.08	5.26
Explosives	--	--	73.21	288.52	8.61	--
Disturbed Acres - Complete (< 2 Yr.)	9.95	0.99	--	--	--	--
Disturbed Acres - Complete (> 2 Yr.)	0.00	0.00	--	--	--	--
Disturbed Acres – Facilities	0.00	0.00	--	--	--	--
Disturbed Acres - Partial (< 1 Yr.)	33.52	3.35	--	--	--	--
Disturbed Acres - Partial (> 1 Yr.)	29.88	2.99	--	--	--	--
Disturbed Acres - Pits, Peaks, Soil Stripping	266.53	26.65	--	--	--	--
Portable/Stationary Equipment - Gasoline Engines	0.25	0.25	4.08	2.48	0.21	7.58
Waste coal hauling to Rosebud Power Plant	0.26	0.22	6.30	1.73	0.00	0.30
Truck Dump – Coal	0.05	0.01	--	--	--	--
Coal Crushing	0.12	0.01	--	--	--	--
Coal Conveyors	0.02	0.00	--	--	--	--
Total	**833.19**	**89.80**	**399.09**	**372.75**	**9.19**	**28.19**

Project Area Hazardous Air Pollutant Emissions

The project area would also be a source of HAPs. Raw coal contains a large number of HAPs and the mining, processing, and handling of project area coal would result in the emission of the HAP-containing fugitive coal dust. In addition, the use of diesel equipment throughout the project area and the associated support facilities would result in the emission of DPM. DPM is not currently regulated by the EPA, but is considered a carcinogenic air toxic (EPA 2002).

Coal fugitive dust sources due to the Proposed Action include coal drilling, coal blasting, coal removal, coal truck dump, coal crushing and coal conveyors. Potential project area HAP emissions from fugitive coal dust were quantified as the product of project area PM_{10} emissions from these sources and the average concentration of HAPs in project area coal across thirteen samples (PPL Montana 2014) (see **Appendix D-8**). The estimated HAP emissions from fugitive coal dust are shown in **Table 101**. More than 97 percent of fugitive coal dust emissions from the project area are the result of coal blasting, which occurs within the active mining passes.

Table 101. Project Area Trace Metal HAP Emissions from Fugitive Coal Dust.

Metal HAP	Concentration in Project Area Coal[1] (ppm)	HAP Emissions (lb / year)
Antimony	0.30	6.52E-03
Arsenic	0.72	1.56E-02
Beryllium	0.28	6.08E-03
Cadmium	0.04	8.69E-04
Chromium	2.56	5.56E-02
Copper	5.05	1.10E-01
Lead	3.75	8.15E-02
Manganese	70.59	1.53E+00
Mercury	0.03	5.68E-04
Nickel	0.91	1.98E-02
Selenium	0.55	1.20E-02

ppm = parts per million.
lb/year = pound(s) per year.
[1]HAP concentration is the moisture-corrected average value from 13 samples of project area coal.

All fine particulate matter emissions ($PM_{2.5}$) from diesel sources (i.e., haul/water trucks, graders, dozers, and waste coal haul trucks) were considered to be DPM. The potential project area DPM emissions are provided in **Table 102**. Haul/water trucks, which operate on the haul roads between the project area and the coal processing facilities in Area C, contribute to the majority of project area DPM emissions.

Table 102. Potential Project Area Diesel Particulate Matter (DPM) Emissions.

Emission Source(s)	DPM[1] (tons / year)
Mobile Sources Diesel Exhaust - Haul/Water Trucks	9.12
Mobile Sources Diesel Exhaust - Grader	0.06
Mobile Sources Diesel Exhaust - Dozer	3.41
Waste coal hauling to Rosebud Power Plant	0.22
Total Project Area DPM	**12.81**

[1]Project area DPM estimates are conservative because the maximum distance between project area and coal processing facilities in Area C was used in calculating additional hauling emissions.

Air Concentrations and Related Values

Criteria Air Pollutants and Precursors

The direct impacts of the project area on criteria air pollutants are described below.

Figure 71 through **Figure 76** display the spatial distribution of direct impacts on NO_2, O_3, $PM_{2.5}$, PM_{10} and SO_2 in the analysis area for direct impacts (1 km resolution modeling domain) in terms of metrics included in the NAAQS and MAAQS. The 4 km domain spatial patterns are shown only for comparison.

The direct impacts on NO_2 (**Figure 71**) are mostly within or adjacent to the Rosebud Mine. The maximum values in the analysis area of the 8th highest 1-hour daily maximum NO_2 and annual average NO_2 concentrations are 39.4 and 2.5 ppb, respectively, both within the project area. Impacts are further lower (1-hr and annual concentrations less than 30 and 1.6 ppb, respectively) outside the proposed project area where the public would typically have access. The direct impacts on O_3 (**Figure 72**) are mostly seen in Rosebud, Custer, Treasure, and Bighorn Counties. The spatial maxima within the analysis area of the 2nd highest 1-hour and 4th highest 8-hour O_3 are 3.1 ppb and 1.6 ppb, respectively, and occur south of the project area. Impacts are further lower in areas in the analysis area that are outside the project area.

Project area impacts on NO_2 and O_3 concentrations in the analysis area are well below the NAAQS and MAAQS (provided in **Section 3.3.1.1**, **Ambient Air Quality Standards**). Although the form of the MAAQS for 1-hour NO_2 is different from that of the NAAQS, the MAAQS is three times that of the NAAQS (300 ppb vs. 100 ppb), so impacts much lower than the NAAQS would also imply compliance with the MAAQS. As noted under **Section 5.3.2.2, Cumulative Impacts on Air Quality**, NO_2 and O_3 concentrations due to all cumulative sources in the analysis area are below the NAAQS and MAAQS. Thus, direct impacts for NO_2 and O_3 in the analysis area under the Proposed Action alternative would be short-term, minor, and adverse.

Direct impacts on $PM_{2.5}$ and PM_{10} air concentrations are within or near the Rosebud Mine. The spatial peaks of the 8th highest daily average $PM_{2.5}$ and the annual average $PM_{2.5}$ (**Figure 73**) are 6.0 µg/m^3 and 1.8 µg/m^3, respectively. Both of these peaks occur within the project area. When considering areas outside the project area, the corresponding concentrations are typically less than 3.7 µg/m^3 and 1.0 µg/m^3, respectively, and drop further with distance from the project area. The spatial maxima of the 2nd highest daily average and annual average PM_{10} due to direct impacts (**Figure 74**) are 54.1 µg/m^3 and 15.9 µg/m^3, respectively, both occurring again within the project area. Outside the project area, the corresponding concentrations are typically less than 29 µg/m^3 and 9 µg/m^3, respectively, and drop further with distance. Concentrations of $PM_{2.5}$ and PM_{10} modeled and reported here include both primary emitted PM and secondary formation of PM from emissions of NOx, VOC, and SO_2.

Project area impacts on $PM_{2.5}$ and PM_{10} concentrations are well below the NAAQS and MAAQS. Thus, current compliance of the mine with the NAAQS and MAAQS determined from ambient air monitoring (**Section 3.3.3, Air Quality Monitoring at Rosebud Mine**) is expected to continue with project area operations. Direct impacts for $PM_{2.5}$ and PM_{10} in the analysis area under the Proposed Action would be short-term, minor, and adverse. Background concentrations due to other sources are considered in the context of cumulative effects (**Section 5.3.2.2, Cumulative Impacts on Air Quality**).

The maximum values in the analysis area of direct contributions to the 4th highest 1-hour and 2nd highest 3-hour SO_2 are 13.3 ppb and 7.0 ppb, respectively (**Figure 75**). The maximum values for 2nd highest 24-hour SO_2 and annual average SO_2 are both less than 0.1 ppb (**Figure 76**). The SO_2 concentrations are well below the NAAQS and MAAQS, including the forms of the standard (24-hr and annual) where the MAAQS is more stringent than the NAAQS. Background concentrations due to other sources are considered in the context of cumulative effects (**Section 5.3.2.2, Cumulative Impacts on Air Quality**). Direct impacts for SO_2 in the analysis area under the Proposed Action would be short-term, minor, and adverse.

The negligible contributions of direct impacts on areas currently designated as non-attainment/ maintenance for SO_2 and PM_{10} in Montana, and for PM_{10} and O_3 in Wyoming are documented in **Section 5.3.2.2, Cumulative Impacts on Air Quality**.

Impacts for CO are discussed in **Section 5.3.2.2, Cumulative Impacts on Air Quality**; modeling results show that the cumulative effects for CO after considering all sources including direct, indirect, and other sources are well below the NAAQS and the MAAQS. Thus, direct impacts for CO would be short-term, minor, and adverse.

Impacts on Pb are discussed under hazardous air pollutants below.

The project area is expected to have minimal impact on or is not relevant to the MAAQS for settleable PM, hydrogen sulfide, fluoride in forage, and visibility for the reasons provided below.

The Montana Settleable PM standard was designed for much larger particles than those covered under the federal NAAQS for PM_{10} and $PM_{2.5}$. Montana utilizes a number of measures through permitting and enforcement that serve to provide reasonable precautions against excess PM generation. ARM 17.8.308 includes, but is not limited to, the following requirements: (1) No person shall cause or authorize the production, handling, transportation, or storage of any material unless reasonable precautions to control emissions of airborne particulate matter are taken. Such emissions of airborne particulate matter from any stationary source shall not exhibit an opacity of 20 percent or greater averaged over six consecutive minutes, except for emission of airborne particulate matter originating from any transfer ladle or operation engaged in the transfer of molten metal which was installed or operating prior to November 23, 1968. (2) No person shall cause or authorize the use of any street, road, or parking lot without taking reasonable precautions to control emissions of airborne PM. These measures would also be applicable to the project area. In addition, when Montana PM, $PM_{10,}$ and $PM_{2.5}$ sources trigger permitting, they must go through a BACT analysis and controls that, while reducing PM_{10} and $PM_{2.5}$ would also provide total PM reductions.

Hydrogen sulfide and fluoride emissions are negligible from the project area.

The Montana visibility standard is applicable only to Class I areas. Visibility impairment due to direct impacts at Federal and Tribal Class I areas is shown to be negligible in the Air Quality Related Values discussion below.

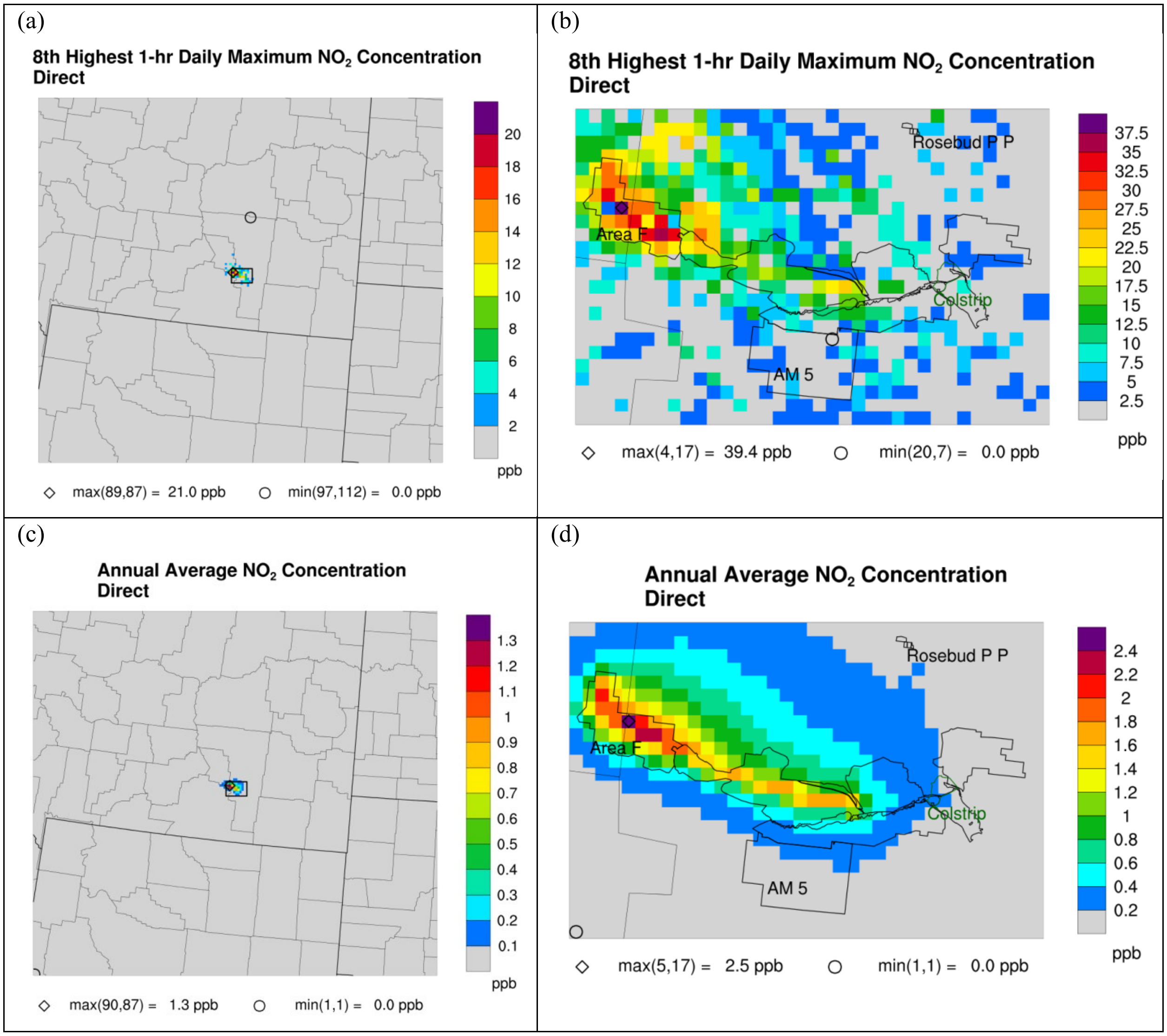


Figure 71. Spatial Distribution of Direct Impacts on NO_2 (1-hour and Annual Average) within the 4 km (Left) and 1 km (Right) Resolution Modeling Domains, Respectively.

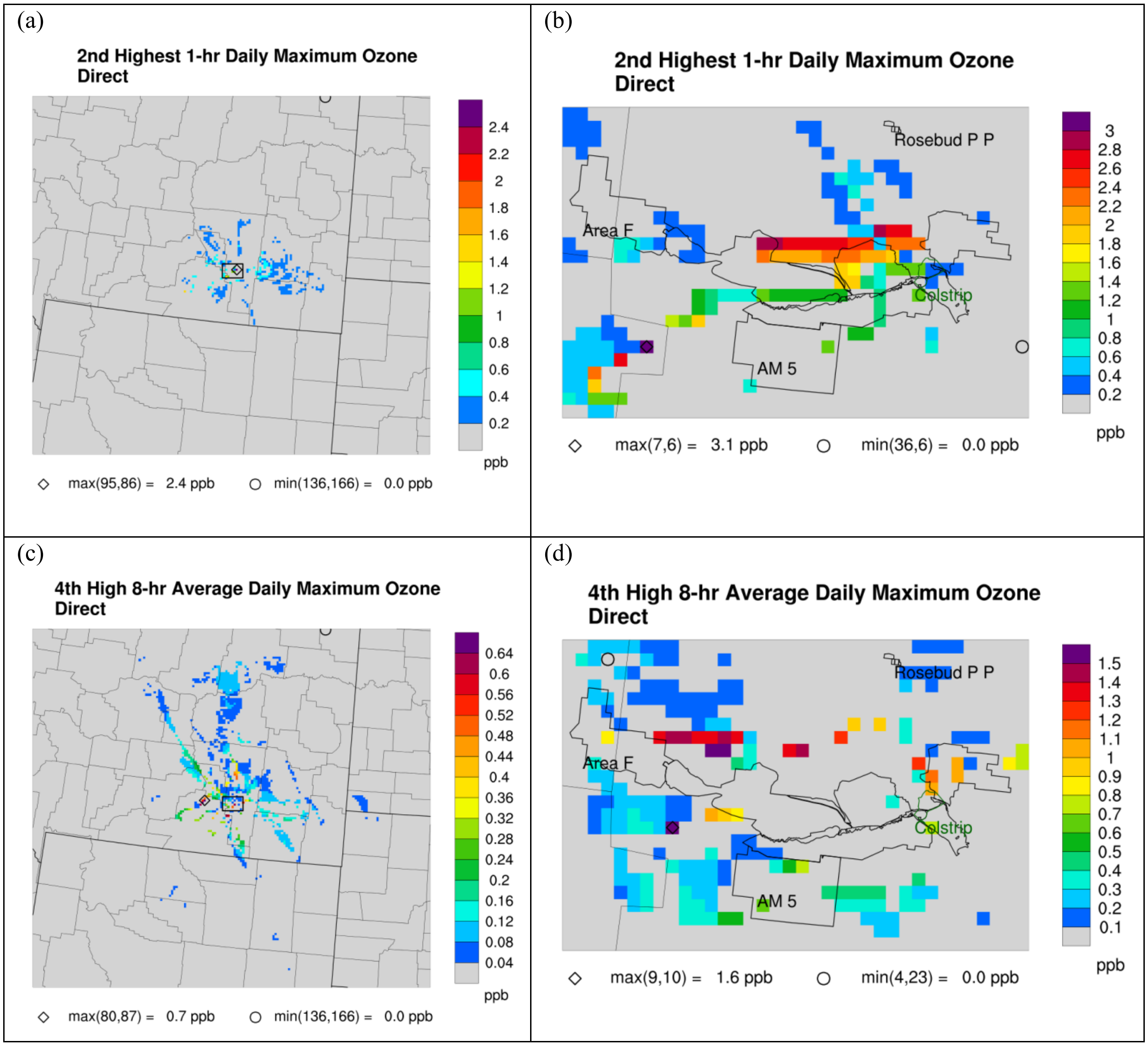


Figure 72. Spatial Distribution of Direct Impacts on O_3 (1-hour and 8-hour) within the 4 km (Left) and 1 km (Right) Resolution Modeling Domains, Respectively.

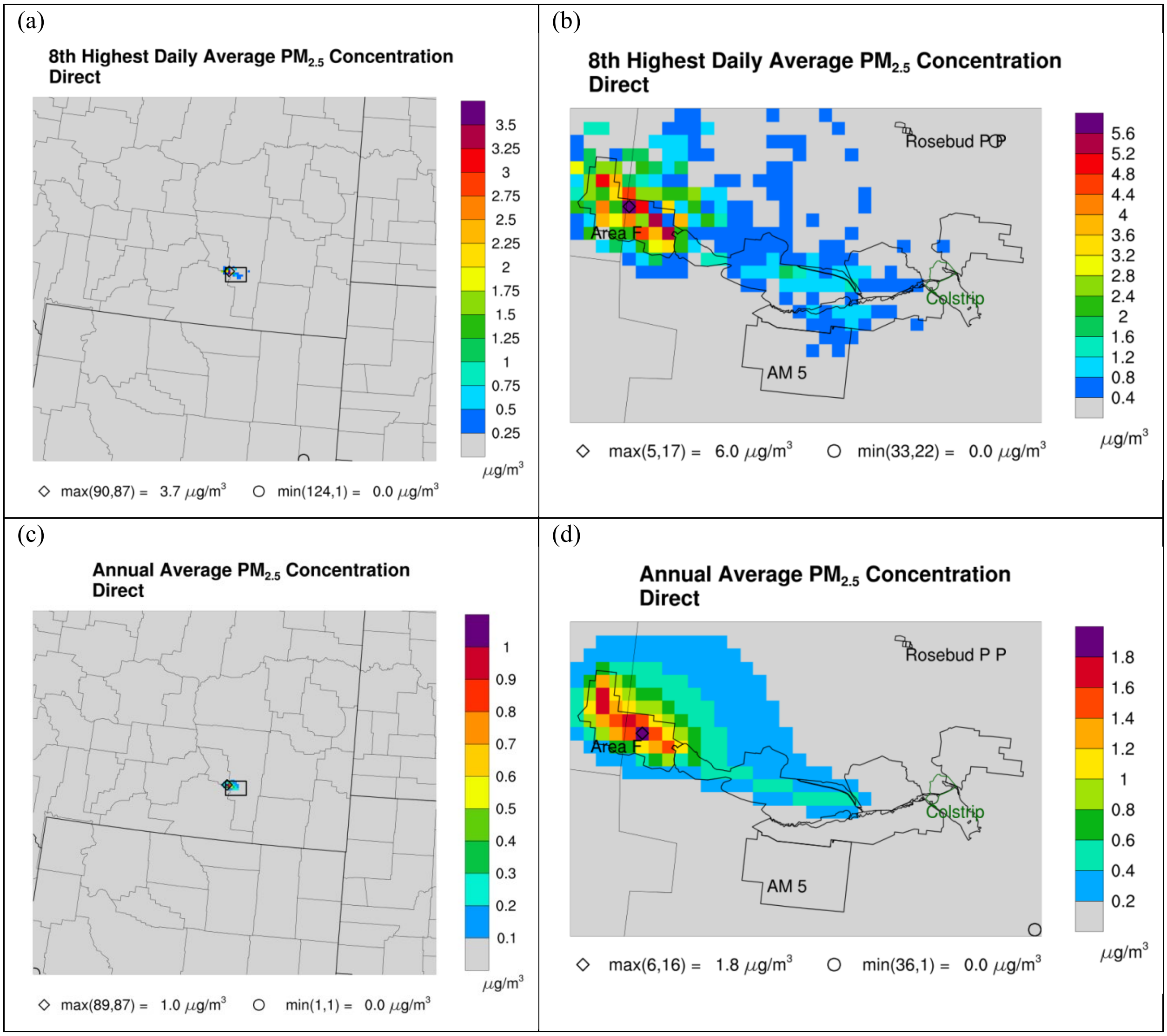


Figure 73. Spatial Distribution of Direct Impacts on $PM_{2.5}$ (Daily and Annual Average) within the 4 km (Left) and 1 km (Right) Resolution Modeling Domains, Respectively.

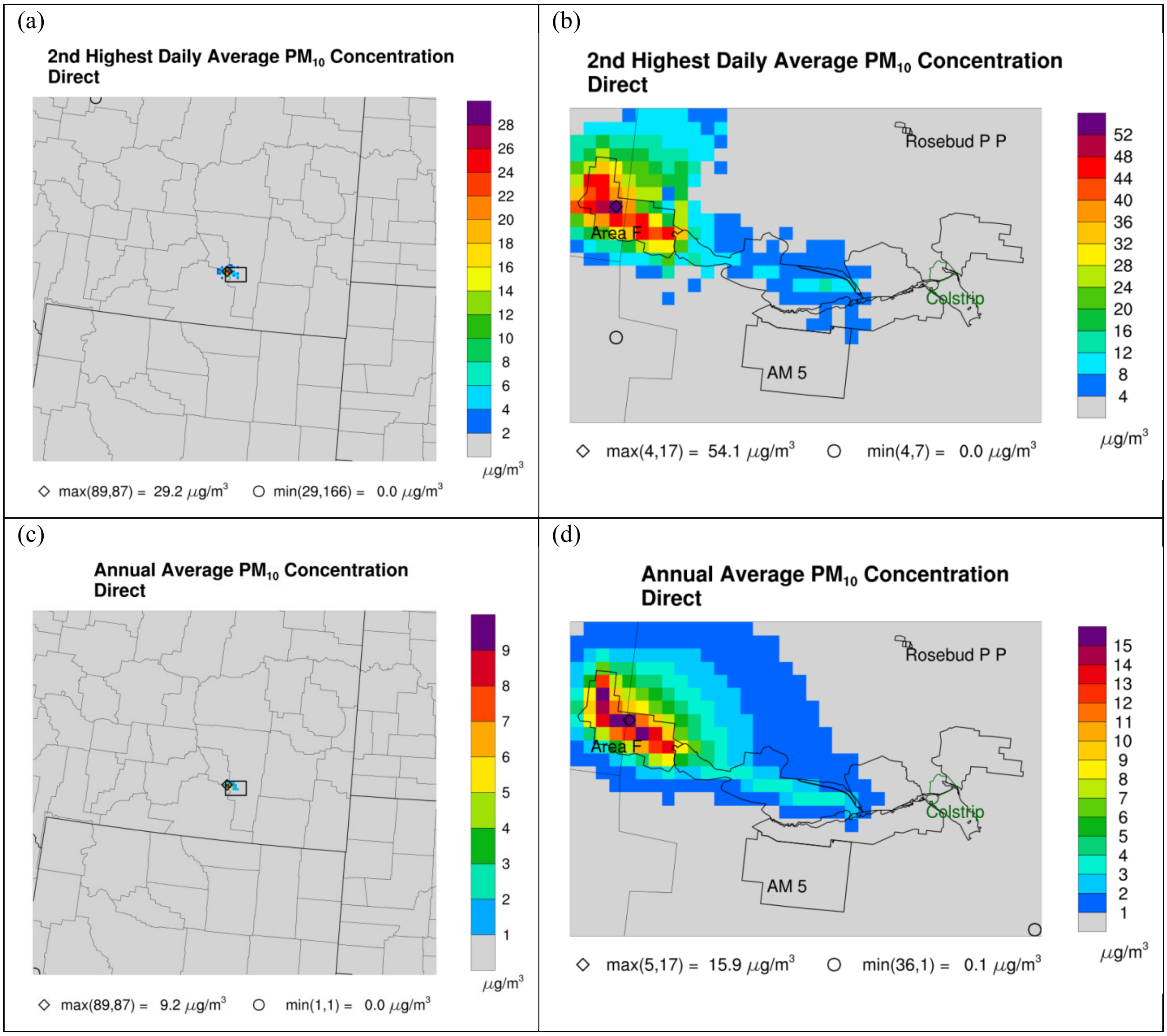


Figure 74. Spatial Distribution of Direct Impacts on PM_{10} (Daily and Annual Average) within the 4 km (Left) and 1 km (Right) Resolution Modeling Domains, Respectively.

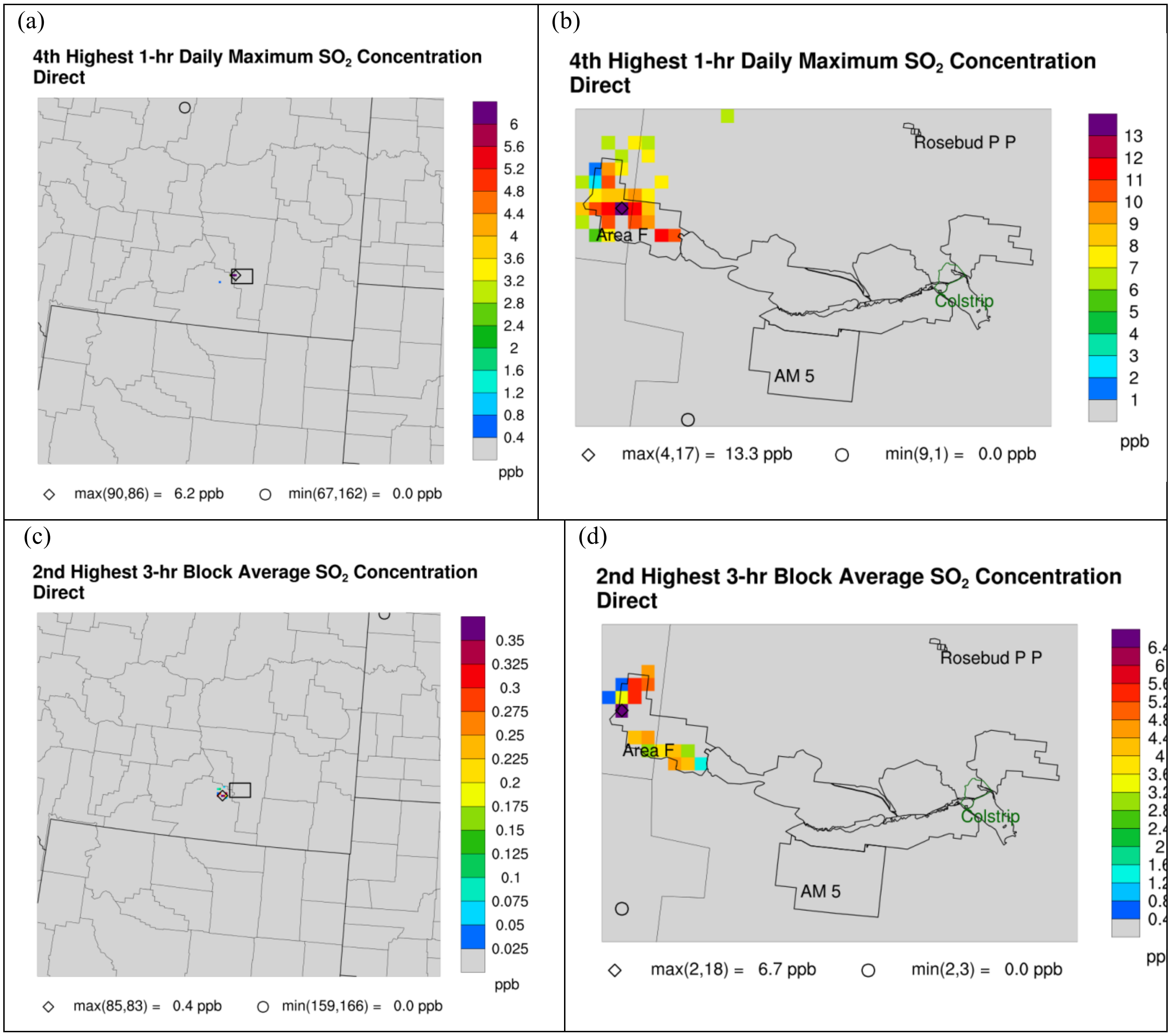


Figure 75. Spatial Distribution of Direct Impacts on SO_2 (1-hour and 3-hour) within the 4 km (Left) and 1 km (Right) Resolution Modeling Domains, Respectively.

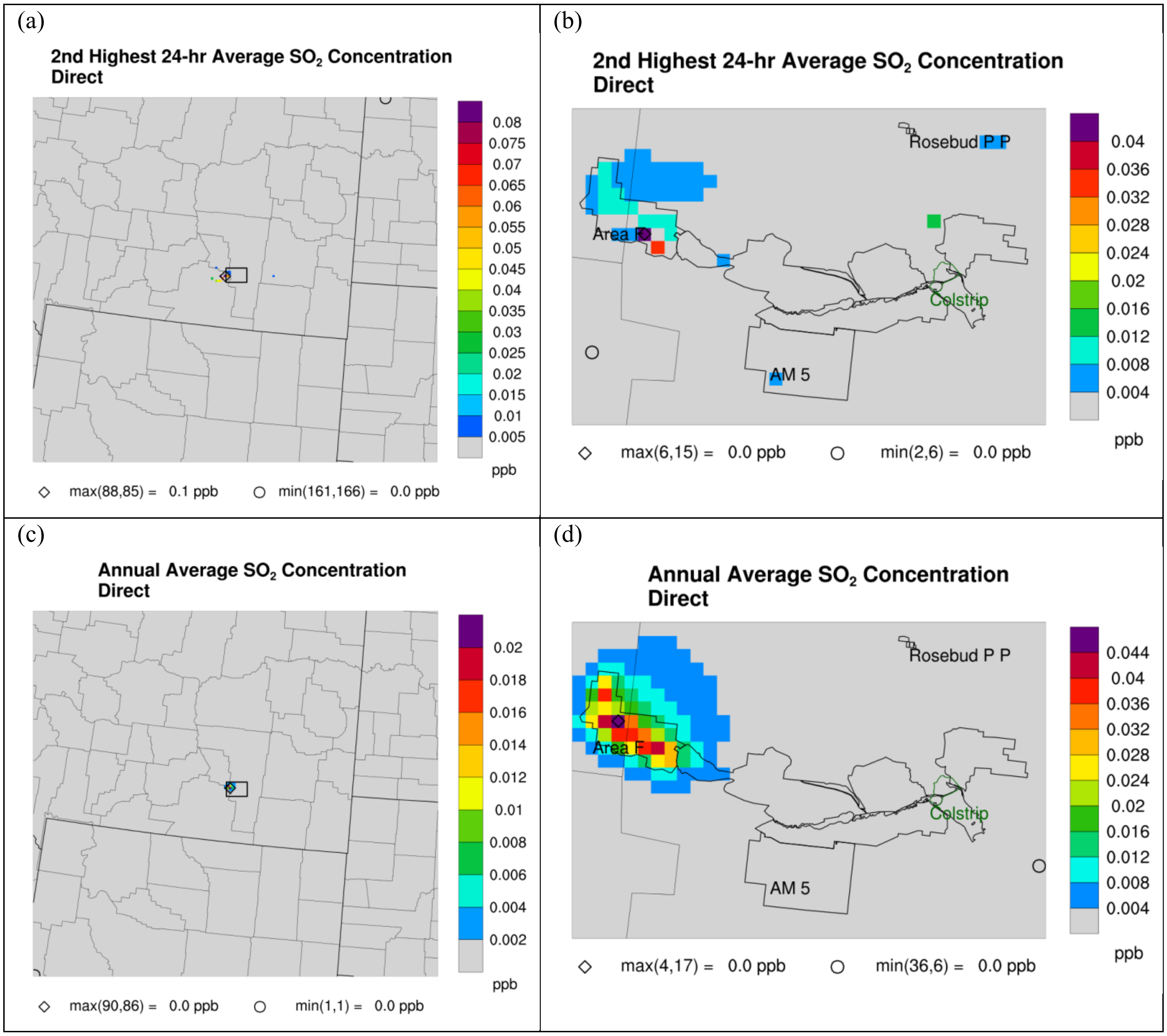


Figure 76. Spatial Distribution of Direct Impacts on SO_2 (24-hour and Annual Average) within the 4 km (Left) and 1 km (Right) Resolution Modeling Domains, Respectively.

Air Quality Related Values

Nitrogen and Sulfur Deposition

The modeled sulfur deposition consists of wet and dry deposition of SO_2 and particulate sulfate; the latter may be emitted or formed in the atmosphere from SO_2. Modeled nitrogen deposition includes wet and dry deposition of the following nitrogen compounds: nitric oxide (NO), NO_2, dinitrogen pentoxide (N_2O_5), nitrous acid (HNO_2), nitric acid (HNO_3), peroxynitric acid (HNO_4), particulate nitrate (NO_3^-), organic nitrates, and the reduced nitrogen compounds of NH_3 and particulate ammonium (NH_4^+).

Within the analysis area for direct impacts, modeled annual nitrogen deposition due to direct impacts ranges from 0 to 0.6 kg/ha and sulfur deposition varies from 0 to 0.1 kg/ha (see **Supporting Information for Air Quality Impact Analysis for Rosebud Mine Area F DEIS** in **Appendix D-8**) for more information). There are no regulatory thresholds with regards to atmospheric deposition of air emissions.

Therefore, modeled annual deposition due to the Proposed Action is compared to the modeled cumulative annual deposition if project area were not approved to assess the relative intensity of impacts.

To identify potential impacts on sensitive areas, the direct impacts on nitrogen and sulfur deposition are examined at Federal and Tribal Class I areas in the cumulative effects analysis area (a map of these areas is shown in **Section 3.3.1.2, Analysis Area**). **Table 103** shows the modeled annual total (i.e., wet + dry) deposition of nitrogen and sulfur due to direct impacts at Class I areas. The "maximum" value for each Class I area represents the maximum across all model grid cells spanning that area and the "average" value is the average across all grid cells in the area.

Annual nitrogen deposition due to direct impacts varies from 0.0001 kilograms/hectare (kg/ha) to 0.0084 kg/ha across all Class I areas when considering the spatial maximum in each area and from 0.0000 kg/ha to 0.0045 kg/ha when considering the average in each area. Northern Cheyenne is modeled to experience the highest nitrogen deposition due to direct impacts across Class I areas. When conservatively considering the maximum deposition due to direct impacts across all model grid cells spanning Northern Cheyenne, the Class I area closest to the project area, the contribution of direct impacts to nitrogen deposition is 0.4 percent of the modeled cumulative annual deposition if project area were not approved (**Appendix D-8**). The corresponding relative impact at other Class I areas is 0.0 percent. Thus, direct impacts on nitrogen deposition at Class I areas under the Proposed Action would be negligible.

Annual sulfur deposition due to direct impacts is 0.0000 kg/ha at all Class I areas except at Northern Cheyenne where it is 0.0004 kg/ha, when considering the spatial maximum in each area. This value is negligible relative to the modeled cumulative annual deposition if the project were not approved. When considering the spatial average across each area, sulfur deposition is 0.0000 kg/ha at all Class I areas except at Northern Cheyenne where it is 0.0002 kg/ha. Thus, direct impacts on sulfur deposition at Class I areas under the Proposed Action would be negligible.

Table 103. Modeled Annual Nitrogen and Sulfur Deposition due to Direct Impacts at Class I Areas.

Class I Area	Nitrogen Maximum (kg/ha)	Nitrogen Average (kg/ha)	Sulfur Maximum (kg/ha)	Sulfur Average (kg/ha)
Badlands National Park	0.0004	0.0004	0.0000	0.0000
Bridger	0.0001	0.0001	0.0000	0.0000
Fitzpatrick	0.0001	0.0001	0.0000	0.0000
Fort Peck Indian Reservation	0.0004	0.0002	0.0000	0.0000
Gates of the Mountains Wilderness	0.0001	0.0001	0.0000	0.0000
Grand Teton National Park	0.0001	0.0000	0.0000	0.0000
Lostwood National Wildlife Refuge	0.0001	0.0001	0.0000	0.0000
Lostwood Wilderness	0.0001	0.0001	0.0000	0.0000
Medicine Lake (Class I)	0.0001	0.0001	0.0000	0.0000
North Absaroka	0.0003	0.0001	0.0000	0.0000
Northern Cheyenne	0.0084	0.0045	0.0004	0.0002
Teton	0.0001	0.0000	0.0000	0.0000
Theo Roosevelt National Park	0.0006	0.0004	0.0000	0.0000
UL Bend National Wildlife Refuge	0.0006	0.0005	0.0000	0.0000
UL Bend Wilderness	0.0006	0.0004	0.0000	0.0000
Washakie	0.0002	0.0001	0.0000	0.0000
Wind Cave National Park	0.0005	0.0004	0.0000	0.0000
Yellowstone National Park	0.0001	0.0000	0.0000	0.0000

kg = kilograms.
ha = hectare.

Visibility Impairment

Procedures outlined by the Federal Land Managers' Air Quality Related Values Work Group (FLAG 2010) were used to assess impacts on atmospheric extinction and corresponding change in the haze index. Light extinction was calculated using CAMx modeled estimates of direct contributions to concentrations of particulate sulfate, nitrate, elemental carbon, organic carbon, coarse particles, and NO_2, and subsequently converted to the haze index. The modeled haze index measured in deciviews (dv) was compared to annual average natural conditions to estimate the change in haze index Δdv and the number of days it exceeded 0.5 or 1.0 at any Class I area as well as the 98th percentile Δdv over the year (FLAG 2010). Here, 0.5 and 1.0 represent levels at which the source is considered to contribute to regional haze visibility impairment or cause such visibility impairment (FLAG 2010).

The change in haze index does not exceed 1.0 at any Class I area. Also, it does not exceed 0.5 at any Class I area. The 98th percentile value over the year is highest at Northern Cheyenne with a value of 0.377 (**Table 104**).

Thus, direct impacts on haze visibility impairment would be negligible at all Class I areas.

Table 104. Visibility Impacts from Direct Emissions at Class I Areas.

Class I Areas	Number of Days in Year		98th percentile Δdv over year
	Δdv > 1.0	Δdv > 0.5	
Class I			
Badlands National Park	0	0	0.014
Bridger	0	0	0.002
Fitzpatrick	0	0	0.002
Fort Peck Indian Reservation	0	0	0.027
Gates of the Mountains Wilderness	0	0	0.002
Grand Teton National Park	0	0	0.001
Lostwood National Wildlife Refuge	0	0	0.016
Lostwood Wilderness	0	0	0.014
Medicine Lake (Class I)	0	0	0.019
North Absaroka	0	0	0.005
Northern Cheyenne	0	0	0.377
Teton	0	0	0.002
Theo Roosevelt National Park	0	0	0.030
UL Bend National Wildlife Refuge	0	0	0.015
UL Bend Wilderness	0	0	0.018
Washakie	0	0	0.005
Wind Cave National Park	0	0	0.008
Yellowstone National Park	0	0	0.003

dv = deciviews.
Δdv = Change in deciviews.

Hazardous Air Pollutants

The proposed project would be a source of both fugitive coal dust and DPM, and thus would increase the ambient air concentration and deposition of HAPs in the analysis area. The potential impacts were quantified using CAMx for the emissions described in **Criteria Air Pollutants** (under **Section 4.3.1.1**). **Figure 77** shows the annual average air concentration and annual deposition of PM_{10} due to project area fugitive coal dust emissions. The maximum annual average air concentration and annual deposition of 0.15 μg/m^3 and 153.1 kg/ha, respectively, occur within the boundaries of the project area and fall off rapidly with distance from the mine. For example, the annual average air concentration and annual deposition are typically less than 0.05 μg/m^3 and 50.0 kg/ha outside the mine, respectively.

These maxima along with the known concentrations in project area coal were used to estimate the maximum annual concentrations and annual deposition of trace metal HAPs with known concentrations in project area coal (**Table 105**). This approach conservatively considers all areas within the project area even though the public do not typically have access to these areas.

Table 105. Maximum Annual Average Air Concentration and Annual Deposition of HAPs from Project Area Fugitive Coal Dust Emissions.

Metal HAP	Maximum Annual Average Air Concentration[1] (μg/m^3)	Maximum Deposition[1] (kg/ha-year)
Antimony	4.50E-08	4.59E-05
Arsenic	1.08E-07	1.10E-04
Beryllium	4.20E-08	4.28E-05
Cadmium	6.00E-09	6.12E-06
Chromium	3.84E-07	3.92E-04
Copper	7.58E-07	7.73E-04
Lead	5.63E-07	5.74E-04
Manganese	1.06E-05	1.08E-02
Mercury	4.50E-09	4.59E-06
Nickel	1.36E-07	1.39E-04
Selenium	8.25E-08	8.42E-05

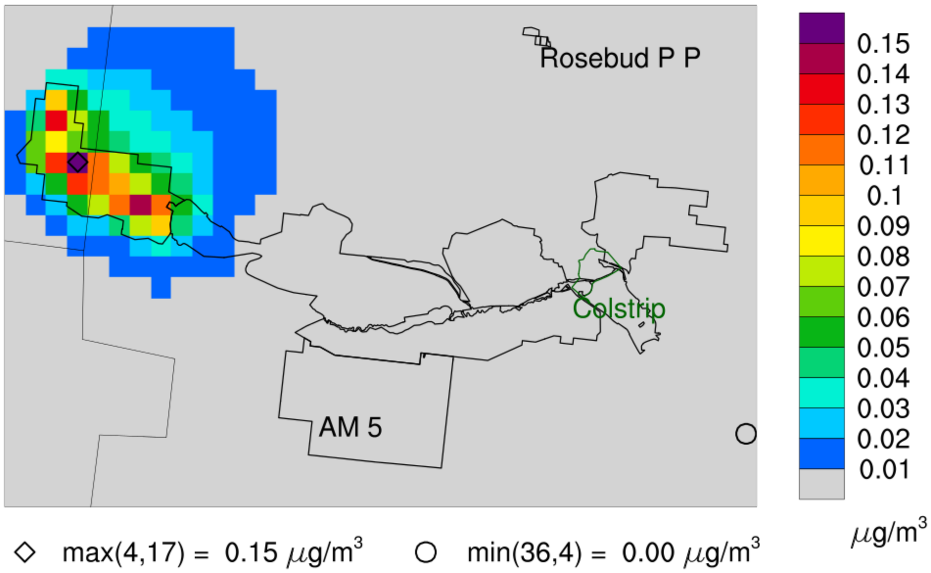
μg/m^3 = micrograms per cubic meter
kg/ha-year = kilogram per hectare per year
[1]These results conservatively consider all areas within the project area permit boundary even though the public do not typically have access to these areas.

While the form of the Pb NAAQS and MAAQS are different from the annual average concentration reported above, these modeled concentrations due to direct impacts are negligible relative to the NAAQS/MAAQS values, so they will meet the NAAQS and MAAQS.

The annual average DPM concentration resulting from project area emissions is shown in **Figure 78**, and in a similar fashion to fugitive coal dust, the maximum concentration of 0.22 μg/m^3 occurs within the project area boundary and falls off rapidly with distance from the mine. For example, DPM concentrations are typically less than 0.1 μg/m^3 outside the mine.

DPM concentrations resulting from project area emissions are spread throughout both the project area and Area C. This is so because the majority of project area DPM emissions results from haul/water truck operation on the haul roads between the project area and the coal processing facilities in Area C. In contrast, project area fugitive coal dust emissions are almost entirely (greater than 97 percent) from coal blasting which only occurs in the mining passes of the project area.

(a) Annual Average Air Concentration of PM_{10} due to Project Area Fugitive Coal Dust Emissions



(b) Annual Deposition of PM_{10} due to Project Area Fugitive Coal Dust Emissions

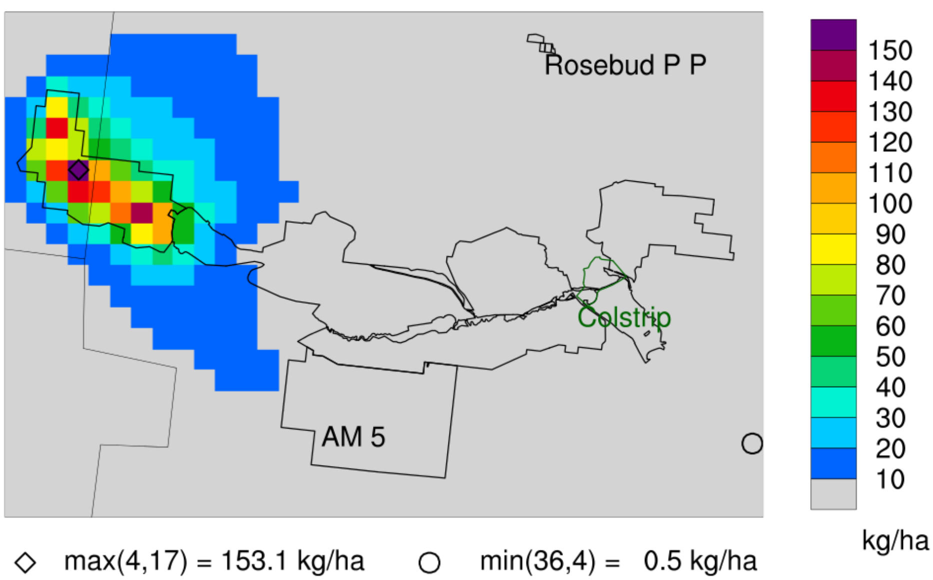


Figure 77. Spatial Distribution of (a) Annual Average Air Concentration and (b) Annual Deposition of Fugitive Coal Dust PM_{10} due to Project Area Emissions.

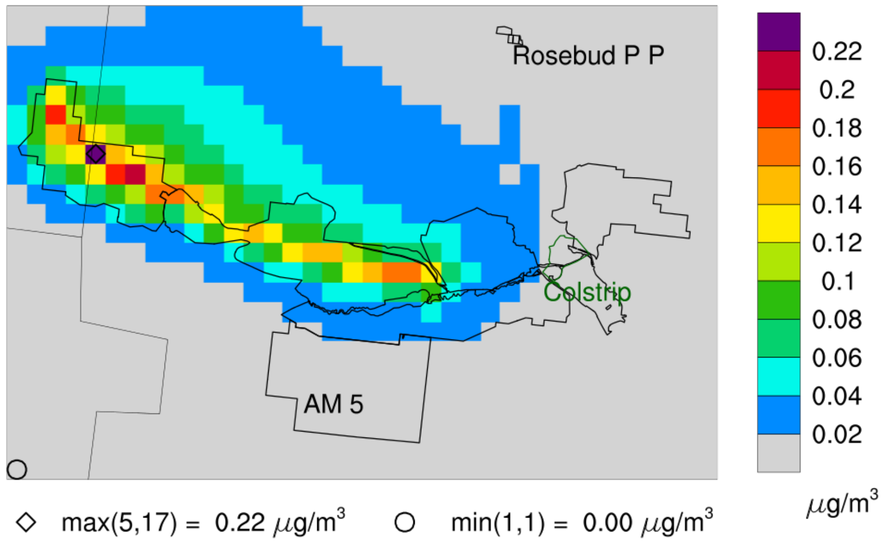


Figure 78. Spatial Distribution of Annual Average DPM Air Concentrations due to Project Area Diesel Exhaust Emissions.

4.3.3.2 Indirect Impacts of Coal Combustion

Emissions of Criteria and Hazardous Air Pollutants

The indirect effects of the Proposed Action are the result of the combustion of project area coal. If approved, the subbituminous coal mined in the project area would be burned in Units 3 and 4 of the Colstrip Power Plant, while the waste coal would be burned at the Rosebud Power Plant. These facilities are currently in operation and utilize coal from the existing areas of the Rosebud Mine, and so emission rates are not expected to significantly deviate from current levels. For this reason, the emissions reported to DEQ for 2015 were used to develop the expected future emission inventory for each facility. The emission inventories do not include on-road and non-road mobile exhaust emissions for these facilities, so on-road and non-road emissions were estimated for the Colstrip Power Plant by apportioning the emissions from the 2013 mobile source emissions inventory of the BLM-MT/DK air quality modeling (BLM 2016a). On-road and non-road exhaust emissions are expected to be very small at the Colstrip Power Plant because of limited use of mobile source equipment at the facility.

Fugitive dust, petroleum product evaporation, and diesel generator emissions from the Colstrip Power Plant are provided as facility totals, as well as the calculated on-road and non-road emissions. Therefore, these emissions were apportioned between Units 1 and 2, and Units 3 and 4 to allow for determination of the indirect effects of the Proposed Action. Fugitive dust, petroleum product evaporation, and non-road and on-road emissions were apportioned using the ratio of 2011-2015 average heat input of each set of units to the facility total average heat input reported to the EPA Clean Air Markets Program Data (AMPD) (https://ampd.epa.gov/ampd/). The emissions from diesel generators were split equally between Units 1 and 2 and Units 3 and 4. The resulting emission inventories for Colstrip Units 3 and 4 and the Rosebud Power Plant are shown in **Table 106**.

Table 106. Emissions from Colstrip Units 3 and 4 and Rosebud Power Plant.[1]

Emission Source(s)	PM_{10}	$PM_{2.5}$	NOx	CO	SO_2	VOC
Colstrip Units 3 and 4	(tons / year)					
Boiler - Unit 3	788.32	632.93	4611.53	859.66	2543.08	120.32
Boiler - Unit 4	824.91	662.30	4725.22	899.48	2622.98	125.90
Coal Storage Pile	10.16	1.52	0	0	0	0
Fugitive Dust - Haul Roads	0.28	0.00	0	0	0	0
Diesel Emergency Generator	0.0177	0.0171	0.56	0.29	0.14	0.0023
On-road Mobile	0.0126	0.0075	0.32	2.35	0.0012	0.50
Non-road Mobile	0.0143	0.0138	0.12	2.25	0.0003	0.10
Rosebud Power Plant	(tons / year)					
Boiler	16.52	5.04	856.39	3.42	1195.30	6.71
Fugitive Dust - Haul Roads	7.81	1.17	0	0	0	0
Coal Unloading, Crushing, Conveying and Storage	3.22	0.54	0	0	0	0
Limestone Handling System	0.60	0.10	0	0	0	0
Ash Conveying, Storage, and Silo-unloading	2.13	0.33	0	0	0	0
Ash Dump Area Fugitives	0.15	0.02	0	0	0	0
Ash Truck Unloading	3.91	0.60	0	0	0	0
Open Coal Storage	0.27	0.19	0	0	0	0

Source: DEQ Annual Emission Inventory Reporting Records for 2015.
[1]Emissions are rounded to two decimal places, except when additional significant figures are required to highlight differences or to show differences between pollutants.

The HAP emissions from the combustion of project area coal in Colstrip Units 3 and 4 and Rosebud Power Plant are attributable to the indirect effects of the Proposed Action. The emission and deposition of eight trace metal HAPs were modeled to quantify the air quality impacts of HAP emissions. These trace metals were antimony, arsenic, cadmium, chromium, copper, lead, selenium, and mercury. These eight metals are the same HAPs studied for the deposition analysis area (see **Deposition Analysis Area for Special Status Species due to Indirect Combustion Impacts**).

Emission rates of the selected metals from the Colstrip and Rosebud Power Plants were estimated for the AERMOD modeling period (2011-2015). Stack testing data from 2010 and 2011 was used for Colstrip 3 and 4, while the emission limits described in the Mercury and Air Toxics Standards (MATS, ARM 17.8.771) were used for Rosebud Power Plant (for which no stack test data is available), with the exception of mercury and copper. Mercury emissions are monitored at both facilities and annual emissions data was used for each year of the modeling period. Copper emissions were not provided in stack test data from Colstrip, and copper does not have an explicitly defined emission limit in MATS. The emission rates of copper were acquired from an Electric Power Research Institute (EPRI) trace substance database for coal combustion units (EPRI 2014).

The emission rates used for all HAPS except mercury were per unit of heat input, and thus estimation of annual emission rates requires estimation of the boiler heat input of each facility. For Colstrip Units 3 and 4, the permitted nominal heating values of 7573 MMBtu (million Btu) per hour for each unit were used along with assuming continuous operation throughout each year (8,760 hours per year). For the Rosebud Power Plant, the heat content of the waste coal (7920 Btu per lb of coal) and maximum waste coal consumption (364,000 tons per year) provided in the plant's Montana Air Quality Permit (MAQP) #2035-05 were used to estimate heat input for use in emission estimations. The calculated emission rates other than mercury are provided in **Table 107**.

Table 107. Selected Metal HAP Emission Rates for Colstrip Units 3 and 4, and Rosebud Power Plant.

Pollutant	Emission Rates			
	Colstrip Units 3 and 4		Rosebud Power Plant	
	(lb/year)	(g/s)	(lb/year)	(g/s)
Antimony	123.92	1.78E-03	4.61	6.63E-05
Arsenic	286.59	4.12E-03	6.34	9.12E-05
Cadmium	77.75	1.12E-03	1.73	2.49E-05
Chromium	411.30	5.92E-03	16.14	2.32E-04
Copper [1]	1711.56	2.46E-02	74.38	1.07E-03
Lead	670.03	9.64E-03	6.92	9.95E-05
Selenium	1216.67	1.75E-02	28.83	4.15E-04

lb/TBtu = pounds per Trillion British thermal units.
lb/year = pounds per year.
g/s = gram per second.

To estimate mercury emissions, the measured elemental (Hg^0) and ionic mercury (sum of gaseous divalent mercury, Hg^{2+}, and particulate mercury, HgP) from MEMS were used for Colstrip Units 3 and 4 for each year of modeling, while total annual mercury emissions from EPA's Toxic Release Inventory (TRI, https://www.epa.gov/toxics-release-inventory-tri-program) were used for the Rosebud Power Plant. For Colstrip Units 3 and 4, HgP was assumed to be 1 percent of the total mercury emissions based on the scrubber control class of the EPRI HAP database for coal combustion (EPRI 2014), and the remainder of the ionic mercury emissions from MEMS were apportioned to Hg^{2+}. For the Rosebud Power Plant, the total mercury emissions from TRI were apportioned assuming that Hg^0, Hg^{2+} and HgP comprised 23%, 76.24 percent, and 0.76 percent of the total Hg emissions, respectively, based on the EPRI database for the fabric filter control class. The calculated speciated mercury emissions rates are shown in **Table 108**, and the stack parameters used in modeling are provided in **Table 109**.

The use of the total HAP emissions from Colstrip 3 and 4, and the Rosebud Power Plant to represent the indirect effects of the Proposed Action is a conservative approach (i.e., protective of the environment) as it assumes that the project area would supply all of the coal combusted in these facilities, whereas coal may also be supplied to the power plants from the other active areas of the mine and thus actual indirect emissions would be lower.

Table 108. Mercury Emission Rates from Colstrip Units 3 and 4, and Rosebud Power Plant.

Year	Colstrip Units 3 and 4						Rosebud Power Plant					
	Hg^0		Hg^{2+}		HgP		Hg^0		Hg^{2+}		HgP	
	(lb/ year)	(g/s)	(lb/ year)	(g/s)	(lb/ year)	(g/s)	(lb/ year)	(g/s)	(lb/ year)	(g/s)	(lb/ year)	(g/s)
2011	42.40	6.10E-04	42.94	6.18E-04	0.86	1.24E-05	0.36	5.19E-06	1.20	1.72E-05	0.01	1.72E-07
2012	37.40	5.38E-04	43.48	6.25E-04	0.82	1.17E-05	0.61	8.77E-06	2.02	2.91E-05	0.02	2.90E-07
2013	32.60	4.69E-04	48.18	6.93E-04	0.82	1.17E-05	0.33	4.76E-06	1.10	1.58E-05	0.01	1.57E-07
2014	39.00	5.61E-04	63.07	9.07E-04	1.03	1.48E-05	0.33	4.70E-06	1.08	1.56E-05	0.01	1.55E-07
2015	54.40	7.82E-04	65.29	9.39E-04	1.21	1.74E-05	0.22	3.11E-06	0.72	1.03E-05	0.01	1.03E-07
AVG	**41.16**	**5.92E-04**	**52.59**	**7.56E-04**	**0.95**	**1.36E-05**	**0.37**	**5.31E-06**	**1.22**	**1.76E-05**	**0.01**	**1.75E-07**

lb/y = pounds per year.
g/s = gram per second.

Table 109. Modeled Stack Parameters.

Facility	Source ID	Stack Exit Temperature	Stack Height	Stack Inside Exit Diameter	Stack Exit Velocity
		(°C)	(m)	(m)	(m/s)
Rosebud Power Plant	Rosebud PP	160.00	60.96	2.51	22.56
Colstrip	UNIT03	86.75	210.90	7.32	37.40
Colstrip	UNIT04	87.05	210.90	7.32	36.90

°C = degrees Centigrade.
m = meters.
m/s = meters per second.

Air Concentrations of Criteria Pollutants

The indirect impacts of burning project area coal at Colstrip Units 3 and 4 and the Rosebud Power Plant are described below.

Figure 79 through **Figure 84** display the spatial distribution of indirect impacts on NO_2, O_3, $PM_{2.5}$, PM_{10}, and SO_2 in the analysis area. The analysis area here is represented by both the 4 km and 1 km resolution domains. For the overlapping region between the two domains, the higher value among the two domains is conservatively selected in each case.

The maximum modeled values in the analysis area of the 8^{th} highest 1-hour daily maximum NO_2 and annual average NO_2 concentrations (**Figure 79**) are 24.0 ppb and 0.3 ppb, respectively. Indirect combustion impacts of the Proposed Action on NO_2 concentrations in the analysis area are well below the NAAQS and MAAQS. Although the form of the MAAQS for 1-hour NO_2 is different from that of the NAAQS, the MAAQS is three times that of the NAAQS, so concentrations much lower than the NAAQS would also imply that they are lower than the MAAQS. Furthermore, as noted under **Section 5.3.2, Cumulative Effects, Air Quality**, NO_2 concentrations due to all cumulative sources in the analysis area are below the NAAQS and MAAQS. Therefore, indirect impacts for NO_2 in the analysis area under the Proposed Action would be short-term, minor, and adverse.

The indirect combustion impacts on O_3 (**Figure 80**) occur farther away from the Colstrip and Rosebud Power Plants compared to NO_2 due to the secondary formation of O_3 from NOx and VOC. The highest modeled concentrations in the analysis area of 1-hour and 8-hour O_3 in the form of the MAAQS and NAAQS, respectively, due to indirect impacts are 6.8 ppb in Rosebud County to the southeast of the mine and 4.9 ppb in Bighorn County to the south. Ozone concentrations due to all cumulative sources in the analysis area are also below the NAAQS and MAAQS (**Section 5.3.2.2, Cumulative Impacts on Air Quality**). Thus, indirect impacts for O_3 in the analysis area under the Proposed Action would be short-term, minor, and adverse.

The indirect combustion impacts on $PM_{2.5}$ and PM_{10} are higher within the 1 km domain than outside (less than 1 $\mu g/m^3$). The highest modeled indirect impacts on daily and annual $PM_{2.5}$ (**Figure 81**) in the analysis area are 1.8 $\mu g/m^3$ near the Colstrip Power Plant and 0.5 $\mu g/m^3$ near the Rosebud Power Plant, respectively. The daily and annual $PM_{2.5}$ concentrations are well below the NAAQS. There are no MAAQS for $PM_{2.5}$. The highest modeled indirect impacts in the analysis area on daily and annual average PM_{10} (**Figure 82**) are 5.8 $\mu g/m^3$ and 2.8 $\mu g/m^3$, respectively, both near the Rosebud Power Plant. These peak concentrations are well below the NAAQS and MAAQS, respectively. Indirect impacts for $PM_{2.5}$ and PM_{10} in the analysis area under the Proposed Action would be short-term, minor, and adverse. Background concentrations due to other sources are considered in the context of cumulative effects (**Section 5.3.2.2, Cumulative Impacts on Air Quality**).

Modeled indirect impacts on SO_2 are shown in **Figure 83** and **Figure 84**. The maximum modeled indirect impacts on 1-hour, 24-hour, and annual average SO_2 are 18.7 ppb, 4.8 ppb, and 0.4 ppb, respectively; all three are seen adjacent to the Rosebud Power Plant. The maximum modeled indirect impacts on 3-hour SO_2 is 18.2 ppb, found near the Colstrip Power Plant. The SO_2 concentrations are well below the NAAQS and MAAQS, including the forms of the standard (24-hr and annual) where the MAAQS is more stringent than the NAAQS. Background concentrations due to other sources are considered in the context of cumulative effects (**Section 5.3.2.2, Cumulative Impacts on Air Quality**). Thus, indirect impacts for SO_2 in the analysis area under the Proposed Action would be short-term, minor, and adverse.

The results discussed above for indirect impacts are conservative as the total emissions from Colstrip 3 and 4, and Rosebud Power Plant are used in modeling although the project area may not supply all of the coal combusted in these units.

Impacts on CO are discussed under **Section 5.3.2.2, Cumulative Impacts on Air Quality**; modeling results show that the cumulative effects for CO after considering all sources are well below the NAAQS and the MAAQS. Thus, direct impacts for CO would be negligible.

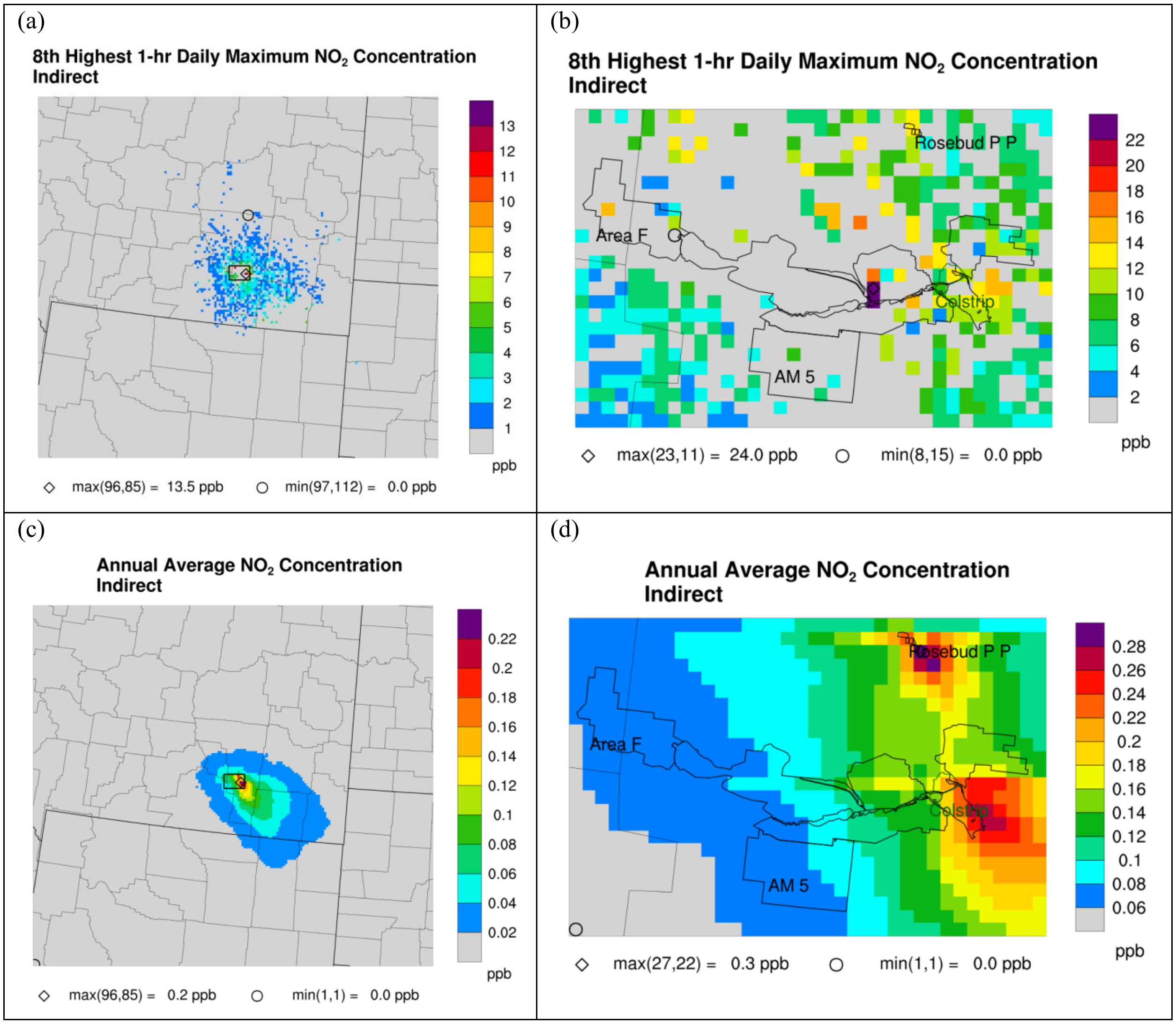


Figure 79. Spatial Distribution of Indirect Combustion Impacts on NO_2 (1-hour and Annual Average) within the 4 km (Left) and 1 km (Right) Modeling Domains, Respectively.

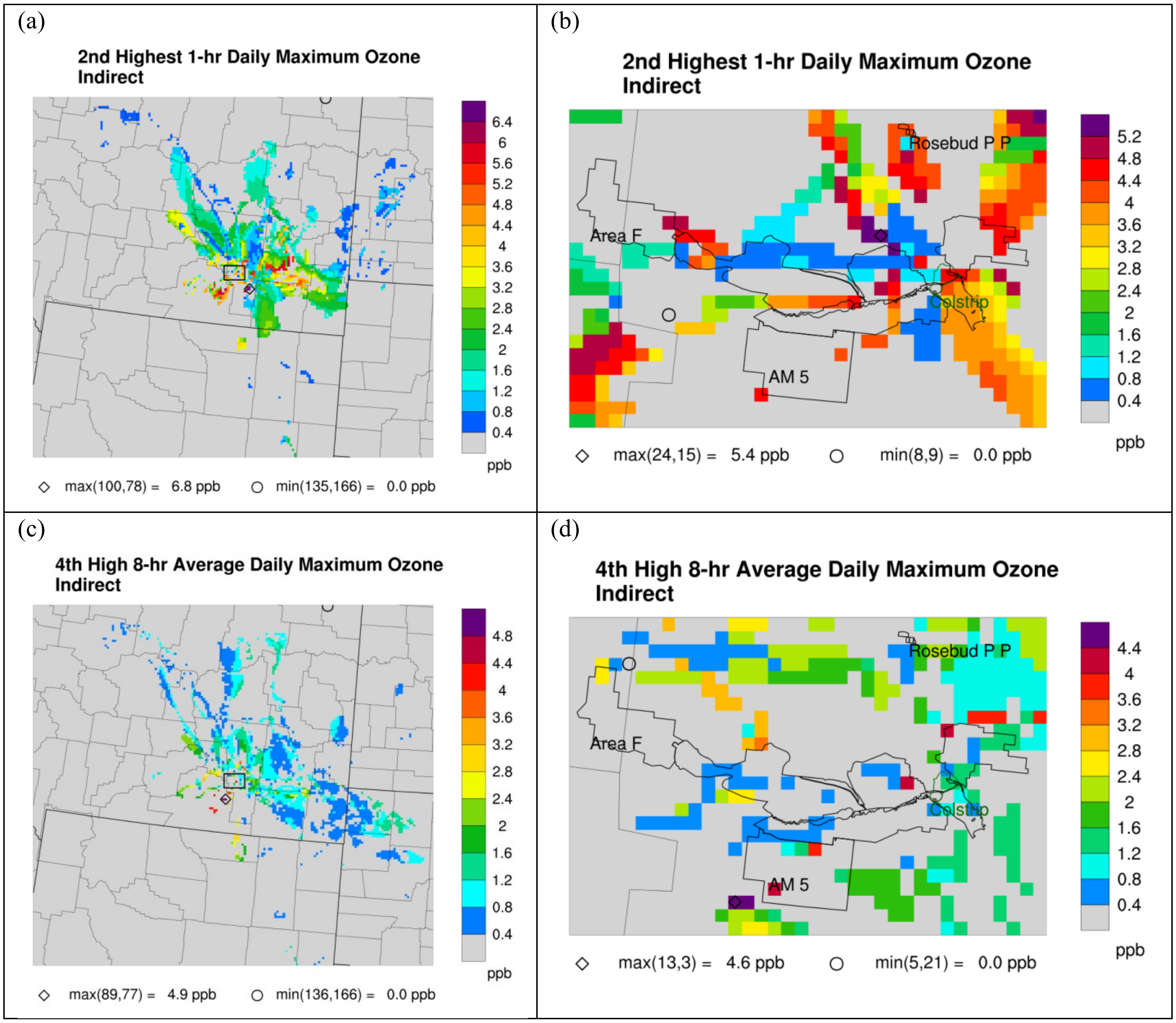


Figure 80. Spatial Distribution of Indirect Combustion Impacts on O_3 (1-hour and 8-hour) within the 4 km (Left) and 1 km (Right) Modeling Domains, Respectively.

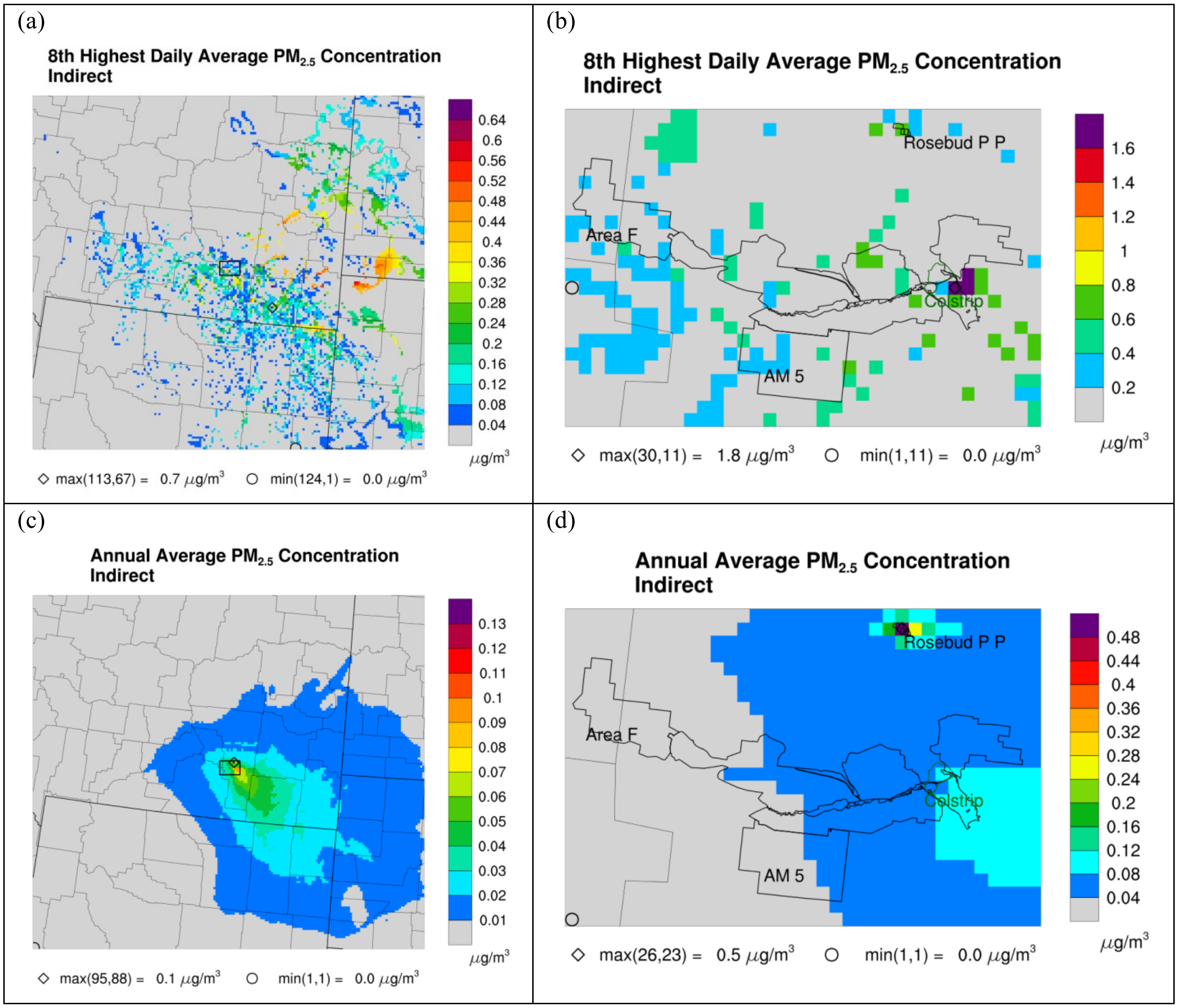


Figure 81. Spatial Distribution of Indirect Combustion Impacts on $PM_{2.5}$ (Daily and Annual Average) within the 4 km (Left) and 1 km (Right) Modeling Domains, Respectively.

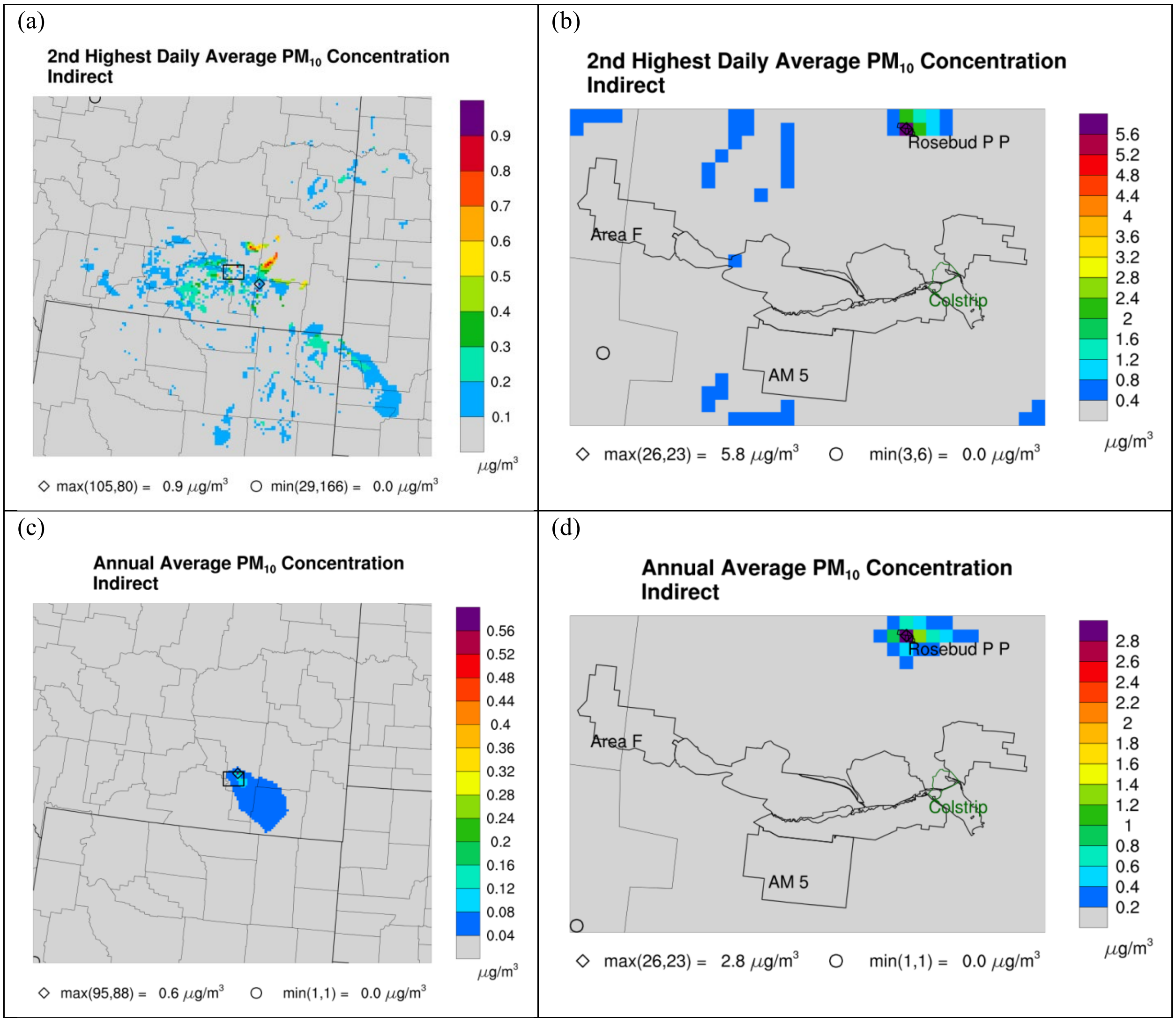


Figure 82. Spatial Distribution of Indirect Combustion Impacts on PM_{10} (Daily and Annual Average) within the 4 km (Left) and 1 km (Right) Modeling Domains, Respectively.

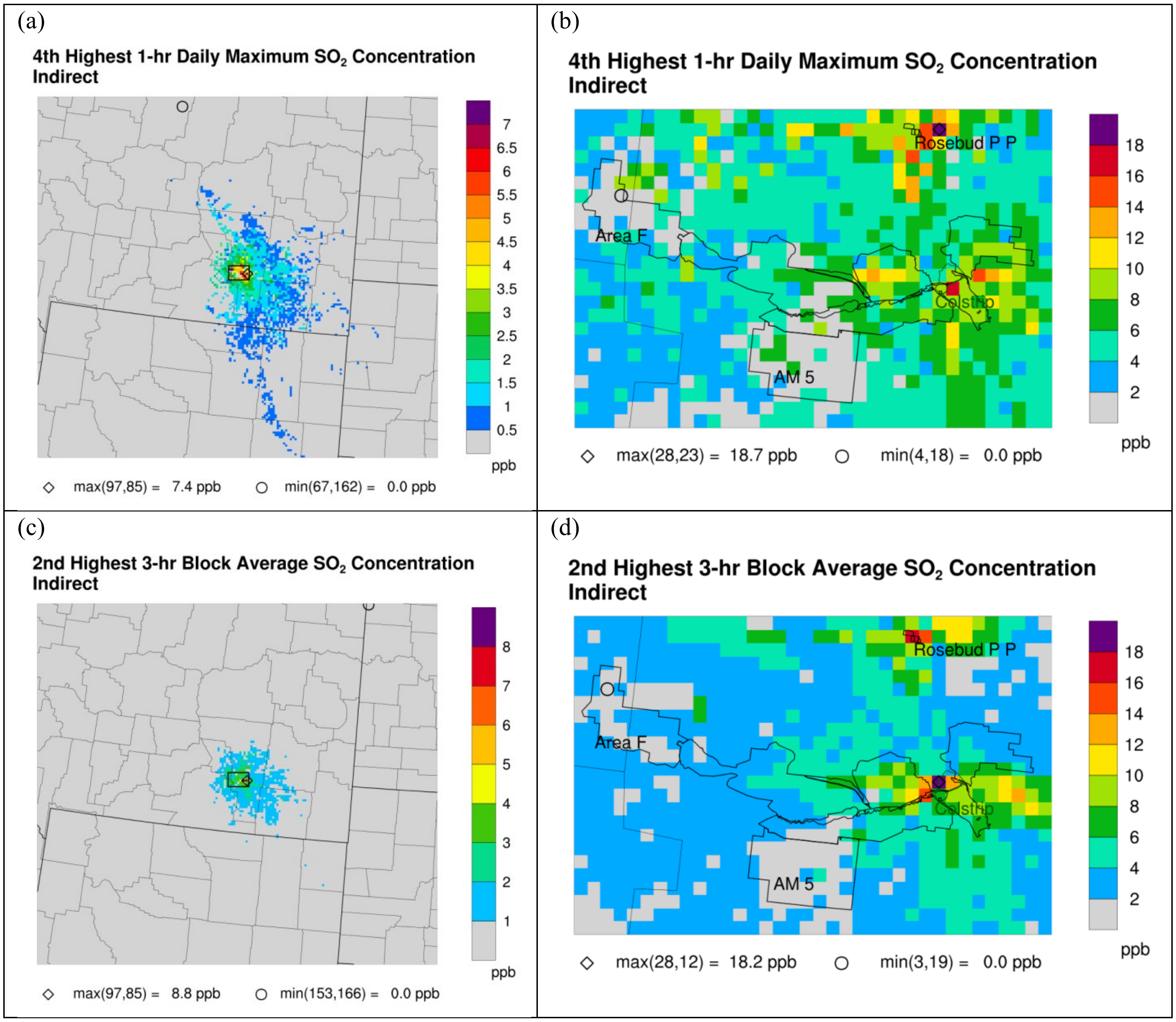


Figure 83. Spatial Distribution of Indirect Combustion Impacts on SO_2 (1-hour and 3-hour) within the 4 km (Left) and 1 km (Right) Modeling Domains, Respectively.

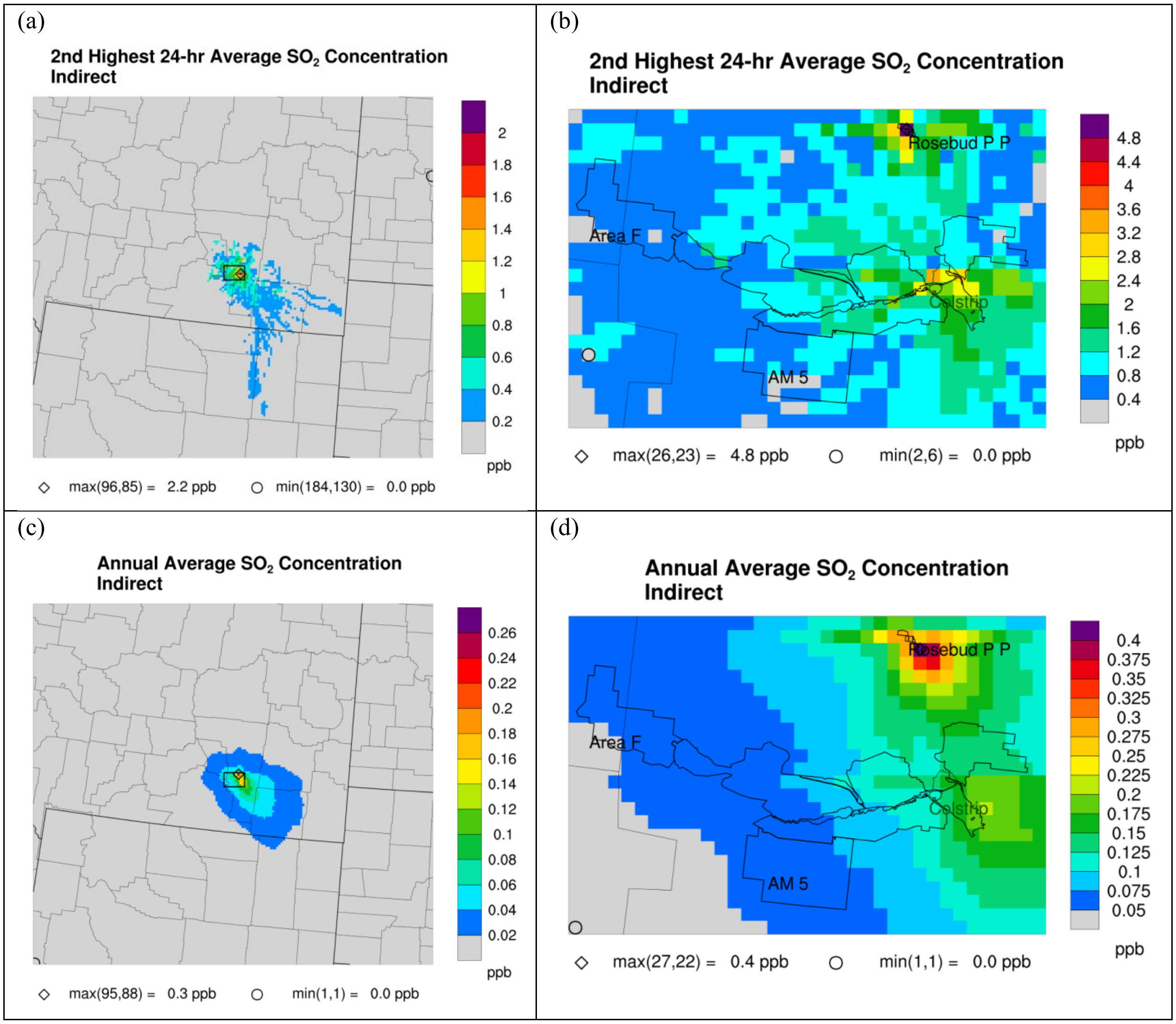


Figure 84. Spatial Distribution of Indirect Combustion Impacts on SO_2 (24-hour and Annual Average) within the 4 km (Left) and 1 km (Right) Modeling Domains, Respectively.

Air Quality Related Values

Indirect impacts of burning project area coal on air quality related values –acidic deposition (of nitrogen and sulfur) and visibility – are discussed below.

Nitrogen and Sulfur Deposition

Modeled annual nitrogen deposition due to indirect impacts ranges from 0 to 0.2 kg/ha within the indirect/cumulative effects analysis area while sulfur deposition varies from 0 to 0.7 kg/ha (see **Supporting Information for Air Quality Impact Analysis for Rosebud Mine Area F DEIS** in **Appendix D-8** for more information). There are no regulatory thresholds for atmospheric deposition of air emissions. Therefore, indirect impacts on deposition due to the Proposed Action were compared to total modeled cumulative deposition if the project area were not approved to assess the relative intensity of impacts.

Indirect impacts on nitrogen and sulfur deposition are examined at Federal and Tribal Class I areas in the analysis area. **Table 110** shows the modeled annual total deposition of nitrogen and sulfur due to indirect impacts at Class I areas (a map of these areas is shown in **Section 3.3.1.2, Analysis Area**).

Annual nitrogen deposition due to indirect impacts varies from 0.0015 kg/ha to 0.1415 kg/ha across all Class I areas when considering the spatial maximum in each area and from 0.0008 kg/ha to 0.0704 kg/ha when considering the average in each area. Northern Cheyenne experiences the highest nitrogen deposition due to indirect impacts across the Class I areas within the analysis area. The contribution of indirect impacts to nitrogen deposition is 6.6 percent of the modeled cumulative annual deposition if the project area were not approved at Northern Cheyenne, the Class I area with highest impact, when conservatively considering the maximum deposition across all model grid cells spanning this Class I area (**Appendix D-8**). The corresponding relative impact when considering the spatial average in the area is 4.6 percent. Relative impacts at other Class I areas range from 0.1 percent to 0.5 percent. Therefore, indirect impacts on nitrogen deposition at Class I areas in the analysis area under the Proposed Action would be long-term, minor, and adverse. Impacts are long-term because the effect of the deposition would occur beyond the period of deposition.

Annual sulfur deposition due to direct impacts across the Class I areas ranges from 0.0008 kg/ha to 0.1752 kg/ha when considering the spatial maximum in each area and from 0.0004 kg/ha to 0.0722 kg/ha when considering the spatial average across each area. The largest impact is modeled at Northern Cheyenne. Maximum sulfur deposition due to indirect impacts is 21.9 percent of the modeled cumulative annual deposition at Northern Cheyenne if the project area were not approved (**Appendix D-8**) when considering the considering the spatial maximum in the area; the corresponding value is 13.5 percent when considering the spatial average in the area. Relative impacts at other Class I areas range from 0.1 percent to 1.6 percent. Therefore, indirect impacts on sulfur deposition at Class I areas in the analysis area under the Proposed Action would be long-term, minor, and adverse.

Table 110. Modeled Annual Nitrogen and Sulfur Deposition due to Indirect Impacts at Class I Areas.

Class I Area	Nitrogen Maximum (kg/ha)	Nitrogen Average (kg/ha)	Sulfur Maximum (kg/ha)	Sulfur Average (kg/ha)
Badlands National Park	0.0122	0.0094	0.0074	0.0057
Bridger	0.0020	0.0011	0.0021	0.0009
Fitzpatrick	0.0022	0.0012	0.0019	0.0012
Fort Peck Indian Reservation	0.0100	0.0055	0.0072	0.0036
Gates of the Mountains Wilderness	0.0026	0.0025	0.0022	0.0019
Grand Teton National Park	0.0015	0.0008	0.0008	0.0004
Lostwood National Wildlife Refuge	0.0026	0.0022	0.0026	0.0021
Lostwood Wilderness	0.0028	0.0026	0.0024	0.0023
Medicine Lake (Class I)	0.0043	0.0037	0.0036	0.0028
North Absaroka	0.0058	0.0022	0.0029	0.0013
Northern Cheyenne	0.1415	0.0704	0.1752	0.0722
Teton	0.0022	0.0011	0.0020	0.0007
Theo Roosevelt National Park	0.0100	0.0073	0.0075	0.0055
UL Bend National Wildlife Refuge	0.0115	0.0093	0.0062	0.0058
UL Bend Wilderness	0.0098	0.0083	0.0064	0.0056
Washakie	0.0052	0.0019	0.0048	0.0017
Wind Cave National Park	0.0145	0.0115	0.0091	0.0071
Yellowstone National Park	0.0025	0.0010	0.0013	0.0006

kg = kilograms.
ha = hectare.

Visibility Impairment

The methods outlined under **Section 4.3.3.1, Direct Impacts** to assess visibility impairment for direct impacts were also used to assess potential haze visibility impairment due to indirect impacts. The modeled change in haze index due to indirect impacts compared to annual average natural conditions is reported below in terms of the number of days the haze index value exceeded 0.5 or 1.0 at any Class I area (FLAG 2010).

Across the Class I areas in the analysis area, the change in haze index exceeds 1.0 on seven days or less except at Northern Cheyenne where it is exceeded 20 days in the year (**Table 111**). The change in haze index exceeds 0.5 on fourteen days or less except at Northern Cheyenne where it is exceeded 96 days in the year with a 98th percentile value of 1.425.

Therefore, indirect impacts on haze visibility impairment at Class I areas would be short-term, minor, and adverse.

Table 111. Visibility Impacts from Indirect Emissions at Class I Areas.

Class I Areas	Number of Days in Year		98th percentile Δdv over year
	Δdv > 1.0	Δdv > 0.5	
Class I			
Badlands National Park	2	8	0.504
Bridger	0	0	0.091
Fitzpatrick	0	0	0.114
Fort Peck Indian Reservation	7	14	0.841
Gates of the Mountains Wilderness	0	0	0.076
Grand Teton National Park	0	0	0.064
Lostwood National Wildlife Refuge	1	4	0.308
Lostwood Wilderness	1	4	0.279
Medicine Lake (Class I)	3	9	0.680
North Absaroka	0	0	0.143
Northern Cheyenne	20	96	1.425
Teton	0	0	0.090
Theo Roosevelt National Park	4	11	0.773
UL Bend National Wildlife Refuge	1	3	0.243
UL Bend Wilderness	1	2	0.237
Washakie	0	0	0.132
Wind Cave National Park	0	2	0.338
Yellowstone National Park	0	0	0.088

dv = deciviews.
Δdv = Change in deciviews.

Hazardous Air Pollutants

To estimate the annual deposition for the modeled trace metal emissions resulting from the combustion of project area coal **(Section 4.3.3.2, Emissions of Criteria and Hazardous Air Pollutants**), the annual total deposition (i.e., wet + dry) of each metal was averaged over the 5-year modeling period (2011-2015). This deposition was considered to be representative of the deposition due to Colstrip 3 and 4, and the Rosebud Power Plant during the period of the Proposed Action. Contour plots of the modeled deposition rates are provided for each examined metal in **Figure 85** through **Figure 92**. The modeled deposition rates for all of the metals are highest in the immediate area surrounding Colstrip Units 3 and 4, and then decrease with distance from the power plant. The maximum modeled deposition of each trace metal is provided in **Table 112**. There are no regulatory thresholds for atmospheric deposition of HAPs.

Mercury deposition due to indirect impacts constitutes a small fraction (a few percent) of total mercury deposition in the region as discussed in **Mercury Deposition** under **Section 5.3.2.2, Cumulative Impacts on Air Quality**. Therefore, indirect impacts on mercury deposition would be long-term, minor, and adverse. Impacts are long-term because the effect of the mercury deposition would occur beyond the period of deposition due to Colstrip and Rosebud Power Plant emissions during the period of the Proposed Action.

Table 112. Modeled Maximum Total Deposition of Trace Metals.

Chemical	Maximum Total Annual Deposition[1] (μg/m²-year)
Antimony	9.31E+00
Arsenic	2.15E+01
Cadmium	5.83E+00
Chromium	3.09E+01
Copper	1.28E+02
Lead	5.01E+01
Mercury	1.45E+00
Selenium	9.12E+01

μg/m²-year = micrograms per square meter per year.
[1]AERMOD was run from 2011-2015, and the annual total deposition (wet + dry) for each year were averaged at each receptor.

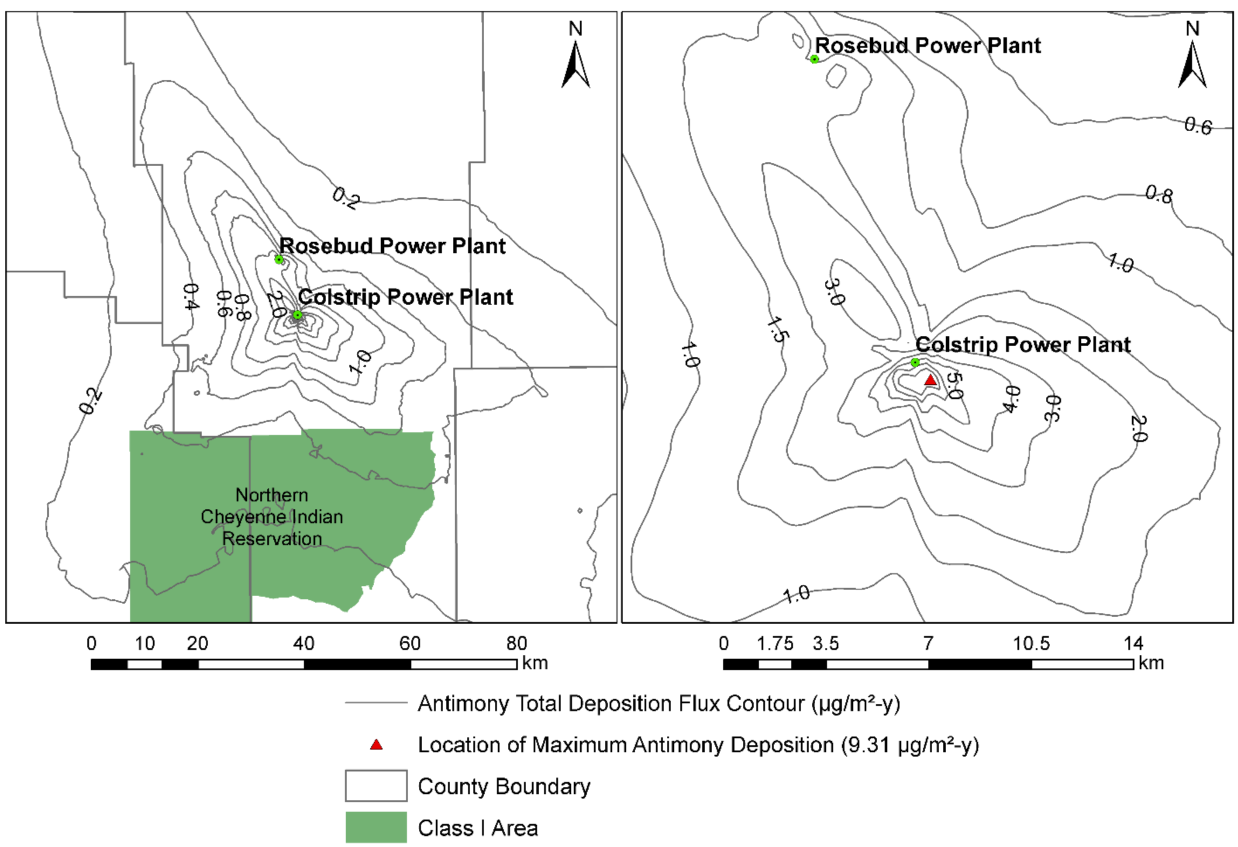


Figure 85. Spatial Distribution of the Modeled 5-year Average Annual Antimony Deposition Resulting from Colstrip Units 3 and 4, and Rosebud Power Plant Emissions.

km = kilometers.
μg/m²-y = micrograms per square meter per year.

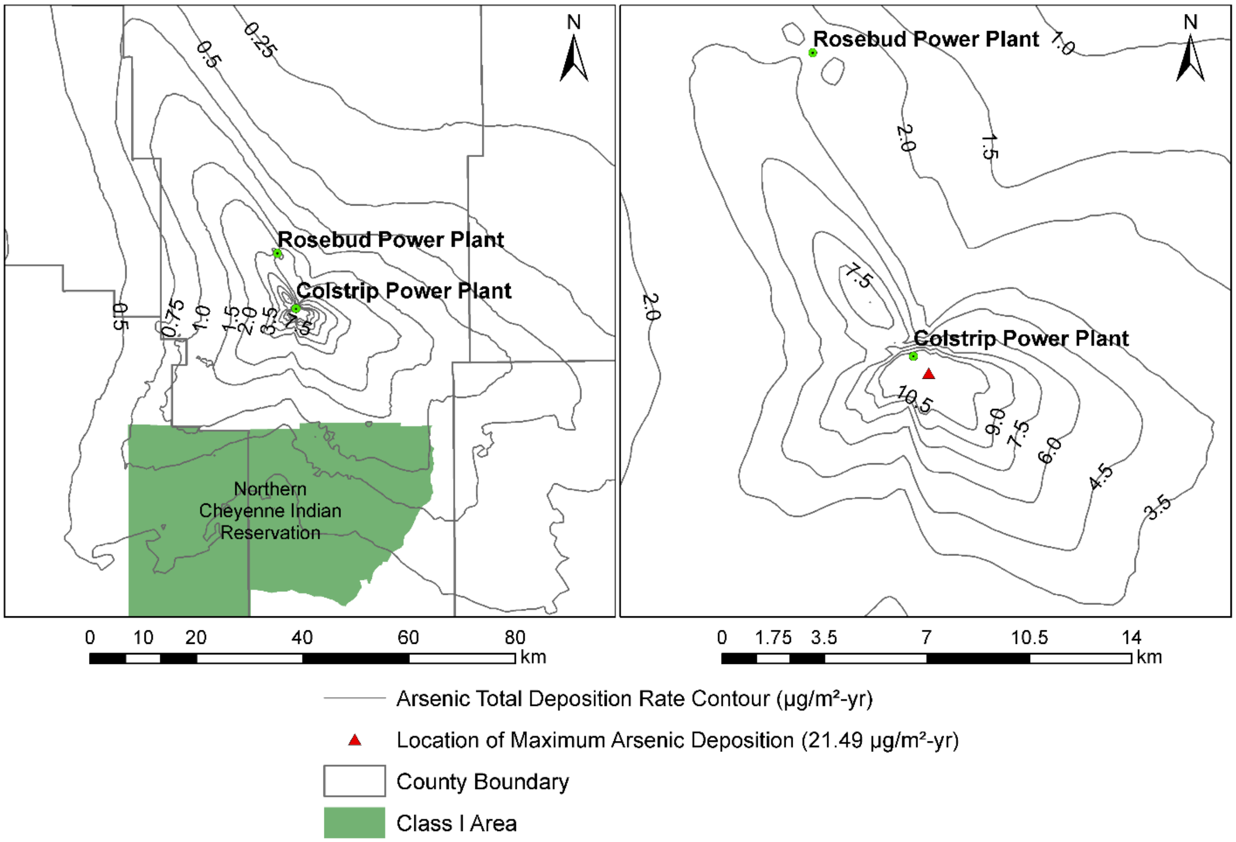


Figure 86. Spatial Distribution of the Modeled 5-year Average Annual Arsenic Deposition Resulting from Colstrip Units 3 and 4, and Rosebud Power Plant Emissions.

km = kilometers.

µg/m^2-y = micrograms per square meter per year.

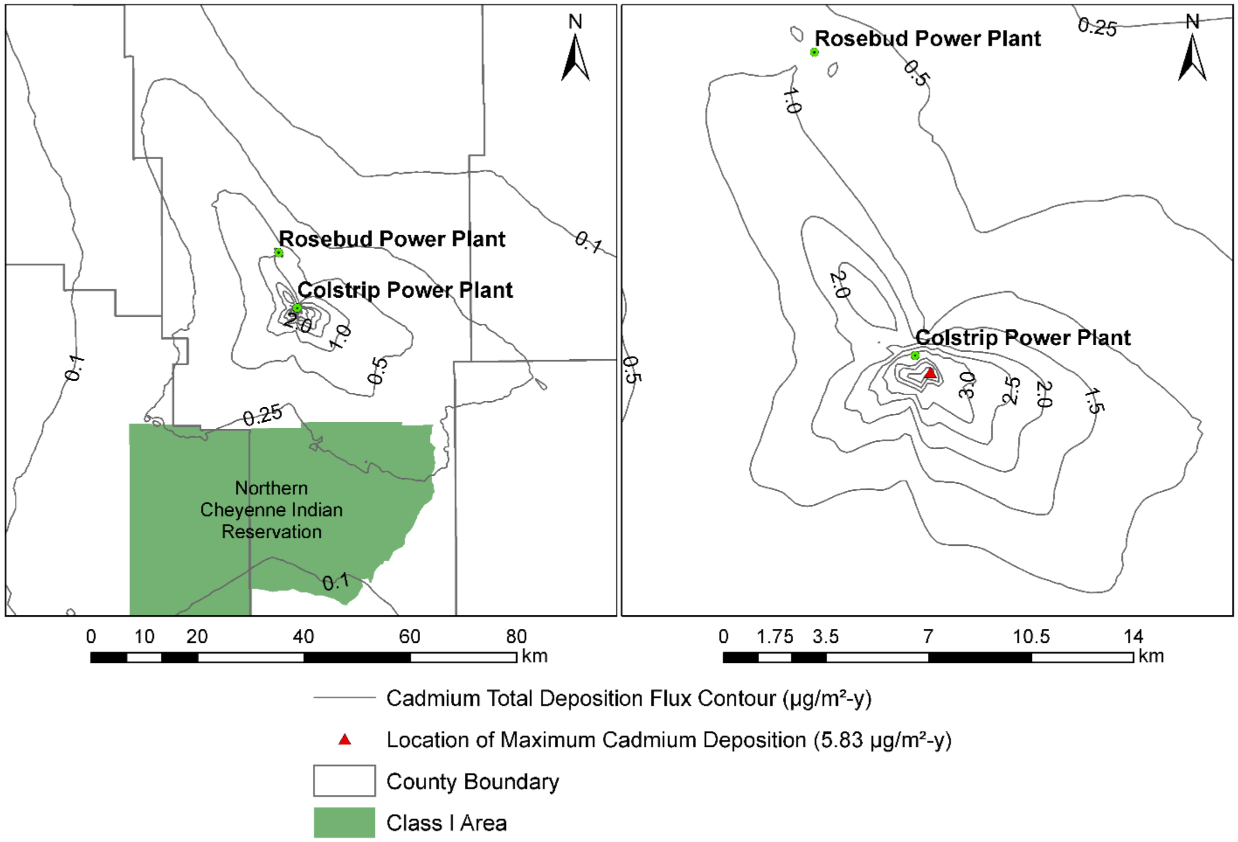


Figure 87. Spatial Distribution of the Modeled 5-year Average Annual Cadmium Deposition Resulting from Colstrip Units 3 and 4, and Rosebud Power Plant Emissions.

km = kilometers.

µg/m^2-y = micrograms per square meter per year.

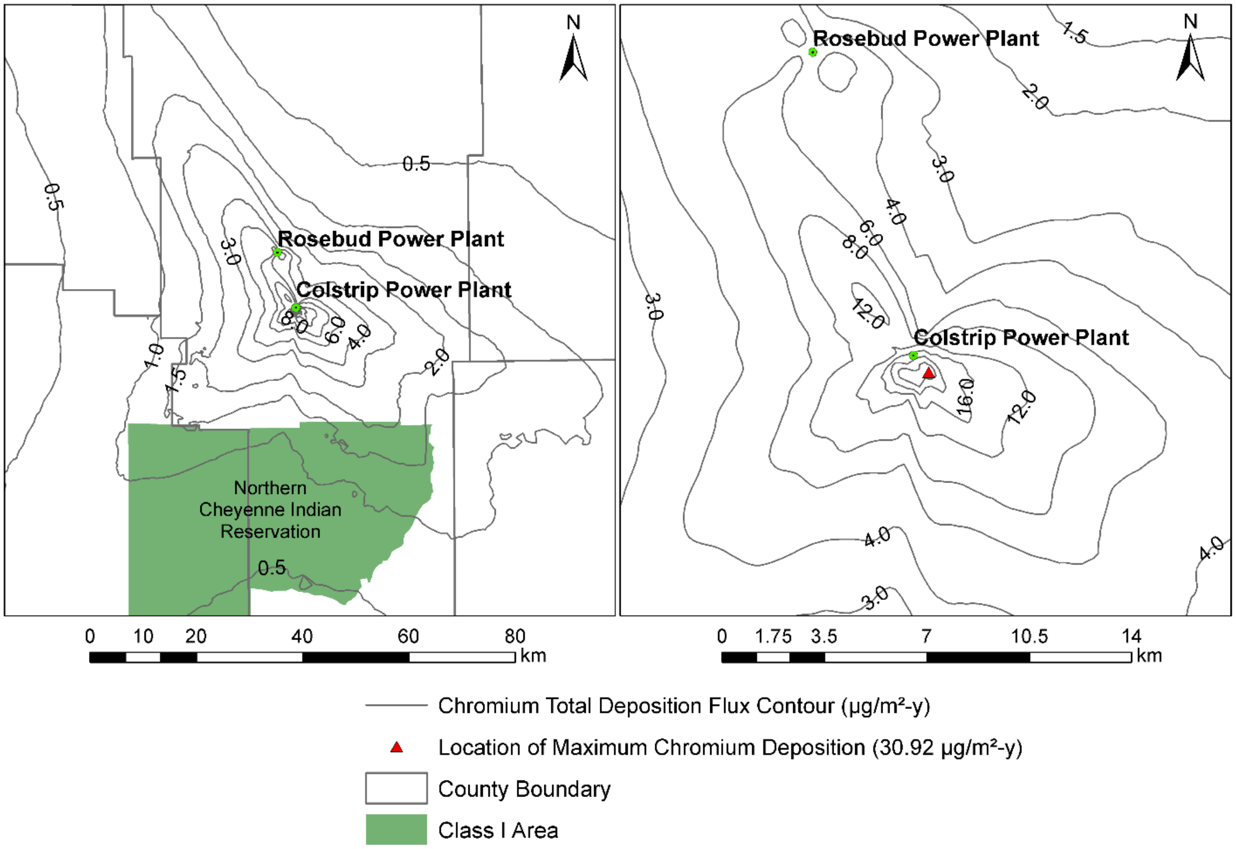


Figure 88. Spatial Distribution of the Modeled 5-year Average Annual Chromium Deposition Resulting from Colstrip Units 3 and 4, and Rosebud Power Plant Emissions.

km = kilometers.

µg/m^2-y = micrograms per square meter per year.

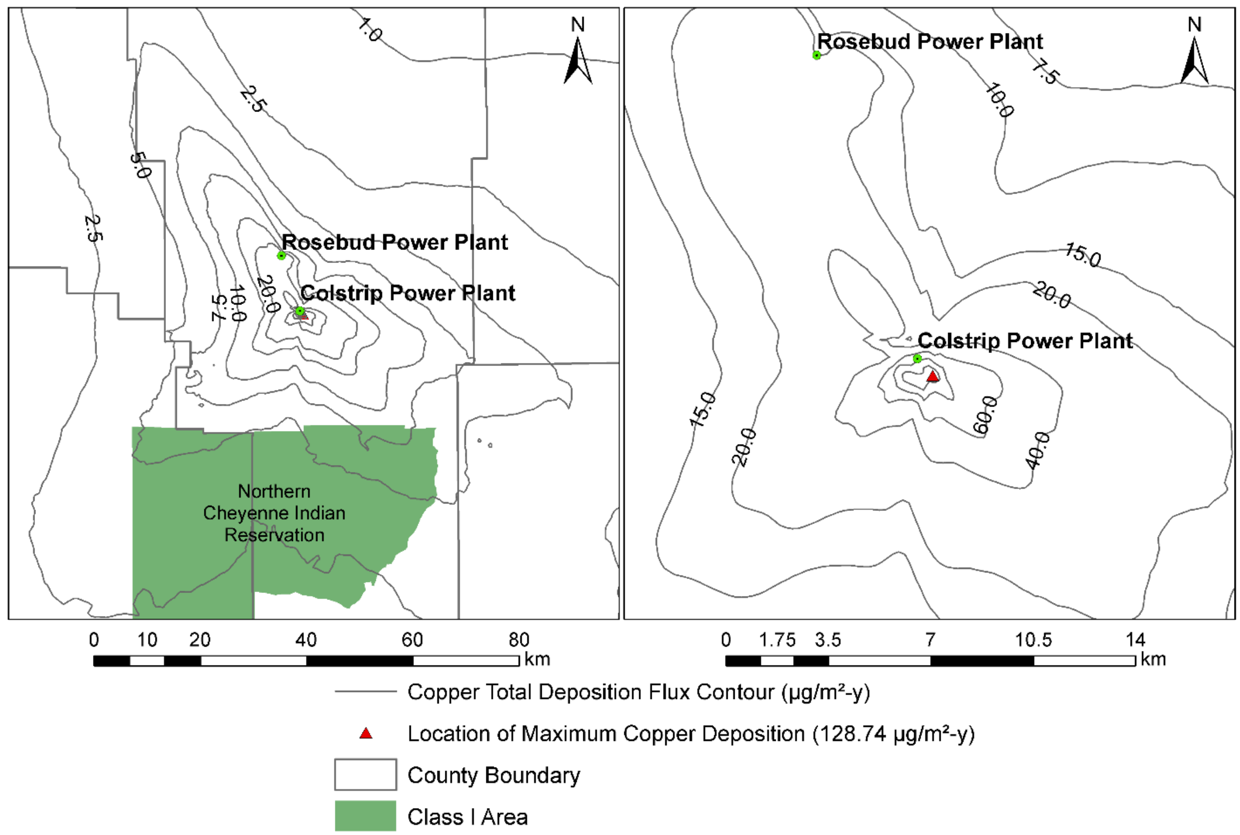


Figure 89. Spatial Distribution of the Modeled 5-year Average Annual Copper Deposition Resulting from Colstrip Units 3 and 4, and Rosebud Power Plant Emissions.

km = kilometers.

µg/m²-y = micrograms per square meter per year.

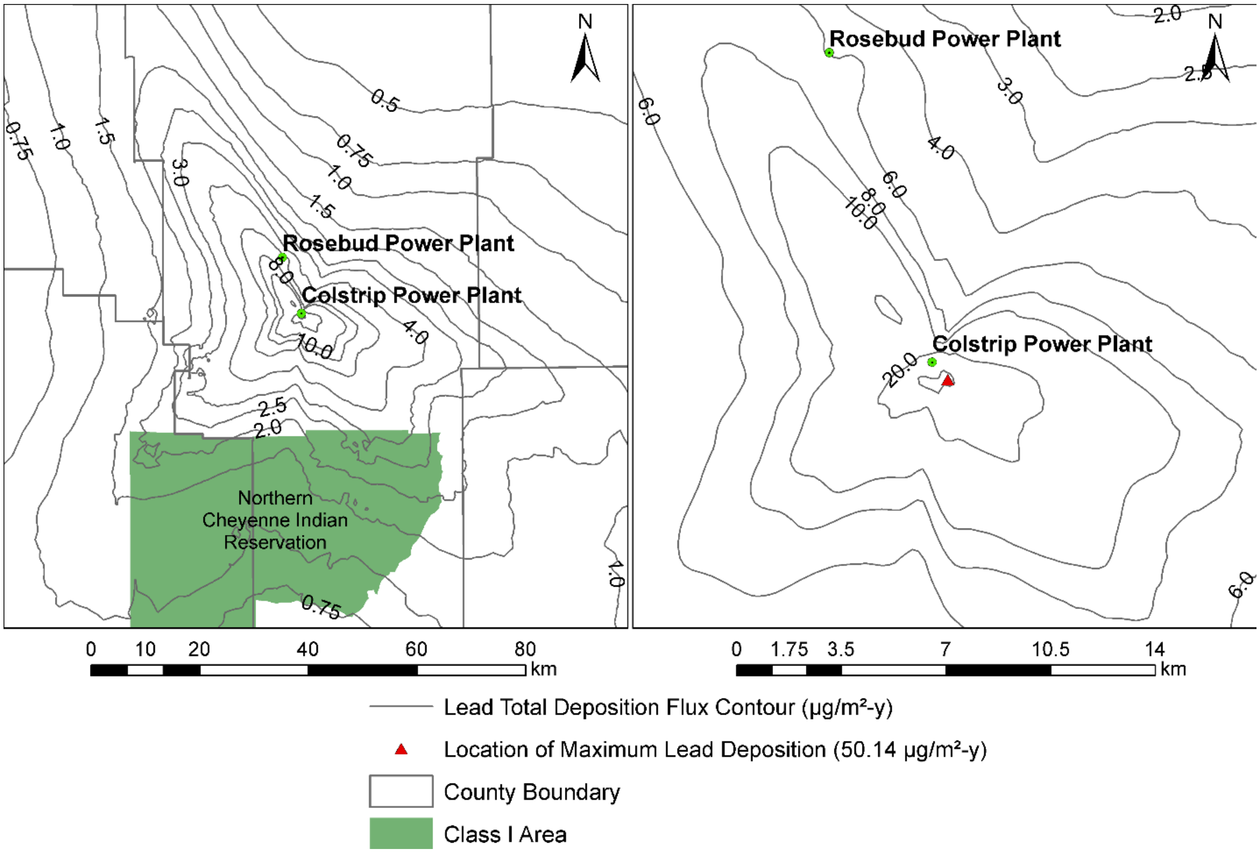


Figure 90. Spatial Distribution of the Modeled 5-year Average Annual Lead Deposition Resulting from Colstrip Units 3 and 4, and Rosebud Power Plant Emissions.

km = kilometers.

µg/m^2-y = micrograms per square meter per year.

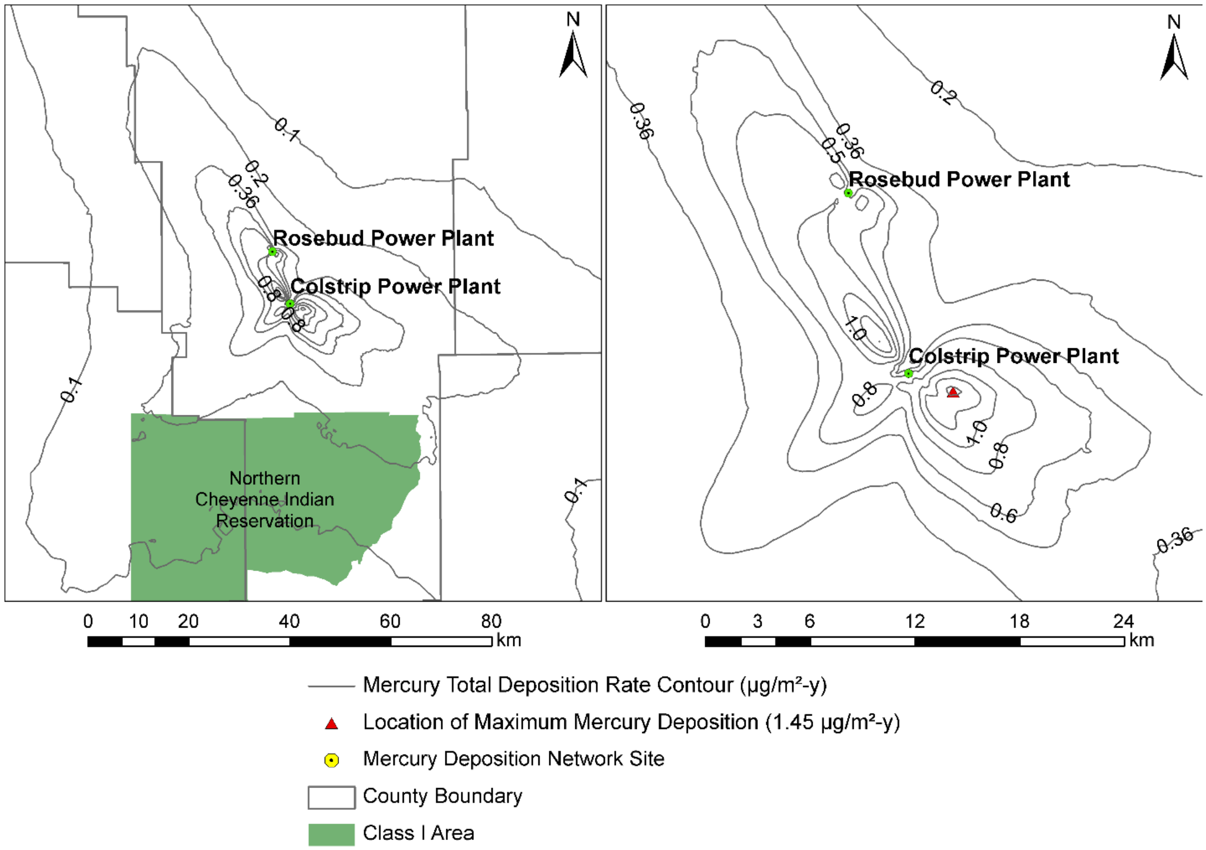


Figure 91. Spatial Distribution of the Modeled 5-year Average Annual Mercury Deposition Resulting from Colstrip Units 3 and 4, and Rosebud Power Plant Emissions.

km = kilometers.

µg/m^2-y = micrograms per square meter per year.

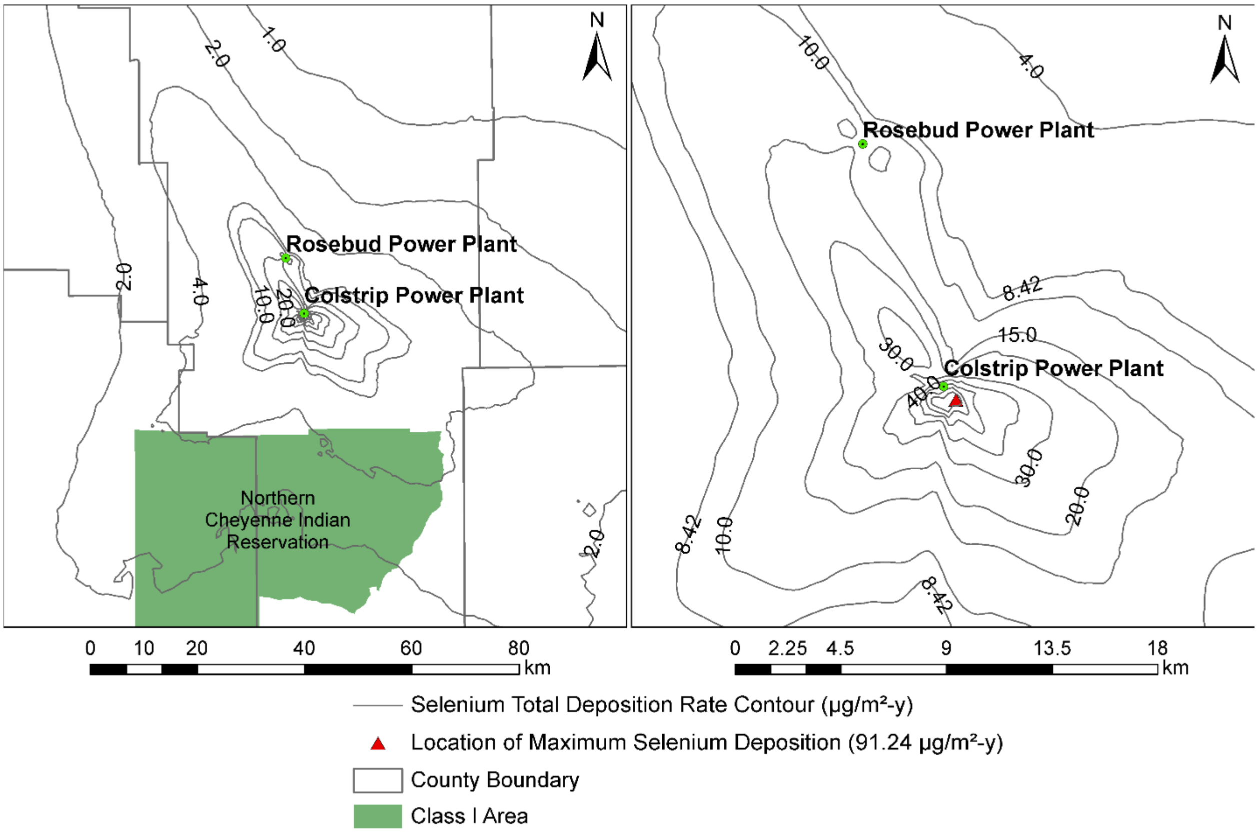


Figure 92. Spatial Distribution of the Modeled 5-year Average Annual Selenium Deposition Resulting from Colstrip Units 3 and 4, and Rosebud Power Plant Emissions.

km = kilometers.

µg/m^2-y = micrograms per square meter per year.

Deposition Analysis Area for Special Status Species due to Indirect Combustion Impacts

To establish the analysis area for special status species (see **Section 4.13, Special Status Species**) for indirect effects, the atmospheric dispersion and deposition of selected trace metal HAPs emitted as a result of the combustion of project area coal were simulated by applying the AERMOD model discussed above. The AERMOD modeling configuration is provided in the **Supporting Information for Air Quality Impact Analysis for Rosebud Mine Area F DEIS** in **Appendix D-8**.

Eight metal HAPs were modeled to establish the deposition analysis area for special status species for indirect effects. These HAPs are selected as they are commonly emitted from coal-fired power plants and due to their known relation to the ecological impacts from coal combustion and potential to act as primary ecological risk indicators (EPRI 2009, 2011). The examined metals were antimony, arsenic, cadmium, chromium, copper, lead, selenium, and mercury. The emissions of these eight trace metal HAPs are discussed in **Section 4.3.3.2, Emissions of Criteria and Hazardous Air Pollutants**.

Soil screening thresholds were used to delineate the area with potential impacts of the project area indirect effects on special status species as a result of the atmospheric deposition of the eight HAPs emitted during the combustion of project area coal at the Colstrip and Rosebud Power Plants. The analysis area for indirect effects of deposition on special status species was defined as the largest spatial extent for which incremental increases in soil concentrations caused by deposition from the HAPs from the two power plants exceeded 1 percent of the 95 percent upper confidence limit on the mean (95-percent UCL) soil concentration. This method is similar to the approach applied in the Four Corners Power Plant and Navajo Mine Energy Project Draft EIS Biological Assessment (OSMRE 2014b). It should be noted that the Four Corners Power Plant and Navajo Mine are in a different region of the country (northwestern New Mexico) and represent a connected action between the coal mine and power plant burning the coal while the project area analyzed in this EIS is not a connected action. Although, the project area analyzed in this EIS is not a connected action between the project area and the Colstrip and Rosebud Power Plants, we conservatively assessed the indirect effects of deposition due to the power plants.

The soil screening thresholds were defined using soil concentrations in Rosebud and Treasure Counties. These soil concentrations were obtained from data collected by the United States Geological Survey (USGS) from 2007 to 2010 (Smith et al. 2013). Surface soil data (0-5 centimeters) of all samples taken in Rosebud and Treasure Counties (and within 1 km of their borders) were used to characterize soil concentrations. The 95-percent UCL soil concentrations are shown in **Table 113**. The 95-percent UCL values were calculated using the EPA's ProUCL software (version 5.1) (https://www.epa.gov/land-research/proucl-software) using the non-detect method that accounts for samples that were below the detection limit. The locations and measured concentrations at each site are shown in **Supporting Information for Air Quality Impact Analysis for Rosebud Mine Area F DEIS** in **Appendix D-8**.

Table 113. Measured Soil Concentrations for Selected Metals.

	Antimony	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Selenium
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
95% UCL[1]	9.01E-01	1.09E+01	2.81E-01	5.05E+01	1.91E+01	1.78E+01	2.30E-02	5.33E-01

mg/kg = milligram per kilogram dry weight in soil.
[1]95% UCL calculated using EPA ProUCL v.5.1 with the option for data with non-detects.

The deposition (micrograms per square meter, $\mu g/m^2$) that would result in the soil concentration threshold for each metal was estimated by assuming an untilled soil mixing depth of 2 cm and a soil dry bulk density of 1.5 g/cm^3 as recommended by EPA (2005c). Annual deposition corresponding to soil screening thresholds ($\mu g/m^2$-year) was calculated by dividing each of the total deposition rate thresholds by 19, the number of years of combustion of project area coal. The maximum deposition for each trace metal is shown in **Table 114**, along with the deposition corresponding to the soil screening thresholds.

Table 114. Screening Thresholds for Selected Metals.

Chemical	Soil Screening Threshold [1% of 95-percent UCL on Mean Soil Concentration] (mg/kg)	Corresponding Annual Deposition ($\mu g/m^2$-y)
Antimony	9.01E-03	1.42E+01
Arsenic	1.09E-01	1.72E+02
Cadmium	2.81E-03	4.44E+00
Chromium	5.05E-01	7.97E+02
Copper	1.91E-01	3.02E+02
Lead	1.78E-01	2.80E+02
Mercury	2.30E-04	3.63E-01
Selenium	5.33E-03	8.42E+00

mg/kg = milligram per kilogram dry weight in soil.
$\mu g/m^2$-y = micrograms per square meter per year.

Cadmium, mercury, and selenium are the only metals whose modeled deposition rates exceed the soil screening thresholds beyond the Colstrip Power Plant fenceline. The distances from Colstrip Units 3 and 4 beyond which the deposition rates of these metals fall below the screening thresholds are listed in **Table 115**. The selenium deposition reaches a maximum of 91.24 $\mu g/m^2$-year along the Colstrip Power Plant fenceline approximately 800 meters south-southeast of the Unit 3 and 4 stacks, while the mercury deposition reaches its maximum of 1.45 $\mu g/m^2$-year approximately 2.9 km to the east-southeast.

Table 115. Distance from Colstrip Beyond Which Modeled Deposition Drops Below Thresholds.

Threshold	Distance (km)			
	Mercury	Selenium	Cadmium	Antimony, Arsenic, Chromium, Copper, and Lead
1% of 95% UCL on mean soil concentrations	32	24	1	--- (within fence-line)

Over the 19-year operations period of the Proposed Action, surface soil concentrations of cadmium, selenium, and mercury were predicted to reach 1 percent of the 95-percent UCL of soil concentrations in an area extending to a maximum of approximately 1, 24, and 32 km from the Colstrip Power Plant, respectively. The extents of the areas in which mercury and selenium deposition exceed their soil concentration threshold are shown in **Figure 93** and **Figure 94**. The area in which the cadmium deposition is predicted to exceed its soil concentration threshold is a relatively small area south from Colstrip reaching a maximum distance of approximately 1 km from Units 3 and 4. Because the spatial extent of the irregular shape of the analysis area largely follows the prevailing wind directions, the analysis area for special status species was conservatively defined as a 32-km radius circle around the Colstrip Power Plant to account for uncertainties in wind direction. The choice of a circle rather than the smaller irregular extent represents a conservative measure of the analysis area because large parts of the circular region were below the threshold.

The analysis area for special status species from indirect combustion impacts at Colstrip Units 3 and 4 and Rosebud Power Plant is 32 km. The potential impacts on special status species due to indirect combustion impacts are discussed in **Section 4.13, Special Status Species**.

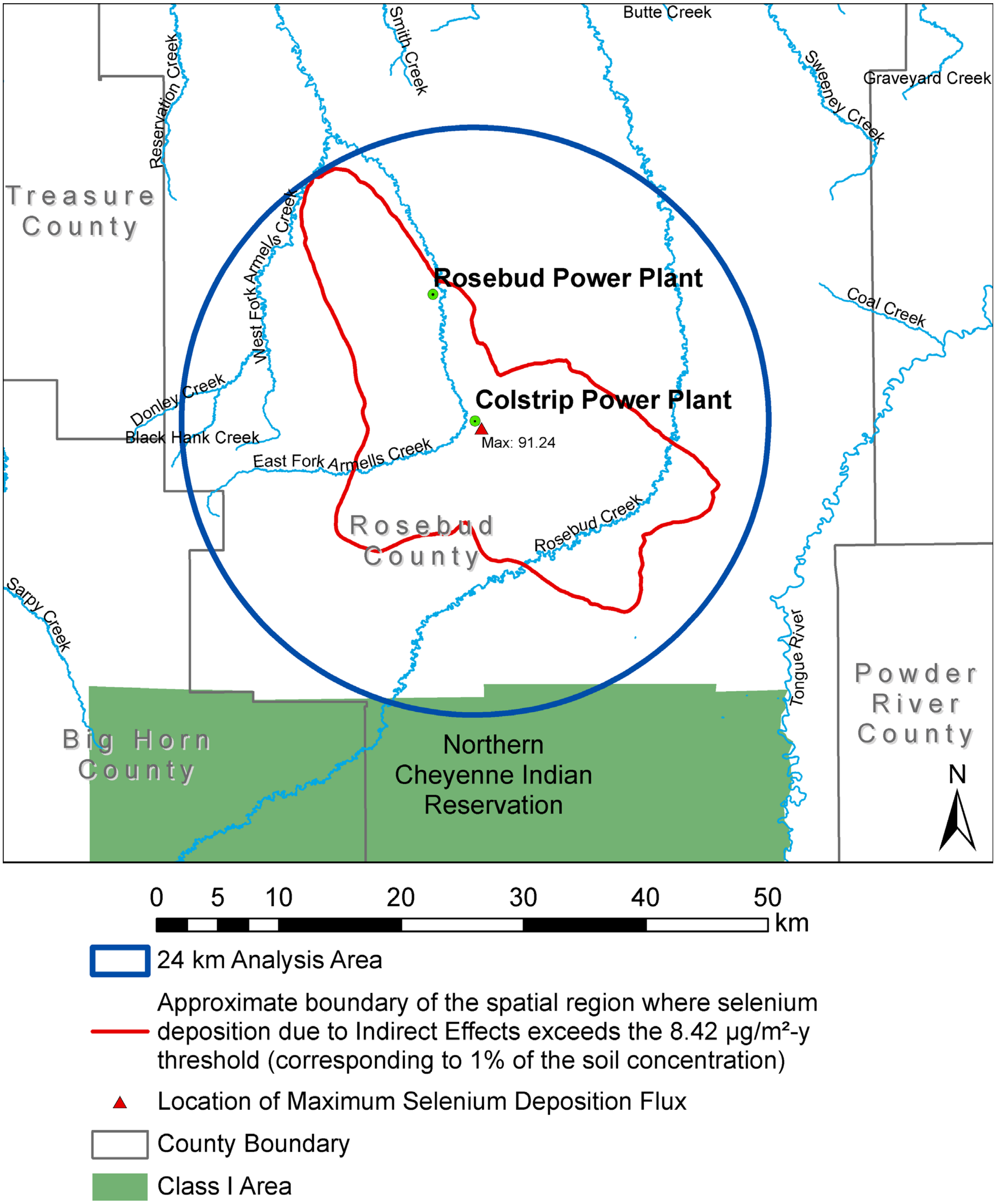


Figure 93. Indirect Effects Selenium Deposition Analysis Area for Special Status Species.
km = kilometers.

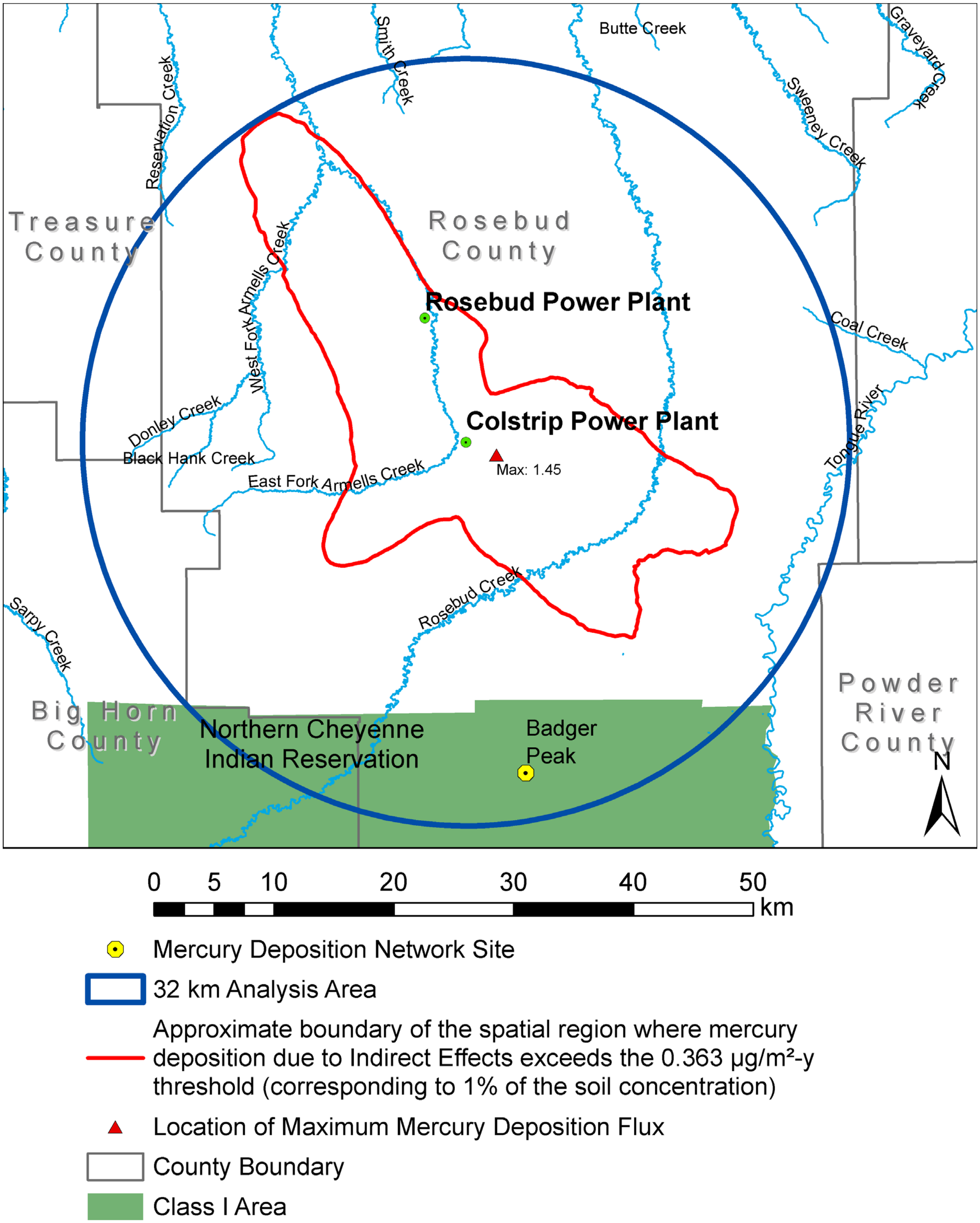


Figure 94. Indirect Effects Mercury Deposition Analysis Area for Special Status Species.

km = kilometers.

4.3.4 Alternative 3 – Proposed Action Plus Environmental Protection Measures

Several control measures are in place at the Rosebud Mine to reduce air emissions; these have been reported in the MAQP #1570-08 and MAQP #1483-08 (Appendices A and B) and discussed in **Section 3.3.4.1, Existing Emissions from Rosebud Mine**.

In addition, the state of Montana utilizes a number of measures through permitting and enforcement that serve to provide reasonable precautions against excess PM generation, as specified in ARM 17.8.308. These measures, discussed in **Section 3.3.1.1, State Requirements**, will be applicable to the project area and other areas of the Rosebud Mine. The Proposed Action, including direct and indirect effects, would not result in major adverse effects on air quality; therefore, no additional environmental protection measures are recommended.

The impacts of Alternative 3 on air quality would be the same as Alternative 2.

4.3.5 Irreversible and Irretrievable Commitment of Resources

The irreversible and irretrievable commitment of resources is not applicable to Air Quality.

4.4 CLIMATE AND CLIMATE CHANGE

4.4.1 Analysis Methods and Impact and Intensity Thresholds

4.4.1.1 Analysis Methods

Climate and climate change are studied through examining the scientific literature on trends in climate-change indicators such as temperature and precipitation and trends in global, national, and state greenhouse gas (GHG) emissions and by estimating GHG emissions from project area sources and other mine areas and the combustion of project area coal at Colstrip and Rosebud Power Plants.

4.4.1.2 Impact and Intensity Thresholds

There are no impact and intensity thresholds available to characterize the significance of the effect of a single action on global climate change; as such, no thresholds are presented here. Rather, the anticipated GHG emissions changes relative to current conditions will be disclosed for the Proposed Action and each alternative.

4.4.2 Alternative 1 – No Action

As described in **Section 2.3**, Western Energy would not develop the project area under the No Action Alternative. The conditions described in **Section 3.4** would continue into the foreseeable future, resulting in no change to current operations at the Rosebud Mine, and selection of this alternative would not necessarily lead to mine closure. Areas A, B, and C are still actively mined (see **Section 2.2.3**). In addition, Western Energy is in the process of applying for the AM5 permit. If approved, AM5 would be mined until 2043 (see **Section 5.2.2, Reasonably Foreseeable Future Actions**).

Because selection of the No Action Alternative would not impact operations at existing areas of the mine, AM5, Colstrip, or the Rosebud Power Plant, GHG emissions from these areas and facilities are discussed below along with projected global, national, and regional GHG emission trends and climate impacts. While projected GHG emissions are used as means of assessing potential climate impacts, it should be noted that GHG emissions are influenced by a number of complex factors including but not limited to population growth, changes in energy production and land use, climate policy, economic and technological development, and human lifestyle changes (IPCC 2014). Thus, projections of GHG emissions are fundamentally uncertain and are not predictions of future GHG emissions, but are instead evaluations of the likely range of possible emission scenarios given the underlying assumptions (Melillo et al. 2014).

4.4.2.1 Global Projected GHG Emission Trends and Climate Impacts

In its fifth assessment report (AR5), IPCC uses four representative concentration pathways (RCPs) that represent different progressions of GHG emissions and concentrations, air-pollutant emissions, and land use that result in radiative forcing[23] values for the year 2100 that range from 2.6 watts per square meter (W/m^2) to 8.5 W/m^2 relative to 1750 (IPCC 2014). The RCPs, which are named after the corresponding radiative forcing in 2100, characterize a wide range of possible scenarios and include a stringent mitigation scenario in which GHG emissions are reduced by more than 70 percent by 2050 (RCP2.6), a very high GHG emission scenario (RCP8.5), and two intermediate scenarios (RCP4.5 and RCP6.0). The

[23] Radiative forcing is the difference between sunlight absorbed by the earth and energy radiated back to space.

2100 GHG concentrations, in parts per million (ppm) CO_2e, and radiative forcing associated with the RCPs are shown in **Figure 95**, along with the range of scenarios used by IPCC's Working Group III (WGIII) in the "Mitigation of Climate Change" report of AR5 (IPCC 2014). The RCP scenarios range from 450 ppm to greater than 1000 ppm CO_2e in 2100. The annual GHG emissions corresponding to the RCPs are shown in **Figure 96**. Global GHG emissions through the first half of the 21st century are projected to continue to increase in all cases except for the most stringent mitigation scenario (RCP2.6).

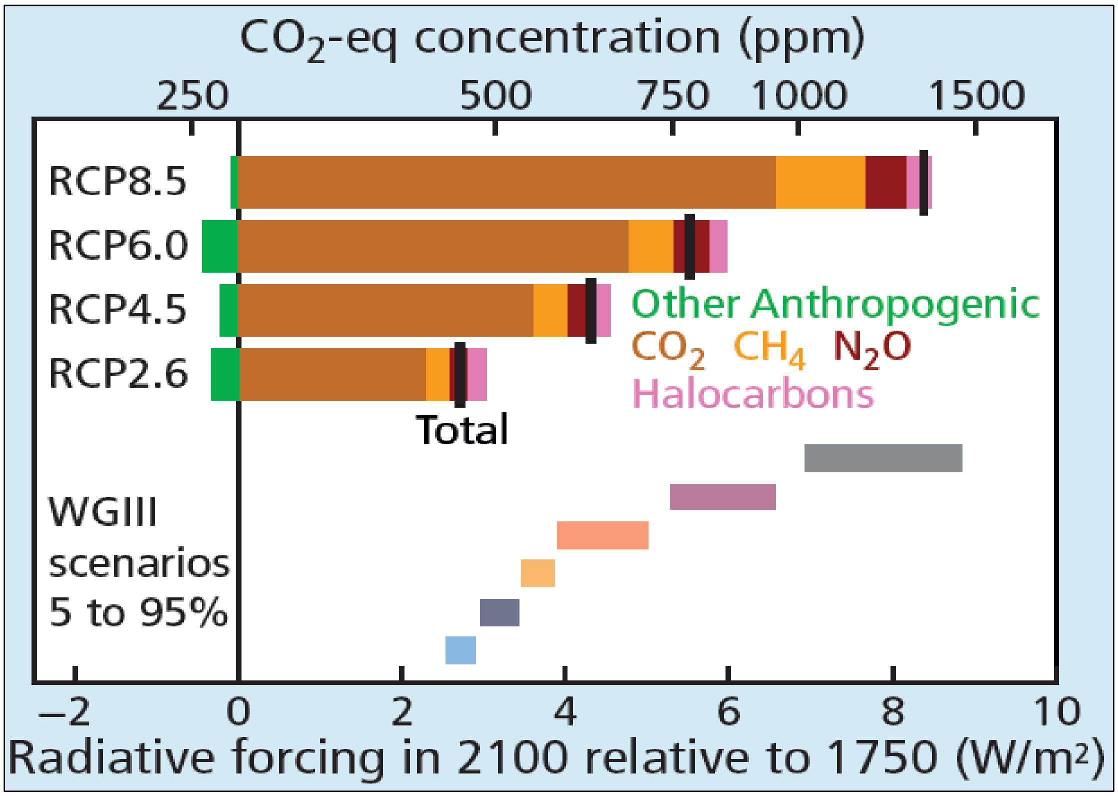


Figure 95. CO_2 Equivalent Concentrations and Radiative Forcing in 2100 Associated with the Four Representative Concentration Pathways Used in IPCC's Fifth Assessment Report.

The range of scenarios used in the Mitigation of Climate Change assessment of IPCC's Working Group III (WGIII) is also shown.
Source: IPCC 2014.
ppm = parts per million; W/m^2 = watts per square meter.

Future climate impacts will be influenced by both past and future anthropogenic GHG emissions. Climate studies find a strong, near-linear relationship between cumulative CO_2 emissions since 1870 and the projected global temperature change relative to 1861–1880 (**Figure 97**). Projected global mean surface temperature change for the late 21st century (2081–2100) relative to 1986–2005 ranges from 1.0 degrees Celsius (°C) to 3.7 °C, with all scenarios except RCP2.6 likely resulting in warming that exceeds 1.5 °C (**Figure 98**). The projected global mean sea level rise ranges from 0.40 meters (m) to 0.63 m for the same period (**Figure 98**).

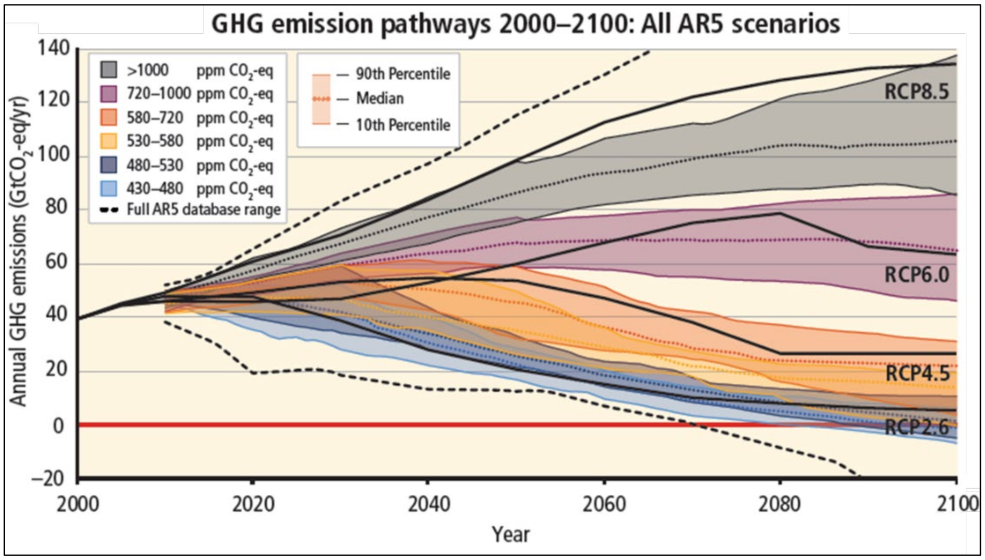


Figure 96. Global Greenhouse Gas Emissions (Gigatonne CO2e per Year) for the RCP Used in IPCC's AR5.

Source: IPCC 2014.

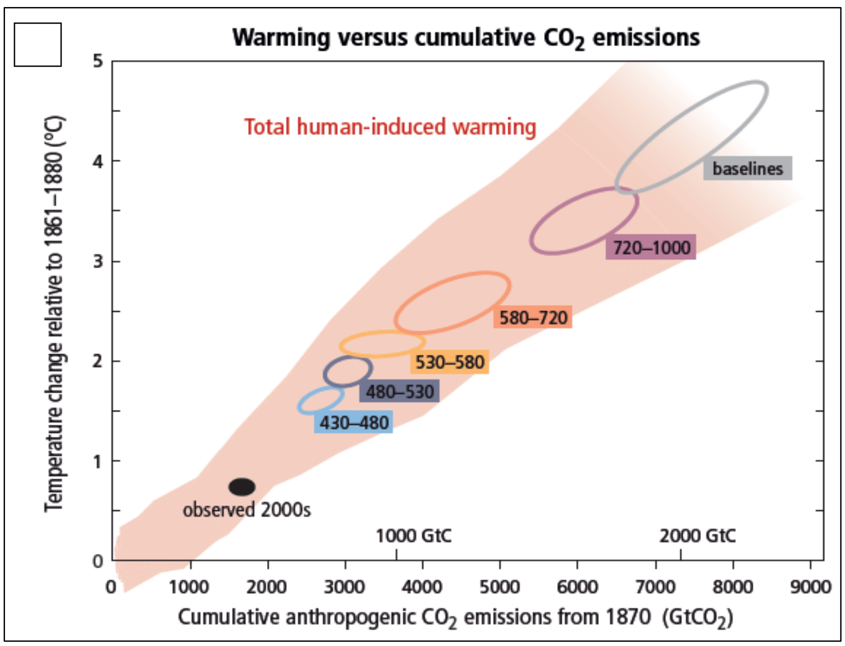


Figure 97. The Relationship between Cumulative Anthropogenic CO_2 Emissions from 1870 and Projected Temperature Change Relative to 1861–1880.

Source: IPCC 2014.

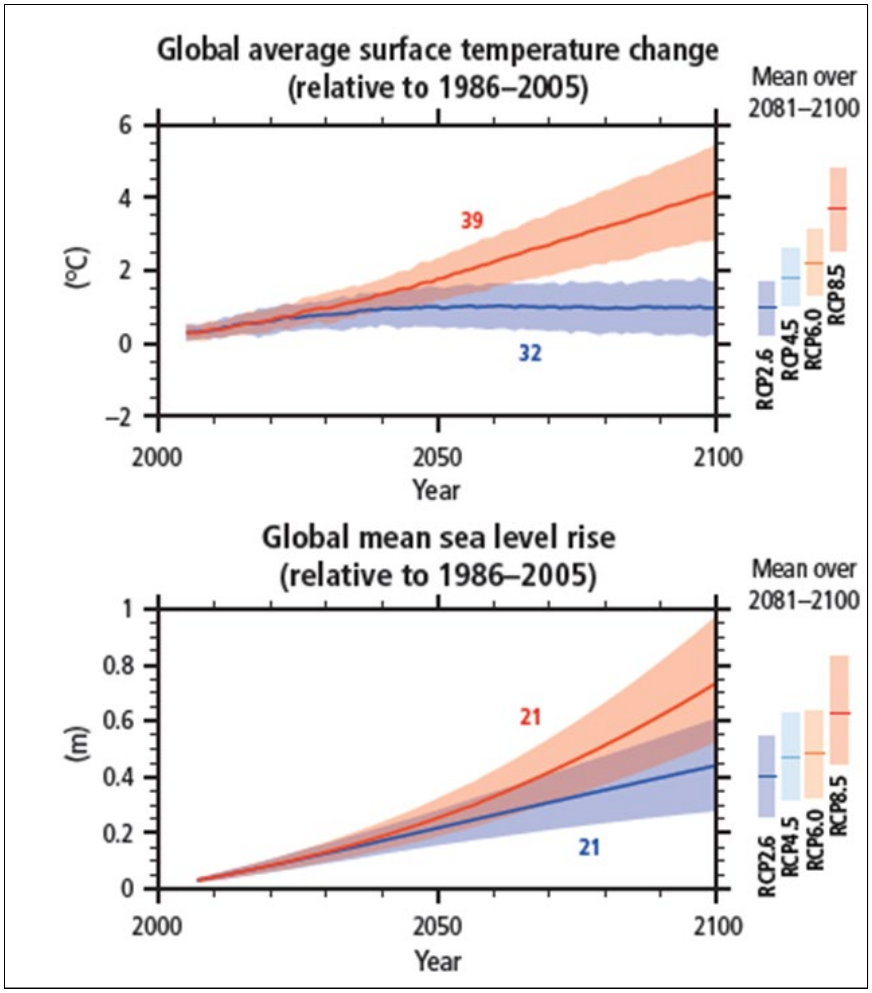


Figure 98. Time Series of Global Annual Change in Mean Surface Temperature and Mean Sea Level Rise Relative to 1986 to 2005 for the RCP2.6 and RCP8.5 Scenarios.

Source: IPCC 2014.

The Arctic is projected to continue to warm more than the global mean with year-round reductions in Arctic sea ice projected for all scenarios (IPCC 2014). The September Arctic sea-ice extent is projected to approach or exceed "essentially ice-free" conditions by the late 21st century in all emission scenarios except for RCP2.6 (**Figure 99**). In addition, warming global surface temperatures will result in more hot and less cold temperature extremes over most land areas, changes in precipitation, increases in ocean acidification, and reduction in near-surface permafrost extent at high northern latitudes for all scenarios.

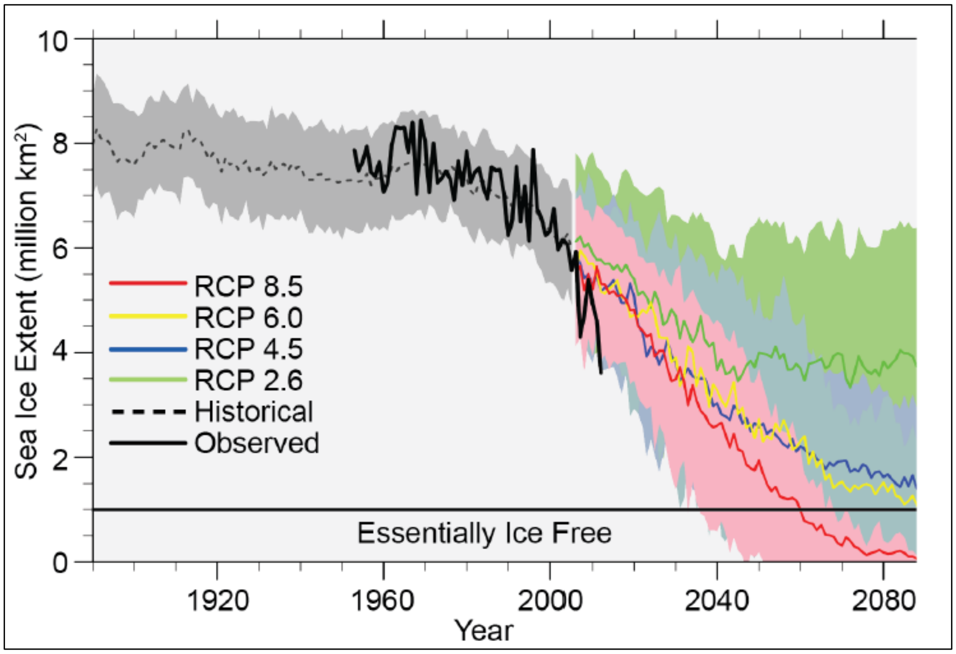


Figure 99. Time Series of Historical and Projected Arctic Sea-Ice Extent for September.

Source: Stroeve et al. 2012; Melillo et al. 2014.

4.4.2.2 National GHG Emission Trends and Climate Impacts

Much like global emissions, future U.S. GHG emissions trends will be influenced by many factors including economic growth and policy changes. The Energy Information Administration (EIA) projected future energy-related CO_2 emissions from the United States for a number of different scenarios in its 2017 Annual Energy Outlook (**Figure 100**). The reference case assumes trend improvement in known technology, uses trends in economic and demographic changes that are representative of current forecasts, and accounts for existing laws and regulations (EIA 2017). In most cases, the EIA projects that U.S. GHG emissions will decrease. However, annual energy-related CO_2 emissions are projected to decrease at a slower average annual rate (0.2 percent) than they did between 2005 and 2016 (1.4 percent). Increases in domestic industries are projected to result in increases in U.S. CO_2 emissions from the industrial sector, while the replacement of coal-fired power plants with natural gas, solar, and wind capacity is expected to reduce U.S. electricity-related GHG emissions (EIA 2017).

Projected climate impacts in the United States vary both between emission scenarios and spatially within a single emission scenario. The projected surface temperature changes in the late 21st century (2071–2099) relative to average surface temperatures from 1970 to 1999 are shown in **Figure 101** for each of the RCP scenarios. Warming is projected for all parts of the country with the larger increases in the northern latitudes. However, the magnitude of surface temperature change ranges from 3 °F to 15 °F across RCP scenarios. Frost-free season lengths are expected to increase across the United States with the largest projected increases being more than 8 weeks in the western United States under scenarios in which GHG emissions continue to increase (Melillo et al. 2014).

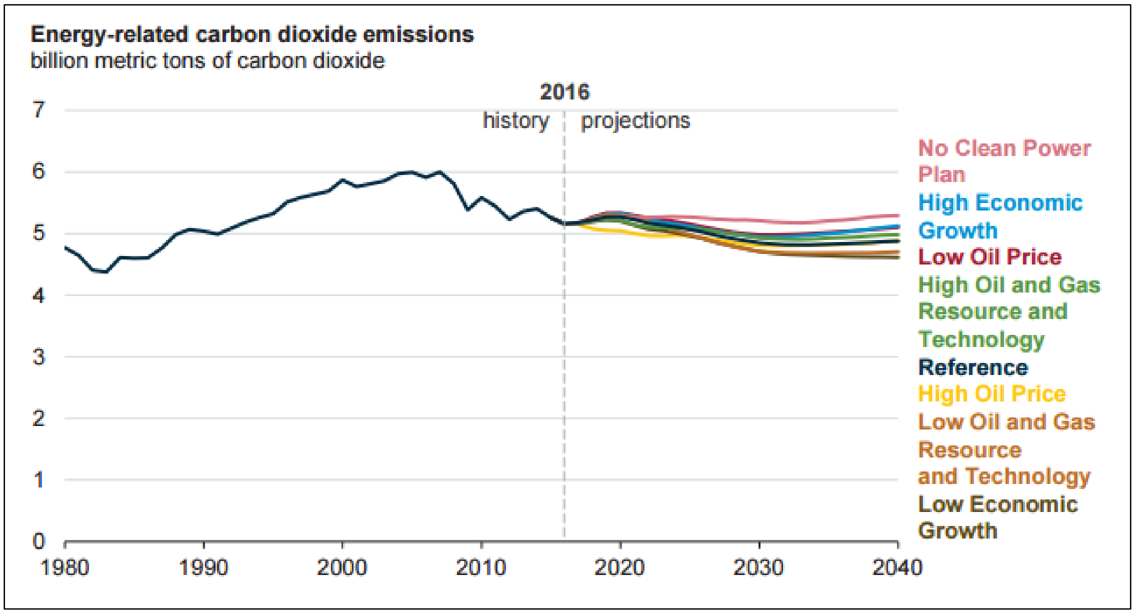


Figure 100. Historical and Projected Energy-Related U.S. CO_2 Emissions for Different Energy Production Scenarios.

Source: EIA 2017.

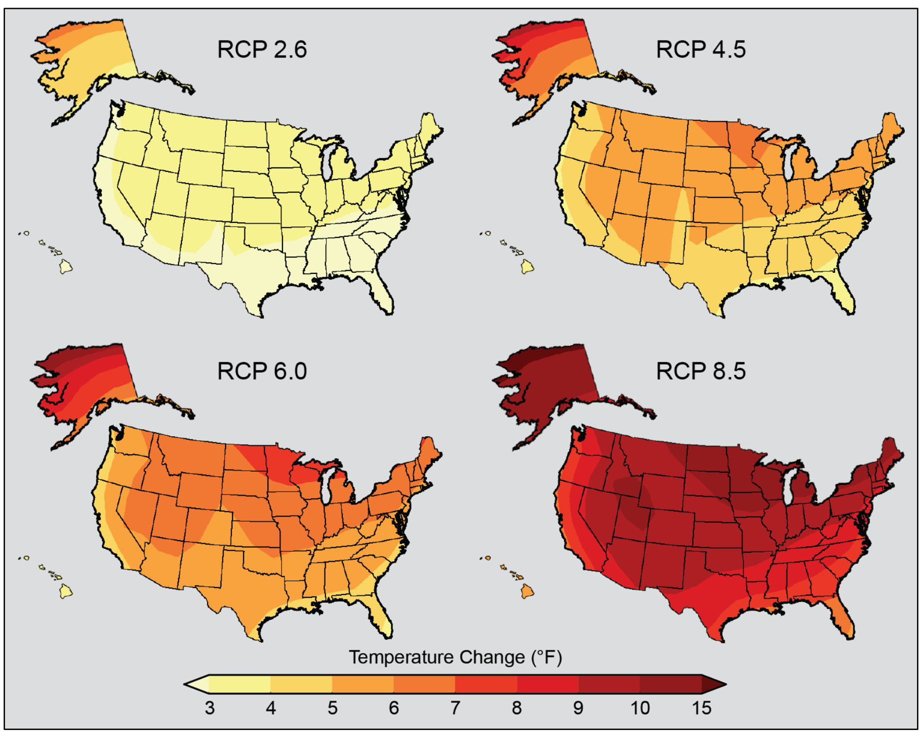


Figure 101. Projected Change in Surface Air Temperatures in the Late 21st Century (2071–2099) Relative to Average Surface Temperatures from 1970 to 1999.

Source: Melillo et al. 2014.

Changes in precipitation in the United States are projected with generally higher precipitation in the north and lower precipitation in the south (**Figure 102**). The recent trend in increased heavy precipitation events is also projected to continue, including the areas where total precipitation is projected to decrease (Melillo et al. 2014). Extreme daily precipitation events in the United States are projected to nearly double under RCP 2.6 and are projected to occur up to five times as often under RCP 8.5. In addition, the number of extremely hot days is projected to continue to rise with extreme heat days that previously occurred once in 20 years occurring once every 2 to 3 years over most of the country (Melillo et al. 2014).

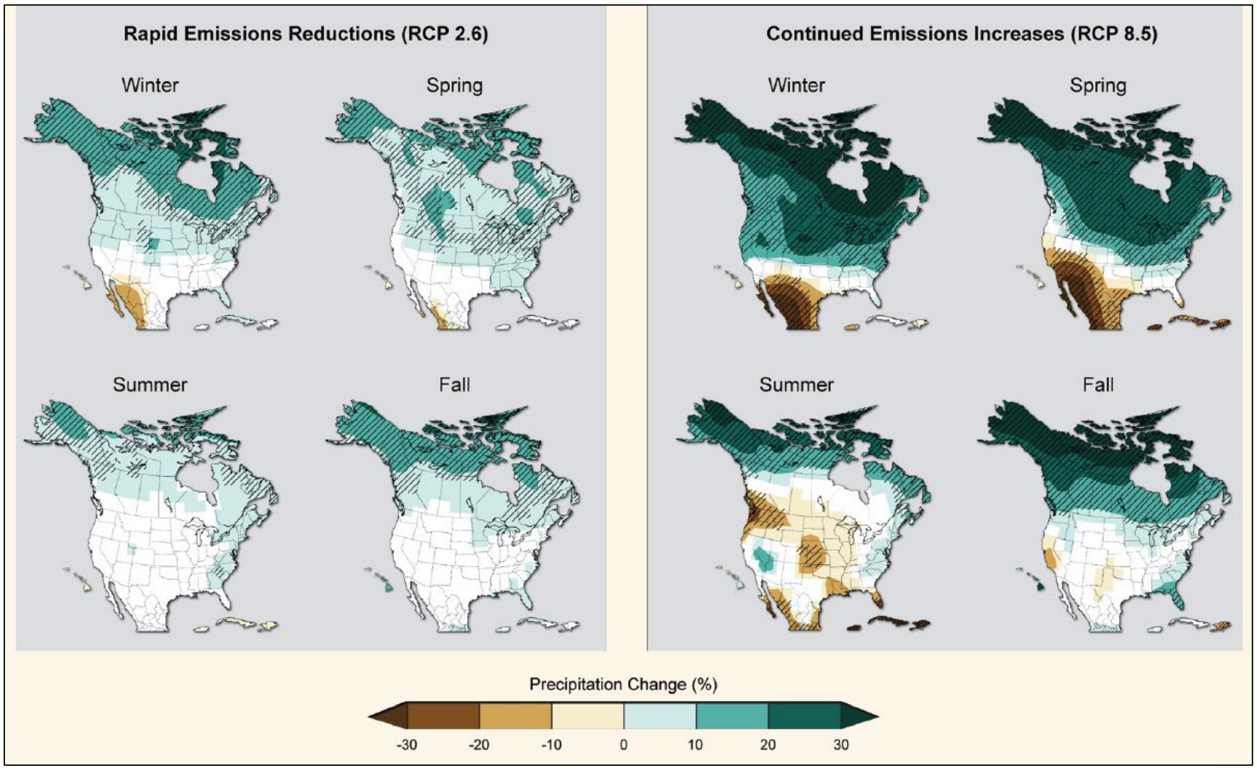


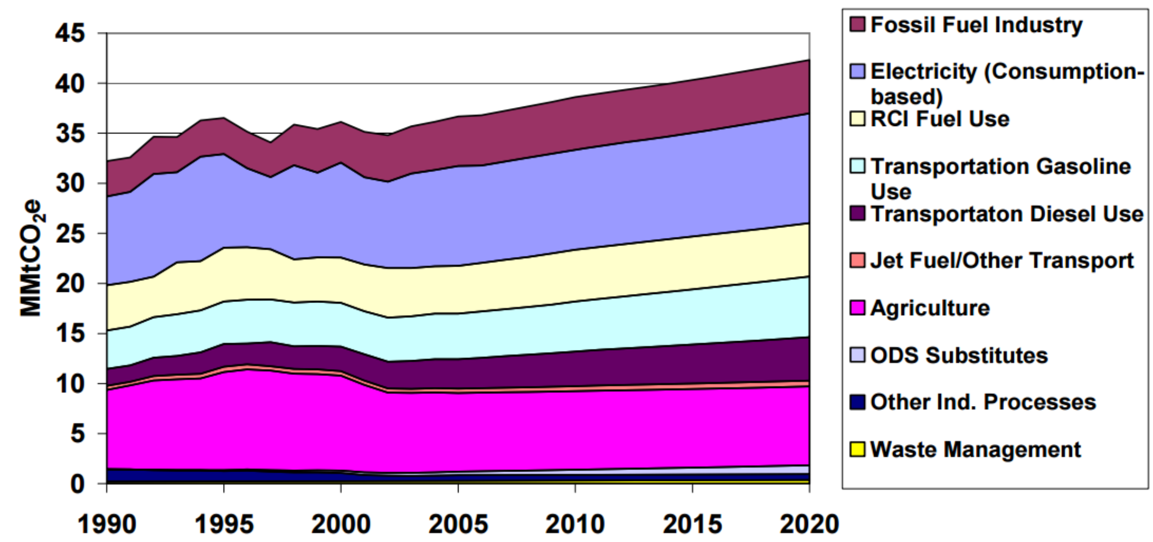
Figure 102. Projected Seasonal Precipitation Change in the Late 21st Century (2071–2099) Relative to 1970 to 1999 for the Rapid Mitigation Scenario (RCP2.6) and the High GHG Emission Scenario (RCP8.5).

Source: Melillo et al. 2014.

4.4.2.3 State and Regional GHG Emission Trends and Climate Impacts

In 2007, the Montana Climate Change Advisory Committee reported an inventory of historical and projected GHG emissions for the state from 1990 to 2020 for a reference case and a high fossil-fuel production and consumption scenario (Center for Climate Strategies 2007).

Figure 103 presents the gross GHG emissions by sector for the reference case, which excludes sequestration and GHG emissions from exported electricity.



*RCI = direct fuel use in residential, commercial, and industrial sectors (excluding the fossil fuel production industry); ODS = ozone-depleting substance. Other Ind. Processes includes process-related GHG emissions from aluminum production, cement production, and soda ash, limestone, and dolomite use.

Figure 103. Montana Historical and Projected Gross GHG Emissions by Sector, 1990–2020.

Source: Center for Climate Strategies 2007.

In this scenario, GHG emissions are projected to continue to rise, reaching 42 million metric tons of carbon dioxide equivalents (MMtCO_2e) by 2020, which is 30 percent higher than 1990 emissions. Most of the projected growth is expected to come from the transportation sector, and the transportation, electricity, and agriculture sectors continue to be the largest sources of MT's GHG emissions (DEQ 2007). In the high fossil-fuel scenario, which was intended to be representative of the high end of possible fossil-fuel growth, MT's gross GHG emissions are projected to reach 52 MMtCO_2e by 2020, which is 61 percent higher than 1990 emissions. The 20 largest sources of GHG within about 300 km of the Rosebud Mine are provided in **Section 3.4.2.3.3** and are reproduced in **Table 116** below**.** While the emissions are provided for 2015, these facilities are expected to remain as large sources of GHG for the near future with no reasonably foreseeable changes in emissions.

Table 116. 20 Largest GHG Emission Sources within 300 km of the Rosebud Mine.

Facility	Annual GHG Emissions[1] (MT CO_2e)
Colstrip	15,972,993
Dave Johnston	5,558,885
Dry Fork Station	3,123,225
Wyodak	3,114,905
Yellowstone Energy Limited Partnership	906,819
Wygen I	872,061
Phillips 66 Billings Refinery	837,699
Wygen III	828,737
Wygen II	770,723
ExxonMobil Refining and Supply Billings Refinery	766,725
Neil Simpson II	761,209
CHS Inc. Laurel Refinery	747,231
Hardin Generating Station	615,245
GCC Dacotah	592,051
Rosebud Power Plant	476,129
Graymont Western - U.S. Inc. Indian Creek	342,287
Pete Lien & Sons, Inc.	334,913
Bison Treating Facility	329,161
Trident	304,320
Lewis & Clark	300,808

Source: EPA 2017g.
[1]CO_2e are calculated using global warming potentials from IPCC's AR4 report.
MT CO_2e = metric tons CO_2 equivalent.

Much like the United States in general, the number of days with hot temperatures is projected to largely increase across the Great Plains region even under scenarios in which GHG emissions are reduced. Days with temperatures over 100 °F are projected to double in the north and quadruple in the south, with similar increases in nights with temperatures higher than 80 °F (Melillo et al. 2014). **Figure 104** shows the projected increases in hot days and warm nights for the Great Plains for lower (B1) and higher (A2) GHG emission scenarios. Increasing temperatures will result in warmer winters and a longer growing season but also increases in surface water losses and increases in demand for air conditioning in the summer. Warmer winters will also allow pests and invasive weeds (e.g., cheatgrass) to increase in distribution and frequency in wheat cropland and rangeland (Melillo et al. 2014; Whitlock et al 2017).

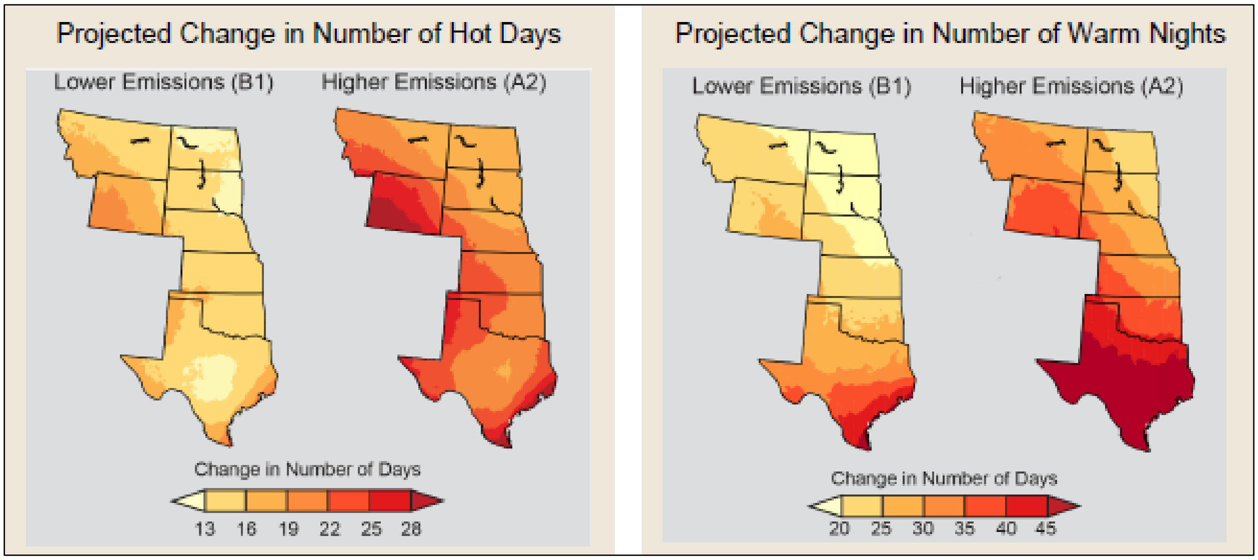


Figure 104. Projected Change in the Number of Hot Days and Warm Nights in the Great Plains Region for the Mid-21st Century (2041–2070) Relative to the 1971 to 2000 Average.
Source: Melillo et al. 2014.

Winter and spring precipitation is projected to increase in the northern states by the mid-21st century, including MT, along with the number of days with heavy precipitation (Melillo et al. 2014). However, little change in the number of consecutive dry days is projected in MT and the northern Great Plains. Projected increases in winter and spring precipitation will increase soil moisture reserves during the early growing season (Melillo et al. 2014), but decreasing mountain snowpack will result in reductions in stream flow and irrigation capacity during the late growing season (Whitlock et al. 2017). Rising temperatures will worsen the persistent droughts that periodically occur in MT (Whitlock et al. 2017). Continued increases in the number and intensity of rainfall events will result in elevated soil erosion and nutrient runoff (Melillo et al. 2014).

Estimates of climate change impacts on temperature and precipitation in Rosebud and Treasure Counties were acquired from the USGS National Climate Change Viewer (NCCV), which includes 30 climate-model projections of the RCP4.5 and RCP8.5 scenarios (Alder and Hostetler 2013; Hostetler and Alder 2016; Thrasher et al. 2013). The 1- to 3-degree resolution output of the climate models is downscaled to a very fine 800-meter grid over the contiguous United States for use in the NCCV. The projected maximum air temperature and precipitation are shown for both counties in **Figure 105** and **Figure 106**, respectively.

Maximum air temperature is projected to increase for both RCP scenarios in all months, with the largest and most significant predicted changes in summer (July and August). Projected changes in average monthly precipitation show more seasonal variability, with a predicted increase in precipitation in winter and spring and a predicted decrease in precipitation in summer months. However, the significance of the predicted changes in precipitation and the agreement between models is less than 55 percent in all cases except for the RCP8.5 scenario in March in 2050–2074, and January and March in 2075–2099.

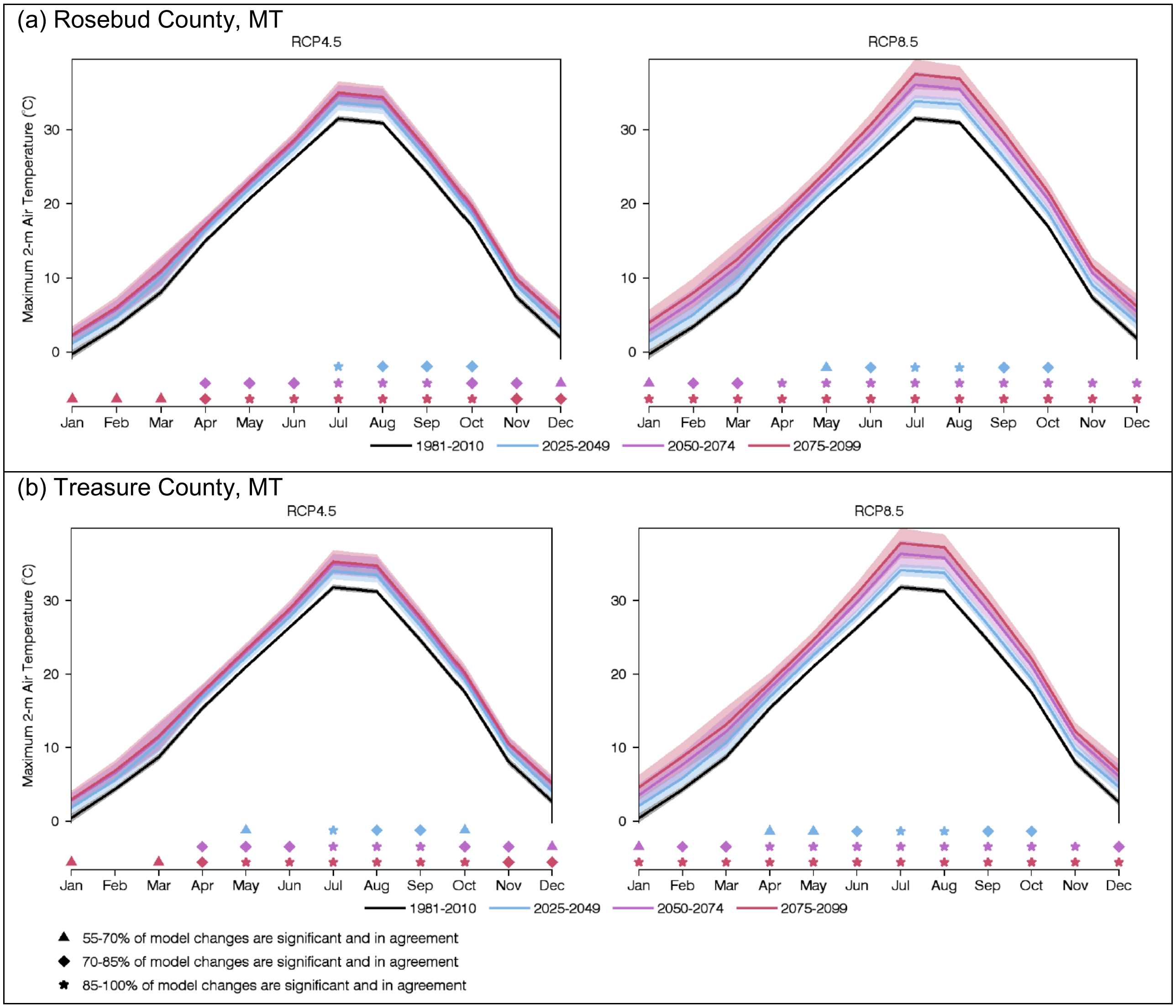


Figure 105. Monthly Averages of Maximum 2-Meter Air Temperature for Four Time Periods for the RCP4.5 and RCP8.5 Scenarios in (a) Rosebud County and (b) Treasure County.

Source: Alder and Hostetler 2013; Hostetler and Alder 2016; Thrasher et al. 2013.

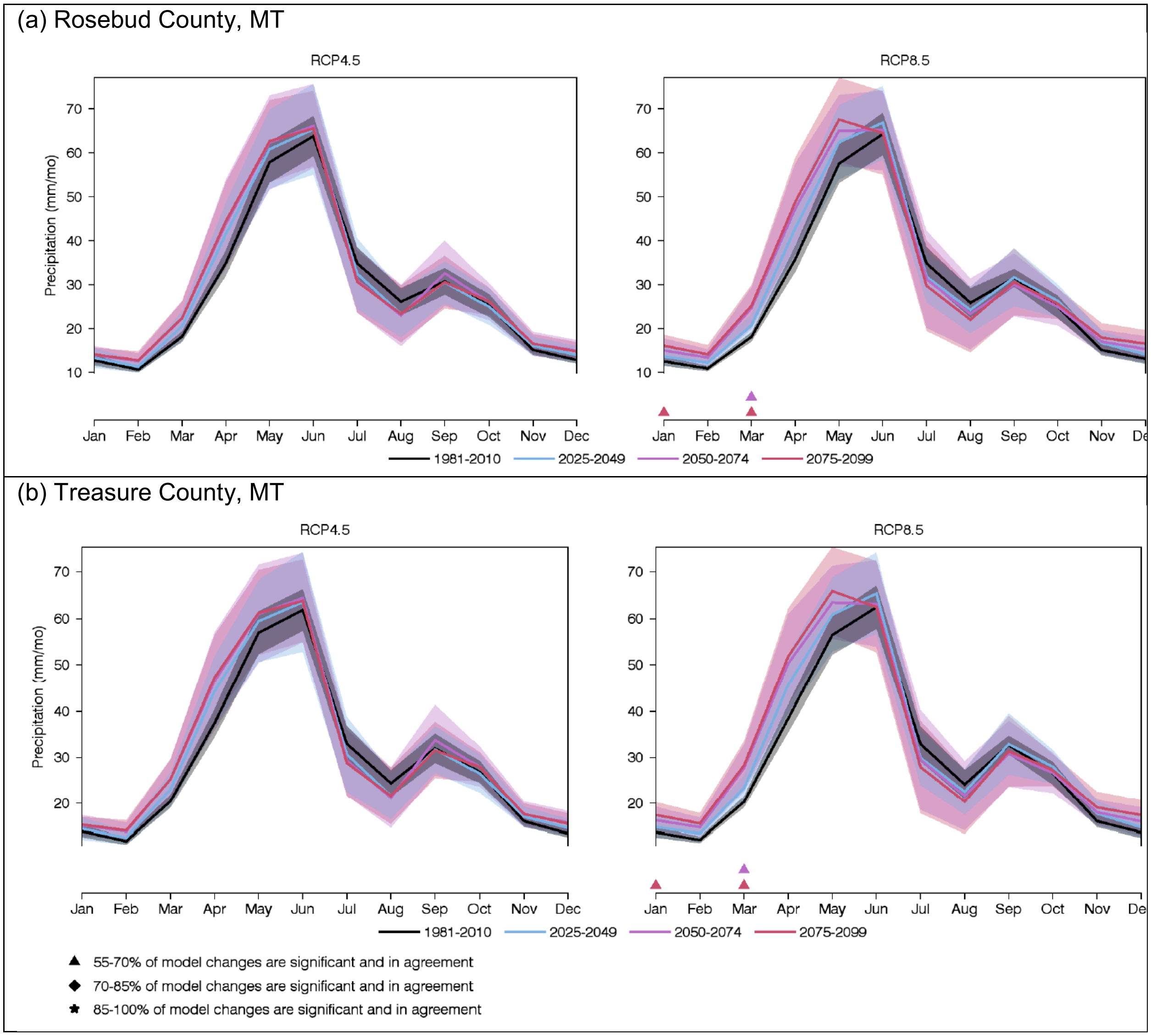


Figure 106. Monthly Averages of Precipitation for Four Time Periods for the RCP4.5 and RCP8.5 Scenarios in (a) Rosebud County and (b) Treasure County.

Source: Alder and Hostetler 2013; Hostetler and Alder 2016; Thrasher et al. 2013.

4.4.2.4 Future GHG Emissions from Other Rosebud Mine Permit Areas

Under the No Action Alternative, the existing operations at the Rosebud Mine would continue as permitted. Areas A, B, and C are still actively mined, while Areas D and E are undergoing reclamation.

Estimates of annual GHG emissions from the active permit mine areas (Areas A, B, and C) and AM5 are provided for the projected coal-production years (**Table 117**) in **Table 118** and **Table 119**, respectively. Actual coal production in these areas may be lower than the values shown in these tables depending on the split between the various areas of the mine; thus, GHG emissions reported are conservative.

Table 117. Projected Annual Coal Production in Existing Mine Areas and AM5.

Year of Active Mining	Projected Annual Coal Production (tons/year)		
	Areas A + B[1]	Area C[2]	AM5
1	2,466,100	3,483,050	--
2	2,574,300	3,483,050	--
3	2,468,700	2,786,440	1,393,220
4	2,516,300	2,786,440	1,393,220
5	1,217,300	1,741,525	1,741,525
6	--	1,741,525	1,741,525
7	--	1,741,525	1,741,525
8	--	766,271	3,483,050
9	--	--	4,876,270
10	--	--	4,876,270
11	--	--	4,876,270
12	--	--	4,876,270
13	--	--	4,876,270
14	--	--	4,876,270
15	--	--	4,876,270
16	--	--	4,876,270
17	--	--	4,876,270
18	--	--	4,876,270
19	--	--	4,876,270

Source: Email communications from Western Energy on January 5, 2017.
[1]Includes coal production from AM4, BX, and Area B BLM Lease Modification.
[2]Includes coal production from Area C BLM Lease Modification.

Future surface methane emissions were estimated using projected annual coal production and a methane emission rate of 33.1 standard cubic feet (scf)/ton (EPA 2005a), following the same approach used to estimate historic methane emissions in **Section 3.4.2.4**. GHG emissions from off-road mobile sources were estimated using the average GHG emissions per ton of coal from the existing areas of the mine from 2010 to 2015 and projected annual coal production for each area. GHG emissions from these sources could not be estimated using the historic emission approaches because projections of future annual fuel usage are not available.

Table 118. Future GHG Emissions from Existing Mine Permit Areas.

Year of Active Mining	Projected Coal Production (MT/year)	Greenhouse Gas Emissions (MT/year)			
		CO_2	CH_4	N_2O	CO_2e
1	5,396,974	27,829	3,624	0.69	129,473
2	5,495,131	28,335	3,689	0.71	131,828
3	4,767,379	24,582	3,201	0.61	114,369
4	4,810,561	24,805	3,230	0.62	115,405
5	2,684,199	13,841	1,802	0.34	64,394
6	1,579,884	8,147	1,061	0.20	37,901
7	1,579,884	8,147	1,061	0.20	37,901
8	695,149	3,584	467	0.09	16,677

MT/year = metric tons per year.

Table 119. Future GHG Emissions from AM5.

Year of Active Mining	Projected Coal Production (MT/year)	Greenhouse Gas Emissions (MT/year)			
		CO_2	CH_4	N_2O	CO_2e
3	1,393,220	7,184	935	0.18	33,423
4	1,393,220	7,184	935	0.18	33,423
5	1,741,525	8,980	1,169	0.22	41,779
6	1,741,525	8,980	1,169	0.22	41,779
7	1,741,525	8,980	1,169	0.22	41,779
8	3,483,050	17,960	2,339	0.45	83,558
9	4,876,270	25,144	3,274	0.63	116,981
10	4,876,270	25,144	3,274	0.63	116,981
11	4,876,270	25,144	3,274	0.63	116,981
12	4,876,270	25,144	3,274	0.63	116,981
13	4,876,270	25,144	3,274	0.63	116,981
14	4,876,270	25,144	3,274	0.63	116,981
15	4,876,270	25,144	3,274	0.63	116,981
16	4,876,270	25,144	3,274	0.63	116,981
17	4,876,270	25,144	3,274	0.63	116,981
18	4,876,270	25,144	3,274	0.63	116,981
19	4,876,270	25,144	3,274	0.63	116,981

4.4.2.5 Future GHG Emissions from the Colstrip and Rosebud Power Plants

Under the No Action Alternative, the Colstrip and Rosebud Power Plants are assumed to continue existing operations, except for the required retirement of Colstrip Units 1 and 2 by 2022 (**Section 1.2.2.1**). Therefore, historical GHG emissions are representative of the future emissions from the Rosebud Power Plant and the pre-2022 emissions from the Colstrip Power Plant. Retirement of Colstrip 1 and 2 in 2022 will reduce GHG emissions from the Colstrip Power Plant by about 26 percent. GHG emissions from 2015 are assumed to be most representative of future emissions and are provided separately for Colstrip Units 1 and 2, Colstrip Units 3 and 4, and the Rosebud Power Plant in **Table 120**.

Table 120. Future GHG Emissions from the Colstrip and Rosebud Power Plants.[1]

	Greenhouse Gas Emissions (MT/year)			
	CO_2	CH_4	N_2O	CO_2e
Colstrip Pre-2022				
Units 1 and 2	4,135,169	439	64	4,164,393
Units 3 and 4	11,718,872	1,301	189	11,805,466
Colstrip Post-2022				
Units 3 and 4	11,718,872	1,301	189	11,805,466
Rosebud Power Plant	472,857	48	7	476,043

Source: EPA 2017g.
[1]The CO_2e values reported by FLIGHT were updated to use the global warming potentials (GWP) recommended in IPCC's AR5.

4.4.3 Alternative 2 – Proposed Action

Coal mined at the project area would be processed, transported, and shipped using identical methods and equipment to those currently used at Area C. Portable and mobile equipment emission sources would be associated with the project area as a result of construction activities, operations, and maintenance.

4.4.3.1 Direct Impacts

Under the Proposed Action, annual CO_2e emissions would be expected to increase relative to the existing operations at Area C as a result of the additional fuels (especially diesel) that would be used by vehicles hauling coal over a longer haul-road distance (i.e., 5 additional miles). In addition, the life-of-mine projected total coal production would increase, thus increasing the total GHG emissions over the life of the Rosebud Mine.

In the permit modification application for the project area (Bison Engineering 2013b), the maximum potential CO_2 emissions from off-road mobile sources were estimated from both the existing operations in Area C and the additional hauling required for operations in the project area. Those potential-to-emit (PTE) estimates for Area C used the maximum permitted coal production of 8 million tons per year, while the additional PTE estimates for the project area used the largest distance between the project area and the coal-processing facilities in Area C.

To estimate the annual project area CO_2 emissions from off-road mobile sources, the existing PTE from Area C was apportioned using the ratio of the projected annual coal production for the project area (4 million tons/year, **Table 7** in **Section 2.4.1**) to the coal production limit for both areas (8 million tons/year). The fraction of existing emissions attributable to the project area was then added to the additional emissions from hauling to get the maximum annual CO_2 project area emissions.

CH_4 emissions from off-road mobile sources were not estimated in the permit modification application, but the volatile organic compound (VOC) emissions were estimated. CH_4 emissions were calculated by apportioning the Area C emissions of VOCs in the same manner and then applying VOC/total hydrocarbons (THC) and non-methane hydrocarbon/THC ratios for diesel equipment.[24] N_2O emissions from off-road mobile sources were calculated by scaling 2010 to 2015 average mobile diesel fuel usage with coal production and applying a 2016 emission factor from the Climate Registry for diesel fuel combustion.[25]

The PTE from existing air quality permits did not include emissions from the hauling of refuse coal to the Rosebud Power Plant, and so these emissions were estimated using the EPA MOVES (Motor Vehicle Emissions Simulator) model with data provided by Western Energy. All of the emissions from waste coal hauling were conservatively attributed to the project area.

Portable/stationary gasoline equipment GHG emissions for the project area were estimated by apportioning the existing gasoline usage rate for Area C (provided in the Area F permit modification application) as outlined above, along with stationary gasoline equipment emission factors.[26] Surface methane emissions were calculated based on an emission rate of 33.1 scf/ton,[27] along with methane density and maximum project annual coal production. The resulting total GHG emissions for the project area are provided in **Table 121** by year, and the maximum annual GHG emissions (based on 4 million tons/year) are provided in **Table 122** for each source category.

The total projected project area emissions would increase the GHG emissions under the Proposed Action by up to approximately 0.9 percent on an annual basis relative to the No Action alternative. Fugitive

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[24] Conversion Factors for Hydrocarbon Emission Components: https://www3.epa.gov/otaq/models/nonrdmdl/nonrdmdl2010/420r10015.pdf.

[25] The Climate Registry. 2016 Default Emission Factors, Table 13.7. https://www.theclimateregistry.org/wp-content/uploads/2014/11/2016-Climate-Registry-Default-Emission-Factors.pdf.

[26] 40 CFR Part 98, Appendix Tables C-1 and C-2. https://www.law.cornell.edu/cfr/text/40/part-98/subpart-C.

[27] https://www.epa.gov/sites/production/files/2016-03/documents/us_surface_coal_mines_markets-update_feb2015.pdf.

methane emissions from coal comprise over 65 percent of the annual total project area CO_2e emissions and over 99 percent when combined with off-road diesel CO_2 emissions. The projected maximum annual emissions for the project area comprise 0.45 percent, 0.28 percent, and 0.0016 percent of 2015 GHG emissions from major sources in MT, major regional sources within 300 km of the Rosebud Mine, and the total U.S. GHG emissions, respectively (based on global warming potentials from IPCC's Fourth Assessment Report).

The project area GHG emissions would contribute incrementally to the climate change impacts discussed in **Sections 3.4.2.3** and **4.4.2.3**. However, total annual projected GHG emissions for the project area, calculated using conservative assumptions, comprise a very small fraction of the total 2015 state, regional, and national GHG emissions. Total GHG emissions from other sources may decrease further with the ongoing transition to renewable energy sources across the country; nonetheless, project area GHG emissions would continue to constitute a very small fraction of the future emissions.

Table 121. Total Annual GHG Emissions from the Project Area.

Year of Active Mining	Projected Coal Production (MT/year)	Greenhouse Gas Emissions (MT/year)			
		CO_2	CH_4	N_2O	CO_2e
1	4,000,000	37,266	2,685	0.45	112,559
2	4,000,000	37,266	2,685	0.45	112,559
3	4,000,000	37,266	2,685	0.45	112,559
4	4,000,000	37,266	2,685	0.45	112,559
5	4,000,000	37,266	2,685	0.45	112,559
6	4,000,000	37,266	2,685	0.45	112,559
7	4,000,000	37,266	2,685	0.45	112,559
8	4,000,000	37,266	2,685	0.45	112,559
9	4,000,000	37,266	2,685	0.45	112,559
10	4,000,000	37,266	2,685	0.45	112,559
11	4,000,000	37,266	2,685	0.45	112,559
12	4,000,000	37,266	2,685	0.45	112,559
13	3,250,000	32,624	2,181	0.37	93,801
14	3,250,000	32,624	2,181	0.37	93,801
15	3,250,000	32,624	2,181	0.37	93,801
16	3,250,000	32,624	2,181	0.37	93,801
17	3,250,000	32,624	2,181	0.37	93,801
18	3,250,000	32,624	2,181	0.37	93,801
19	3,250,000	32,624	2,181	0.37	93,801
Total	**70,750,000**	**675,568**	**47,487**	**8.00**	**2,007,318**

MT/year = metric tons per year.

Table 122. Annual GHG Emissions from the Project Area by Source Category (Corresponding to Coal Production of 4 Million Tons per Year).

Mobile and Fugitive Sources	Emissions (MT/year)			
	CO_2	CH_4	N_2O	CO_2e
Mobile sources diesel exhaust (off-road)	36,461	2.55E-01	4.47E-01	36,587
Mobile sources diesel exhaust (on-road)	444	6.00E-04	6.60E-04	444
Portable/stationary equipment (gasoline engines)	361	1.50E-02	3.10E-03	363
Fugitive CH_4 emissions from coal	--	2,684	--	75,166
Annual totals	**37,266**	**2,685**	**0.45**	**112,559**

4.4.3.2 Indirect Combustion Impacts

Project area coal would be burned at Colstrip Units 3 and 4 and at the Rosebud Power Plant, and thus would indirectly contribute to GHG emissions from these facilities. The only change in operations under the Proposed Action would be the use of project area coal instead of coal from other Rosebud Mine permit areas. For this reason, the GHG emissions provided for Colstrip Units 3 and 4 and the Rosebud Power Plant in **Section 4.4.1.5** are assumed to be representative of the GHG emissions from these facilities during the period of the Proposed Action. Furthermore, the total emissions of 12.3 $MMtCO_2e$ per year are conservatively assigned to indirect effects of the Proposed Action; that is, Colstrip Units 3 and 4 and the Rosebud Power Plant are conservatively assumed to burn only project area coal during the period of the Proposed Action (**Table 123**). More than 99 percent of the indirect GHG emissions would be CO_2.

Table 123. Annual Indirect GHG Emissions.

Greenhouse Gas Emissions (MT/year)			
CO_2	CH_4	N_2O	CO_2e
12,191,729	1,349	196	12,281,509

MT/year = metric tons per year.

The indirect GHG emissions would contribute incrementally to the climate change impacts discussed in **Sections 3.4.2.3** and **4.4.2.3**. Indirect emissions of CO_2e comprise approximately 54 percent and 33 percent of the GHG emissions from major sources in MT and major regional sources (within 300 km of the Rosebud Mine), respectively, based on 2015 GHG emissions reported to EPA's FLIGHT tool (EPA 2017g). However, total projected indirect GHG (CO_2e) emissions would comprise a small fraction—0.19 percent—of the total 2015 U.S. GHG emissions. The state, regional, and national GHG emissions may decrease further with the ongoing transition to renewable energy sources across the country.

4.4.3.3 Effect of Climate Change on Air Quality Impacts Due to the Proposed Action

As seen in **Figure 105** of **Section 4.4.2.3**, air temperatures predicted by the ensemble of 30 climate models reported by the USGS NCCV tool (Alder and Hostetler 2013; Hostetler and Alder 2016; Thrasher et al. 2013) are anticipated to increase in Rosebud and Treasure Counties. This would likely result in a slight increase in regional ozone concentrations because of increased photolysis and higher air temperatures (EPA 2014a). The ozone concentrations due to NO_x emissions from indirect effects (Colstrip Units 3 and 4 and the Rosebud Power Plant) may increase slightly in areas that are NO_x limited (i.e., have a deficiency of NO_x relative to VOC in the atmosphere).

Climate change could also affect the Proposed Action. Wet deposition of criteria and hazardous air pollutants due to direct and indirect effects would be strongly influenced by precipitation. As seen in **Figure 106** in **Section 4.4.2.3**, long-term precipitation in Rosebud and Treasure Counties either increases or decreases due to climate change depending on the season. Precipitation is predicted to increase in winter and spring from the ensemble of climate models used in the USGS NCCV tool due to climate change in Rosebud and Treasure Counties; this would result in an increase in wet deposition due to the Proposed Action. Conversely, precipitation is predicted to decrease in summer, and this would result in a decrease in wet deposition.

4.4.4 Alternative 3 – Proposed Action Plus Environmental Protection Measures

No additional environmental protection measures are recommended for the project area in regard to greenhouse gas emissions.

The impacts of Alternative 3 on climate and climate change would be similar to those of Alternative 2.

4.4.5 Social Cost of Carbon

A protocol to estimate what is referenced as the "social cost of carbon" (SCC) associated with GHG emissions was developed by a federal Interagency Working Group (IWG), to assist agencies in addressing EO 12866. That EO required federal agencies to assess the cost and the benefits of intended regulations as part of their regulatory impact analyses. The SCC protocol was also developed for use in cost-benefit analyses of proposed regulations that could impact cumulative global emissions (Shelanski and Obstfeld 2015).

Notably, the SCC protocol does not measure the actual incremental impacts of a project on the environment and does not include all damages or benefits from carbon emissions. The SCC protocol estimates economic damages associated with an increase in carbon dioxide emissions – typically expressed as a one mt increase in a single year — and includes, but is not limited to, potential changes in net agricultural productivity, human health, and property damages from increased flood risk over hundreds of years. The estimate is developed by aggregating results "across models, over time, across regions and impact categories, and across 150,000 scenarios" (Rose et al. 2014). The dollar cost figure arrived at based on the SCC calculation represents the value of damages avoided if, ultimately, there is no increase in carbon emissions.

A recent EEO titled, "Promoting Energy Independence and Economic Growth," issued on March 28, 2017, directed that the IWG be disbanded and that technical documents issued by the IWG be withdrawn as no longer representative of federal policy. The 2017 EO further directed that when monetizing the value of changes in GHG emissions resulting from regulations, agencies follow the guidance contained in OMB Circular A-4 of September 17, 2003. In all cases, a federal agency should ensure that its consideration of the information and other factors relevant to its decision is consistent with applicable statutory or other authorities, including requirements for the use of cost-benefit analysis.

Based on emission estimates for coal combustion, SCC calculations can quickly rise to large values; however, specific threshold levels for the determination of significance can vary depending on numerous project factors. OSMRE has elected not to specifically quantify the SCC in its assessment of the new federal mining plan for Area F. NEPA does not require a cost-benefit analysis (40 CFR 1502.23) or the presentation of the SCC cost estimates quantitatively in all cases, and that analysis was not undertaken here. Without a complete monetary cost-benefit analysis, which would include the social benefits of energy production to society as a whole and other potential positive benefits, inclusion solely of a SCC analysis would be unbalanced, potentially inaccurate, and not useful.

Given the uncertainties associated with assigning a specific and accurate SCC resulting from 8 additional years of operation under the Area F permit (C2011003F) and a new federal mining plan, and that the SCC protocol and similar models were developed to estimate impacts of regulations over long time frames, this EIS quantifies direct and indirect GHG emissions and evaluates these emissions in the context of global, U.S., state, and regional GHG emission inventories as discussed in **Section 4.4.3**.

Further, any increased economic activity, in terms of revenue, employment, labor income, total value added, and output, that is expected to occur with the Proposed Action is simply an economic impact, rather than an economic benefit, inasmuch as such impacts might be viewed by another person as negative or undesirable impacts due to potential increase in local population, competition for jobs, and concerns that changes in population will change the quality of the local community. Economic impact is distinct from "economic benefit" as defined in economic theory and methodology, and the socioeconomic impact analysis required under NEPA is distinct from cost-benefit analysis, which is not required.

To summarize, this EIS does not undertake an analysis of SCC because 1) it is not engaged in a rulemaking for which the protocol was originally developed; 2) the IWG, technical supporting documents, and associated guidance have been withdrawn; 3) NEPA does not require cost-benefit analysis and the agency did not undertake one here; and 4) because the full social benefits of coal-fired energy production have not been monetized, quantifying only the costs of GHG emissions would provide information that is both potentially inaccurate and not useful.

4.5 PUBLIC HEALTH AND SAFETY

This section analyzes potential effects on public health in the analysis area resulting from the No Action (Alternative 1), the Proposed Action (Alternative 2), and the Proposed Action plus Environmental Protection Measures (Alternative 3); cumulative impacts are disclosed in **Chapter 5**. The analysis area is described in **Section 3.5, Public Health and Safety**.

4.5.1 Analysis Methods and Impact and Intensity Thresholds

4.5.1.1 Analysis Methods

Public Health

The public health analysis of the alternatives follows methodological recommendations by the EPA (2005c); NRC (2011); and Center for Disease Control ((CDC) 2005). Guidance from the International Council on Mining and Metals ((ICMM) 2010) is also referenced. No universally agreed upon formula exists for assessing overall public health impact (ICMM 2010). Characterization of public health effects relies on qualitative and quantitative evidence and professional judgment (NRC 2011; ICMM 2010). Evaluating a proposed project's effects on public health should consider the environment, economy, demographics, and social characteristics (see **Section 3.5, Public Health and Safety**; NRC 2011). Possible health impacts associated with the alternatives focus on exposures to PM, specifically PM2.5. Thus, this discussion focuses on the potential impacts on public health associated with PM emissions from the alternatives.

The evaluation of potential overall public health impacts includes consideration of exposure pathways, magnitude, likelihood, and duration (NRC 2011). Both beneficial and adverse public health impacts are considered. The determination of an impact's magnitude considers the population density in areas where public health impacts may occur. The likelihood of an impact considers the probability that it would occur. The evaluation of impacts discussed throughout this section is summarized in **Table 125** at the end of this section.

EPA Guidance

EPA regulatory guidance for public and human health advises regulators to base their permitting decisions on the statute and regulations as applied to the specific combustion facility and retain their discretion to use approaches on a case-by-case basis (EPA 2005c). The nature of the health effects analysis depends upon the information available, the regulatory application of the risk information, and the resources (including time) available. In all cases the assessment should identify and discuss the major issues associated with determining the nature and extent of effects on public and human health (EPA 1995b, in Appendix A of the Risk Characterization Handbook). A public health assessment does not use a human health risk assessment (HHRA) approach, which would model and quantify the potential risks and thresholds for individuals as a result from a proposed action. Rather, the Proposed Action's potential effects to public health is considered in relation to the community's public health environment (see **Section 3.5, Public Health and Safety**). Quantitative and qualitative data, the best available science and research, and professional expertise all inform a public health assessment.

Public Safety

For purposes of this analysis, public safety addresses the risks of direct public exposure to operational activities (e.g., blasting with potential noise and vibration effects), hazards associated with transportation of hazardous materials, and railway and transportation safety. The EPA provides continuing oversight for major federal environmental programs, including the transport and storage of hazardous materials and waste. Bulk products and chemicals, including petroleum products, are delivered to the Rosebud Mine and the power plants over the public highway system. MT has no jurisdiction over public safety at NGS and associated facilities.

The evaluation of potential public safety impacts as they relate to noise and to exposure to solid and hazardous waste is based on the analyses in **Section 4.22, Noise** and **Section 4.21, Solid and Hazardous Waste**. Thresholds and guidance for human exposure to noise are outlined in **Section 3.22, Noise** and discussed in **Section 3.5, Public Health and Safety**. Regulations and practices related to the containment, storage, transportation, and disposal of waste to reduce risk of exposure to the public are discussed in **Section 3.21, Solid and Hazardous Waste**.

4.5.1.2 Impact Intensity Thresholds

The thresholds of change for the intensity of an impact on public health and safety are described in **Table 124**.

Table 124. Public Health Impact and Intensity Thresholds.

Impact Intensity	Intensity Description
Negligible	The effects would be at low levels of detection and would not have appreciable effects on public health.
Minor	The effects would be detectable and would be of a magnitude that would not have appreciable effects on public health.
Moderate	The effects would be readily apparent and result in a change in public health.
Major	The effects would be readily apparent, would result in a substantial change in public health in a manner noticeable to the public, and would be markedly different from existing operations.

Impacts are also defined as short-term, long-term, or both (see **Section 4.1.1, Definitions**).

4.5.2 Alternative 1 – No Action

The No Action alternative would not change the status of other areas of the Rosebud Mine that are currently permitted and being mined and/or reclaimed by Western Energy (see **Section 2.2, Existing Operations**), nor would it affect development of any other proposed Rosebud Mine areas currently in the permitting process (see **Section 5.2.2, Related Future Actions**).

Under the No Action alternative, there would be no immediate effects on public health. If and when the Rosebud Mine closes (closure year is dependent on selection of the No Action alternative or Alternatives 2 or 3, see **Section 2.2.3, Life of Operations**), there may be long-term negligible impacts on public health within the direct effects analysis area, both during and after reclamation activities. Fugitive dust from reclamation activities would result in negligible impacts on those passing directly through the mine area.

There would be no immediate effects on the public health of the analysis area's overall population and sensitive subpopulations, including those with chronic disease and American Indian populations, under the No Action alternative. If and when the Rosebud Mine does close (see **Section 2.2.3, Life of**

Operations), revenues that support access to public health services, such as hospitals, libraries, schools, and other services, would cease, resulting in direct and indirect moderate to major long-term effects on social services and resources. Chronic and infectious disease rates are not likely to be affected under the No Action alternative. Public health is influenced by many variables, such as poverty, behavioral risk, and lack of social services (see **Section 3.5, Public Health and Safety**) (UWPHI 2017).

Land use would not be impacted under the No Action alternative and, therefore, community well-being related to land use would not be impacted. There would be no additional ground disturbance within the project area and, therefore, no potential for adverse effects on cultural resources. Existing land uses within the analysis area, including agricultural and traditional uses by the Northern Cheyenne and Crow Tribes, would not be impacted (see **Section 4.23, Land Use** and **Section 4.14, Cultural Resources**). There would be no noise impacts that would result from the No Action alternative (see **Section 4.22, Noise**).

The existing noise sources described in **Section 3.22, Noise** would continue through 2030 since any changes associated with development of the project area would not occur. Noise generated at other parts of the mine would still continue 2030 (expected life of the Rosebud Mine as permitted). There would be no new noise impacts on public safety as a result of the Proposed Action.

There would be no impacts to public safety from the No Action alternative because there would be no changes related to the current management of solid and hazardous waste as described in **Section 3.21, Solid and Hazardous Waste**.

4.5.3 Alternative 2 – Proposed Action

4.5.3.1 Direct Impacts

Environmental Health

Air Quality

In the direct effects analysis area (i.e., the project area and nearby public access roads), DPM and fugitive dust are the most likely sources of risk to public health. Using data from the air quality analysis (see **Sections 3.3** and **4.3**), the risk from DPM is localized and would most likely affect those working in proximity of heavy machinery. The air quality analysis indicates that DPM emissions and fugitive coal dust are largely confined to the project area and to Area C (see the **Hazardous Air Pollutants** discussion in **Section 4.3.3.1** and **Figures 77** and **78**). Air concentrations of DPM and PM from coal dust drops off precipitously at the mine boundary, and neither are detectable in the vicinity of Colstrip. Based on this information, the analysis considers DPM and PM from coal dust where exposure is likely to occur (i.e., in the project area boundary and immediate vicinity).

As described in **Section 3.5, Public Health and Safety**, workers at the Rosebud Mine are protected under MSHA regulations, and the mine is obligated to comply with MSHA and OSHA, which include standards for protecting miner health and safety (see specifically **Section 3.5.1.1, Regulatory Framework** and **Section 3.5.1.2, Analysis Area**). Therefore, workers at the mine are covered by MSHA regulations and effects to them were not considered in this analysis.

The radius for exposure includes the project area and the access roads where mine-related traffic would travel. No sensitive receptors are living within the project area. Limited exposure to the public may occur when access (county) roads are used by the public and for recreation use on adjacent areas. The public's exposure to DPM and fugitive dust, including coal dust, would be low due to limited exposure time and extent. Emissions due to coal transport from the mine to the Rosebud Power Plant were included in the air quality modeling and did not result in any exceedance of public health standards or air quality thresholds that would result in adverse impacts on the environment (see **Section 4.3, Air Quality**).

Direct impacts on public health from air quality would include exposure to emissions from mine operations, processing and handling of project area coal, and postmine reclamation of the area. Sources may include fugitive dust from mining activities (topsoil removal and unloading; overburden drilling, blasting, and removal; coal drilling, blasting, removal, loading, dumping, crushing, and conveying; haul and access roads; and wind erosion of disturbed areas), explosives used for overburden and coal blasting, and DPM emissions from mobile and stationary sources' engines (see **Section 4.3, Air Quality** for a complete discussion of these sources). Deposition of airborne COPCs on soils and surface waters may occur, but it is not likely that the public would be exposed to these except incidentally.

Air concentrations for both PM_{10} and $PM_{2.5}$ fall below NAAQS and MAAQS in the project area, and project impacts would result in a short-term minor adverse impact on public health within the project area and public access roads (i.e., county roads such as Horse Creek Road or Castle Rock Road). The concentrations of PM, along with other COPCs found in DPM and coal dust, drop off outside the project area to levels well below the MAAQS and NAAQS levels. Additionally, there would be few if any members of the public permitted within the project area where PM and other hazardous substances would be present at higher concentrations. Any potential exposure of sensitive receptors to PM would be incidental and limited in duration. Therefore, the direct impacts on public health from $PM_{2.5}$ and PM_{10}, including from DPM and coal dust, would be short-term, negligible to minor, and adverse.

Surface and Ground Water Quality

Direct impacts on surface and ground water quality due to mine activities are discussed in **Section 4.7, Water Resources – Surface Water** and **Section 4.8, Water Resources – Ground Water**. There are no known public recreational uses of surface water within the direct effects analysis area or project area, and would not be allowed in areas where mine activities would occur (see **Section 3.5, Public Health and Safety**). The project area is and would continue to be used for livestock grazing, and several surface water livestock drinking sources are monitored for water quality. If these sources were to fail to meet water quality standards for livestock consumption, mitigation and, if necessary, replacement would occur (see **Section 4.7, Water Resources – Surface Water** and **Section 4.8, Water Resources – Ground Water**).

All discharges from the proposed mining areas to state surface waters would be required to comply with applicable MPDES permit effluent limits. Water management and erosion-control BMPs would be implemented to avoid adverse impacts on surface water quality from mine activities (see **Section 4.7, Water Resources – Surface Water**). There is a possibility that a precipitation event that exceeded the capacity of the erosion control structures could occur, resulting in short-term increases in suspended sediment, dissolved solids, and metal concentrations in surface water (see **Section 4.7, Water Resources – Surface Water**).

The population density in the immediate vicinity of the project area is sparse. Domestic water wells are located within the project area and vicinity. These would be monitored and replaced if they failed to meet water quality standards for human consumption. Ground water contamination in Areas A, B, and C, including increased concentrations of metals and nutrients, has been documented, and similar impacts would be expected for the Proposed Action (see **Section 4.8, Water Resources – Ground Water**). Containment, monitoring and mitigation of ground water contamination would occur to avoid impacts to ground water outside of the project area and to wells within the project area.

During mining, surface and ground water in the project area would not be used by the public. Surface and ground water within and near the project area would be monitored to ensure they meet water quality standards (see **Section 4.7, Water Resources—Surface Water** and **Section 4.8, Water Resources – Ground Water**). Downgradient ground water quality may be impacted because of eliminating recharge from the project area during both mining and postmining, resulting in increased TDS. This could adversely impact ground water sources that are used by downgradient ranchers and residents who use ground water for livestock and consumption. This may result in an adverse, long-term moderate to major impact to public health if no mitigation occurs. Monitoring of ground water quality and mitigation of contamination would be implemented to avoid and minimize risk to downgradient water users.

Postmining, springs may develop in or near the mined area that may have higher concentrations of dissolved solids, nutrient, and metal concentrations (see **Section 4.7, Water Resources—Surface Water** and **Section 4.8, Water Resources—Ground Water**. Discharge from the spoil to streams could result in higher concentrations of dissolved solids, nutrient, and some metal compared to pre-mining conditions. While unlikely that streams and springs near the project area would be used directly for drinking water or recreational use after mining, some surface water sources are used by livestock and wildlife, and ranching may occur in the project area (see **Section 3.7, Water Resources—Surface Water**, **Section 3.12**, **Fish and Wildlife**, and **Section 3.23, Land Use**).

The mined area would be reclaimed to support ranching activities after reclamation (see **Section 2.5.14, Reclamation Plan**). Mitigation of adverse impacts, including the replacement of water supply sources if needed, and monitoring of water quality to comply with surface and ground water quality standards for humans, wildlife and livestock, and aquatic resources would occur (see **Section 4.7, Water Resources—Surface Water** and **Section 4.8, Water Resources – Ground Water**, for a discussion of potential impacts and implementation of mitigation and monitoring). With the implementation of BMPs, and mitigation measures, including the replacement of surface and ground water supplies adversely affected by mining, the direct impacts on public health would be short-term and negligible.

Based on the discussion above, there is a low likelihood that human consumption or contact with contaminated surface or ground water would occur from the Proposed Action. With monitoring and mitigation activities, increased risk to public health from exposure to water because of the Proposed Action is not likely. In the event water quality standards are violated, the mine operators would be required to mitigate and remediate the violations and are subject to penalties for violating the terms of the permit.

Socioeconomic Environment and Health

Demographics and Sensitive Populations

There are no residents within the project area where risk of exposure to PM and DPM would be greatest. Population density in the immediate vicinity of the project area is sparse. There are no subsistence farmers within the project area or immediate vicinity. There would be potential for incidental exposure to PM, DPM, and coal dust for persons traveling along county roads adjacent to the project area. Because exposure would be incidental and short in duration, the risk to the public health of the overall population and to sensitive subpopulations would be short-term and negligible.

Economics

The Proposed Action would support continued revenues and jobs at the Rosebud Mine, which contribute to funding for local health resources. **Section 4.18, Socioeconomics** discusses the economic impacts, which occur predominantly in Rosebud County where the project area is located, and on the Northern Cheyenne Indian Reservation, where 15 to 20 percent of the Rosebud Mine employees reside. Through 2030, as discussed in **Section 4.15, Socioeconomics**, the economic impacts from the Proposed Action would be the same as from the No Action alternative. The Proposed Action would extend the life of the mine by 8 years, sustaining economic support of public health services and availability of health insurance for individuals and families employed directly by the mine. Thus, the Proposed Action would have a moderate short-term beneficial effect on public health as it relates to economic conditions.

Social Characteristics

Social Services

The Proposed Action would not result in immediate impacts on social services, including health care facilities, schools, libraries, and other services. The life of the mine would be extended by 8 years, which would sustain jobs and funding for services, as discussed above and in **Section 4.15, Socioeconomics**. There would likely be no change to the rate of insured individuals, availability of health care services, or number of health care providers in the area. The Proposed Action would have a short-term moderate beneficial impact on social services within Rosebud County.

Community Health

The Proposed Action is not likely to have an immediate impact on community health. Because there are not likely to be members of the public within the project area, it is not likely that impacts on community health would occur. There may be incidental exposure of sensitive subpopulations, including individuals with chronic or infectious diseases, passing through the area on access roads. Exposure to PM would be limited in duration and intensity, and the likelihood of exposure that would result in increased public health risk would be low. Therefore, the impact on community health, including sensitive subpopulations, would be short-term and negligible.

Likewise, it is not likely that impacts on nutrition-related disease would occur, as there are no subsistence farmers within the project area. There are no prime or unique farmlands that would be impacted (see **Section 3.24, Soils**). It is not likely that public health would be affected by local consumption of livestock or wildlife impacted by the Proposed Action (see discussion above and **Section 4.3- Air Quality, Sections 4.7, Water Resources—Surface Water** and **Section 4.12- Fish and Wildlife Resources**). Therefore, adverse impacts on public health related to nutrition would be short-term and negligible.

Well-being would not likely be impacted by the Proposed Action. As discussed above and in **Section 3.5, Public Health and Safety**, poor physical and mental health are compounded by poverty, behavioral risk, and lack of social services (UWPHI 2017). These factors are not likely to be affected by the Proposed Action, although the sustained economic benefits, including jobs and revenues, would sustain funding for social services and access to existing physical and mental health care and health insurance for some community members for an additional 8 years. Injury may result if trespassers enter the project area, but trespassing is not likely and any instance would be isolated. As population density within proximity to the project area is sparse, it is not likely that residents would be adversely affected by noise and vibrations from mine operations. Therefore, impacts on community well-being would be beneficial, short-term, and moderate.

Land Use and Cultural Resources

There would be some displacement of historic land use practices because of the Proposed Action (see **Section 4.23, Land Use**). There would be a short-term displacement of livestock and wildlife within the project area where mine activities are taking place. The project area would be reclaimed and ranching and wildlife habitat would be restored upon mine closure (see **Section 2.5.14, Reclamation Plan**). Disturbance of cultural resources from the Proposed Action would be resolved through a programmatic agreement with the state historic preservation officer (SHPO) (see **Section 4.14, Cultural Resources**). Tribal consultations with the Northern Cheyenne and Crow Tribes have been initiated to mitigate impacts on culturally significant resources within the direct affects analysis area and to mitigate effects on cultural resources that might affect traditional tribal ways of life (see **Section 6.1.3, Tribal Consultation Process**). Recreation opportunities at surface water bodies and land within the project area would be lost until reclamation activities are completed, which would result in short-term, minor, and adverse effects on land use as it relates to public health (see **Section 4.18, Recreation**).

Public Safety

Noise

Noise from proposed project activities would include coal and overburden blasting, use of heavy machinery, hauling, excavation, and truck traffic for coal transport and waste disposal, as described in **Section 4.22.3.1**. The nearest noise sensitive receptors to the project area are 7 scattered residences between 2.2 and 8 miles away from the project area boundary; and the city of Colstrip located 12 miles away from the project area. At these distances, no noise impacts are anticipated that would affect sensitive receptors. Mine workers and equipment operators in close proximity to noise sources would be required to wear protective hearing devices in accordance with MSHA regulations.

Solid and Hazardous Waste

Solid and hazardous waste would be contained, stored, transported, and disposed of as described in **Section 4.21, Solid and Hazardous Waste**. Any waste materials meeting the definition of “hazardous” would be handled in accordance with RCRA and other applicable regulations (see **Section 3.21.1.1, Regulatory Framework** and **Section 3.5.1.1, Regulatory Framework**). Non-hazardous solid waste would be disposed of at the Rosebud County Landfill or in pits at the mine site in accordance with ARM 17.24.507. Western Energy would handle all waste as outlined in the Waste Management Program. Workers would be required to wear protective gear and would follow procedures to reduce or eliminate risk from exposure to hazardous waste, in compliance with MSHA. Because regulatory compliance with applicable federal and state laws would reduce or eliminate the risk of the public being exposed to hazardous waste from project activities, the effects of the Proposed Action on public health would be long-term, negligible, and adverse.

4.5.3.2 Indirect Impacts

Environmental Health

Air Quality

Indirect public health effects from air quality would include those from the Colstrip and Rosebud Power Plants. **Section 4.3, Air Quality** provides a discussion of indirect air quality impacts, which are associated with coal combustion from the Colstrip and Rosebud Power Plants. Predicted air concentrations are expected to remain below NAAQS and MAAQS, and $PM_{2.5}$ and PM_{10} are expected to remain well below the NAAQS at locations impacted by either the project area or Colstrip Units 3 and 4 and Rosebud power plant (i.e., indirect impacts). Therefore, the Proposed Action would have a short-term, negligible to minor, adverse effect on public health as it relates to air quality.

The air quality model (**Section 4.3.1.1**) indicates that DPM would drop off sharply outside of the immediate project area; therefore, risk to the public and sensitive receptors would be low due to limited exposure time and extent. PM is expected to remain below NAAQS and MAAQS thresholds in the indirect impacts analysis area.

Surface and Ground Water Quality

Municipal and residential drinking water in the area comes from aquifers and from the Yellowstone River, which would not be affected by the Proposed Action (see **Section 4.7, Water Resources – Surface Water** and **Section 4.8, Water Resources – Ground Water**). The most likely exposure pathways from surface water would be through recreational use of surface waters (e.g., wading, swimming, or fishing) or from incidental contact.

The general water quality in the indirect affects analysis area generally meets or exceeds water quality standards, and water quality monitoring data indicate that emissions from the Colstrip and Rosebud Power Plants would not adversely affect overall surface water quality in the analysis area (see **Section 4.3, Air Quality**, **Section 3.5, Public Health and Safety**, and **Section 3.7, Water Resources – Surface Water**). It is not likely that the Proposed Action would affect mercury concentrations at Castle Rock Lake. The Proposed Action would result in increased concentrations of selenium in the East Fork Armells Creek and nitrogen in Rosebud Creek. Concentrations of other metals and nutrients in other surface waters would not be affected (see **Section 4.7, Water Resources – Surface Water**). Due to the area's sparse population density and low recreational use frequency of these creeks, there is a low likelihood that increased risk to public health would occur from exposure to water during recreation or by incidental skin contact because of the Proposed Action. Selenium and nitrogen concentrations in drinking water sources, including the Yellowstone River, would not be affected, and no increase to public health risk through drinking water consumption would occur because of the Proposed Action.

Based on the discussion above, the likelihood that the Proposed Action would result in impacts on surface water and ground water that would increase public health risk is low. Indirect effects on public health through impacts on water quality would be long-term and negligible.

Socioeconomic Environment and Health

Demographics and Sensitive Populations

Environmental justice populations within the indirect effects analysis area include a high proportion of American Indians and low-income populations (see **Sections 3.16** and **4.16, Environmental Justice**). The Northern Cheyenne and Crow Indian Reservations are located within the analysis area, and both tribes partake in ranching, hunting, fishing, gathering, and farming. Based on the air quality and water quality discussions (above and in **Section 4.3, Air Quality** and **Section 4.7, Water Resources – Surface Water**), the Proposed Action would not have a disproportionate impact on the environmental health of tribal members as a result of partaking in these activities.

Subpopulations with higher rates of chronic disease, including cancer, respiratory illness, and diabetes, are present within the analysis area. The incidence of asthma in Rosebud County, where the Colstrip and Rosebud Power Plants are located, is higher than the state and regional rates (see **Section 3.5, Public Health and Safety**). Air and water quality, as discussed above and in **Section 4.3, Air Quality** and **Section 4.7, Water Resources – Surface Water**, would not likely fall below the regulatory standards for human health (i.e., NAAQS, MAAQS, MT Surface Water Quality Standards). However, sensitive subpopulations in the area may experience adverse effects, including increased risk of infectious disease and exacerbation of chronic disease symptoms from sustained exposure to combustion emissions from project area coal (Clean Air Task Force 2010). Therefore, the indirect effects on sensitive subpopulations would be short-term, minor to moderate, and adverse. These effects from the Proposed Action, however, would be comparable to effects under the No Action alternative, as the power plants would operate at the same level of output under both alternatives.

Economics

The Proposed Action would support continued indirect sources of revenues and jobs within the analysis area, sustaining funding and access to local health resources and funding of public health and social services. **Section 4.18, Socioeconomics** provides a discussion of the indirect economic impacts of the Proposed Action, which are assumed to occur in Rosebud, Treasure, and Big Horn Counties, and on the Northern Cheyenne and Crow Indian Reservations. Members of the Northern Cheyenne Tribe hold about 30 percent of indirect jobs created by the Rosebud Mine. Through 2030, as discussed in **Section 4.15, Socioeconomics**, the indirect economic impacts from the Proposed Action would be the same as for the No Action alternative. The Proposed Action would extend the life of the mine by an additional 8 years, resulting in sustained indirect economic support of public health services, income, and availability of health insurance through mine-related jobs and revenues. Thus, the Proposed Action would have a beneficial short-term minor effect on public health as it relates to economic conditions.

Social Characteristics

Social Services

There would be no immediate impacts on social services from the Proposed Action. Health care facilities and services, schools, libraries, and other services would not be impacted as the Colstrip and Rosebud Power Plants and indirect jobs and revenues would remain the same as under the No Action alternative until 2021. The Proposed Action would extend the life of the Rosebud Mine would by 8 years, which would extend indirect revenues and funding for social services, as discussed above. This would result in a short-term moderate beneficial impact within the region. There would likely be no change to rates of insured individuals or to the availability of health care services or ratios of providers in the area because of the Proposed Action (see **Section 4.18, Socioeconomics**).

Community Health

The Proposed Action is not likely to have immediate indirect effects on community health. It is not likely that increases in chronic or infectious disease would be experienced, as there is little potential for increases in exposure to air and water pollutants. There may be minor effects on sensitive subpopulations, including those with asthma or compromised respiratory systems, who live or are present within proximity to the Colstrip and Rosebud Power Plants. Likewise, it is not likely that indirect impacts on nutrition-related disease would be experienced through consumption of livestock and wildlife (see discussion above, **Section 4.7, Water Resources—Surface Water**, and **Section 4.12, Fish and Wildlife Resources**).

The Proposed Action would not likely adversely affect the well-being of communities within the analysis area. Poor overall physical and mental health are compounded by poverty, behavioral risk, lack of social services, as discussed in **Section 3.5, Public Health and Safety** (UWPHI 2017). The Proposed Action is not likely to affect quality of life, although the sustained economic benefits and revenues would prolong funding for social services and access to existing physical and mental health care and health insurance. Behavioral risk factors, such as physical inactivity and adult smoking rates, are unlikely to be affected because there would be no significant change to the community health environment in the analysis area. Likewise, injury rates and mortality rates within the analysis area would not likely change because of the Proposed Action. Sustained economic security for families and individuals who are indirectly employed would maintain existing levels of well-being, including Northern Cheyenne and Crow tribal members, and sensitive subpopulations.

Based on the above discussion, the Proposed Action would have short-term minor to moderate beneficial impacts on the community public health in the analysis area.

Land Use

The Proposed Action would not affect land use in the region outside of the project area, nor would it adversely affect culturally significant resources.

Public Safety

Noise

Indirect public health impacts from noise include the operations of the Colstrip Power Plant (Units 3 and 4 after dry-stack conversion) and its associated paste plant, plus the Rosebud Power Plant. These are discussed in detail in **Section 4.22.3.2**. Workers and equipment operators in close proximity to noise sources would be required to wear protective hearing devices in accordance with OSHA regulations.

The impact of noise from the Colstrip Power Plant when operating at full capacity for the nearest Colstrip residences to the plant would exceed the EPA's recommended levels (see **Section 4.22; Figure 115**). Therefore, the impact to these residents would be long-term, moderate, and adverse. The noise impact for the Colstrip Power Plant on the seven residences nearest to the project area would be considered a less-than-negligible.

The impact of noise from the Rosebud Power Plant for the nearest residents to the plant would exceed the EPA's recommended levels, Therefore, impacts to these residents would be long-term, minor to moderate and adverse (see **Section 4.22; Figure 116**). The noise impacts at the seven residences nearest to the project area and the city of Colstrip would be considered a less-than-negligible.

Solid and Hazardous Waste

Indirect public health impacts from waste and hazardous materials include exposure to coal combustion residuals (CCR) waste generated at both the Colstrip and Rosebud Power Plants in proportion to the amount of coal burned at the plants, and on ground water impacts from waste disposal. These are discussed in detail in **Section 4.21.3.2** and **Section 4.8.3.2**. Workers would be required to wear protective gear and would follow procedures to reduce or eliminate risk from exposure to hazardous waste, in compliance with OSHA.

CCR would continue to be disposed of as described in **Sections 3.21.2.4** and **Section 3.21.2.5**, and in compliance with RCRA and other state and federal regulations. Because compliance with regulations would reduce the risk of the public being exposed to hazardous waste from the power plants, the Proposed Action would have a less than long-term, negligible, and adverse effect on public health as it relates to waste.

Bottom ash produced at the Colstrip Power Plant may be used in construction of parking lots and as a sanding agent (see **Section 3.21.2.4**). Because use of bottom ash is contingent upon the requirements of the monitoring plan, impacts to public safety and health from boron toxicity related the use of bottom ash would be short-term and negligible and identified prior to the impact having long-term consequences.

4.5.4 Alternative 3 – Proposed Action Plus Environmental Protection Measures

The effects of Alternative 3 on public health would be the same as those described for Alternative 2 – Proposed Action.

4.5.5 Irreversible and Irretrievable Commitment of Resources

There would be no irreversible and irretrievable commitments of public health resources because of any of the alternatives.

Table 125. Potential Effects on Public Health from Alternative 2 and Alternative 3.

Public Health Topic	Effect Pathway	Specific Impact	Affected Area	Effect Type	Magnitude	Likelihood	Duration	Intensity
Environ-mental Health	Air Quality and Surface Water Quality	Exacerbation of existing chronic disease conditions for sensitive subpopulations (asthmatics, diabetics, others with compromised respiratory/circulatory systems) resulting from direct contact with COPCs and HAPs through inhalation and contact with water	Direct and Indirect	Adverse	Low	Moderate	Short-term and Long-term	Negligible to Moderate
	Air Quality and Surface Water Quality	Increase in respiratory infectious disease for sensitive subpopulations with respiratory health complications	Direct and Indirect	Adverse	Low	Moderate	Short-term	Minor
	Economic	Sustained revenues to support social services and infrastructure, including access to healthcare	Direct and Indirect	Beneficial	Moderate	High	Short-term	Moderate
Economics	Economic	Sustained local employment, income, and economic resources for individuals and families, including members of the Northern Cheyenne Tribe	Direct and Indirect	Beneficial	Moderate	High	Short-term	Moderate
	Economic	Sustained revenues to county, state, and federal governments through extension of lease and coal royalties to support social services and infrastructure, including access to healthcare	Direct and Indirect	Beneficial	Moderate	High	Shorn-term	Moderate
Demo-graphics and Sensitive Populations	Air Quality and Surface Water Quality	Potential effects on overall community health (e.g., exacerbation of asthma, impacts on lung/heart disease rates, diabetes rates)	Direct and Indirect	Adverse	Low	Low	Short-term	Minor to Moderate
	Economic and Social	Sustained funding for health services and social services	Direct and Indirect	Beneficial	Moderate	High	Short-term	Moderate
Social Character-istics	Well-Being	Increase in stress or annoyance levels for populations living nearest to the mining areas due to noise and vibration	Direct	Adverse	Low	Low	Shorn-term	Negligible
	Social Services	Sustained funding and demand for schools, hospitals, health care providers, libraries, police and fire response	Direct and Indirect	Beneficial	Moderate	High	Shorn-term	Moderate

Table 125. Potential Effects on Public Health from Alternative 2 and Alternative 3.

Public Health Topic	Effect Pathway	Specific Impact	Affected Area	Effect Type	Magnitude	Likelihood	Duration	Intensity
	Community Health	Sustained resources available to purchase healthy foods for individuals and households	Direct and Indirect	Beneficial	Moderate	High	Shorn-term	Moderate
	Community Health	Decreased stress due to sustained secure economic situation for individuals and families	Direct and Indirect	Beneficial	Moderate	High	Shorn-term	Moderate
	Community Health	Decreased stress due to sustained access to health care resources, social services, and health insurance	Direct and Indirect	Beneficial	Moderate	High	Short-term	Moderate
	Land Use	Impacts to cultural resources	Direct	Adverse	Low	High	Long-term	Moderate
	Land Use	Temporary and long-term loss of livestock grazing areas	Direct	Adverse	Low	High	Short-term and Long-term	Minor

4.6 GEOLOGY

This section discloses the direct and indirect effects that the No Action (Alternative 1), the Proposed Action (Alternative 2), and the Proposed Action Plus Environmental Protection Measures (Alternative 3) would have on geology; cumulative impacts are disclosed in **Chapter 5**. The analysis area for direct and indirect effects is described in **Section 3.7, Geology**.

4.6.1 Analysis Methods and Impact and Intensity Thresholds

4.6.1.1 Analysis Methods

Geologic impacts were determined based on the information contained in Western Energy's PAP. The PAP provided the mining disturbance area, geologic descriptions and cross-sections, and spoil analysis for the project area.

4.6.1.2 Impact and Intensity Thresholds

The thresholds for the intensity of impacts on geology are defined in **Table 126** and are used to describe the impacts in the sections below.

Table 126. Geology Impact and Intensity.

Impact Intensity	Intensity Description
Negligible	An action that would result in a change in a geologic feature or process, but the change would be so small that it would not be of any measurable or perceptible consequence
Minor	An action that would result in a change in a geologic feature or process, but the change would be small, localized, and of little consequence
Moderate	An action that would result in a noticeable change in a geologic feature or process; the change would be measurable and of consequence
Major	An action that would result in an extensive change in a geologic feature or process; the change would be measurable and result in a severe adverse impact

Impacts are also defined as short-term, long-term, or both (see **Section 4.1.1, Definitions**). All impacts on geology would be considered long-term.

4.6.2 Alternative 1 – No Action

Under the No Action alternative, Western Energy would not develop the project area. There would be no impact on geological resources described in **Section 3.6, Geology** because none of the disturbances associated with development of the project would occur.

The No Action alternative would not change the status of other areas of the Rosebud Mine that are currently permitted and being mined and/or reclaimed by Western Energy (**Section 2.2, Existing Operations**) nor would it affect development of any other proposed Rosebud Mine areas currently in the permitting process (**Section 5.2.2, Related Future Actions**).

4.6.3 Alternative 2 – Proposed Action

4.6.3.1 Direct Impacts

Impacts from mining under the Proposed Action would result in the disturbance of 4,260 acres within the proposed direct effects analysis area and the direct removal of an estimated 70.8 million tons of coal over a 19-year period. The mining process would alter the overburden geology in the analysis area. The removal of overburden and the Rosebud Coal and the subsequent replacement of spoil would result in the removal of rock outcrop features and the alteration of the horizontal continuity of the overburden, resulting in a long-term major adverse impact on geologic resources that would last until the spoil is eroded away. As discussed in **Section 4.2, Topography**, rock-outcrop features may be created with DEQ approval from sandstone rock piles and with highwall-reduction techniques to mitigate the loss of sandstone outcrops and cliffs/bluffs. In the short term, manmade features would mimic the habitat-diversity benefits that the sandstone outcrops and cliffs/bluffs currently provide. However, their longevity would be compromised in comparison to the features they are attempting to replicate. Sandstone rock piles would be more easily eroded than the current outcrops they are replacing and unless the highwall reduction left only competent unaltered sandstone, as opposed to more easily eroded siltstone, mudstone, or claystone, these would also be more easily eroded than the current features they are attempting to replicate.

The spoil would consist of a mixture of geologically distinct vertical layers of sandstone, siltstone, mudstone, and claystone. As a result, the physical characteristics of the overburden as spoil would be altered and would represent a mélange deposit consisting of fragments of the overburden geologic deposits (sandstone, siltstone, mudstone, claystone) and the resulting fine-grained sediment generated due to the destruction of these stones into fragments. In addition, the spoil would contain non-hazardous construction, mining, or agricultural debris allowed by DEQ for disposal in the mine pits (PAP). The spoil would consist of a well-graded heterogeneous mixture of lithified and non-lithified material and non-hazardous construction debris of wood, metal, and concrete. The lithified fragments of rock would likely vary in size; vertical distribution would occur with large rock fragments rolling into the bottom of the pit as spoil is backfilled. The Proposed Action would result in a long-term major adverse impact on the analysis area geology that would result in impacts on the hydrogeologic system (see discussion of hydrogeologic impacts in **Section 3.8**, **Water Resources – Ground Water** and **Section 3.24, Soil**). If acid, acid-forming, toxic, toxic-forming, or other deleterious geologic materials are identified as part of implementation of the Spoil Monitoring Plan, they would not be buried as spoil or stored close to streams, negating their impact on hydrogeological resources. In addition to the geologic impacts related to mining, the placement of heterogeneous spoil could preclude future access to the McKay Coal bed.

4.6.3.2 Indirect Impacts

The creation of spoil next to geologically unaltered unmined areas either outside of the project area or the drainage areas within the indirect effects analysis area would result in indirect long-term impacts due to the different rates at which these materials would erode. Differential erosion of the spoil itself would be the preferential erosion of the softer stone fragments and non-lithified sediment relative to the harder stone, metal, and concrete fragments. Differential erosion in the indirect effects analysis area would be the preferential erosion of the spoil relative to areas not mined along the major drainages and the undisturbed areas outside of the analysis area. Long-term differential erosion of these two dissimilar materials over an unknown geologic time would likely result in the topographic inversion of the area where the drainage valleys become buttes over time as the more easily eroded spoil is eroded more quickly than the undisturbed former drainage valleys. This would result in topographic changes unique to the areas where spoil was deposited until the erosion of the spoil material was complete. Because the current rock outcrops and overburden are short-lived occurrences (in that they would be eroded over time regardless of the Proposed Action) there would be long-term minor adverse impacts on the overburden and rock outcrop features. New rock outcrop features would be created due to differential erosion.

4.6.4 Alternative 3 – Proposed Action Plus Environmental Protection Measures

The effects of Alternative 3 on geology would be the same as those described under the Proposed Action (Alternative 2). There are no available environmental protection measures related to the alteration of the distribution and physical characteristics of the overburden. Although underground mining would prevent geologic impacts on the overburden that result from surface mining, this is not a viable alternative as discussed in **Section 2.6.3, Underground Mining**. Therefore, adverse impacts on horizontal continuity and vertical alteration of the overburden under the Proposed Action cannot be mitigated and the effects of Alternative 3 on geology would be the same as those described under Alternative 2 – Proposed Action.

Rock outcrop features that are of historical significance would be identified prior to disturbance as part of the Geological Resources Survey. If DEQ determines the feature should remain in place, the mining plan would be adjusted to mine around the feature to avoid long-term major adverse impacts on these rock outcrop features. However, the longevity of these outcrop features would be reduced with the placement of more easily erodible spoil material around the features.

4.6.5 Irreversible and Irretrievable Commitment of Resources

Removal of the Rosebud Coal and the associated overburden would be an irreversible and irretrievable impact on geologic features and coal reserves. This would represent an irreversible impact on the analysis area geology. After the spoil erodes below the depth of mining, the underlying unaltered rocks below the mined-out former Rosebud Coal would begin to be exposed. Because the geology below the Rosebud Coal would not be altered by the Proposed Action, impacts related to the Proposed Action would cease after the spoil eroded away.

4.7 WATER RESOURCES – SURFACE WATER

This section discloses direct and indirect impacts on surface waters resulting from the No Action (Alternative 1), Proposed Action (Alternative 2), and the Proposed Action Plus Environmental Protection Measures (Alternative 3); cumulative impacts are disclosed in **Chapter 5**. Existing surface water conditions and the analysis areas used for this impacts analysis are described in **Section 3.7, Water Resources – Surface Water**.

4.7.1 Analysis Methods and Impact and Intensity Thresholds

4.7.1.1 Analysis Methods

Direct Effects

Hydrology and water quality data collected by Western Energy in the analysis area from mid-2011 through 2016 were used to describe existing conditions. During that period, climate conditions represented a wide range of very wet to very dry conditions, and average conditions, as described in **Section 3.7, Surface Water**. Only one stream monitoring location in the project area (SW-90, monitored since 2011) was monitored prior to 2013. The hydrologic and water quality information for the project area may not be representative of typical seasonal or annual conditions, and does not represent the variability that occurs over the long term.

Effects on peak stream flows were quantitatively analyzed using USGS regression equations developed for Montana (Parrett and Johnson 2004). Western Energy used the USDA Water Erosion Prediction Project (WEPP) and Sediment, Erosion, Discharge by Computer Aided Design (SEDCAD) models to evaluate the impact of mining disturbance on sediment yields in drainages in the analysis area (PAP, Appendix U). The WEPP model was used to estimate average annual sediment yield based on existing vegetation and land use in the direct effects analysis area. Sediment yield from the postmine reclaimed land in the analysis area was modeled using SEDCAD. Other effects were evaluated qualitatively or quantitatively based on data provided by Western Energy in its water quality database, information provided by Western Energy in the Area F PAP and Appendices, information collected in an October 2014 field visit to the project area, information provided by DEQ on the Rosebud and Big Sky Mines, and the analysis provided in **Section 4.8, Water Resources – Ground Water**.

Indirect Effects

Water quality data collected by DEQ, the Northern Cheyenne Tribe, and Montana PPL Corporation were reviewed to determine historical and recent (where data are available) mercury, selenium, and copper concentrations in Sarpy, Armells, Rosebud, Pony, and Spring Creeks. In addition to the water quality data, air quality modeling conducted for this EIS (see **Section 4.3, Air Quality**) was used to evaluate potential effects of atmospheric deposition of mercury, selenium, and copper from the Colstrip and Rosebud Power Plants on stream water quality within the indirect effects analysis area. An analysis of effects on stream water quality from deposition in the indirect effects analysis area was limited to mercury and selenium, for which the most stream water quality data were available in the analysis area, and copper, which was predicted by the air quality modeling to have the greatest deposition rate of all the modeled metals. Other metals were not evaluated because the deposition areas for antimony, arsenic, cadmium, chromium, and lead were predicted to be very small.

Water quality data from PPL Montana LLC's Colstrip Stream Electric Station Administrative Order on Consent Plant Site Report (Hydrometrics 2015) were used to evaluate how the disposal of coal combustion products in ponds, as well as the use of other on-site ponds and ponds near Colstrip, has affected downstream surface water quality.

4.7.1.2 Impact and Intensity Thresholds

The thresholds of change for the intensity of impacts on surface water hydrology and water quality are defined in **Table 127** and are used to describe impacts in the sections below.

Table 127. Surface Water Impact and Intensity Thresholds.

Impact Intensity	Intensity Description
Negligible	The action would result in a change to surface water hydrology and/or water quality that would be indistinguishable from those caused by fluctuations in natural processes, and of negligible consequence to existing land uses and/or beneficial uses of surface water.
Minor	The action would result in a change to surface water hydrology and/or water quality that would be localized, and/or of little consequence to existing land uses and beneficial uses.
Moderate	The action would have measurable effects on surface water hydrology and/or water quality that are distinguishable from the fluctuations in natural processes, but do not permanently preclude existing land uses and/or beneficial uses of surface waters.
Major	The action would have measurable effects on surface water hydrology and/or water quality that are distinguishable from the fluctuations in natural processes, and would permanently preclude existing land uses and/or beneficial uses of surface waters.

Impacts are also defined as short-term, long-term, or both (see **Section 4.1.1, Definitions**).

4.7.2 Alternative 1 – No Action Alternative

Under the No Action Alternative, Western Energy would not develop the project area within the Rosebud Mine. There would be no impact on the surface water hydrology and/or water quality in the project area described in **Section 3.7, Water Resources – Surface Water** because changes associated with development of the project area would not occur.

The No Action Alternative would not change the status of other areas of the Rosebud Mine that are currently permitted and being mined and/or reclaimed by Western Energy (see **Section 2.2, Description of Existing Mine and Reclamation Operations**) nor would it affect development of any other proposed Rosebud Mine permit areas currently in the permitting process (see **Section 5.2.2, Related Future Actions**). Effects on surface water hydrology and/or water quality due to current and future mining and/or reclamation in other permit areas of the Rosebud Mine would occur.

4.7.3 Alternative 2 – Proposed Action

4.7.3.1 Summary of Impacts

It is anticipated that the greatest impacts on surface waters would be:

- the loss of tributaries and upper McClure Creek within the mining footprint during mining
- the loss of some existing springs and stock ponds within the mine disturbance boundary
- the reduction or elimination of stream flows, spring flows, and water supply to stock ponds where the source of water is from the Rosebud and/or McKay Coal aquifers.

Some surface runoff to streams would be captured in sediment ponds and discharged to streams at permitted MPDES outfalls during mining. Western Energy must obtain MPDES permit coverage for all discharges from the project area to surface waters and has submitted an application to DEQ. The application currently is under DEQ review.

Changes to site hydrology in the direct effects analysis area would continue throughout project area mining and reclamation until sedimentation ponds were removed during the reclamation process and the watershed topography and hydrology were restored to conditions similar to pre-mine conditions. Based on Western Energy's ground water model, the ground water table will take more than 50 years after site reclamation to be reestablished (PAP, Appendix O). Presently, in areas reclaimed 40 years ago, the ground water table in the spoil is still recovering. In addition, it may take hundreds of years for the bedrock (overburden and Rosebud coal) aquifers to recover to near pre-mining conditions (Nicklin 2017). Other effects would be changes to in-stream and spring fed pond water quality during mining and to stream water quality, which would occur after mining and reclamation was completed due to the discharge of ground water from the spoil to streams downslope of the mine. Western Energy would be required to meet postmine land use performance standards and protect pre-mine and anticipated beneficial uses of the water.

To mitigate the general lack of water in the vicinity of the project area (due to climate and not primarily as a consequence of mining), Western Energy proposes enhancement features within the postmine topography to capture water when available and use it to enhance habitat for wildlife and livestock, and to establish wetlands. These features would be in the form of small depressions that would store water following runoff events, thereby providing water sources, promoting establishment of wetland species, and diversifying the postmine habitat types within the project area. These small depressions would also help to retain sediment within the project area.

4.7.3.2 Direct Impacts

Surface Water Hydrology Impacts

Springs

Overburden springs located southwest of the analysis area and upgradient of the area to be mined (within the disturbance boundary) such as Springs 1, 4, 5, and 6 would not be affected by mining. Springs located within the mining footprint would be eliminated; these may include Springs 7, 10, and 11. The flow of springs near the mining footprint would be reduced or eliminated by mining if their water source is the overburden or Rosebud Coal (which would be removed) or the McKay Coal, in which ground water drawdown would occur; these include Springs 7, 8, and 13. The flow of Spring 12 may be reduced by mining, and Spring 14 may not be affected by mining. The timing of effects on spring flow would be related to the mining sequence (see PAP, Exhibit A). Spring flows would not be reduced or eliminated until the Rosebud Coal in the vicinity of the spring was mined out. After mining ceased, pre-mine flow conditions would not return to springs whose aquifer sources were removed. If some of the entire spring source is McKay Coal and ground water drawdown in the McKay Coal reduced the flow during mining, spring flow would recover as the ground water table recovered. As described in **Section 4.8, Water Resources – Ground Water**, the backfilled spoil would be less capable of transmitting ground water horizontally than the original overburden; however, it is possible that springs from the backfilled spoil may develop within or downslope of the direct effects analysis area. For example, in permit Area B of the Rosebud Mine, two small springs have developed in drainage bottoms during reclamation that appear to be a result of preferential subsurface flow paths in the spoil (DEQ 2015d).

Springs 2, 8, 11, 12, and 13 would be affected by relocation of the county road and construction of the haul road (see **Section 2.4.3.4, Roads**), which would disturb the ground surface near the springs. Potential effects on the 14 monitored springs in the project area during and after mining are summarized in **Table 128**. The immediate effects of mining on Springs 3, 7, 8, 9, 10, 11, and 13 would be that these springs would be eliminated. However, the impact of the removal of the springs on the direct effects analysis area would be reduced as a result of wetland mitigation, postmine reclamation to reestablish to the extent possible the hydrologic balance, and water supply replacement as described in the PAP. Overall impacts on spring flows and the beneficial uses of spring water in the analysis area as a result of the Proposed Action would be long-term and moderate.

Table 128. Potential Effects of Mining on Monitored Springs in and near the Project Area.

Spring Name	Water Source	Potential Impact during Mining	Potential Impact Postmining
Spring 1	Overburden	Not affected	Not affected
Spring 2	Unknown (possibly overburden)	Not affected by mining, but may be affected by nearby road construction	Not affected
Spring 3	Overburden	Eliminated (within disturbance area near mine passes)	Eliminated
Spring 4	Overburden	Not affected	Not affected
Spring 5	Overburden	Not affected	Not affected
Spring 6	Overburden	Not affected	Not affected
Spring 7	Rosebud Coal[£]	Eliminated (in mined area)	Eliminated (in mined area)
Spring 8	Rosebud Coal (and possibly clinker)	Eliminated	Eliminated
Spring 9	Overburden	Eliminated (within disturbance area near mine passes)	Eliminated
Spring 10	Overburden (and possibly Rosebud Coal)	Eliminated (in mined area)	Eliminated (in mined area)
Spring 11	Rosebud Coal and clinker	Eliminated (in mined area)	Eliminated (in mined area)
Spring 12	Unknown	Not affected by mining, but may be affected by nearby road construction	Not affected
Spring 13	McKay Coal	Flow reduced, and may be affected by nearby road construction	Spring flow would eventually recover
Spring 14	Sub-McKay sandstone	Not affected	Not affected

Streams

Streams located south and west of the direct effects analysis area are upstream of the project area and would not be affected by mining. During mining, perennial and intermittent stream flows in the project area in sections of Trail, McClure, Robbie, and Donley Creeks would be reduced and may be eliminated except at locations upstream of the areas to be mined (such as upper Donley Creek). These stream sections are described in **Section 3.7.5.2, Streams**. Effects on ground water contributions to perennial and intermittent stream flow would occur due to reduced water availability from the McKay Coal and/or removing the overburden and/or Rosebud Coal aquifers that are sources of water to these streams either via springs (for which effects are shown in **Table 128**) or the alluvium. In addition, the direction of ground water flow in the unmined areas where the Rosebud Coal was not mined would be shifted toward the mine pits rather than to the alluvium in the stream channels. After mining, until the backfilled spoil was resaturated, remaining Rosebud Coal ground water would not reach the major drainages. As the spoil resaturated, water would begin to flow from the spoil to downslope stream channels. Based on Western Energy's ground water model, the ground water table will take more than 50 years after site reclamation to be reestablished (PAP, Appendix O). Presently, in areas reclaimed 40 years ago, the ground water table in the spoil is still recovering. In addition, it may take hundreds of years for the bedrock (overburden and Rosebud coal) aquifers to recover to near pre-mining conditions (Nicklin 2017). Ground water contributions to stream flow from the reclaimed area would eventually return to Robbie and Donley Creeks, but as described in **Section 4.8, Water Resources – Ground Water**, the rate of flow at these locations would be less because there would no longer be discharge from the Rosebud Coal and, due to the nature of the spoil, discharge from the spoil would likely be less than previously occurred from the Rosebud Coal. In addition, the location of ground water discharge and perennial or intermittent flow in the creeks may change due to the change in water source (from Rosebud Coal to spoil). Once the water table recovered in the McKay Coal, water from the McKay would discharge again to stream channels where it had previously discharged. Growth and propagation of aquatic life may be lost in reaches adjacent to mining which become ephemeral during mining and until water level recovery was complete. The effects of reducing ground water contributions to stream flow at specific locations would be mitigated through wetland mitigation and postmine reclamation to reestablish to the extent possible the hydrologic balance, as described in the PAP. Effects on ground water contributions to stream flows and to the overall beneficial uses of perennial and intermittent stream flows in the direct effects analysis area would be long-term, minor to moderate, and adverse.

Much of the flow in the direct effects analysis area streams occurs as a result of runoff from storm events or snowmelt. During mining, the majority of runoff from undisturbed land upstream of the mine would flow through the undisturbed main stream channels (see **Figure 36** in **Section 3.7, Water Resources – Surface Water**). Tributary drainages would be mined out, and runoff from undisturbed lands upstream of the active pit would be captured in the pit or sediment ponds. Surface runoff from disturbed areas would be impounded in the mine pits or sediment ponds, resulting in reduced ephemeral flows during precipitation or snowmelt runoff events. Based on the expected 19-year mining sequence (see **Section 2.4.3.5, Approximate Mining Sequence**; see also PAP, Exhibit A), the Donley Creek drainage and a small part of the Black Hank Creek drainage would be affected first, then the Robbie Creek drainage, followed by the McClure Creek drainage, Trail Creek drainage, and finally the rest of the Black Hank Creek drainage. Estimated mean annual runoff and peak flows for analysis area streams and other ungaged streams in southeast Montana were determined using multiple regression equations developed by the USGS (Parrett and Johnson 2004). Using the regression equations based on basin characteristics, the single most important independent variable is drainage area, and in southeast Montana, the other variable used in the equations is percent of basin covered by forest (defined in the analysis area as the conifer/sumac and woody draw vegetation communities; see **Section 3.10, Vegetation** and **Figure 45**). Other variables considered were precipitation, basin elevation, and channel length and slope. During mining, the watershed areas of Trail, McClure, Robbie, Donley, and Black Hank Creeks would be reduced as each watershed was mined; thus, it is expected that runoff to streams would decrease. Using the USGS equations (Parrett and Johnson 2004) to estimate peak flows on these streams, percent flow reductions at full mine development are provided in **Table 129**. To show the effect of a reduction in watershed area, the calculations assume that the percent forest cover in each basin would not change as a result of mining; however, if the percent forest cover decreased, peak flows would increase or if the percent forest cover increased, peak flows would decrease. The flows provided in **Table 129** are for each stream from the top of each watershed to the downstream, northeastern project area boundary. Before all mine passes were excavated in each watershed, effects on stream flows would be less, and would progressively increase to those shown in **Table 129**. The drainage area and stream flow in Horse Creek would not change because no mining disturbances would occur in that drainage.

Table 129. Estimated Peak Flows for Streams in the Project Area Before Mining and at Full Mine Development.

Drainage Basin	Watershed Area in the Project Area (acres)	Pre-mining 2-yr Peak Flow (cfs)	2-yr Peak Flow at Full Mine Development (cfs)	Percent Reduction in 2-yr Peak Flow	Pre-mining 10-yr Peak Flow (cfs)	10-yr Peak Flow at Full Mine Development (cfs)	Percent Reduction in 10-yr Peak Flow	Pre-mining 100-yr Peak Flow (cfs)	100-yr Peak Flow during Mining (cfs)	Percent Reduction in 100-yr Peak Flow
Trail Creek	172.5	11	8	27	62	50	19	246	206	16
McClure Creek	463.1	9	7	22	59	47	20	260	211	19
Robbie Creek	2,678.8	29	24	17	158	136	14	591	519	12
Donley Creek	5,440.6	41	38	7	217	204	6	783	742	5
Black Hank Creek	6,344.6	44	42	5	232	220	5	830	792	5

Source for peak flow calculations: http://wy-mt.water.usgs.gov/freq?page_type=gen_stats_1.

Within each analysis area watershed, when all of the mine passes were being or had been mined, and until the watersheds were fully restored, estimated 2-year, 10-year, and 100-year peak flows would be reduced by up to 20 percent in Trail and McClure Creeks; up to 15 percent in Robbie Creek; and less than 10 percent in Donley and Black Hank Creeks. In addition, disturbed area runoff would be controlled by a network of roadside ditches, sediment-control ponds, and sediment traps. Surface runoff from disturbed areas would be impounded in the mine pits and/or sediment-control structures in accordance with the Hydrologic Control Plan (**Figure 107**). The detention and controlled release of surface runoff would result in additionally reduced peak flows to the West Armells Creek drainage. Some of the water stored in the sediment ponds or mine pits would be used (such as for dust control), some would evaporate, and some would infiltrate to the subsurface; this is water that would be lost as surface or subsurface flow in the stream channels. Loss of runoff water due to storage of runoff in the sediment ponds or mine pits, evaporation, or infiltration could affect the local hydrologic balance (EPA 2001). The volume, timing, and frequency of ephemeral flows in direct effects analysis area streams and West Fork Armells Creek would change. The effect of reduced peak flows may be changes to stream morphology and reduced surface and subsurface (via the alluvium) recharge to the streams below the analysis area, including the West Fork Armells Creek. Reduced peak flows may result in less sediment transport, channel narrowing, and less water storage within channel banks and floodplains. It may be difficult to separate these effects from the effects of variability in runoff producing storm events.

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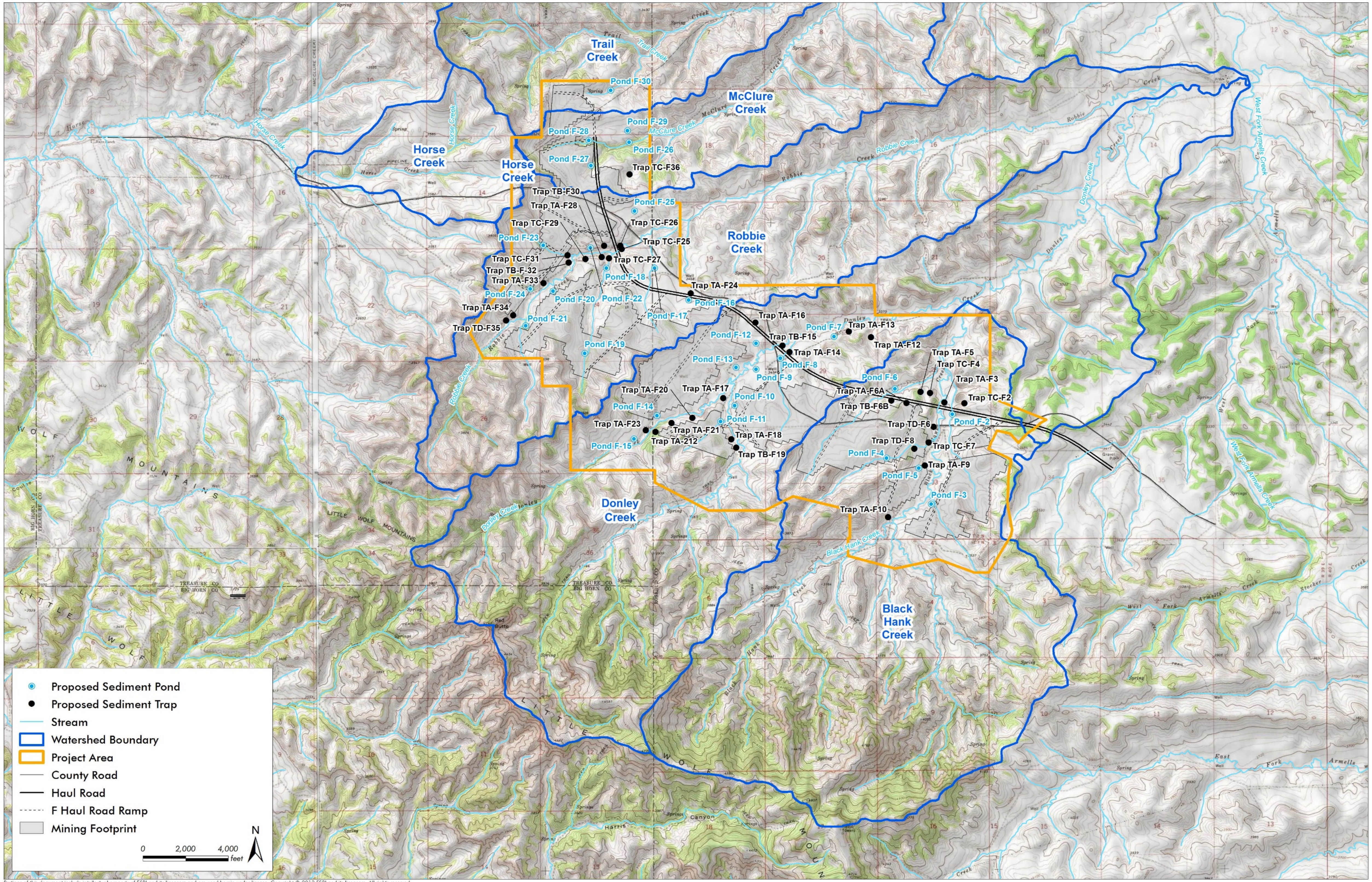

Figure 107. Proposed Project Area Mining Footprint, Haul Roads, and Sediment Ponds and Traps.

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During mining, water would be discharged when needed from sedimentation ponds to Trail, McClure, Robbie, Donley, and Black Hank Creeks via MPDES outfalls. The sedimentation ponds would be designed to retain up to the volume of runoff produced by the theoretical 10-year 24-hour storm event, so runoff from larger events would discharge to the main channels (PAP, Appendix O). Discharge may also occur when the ponds needed to be drained to comply with the minimum 24-hour retention capacity requirement per ARM 17.24.639(2). Stored water would be removed by using a non-clogging dewatering device or conduit approved by DEQ. Discharges to mine area streams would replace some of the storm water runoff but the volume, timing, and frequency of such discharges would not be the same as would occur naturally, so effects on channel morphology would not be offset by discharges at the MPDES outfalls (**Figure 11**).

As the mine site is reclaimed (see **Section 2.4.4, Reclamation Plan** and **Figure 8** for the proposed timing of reclamation), the postmine topography, drainage areas, and geomorphic characteristics would be designed to be similar to pre-mine topography (given the constraints of earth moving equipment, costs, other ongoing reclamation, and the volume of spoil available to fill the pits and restore the site topography) (PAP, Appendix J, Tables J-1 and J-2). As a result, peak flows would return to near pre-mine peak flows (PAP, Appendix J, Tables J-3 to J-5). MSUMRA (ARM 17.24.601 et seq.) requires that drainage basins be restored during reclamation to the original stream function. To the extent possible during reclamation, smooth transitions would be constructed between undisturbed and reclaimed land to reestablish surface drainage patterns. The disturbed tributary drainages and stream channels would be reconstructed to the approximate original drainage configurations, with channel geometry similar to pre-mine conditions; however, there would be small differences in watershed areas and shapes postmining that would slightly alter runoff within the watersheds (see **Section 2.4.4.5, Postmining Topography and Drainage Basin Design** and **Figure 9**). The disturbed stream channels within the project area formerly governed by geologic structure and the inherent variability of different strata would no longer exist. Geologic structure within the stream channels would not be disturbed upstream and downstream of the project area. Spoil in the designed postmine drainages would be covered by several feet of topsoil and vegetated. The reclaimed drainages would be designed to minimize erosion and protect the hydrologic balance.

Although stream flows may be restored to conditions similar to pre-mine stream flows, stream flow from the upstream areas of the tributaries may be reduced or may not flow through the reclaimed area because the vertical percolation rate in the spoil would be greater than in the overburden (see **Section 4.8, Water Resources – Ground Water**). Some or all surface flow may infiltrate into the spoil rather than flowing to the lower portion of the watershed, as has been observed at the Big Sky Mine during reclamation (DEQ 2015e). Whether surface flow across the spoil was reduced or totally infiltrated would be dependent on topography; where fairly flat, there may be no flow after reclamation. In addition, baseflow in the streams from ground water discharge to the stream channels would not begin until after ground water levels recovered more than 50 years to possibly hundreds of years after mining, and discharges to streams may occur at different locations than occurred before mining. Based on Western Energy's ground water model, the ground water table will take more than 50 years after site reclamation to be reestablished (PAP, Appendix O). Presently, in areas reclaimed 40 years ago, the ground water table in the spoil is still recovering. In addition, it may take hundreds of years for the bedrock (overburden and Rosebud coal) aquifers to recover to near pre-mining conditions (Nicklin 2017). The overall impacts from the Proposed Action on ephemeral stream flows in the direct effects analysis area would be adverse and minor in the short term, to negligible in the long term.

Ponds

None of the seven monitored man-made livestock ponds would be removed during mining. Other ponds in the analysis area are not mapped, but if they are within the mining footprint, they would be eliminated.

The water supply of some ponds may be reduced or eliminated during mining due to the impoundment of runoff that is a source of supply to the ponds or due to the reduction or elimination of spring flows that are a source of supply to some ponds. After mining, some ponds would be reestablished and some sediment ponds would be retained to provide water supplies for wildlife and livestock; thus, the overall effect on pond water supply in the direct effects analysis area would be short-term, minor to moderate, and adverse. As discussed in **Section 4.9, Water Resources – Water Rights**, if a pond with a water right for stock watering were to become unusable, a suitable replacement source would be provided by Western Energy.

Hydrologic Balance

Mining would affect the hydrologic balance within and downstream of the project area in the following ways:

- mining through tributaries, which would affect stream and alluvial flows
- altering the topography, which would affect stream and alluvial flows
- storing runoff, which would affect stream and alluvial flows and alter surface water storage
- decreasing or eliminating spring flows, which would affect stream and alluvial flows
- eliminating some stock ponds, which would reduce surface water storage
- storing water in sediment ponds and discharging water from MPDES outfalls, which would affect stream and alluvial flows and recharge to ground water
- disturbing the soil surface and removing vegetation, which would affect the interception, infiltration, evaporation, sublimation, and transpiration of water at the land surface
- removing the Rosebud Coal aquifer, which would change ground water storage
- removing the overburden and replacing it with spoil, which would permanently change the vertical percolation rate (**Section 4.8, Water Resources – Ground Water** states that the vertical percolation would be greater in the spoil than the overburden) and change ground water storage.

After mining, the watershed topography and hydrology would be restored to reestablish to the extent possible the hydrologic balance in the analysis area (see **Section 2.4.4, Reclamation Plan** and **Section 2.4.5, Protection of the Hydrologic Balance**). This reclamation would be phased (see **Figure 8** for the proposed timing of reclamation), with spoil backfilled into the pit after each subsequent mine pass and grading and stabilization of the spoil occurring within four spoil ridges of the active mining pass. During the final phases of spoil grading, surface drainages would be reconstructed to the approved approximate postmine topography, which would approximate original drainage configurations. A tributary system would be designed and constructed to restore the pre-mine incised drainages. The postmine channels and floodplains would be designed to mimic the pre-mine channels' response to rainfall events by providing channel geometry (length, slope, longitudinal profile, cross-section, and bedform) to create velocities, depths, flow areas, and other hydraulic properties similar to pre-mine properties for the same discharge events. New ponds may be constructed, and surface water flow and quality would be monitored to determine if surface water quantity and quality without treatment had stabilized to its previous undisturbed state and achieved postmine land use performance standards for livestock and wildlife use in and downstream of the project area. Effects on the hydrologic balance would be variable depending on location within the direct effects analysis area. At locations where the overburden and Rosebud Coal were removed, ground water storage would be permanently changed. At the most downstream end of the analysis area at the West Fork Armells Creek, any changes to the relationship between the quality and quantity of water inflow to, water outflow from, and water storage in the West Fork Armells Creek basin, including the dynamic relationships among precipitation, runoff, evaporation, and changes in ground water and surface water storage, would be restored during reclamation.

Based on Western Energy's ground water model, the ground water table will take more than 50 years after site reclamation to be reestablished (PAP, Appendix O). Presently, in areas reclaimed 40 years ago, the ground water table in the spoil is still recovering. In addition, it may take hundreds of years for the bedrock (overburden and Rosebud coal) aquifers to recover to near pre-mining conditions (Nicklin 2017). It would not be possible to completely restore the pre-mine hydrologic balance in the direct effects analysis area after mining due to the removal and replacement of the Rosebud Coal and overburden with spoil. Western Energy would be required to meet postmine land use performance standards and protect pre-mine and anticipated beneficial uses of the water; thus, the overall impacts to the hydrologic balance in the direct effects analysis area would be long-term, moderate, and adverse.

Floodplains

The 100-year floodplains on Trail, McClure, Robbie, Donley, and Black Hank Creeks in the analysis area, which are about 300 feet wide, would not be mined and would remain intact. Haul roads would largely be located outside of the 100-year floodplains, but where they crossed streams, culverts would be installed that were designed for the 10-year, 24-hour storm event (see **Figure 6**). Structural BMPs, described in **Chapter 2**, would be used to control sediment movement and erosion, and stabilize the haul roads within the 100-year floodplains. The only other mine facilities that may be installed in the floodplains would be sediment ponds or traps. The disturbance area of the sediment ponds or traps to project area streams would be very small compared to the area of the 100-year floodplains in the analysis area. Flooding would continue to occur due to large storms, such as the 5-inch precipitation event in late May 2013 that resulted in a flow estimated to be 400 cfs at SW-90 on Donley Creek. Runoff from storms greater than the 10-year, 24-hour event would flow over any haul roads located in the floodplains and some would flow through the culverts. It is possible that damage to the floodplain and an increased hazard to life could occur temporarily if a very large storm event damaged or washed out the haul road within one or more of the creek floodplains. It is not expected that other mine structures or mine activities would damage the floodplains or cause an increased hazard to life downstream of the project area. Effects on floodplains would be short-term, minor, and adverse.

Surface Water Quality Impacts

Surface water quality data for Areas A, B, C, D, and E were evaluated for changes in water quality that may have occurred prior to mining and during or after mining. For the most part, there were inadequate pre-mine data to make such a comparison. In addition, changes in laboratory detection limits since the 1970s and early 1980s (pre-mining), as well as natural water quality variability, made it difficult to analyze changes in stream, spring, and pond water quality due to mining. Another variable for stream water quality was the suspended solids concentration, which is variable during runoff events, and can affect metal concentrations in streams. The only documented difference in water quality occurred in Pond 917 in Area D, where nitrate+nitrite and selenium concentrations were sometimes higher during and after mining than when measured before mining began in Area D.

Springs

The water quality of overburden springs located southwest of the project area and upgradient of the area to be mined such as Springs 1, 4, 5, and 6 would not be affected by mining. The water quality of springs whose source is the McKay Coal (such as Spring 13) would not be affected by mining. Rosebud Coal springs and springs within the mined area (such as Springs 3, 7, 8, 9, 10, and 11) would be eliminated (**Table 79**). The water quality of the spoil would generally be poor (as described in **Section 4.8, Water Resources – Ground Water**), so any springs that developed in or below the mined area from spoil ground water would likely have higher dissolved solids, sulfate, and possibly nutrient and metal concentrations. Springs 8, 11, and 13 would be affected by construction of the haul road, which would disturb the ground surface near the springs; the effects would be short-term and minor.

Streams

Runoff from disturbed lands would be intercepted and treated by the implementation of sediment-control measures. Sedimentation ponds would be designed for total containment of runoff from the 10-year, 24-hour precipitation event plus storage of 3 years of sediment yield from disturbed areas in the mine area. Locations of sedimentation ponds and associated ditches are shown on **Figure 107** (see also **Section 3.7, Water Resources – Surface Water**). During mining, runoff from undisturbed land above the pit would be intercepted by the pit or by temporary impoundments or traps in the drainages above the pit. Very large runoff events would be intercepted by the pit. A system of ditches and traps proposed for the perimeter haul road is shown in the Approximate Hydrologic Control Plan (PAP, Exhibit D) and discussed in **Section 2.4.5.2, Surface Water Management and Sediment Control Measures**. Ditches along the haul road would direct runoff to either sedimentation ponds or sediment traps. In areas where the haul road crossed the ephemeral drainages, runoff from the road embankment would be collected by sediment traps. Ditches would roughly parallel the access roads to intercept runoff from disturbed lands. This containment system should prevent any sediment or untreated runoff from leaving the project area. All discharges from the proposed mining areas to state surface waters would be required to comply with applicable MPDES permit effluent limits.

Western Energy would also use other sediment-control measures for roads and other disturbed areas as described in **Section 2.4.5.2, Surface Water Management and Sediment Control Measures**.

Erosion control BMPs listed by DEQ in the MPDES permit for the project area would be required. Sediment and erosion control structures would remain in place after mining for as long as needed until all disturbed areas were fully reclaimed. Structural BMPs that have been proposed for use in the project area by Western Energy are outlined in **Section 2.4.5.2, Surface Water Management and Sediment Control Measures**.

Assuming all runoff from disturbed lands were effectively captured and treated before release to any of the unmined streams in the analysis area, and all discharges at MPDES permit outfalls met effluent limits, adverse effects on stream water quality should be minimal and beneficial uses should be protected.

If a precipitation event occurred that was greater than the culverts, sediment ponds, ditches, and other erosion control structures were designed for, they would not be capable of routing, holding, and/or treating sediment laden runoff, and may themselves cause erosion to roads, upland disturbed and undisturbed areas, and channels and floodplains in and downslope of the analysis area. Some storm water runoff would be captured in the mine pits, but other runoff from disturbed areas may reach streams and ponds in the unmined areas, temporarily increasing suspended sediment, dissolved solids, and total metal concentrations in streams and ponds.

During mining, the quality of storm water flow from undisturbed areas in the project area would be the same as before mining commenced if no untreated storm water runoff was released from the disturbed areas. The quality of water where it flows perennially and intermittently in sections of Trail, McClure, Robbie, and Donley Creeks, if and when such flows from the coal beds remained, would be similar to the existing quality of the Rosebud and/or McKay Coal water (see tables in **Section 4.8, Water Resources – Ground Water**).

As discussed in **Section 4.8, Water Resources – Ground Water**, after backfilling and once the spoil resaturated, ground water may discharge from the spoil to alluvium along the major drainages and some of the alluvial water could discharge to streams where the ground water table intersects the stream bottom. It is not known where such discharges would occur downstream of the analysis area, and the quantity of such discharges is not known. Discharge from the spoil to streams could result in changes in water quality in the drainages compared to pre-mining conditions. Postmining, discharge to the streams would be from spoil with water quality that, compared to stream water quality, has higher dissolved solids, nutrient, and some metal concentrations. As discussed in **Section 4.8, Water Resources – Ground Water**, the quality of spoil ground water in other areas mined by Western Energy is highly variable, so it is difficult to predict to what extent discharge from the spoil in the analysis area would affect surface water quality, and if changes in water quality due to discharge from the spoil would be separable from natural water quality variability. In addition, an evaluation of several decades of spoil water quality data from Permit Areas A and B of the Rosebud Mine shows that in a number of wells concentrations of the following parameters have increased over time: TDS, sulfate, carbonate alkalinity, total alkalinity, chloride, dissolved iron, and dissolved manganese. After nearly 40 years of monitoring, there is no clear indication that TDS concentrations in the spoil have reached equilibrium or have shown decreases. Possible adverse effects of discharges from spoil on the water quality of down slope streams may increase over time. It is not known how long it would take for the quality of water in spoil to eventually improve as soluble salts and metals are flushed from the system. Based on spoil water quality presented in **Section 4.8, Water Resources – Ground Water,** TDS, sulfate, alkalinity, calcium, sodium, nitrate+nitrite, magnesium, and manganese concentrations in streams below the spoil may increase and exceed nitrate+nitrite and total nitrogen standards, and recommended limits for the other parameters for livestock, other ruminants, and aquatic life when and where ground water discharge is the major or only source of water to streams. As stated in **Section 3.7, Water Resources – Surface Water**, cattle and wildlife can adapt to higher TDS concentrations, but there may be chronic adverse health effects. If surface water became unusable for its specified postmining beneficial use due to water quality changes, a suitable replacement source would be provided. The overall impacts of the Proposed Action on surface water quality and associated beneficial uses of streams in the analysis area would be long-term, minor to moderate, and adverse.

Ponds

During mining, for ponds whose water supply was reduced due to the impoundment of runoff (such as Pond 4), the quality of the pond water may improve due to the reduction in sediment-laden runoff entering the pond and reduced total metals associated with the suspended solids in the water. For any ponds whose water supply was reduced during mining due to the reduction or elimination of spring flows that are a supply source, the water quality of the pond would change. The water quality of all of the ponds may degrade due to a reduction in inflows, which would increase parameter concentrations in any water remaining in the ponds. The overall effects on water quality and associated beneficial uses of ponds in the analysis area would be long-term and moderate. Postmine ponds would be supplied water from storm water runoff, so the water quality of the ponds would be similar to existing ponds whose source of water is only storm runoff.

Sediment Yield

Input parameters for the WEPP model to predict existing sediment yield in the analysis area included pre-mine topography and drainage basin boundaries, NRCS soil survey data, a rangeland grass system with sagebrush vegetative cover, and precipitation data from the Colstrip meteorological station (PAP, Appendix U). Running the model for a 20-year period resulted in a pre-mine average annual sediment yield for the analysis area ranging from 0 to 0.871 tons/acre/year, with an average of 0.142 tons/acre/year. Input parameters for the SEDCAD model included estimated postmine topography and drainage basin boundaries, an assumed 80 percent ground cover after reclamation, postmine soils that would be similar to pre-mine soils, a loam or silt loam soil texture, an erodibility factor with a soil of moderate infiltration rate and runoff potential, and a 10-year 24-hour storm event of 2.45 inches (PAP, Appendix U). The model-predicated postmine average annual sediment yield ranged from 0.001 to 0.18 ton/acre/year for the postmine drainage basins in the analysis area. The postmine sediment yields would be less than pre-mine sediment yields in the Trail Creek watershed, less than or equal to pre-mine sediment yields in the majority of drainages within the Robbie Creek, Donley Creek, and Black Hank Creek watersheds, and greater than pre-mine sediment yields in some of the drainages within the Robbie Creek, Donley Creek, and Black Hank Creek watersheds. In basin area RCT-7, located in lower Robbie Creek within the project area, pre-mine sediment yield was predicted to be 0 ton/acre/year for the 131-acre basin area; postmine sediment yield after disturbance of 82.8 acres was estimated to be 0.046 ton/acre/year, with a yield of 9.4 tons of sediment from a 10-year 24-hour storm event. The largest ton/acre/year sediment yield increase and largest 10-year 24-hour storm yield was predicted to occur in basin area BHCT-6, located in Black Hank Creek within the project area. The predicted increase in BHCT-6 is from 0.021 ton/acre/year to 0.145 ton/acre/year after disturbance of 344.2 acres, with a yield of 121.9 tons of sediment from a 10-year 24-hour storm event. The largest ton/acre/year sediment yield decrease is predicted to occur in RCT-2, located in the upper Robbie Creek watershed; the yield is predicted to decrease from 0.598 ton/acre/year to 0.034 ton/acre/year. Changes in sediment yield indistinguishable from those caused by fluctuations in natural processes would not have measurable effects on streams. Increases or decreases in sediment yield in some of the basins may have localized measurable effects on stream morphology and water quality. Large increases or decreases in sediment yields, such as those predicted for RCT-2 and BHCT-6, may result in measurable effects on stream morphology, stream water quality, and aquatic habitat in parts of the watersheds in the direct effects analysis area. Although a few localized watersheds may show increases in sediment yield, the overall effect of the Proposed Action is to reduce sediment yields within the analysis area from an estimated 0.142 ton per acre per year to 0.058 ton per acre per year. The reduction would be due to less steep slopes in the postmine topography as compared to the pre-mine topography. The overall impact on surface water quality due to changes in sediment yield in the analysis area would be long-term and moderate.

Other Impacts on Surface Water Quality

If not adequately suppressed, dust from mining activities could reach surface water bodies in the analysis area. The dust would add sediment and other pollutants such as metals to surface water. Western Energy would use a surfactant to suppress fugitive dust on haul roads that could enter surface waters in and near the analysis area and may degrade water quality. Effects on surface water quality due to dust from mining activities would be short-term, negligible to minor, and adverse.

4.7.3.3 Indirect Impacts

As described in **Section 1.2.2.1, Colstrip Power Plant** and in **Chapter 5, Cumulative Impacts**, the Rosebud Mine provides between 7.7 and 9.95 million tons of coal annually to the Colstrip Power Plant, which is located in the city of Colstrip, for combustion in Units 1, 2, 3, and 4. Coal mined in the project area would be burned in Units 3 and 4 only along with coal from other active permit areas of the Rosebud Mine. The Rosebud Power Plant, located 6 miles north of the city of Colstrip, would also combust project area coal. As described in **Section 1.2.2.2, Rosebud Power Plant**, the Rosebud Mine provides 300,000 tons of coal annually to the Rosebud Power Plant. The project area would provide 30 to 50% of the mine's total waste coal delivery to the Rosebud Power Plant, with other permit areas of the mine providing the remainder. There are no reports of spills or seepage from storage or disposal of combustion residuals at the Rosebud Power Plant that have affected surface water quality.

At the Colstrip Power Plant, numerous lined ponds are used for various purposes, including disposal of coal combustion products, evaporation of wastewater, and storm water runoff (Hydrometrics 2015). The ponds were designed and constructed to minimize seepage losses; however, over the period of operations, seepage from various ponds has occurred, resulting in measurable impacts on ground water beneath the plant site and on nearby surface water in the East Fork Armells Creek. Spills to the East Fork Armells Creek from Colstrip Power Plant pipelines have also occurred. The power plant operator has collected and continues to collect numerous surface water samples from the creek starting just west of the power plant to about 3 miles north of the power plant. The water quality of the East Fork Armells Creek near the Colstrip Power Plant has been impacted by plant operations but has improved, likely due to capture of contaminated ground water, better water management, and BMPs implemented at the power plant (Hydrometrics 2015).

The area of deposition of coal combustion emissions in soil and surface water around the two power plants is described in **Section 4.3, Air Quality** (see also **Section 3.7.1.2, Analysis Area**). Over the past 10 years, mercury concentrations measured in the streams in the indirect effects analysis area (part of the Armells Creek, Sarpy Creek, and Rosebud Creek watersheds) have been below the laboratory detection limit and below water quality standards; this indicates that mercury deposition from the Colstrip and Rosebud Power Plants, and even from all atmospheric mercury sources, does not adversely affect the water quality of these streams. In the past 10 years, selenium concentrations measured in the streams in the indirect effects analysis area have been well below standards, with the exception of East Fork Armells Creek at some of the sampled locations in and just north of Colstrip, and Spring Creek (a tributary to Rosebud Creek) east of Colstrip. It is possible that atmospheric deposition is a source of selenium to the East Fork Armells Creek. The water quality of Spring Creek may be affected by mining in Permit Area D of the Rosebud Mine (DEQ 2015b). The MPDES permit for the Rosebud Mine allows discharges at 13 outfalls to Spring Creek (see **Section 5.2.1.7, Permitted Discharges for Existing Areas of the Rosebud Mine**). Because selenium surface water concentrations in the indirect effects analysis area are nearly all low, it appears that selenium deposition from the two power plants does not adversely affect the water quality of analysis-area streams, except possibly the East Fork Armells Creek and Spring Creek, although the latter may only be affected by mining in Area D. In the past 10 years, copper concentrations measured in streams in the indirect effects analysis area have been well below copper standards. This indicates that copper deposition from the two power plants has not adversely affected the water quality of analysis area streams. If project area coal is burned at the Colstrip and Rosebud Power Plants, it is expected that there would be no effect on stream water quality, except possibly for selenium in the East Fork Armells Creek. Effects on the East Fork Armells Creek would be long-term, negligible to moderate, and adverse.

Sarpy Creek and the East Fork Armells Creek are listed by DEQ as impaired for nitrate+nitrite and total nitrogen. The source for the impairments is listed by DEQ as agriculture for both streams (DEQ 2016d). Sarpy Creek has not been sampled for nitrogen since 2005. When sampled in the past 10 years, nitrate+nitrite concentrations in Rosebud, East and West Forks Armells Creek, and Armells Creeks have been well below the standard, indicating that nitrogen deposition from all atmospheric nitrogen sources does not adversely affect the water quality of these streams with regard to nitrate and nitrite. Most total nitrogen concentrations in analysis area streams have also been well below the total nitrogen July through September standard of 1.3 mg/L, but a measured total nitrogen concentration of 1.04 mg/L in July 2016 in Rosebud Creek upstream of Pony Creek (east of Colstrip) approached the standard. The average total nitrogen concentration in Rosebud Creek during the summer months when the nitrogen standard applies was 0.3 mg/L in 2014, 2015, and 2016. It is possible that atmospheric deposition is a source of nitrogen to Rosebud Creek, but it is likely that agriculture is also a source of nitrogen to the creek. A measured total nitrogen concentration of 1.22 mg/L in July 2015 in Spring Creek approached the total nitrogen standard. The water quality of Spring Creek may be affected by mining in Permit Area D of the Rosebud Mine (DEQ 2015b). Because total nitrogen surface water concentrations in the indirect effects analysis area are nearly all low, it appears that nitrogen deposition does not affect the water quality of analysis area streams, except possibly Rosebud Creek east of Colstrip. The air quality modeling completed for this EIS shows that at East Armells Creek in Colstrip, the nitrogen deposition from the Colstrip and Rosebud Power Plants is 6 percent of all nitrogen deposition at that location from all atmospheric sources, and at

Rosebud Creek east of Colstrip it is 6.8 percent (the prevailing wind direction is more consistently to the east). At Sarpy Creek west of the Rosebud Mine, the nitrogen deposition from the Colstrip and Rosebud Power Plants is 3.5 percent of all nitrogen deposition at that location from all atmospheric sources. Because atmospheric nitrogen deposition from the Colstrip and Rosebud Power Plants is less than 10 percent of all atmospheric deposition sources to these streams, it is likely that nitrogen deposition from the two power plants does not and would not adversely affect the water quality of the indirect effects analysis area streams.

The alkalinity of indirect effects analysis area streams has nearly always been greater than 100 mg/L, and often has been several hundred mg/L when measured in recent years. Alkalinity refers to the capability of water to neutralize acid, and is an expression of the buffering capacity of a surface water body. Due to the high alkalinity of the analysis area streams, a result of alkaline soils in the analysis area, any acid rain deposition from the Colstrip and Rosebud Power Plants or from any other acid rain source would not change the pH of the streams appreciably. For example, at a site named AR-10PBR in the East Fork Armells Creek located within the city of Colstrip, the pH has remained essentially unchanged, with very little fluctuation, at 8.0 standard units between 2000 and 2016 (EPA 2017h).

Although Castle Rock Lake in Colstrip has a fish consumption advisory related to mercury, there are no water quality data for the lake, so it is not known if atmospheric deposition from the Colstrip and Rosebud Power Plants has adversely affected the water quality of the lake. However, because mercury concentrations in the East Fork Armells Creek, located about ½ mile from Castle Rock Lake, have been below the laboratory detection limit and below water quality standards over the past 10 years, indicating that mercury deposition from the Colstrip and Rosebud Power Plants does not adversely affect the creek, it seems unlikely that the power plants mercury deposition has or would adversely affect Castle Rock Lake.

Very few metal or nitrogen data have been collected from the Yellowstone River in Treasure, Rosebud, or Custer Counties in the last 10 years. The data that exist show very low mercury, copper, and nitrogen concentrations (there are no selenium data) in the river that are well below water quality standards. The depositional effects of coal combustion emissions from the Colstrip and Rosebud Power Plants on the Yellowstone River are not expected to be measurable for the following reasons:

- A comparison of the monthly flow contribution of Sarpy Creek, Armells Creek, and Rosebud Creek to the monthly flows in the Yellowstone River using USGS gage periods of record shows that they contribute from 0.1 percent (July, August, October, and November) to 1.8 percent (March) of the total flow of the Yellowstone River at the Forsyth gage. Any deposition effects from the Colstrip and Rosebud Power Plants on the water quality of the three tributaries are not likely to be detectable in the Yellowstone River due to dilution.
- The air quality modeling completed for this EIS shows that at a location halfway between the Colstrip and Rosebud Power Plants (about 3 miles north of Colstrip), the mercury deposition from the two power plants is less than 3 percent of all mercury deposition at that location from all atmospheric sources. At the Yellowstone River about 25 miles north of Colstrip, the effects of mercury deposition from the two power plants would not be expected to be measurable compared to worldwide atmospheric deposition sources to the Yellowstone River.
- The air quality modeling completed for this EIS shows that at the confluence of Armells Creek and the Yellowstone River the nitrogen deposition from the two power plants is 1.4 percent of all nitrogen deposition at that location from all atmospheric sources, and at the confluence of Rosebud Creek and the Yellowstone River it is 1 percent. The effects of nitrogen deposition from the two power plants would not be expected to be measurable compared to worldwide atmospheric deposition sources to the Yellowstone River.

4.7.4 Alternative 3 – Proposed Action Plus Environmental Protection Measures

The effects of Alternative 3 on surface water resources would be similar to Alternative 2, except as discussed in this section. As described in **Section 2.5.2, Environmental Protection Measures**, Western Energy would be required to develop a Water Management Plan for the project area that would include mitigation measures to protect water quantity and quality and water-dependent ecosystems. To the extent possible, unlined sediment ponds and MPDES discharge points would be located upstream of existing water-dependent ecosystems and pond releases managed to maintain a high water table at those locations in drainages undisturbed by mining (Black Hank, Donley, Robbie, McClure, and Trail Creeks). MPDES outfall releases would be managed both in timing and volume to augment or mimic the water budgets of downstream water-dependent ecosystems. Some ponds would be retained after mine closure to support wetlands and riparian areas for wildlife and/or stock use. Any water not protective of beneficial uses would need to be treated prior to discharge. The effect on surface water resources would be to maintain project area streams as suitable for the growth and propagation of non-salmonid fish and associated aquatic life.

If pit water must be managed by pumping it to storage ponds, and if storage of such water had the potential to affect water resources outside of the project area, the ponds would be lined if located near the perimeter of the project area boundary, or the storage ponds would be located well within the interior of the project area. Shallow monitoring wells would be installed below all unlined ponds that received pit water. The effect of these mitigations would be to minimize the movement of pit water that may contain blasting residuals (such as ammonia and nitrate) and other potential contaminants to surface water, reduce potential surface water quality degradation, and protect the beneficial uses of the streams.

Western Energy currently uses water or a dust palliative such as Lignin Sulfonate to suppress fugitive dust on haul roads in other Rosebud Mine permit areas. Under Alternative 3, Western Energy would use a more benign dust suppression solution approved by DEQ to reduce potential impacts on water quality.

To mitigate long-term impacts on the hydrologic balance in watersheds disturbed during mining, Western Energy would use 5-foot contours to design the postmine topography for the project area instead of the 10-foot contours used under the Proposed Action (**Figure 9**). For select drainages with estimated 2-year, 24-hour peak discharges greater than 5 cfs, Western Energy would submit drainage designs to DEQ for review and approval prior to disturbance (instead of for discharges greater than 15 cfs under the Proposed Action) (see **Section 2.4.4.5, Postmining Topography and Drainage Basin Design**).

4.7.5 Irreversible and Irretrievable Commitment of Resources

The following would be irreversible and irretrievable commitments of surface water resources:

- the loss of water to the springs in the project area whose source of water supply was the Rosebud Coal, which likely would result in the loss of these springs and associated wetlands
- springs, ponds, and associated wetlands within the project area disturbance boundary that would be removed during mining
- reduced stream flow in the reclaimed stream channels because the permeability of the spoil material is higher than the undisturbed native material
- changes in stream flow due to changes in postmine channel morphology
- water quality effects on streams downslope of the spoil where the ground water table intersects the stream bottom.

The loss of wetlands in the project area and the hydrologic conditions that support the wetlands is discussed in **Section 4.11, Wetlands and Riparian Zones**. New springs may appear along project area drainages after the spoil is resaturated postmining. However, based on Western Energy's ground water model, the ground water table will take more than 50 years after site reclamation to be reestablished (PAP, Appendix O). In addition, it may take hundreds of years for the bedrock (overburden and Rosebud coal) aquifers to recover (Nicklin 2017). After mining, some ponds may be constructed to provide water supplies for wildlife and livestock. Because the hydrologic balance in the project area would be restored to the extent possible, there would be no other irreversible or irretrievable commitment of resources.

4.8 WATER RESOURCES – GROUND WATER

This section discloses direct and indirect impacts on ground water resources resulting from the No Action (Alternative 1), Proposed Action (Alternative 2), and the Proposed Action plus Environmental Protection Measures (Alternative 3); cumulative impacts are disclosed in **Chapter 5**. The analysis area used for this impacts analysis is described in **Section 3.8, Water Resources – Ground Water.**

4.8.1 Analysis Methods and Impact and Intensity Thresholds

4.8.1.1 Analysis Methods

Available ground water related data and PAP documents for the proposed project were reviewed. Additional ground water data from other permit areas of the Rosebud Mine were also reviewed. Ground water data from Rosebud Coal and alluvium monitoring wells from the project area were plotted using Western Energy data at a scale sufficient to analyze potential effects from precipitation events and other mine activities. A qualitative analysis of potential effects on ground water resources in the analysis area was performed.

4.8.1.2 Impact and Intensity Thresholds

The thresholds of change for the intensity of an impact on ground water are defined in **Table 130** and are used to describe impacts in the sections below.

Table 130. Ground Water Impact and Intensity Thresholds.

Impact Intensity	Intensity Description
Negligible	The action would result in a change to the ground water hydrology and/or water quality that would be indistinguishable from those caused by fluctuations in natural processes, and of negligible consequences to existing land uses and/or beneficial uses of ground water.
Minor	The action would result in a change to ground water hydrology and/or water quality that would be localized and/or of little consequence to existing land uses and beneficial uses.
Moderate	The action would have measurable effects on ground water hydrology and/or water quality that are distinguishable from fluctuations of natural processes, but do not preclude existing land uses and/or beneficial uses of ground water.
Major	The action would have measurable effects on the ground water hydrology and/or water quality that are distinguishable from natural processes, and would preclude existing land uses and/or beneficial uses of ground water.

Impacts are also defined as short-term, long-term, or both (see **Section 4.1.1, Definitions**).

4.8.2 Alternative 1 – No Action

Under the No Action alternative, Western Energy would not develop the project area. There would be no impact on the ground water resources described in **Section 3.8, Water Resources – Ground Water** because changes associated with development of the project would not occur.

The No Action alternative would not change the status of other areas of the Rosebud Mine that are currently permitted and being mined and/or reclaimed by Western Energy (see **Section 2.2, Existing Operations**) nor would it affect development of any other proposed Rosebud Mine permit areas currently in the permitting process (see **Section 5.2.2, Related Future Actions**).

4.8.3 Alternative 2 – Proposed Action

4.8.3.1 Direct Impacts

Ground Water Quantity

As described in **Section 3.8.2, Site Hydrogeology**, most of the Tongue River Member sedimentary units in the project area are saturated. However, due to the low overall hydraulic conductivity, few of the units are capable of producing water to a well or transmitting water any great distance. Ground water in the more continuous and permeable bedrock units such as the Rosebud Coal flows from the upland areas southwest of the project area to the northeast, which is also the trend of the major drainages. Saturated zones in bedrock that overlie the coal (overburden) are typically perched on low permeability layers and are typically discontinuous. The Rosebud Coal crops out within the project area (see figure in **Section 3.8, Water Resources – Ground Water)**. This outcrop line represents the northeastern-most extent of the Rosebud Coal within the project area. Rosebud Coal ground water currently discharges from the northeastern edge of the coal at the surface as springs or in the subsurface as underflow and ultimately ends up in the alluvium of the major drainages. Removal of the coal and the eventual replacement of the coal by spoil would have long-term, moderate, adverse effects on ground water quantity in the analysis area.

Mining Period

Western Energy proposes to mine the Rosebud Coal starting in areas with the shallowest depth to the coal and moving to the southwest as mining progresses. Removal and stockpiling of overburden would permanently remove any saturated zones within the overburden. This would result in a more homogeneous mixture of sedimentary lithologies such as shale, siltstone, and sandstone that would be temporarily stockpiled and/or returned to the mined areas as spoil. It is unlikely that significant quantities of ground water would flow into the mine pits from the overburden walls because of the low overall hydraulic conductivity and the discontinuous nature of the saturated zones in the overburden. Due to the characteristics of the overburden, it is likely that ground water drawdown in the overburden would extend only a short distance from the pits being mined.

Removal of the Rosebud Coal would likely result in low to moderate ground water inflow to the pits, some of which would be pumped from the pits into storage ponds. Some of the inflowing ground water would evaporate from the walls of the pit due to low inflow rates. The mine pits would intercept ground water that would otherwise have discharged to alluvium in the major drainages, reducing the bedrock contribution to the stream baseflow to near zero within the permit boundary, except in areas where the streams may be receiving ground water from the McKay Coal, which would not be mined. For those reaches of streams where there is intermittent or perennial flow, the relative contributions to baseflow and alluvial ground water flow from existing bedrock ground water sources in the project area are unknown. However, removing the Rosebud Coal adjacent to the major drainages would likely result in lower ground water levels in the alluvium and reduced baseflow in intermittent and perennial reaches of the streams. Many of the mapped wetlands (see **Section 3.11, Wetlands and Riparian Zones**), which typically require a perennial or intermittent source of water, are located just downstream of Rosebud Coal outcrops or subcrops within the major drainages. Their location suggests that the Rosebud Coal is the primary contributor of ground water to these wetlands and drainages. Ground water in unmined Rosebud Coal beneath the unmined drainages would not continue to discharge water to the major drainages because ground water is likely to flow toward the pits on the flanks of the drainages, rather than flow to the northeast, as it currently does. The hydraulic gradient in the unmined Rosebud Coal would change as a result of mining, causing the ground water flow direction to change toward the pits. Because Western Energy would be required to replace any water supply where reduced bedrock inflow or drawdown precluded the beneficial use, the impacts from reduced bedrock inflow and drawdown on the quantity of alluvial ground water would be long term, minor to moderate, and adverse.

Ground water levels in the Rosebud Coal would decline as the coal is dewatered and removed. Drawdown created by removal of the coal would extend out from the mined areas as more of the coal is dewatered and removed. The maximum depth of drawdown would be limited by the depth of the coal, which increases to the southwest. The Western Energy ground water model indicated that the maximum drawdown at the end of mining (Year 2034) would be about 90 feet in the southeast portion of the project area (PAP, Appendix O). The Western Energy ground water model also indicated that where the interburden between the Rosebud Coal and the McKay Coal is relatively thin, approximately 40 feet or less, dewatering and removal of the Rosebud Coal would induce drawdown in the McKay Coal into the pits. This drawdown in the McKay Coal would extend upgradient to the south, resulting in long-term moderate adverse effects.

Ground water levels at the end of mining would decrease upgradient to the southwest of the project area to a maximum drawdown of about 5 feet at a distance of about 1.5 miles in each of the two coals (**Figure 108** and **Figure 109**). Ground water drawdown in the Rosebud **(Figure 108**) and McKay (**Figure 109**) Coals outside of the project area to the south would reduce ground water levels in private wells screened in one or both of the coal units. It is not known if water level decreases of between 5 and 10 feet in private wells in this area as a result of mining would impair the owner's ability to produce water because it would depend on the characteristics of the individual wells such as depth, depth to water, pump location, and specific capacity. Springs in the upgradient areas would not likely be impacted by ground water drawdown due to mining. It is unlikely that their source of water is one of the two coals because of the depth to the coal. Limited alluvium in the drainages in the upgradient areas is also not likely to be hydraulically connected to the coals (PAP, Appendix O).

Spring flows within the project area would be affected by mining. The effects would range from reduced flow, particularly if the source of the spring water is at least partially from the Rosebud Coal, to complete elimination of the spring if its source is solely from the Rosebud Coal or overburden that would be removed. This would include subsurface flow from the Rosebud Coal to alluvium and/or overburden. The timing of effects on spring flow would be related to the mining sequence. Spring flows would not be reduced or eliminated until the Rosebud Coal in the vicinity of the spring was mined out. **Table 131** provides a summary of which springs are likely to be impacted by mining.

Table 131. Impact on Identified Springs in the Project Area.

Spring	Ground Water Source	Likely to be Impacted	Potential Impact during Mining	Potential Impact Postmining
1	Overburden	No	No impact on overburden, up gradient of the project area	No impact on overburden, up gradient of the project area
2	Unknown (possibly overburden)	No	Impact not likely, outside of the project area	Impact not likely, outside of the project area F
3	Overburden	Yes	Spring removed during mining	Spring removed during mining
4	Overburden	No	No impact on overburden, up gradient of the project area	No impact on overburden, up gradient of the project area
5	Overburden	No	No impact on overburden, up gradient of the project area	No impact on overburden, up gradient of the project area
6	Overburden	No	No impact on overburden, up gradient of the project area	No impact on overburden, up gradient of the project area
7	Rosebud Coal	Yes	Spring removed during mining	Spring removed during mining
8	Rosebud and possibly clinker	Yes	Source of water removed by mining	Source of water removed by mining
9	Overburden	Yes	Water source likely to be impacted by mining	Spring not likely to reestablish at this location
10	Overburden and possibly Rosebud Coal	Yes	Spring removed during mining	Spring removed during mining
11	Rosebud/clinker	Yes	Spring removed during mining	Spring removed during mining
12	Unknown	No	Not likely to be impacted except by road construction	Not likely to be impacted except by road construction
13	McKay Coal	No	Flow may be temporarily reduced by mining and may be affected by road construction	Flow may be temporarily reduced by mining and may be affected by road construction
14	Sub-McKay	No	Water source not impacted by mining	Water source not impacted by mining

Source: PAP, Appendix J, Attachment B-J.

Areas of clinker would not be disturbed except for those scoria pits where clinker would be mined for use as road material. As described in **Section 3.8.2.2, Ground Water Conditions**, clinker deposits are typically areas with high infiltration rates and provide significant recharge to the subsurface. Water entering the clinker may discharge to drainages as springs, or slowly discharge to lower permeability units such as overburden, and possibly the Rosebud Coal. Because they would be left unmined, clinker areas would continue to provide recharge to the subsurface and/or springs.

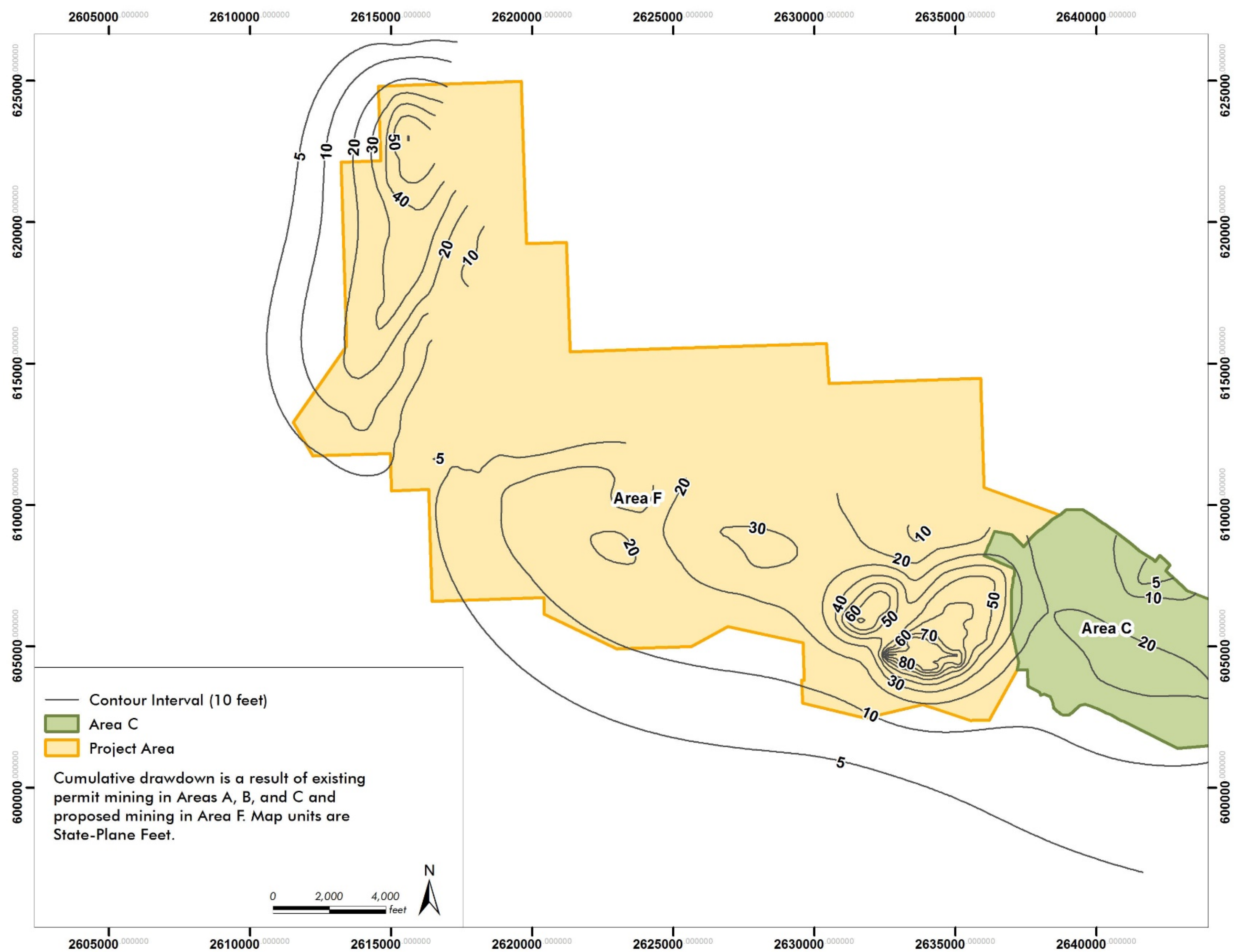

Figure 108. Ground Water Drawdown in the Rosebud Coal at End of Mining.

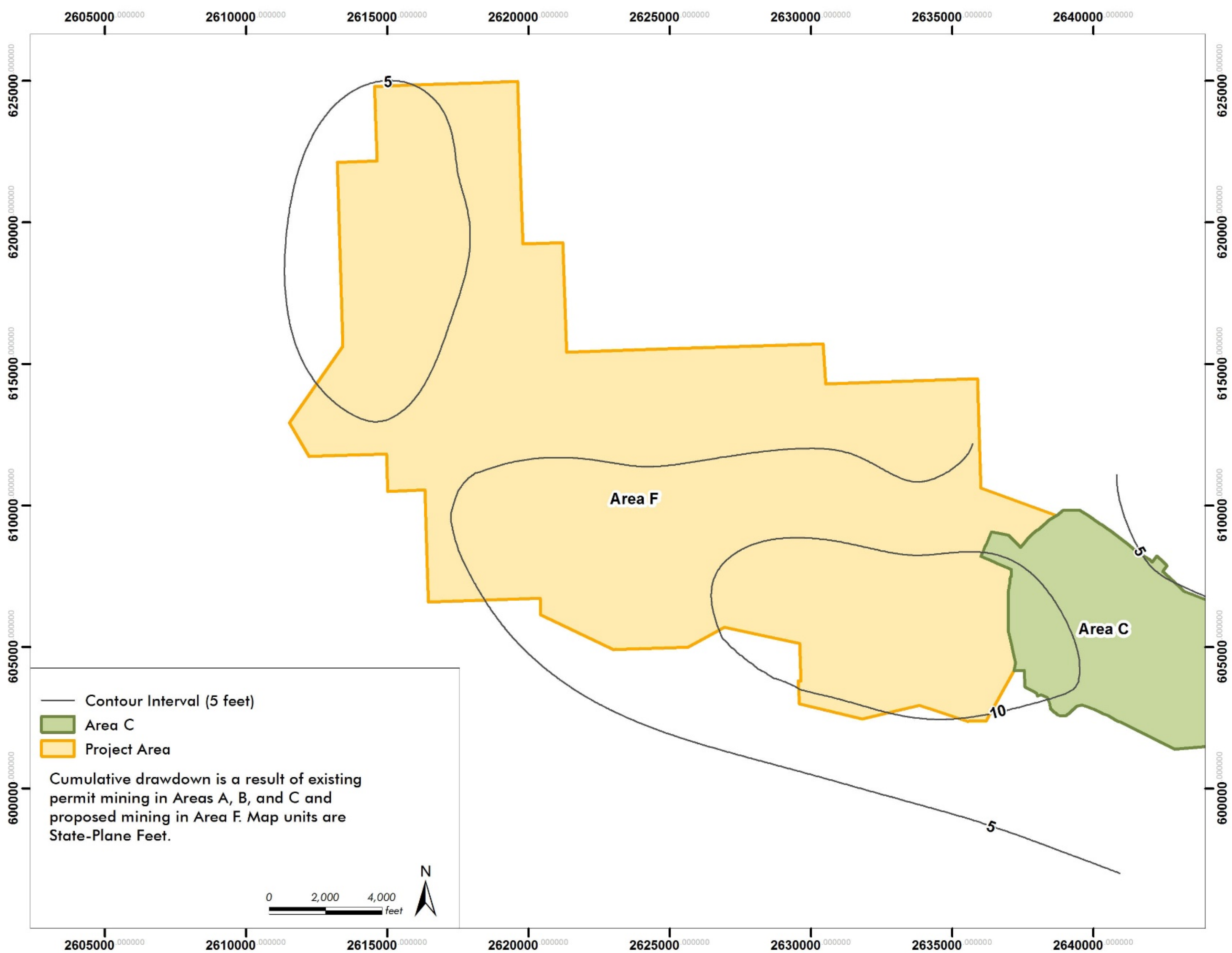

Figure 109. Ground Water Drawdown in the McKay Coal at End of Mining.

Postmining Period

The postmining effects on ground water quantity would include the following:

- Removal of the Rosebud Coal aquifer within the project area
- Change in hydrologic characteristics of the overburden as it becomes spoil
- Elimination of overburden and Rosebud Coal springs within the mined areas
- Long-term (greater than 50 years) ground water drawdown in the Rosebud Coal upgradient of the project area

Removal of the Rosebud Coal aquifer by mining would eliminate recharge to the alluvium of the major channels within the permit boundary for a long period. Ground water that currently discharges at the edge of the coal to the alluvium would be intercepted by pit dewatering during mining and would discharge to the reclaimed spoil placed in the pits during mining. Until the spoil is resaturated, Rosebud Coal ground water would not reach the major drainages. It is not known how much time would be required to resaturate the spoil, but the process is expected to require more than 50 years due to the nature of the spoil (as discussed below). Existing ground water level data collected during the last 40 years from spoils monitoring wells indicate that water levels have not yet reached equilibrium in previously mined areas. Other long-term effects on ground water quality are described below.

The overburden consists of a mixture of lithologies in a layered sequence. Removal, temporary stockpiling, and replacement of overburden would tend to homogenize the various lithologies, eliminating the higher hydraulic conductivity sandstone layers in the overburden. The result would be to mix fine-grained and coarse-grained material leading to overall lower horizontal hydraulic conductivity. According to the PAP, Appendix O, the spoil would be more isotropic than the undisturbed overburden, which is defined as having equal hydraulic conductivity in all directions. As a result, the vertical percolation rate would be greater than in the overburden (PAP, Appendix O) but the spoil would be less capable of transmitting ground water horizontally in the uppermost part of the unit than the original overburden due to the lack of any substantial stratigraphy. As a result, it is unlikely that springs would redevelop at locations similar to those of existing springs.

Assuming at least part of the resaturation process is due to vertical recharge from precipitation, ground water would likely percolate vertically until reaching a saturated zone. Ground water in the developing saturated zone would likely move downgradient to the north. It is not known if any shallow perched zones would develop due to heterogeneities in the spoils or if springs would develop if any perched zones intersected the surface. The pre-mining perennial or intermittent reaches of creeks may change or the creeks may no longer flow in these reaches. It is not known if discharge from the McKay Coal would be sufficient to maintain baseflow at the pre-mining locations. Long-term effects on ground water quality are described below.

As described above, it is unlikely that springs whose source is either the Rosebud Coal or overburden that are to be mined would redevelop in the postmine period. The Rosebud Coal would be removed and the nature of the overburden would be permanently changed due to removal, temporary stockpiling, and/or direct replacement during mining.

The Western Energy ground water model indicated that residual drawdown in the Rosebud and McKay Coals upgradient of the project area would require more than 50 years to recover to pre-mine conditions (PAP, Appendix O). The simulation for 50 years postmining indicated that residual drawdown upgradient of the project area would be less than 10 feet in the Rosebud Coal and less than 5 feet in the McKay Coal (PAP, Appendix O). It is not known whether residual drawdown of 10 feet or less would impact private well owners' ability to produce water from one or both of the two coals, because it would depend on the characteristics of the individual wells such as well depth, depth to water, pump location, and specific capacity of the well. If any private wells were to become unusable, Western Energy would be required to replace the well, thus impacts on private wells in the analysis area from drawdown would be long-term, negligible to moderate, and adverse. Western Energy has identified the Sub-McKay sandstones as the most likely suitable ground water source for any private wells which require replacement.

Ground Water Quality

The primary change to ground water quality would result from removing the Rosebud Coal and replacing the coal with overburden as spoil. The effects on ground water quality in the analysis area are likely to be long-term, moderate, and adverse. Currently, ground water quality in the Rosebud Coal ranges from Class I to Class III, but is typically better than that of other water bearing units in the project area (see **Section 3.8.5, Ground Water Quality**). Ground water in the overburden is considered to have the poorest quality of any of the saturated units, with TDS concentrations ranging from 2,900 to 8,300 mg/L and a median of 4,150 mg/L.

Removing, stockpiling, and returning the overburden material to the pits as spoil would mix and homogenize all of the overburden lithologies, exposing fresh mineral surfaces to water during the resaturation process. As a result, soluble salts would dissolve into ground water, increasing TDS concentrations in ground water. Van Voast and Reiten (1988) reported that TDS concentrations in spoil ground water was between 50 and 200 percent higher than TDS concentrations in undisturbed aquifers at the Decker mine site in southeastern Montana. Site-specific water quality data indicate that the TDS concentrations in spoil from Western Energy's mined areas A, B, and C had TDS concentrations that were between 70 and 200 percent higher than in the overburden. Specifically, the most recent maximum reported spoil TDS concentrations from Areas A, B, and C were 6,400 mg/L, 8,200 mg/L, and 6,420 mg/L, respectively. The increased TDS concentrations are due to increases in the concentration of all major ions, but primarily calcium, magnesium, sodium, and sulfate (Van Voast and Reiten 1988).

Due to the variability of the overburden mineralogy and the somewhat random nature of spoil backfilling, the quality of spoil ground water in other areas mined by Western Energy has also been highly variable. Consequently, some areas have shown rapid increases in TDS concentrations during approximately 40 years of data collection, while other areas show only small increases in TDS concentrations through the same period. In addition to the major ions, this also appears to be true for other constituents such as nitrate, iron, and manganese (**Table 132**). Most data for spoil ground water collected from other Western Energy mine sites have low nitrate concentrations (< 5 mg/L), but there are a few locations with nitrate concentrations that equaled or exceeded the standard (10 to 34 mg/L). In Western Energy's 2014 Annual Hydrology Report (Nicklin Earth & Water, Inc. 2015), it was stated that the elevated nitrate+nitrite concentrations in three spoil wells in or near Areas A, D and E, which ranged from 23.4 to 29.8 mg/L, may have been due to ongoing saturation of spoil containing "remnants of highly soluble ammonium-nitrate explosives used in blasting coal and overburden." There are also a few locations with high ammonia concentrations (2.4 to 4.5 mg/L) and high phosphate concentrations (1 to 14 mg/L), for which there are no ground water standards or recommended livestock limits. The water quality of the spoil in Areas A, B, and C when monitored between 1978 and 2016 had exceedances in arsenic, cadmium, lead, nitrate, and zinc ground water standards, and concentrations of calcium, magnesium, manganese, sodium, sulfate, and TDS exceeding upper recommended limits for livestock. The pre-mining ground water quality of the Rosebud Coal in the project area (see **Section 3.8, Water Resources – Ground Water**) did not show any exceedances of arsenic, cadmium, lead, and nitrate standards, with the exception of one lead standard exceedance. It would be expected that the project area spoil would have similar spatial and temporal variability in ground water quality.

Table 132. Water Quality of Spoil Ground Water in Areas A, B, and C.

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard or Recommended Concentration for Livestock
Acidity (mg/L)	82	29	<1	<1	<1	<5	<306	NS
Aluminum (mg/L)	174	87	0.004	0.057	0.1	0.1	1.1	10
Ammonia (mg/L)	28	26	<0.045	0.36	0.66	1.31	4.49	NS
Arsenic (mg/L)	86	47	<0.0001	<0.001	<0.003	<0.003	**0.02**	0.01
Bicarbonate Alkalinity (mg/L)	191	191	41	499	620	782	**1,648**	999
Boron (mg/L)	190	184	<0.1	0.2	0.3	0.5	1.2	30
Cadmium (mg/L)	186	51	<0.00001	<0.0001	<0.001	<0.005	0.02	0.005
Calcium (mg/L)	192	192	80	**02**	**325**	**410**	**3,820**	150
Carbonate Alkalinity (mg/L)	40	3	<0.5	<1	<1	<5	<5	NS
Chloride (mg/L)	191	191	4	20	27	39	200	300
Chromium (mg/L)	8	3	0.01	<0.02	<0.02	<0.02	0.09	0.1
Copper (mg/L)	133	48	<0.00002	<0.01	<0.01	<0.02	0.07	0.5
Fluoride (mg/L)	192	161	<0.004	0.12	0.16	0.21	2	2
Hydroxide Alkalinity (mg/L)	37	1	<1	<1	<1	<5	<5	NS
Iron (mg/L)	191	142	<0.01	0.05	0.08	0.46	34	NS
Laboratory Conductivity (µS/cm)	191	191	864	2,600	3,340	4,050	8,420	NS
Laboratory pH (s.u.)	192	192	4.9	6.8	7.1	7.5	8.4	NS
Lead (mg/L)	184	52	<0.000004	<0.0001	<0.01	<0.02	**0.08**	0.015
Magnesium (mg/L)	192	192	69	**231**	**305**	**373**	**1,070**	100
Manganese (mg/L)	174	171	<0.005	0.34	**0.72**	**1.5**	**7.3**	0.5
Mercury (mg/L)	86	0	<0.0005	<0.001	<0.001	<0.001	**<0.005**	0.002
Nickel (mg/L)	39	29	<0.0005	0.003	0.007	0.01	0.02	0.1
Nitrate+Nitrite (mg/L)	178	126	<0.003	<0.05	<0.05	0.30	**34**	10
Ortho Phosphate (mg/L)	109	98	<0.01	0.02	0.04	0.21	13	NS
Total Phosphate (mg/L)	51	49	<0.01	0.02	0.07	0.43	14	NS
Potassium (mg/L)	179	179	1	4	8	13	21	NS
Selenium (mg/L)	115	19	<0.0002	<0.005	<0.005	<0.005	0.026	0.05

Table 132. Water Quality of Spoil Ground Water in Areas A, B, and C.

Parameter	Number of Samples	Number of Detections	Minimum	25th Percentile	50th Percentile (Median)	75th Percentile	Maximum	Lowest Water Quality Standard or Recommended Concentration for Livestock
Sodium (mg/L)	192	192	42	116	164	280	**858**	300
Sulfate (mg/L)	191	191	368	1,285	1,750	2,450	**5,440**	2,500
Total Alkalinity (mg/L)	192	192	34	443	538	736	1,350	NS
Total Dissolved Solids (mg/L)	188	188	860	2,333	3,170	4,148	**8,750**	4,999
Total Hardness (mg/L)	190	190	519	1,540	2,042	2,493	5,407	NS
Vanadium (mg/L)	108	24	<0.00004	<0.01	<0.1	<0.2	<0.2	0.1
Zinc (mg/L)	191	145	<0.001	<0.01	0.03	0.15	**2.61**	2

Ground water data collected from 1978 to 2016.
All metals are dissolved.
NS = no numeric standard or recommended concentration. μS/cm = micro Siemens/centimeter; s.u. = standard units.
For less than detection limit concentrations, detection limits are used to calculate percentile concentrations. Concentrations shown with less than symbols indicate some or all measured concentrations were less than the detection limit.
Concentrations in bold exceed Montana numeric ground water quality standards or recommended concentrations for livestock (see Section 3.7, Water Resources – Surface Water).

As noted above, the concentration trend for TDS over the 40-year data collection period varies significantly between locations, with some showing rapid and large increases, and others showing minimal increases over the same time period. After nearly 40 years of ground water sampling, there is no clear indication that TDS concentrations in the spoil have reached equilibrium or have shown decreases. According to the PAP, Appendix O, TDS concentrations in the spoil should reach equilibrium after one or two pore volumes of water pass through the spoil, based on bench-scale testing. However, Van Voast and Reiten (1988) noted that this concept is only valid where there is no vertical recharge. Pre-mining water level data from the project area indicate that vertical recharge does occur in some areas (see **Section 3.8.3, Conceptual Hydrogeological Model**). Also, Van Voast and Reiten (1988) state that vertical recharge to the spoil may occur where the spoil contains large quantities of sand. In arid environments where the potential evaporation rate exceeds the annual precipitation, it is not uncommon for there to be net vertical recharge to ground water under certain conditions, such as unusually wet periods. Therefore, one or two pore volumes of ground water in the project area may not be sufficient to reach equilibrium with respect to water quality of the spoil. Based on the spoil water quality from areas A, B, and C, it will require more than 40 years postmining to reach equilibrium in project area spoil, which constitutes an irreversible commitment of resources where the Rosebud Coal is replaced by mine spoil (see **Section 4.8.5, Irreversible and Irretrievable Commitment of Resources**).

Once the spoil has been resaturated and ground water moved toward the various drainages, ground water may again discharge to alluvium along the major drainages. Recharge from the spoil to the alluvium would result in changes in alluvial ground water quality in the drainages compared to pre-mining conditions. The current alluvial ground water quality is variable, but TDS concentrations are generally lower than overburden concentrations and higher than Rosebud Coal TDS concentrations. Postmining, discharge to the alluvium would be from spoil containing generally poor-quality ground water. It is not known how much time would be required for the quality of water in the spoil to improve as the soluble salts and metals are flushed from the system.

As a result of mining, it is possible that downgradient alluvial water quality near the mine pits could change as a result of eliminating the recharge from the Rosebud Coal. The current average TDS concentration of alluvial ground water is about midway between the average TDS concentrations of overburden and Rosebud Coal ground water. Without recharge from the Rosebud Coal, the TDS concentrations in the alluvial ground water would increase to look more like that of the overburden TDS. Postmining, after the spoil was saturated to a level that would result in discharge to the major drainages, TDS concentrations in the alluvium would increase. During the postmine period, alluvial ground water concentrations would increase from median pre-mine concentrations of 3,120 mg/L for TDS and 1,765 mg/L for sulfate due to the expected higher TDS and sulfate concentrations in spoil ground water. Depending on the level of increase in TDS and sulfate concentrations above pre-mine concentrations, downstream ground water users may be adversely affected. Most, if not all, alluvial ground water users downstream of the project area use ground water for stock watering, and it is possible that in some areas adjacent to the spoil the water may become too degraded for livestock use due to possible increases in nitrate, calcium, magnesium, manganese, sodium, sulfate, or TDS concentrations to above upper recommended limits for livestock (see **Table 3**, **Section 3.7, Surface Water**). If this were to occur, a suitable replacement source would be provided, thus the impacts to alluvial ground water use in the analysis area would be long-term, minor to moderate, and adverse.

It is unlikely that ground water quality in upgradient areas would be affected by mining because the regional flow direction is toward the mined areas.

4.8.3.2 Indirect Impacts

As described in **Section 1.2.2.1, Colstrip Power Plant**, and in **Chapter 5, Cumulative Effects**, the Rosebud Mine currently provides between 7.7 and 9.95 million tons of coal annually to the Colstrip Power Plant for combustion in Units 1, 2, 3, and 4. Coal mined in the project area would be burned in Units 3 and 4. The Colstrip Power Plant uses a closed-loop process (with respect to water) to minimize impacts on local surface and ground water. All water used by the Colstrip Power Plant is imported via pipeline from the Yellowstone River. Local surface and ground water are not used at the plant. Numerous lined ponds are used to store combustion residuals and storm water runoff. The ponds were designed to minimize seepage losses and were constructed with either synthetic liners or compacted clay liners (Hydrometrics 2015). However, over the period of operation, seepage from various ponds has occurred, resulting in measurable impacts on ground water beneath the plant site. A site characterization investigation indicated that the clay lined ponds were responsible for almost all of the seepage (Hydrometrics 2015). The synthetic lined ponds contributed insignificant amounts of seepage. As a result of the impacts on ground water and related litigation, DEQ and PPL Montana (now Talen Energy) entered into an Administrative Order of Consent on August 3, 2012 to characterize the extent of the impacts and remediate the plant site area ground water (see **Section 1.2.2.1, Colstrip Power Plant**).

The characterization process resulted in the installation of monitoring wells, ground water capture wells, trenches, leachate collection systems between and below pond liners, and in-dam toe and chimney drains on the plant site. The extent of the ground water impact beneath the plant site has been determined and ground water capture has been in operation for a number of years. Ponds contributing to the ground water impact typically have elevated TDS, specific conductance, sulfate, boron, and chloride concentrations. Elevated concentrations of these constituents have been identified in ground water beneath and downgradient from various ponds. Impacted ground water is limited to the Colstrip Power Plant site. The Revised Cleanup Criteria and Risk Assessment Report (Marietta Canty, LLC and Neptune and Company, LLC 2017) revised the constituents of interest/constituents of concern list to include boron, sulfate, cobalt, lithium, molybdenum, selenium, and manganese.

The ground water impacts at the Colstrip Power Plant have been characterized and ground water impacts are currently being remediated via capture wells, preventing offsite migration. As a result of seepage from ponds to ground water, the Colstrip Power Plant has modified its operations to use ponds with clay liners for only storm water runoff. Coal combustion residual is currently being stored in synthetically lined ponds.

With the exception of accidental spills, which cannot be predicted, burning of project area coal at the Colstrip Power Plant would not likely result in any indirect impacts on ground water because of the recent operational changes at the plant. Plant operations were modified due to past seepage losses and the resulting ground water impacts. Existing ground water impacts are currently being remediated.

The Rosebud Power Plant, located 6 miles north of the city of Colstrip, would also combust project area coal. As described in **Section 1.2.2.2, Rosebud Power Plant**, and **Chapter 5, Cumulative Effects**, the Rosebud mine provides 300,000 tons of coal annually to the Rosebud Power Plant. There have been no reported impacts on local ground water or ongoing ground water issues related to the Rosebud Power Plant. The source of water for the Rosebud Power Plant is ground water from deep wells; these wells likely would continue to be the source for the Rosebud Power Plant. As discussed in **Section 4.9, Water Resources – Water Rights**, the Rosebud Power Plant was required by DNRC to demonstrate that there was adequate water to supply its demand when it applied for a Beneficial Use Permit. Given that the water source for the Rosebud Power Plant has been approved and is unlikely to change, it is unlikely that there would be any impacts on regional ground water levels as a result of burning project area coal. The Rosebud Power Plant would not receive significant amounts of coal from the project area and without any existing ground water issues, mining in the project area would not likely result in any indirect impacts on ground water.

4.8.4 Alternative 3 – Proposed Action Plus Environmental Protection Measures

The effects of Alternative 3 on ground water resources would be similar to Alternative 2, except as discussed below.

As part of the Water Management Plan to protect and support water-dependent ecosystems, Western Energy would perform the following:

Where pit water must be managed by pumping to storage ponds, measures would be taken to assess and evaluate the potential for pit water stored in sediment ponds to affect off-permit water resources. It is possible that the use of ammonium nitrate explosives during mining may increase nitrogen concentrations in ground water in and downgradient of the project area. Where it is determined that the potential for pit water to affect off-permit water resources exists, Western Energy would be required to implement measures to minimize impacts on the hydrologic balance. These measures may include:

- Limit and/or eliminate storage of pit water in sediment ponds along the permit perimeter
- Line all perimeter sediment ponds where pit water is stored
- Install shallow monitoring wells below all unlined sediment ponds that receive pit water
- Implement other measures, as approved, that would allow the assessment and evaluation of potential effects of pit water on the hydrologic balance

To protect existing water-dependent ecosystems, and alluvial water quality downstream of these ponds, the monitoring wells would be sampled monthly and results would be included in Western Energy's Annual Report. If concentrations of any parameters increased to concentrations that would adversely affect beneficial uses of the alluvial water (based on the ground water classification), Western Energy would resample for that parameter immediately after receiving laboratory results. If the sample again showed the same or a similar increase, Western Energy would submit a mitigation plan to DEQ within 5 days (per ARM 17.25.646) to reduce the alluvial ground water concentrations so that adverse effects on beneficial uses would be eliminated. The effect of this mitigation would be to protect alluvial ground water quality and maintain the beneficial uses of the alluvial water.

4.8.5 Irreversible and Irretrievable Commitment of Resources

The Rosebud Coal aquifer within the mine pit footprint would be irreversibly and irretrievably lost due to mining. The coal would be replaced with spoil which would likely have different hydrologic characteristics and water quality.

Ground water springs within the project area would be irreversibly and irretrievably lost due to mining. It is possible that after the spoil resaturates, new springs may appear along the various drainages.

Ground water quality in the saturated zones that would develop in the spoil would require an undetermined but significant amount of time to reach equilibrium and begin to improve. As defined under NEPA, this would be an irreversible commitment of resources which cannot be reversed except over extremely long periods.

4.9 WATER RESOURCES – WATER RIGHTS

This section discloses direct and indirect impacts on water rights resulting from the No Action (Alternative 1), Proposed Action (Alternative 2), and the Proposed Action Plus Environmental Protection Measures (Alternative 3); cumulative impacts are disclosed in **Chapter 5**. Existing water rights and the analysis area used for this impacts analysis are described in **Section 3.9, Water Resources – Water Rights**. A list with descriptions of surface water and ground water rights is provided in **Appendix E.**

4.9.1 Analysis Methods and Impact and Intensity Thresholds

4.9.1.1 Analysis Methods

Impacts on spring water rights were evaluated based on the location of the water rights in or near disturbed areas within the analysis area and the source of water to the springs. Possible impacts on surface water rights due to changes in stream flow or water quality were evaluated based on the locations of the points of diversion for these existing water rights relative to where surface water would be impounded during mining, and where streams have baseflow from ground water discharge. Impacts on ground water rights were evaluated based on the location of the ground water rights with respect to the drawdown contours and the source of water to the wells (see **Section 3.8, Water Resources – Ground Water**) predicted by Western Energy's ground water model (PAP, Appendix I-B).

Potential impacts on water rights, including the volume and timing of withdrawals, are tied to hydrologic and water quality changes associated with mining and reclamation activities. Impacts on ground water and surface water hydrology and water quality are discussed in greater detail in **Section 4.7, Water Resources – Surface Water** and **Section 4.8, Water Resources – Ground Water**, respectively.

4.9.1.2 Impact and Intensity Thresholds

The thresholds of change for the intensity of an impact on water rights are defined in **Table 133** and are used to describe impacts in the sections below.

Table 133. Water Rights Impact and Intensity Thresholds.

Impact Intensity	Intensity Description
Negligible	The action would result in a change which was indistinguishable from natural variations, and the water rights owner would still have adequate flow and/or water quality to meet beneficial use needs.
Minor	The action would result in a change which would be distinguishable from natural variations, but the change would be small enough that the water rights owner would still have adequate flow and/or water quality to meet beneficial use needs.,
Moderate	The action would result in a water right becoming unusable for its specified purpose due to flow or water quality changes. A suitable replacement source would be provided by Western Energy per ARM 17.24.648.
Major	The action would result in a water right becoming unusable for its specified purpose due to flow or water quality changes and no replacement water supply would be available.

Impacts are also defined as short-term, long-term, or both (see **Section 4.1.1, Definitions**).

4.9.2 Alternative 1 – No Action

Under the No Action alternative, Western Energy would not develop the project area. There would be no impact on the surface or ground water rights described in **Section 3.9, Water Resources – Water Rights** because changes associated with development of the project would not occur.

The No Action alternative would not change the status of other areas of the Rosebud Mine that are currently permitted and being mined and/or reclaimed by Western Energy (see **Section 2.2, Existing Operations**) nor would it affect development of any other proposed Rosebud Mine permit areas currently in the permitting process (see **Section 5.2.2, Related Future Actions**).

4.9.3 Alternative 2 – Proposed Action

4.9.3.1 Direct Impacts (Active Mining)

Spring Water Rights

There are 16 spring rights used for stock watering located in the direct effects analysis area on unnamed tributaries of Trail, McClure, Robbie, Donley, and Black Hank Creeks (**Figure 26; Table 134**). Some of the springs listed in **Table 134** are or may be the same as some of the 14 springs that have been monitored by Western Energy, but Western Energy states that there is some uncertainty regarding which water rights are associated with the monitored springs. In addition, it is stated in PAP, Appendix O, Table O-6 that some of the springs with water rights could not be found at the listed location. Some of the spring water rights listed in **Table 85** would be mined out, their water source would be removed, or their flow rate would be reduced until after mining. If a spring water right were to become unusable for its specified purpose due to flow or water quality changes a suitable replacement source would be provided by Western Energy, so the impact would be moderate and short-term. Possible replacement water sources are discussed in **Section 4.9.3.3, Replacement Water Sources**. If a spring water right were impacted by mining but still contained sufficient water of adequate quality to meet beneficial use needs, the intensity of the impact would be negligible to minor and short-term.

Table 134. Spring Water Rights in the Direct Effects Analysis Area.

DNRC Water Right Number (Monitored Spring #)	Water Source	Potential Impact during Active Mining	Potential Impact Postmining
42KJ 44613 00 (Spring 7)	Rosebud Coal	Water source removed, at edge of mine passes	Water source removed, would not return
42KJ 108394 00 (Spring 10)	Overburden and possibly Rosebud Coal	Water source removed, at edge of mine passes	Water source removed, would not return
42KJ 108396 00	Rosebud/Clinker	Would be mined out	Water source removed, would not return
42KJ 108673 00 (Spring 11)	Rosebud/Clinker	Water source removed, at edge of mine passes	Water source removed, would not return
42KJ 108393 00	Overburden and possibly Rosebud Coal	Would be mined out	Water source removed, would not return
42JK 108395 00 (Spring 13)	McKay Coal	Flow rate temporarily reduced; near haul road, so ground disturbance near spring	None after water table recovery in McKay Coal
42KJ 183350 00 (Spring 3)	Overburden	Water source removed, at edge of mine passes	Water source removed, would not return
42KJ 183353 00 (Spring 13)	McKay Coal	Flow rate temporarily reduced; near haul road, so ground disturbance near spring	None after water table recovery in McKay Coal
42KJ 183492 00	Overburden and possibly Rosebud Coal	Would be mined out	Water source removed, would not return
42KJ 183510 00	Unknown, possibly Rosebud	Water source removed, at edge of mine passes	Water source removed, would not return
42KJ 183508 00	Overburden	Water source removed, at edge of mine passes	Water source removed, would not return
42KJ 108264 00	Overburden	Would be mined out	Water source removed, would not return
42KJ 162860 00	Overburden	None, upgradient of project area	None, upgradient of project area
42KJ 108383 00	Overburden	None, upgradient of project area	None, upgradient of project area
42KJ 162812 00	McKay/Clinker	Flow rate temporarily reduced	None after water table recovery in McKay Coal
42KJ 183339 00	Sub-McKay Coal	None, source would not be mined	None, source not removed

Surface Water Rights

Because streams located south and west of the analysis area would not be affected by mining, surface water rights located south and west of the project area would not be affected by mining. During mining, runoff from disturbed areas would be detained and contained in mining pits and/or sediment-control structures, resulting in a loss of water downstream. Although the main creek channels would not be mined, tributaries to the creeks in the project area would be mined, temporarily reducing stream flows. Impounded water would be discharged at times, after sediment settling treatment, from the sediment ponds to all of the creeks in the project area, changing the timing of water availability to downstream surface water users. Some of the impounded water would be used for dust control or would evaporate or infiltrate. In addition, removal of the Rosebud aquifer that is a source of water to some sections of McClure, Robbie, and Donley Creeks, plus the reduction of water availability from the McKay Coal, would reduce baseflow in and downstream of the project area until the ground water table recovered after many decades. Effects on stream flow are described in greater detail in **Section 4.7, Water Resources – Surface Water**. Due to the irregular nature of stream flow in Trail, Donley, Robbie, McClure, and Black Hank Creeks, it is not possible to quantify the effect on water rights on these creeks. If a surface water right were to become unusable for its specified purpose due to flow or water quality changes a suitable replacement source would be provided by Western Energy, thus the impact would be moderate and short-term. Possible replacement water sources are discussed in **Section 4.9.3.3, Replacement Water Sources**. If a surface water right were impacted by mining, but changes in flow or water quality were small enough that the flow and/or water quality were still adequate to meet beneficial use needs, the intensity of the impact would be negligible to minor and short-term.

There are surface water rights on the West Fork Armells Creek, but because the mine disturbance area is small (less than 5 percent) relative to the overall watershed area of the creek, it is expected that effects on these water rights would not be measurable except when flows from a large, localized storm event at the project area are detained during mining. The intensity of the impact on any surface water rights on the West Fork Armells Creek as a result of mining would be expected to be short-term and negligible.

Some of the surface water rights are for on-stream reservoirs used for stock watering. Stock ponds located within the disturbed area in the project area would be lost due to mining. Other ponds located near the disturbance area, both within and near the project area, may lose some or all of their water supply due to:

- reductions in stream flow as a result of impounding water during mining
- reductions in stream flow due to the loss of mined sections of the watersheds
- reductions or elimination in ground water discharge from the Rosebud and McKay aquifers to perennial or intermittent stream reaches

As discussed in **Section 4.7, Water Resources – Surface Water**, the water quality of the stock ponds may be degraded as a result of mining. If a stock pond were to become unusable due to flow or water quality changes a suitable replacement source would be provided by Western Energy thus the impact would be moderate and short-term. If a pond were impacted by mining but still contained sufficient water of adequate quality for stock watering, the intensity of the impact would be short-term and negligible to minor.

Ground Water Rights

Ground water wells located within the 4,260-acre disturbance area of the analysis area, described in **Section 3.8, Water Resources – Ground Water**, would be removed as a result of mining. Western Energy’s ground water model (PAP, Appendix I-B) estimated that the maximum drawdown in the Rosebud aquifer at the end of mining would be 90 feet and in the McKay aquifer would be 10 feet (see **Section 3.8, Water Resources – Ground Water)**. For wells not removed by mining, depending on the well location, the ground water level could be drawn down in the Rosebud aquifer from a few feet up to 90 feet as a result of mining, and in the McKay aquifer by up to 10 feet. The ground water model also showed that ground water levels in water wells located outside of and within up to 1 mile to the south or west of the project area would be drawn down by 5 to 20 feet in the Rosebud aquifer and up to 5 feet in the McKay aquifer. It is not known what water level decreases in private wells would impair the owner’s ability to produce water; production would depend on the characteristics of the individual wells such as depth, depth to water, pump location, and specific capacity. Western Energy provided an impact assessment of individual wells in Table O-5 (PAP, Appendix O). In general, wells would not be affected by mining if they are located outside the model-predicted drawdown area or if they are screened in the Sub-McKay unit. Wells would be impacted by mining if they are in the area of disturbance within the analysis area (42KJ 28394 00, 42KJ 44622 00, 42KJ 183509 00, 42KJ 46519 00, and 42KJ 108400 00). For many wells, the impact cannot be assessed due to a lack of information on the screened interval, static water level, or water column. If a well were to become inadequate or unusable for its specified purpose due to drawdown in the well or change in water quality it would be replaced by Western Energy or a suitable replacement water source would be provided thus the impact would be moderate and short-term. Possible replacement water sources are discussed in **Section 4.9.3.3, Replacement Water Sources**. If a ground water right were impacted by mining, but still contained sufficient water of adequate quality to meet beneficial use needs, the intensity of the impact would be short-term and negligible to minor.

4.9.3.2 Direct Impacts (Postmining)

Spring Water Rights

Postmining effects on spring water rights are described in **Table 134**. The water table would recover in the McKay Coal after mining, so the flow of any spring from the McKay Coal would return to near pre-mine conditions many decades after mine closure. Rosebud springs would no longer exist and overburden and clinker springs would not be affected. If a spring water right were unusable for its specified purpose due to flow or water quality changes a suitable replacement source would be provided by Western Energy thus the impact would be moderate and short-term. If a spring water right were impacted by mining, but still contained sufficient water of adequate quality to meet beneficial use needs, the intensity of the impact would be short-term and negligible to minor.

Surface Water Rights

After mining, when the site was reclaimed and the hydrologic balance restored in accordance with MSUMRA requirements for Phase IV bond release (ARM 17.24.1116(6)(d); see also **Section 1.6.4, Bond Release**), effects on surface water rights would diminish and may, after many decades, return to near pre-mine conditions. The only direct surface water diversions are two water rights downstream of the project area—one on Robbie Creek and one on Donley Creek. Both of these water rights are for stock watering directly from the source or from a ditch system. If these surface water rights were to become unusable for their specified purpose due to flow or water quality changes a suitable replacement source would be provided by Western Energy thus the impact would be moderate and short-term. If these surface water rights were impacted by mining either during or after mining, but changes in flow or water quality were small enough that the flow and/or water quality were still adequate to meet beneficial use needs, the intensity of the impact would be short-term and negligible to minor.

Stock ponds with water rights located near the disturbed area within the analysis area whose source of supply was runoff would return to near pre-mine conditions after reclamation was completed and the hydrologic balance restored to the extent possible. The ponds would fill when precipitation events resulting in stream flow and direct runoff to the ponds occurred. For stock ponds located near the disturbed area whose source of supply was at least in part spring flows, there would not be a return to pre-mine conditions. Stock ponds for livestock and wildlife watering in the project area would be reestablished or mitigated by Western Energy during postmining reclamation. If a stock pond were to become unusable either during or after mining due to flow or water quality changes a suitable replacement source would be provided by Western Energy thus the impact would be moderate and short-term. If a pond were impacted during or after mining but still contained sufficient water of adequate quality for stock watering, the intensity of the impact would be short-term and negligible to minor.

Ground Water Rights

Western Energy's ground water model showed that 50 years after the end of mining, there would still be residual drawdown in the coal aquifers outside of the mined area (PAP, Appendix I-B). It is predicted that ground water levels would return to pre-mine conditions in the McKay Coal many decades after mine closure. Ground water levels in the Rosebud Coal upgradient of the analysis area would return to pre-mine conditions many decades after mine closure. If a well were to become inadequate or unusable for its specified purpose due to drawdown in the well or change in water quality, it would be replaced by Western Energy or a suitable replacement water source would be provided thus the impact would be moderate and short-term. If a ground water right were impacted by mining but still contained sufficient water of adequate quality to meet beneficial use needs, the intensity of the impact would be short-term and negligible to minor.

4.9.3.3 Replacement Water Sources and Replacement Process

Possible sources of replacement water for stock and domestic ground water, spring, and surface water rights would likely be ground water pumped from the unmined areas of the Rosebud Coal aquifer west and south of the project area, the McKay Coal aquifer, or the Sub-McKay aquifer. The most likely source may be the Sub-McKay aquifer because it generally yields more water than the coal aquifers. The water quality of these aquifers is comparable to the existing quality of the streams, springs, and wells in and near the project area, so it is unlikely that beneficial uses of the existing water rights would be impaired. All of these aquifers would produce water if developed. MSUMRA requires the applicant to provide "a description of alternative water supplies, not to be disturbed by mining that could be developed to replace water supply diminished or otherwise adversely impacted in quality or quantity by mining activities so as not to be suitable for the approved postmining land uses." Approximate yields in Sub-McKay wells range from 3.5 to 35 gpm (PAP, Appendix O), which should be sufficient for stock and domestic-water use. Power would need to be provided to the pumps in any wells installed for replacement water. Water could also be delivered by truck or pipeline from other areas, which may be a viable alternative for domestic water rights, but may be cost prohibitive for stock watering. Stock ponds would be constructed in the project area during reclamation.

As is set forth more fully in **Section 3.9.1.1, Regulatory Framework** of this EIS, the replacement of water sources may implicate the jurisdiction of both DEQ and DNRC. MSUMRA requires Western Energy to identify the probable need for and hydrologic availability of water supplies that could be used to replace any water supply interrupted, diminished, or otherwise adversely impacted by mining activities (Section 82-4-222(1)(m), MCA; ARM 17.24.648; ARM 17.24.304(1)(f)(iii)). Western Energy's obligation to provide replacement water is unconditional (Section 82-4-253(3)(d), MCA). To the extent that such provision of replacement water implicates the Montana Water Use Act, Western Energy would also need to fully comply with that law and any associated DNRC rules. *Id*. DEQ has neither the authority nor the expertise to determine, on an advisory basis or otherwise, water rights issues. See Section 85-2-311, MCA; *Confederated Salish & Kootenai Tribes v. Clinch*, 2007 MT 63, P35, 336 Mont. 302, 318 (2007); see also *Confederated Salish & Kootenai Tribes v. Clinch*, 1999 MT 342, P14-P15, 297 Mont. 448, 453-454 (19990; *Peabody Coal Co. v. OSMRE*, 123 IBLA 195; 1992 IBLA LEXIS 55, 123 IBLA 195; and 1992 IBLA LEXIS 55 at [2]. The process for replacing a water right impacted by mining is described in **Section 3.9.1.1** of this EIS.

4.9.3.4 Indirect Impacts

Coal currently mined by Western Energy at the Rosebud Mine is used by two coal fired power plants (the Rosebud and Colstrip Power Plants) to generate electricity. Project area coal would be used at these same power plants, thus contributing to their annual emissions; for the Colstrip Power Plant, project area coal would only be used in Units 3 and 4. The source of water supply to the Colstrip Power Plant is water piped from the Yellowstone River. There would be no indirect impacts from the Colstrip Power Plant on water levels in wells, spring flows, or stream flows that would affect any water rights in the indirect impacts analysis area.

The source of water to the Rosebud Power Plant is deep ground water wells. There are other deep ground water wells near the Rosebud Power Plant wells, but for the power plant to have obtained a Beneficial Water Use Permit from DNRC to pump water from their wells required proof that water was physically and legally available at the proposed point of diversion in the amount requested. In addition, senior water rights cannot be impaired. There may be indirect impacts from the Rosebud Power Plant on water levels in nearby wells due to pumping water for the power plant, but adequate water would still be available for the other nearby ground water rights. There have been no reported impacts on local ground water or ongoing ground water issues related to the Rosebud Power Plant, so there would be no indirect impacts on the water quality of ground water rights in the analysis area. There would be no indirect impacts on spring flows or stream flows that would affect analysis area spring or surface water rights.

Impacts on ground water quality due to the disposal of CCR at the Colstrip Power Plant are described in **Chapter 4, Water Resources – Ground Water** and are limited to the Colstrip Power Plant site. There would be no impacts on ground water quality except on the Colstrip Power Plant site (Hydrometrics 2015). There are no ground water wells on the Colstrip Power Plant site except for a very deep well owned by the electric power companies and City of Colstrip (see **Section 1.2.2.1, Colstrip Power Plant**), as well as capture wells for site remediation, so there would be no indirect impacts on ground water rights due to the disposal of CCR. Pumping from the on-site wells would not impair nearby senior water rights. There may be indirect impacts from the Colstrip Power Plant on water levels in nearby wells due to pumping ground water on the power plant site, but adequate water would still be available for the other nearby ground water rights. Therefore, there would be no indirect impacts on ground water rights due to pumping ground water on the Colstrip Power Plant property.

Based on the described effects on surface water quality of atmospheric deposition from the two power plants described in **Section 4.7, Water Resources – Surface Water**, it is not expected that there would be any effects on surface water rights in the analysis area. It is not expected that atmospheric deposition from the two power plants would affect ground water quality, so there would be no effects on ground water rights in the analysis area.

4.9.4 Alternative 3 – Proposed Action Plus Environmental Protection Measures

The effects of Alternative 3 on surface and ground water rights would be the same as those described under Alternative 2 – Proposed Action.

4.9.5 Irreversible and Irretrievable Commitment of Resources

Assuming that any adversely affected water rights would be replaced with an adequate water supply, no irreversible or irretrievable commitment of resources would occur. If there was not an adequate water supply to replace all adversely affected water rights, then the loss of some water rights would be an irreversible and irretrievable commitment of resources.

4.10 VEGETATION

This section discloses the direct and indirect effects that the No Action (Alternative 1), the Proposed Action (Alternative 2), and the Proposed Action Plus Environmental Protection Measures (Alternative 3) alternatives would have on vegetation; cumulative impacts are disclosed in **Chapter 5**. The analysis area is described in **Section 3.10, Vegetation**. Vegetation impacts are of concern because of the role vegetation plays in providing wildlife habitat, protecting soils, supporting agricultural operations, and providing other ecosystem functions. In addition, ground-disturbing activities have the potential for the introduction and spread of noxious weeds.

4.10.1 Analysis Methods and Impact and Intensity Thresholds

4.10.1.1 Analysis Methods

Direct Effects

Western Energy's PAP and the surface water and ground water analyses conducted for this EIS (see **Section 4.7, Surface Water** and **Section 4.8, Ground Water**) were used to assess direct impacts on vegetation. Western Energy's PAP included a baseline inventory of vegetation conducted between 2005 and 2007 and updated in 2014 by Cedar Creek Associates, Inc. (PAP, Appendix E); estimated acreages of impacts from the Proposed Action by vegetation community; and proposed reclamation acreages by vegetation community, which were all used to assess impacts on vegetation from Alternative 2 and Alternative 3. Western Energy's PAP was also used to determine where ground-disturbing activities would occur that would result in impacts on vegetation. Western Energy's PAP also included a hydrology analysis, which was used in conjunction with the surface water and ground water analyses in this EIS to determine where changes to hydrology would occur within the direct effects analysis area and how those changes could affect vegetation communities.

Indirect Effects

The deposition modeling results for special status species (see **Section 3.13, Vegetation Analysis Area** and **Section 4.3, Air Quality** for information on modeling and results), in conjunction with ecotoxicological screening values protective of plants, were used to infer potential power-plant emissions impacts on vegetation within the indirect effects analysis area (see **Section 3.24.1.2, Analysis Area**). The EPA ecological soil-screening levels (Eco-SSLs) represent the most comprehensive evaluation of soil-screening levels for plants, and these Eco-SSL values were preferentially used when available (2007). For those trace metals where Eco-SSLs have not been developed, the ecotoxicological screening values presented for vegetation cited by EPA were used (2015b). The soil background levels of trace metals also were considered. As described in **Section 4.24, Soils**, the background concentrations were based on a USGS geochemical study completed in the region of the Colstrip and Rosebud Power Plants (Smith et al. 2013). Estimated deposition relative to background values and estimated deposition combined with background concentrations of trace metals were compared to the plant ecotoxicological screening levels to determine if impacts on vegetation may occur.

4.10.1.2 Impact and Intensity Thresholds

The thresholds of change for the intensity of impacts on vegetation are defined in **Table 135** and are used to describe impacts below.

Table 135. Vegetation Impact and Intensity Thresholds.

Impact Intensity	Intensity Description
Negligible	The impacts on vegetation (individuals or communities) would be at the lower level of detection. The abundance or distribution of individuals would not be affected or would be slightly affected. The effects would be on a small scale. Ecological processes and biological productivity would not be affected.
Minor	The action would not necessarily decrease or increase the project area's overall biological productivity. The action would affect the abundance or distribution of individuals in a localized area but would not affect the viability of local or regional populations or communities.
Moderate	The action would result in effects on some individual native plants and would also affect a sizeable segment of the species' population over a relatively large area. Permanent impacts would occur on native vegetation, but in a relatively small area.
Major	The action would have considerable effects on native plant populations and would affect a relatively large area within and outside the project area.

Impacts are also defined as short-term, long-term, or both (see **Section 4.1.1, Definitions**).

4.10.2 Alternative 1 – No Action

Under the No Action alternative, Western Energy would not develop the project area. There would be no impact on vegetation, as described in **Section 3.10, Vegetation**, because any changes or ground disturbances associated with development of the project area would not occur.

The No Action alternative would not change the status of other areas of the Rosebud Mine that are currently permitted and being mined and/or reclaimed by Western Energy (**Section 2.2, Existing Operations**), nor would it affect development of any other proposed Rosebud Mine areas currently in the permitting process (**Section 5.2.2, Related Future Actions**).

4.10.3 Alternative 2 – Proposed Action

4.10.3.1 Direct Impacts

The Proposed Action would result in the removal and loss of vegetation communities on up to 4,260 acres in the direct effects analysis area during mining operations in the project area, which would result in a short-term, moderate, adverse effect on vegetation. The upland grassland community would be most affected, with up to 1,538 acres disturbed, followed by agricultural and pastureland with a total of 985 acres impacted. When the various shrub grassland communities are combined, they make up the third-largest vegetation community impacted, with a disturbance of 918 acres. **Table 136** lists the acreages of disturbance for each vegetation type in the direct effects analysis area and the proposed postmine revegetation target acres for each type (see also PAP, Appendix O). The vegetation types are categorized by the communities proposed for revegetation. The vegetation types listed in **Table 136** match those used by Western Energy in the PAP. These terms are similar to but differ from the terms used in the Cedar Creek 2014 report (PAP, Appendix E) as described in the affected environment discussion in **Section 3.10, Vegetation**.

Table 136. Vegetation Impacts and Proposed Revegetation Acreages.

Vegetation Type	Acres in Project Area	Acres Disturbed	Postmine Revegetation Target Acres
LOWLAND			
Grassland	0.4	0.4	0
Deciduous tree/shrub	61	19	22
UPLAND			
Grassland	2,383	1,538	2,006
Shrub grasslands			
• Big sagebrush	443	285	253
• Silver sagebrush	643	327	429
• Skunkbush sumac	394	223	240
• Deciduous tree/shrub	159	83	145
Mixed shrub	184	82	101
Conifer	1,373	672	734
OTHER			
Pastureland	537	516	0
Agricultural fields	513	469	318
Ranch yards/county roads	41	32	3
Sandstone features			
• Cliff	2	2	0
• Sandstone rock	4	4	6
Scoria pit	5	5	0
Ponds	1	0	0
Wet meadow	5	2	3
TOTAL	**6,746[1]**	**4,260**	**4,260**

[1]Based on Table 313-1 from Western Energy's PAP. Please note this number actually equals 6.748 due to rounding to the nearest whole number.

Areas that require vegetation clearing and removal under the Proposed Action would be subject to an overall loss of biodiversity and a short-term loss of productivity in the direct effects analysis area during the active mining period. Reclamation would reestablish plant communities, but biodiversity would be reduced and species composition would not be the same (Holl 2002). In 2014, Cedar Creek documented 238 plant species in the project area (PAP, Appendix E). After reclamation of mine disturbances, shrublands and grasslands can take many years to reestablish a community with a diversity of plants similar to but less than the original plant community. As discussed in **Section 4.24, Soils**, the Proposed Action would impact soil structure by altering ecological processes (e.g., propagule pressure, nutrient cycling, competition, interference) and adversely affect soil/plant interaction due to decreased soil water-holding capacity, loss of aeration and pore space, and increased bulk density (Sharma and Doll 1996). Soil compaction, loss of soil structure, loss of organic matter due to mixing and storage, and loss of microorganisms due to prolonged storage of soil could lower postmining vegetation vigor and diversity for an extended period.

Upon completion of mining in the project area, disturbed areas would be reclaimed and revegetated. Western Energy's reclamation requirement is to establish a postmining environment comparable with existing conditions. The reclamation plan includes areas designated for various shrublands and grasslands (PAP, Appendix O). Shrublands would likely take longer to restore to pre-mine conditions, with grasslands recovering more quickly following reclamation. Western Energy proposes to revegetate the existing pasturelands with grasslands to reflect landowner preference for more grazing land usage (PAP, Appendix O). Overall, the reclamation plan will reestablish plant species that will have the same seasonal growth characteristics as the original vegetation, be capable of self-regeneration and plant succession, be compatible with the plant and animal species of the area, and meet the requirements of applicable seed, poisonous and noxious plant, and introduced species laws and regulations (PAP, Appendix O).

Success of reclamation would be measured through monitoring as described in the revegetation monitoring plan and revegetation success criteria (PAP, Appendix O). Ongoing monitoring of existing reclamation activities at other permit areas of the Rosebud Mine indicates revegetation in most areas is equal to or exceeds reference-area cover values and production values (PAP, Appendix E). Although the seed mixes for revegetation would be dominated by native species, it is likely over the long term that reclaimed areas would have fewer native species than existing communities.

In addition to ground-disturbing activities, mining dewatering activities could lower the regional water table, which would adversely impact adjacent vegetation communities, especially wetland and riparian areas. As discussed in **Section 4.11, Wetlands and Riparian Zones**, a majority of the wetlands in the project area could be impacted from mining, including a reduction in ground water and surface water support. Although sections of these drainages would not be directly impacted by mining activities, the reduction in surface and ground water could cause changes to the vegetation communities along the drainages. Forty-six acres of riparian habitat (woody draw community as described in **Section 3.10, Vegetation**) occur along drainages that would have reduced flow due to mining activities (PAP, Appendix O). Changes to hydrology could cause these riparian areas to shift to grassland/upland communities. Loss of hydrology to wetland and riparian areas often leads to an increase in noxious and nonnative species along drainages. Although hydrology would be returned during reclamation, it could take decades before the wetland/riparian communities return to pre-mine conditions.

Adverse effects on surrounding vegetation could also occur from increased dust in the project area from mining activities. Increased dust that settles on vegetation can block photosynthesis and growth (Wijayratne et al. 2009). These impacts would be localized, and dust-control measures (see **Section 4.3, Air Quality**) would reduce the short-term negligible effects from dust.

The Proposed Action may result in new or expanded populations of noxious weeds by disturbing 4,260 acres of land that could become potential paths for dispersal of weed seeds. Existing weed populations could disperse to newly disturbed areas and other areas via vehicular traffic or soil transport. An increase in abundance and distribution of noxious weeds has the potential to displace native species and reduce vegetation diversity. The noxious weed control plan would prevent any large populations of noxious weeds from establishing within the project area. With the implementation of the noxious weed control plan, reclamation plan, and BMPs, the Proposed Action would have a short-term, minor, adverse impact on surrounding vegetation. Overall, the Proposed Action would have a short-term, moderate, adverse effect on vegetation due to the removal of 4,260 acres of vegetation for mining activities in the direct effects analysis area; however, these areas would be reclaimed following mining. Some long-term, minor, adverse effects on vegetation would occur due to decreased vegetation vigor or diversity and due to the potential for changes to vegetation communities from the reduced amount of surface and ground water in the area.

4.10.3.2 Indirect Impacts

Deposition modeling results (see **Section 4.3, Air Quality**) indicate that the operation of the Colstrip and Rosebud Power Plants during the 19-year mining operations period in the project area would not result in adverse impacts on plants (see **Section 4.3.3.2, Indirect Impacts of Coal Combustion**). **Table 137** provides a summary of background concentrations for the trace metals analyzed plus deposition in the indirect effects analysis area, compared to the ecological screening values for plants.

Table 137. Trace Metal Background, Potential Soil Impact Distance, and Ecological Screening Values for Plants.

Analyte	Background 95-percent UCL	Total Deposition over 19-year Operations Period[1]	Total Expected Concentration (Background + Total Deposition)	Ecological Screening Values for Plants[2]	Percentage of Deposition Relative to Background	Percentage of Deposition Relative to Plant Ecological Screening Values[2]	Does Deposition plus Background Exceed the Plant Ecological Screening Values?	Potential Adverse Indirect Impacts on Plants
	mg/kg, DW	mg/kg, DW	mg/kg, DW	mg/kg, DW	Percent	Percent	(Yes/No)	(Yes/No)
Antimony	0.9	0.00504	0.90504	NA	0.56	NA	No	No
Arsenic	10.9	0.00694	10.90694	18	0.06	0.04	No	No
Cadmium	0.3	0.00189	0.30189	32	0.63	0.01	No	No
Chromium	50.5	0.01765	50.51765	NA	0.03	NA	No	No
Copper	17.8	0.08133	17.88133	70	0.46	0.12	No	No
Lead	19.1	0.00757	19.10757	120	0.04	0.01	No	No
Selenium	0.56	0.03153	0.59153	0.52	5.60	6.10	Yes	No
Mercury	0.023	0.00085	0.02385	0.3	3.70	0.28	No	No

NA = Not available. Insufficient data to derive Eco-SSLs.
DW = Dry weight.
[1]Assumes an untilled soil mixing depth of 2 centimeters and a soil dry-bulk density of 1.5 g cm^{-3} as recommended by the EPA (2005).
[2]**Section 4.10.1.1, Analysis Methods** describes the hierarchy of plant ecological screening values.

As summarized in **Table 137**, the trace metals from total deposition during the 19-year operations period of the Proposed Action provide a very low contribution to the background concentrations. The trace concentrations from deposition, even when combined with naturally occurring background concentrations, would not exceed plant ecological screening values for the majority of metals. As such, there would be no indirect effects on vegetation from deposition of trace metals.

As indicated in **Table 137**, the selenium background concentrations (0.56 mg/kg) slightly exceed the Eco-SSL for plants (0.52 mg/kg). Therefore, the background concentration plus the modeled deposition amount of 0.59153 mg/kg also exceeds the Eco-SSL for plants. Based on the exceedance of selenium, further research was completed to determine the intensity of the impact. In EPA's report *Ecological Soil Screening Levels for Selenium* (2007), EPA acknowledges that background concentrations of selenium from the western United States may exceed the Eco-SSL for plants. EPA also states that selenium is an essential trace element for plant growth. The most bioavailable forms of selenium are those fractions that are most soluble. The factors that influence selenium content in plants include pH, soil minerology, and plant species (EPA 2007). The Eco-SSL for selenium is very protective and is based on eight studies where the range for toxicity was 0.1 mg/kg to 1.6 mg/kg for species such as alfalfa, barley, and cowpeas. The Eco-SSL is the geometric mean of this range and reflects a threshold level where a low impact on growth may be observed for these sensitive species. Five studies considered by EPA when deriving the Eco-SSL for selenium had threshold values of 0.8 mg/kg or higher, meaning that for these studies, even concentrations as high as 1.6 mg/kg showed very low impact on plant growth, even for sensitive species. Because crop species that would be more sensitive to selenium levels cover only 3 percent of the total indirect effects analysis area, it is likely the impacts from increased selenium levels within the indirect effects analysis area would have a negligible effect on vegetation.

In summary, for all trace metals except mercury and selenium, deposition of 1 percent of background concentrations would not be reached from combustion of project area coal over the 19-year operations period, and mercury deposition inside the analysis area would be less than the Eco-SSL for plants. Although the combined background levels and expected deposition for selenium exceeds the Eco-SSL for plants, the expected deposition is only 6.1 percent of the Eco-SSL. Because the deposition of trace metals around the Colstrip and Rosebud Power Plants would not reach 1 percent of the background soil concentrations, would be significantly less than the Eco-SSLs for plants, or would be only a small percentage of the total concentrations (for selenium), the indirect effects on vegetation from power-plant emissions would likely be long-term, minor, and adverse.

4.10.4 Alternative 3 – Proposed Action Plus Environmental Protection Measures

The effects of Alternative 3 on vegetation would be similar to those of Alternative 2, except as discussed below. Development of a water-management plan would be beneficial to vegetation in the direct effects analysis area. Development of a water-management plan under Alternative 3 would result in potential beneficial impacts on vegetation, specifically for wetland and riparian vegetation communities. Development of a water-management plan would provide hydrology along drainages that support wetland and riparian habitat and potentially prevent these vegetation communities from changing to an upland community, as described in more detail in **Section 3.10, Vegetation**.

Under Alternative 3, Western Energy would be required to modify its reclamation practices related to soil stockpiling, soil redistribution, and seeding to better manage water and improve reclamation success. Western Energy would also be required to use a different methodology for postmine topography and drainage-basin design to improve water management. These practices would improve reclamation success and have a beneficial effect on vegetation. Overall, Alternative 3 would have a short-term, moderate, adverse effect on vegetation due to the removal of 4,260 acres of vegetation for mining activities. Some long-term, minor, adverse effects on vegetation would occur due to reduced vegetation, vigor, or diversity.

4.10.5 Irreversible and Irretrievable Commitment of Resources

Both Alternatives 2 and 3 would disturb vegetation communities dominated by native species, the effects of which would be subsequently mitigated by revegetation. Revegetated areas would eventually return to pre-disturbance productivity, but vegetation diversity would be lower than existing conditions. The loss of some native plant species in both alternatives would be an irreversible resource commitment.

4.11 WETLANDS AND RIPARIAN ZONES

This section discloses the direct and indirect effects on wetlands and riparian zones resulting from the No Action (Alternative 1), the Proposed Action (Alternative 2), and the Proposed Action Plus Environmental Protection Measures (Alternative 3) alternatives; cumulative impacts are disclosed in **Chapter 5**. The analysis area is described in **Section 3.11, Wetlands and Riparian Zones**.

4.11.1 Analysis Methods and Impact and Intensity Thresholds

4.11.1.1 Analysis Methods

Direct Effects

Western Energy's PAP and the surface water and ground water analyses done for this EIS (see **Section 4.7, Surface Water**, and **Section 4.8, Ground Water**) were used to assess the direct impacts on wetlands. Western Energy's PAP included baseline inventories of wetlands conducted in 2006 and 2013 by Cedar Creek Associates, Inc. (PAP, Appendix E). Wetlands were delineated using methods outlined in the 1987 Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory 1987) and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Great Plains Region (Corps 2010). Based on those methods, three wetland indicators were used: hydrophytic vegetation, hydric soil, and wetland hydrology.

Indirect Effects

The deposition modeling results for special status species (see **Section 3.13, Vegetation Analysis Area** and **Section 4.3, Air Quality** for information on modeling and results), in conjunction with ecotoxicological screening values protective of plants, were used to infer potential Colstrip and Rosebud Power Plant emissions impacts on wetlands within the indirect effects analysis area (see **Section 3.11, Wetlands and Riparian Zones, Analysis Area**). The EPA (Eco-SSLs) represent the most comprehensive evaluation of soil screening levels for plants, and these Eco-SSL values are preferentially used when available (2007). For those trace metals where Eco-SSLs have not been developed, the screening values presented for vegetation are those cited by EPA (2015b). The soil background levels of trace metals were also considered based on based on a USGS geochemical study completed in the region of the Colstrip and Rosebud Power Plants (Smith et al. 2013). Estimated deposition relative to background values and estimated deposition combined with background concentrations of trace metals were compared to the plant ecological screening levels to determine if impacts on vegetation may occur. In addition, water-quality data collected by DEQ, the Northern Cheyenne Tribe, and Montana PPL Corporation were reviewed to determine historical and recent (where data were available) mercury, selenium, and copper concentrations in Sarpy, Armells, Rosebud, Pony, and Spring Creeks and how those concentrations could affect adjacent wetlands.

4.11.1.2 Impact and Intensity Thresholds

Potential impacts on wetlands and riparian zones were assessed based on the intensity of the effect as defined in **Table 138** and are used to describe impacts in the sections below.

Table 138. Wetland and Riparian Zone Impact and Intensity Thresholds.

Impact Intensity	Intensity Description
Negligible	No measurable or perceptible changes in wetland or riparian size, integrity, or continuity would occur.
Minor	Any impact would be measurable or perceptible, but slight. A small change in size, integrity, or continuity could occur due to short-term indirect effects such as construction-related runoff. However, the overall viability of wetlands or riparian areas would not be affected. There would be no direct impacts on wetlands or riparian areas or, if direct impacts occur, mitigation would be simple to implement and would likely be successful.
Moderate	Any impact would be sufficient to cause a measurable change in the size, integrity, or continuity of the wetlands or riparian areas or would result in a small, but permanent, loss or gain in wetland or riparian acreage.
Major	The action would result in a measurable change in all three parameters (size, integrity, and continuity) or a permanent loss of large wetland or riparian areas (greater than 10 acres). The impact would be substantial and highly noticeable.

Impacts are also defined as short-term, long-term, or both (see **Section 4.1.1, Definitions**).

4.11.2 Alternative 1 – No Action

Under the No Action alternative, Western Energy would not develop the project area. There would be no impact on wetlands and riparian areas described in **Section 3.11, Wetlands and Riparian Areas,** because none of the disturbances associated with development of the project would occur.

The No Action alternative would not change the status of other areas of the Rosebud Mine that are currently permitted and being mined and/or reclaimed by Western Energy (**Section 2.2, Existing Operations**) nor would it affect development of any other proposed Rosebud Mine areas currently in the permitting process (**Section 5.2.2, Related Future Actions**).

4.11.3 Alternative 2 – Proposed Action

4.11.3.1 Direct Impacts

Riparian Zones

The Proposed Action would have a short-term and long-term moderate adverse impact on riparian zones. The riparian habitat along the drainages in the analysis area would likely be impacted by changes to surface and ground water. Although sections of these drainages would not be directly impacted by mining activities, the reduction in surface and ground water flow from springs could cause changes to the vegetation communities along the drainages. Approximately 46 acres of riparian habitat (Woody Draw community as described in **Section 3.10, Vegetation**) occur along drainages that would have reduced flow due to mining activities (PAP, Appendix O). Changes to hydrology could cause these riparian areas to shift to grassland/upland communities. Loss of hydrology to wetland and riparian areas often leads to an increase in noxious and nonnative species along drainages. Although hydrology would be returned during reclamation, it could take decades before the wetland/riparian communities return to pre-mine conditions.

Wetlands

Wetlands in the direct effects analysis area are described in **Section 3.11.2.1, Location and Classification of Wetlands in the Direct Effects Analysis Area**. Under the Proposed Action

(Alternative 2), 8.38 acres of palustrine persistent emergent saturated wetlands would be directly impacted by mining activities in the analysis area (**Table 139**). The wetlands would be impacted by surface mining, construction of the haul road, installation of utility structures, or by changes to surface and ground water hydrology due to mining activities. Overall, the Proposed Action would have a short-term and long-term moderate adverse impact on wetlands (**Figure 110**). Below is a summary of each wetland that would be impacted:

- Wetland A (1.22 acres) – No impact.
- Wetland B (1.19 acres) – Approximately 0.16 acre of Wetland B would be impacted by ground-disturbing activities from mining. In addition, the wetland is supported by Spring 7, which will be removed during mining and has significant potential to exhibit altered flow as a result of mining (see **Section 4.8, Water Resources – Ground Water**; PAP, Appendix O). Therefore, there would be a long-term moderate adverse impact on all 1.19 acres of Wetland B.
- Wetland C (0.80 acre) – Approximately 0.61 acre of Wetland C would be impacted by ground-disturbing activities from mining. In addition, Wetland C is supported by Spring 10, which would not reestablish after mining is completed (see **Section 4.8, Water Resources – Ground Water**). Therefore, there would be a long-term moderate adverse impact on all 0.80 acre of Wetland C.
- Wetland D (1.64 acres) – Approximately 0.04 acre of Wetland D would be impacted by ground-disturbing activities. In addition, Wetland D is supported by Spring 13, which may be temporarily impacted by mining or road construction (see **Section 4.8, Water Resources – Ground Water**). Therefore, there would be a short-term minor adverse impact on all 1.64 acres of Wetland D.
- Wetland E (1.23 acres) – This wetland is supported by Spring 12, which may experience limited impacts from road construction. Therefore, there may be a short-term minor adverse impact on all 1.23 acres of Wetland E.
- Wetland F (2.38 acres) – This wetland is supported by overburden Spring 9, which would be impacted by mining and is not likely to reestablish at the same location after mining. Therefore, there would be a long-term moderate adverse impact on all 2.38 acres of Wetland F.
- Wetland F028 (0.60 acre) – This wetland is supported by Spring 11, which would be impacted during mining and is not expected to return postmining (see **Section 4.8, Water Resources – Ground Water**). Therefore, there would be a long-term moderate adverse impact on all 0.60 acre of Wetland F028.
- Wetland F049 (0.46 acre) – No impact.
- Wetland F058 (2.01 acres) – No impact.
- Wetland F061 (0.13 acre) – This wetland is along Donley Creek, where reduced flow to the alluvium is most likely (see PAP, Appendix O), however the primary source of water supporting this wetland is surface water (see **Table 66**). Therefore, there would be a negligible impact on Wetland F061.
- Wetland F081 (0.54 acre) – This wetland is supported by Spring 2, which may experience limited impacts from road construction. Therefore, there may be a short-term minor adverse impact on all 0.54 acre of Wetland F081.

Table 139. Wetland Impacts.

Wetland Identification	Direct Short-Term Impact (acres)	Direct Long-Term Impact (acres)
A	0	0
B	0	1.19
C	0	0.80
D	1.64	0
E	1.23	0
F	0	2.38
F028	0	0.60
F049	0	0
F058	0	0
F061	0	0
F081	0.54	0
Total Impacts	**3.41**	**4.97**

In total, the Proposed Action would have a short-term impact on 3.41 acres of wetlands and a long-term impact on 4.97 acres of wetlands. Based on the mining sequence illustrated in Western Energy's PAP, Exhibit A, a majority of these direct impacts would occur 10 years or more after mining begins.

The project would not require any CWA Section 404 permits because all of the wetlands identified in the project area were determined to be nonjurisdictional. MSUMRA (ARM 17.24.751) requires wetlands to be restored. The watershed topography and hydrology would be reclaimed to reestablish to the extent possible the hydrologic balance in and near the project area; however, as discussed above and in **Section 4.8, Water Resources – Ground Water**, the baseflow in the streams from ground water discharge to the stream channels would not begin until after ground water levels recovered many decades after mining, and discharges to streams may occur at different locations than where they occurred before mining. In addition, pre-mine flow conditions would not return to springs whose aquifer sources were removed. There would be no impact on those springs supported by aquifers that were not impacted by mining, and they would remain fully functional. New wetlands may appear along drainages in the analysis area postmining after the spoil resaturates. After mining, some ponds may be constructed to provide water supplies for wetlands. Reclamation of wetlands on-site would achieve the same functions and values of pre-mining conditions, but may not do so for a considerable amount of time. The mitigation of wetlands would provide replacement of the functions and values lost.

As discussed in **Section 2.4.8.5, Wetland Mitigation Plan**, Western Energy has developed a wetland mitigation plan to mitigate for the loss of wetland functions and values from the proposed project. A wetland functional assessment was completed on the wetlands to determine the functions and values that need to be replaced. Based on the functional assessment completed, a total of 39 functional units would be impacted by the proposed project. Western Energy has completed preliminary research into available mitigation options in the watershed service area and would consult with DEQ to establish a mutually-agreed upon plan to mitigate for the loss of wetland functions and values. Following consultation, Western Energy would develop a detailed mitigation plan for DEQ approval detailing how impacted wetlands would be mitigated. Options that have been researched include:

- Restoring other wetlands within the same watershed area;
- Enhancing wetlands that may only be minimally impacted by proposed mining activities, such as Wetland D; or
- Develop wetlands during reclamation of those areas mined early in the project area prior to impacting wetlands in the later stages of the project.

4.11.3.2 Indirect Impacts

Indirect impacts on wetlands and riparian zones associated with the Proposed Action (Alternative 2) would result from air emissions due to the combustion of coal from the project area in the Rosebud Power Plant and in Units 3 and 4 of the Colstrip Power Plant. Indirect impacts would be similar to those described in **Section 3.10, Vegetation**. For all trace metals except mercury and selenium, deposition of 1 percent of background concentrations would not be reached from combustion of project area coal over the 19-year operations period, and mercury deposition inside the analysis area would be less than the Eco-SSL for plants. Although the combined background levels and expected deposition for selenium exceeds the Eco-SSL for plants, the expected deposition is only 5.3 percent of the Eco-SSL. In addition, the mercury and selenium concentrations measured in the streams within the indirect effects analysis area have been below water-quality standards, with the exception of East Fork Armells Creek as described in **Section 4.1.1.3, Surface Water Indirect Effects**. Indirect effects on wetlands and riparian zones from Colstrip and Rosebud Power Plant emissions likely would be negligible for one or more of the following reasons: (1) the deposition of trace metals around the power plant would not reach 1 percent of the background soil concentrations; (2) deposition would be significantly less than the Eco-SSLs for plants; or (3) deposition would only be a small percentage of the total concentrations (for selenium).

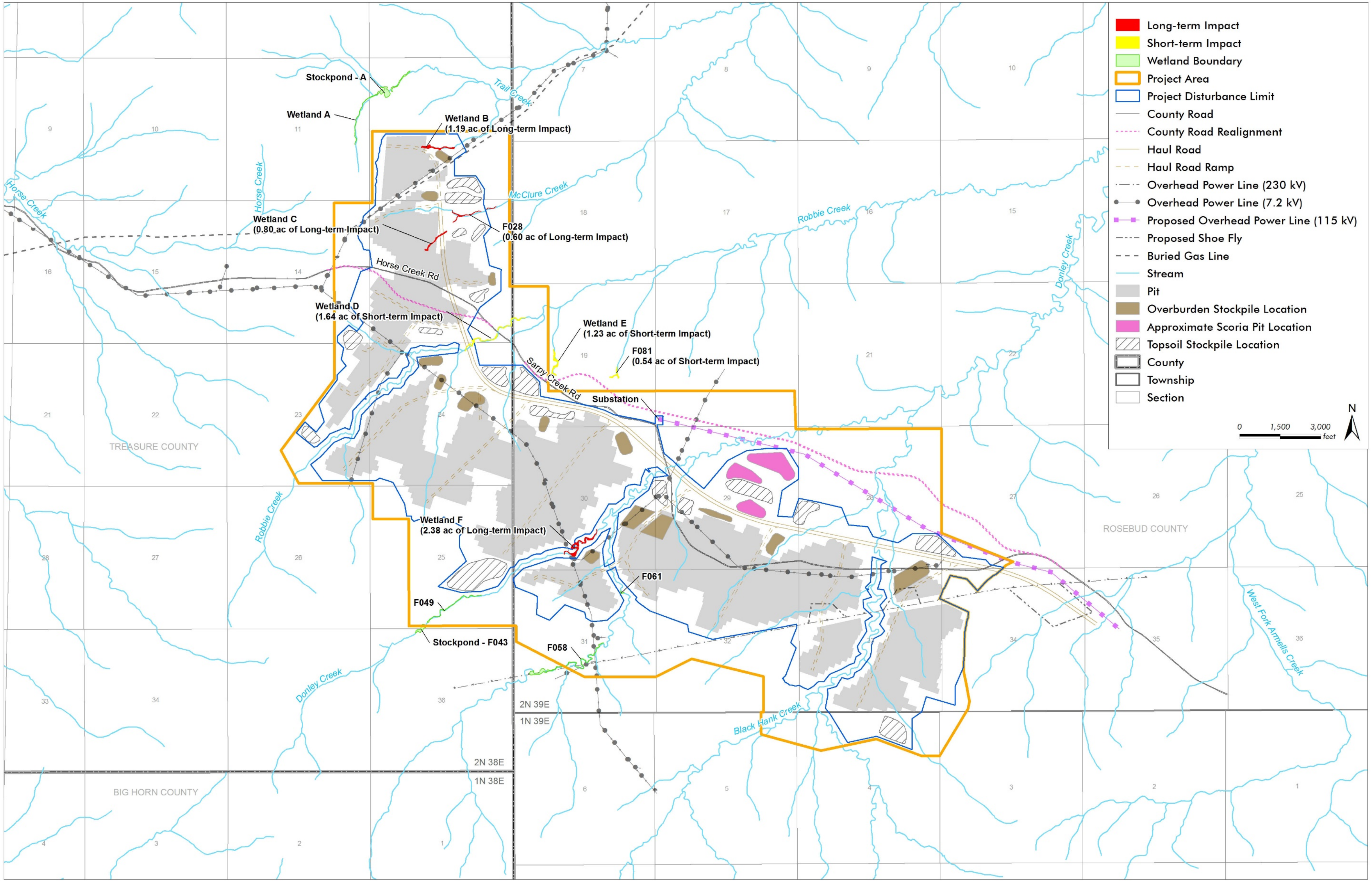

Figure 110. Wetland Impacts, Proposed Action.

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4.11.4 Alternative 3 – Proposed Action Plus Environmental Protection Measures

The direct and indirect effects of Alternative 3 on wetlands would be similar to Alternative 2, except as discussed in this section. Western Energy would be required to develop a Water Management Plan for the project (see **Section 2.5.2.1, Develop a Water Management Plan**). Under the Water Management Plan, to the extent possible, unlined sediment ponds and MPDES discharge points would be located upstream of existing water-dependent ecosystems to maintain a high water table at those locations in drainages undisturbed by mining (Black Hank, Donley, Robbie, McClure and Trail Creeks). This may include managing the timing and volume of MPDES releases to augment or mimic water budgets of downstream ecosystems. Some ponds that could be retained postmine could be used to support wetlands and riparian areas. This would potentially allow for a reduction in the amount of wetlands impacted by mining activities or for the development of new wetlands along the drainages. By supplying water to wetlands and riparian zones that may have otherwise lost hydrology, the impacts on wetlands and riparian zones under Alternative 3 would be less than those under Alternative 2. Many of the wetlands, such as Wetlands D, E, F, F028, and F081, may not be impacted at all if supported by other water sources. Impacts on Wetlands B and C could also be reduced if they are supported by other water sources. Depending on which wetlands are provided with additional water sources, Alternative 3 would have a short-term to long-term minor to moderate adverse impact on wetlands and riparian zones.

Under Alternative 3, there would be additional requirements for the Wetland Mitigation Plan. The mitigation plan would ensure that the functions, values, and replacement of wetlands would be successful by (1) requiring a natural water source(s) for the off-site mitigation sites; (2) requiring mitigation sites to be located outside of the drawdown area but within the same watershed of directly impacted wetlands; and (3) requiring any off-site mitigation areas to be protected by an easement or deed restriction.

In addition, Western Energy would salvage soil and sod from the wetlands in the project area that would be directly affected by mining and/or haul-road construction (Wetlands B, C, and D). The Wetland Mitigation Plan would include a description of the thicknesses of salvageable soil in each impacted wetland. If possible, salvage would be completed in the dry season to allow maximum salvage of soil and sod. Salvage would be completed in two lifts: the first lift would consist of O (layer that forms above the mineral soil) and A (topsoil) horizons, and the second lift would consist of suitable subsoil. New wetlands would be created as soon as possible after salvage to take advantage of the viable seed bank. If salvaged soil must be stockpiled, the first and second lifts would be stockpiled separately.

In addition to creating a Wetland Mitigation Plan, per the Water Management Plan (see **Section 2.5.2.1, Develop a Water Management Plan**), wetlands that are impacted by changes to hydrology would be augmented with managed water releases, such as directing the water releases to the upstream end of the wetlands or creating a stock pond that would seep or direct water to the wetlands. This would provide a new water source for the wetlands that could prevent them from drying up due to the ground water drawdown.

4.11.5 Irreversible and Irretrievable Commitment of Resources

The following would be irreversible and irretrievable commitments of wetlands:

- The loss of wetlands in the analysis area whose source of water supply will be permanently affected by mining activities

- Wetlands within the 4,260-acre disturbance area that would be removed during mining or other related disturbance

The loss of surface water and ground water hydrology in the analysis area are discussed in **Section 4.7, Water Resources – Surface Water** and **Section 4.8 Water Resources – Ground Water**.

4.12 FISH AND WILDLIFE RESOURCES

This section discloses the direct and indirect effects that the No Action (Alternative 1), the Proposed Action (Alternative 2), and the Proposed Action Plus Environmental Protection Measures (Alternative 3) alternatives would have on fish and wildlife resources; cumulative impacts are disclosed in **Chapter 5**. The analysis area is described in **Section 3.12, Fish and Wildlife Resources**.

4.12.1 Analysis Methods and Impact and Intensity Thresholds

4.12.1.1 Analysis Methods

Direct Effects

Baseline survey data from 2006 and from 2011 to 2013 baseline reports conducted by KC Harvey and ICF within the project area footprint were used to describe existing conditions for fish and wildlife resources in **Chapter 3** (see **Section 3.11, Fish and Wildlife Resources**). Documented occurrences of various wildlife species also are described in **Chapter 3**.

Effects on special status species were assessed qualitatively based on known species-occurrence data and direct habitat disturbance within the 4,260 acres of habitat in the 6,746-acre project area. Impact intensity thresholds have been used to describe the level of direct effects on species of concern.

Wildlife monitoring on the mine has occurred since 1973. Baseline surveys for the analysis area were initiated in 2006 and conducted a second time in 2011 (ICF 2011). Subsequent annual monitoring reports for the Rosebud Mine and the project area were conducted by ICF in 2012 and 2013 and contribute to baseline survey information. All surveys and annual monitoring conducted by ICF followed recommended protocols provided by DEQ, FWP, and USFWS (DEQ 2001). Annual monitoring will continue for the life of the mine as described in **Section 2.4.7**, **Monitoring Plans**.

Indirect Effects

The deposition modeling results for special status species (see **Section 3.12, Fish and Wildlife Resources, Indirect Effects Analysis Area** and **Section 4.3, Air Quality** for information on modeling and results), in conjunction with ecotoxicological screening values protective of soil invertebrates, birds, and mammals, were used to infer potential Colstrip and Rosebud Power Plant emissions impacts on fish and wildlife resources within the indirect effects analysis area. The analysis area was determined to be a 32-km radius around the Colstrip and Rosebud Power Plants. The EPA ecological soil-screening levels (Eco-SSLs) represent the most comprehensive evaluation of soil-screening levels for soil invertebrates, birds, and mammals, and these Eco-SSL values are preferentially used when available (EPA 2005b). For those trace metals where Eco-SSLs have not been developed, the protective ecological screening values presented for wildlife and cited by EPA (2015b) are used. The soil background levels of trace metals are also considered. As described in **Section 4.24, Soils**, the background concentrations were based on a USGS geochemical study completed in the region of the Colstrip and Rosebud Power Plants (Smith et al. 2013). Estimated deposition relative to background values and estimated deposition combined with background concentrations of trace metals were compared to the soil invertebrate, bird, and mammal screening levels to determine if impacts on wildlife may occur. Eco-SSLs are not available for reptiles, amphibians, or fish.

Impacts were qualitatively assessed based on general habitat types for fish and wildlife species within the 32-km buffer (see **Section 3.12, Fish and Wildlife Resources**).

4.12.1.2 Impact and Intensity Thresholds

The thresholds of change for the intensity of impacts on fish and wildlife resources are defined in **Table 140** and are used to describe the impacts below.

Table 140. Fish and Wildlife Resources Impact and Intensity.

Impact Intensity	Intensity Description
Negligible	There would be no observable or measurable impacts on native species, their habitats, or the natural processes sustaining them. Impacts would be well within natural fluctuations.
Minor	Impacts would be detectable and would not be expected to be outside the natural range of variability of native species' populations, their habitats, or the natural processes sustaining them.
Moderate	Breeding animals of concern are present; animals are present during particularly vulnerable life stages such as migration or juvenile stages; mortality or interference with activities necessary for survival would be expected on an occasional basis but would not be expected to threaten the continued existence of the species in the project area. Impacts on native species, their habitats, or the natural processes sustaining them would be detectable and would be outside the natural range of variability.
Major	Impacts on native species, their habitats, or the natural processes sustaining them would be detectable and would be expected to be outside the natural range of variability. Key ecosystem processes might be disrupted. Loss of habitat might affect the viability of at least some native species.

Impacts are also defined as short-term, long-term, or both (see **Section 4.1.1, Definitions**).

4.12.2 Alternative 1 – No Action

Under the No Action alternative, Western Energy would not develop the project area. There would be no impact on fish and wildlife resources, as described in **Section 3.12, Fish and Wildlife Resources**, because any changes or ground disturbances associated with development of the project area would not occur.

The No Action alternative would not change the status of other areas of the Rosebud Mine that are currently permitted and being mined and/or reclaimed by Western Energy (**Section 2.2, Existing Operations**), nor would it affect development of any other proposed Rosebud Mine areas currently in the permitting process (**Section 5.2.2, Related Future Actions**). Wildlife use and habitat in the analysis area would remain unchanged, except as affected by ongoing mining activities in other areas of the Rosebud Mine, agricultural practices, wildfire, hunting, and land-management activities in the region.

4.12.3 Alternative 2 – Proposed Action

4.12.3.1 Direct Impacts

Potential adverse effects from the Proposed Action include loss of habitat due to surface disturbances that remove vegetation, direct mortality of or injury to wildlife, and behavioral shifts such as a change in movement or displacement to other areas due to increased human activity and noise from blasting and mining operations.

Wildlife species are closely tied to habitat and the plant communities that characterize these specific habitats. Thus, effects on wildlife are generally related to impacts on the plant communities as described in **Section 3.10, Vegetation** and **Section 3.11, Wetlands and Riparian Zones.** Reclamation of impacts on vegetation communities (at a 1:1 ratio based on acreage) would eventually offset some adverse wildlife impacts, although species composition and maturity of certain communities may take years, which may result in long-term adverse impacts, or shifts in species composition. Mortality or injury to wildlife may occur from habitat removal (especially for less mobile species including ground-nesting birds, small mammals, reptiles, and amphibians) and collisions with mine-related vehicles. Restricted movement of less mobile species due to barriers such as construction fences, pits, and stockpiles is also possible during active mining. Animals that are displaced may move to less suitable habitat or suitable habitat occupied by predators or competitors, which could result in lower survival and reproduction rates.

Reclamation following mining would restore vegetation communities, but vegetation species composition and structure would take time to establish and mature. For example, reclaimed conifer areas may initially see an influx of early successional communities before a coniferous or deciduous overstory develops (Buehler and Percy 2012). Wildlife favoring early successional stages of plant growth would be the first to move into a reclaimed area. As vegetation matures, reclaimed mined areas would support a greater diversity of wildlife.

Because mining would be conducted in phases, surface disturbance and vegetation removal would occur incrementally over 20 years. Initial stages of reclamation (grading, application of soil, and seeding) of disturbed lands would begin approximately 2 years after the removal of coal and would occur in phases throughout the life of the mine until all disturbed lands are revegetated (see **Section 2.4.4, Reclamation Plan**). Land in the project area that has been reclaimed and successfully revegetated, along with unmined land, would provide habitat for wildlife during mine operations.

Mammals

Small Mammals

The Proposed Action would result in moderate, short-term and possible long-term, adverse effects on small mammals. Direct losses of small mammals due to habitat loss would occur since mobility of small animals is limited and many use burrows for shelter. It is possible that localized small-mammal populations (mice, voles, shrews, and lagomorphs) would decline during land clearing. Some small mammals may be displaced to adjacent land, which could lead to increased competition.

Long-term effects would depend on how quickly different habitat types establish following reclamation. Grasslands would mature more quickly than woodland and shrub grassland habitat. Reclaimed areas would first be revegetated with early successional species providing habitat for grassland-associated species. Habitat for small mammals adapted to woodland habitats would take longer to recover. Many small mammals (lagomorphs and rodents) would be able to quickly recolonize areas due to high reproductive rates. These species tend to adapt to reclaimed areas fairly quickly. Generalist species such as deer mice and cottontail rabbits would establish more quickly than those species with specialized habitat requirements.

Bats

Bat surveys conducted in the direct effects analysis area in 2011 identified snags and vertical rock outcrops as potential roosting habitat. Roosting habitat in the analysis area consists of structures (e.g., bridges and buildings), rock outcrops, and trees. Mining activities could remove potential roosting habitat or deter bats from roosting.

Due to surface disturbances and vegetation removal, mining in the project area would impact a variety of habitats used by bats. Vegetation removal would reduce available habitat for roosting and foraging. Common wide-ranging species such as big brown bat and long-eared myotis would be impacted by vegetation removal in all habitat types. Fringed myotis and pallid bat would be impacted by the loss of shrublands. Impacts would be greatest for forest-dwelling species such as hoary bat, Townsend's big-eared bat, and silver-eared bat due to the longer recovery time for reclaimed forest habitats.

Bat foraging behavior would possibly be affected by increased human presence and mine-related noise, because such effects may cause bats to avoid suitable foraging habitat. Studies conducted in the direct effects analysis area have determined that most bats were detected foraging near water or riparian areas. Because riparian areas would not be impacted by mining activities, bats would continue to forage in these areas. However, removal of roosting habitat could result in an overall lower number of bats.

Other effects on local bat populations would likely occur over the long term due to potential changes in habitat over time. Generalist species would likely recover more quickly due to adaptation to different habitats. Effects on forest- and shrub-dwelling species such as the hoary bat, pallid bat, and Townsend's big-eared bat would last longer and could result in a decline in these species in the analysis area. However, these localized effects would not likely affect bat populations outside of the analysis area. The Proposed Action would likely result in moderate, short- and long-term, adverse effects on bat species.

Carnivores

The effects on small carnivores from the Proposed Action are expected to be minor and short-term due to relatively high reproductive rates and ability to adapt to human presence. Smaller carnivores such as skunk, raccoon, and weasel may decline in the analysis area due to habitat loss from mine-related surface disturbance. Small carnivores may respond to such disturbance by moving to other nearby habitat. Displacement could result in lower production or survival of local populations in the analysis area depending on the level of competition in other nearby habitats and abundance of food sources. Most large carnivore sightings in the project area have been incidental. Because larger carnivores are somewhat nomadic in nature and pass through areas while foraging, effects are expected to be minor, short-term, and adverse due to mining operations. Larger carnivores including coyote, black bear, and mountain lion are mobile and would avoid active mine areas. Predatory species would likely return following reclamation and recolonization by prey species.

Big Game Animals

Mule Deer, Elk, and Pronghorn

Direct effects on large game from mining in the project area would include loss of habitat due to mine-related surface disturbances and vegetation removal. Over the life of the mine, about 4,260 acres of grassland, shrub grassland, conifer, and agricultural habitat would be impacted. Habitat loss, combined with other mine-related activity such as increased human activity and noise from blasting and mining operations, could result in behavioral changes in large game. Behavioral changes may affect movement patterns, resulting in displacement of large game to other areas.

Mule deer are the most abundant of the large game animals documented on the Rosebud Mine, including the project area. Mule deer are habitat generalists (populations have been documented in nearly every habitat type in the Rosebud Mine), and ample nearby suitable habitat is available for mule deer displaced by mining (**Table 70**). Relatively low numbers (compared to mule deer) of elk and pronghorn have been documented in the direct effects analysis area (**Table 71** and **Table 72**). Mining in the project area may affect elk and pronghorn individuals but would not likely affect regional populations of either species because of the limited suitable habitat for these species in the project area compared to surrounding areas. Monitoring of reclaimed habitat near active portions of the Rosebud Mine indicates that large game animals have continued to inhabit areas adjacent to active mining areas throughout the duration of mining activities (ICF 2011, 2013, and 2014).

Large game animals are highly mobile and able to move to undisturbed areas relatively readily; however, mine-related disturbance may not preclude big game animals from using active mine areas. Annual monitoring reports from the Rosebud Mine indicate that large game animals do use active mine areas, including soil stockpiles, spoil piles, and areas in the process of reclamation (ICF 2013).

Movement through the project area would be somewhat restricted due to placement of open pits, roads, stockpiles, and staging areas associated with mining activities, as well as by the use of additional fencing (if needed). Pronghorn seem to be most susceptible to such barriers (Sawyer et al. 2005). Although no big game movement corridors have been identified in the project area, mining activities could shift big game movement patterns.

Postmine reclamation would restore vegetation communities similar to pre-mine conditions. It is likely to take several years following reclamation to restore vegetation communities to the same wildlife carrying capacity that pre-mine conditions provided. Eventual development of mature vegetation in reclaimed areas is anticipated to support large game animals in similar numbers as pre-mining. Therefore, anticipated effects are expected to be short-term and minor.

Other Big Game Species

White-tailed deer, bighorn sheep, and moose have not been documented in the project area, although limited suitable habitat for these species is available. Given the lack of documented use of the project area by these species, effects are likely to be negligible.

Birds

Upland Game Bird Species

Mining operations in the project area would impact habitat used by upland game birds. Wild turkey, sharp-tailed grouse (**Figure 111**), ring-necked pheasant, gray partridge, and mourning dove are all associated with various habitats in the analysis area. Mining activities would likely displace upland game birds from active mining areas within the project area to other areas. Each of the species listed above is somewhat mobile and is likely to avoid areas of active mining and disturbed habitat in the project area.

Figure 111. Sharp-Tailed Grouse.
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A total of 18 active sharp-tailed grouse leks were observed on the Rosebud Mine in 2013 (including those in the project area). Two additional leks occur near the project area boundary. Previous annual monitoring from other areas of the Rosebud Mine, and studies from the Absaloka Mine to the west, show that impacts from mining activities on sharp-tailed grouse appear to be short-term. Sharp-tailed grouse returned to reclaimed portions of Area C of the Rosebud Mine two years after active mining ceased and reclamation was implemented (Yde 2015). Similar results are likely for sharp-tailed grouse and perhaps other game birds in the project area. Mitigation and minimization measures such as soil salvaging outside of the spring months, phasing mine development areas, and establishing vegetation following mining would reduce impacts on sharp-tailed grouse. Planned reclamation following mining disturbance would restore habitats currently used by all game birds. Therefore, it is anticipated that the impacts on upland game birds would likely be short-term and minor.

Migratory Birds

Mining activities could cause abandonment or direct removal of nests if land-clearing activities occur during the breeding season. Bird use of undisturbed lands in the project area or adjacent lands in the direct effects analysis area could also be displaced as a result of human activity and noise from mining and vehicle travel.

Mining in the project area would impact a variety of habitats used by migratory birds. Vegetation removal would reduce available habitat for breeding, roosting, and foraging songbirds and other avian species. Common wide-ranging species such as meadowlark, American robin, and lark sparrow would be impacted by vegetation removal in all habitat types. Vesper sparrow, Brewer's sparrow, Eastern king bird, and similar species would be impacted by the loss of grassland and shrub grassland. Forest-dwelling species such as Bullock's oriole, black-capped chickadee, and black-headed grosbeak would be impacted by the loss of conifer and deciduous tree/shrub habitat. Mining activities would avoid disturbance in riparian and wetland habitat used by many avian species.

Habitat loss would be short-term for species that are adapted to a variety of habitats (generalists) or those adapted to open grasslands or agricultural areas (such as western meadowlark, American crow, or black-billed magpie). Longer-term impacts would occur to those species that depend on shrubland or forested habitats (loggerhead shrike and woodpecker), as these habitats may take decades to become mature. Reclamation of disturbed land following coal extraction would occur concurrently with mining of new sections and would provide habitat for avian species that use grassland and cropland habitats. Effects on migratory birds would likely be short-term and minor to moderate depending on species.

Shorebirds and Waterfowl

Waterfowl and shorebird species that have been documented in the direct effects analysis area are discussed in **Section 3.12.4.3, Shorebirds and Waterfowl**. Open water and aquatic habitat is limited in the project area, and most waterfowl observations have been incidental. Approximately 5.1 acres of long-term wetland impacts and about 4.63 acres of short-term wetland impacts are anticipated. Long-term impacts on wetlands would be mitigated either within the project area or within the same watershed during reclamation (see also **Section 4.7, Water Resources – Surface Water** and **Section 4.11, Wetlands and Riparian Zones**). Thus, long-term impacts on potential shorebird and waterfowl habitat would be minor.

Activities associated with mining would possibly deter shorebirds and waterfowl from using the project area as foraging habitat, but surrounding undisturbed areas and reclaimed areas would provide habitat. Development of sediment ponds may attract some species. Mining in the project area would not likely affect breeding pairs of aquatic birds because no shorebird or waterfowl breeding has been documented in the project area, and breeding pairs would likely continue to nest in suitable habitat outside of the project area.

Raptors

Raptor tolerance of disturbance varies among species and individuals within the same species (Whittington and Allen 2008). Generally, species such as golden eagle respond to disturbance (associated with human activity) at greater distances than Cooper's hawk. USFWS has recommended spatial nest buffers for various raptor species that occur within the western United States. The purpose of a spatial buffer is to serve as a guideline for reducing the likelihood of raptor abandonment of nests (roosting or breeding) due to human-related disturbance (e.g., construction activity). Recommended buffers for species documented in the direct effects analysis area are shown in **Table 141**. **Figure 112** shows documented raptor nests within or adjacent to the project area and the recommended buffers for each. Mining activities within these buffers may result in nest abandonment or unsuccessful breeding.

Table 141. Raptor Species Documented in the Analysis Area and USFWS Recommended Nest Buffers.

Species	Scientific Name	Recommended Buffer (Miles)	Recommended Buffer (Meters)
Species Documented on the Rosebud Mine (including the Project Area)			
Cooper's Hawk	*Accipiter cooperii*	0.25	400
Golden Eagle	*Aquila chrysaetos*	0.50	800
Burrowing Owl	*Athene cunicularia*	0.25	400
Great Horned Owl	*Bubo virginianus*	0.125	200
Red-Tailed Hawk	*Buteo jamaicensis*	0.33	530
Merlin	*Falco columbarius*	0.25	400
Prairie Falcon	*Falco mexicanus*	0.50	800
Osprey	*Pandion haliaetus*	0.25	400
Additional Species Documented in the Analysis Area			
Northern Goshawk	*Accipiter gentilis*	0.50	800
Ferruginous Hawk	*Buteo regalis*	1.00	1,600
Peregrine Falcon	*Falco peregrinus*	1.00	1,600

Source: Whittington and Allen 2008.

Annual monitoring on the Rosebud Mine, including the project area, has documented successful raptor nesting in close proximity to active mining, indicating that some species may have become adapted to gradual encroachment of mining and may have benefitted from mitigation efforts such as erection of nesting poles in other areas of the mine. Studies near Wyoming coal mines in the Powder River Basin have documented nesting raptors near active mines (WWC Engineering 2010). Similarly, red-tailed hawks and great horned owls have bred successfully around the periphery of active portions of the Rosebud Mine between 2009 and 2013 (ICF 2014).

While mining in the project area would not likely affect regional raptor populations, mining activities could disrupt normal activities of individual raptors or breeding pairs. Mining could result in the loss of nests that occur in the project area. Mining activities could cause breeding raptors to abandon nests that are located close to disturbance. Long-term effects on tree-nesting species including red-tailed hawk, golden eagle, and Cooper's hawk are possible with removal of 688 acres of conifer and 84 acres of deciduous tree/shrub areas. Ground-nesting species such as short-eared owl and northern harrier may be impacted during active mining but would likely return to the area after reclamation. Species such as northern harrier that inhabit open areas may benefit in the short term from changes in habitat until woodlands begin to form and mature.

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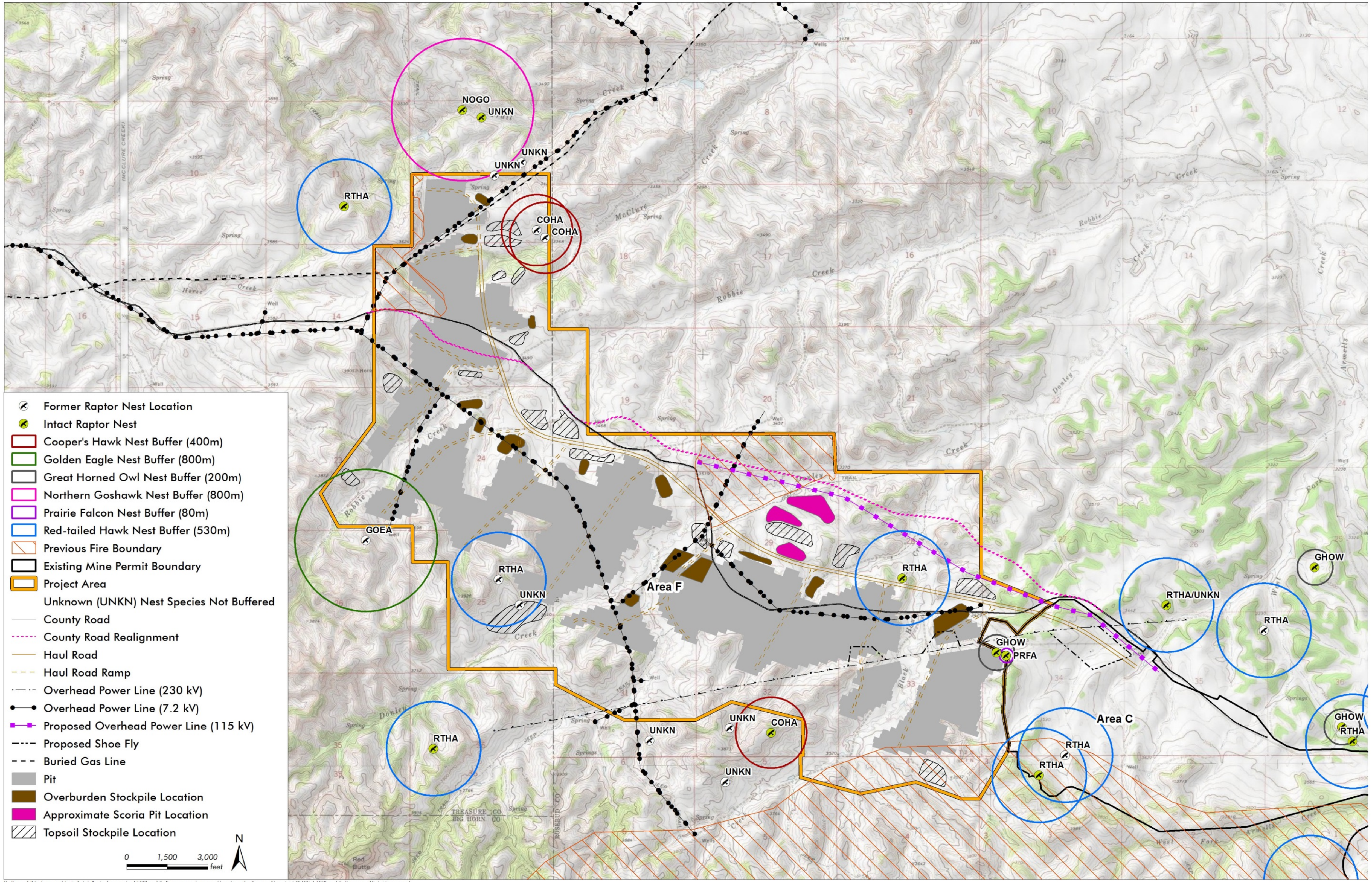

Figure 112. Known Raptor Nests and USFWS Recommended Buffers in and adjacent to the Project Area.

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Prey availability in the project area during mining may decrease, potentially impacting raptor foraging. Raptors currently nesting in the project area would be displaced by removal of habitat, possibly resulting in increased competition in surrounding areas. Effects on raptors would be short- and long-term and would overall likely be moderate.

Amphibians and Reptiles

Under the Proposed Action, mining activities would adversely affect amphibians and reptiles due to habitat loss. Direct impacts on amphibians and reptiles would occur during land-clearing due to limited mobility and the need for fairly specialized habitat. Impacts on amphibians and reptiles would possibly be long-term because their reproductive rates are relatively low and vary seasonally. Following reclamation, it is likely that amphibians and reptiles would slowly return to the area. Planned avoidance of streams and wetlands would minimize impacts on amphibian and reptile species adapted to those habitats, although flows in some aquatic habitats may be altered, which is outlined in more detail in **Section 4.7, Water Resources – Surface Water**. Due to the limited mobility and habitat alteration, effects on amphibians and reptiles would likely be long-term, moderate, and adverse.

Aquatic Species

Habitat for aquatic species is limited and poor in the project area. Armells Creek is located about 16 miles northeast of the project area, although several tributaries to Armells Creek traverse the project area. Aquatic and riparian habitat along tributaries to Armells Creek would be avoided during mining. The Proposed Action would potentially impact local populations of macroinvertebrates and notropids that may occur in impacted stock ponds, springs, and perennial and intermittent streams. Aquatic habitat could be indirectly impacted by changes in stream flow and/or water quality due to mining. Reclamation and action to maintain the hydrologic balance would reduce potential impacts on aquatic habitat and species. Effects on surface water resources are explained in more detail in **Section 4.7, Water Resources – Surface Water.** Effects on aquatic species due to changes in stream flow and/or water quality would be short-term or long-term, minor to moderate, and adverse.

4.12.3.2 Indirect Impacts

Deposition modeling was completed to determine the indirect effects analysis area for special status species and was also used to determine the indirect effects analysis area for fish and wildlife (non-special status species) (see **Section 4.3, Air Quality** and **Section 3.12, Fish and Wildlife**). The model determined deposition due to emissions from the Colstrip and Rosebud Power Plants in the analysis area during the 19-year period of operations.

Table 142, **Table 143**, and **Table 144** present the following:

- Summaries of trace-metal concentrations estimated for deposition over the 19-year period
- Naturally occurring background concentrations for trace metals (reflected as the 95-percent UCL)
- Soil invertebrate, bird, and mammal Eco-SSLs (EPA 2005b) and protective ecological screening values for those metals with no Eco-SSL (LANL 2012); although these values are differentiated in the analysis discussion for these wildlife classes, the values are jointly referred to as “ecological screening values” in the tables below to simplify
- A comparison of the deposition concentrations to background levels and soil invertebrate, bird, and mammalian screening values
- Percentage of total deposition relative to background
- Percentage of deposition relative to the soil invertebrate, bird, and mammalian screening values
- Whether deposition plus background exceeds each ecological screening value

- An overall summary of whether trace metals pose adverse indirect effects on each wildlife class

As summarized in **Table 142** through **Table 144**, trace metals from total deposition of the 19-year period of operations provide a minimal contribution to background concentrations. The trace concentrations from deposition, even when combined with naturally occurring background concentrations, do not exceed wildlife ecological screening thresholds for the majority of metals.

The combined background levels and expected deposition of chromium, lead, and mercury would exceed the Eco-SSLs for birds. In addition, the combined background levels and expected deposition of antimony and chromium would exceed the Eco-SSLs for mammals. All other trace metals were below the Eco-SSLs for birds and mammals when background levels and expected deposition were combined (**Table 143** and **Table 144**). EPA studies determined that toxicity data were not sufficient to derive Eco-SSLs for fish, amphibians, and reptiles; therefore, there are no data for these classes (EPA 2005b). It is worth noting that the avian and reptilian classes share some physiological traits and may be affected similarly by various metal concentrations. Based on the determination that combustion of project area coal would have no effect on surface water quality except possibly for selenium in the East Fork Armells Creek (see **Section 4.7, Water Resources – Surface Water)**, indirect effects on aquatic species (fish, amphibians, and aquatic invertebrates) are anticipated to be negligible to moderate.

Soil Invertebrates

Within the indirect effects analysis area, the 95-percent UCL background levels for each of the trace metals analyzed are below the Eco-SSLs for soil invertebrates such as earthworms or burrowing insects and arthropods (**Table 142**). Given that the expected deposition of these trace metals is below the Eco-SSLs for soil invertebrates, indirect effects on soil invertebrates from project area coal combustion would be negligible.

Table 142. Trace Metal Background, Potential Soil Impact Distance, and Ecological Soil-Screening Levels for Soil Invertebrates.

Analyte	Background – 95-Percent UCL	Total Deposition over 19-Year Period of Operations[1]	Total Expected Concentration (Background + Total Deposition)	Ecological Screening Value for Soil Invertebrates[2]	Percent of Deposition Relative to Background	Percent of Deposition Relative to Soil Invertebrate Ecological Screening Value[2]	Does Deposition plus Background Exceed the Soil Invertebrate Ecological Screening Value?	Potential Adverse Indirect Impacts on Soil Invertebrates
	mg/kg, DW	mg/kg, DW	mg/kg, DW	mg/kg, DW	Percent	Percent	(Yes/No)	(Yes/No)
Antimony	0.9	0.00504	0.90504	78	0.56	0.01	No	No
Arsenic	10.9	0.00694	10.90694	60	0.06	0.12	No	No
Cadmium	0.3	0.00189	0.30189	140	0.63	0.01	No	No
Chromium	50.5	0.01765	50.51765	NA	0.03	NA	No	No
Copper	17.8	0.08133	17.88133	80	0.46	0.1	No	No
Lead	19.1	0.00757	19.10757	1,700	0.04	0.01	No	No
Selenium	0.56	0.03153	0.59153	4.1	5.6	0.76	No	No
Mercury	0.023	0.00085	0.02385	0.1	3.7	0.85	No	No

NA = Not available. Insufficient data to derive ecological screening value.
DW = Dry weight.
[1]Assumes an untilled soil mixing depth of 2 centimeters and a soil dry-bulk density of 1.5 g cm^{-3} as recommended by EPA (2005b).
[2]Section 4.1.1.1 describes the hierarchy of soil invertebrate, bird, and mammal ecological screening values.

Birds

The total expected concentrations (background plus total deposition over the 19-year period of operations) for arsenic, cadmium, copper, and selenium would not exceed the protective ecological screening values for birds (**Table 143**). Therefore, there would be no unacceptable risks for birds from potential deposition of these trace metals under the Proposed Action. There are no avian Eco-SSLs for antimony. The modeled antimony deposition over the 19-year period of operations is 0.56 percent of the background value. As such, there would be no unacceptable risks expected for birds exposed to antimony due to the potential deposition from the Proposed Action.

As indicated in **Table 143**, the total expected chromium, lead, and mercury concentrations (50.51 mg/kg, 19.11 mg/kg, and 0.024 mg/kg) slightly exceed the ecological screening levels for birds (26 mg/kg, 11 mg/kg, and 0.013 mg/kg). The background values for chromium, lead, and mercury slightly exceed the bird ecological screening values. Therefore, the additional modeled total deposition over the 19-year period of operations, when added to background, exceeds the bird ecological screening values. Exceedance of these screening values alone does not mean that there would be adverse impacts on birds from chromium, lead, and mercury deposition. This indicates, however, that further scrutiny is warranted for these trace metals related to bird exposures. Therefore, each of these trace metals is discussed in detail, as follows.

Table 143. Trace Metal Background, Potential Soil Impact Distance, and Ecological Soil-Screening Levels for Birds.

Analyte	Background – 95 Percent UCL	Total Deposition over 19-Year Period of Operations[1]	Total Expected Concen-tration (Background + Total Deposition)	Ecological Screening Value for Birds[2]	Percent of Deposition Relative to Background	Percent of Deposition Relative to Bird Ecological Screening Value[2]	Does Deposition plus Background Exceed the Bird Ecological Screening Value?	Potential Adverse Indirect Impacts on Birds
	mg/kg, DW	mg/kg, DW	mg/kg, DW	mg/kg, DW	Percent	Percent	(Yes/No)	(Yes/No)
Antimony	0.9	0.00504	0.90504	NA	0.56	NA	No	No
Arsenic	10.9	0.00694	10.90694	43	0.06	0.02	No	No
Cadmium	0.3	0.00189	0.30189	0.77	0.63	0.25	No	No
Chromium	50.5	0.01765	50.51765	26	0.03	0.07	Yes	No
Copper	17.8	0.08133	17.88133	28	0.46	0.3	No	No
Lead	19.1	0.00757	19.10757	11	0.04	0.07	Yes	No
Selenium	0.56	0.03153	0.59153	1.2	5.60	2.6	No	No
Mercury	0.023	0.00085	0.02385	0.013	3.70	6.5	Yes	No

NA = Not available. Insufficient data to derive ecological screening levels.

[1]Assumes an untilled soil mixing depth of 2 centimeters and a soil dry-bulk density of 1.5 g cm^{-3} as recommended by EPA (2005b).

[2]**Section 4.12.1.1, Analysis Methods** describes the hierarchy of soil invertebrate, bird, and mammal ecological screening values.

Chromium: There is sufficient information to conclude that the total expected concentration for chromium (background plus total deposition over the 19-year period of operations, 50.51765 mg/kg) would not pose unacceptable risks to birds. The modeled deposition over the 19-year period for chromium is estimated at 0.03 percent of the background value and 0.07 percent of the Eco-SSL for chromium (**Table 143**). The Eco-SSL for chromium of 26 mg/kg is a very conservative and protective value. EPA acknowledges that background concentrations for chromium throughout the United States may exceed Eco-SSLs for birds (EPA 2008d). EPA also acknowledges that chromium is an essential nutrient for many animals (including humans). In fact, chromium is a supplement given to birds in the agricultural setting. According to NRC (1997), chromium in the diet of birds increases the rate of glucose utilization by livers of chicks and young chickens. For example, supplemental dietary chromium also has been reported to decrease mortality and cholesterol in serum and egg yolks and to improve glucose metabolism of chickens. The Eco-SSL for chromium is very protective and is based on a toxicity reference value (TRV) for 13 studies where the range of toxicity was between 26 mg/kg and 780 mg/kg for species such as dove, chicken, and hawk. The TRV used to derive the Eco-SSL is based on the geometric mean of this range and reflects a threshold level where a low adverse effect may be observed.

Lead: There is sufficient information to conclude that the total expected concentration for lead (background plus total deposition over the 19-year period of operations, 19.10757 mg/kg) would not pose unacceptable risks to birds. The modeled deposition over the 19-year period for lead is estimated at 0.04 percent of the background value and 0.07 percent of the Eco-SSL for lead (**Table 143**). The avian Eco-SSL for lead of 11 mg/kg is a very conservative value. The Eco-SSL for lead is based on a TRV from 54 studies where the range of toxicity was from 11 mg/kg/day for insectivores to 510 mg/kg/day for hawks. The EPA Eco-SSL is based on the highest no observed adverse effect level (NOAEL) for survival, growth, and reproduction. The actual study upon which the Eco-SSL is based is a NOAEL for growth. Therefore, slightly exceeding the Eco-SSL for lead means that no adverse effects on the survival and reproduction of birds would be expected. While some slight reduction of growth cannot be definitively ruled out for the most highly exposed individual birds, even that is unlikely to occur given the low chance of exceeding the conservative Eco-SSL and given that the Eco-SSL itself is below background levels.

Mercury: The EPA has not developed mercury Eco-SSLs for any receptor (invertebrates, birds, or mammals). However, there is sufficient information to conclude that the total expected concentration for mercury (background plus total deposition over the 19-year period of operations, 0.02385 mg/kg) would not pose unacceptable risks to birds. The total deposition of mercury over the 19-year period of operations is 0.00085 mg/kg, which is well below the 0.013 mg/kg ecological screening level for birds exposed to mercury (**Table 143**). This suggests that the release of mercury from power plant combustion emissions would not cause adverse impacts on birds. The modeled deposition for mercury is estimated at 3.7 percent of the background value. The total expected concentration (i.e., estimated background plus deposition of mercury over the 19-year period of operations) is 0.02385 mg/kg, which exceeds the ecological screening levels for birds exposed to mercury (0.013 mg/kg) by less than a factor of 2. The vast majority of the mercury contribution to soil is from the background mercury concentration of 0.023 mg/kg.

Additional information to support the conclusion that mercury would not pose unacceptable risks to birds includes the following:

- The ecological screening level shown in **Table 143** is based on the EPA Region 4 ecological screening level for mercury (0.013 mg/kg) obtained from the Los Alamos National Laboratory (LANL) ECORISK Database (LANL 2012). The value of 0.013 mg/kg for mercury is the lowest of any of the mercury screening levels provided for birds in the LANL database, and it was derived using studies reporting NOAEL TRVs; thus, it reflects "no adverse effects" on birds.
- The data set that was considered by LANL for the selection of the TRV used to derive the ecological screening level of 0.013 mg/kg consisted of three experiments. The types of endpoints

that were considered included reproduction (egg fertility, hatchability of eggs, hatchlings/hen/day), development (growth rates), and survival (mortality). The test organism used to derive the 0.013 mg/kg ecological screening value was the most sensitive Japanese quail exposed to mercury via the diet. The TRV selected for derivation of the 0.013 mg/kg soil-screening level was 0.019 mg/kg/day of body weight.

- Findings presented in a more recent study (Fuchsman et al. 2017) provides further support that slightly exceeding the value of 0.013 mg/kg is conservative and protective. In a comprehensive review of mercury effects on bird reproduction, Fuchsman et al. (2017) evaluated laboratory and field studies in which observed effects could be attributed primarily to mercury. Applicable data were identified for 23 species. From this data set, the authors identified ranges of TRVs suitable for risk-assessment applications. The LANL TRV of 0.019 mg/kg/day used to derive the 0.013 mg/kg soil-screening level is well below the range of mercury effect thresholds reported in Fuchsman et al. (2017) of 0.05 mg/kg/day to 0.5 mg/kg/day.

Mammals

As summarized in **Table 144**, the total expected concentrations (background plus total deposition over the 19-year period of operations) for arsenic, cadmium, copper, lead, mercury, and selenium would not exceed the protective ecological screening values for mammals. Therefore, there would be no unacceptable risks to mammals from these trace metals related to potential deposition from the Proposed Action.

Table 144. Trace Metal Background, Potential Soil Impact Distance, and Ecological Soil-Screening Levels for Mammals.

Analyte	Background – 95 Percent UCL	Total Deposition over 19-Year Period of Operations[1]	Total Expected Concen-tration (Background + Total Deposition)	Ecological Screening Value for Mammals[2]	Percent of Deposition Relative to Background	Percent of Deposition Relative to Mammal Ecological Screening Value[2]	Does Deposition plus Background Exceed the Mammal Ecological Screening Value?	Potential Adverse Indirect Impacts on Mammals
	mg/kg, DW	mg/kg, DW	mg/kg, DW	mg/kg, DW	Percent	Percent	(Yes/No)	(Yes/No)
Antimony	0.9	0.00504	0.90504	0.27	0.56	1.9	Yes	No
Arsenic	10.9	0.00694	10.90694	46	0.06	0.02	No	No
Cadmium	0.3	0.00189	0.30189	0.36	0.63	0.5	No	No
Chromium	50.5	0.01765	50.51765	34	0.03	0.05	Yes	No
Copper	17.8	0.08133	17.88133	49	0.46	0.17	No	No
Lead	19.1	0.00757	19.10757	56	0.04	0.01	No	No
Selenium	0.56	0.03153	0.59153	0.63	5.6	5.0	No	No
Mercury	0.023	0.00085	0.02385	1.7	3.7	0.05	No	No

[1]Assumes an untilled soil mixing depth of 2 centimeters and a soil dry-bulk density of 1.5 g cm^{-3} as recommended by EPA (2005b).
[2]**Section 4.12.1.1, Analysis Methods** describes the hierarchy of soil invertebrate, bird, and mammal ecological screening values.

As indicated in **Table 144**, the total expected concentration of antimony and chromium (0.90504 mg/kg and 50.51765 mg/kg, respectively) exceed the ecological screening values for mammals (0.27 mg/kg and 34 mg/kg respectively). The background values alone for antimony and chromium exceed the mammal ecological screening values. As such, the additional modeled total deposition over the 19-year lifetime of the Proposed Action, when added to background, exceeds the mammal ecological screening values. Exceedance of these screening values alone does not mean that there would be adverse impacts on mammals from antimony and chromium deposition. This indicates, however, that further scrutiny is warranted for these chemicals related to mammal exposures. Therefore, each of these chemicals is discussed in detail, as follows:

Antimony: There is sufficient information to conclude that the total expected concentration for antimony (background plus total deposition over the 19-year period of operations 0.90504 mg/kg) would not pose unacceptable risks to mammals. The modeled deposition over the 19-year period for antimony is estimated at 0.56 percent of the background value and 1.9 percent of the Eco-SSL for antimony (**Table 144)**. The Eco-SSL for antimony of 0.27 mg/kg is a very conservative and protective value. Exceedance of this value alone does not mean that there would be adverse impacts on mammals from antimony deposition. Rather, this indicates that further scrutiny is warranted for antimony and mammals. EPA acknowledges that background concentrations for antimony throughout the United States may exceed Eco-SSLs for mammals (EPA 2005b).

The Eco-SSL for antimony is based on 11 studies that included 10 growth and reproduction endpoints. Ten growth and reproduction NOAEL results were used to calculate a geometric mean NOAEL. Eight of the 10 endpoints used for the derivation of the TRV were growth endpoints, which do not necessarily translate into population-level effects. Also, the Eco-SSL addresses exposure to the most sensitive of three feeding guilds (insectivores, e.g., shrew). Given that the total expected concentration over the 19-year period of operations is greater than the Eco-SSL of 0.27 mg/kg by only a factor of three and that the Eco-SSL was derived using sensitive growth endpoints, impacts from antimony on even the most sensitive mammals are expected to be negligible.

Chromium: There is sufficient information to conclude that the total expected concentration for chromium (background plus total deposition over the 19-year period of operations, 50.51765 mg/kg) does not pose unacceptable risks to mammals. The modeled deposition over the 19-year period for chromium is estimated at 0.03 percent of the background value and 0.05 percent of the Eco-SSL for chromium (**Table 144**). EPA acknowledges that background concentrations for chromium throughout the United States may exceed Eco-SSLs for mammals (EPA 2008d). EPA also states that chromium is an essential nutrient for animals. As described for birds, chromium is used to supplement the diets of livestock, and many health benefits have been attributed to chromium supplementation, including increased longevity; enhanced reproduction; decreased incidence of metabolic disorders, stress effects, and disease; reduced need for antibiotic usage; and improved immune response (NRC 1997). The Eco-SSL for chromium of 34 mg/kg is a very conservative and protective value. This Eco-SSL is based on a TRV equal to the geometric mean of NOAEL values for reproduction and growth equal to 2.40 mg chromium/kg body weight/day. Twenty papers were reviewed and 14 endpoints on growth and reproduction were used in the derivation of the TRV. The lowest NOAELs were based on growth endpoints, specifically changes in body weight, and, while informative, may not translate into population-level effects. Given that the Eco-SSL of 34 mg/kg was generated to address exposure to the most sensitive feeding guild (insectivores, e.g., shrew) using sensitive growth endpoints and is only slightly less than the total expected concentration of chromium over the 19-year period of operations, impacts from chromium on even the most sensitive mammals are not expected.

Summary of Indirect Effects

For all trace metals except selenium, mercury, and antimony (for mammals), deposition of 1 percent of background concentrations would not be reached from combustion of project area coal over the 19-year period of operations. Additionally, selenium depositions inside the indirect effects analysis area would be less than the ecological screening values for all wildlife groups.

The total expected concentrations (background plus total deposition over the 19-year period of operations) for arsenic, cadmium, copper, and selenium would not exceed the protective ecological screening values for birds. For birds, the combined background levels and expected deposition for chromium, lead, and mercury exceed the ecological screening values. However, the expected deposition is only 0.07 percent of the ecological screening values for chromium and lead, and 6.5 percent of the ecological screening values for mercury for birds. Similarly, for mammals, the combined background levels and expected deposition for antimony and chromium exceed the ecological screening values. Again, the expected deposition is only 1.9 percent of the ecological screening values for antimony and 0.05 percent of the ecological screening values for chromium for mammals. Moreover, even slight exceedances of the ecological screening values are considered protective when the conservative bases of the ecological screening values are considered.

The total expected concentrations (background plus total deposition over the 19-year period of operations) for arsenic, cadmium, copper, lead, mercury, and selenium would not exceed the protective ecological screening values for mammals. Therefore, there would be no unacceptable risks to mammals from these trace metals related to potential deposition for the 19-year Proposed Action. For mammals, the combined background levels and expected deposition for antimony and chromium only slightly exceed the ecological screening values. Even slight exceedances of the Eco-SSLs are considered protective for mammals when the conservative bases of the ecological screening values are considered. Each ecological screening value has been derived from TRVs for each wildlife group. Each calculated TRV is derived from a NOAEL and a lowest adverse effect level (LOAEL). Mean TRVs are calculated from taking the highest NOAEL and lowest LOAEL for a particular metal to derive the ecological screening values, which takes into account food and soil ingestion. The lowest, most conservative ecological screening values for a particular class (e.g., insectivorous birds rather than carnivorous birds) are used as the ecological screening values for all species, which further justifies the conservative derivation of ecological screening values, as follows:

- Ecological screening values were calculated from the lowest NOAELs and LOAELs for invertebrates, birds, and mammals.
- Trace metals are typically less than 1 percent of background with the exception of mercury and selenium.
- There are only a few exceedances of the ecological screening values, and those exceedances are primarily due to the conservative approach to the derivation of the ecological screening values. Slight exceedances of these screening values do not suggest that impacts on wildlife exist.

Therefore, the indirect effects on wildlife from Colstrip and Rosebud Power Plant emissions are expected to be negligible (for metals not exceeding the ecological screening values) to minor (for those metals exceeding the ecological screening values) over the long term.

4.12.4 Alternative 3 – Proposed Action Plus Environmental Protection Measures

The effects of Alternative 3 on wildlife resources would be similar to those of Alternative 2, except as discussed below.

Development of a water management plan in conjunction with a nonjurisdictional wetland mitigation plan under Alternative 3 would result in potential beneficial impacts on most wildlife species that depend on wetland and riparian habitat. Development of a water management plan and wetland mitigation plan would ensure a water source for a wide variety of wildlife that depend on wetland habitat. Beneficial impacts would include the following:

- Development of adequate hydrology along a natural water source could support establishment or expansion of aquatic-dependent wildlife (macroinvertebrates and amphibians).
- Provision of riparian vegetation would provide forage and cover for tree- and ground-nesting bird species and waterfowl.
- Riparian and wetland vegetation would also provide forage and cover for small terrestrial mammals, big game, and reptiles.
- Sufficient hydrology and riparian vegetation would provide potential habitat for many bat species.
- Soil stockpiling to ensure nutrient retention for native plants and analysis of 5-foot contours that could assist in development of microhabitats would benefit a wider range of wildlife species. Several generalist wildlife species or upland species such as big game, raptors and upland songbirds, small mammals, reptiles, and some amphibians would depend on appropriate reclamation and mitigation of non-wetland areas.

4.12.5 Irreversible and Irretrievable Commitment of Resources

Both action alternatives would disturb wildlife species individuals and local populations. Each action alternative would likely result in shifts in species composition from wildlife that is less tolerant of disturbance to species that are able to adapt more readily to disturbance and increased human presence. As revegetation and reclamation of disturbed areas occurs, it is likely that species composition would eventually increase but not to the levels of pre-disturbance diversity due to an anticipated reduction in overall vegetation diversity. The temporal loss of native wildlife habitat in both alternatives would be an irreversible resource commitment.

4.13 SPECIAL STATUS SPECIES

This section discloses the direct and indirect effects that the No Action (Alternative 1), the Proposed Action (Alternative 2), and the Proposed Action Plus Environmental Protection Measures (Alternative 3) would have on special status wildlife and plant species; cumulative impacts are disclosed in **Chapter 5**. The analysis area for direct and indirect effects is described in **Section 3.13, Special Status Species.**

4.13.1 Analysis Methods and Impact and Intensity Thresholds

4.13.1.1 Analysis Methods

Direct Effects

Wildlife monitoring, including monitoring for special status species, has occurred on the Rosebud Mine since 1973. Baseline survey data from 2006 and from 2011 to 2013 within the direct effects analysis area, along with data from MNHP within a 15-mile radius from the project were used to describe existing conditions for SOC in **Chapter 3** (see **Section 3.13, Special Status Species**). Surveys for special status upland game birds, raptors, breeding birds, and nocturnal amphibians and bats were conducted in 2006 and 2011 (PAP, Appendix F). However, no standardized surveys for amphibians or bats were conducted in 2012 or 2013 (PAP, Appendix F). Additionally, incidental observations of all wildlife, including special status species, on the Rosebud Mine were recorded during all surveys (PAP, Appendix F). Records of documented occurrences of species within the 15-mile radius are also described in **Chapter 3** (**Section 3.13, Special Status Species**). Annual monitoring will continue for the life of the mine as described in **Section 2.4.7.6, Wildlife**.

Indirect Effects

The deposition modeling results for special status species (see **Section 3.13, Special Status Species, Indirect Effects Analysis Area** and **Section 4.3, Air Quality** for information on modeling and results), in conjunction with ecotoxicological screening values protective of soil invertebrates, birds, and mammals were used to determine potential Colstrip and Rosebud Power Plant emissions impacts on special status species within the indirect effects analysis area. The EPA Eco-SSLs (EPA 2005b) represent the most comprehensive evaluation of soil-screening levels for soil invertebrates, birds, and mammals. These Eco-SSL values are preferentially used when available. For those trace metals where Eco-SSLs have not been developed, the ecological screening values presented for wildlife and cited by EPA (2015b) are used. The soil background levels of trace metals are also considered. As described in **Section 4.24, Soils,** the background concentrations were based on a USGS geochemical study completed in the region of the Colstrip and Rosebud Power Plants (Smith et al. 2013). Estimated deposition relative to background values and estimated deposition combined with background concentrations of trace metals were compared to the soil invertebrate, bird, and mammal screening levels to determine if impacts on special status species may occur. Eco-SSL's are not available for reptiles, amphibians, or fish.

Impacts were qualitatively assessed based on documented occurrences of special status species within the 32-km buffer (see **Section 3.13, Special Status Species**).

4.13.1.2 Impact and Intensity Thresholds

The thresholds for assessment of impacts on special status species are described in **Table 145** and are used to describe impacts below.

Table 145. Special Status Species Impact and Intensity Thresholds.

Impact Intensity	Intensity Description
Negligible	The action would result in a change to a population or individuals of a species, but the change would not be of measurable or perceptible consequence, and would be well within natural variability. In the case of federally listed species, this impact intensity equates to a USFWS determination of “no effect.”
Minor	The action would result in a change to a population or individuals of a species. The change would be measurable, but small and localized, and not outside the range of natural variability. In the case of federally listed species, this impact intensity equates to a USFWS determination of “may affect, not likely to adversely affect.”
Moderate	Impacts on species, their habitats, or the natural processes sustaining them would be detectable and would occur over a large area. Breeding animals of concern are present, animals are present during particularly vulnerable life stages; mortality or interference with activities necessary for survival would be expected on an occasional basis, but is not expected to threaten the continued existence of the species in the area. In the case of federally listed species, this impact intensity equates to a USFWS determination of “may affect, likely to adversely affect.”
Major	The action would result in noticeable effects on the viability of the population or individuals of a species. Impacts on special status species or the natural processes sustaining them would be detectable. Loss of habitat might affect the viability of at least some special status species. In the case of federally listed species, the impact intensity equates to a USFWS determination of “may affect, likely to jeopardize the continued existence of a species.”

Impacts are also defined as short-term, long-term, or both (see **Section 4.1.1, Definitions**).

4.13.2 Alternative 1 – No Action

Under the No Action Alternative, the project area expansion would not occur. Additional surface mining, soil storage, haul roads, and surface disturbance would not occur within the project area and, therefore, would not result in new impacts on special status species. Species use and habitat in the analysis area would remain unchanged, except as affected by ongoing mining activities in other areas of the Rosebud Mine, agricultural practices, wildfire, hunting, and land management activities in the region.

4.13.3 Alternative 2 – Proposed Action

4.13.3.1 Direct Impacts

Potential adverse effects from the Proposed Action on special status species include loss of habitat due to surface disturbances that remove vegetation; direct mortality of or injury to wildlife due to vehicle/construction equipment collisions; and behavioral shifts such as a change in movement or displacement to other areas due to increased human activity and noise from blasting and mining operations.

Wildlife species are closely tied to habitat and the plant communities that characterize these specific habitats. Thus, effects on wildlife are generally related to impacts on the plant communities as described in **Section 4.10, Vegetation** and **Section 4.12, Fish and Wildlife Resources.** Reclamation of impacts on vegetation communities (at a 1:1 ratio based on acreage) would eventually offset some adverse wildlife impacts, although species composition and maturity of certain communities may take years, which may result in long-term adverse impacts, or shifts in species composition. Mortality or injury may occur to wildlife from habitat removal (especially for less-mobile species including ground-nesting birds, small mammals, reptiles, and amphibians) and collisions with mine-related vehicles. Restricted movement of less-mobile species due to barriers such as construction fences, pits, and stockpiles is also possible during active mining. Animals that are displaced may move to less-suitable habitat or suitable habitat occupied by predators or competitors, which could result in lower survival and reproduction rates.

Reclamation following mining would restore vegetation communities, but vegetation species composition and structure would take time to establish and mature. For example, reclaimed conifer areas may initially see an influx of early successional communities before a coniferous or deciduous overstory develops (Buehler and Percy 2012). Wildlife favoring early successional stages of plant growth would be the first to move into a reclaimed area. As vegetation matures, reclaimed mined areas would support a greater diversity of wildlife.

Because mining would be conducted in phases, surface disturbance and vegetation removal would occur incrementally over 20 years. Reclamation of disturbed lands would begin about 2 years after the initial removal of coal and would occur in phases throughout the life of the mine until all disturbed lands are revegetated. Land in the project area that has been reclaimed and successfully revegetated, along with unmined land, would provide habitat for wildlife during mine operations.

4.13.3.2 Special Status Wildlife Species

Federally Listed Threatened, Endangered, and Candidate Species

Table 73 in Section 3.13.2 lists federally Threatened, Endangered, and Candidate species that potentially occur in Rosebud, Treasure, Big Horn, and Powder River Counties. OSMRE determined based on the best current data and scientific information available that direct effects of expansion of mining in the proposed Area F permit area and indirect effects of emissions from the Colstrip and Rosebud Power Plants would not result in adverse effects on federally listed Threatened, Endangered, or Candidate species or any designated critical habitat. OSMRE effects determinations for these species are described below.

Whooping Crane

The Proposed Action would have no effect on the whooping crane because the analysis area does not provide the wetland and marsh habitat along large rivers, lakes, and reservoirs that cranes typically use. The small ponds and streams in the project area do not provide suitable habitat. Additionally, the whooping crane is migratory through Montana and has not been known to breed in the state. There is no known use of the analysis area by whooping crane.

Black-footed Ferret

The Proposed Action would have no effect on the black-footed ferret in the direct effects analysis area because this species is dependent on prairie dogs for food and uses prairie dog burrows for shelter, and no prairie dog colonies are present in the analysis area. In Montana, ferret populations coincide with black-tailed prairie dog colonies. Black-tailed prairie dogs occur throughout eastern Montana, but none are present in the analysis area. Because no black-footed ferret habitat exists in the analysis area, the proposed mining and reclamation activities would have no effect on this species.

Northern Long-eared Bat

The Proposed Action may affect, but is unlikely to adversely affect, the northern long-eared bat because the indirect effects analysis area is in the area of influence (AOI) for this species; however, no known populations have been documented in this portion of the AOI and habitat is limited in the project area. No northern long-eared bat populations have ever been documented within the direct and indirect effects analysis areas (in Treasure, Big Horn, Rosebud, or Powder River County) and the closest known documentation of this species is in Richland and Roosevelt Counties, about 190 miles north of the project area.

Because a portion of the special status species indirect effects analysis area (see **Section 3.13.1.2, Analysis Area** and **Figure 56**) falls within the AOI for the northern long-eared bat, OSMRE has complied with the USFWS's programmatic BO of the final 4(d) rule dated January 5, 2016 and fulfilled the Section 7 consultation requirements under the ESA through submission of the Northern Long-Eared Bat 4(d) Rule streamlined consultation form on June 21, 2017 to the Montana Ecological Field Services Office.

The Proposed Action may affect the northern long-eared bat; however, there are no effects beyond those previously disclosed in the USFWS's programmatic BO for the final 4(d) rule. This project is consistent with the activities outlined in the programmatic BO and the 4(d) rule and any taking that may occur incidental to the Proposed Action or Alternative 3 is not prohibited under the final 4(d) rule (50 CFR 17.40(o)). Therefore, the programmatic BO satisfies the OSMRE responsibilities under Section 7 of the ESA of 1973, as amended, 16 USC l53l et seq.

Pallid Sturgeon

The Proposed Action would have no effect on the pallid sturgeon because there is no suitable habitat in the direct effects analysis area. Pallid sturgeons are found in large, slow-moving rivers. The pallid sturgeon is rare, but is known to occur in portions of the Yellowstone, Missouri, and Mississippi Rivers. The small streams in the analysis area do not provide suitable habitat for pallid sturgeon; therefore, the proposed project would have no effect on this species.

MNHP Species of Concern

Table 46 in **Section 3.13.1.5, MNHP Species of Concern** lists MNHP SOC (northern leopard frog, plains spadefoot toad, golden eagle, northern goshawk, great blue heron, long-billed curlew, McCown's longspur, short-horned lizard, western milksnake, and hoary bat) that have been documented within 15 miles of the project area and potentially occur in the project area. An additional 18 species have potential to occur in the analysis area based on the presence of suitable habitat. Direct disturbance to wildlife habitat on 4,260 acres and indirect impacts on surrounding lands from noise and project-related activity could adversely impact several MNHP SOC.

Northern goshawk, Clark's nutcracker, pinyon jay, and hoary bat could be affected by the loss of about 688 acres of conifer habitat. Disturbance to 611 acres of shrub grassland could impact Brewer's sparrow, long-billed curlew, loggerhead shrike, sage thrasher, Merriam's shrew, hoary bat, and plains hognose snake. The loss of about 1,538 acres of grassland would potentially impact McCown's longspur, plains spadefoot toad, ferruginous hawk, short-horned lizard, and western milksnake. Because mining disturbance would avoid and minimize impacts on riparian and wetland areas, direct impacts on habitat for black-billed cuckoo, Lewis' woodpecker, red-headed woodpecker, great blue heron, northern leopard frog, fringed myotis, and western smooth green snake would be minimal. However, avian use of riparian habitats could decrease from the noise and disturbance associated with nearby mine operations. Only limited cliff habitat preferred by golden eagle and peregrine falcon for nesting is present in Area F, but impacts on grassland, woodland, and shrubland vegetation types would reduce available foraging habitat for these species. Little brown myotis, pallid bat, and Townsend's big-eared bat could be impacted by the loss of woodland habitat. Townsend's big-eared bat could also be impacted by the loss of rocky outcrops removed during mining operations. Overall direct impacts on SOC would be considered moderate due to the permanent loss or modification of habitat.

Planned reclamation following mining would restore plant communities and wildlife habitat similar to pre-mining conditions. Restoration of wildlife habitat would vary, depending on the habitat types. Because conifer habitat would take longer to establish than grasslands, species like Clark's nutcracker that inhabit coniferous forest would be affected longer than grassland-associated species such as McCown's longspur. The Proposed Action would have short- and long-term, negligible to moderate impacts on MNHP SOC.

4.13.3.3 Special Status Plant Species

No impacts on sensitive plant species are anticipated because none of the potential sensitive species were found in the direct effects analysis area.

4.13.3.4 Indirect Impacts

Deposition modeling results (see **Section 4.3, Air Quality** and **Section 4.13.1.2** above) indicate that the operation of the Colstrip and Rosebud Power Plants during the 19-year project area coal-combustion period would not result in deposition over the Eco-SSLs for invertebrates, birds, or mammals (**Table 2)**. Studies from EPA determined that toxicity data were not sufficient to derive Eco-SSLs for amphibians and reptiles; therefore, there are no data for reptiles and amphibians (EPA 2005b). Eco-SSLs for reptiles are possibly similar to those of birds due to some similarities between the two classes. For aquatic species (fish, amphibians, and aquatic invertebrates), indirect effects could be long-term and negligible to moderate for species inhabiting East Fork Armells Creek due to potential selenium deposition (see **Section 4.7, Water Resources – Surface Water)**. It is anticipated that there would be no effect on aquatic species in other streams in the region based on the determination that combustion of project area coal will have no effect on surface water quality on streams (other than East Fork Armells Creek) (see **Section 4.7, Water Resources – Surface Water).**

There are no Eco-SSLs for specific special status species. Data from the EPA Region 4 (2015j) website exists for mammals, birds, and soil invertebrates. Therefore, it is assumed that the Eco-SSLs for mammalian and avian special status species are similar to those listed in **Table 146** below.

Table 146. Trace Metal Background, Potential Soil Impact Distance, and Ecological Screening Levels for Soil Invertebrates, Birds, and Mammals.

Analyte	Background - Geometric Mean	1 percent of Geometric Mean Background	Area Around Colstrip and Rosebud Power Plants with Higher Deposition than 1 percent of Geometric Mean Background	Ecological Screening Levels for Soil Invertebrates	Ecological Screening Levels for Birds	Ecological Screening Levels for Mammals
	mg/kg, DW	**mg/kg, DW**	**km**	**mg/kg, DW**	**mg/kg, DW**	**mg/kg, DW**
Antimony	0.7	0.007	0	78	NA	0.27
Arsenic	8.0	0.080	0	NA	43	46
Cadmium	0.2	0.002	0	140	0.77	0.36
Chromium	41.2	0.412	0	NA	26	34
Copper	13.2	0.132	0	80	28	49
Lead	15.7	0.157	0	1,700	11	56
Selenium	0.4	0.004	< 19	4.1	1.2	0.63
Mercury	0.016	0.00016	< 30	0.1	0.013	1.7

mg/kg = milligrams per kilogram…
DW = dry weight in soil
km = kilometers
NA = Not available. Insufficient data to derive ecological screening levels.
Section 4.13.1.1, Analysis Methods, describes the hierarchy of soil invertebrate, bird, and mammal ecological screening values.

4.13.3.5 Special Status Species

Federally Listed Threatened, Endangered, and Candidate Species

Whooping Crane

No whooping crane populations have been documented within the 32-km analysis area. The small ponds and streams in the 32-km analysis area do not provide suitable habitat for whooping crane. Additionally, the whooping crane is migratory through Montana and has not been known to breed in the state. Therefore, the emissions from coal combustion at the Colstrip and Rosebud Power Plants would have no indirect effects on this species.

Black-footed Ferret

No known natural populations of black-footed ferret occur in Montana. The last known wild black-footed ferret population was extirpated in 1987 in Wyoming (Miller et al. 1996). Since 1994, reintroductions have occurred in Montana. The nearest introduced populations are on the Crow Reservation in Big Horn County located about 40 miles southwest of the Colstrip and Rosebud Power Plants, and north of Lake Fort Peck, which is more than 200 km (125 miles) north of the Colstrip and Rosebud Power Plants. Therefore, emissions from coal combustion at the Colstrip and Rosebud Power Plants would have no indirect effects on the black-footed ferret.

Northern Long-eared Bat

A portion of Powder River County falls within the 32-km indirect effects analysis area (see **Section 3.13.1.2, Analysis Area** and **Figure 56**). Powder River County is included in the AOI for the northern long-eared bat, although the closest known documentation of this species is in Richland and Roosevelt Counties, about 190 miles north of the project area.

Because a portion of the indirect effects analysis area falls into the AOI for this species, OSMRE has complied with the USFWS's BO of the final 4(d) rule and fulfilled the Section 7 consultation requirements under the ESA through submission of the northern long-eared bat 4(d) rule streamlined consultation form on June 21, 2017 to the Montana Ecological Field Services Office.

The emissions from coal combustion at the Colstrip and Rosebud Power Plants may affect the northern long-eared bat; however, there are no effects beyond those previously disclosed in the USFWS's programmatic BO for the final 4(d) rule. This project is consistent with the activities outlined in the programmatic BO and the 4(d) rule and any taking that may occur incidental to the Proposed Action or Alternative 3 is not prohibited under the final 4(d) rule (50 CFR 17.40(o)). Therefore, the programmatic BO satisfies the OSMRE responsibilities under Section 7 of the ESA of 1973, as amended, 16 USC l53l et seq.

Pallid Sturgeon

The nearest pallid sturgeon populations are located within lower reaches of the Yellowstone River northeast of Miles City, about 96 km (60 miles) from the Colstrip and Rosebud Power Plants. The effects of coal-combustion emissions from the Colstrip and Rosebud Power Plants to the Yellowstone River are not expected to be measurable. Tributaries to the Yellowstone River within the indirect effects analysis area (Sarpy Creek, Armells Creek, Rosebud Creek, and the Tongue River) would not affect water quality as a result of Colstrip and Rosebud Power Plant emissions for the following reasons (see also **Section 4.7,**

Water Resources – Surface Water): 1) any effects of the Colstrip and Rosebud Power Plant deposition on the water quality of the four tributaries are not likely to be detectable in the Yellowstone River due to dilution, and 2) the percent mercury deposition from the two power plants is less than 3 percent of all mercury deposition at that location from all atmospheric sources. At the Yellowstone River about 25 miles north of Colstrip (pallid sturgeon populations are 35 miles farther downstream), the effects of mercury deposition from the two power plants are not expected to be measurable compared to worldwide atmospheric deposition sources to the Yellowstone River. Therefore, the emissions from coal combustion at the Colstrip and Rosebud Power Plants would have no indirect effects on the pallid sturgeon.

4.13.4 Alternative 3 – Proposed Action Plus Environmental Protection Measures

The effects of Alternative 3 on wildlife resources would be similar to Alternative 2, except as discussed below.

Development of a water management plan in conjunction with a nonjurisdictional wetland mitigation plan under Alternative 3 would result in potential beneficial impacts on most wildlife and vegetation species that depend on wetland and riparian habitat. Development of a water management plan and wetland mitigation plan would ensure a water source for a wide variety of species that depend on wetland habitat. Beneficial impacts would include the following:

- Development of adequate hydrology along a natural water source could support establishment or expansion of aquatic-dependent wildlife (macroinvertebrates and amphibians).
- Provision of riparian vegetation would provide forage and cover for tree- and ground-nesting bird species and waterfowl.
- Riparian and wetland vegetation would also provide forage and cover for small terrestrial mammals, big game, and reptiles.
- Sufficient hydrology and riparian vegetation would provide potential habitat for many bat species.
- Several MNHP SOC that depend on riparian and wetland habitat such as black-billed cuckoo, Lewis' woodpecker, fringed myotis, and northern leopard frog, would potentially benefit from mitigation of nonjurisdictional wetlands.
- Soil stockpiling to ensure nutrient retention for native plants, and analysis of 5-foot contours that could assist in development of microhabitats would benefit a wider range of wildlife species. Several generalist wildlife species or upland species such as big game, raptors and upland songbirds, small mammals, reptiles, and some amphibians would depend on appropriate reclamation and mitigation of non-wetland areas.

4.13.5 Irreversible and Irretrievable Commitment of Resources

There would be no irreversible or irretrievable commitment of resources for federally-listed Threatened or Endangered species. Both action alternatives may disturb wildlife SOC individuals and local populations. Each action alternative would likely result in shifts in species composition from wildlife that is less tolerant of disturbance to species that are able to adapt more readily to disturbance and increased human presence. As revegetation and reclamation of disturbed areas occurs it is likely that species composition would eventually increase but not to the levels of pre-disturbance diversity due to an anticipated reduction in overall vegetation diversity. The loss of some native wildlife habitat in both alternatives would be an irreversible resource commitment.

4.14 CULTURAL AND HISTORIC RESOURCES

This section discloses the direct and indirect effects that the No Action (Alternative 1), the Proposed Action (Alternative 2), and the Proposed Action Plus Environmental Protection Measures (Alternative 3) would have on historic properties (those cultural and historic resources that are listed, or eligible for listing, on the National Register of Historic Places (NRHP); cumulative impacts are disclosed in **Chapter 5**. The analysis area for direct and indirect effects is described in **Section 3.14, Cultural and Historic Resources**. The locations of historic properties are exempt from public disclosure under Public Law 94-456 and § 20-3-423(12), MCA, to protect resources from potential vandalism and to retain confidentiality of those resources culturally significant to American Indian tribes. Thus, specific cultural resource locations are not included in the discussion.

4.14.1 Analysis Methods and Impact and Intensity Thresholds

4.14.1.1 Analysis Methods

Evaluative testing for significance occurred during the 2010 and 2012 inventories (PAP, Appendix A-2), while a separate evaluation phase occurred in 2013 (PAP, Appendix A-3), including a separate National Historic Preservation Act (NHPA) evaluation for site 24RB2339 (GCM 2015; Meyer and Ferguson 2013). Cultural resources identified in the APE are described in **Section 3.14.3, Documented Cultural Resources**. Geographic information systems (GIS) mapping from the cultural resource inventories was used to determine which historic properties are located within the APE.

Cultural resources were evaluated for their eligibility (significance) to be listed on the NRHP. Class III (intensive) cultural resource inventories are intended to locate, document, and evaluate all known cultural resources for significance according to criteria listed under 36 CFR 60.4 and in consideration of the seven aspects of integrity (location, design, setting, materials, workmanship, feeling, and association). The method employed during the identification of potential historic properties within the APE used the 50-year age criteria established by the National Park Service (NPS). The most common significance criterion applied to archeological properties within the APE is Criterion D, which identifies an archeological site as containing information important to the interpretation of history or prehistory. Other applicable criteria include cultural resources that are associated with events that have made a significant contribution to history (Criterion A); associated with the lives of significant person(s) (Criterion B); or embody distinctive characteristics of a type, period, or method of construction (Criterion C).

Once a cultural resource is determined eligible for listing on the NRHP, it is considered a historic property and requires consideration of project effects. Unevaluated sites are those that may conform to the eligibility criteria but require further work to determine significance, and for the purposes of Section 106 are treated as potentially eligible. In the context of the properties under consideration here, these are prehistoric sites with suspected buried cultural material or historic sites where additional archival research is necessary to determine historical context and overall significance. Resources that were determined ineligible for inclusion on the NRHP do not meet sufficient eligibility criteria and/or have lost integrity.

The APE was also evaluated for traditional cultural properties (TCPs). As described in **Section 3.14.4, Tribal Consultation**, TCPs are protected under Section 106 of the NHPA as historic properties, and when applicable, have additional protections under the American Indian Religious Freedom Act of 1978 and the Native American Grave Protection and Repatriation Act of 1990.

4.14.1.2 Impact and Intensity Thresholds

The thresholds of change for the intensity of an impact on historic properties are defined in **Table 147** and are used to describe impacts in the sections below.

Table 147. Historic Property Impact and Intensity Thresholds.

Impact Intensity	Intensity Description
Negligible	The impact is at the lowest levels of detection with neither adverse nor beneficial consequences. The determination of effect for Section 106 would be no historic properties affected.
Minor	The alteration of qualities that contribute to significance would not diminish the overall integrity of the resource. The determination of effect for Section 106 would be no adverse effect.
Moderate	The alteration of qualities that contribute to significance would diminish the overall integrity of the resource. The determination of effect for Section 106 would be adverse effect. A Memorandum of Agreement (MOA) and Programmatic Agreement (PA) have been executed with the State Historic Preservation Officer (SHPO) in accordance with 36 CFR 800.6(b). Measures identified in the MOA or PA to minimize or mitigate adverse effects would reduce the intensity of impacts under NEPA.
Major	The alteration of qualities that contribute to significance would diminish the overall integrity of the resource. The determination of effect for Section 106 would be adverse effect. Measures to minimize or mitigate adverse effects cannot be agreed upon with the SHPO and/or ACHP in accordance with 36 CFR 800.6(b).

Impacts are also defined as short-term, long-term, or both (see **Section 4.1.1, Definitions**). All impacts on cultural and historic resources would be long-term because these resources are irreplaceable.

4.14.2 Alternative 1 – No Action

Under the No Action alternative, Western Energy would not develop the project area. There would be no additional ground disturbance within the analysis area and, therefore, no potential for adverse effects on cultural resources. There would be no effect on the cultural and historic resources described in **Section 3.14, Cultural and Historic Resources**, because none of the disturbances associated with development of project would occur. However, continued natural degradation of historic properties may result in a loss of information that would otherwise be preserved through mitigation.

The No Action alternative would not change the status of other areas of the Rosebud Mine that are currently permitted and being mined and/or reclaimed by Western Energy (**Section 2.2, Existing Operations**), nor would it affect development of any other proposed Rosebud Mine areas currently in the permitting process (**Section 5.2.2, Related Future Actions**).

4.14.3 Alternative 2 – Proposed Action

4.14.3.1 Direct Impacts

Under the Proposed Action, 24 potential historic properties may be adversely affected by ground disturbing activity over the life of the mine, including 16 sites determined eligible for listing on the NRHP, 6 sites that remain unevaluated for listing on the NRHP, and 2 historic districts. Direct and indirect adverse effects on historic properties within the analysis area from surface mining beyond the first five years of permitted operations are currently undetermined, as those determinations would be phased. An existing MOA between Western Energy, SHPO, DEQ, BLM, and OSMRE implements mitigation measures at four archaeological properties (24RB958, 24RB2334, 24RB2339, and 24RB2438) within the analysis area that would be adversely affected within the first five years of permitted operations. Adverse effects on the remaining 20 potential historic properties would be resolved through the executed PA as described in **Section 3.14.1.1, Regulatory Framework, Federal Requirements, Resolution of Adverse Effects**. The PA incorporated the mitigation measures for the above-referenced MOA and corresponding four sites, and includes stipulations to treat unanticipated discoveries during mining.

4.14.3.2 Indirect Impacts

The analysis area for indirect effects would be the APE as described in **Section 3.14.1.2, Analysis Area**; therefore, indirect effects on historic properties would not increase related to the combustion of mined coal at the power plants or other activities.

4.14.4 Alternative 3 – Proposed Action Plus Environmental Protection Measures.

The effects of Alternative 3 on 24 historic properties would be similar to Alternative 2, except that development of a wetland mitigation plan may have an adverse effect on unknown historic properties. The identified wetland mitigation area, as a mining-related action, would be subject to Section 106 compliance for the management of known and undiscovered historic properties under the executed PA (**Appendix H**). The identification of historic properties and the effects determination would occur prior to the development of the wetland mitigation area.

4.14.5 Irreversible and Irretrievable Commitment of Resources

Adverse effects on historic properties in the analysis area would be resolved initially through the MOA for the four affected properties identified above and through the executed PA for the remaining properties; however, agreed-upon resolved adverse effects would represent an irreversible and irretrievable commitment of resources. Because avoidance and/or minimization of effects is not feasible for historic properties, excavation is an accepted method to resolve adverse effects by recovering information important to the interpretation of history or prehistory, but this mitigation measure is not the only available option.

Accidental destruction of presently unknown cultural resources, including resources with Native American significance, would constitute irreversible and irretrievable losses. The process for resolving unanticipated discoveries is addressed in the PA (**Appendix H)**.

4.15 SOCIOECONOMIC CONDITIONS

This section discloses the direct and indirect effects on socioeconomic conditions in the analysis area resulting from the No Action (Alternative 1), the Proposed Action (Alternative 2), and the Proposed Action Plus Environmental Protection Measures (Alternative 3); cumulative impacts are disclosed in **Chapter 5**. The analysis area is described in **Section 3.15, Socioeconomic Conditions**. The effects analysis for socioeconomic conditions is structured differently than for other resource areas due to the nature of the issue and the methods used for analysis, as described in the following section.

4.15.1 Analysis Methods and Impact and Intensity Thresholds

The impact analysis focused on the current economic effects of the entire Rosebud Mine operations, which are assumed to remain approximately the same through 2021, regardless of whether the project is permitted (see **Assumptions** below), and the longer-term effects of operations of the Rosebud Mine from 2022 until the end of operational mine life (defined differently for each alternative). The distinction between the current economic effects and the longer-term effects was the closure of Colstrip Power Plant Units 1 and 2 in 2022. Retirement of Colstrip Power Plant Units 1 and 2 is an action considered under cumulative impacts, but it is discussed in this section (and referenced in **Chapter 5, Cumulative Impacts**) due to the socioeconomic relationship between the Rosebud Mine and the Colstrip Power Plant.

4.15.1.1 Assumptions

This analysis assumed that if the project were not permitted (as described in **Section 2.3, Alternative 1 – No Action**), then the operations and status of the other permit areas of the Rosebud Mine (including those currently in the permitting process) would be unaffected. It also assumed that the Colstrip and Rosebud Power Plants would continue to operate as described in **Section 2.3, Alternative 1 – No Action**.

This analysis assumed that two of the four electricity-generating units at the Colstrip Power Plant (Units 1 and 2) would be retired in 2022 (an action that is considered cumulatively with the Proposed Action). The retirement of these units would reduce the Colstrip Power Plant's production and annual electric generation by about 30 percent (Criswell 2017). Maximum capacity of the Colstrip Power Plant is 2,094 megawatts; currently, however, Units 1 and 2 are operating at about 71 percent of capacity and Units 3 and 4 are operating at 79 percent of capacity (Criswell 2017). Annual electric generation is currently about 17,000 gigawatt hours.

This analysis assumed that retirement of Units 1 and 2 would reduce coal production at the Rosebud Mine by approximately 30 percent (Peterson 2016c). Currently, the Rosebud Mine produces about 10 million tons of coal annually; of this total, between 2.5 and 3 million tons goes to Units 1 and 2 and about 7 million tons goes to Units 3 and 4 (Peterson 2016c). Note that a small amount of waste coal goes to the Rosebud Power Plant as described in **Section 1.2.2.2, Rosebud Power Plant**; this would remain unchanged. Without the need to serve Units 1 and 2, the Rosebud Mine would only need to produce about 7 million tons annually.

Note that this is not to say the mine and power plants are dependent on one another (i.e., the Rosebud Mine could ship their coal to other power plants and the Colstrip Power Plant could get coal from other mines to produce power). For the purposes of this analysis, it was assumed that there would be a decrease in coal production after retirement of Units 1 and 2. It is possible that another power entity may purchase coal from the Rosebud Mine in the future; however, that scenario is outside the scope of this analysis.

In general, existing patterns and trends of population growth, employment, and income described in **Section 3.15, Socioeconomic Conditions** would continue to drive the social structure and economy of the area.

4.15.1.2 Analysis Methods

The regional economic effects of current (2017) and future mine operations were evaluated in a study conducted by BBC Research & Consulting (termed the "BBC Effects Analysis" in this section) for use in this EIS (BBC 2017). The BBC Effects Analysis is included in **Appendix G** of this EIS. BBC analyzed topics that are interrelated with and relevant to the proposed project, including the direct, indirect, and induced effects that the Proposed Action would have on the social and economic environment. The Proposed Action would result in environmental, social, and economic effects. Without the Proposed Action, the economic effects (e.g., tax revenues, jobs, and induced effects) would not occur.

Projected future employment and economic output were based on continued operation of the mine at 2017 levels. Actual economic effects and the duration of the mine life could fluctuate or vary from projections, depending upon the resources applied by Western Energy at full-scale operations. Coal and input market conditions also could cause operations to be curtailed or shut down on short notice at any point during projected mine life.

Employment and income impacts were estimated in the BBC Effects Analysis using input-output analysis (IMPLAN model). Input-output analysis is a means of examining relationships within an economy between businesses, and between businesses and final consumers. Three types of economic impacts (effects) are identified in the analysis: direct, indirect, and induced. Direct effects are associated with the immediate effects tied to mine activity (e.g., the payroll and the supplies, materials, and services purchased by the Rosebud Mine) and should not be confused with direct effects as described in **Section 4.1.1, Definitions**. Indirect effects are production changes resulting from spending during operations in industries that supply products and services to mine operations and should not be confused with indirect effects as described in **Section 4.1.1, Definitions**. Induced effects are changes in economic activity resulting from households spending income earned directly or indirectly as a result of mine operations. The sum of indirect and induced economic effects are referred to as secondary effects, which is the term used in the remainder of the discussion.

Direct employment and labor income effects were estimated using information provided by Western Energy. Indirect effects were estimated using non-labor expenditure information provided by Western Energy and IMPLAN. Induced effects were estimated using IMPLAN. Other specific information on the methodological approach and assumptions used in the analysis presented below can be found within the BBC Effects Analysis report (BBC 2017). Projected employment and labor income effects identified in the BBC Effects Analysis are presented below.

In addition to the effects of mine operations on the two counties in the study area, the BBC Effects Analysis also estimated the effects of mine operations on Big Horn County and on two nearby Tribes: the Northern Cheyenne Reservation is located primarily in Rosebud County and the Crow Reservation is located in Big Horn County (BBC 2017). Potential economic effects on the Tribes were estimated by applying the overall economic effects on each major sector in the relevant county to the proportion of the county's economic sector estimated to be located within the reservation. For example, if mine operations were estimated to support 20 jobs in retail trade in Rosebud County and the Northern Cheyenne Reservation were estimated to contain 30 percent of the retail trade jobs in Rosebud County, the estimated effect on retail trade within the Northern Cheyenne Reservation would be 20 jobs multiplied by 30 percent, or 6 jobs.

Because of the limited impacts within Big Horn County (described later), the economic effects within the Crow Reservation were assumed to be negligible and were not calculated (BBC 2017). The Northern Cheyenne Reservation would be expected to experience greater economic effects because of its proximity and relationship to the mine. For additional discussion of effects on tribes, see **Section 4.16, Environmental Justice**.

4.15.1.3 Impact and Intensity Thresholds

The thresholds of change for the intensity of impacts on socioeconomics are described in **Table 148**.

Table 148. Socioeconomic Impact and Intensity Thresholds.

Impact Intensity	Intensity Description
Negligible	No effects would occur or the effects on socioeconomic conditions would be below the level of detection.
Minor	The effects on socioeconomic conditions would be small but detectable.
Moderate	The effects on socioeconomic conditions would be readily apparent. Any effects would result in changes to socioeconomic conditions on a local scale.
Major	The effects on socioeconomic conditions would be readily apparent and would cause substantial changes to socioeconomic conditions in the region.

Impacts are also defined as short-term, long-term, or both (see **Section 4.1.1, Definitions**).

4.15.2 All Alternatives

As described in the sections below, the annual economic effects associated with continued operation of the Rosebud Mine would be the same for Alternative 1 – No Action, Alternative 2 – Proposed Action, and Alternative 3 – Proposed Action Plus Environmental Protection Measures. The difference among alternatives is that selection of Alternatives 2 or 3 would extend the life of the Rosebud Mine (and the annual direct, indirect, and induced socioeconomic effects at 2022 levels) by 8 years (see **Section 2.2.3, Life of Operations**). Under the No Action alternative, the operational life of the Rosebud Mine would be expected to end in 2030. The analysis in this EIS assumes, based on information from Western Energy, that employment and annual coal production would remain the same through the end of 2030. It is possible that under the No Action Alternative, annual coal production may decrease over time until the end of mining in 2030, resulting in an associated decrease of employees at the mine. However, it would be speculative to analyze the impacts of this scenario because this information is not available at this time. Under this scenario, there is potential for Alternative 2 – Proposed Action to have slightly greater economic impacts than what is disclosed in this section.

For all alternatives, current socioeconomic conditions would remain the same through 2021. As a result of the retirement of the Colstrip Power Plant Units 1 and 2 in 2022 (an action that is considered cumulatively with the Proposed Action), production at the Rosebud Mine would be expected to drop by 30 percent (see **Assumptions** above), regardless of alternative for the remainder of the Rosebud Mine's operational life.

Given that the annual economic effects associated with continued operation of the Rosebud Mine would be the same for all alternatives, impacts would be short-term and negligible because the mine would support local economic activity at a reduced level. With the retirement of the Colstrip Power Plant Units 1 and 2 in 2022, impacts of mine operation changes would likely be short-term and moderate.

Socioeconomic Impacts of Mine Closure

When the Rosebud Mine eventually closes (closure year is dependent on selection of the No Action alternative or Alternatives 2 and 3 (see **Section 2.2.3, Life of Operations)**, unemployment rates would likely increase and income would decrease with the loss of jobs. It is possible the analysis area would experience further negative population growth and increased poverty rates compared to both present conditions and conditions post-closure of the Colstrip Power Plant Units 1 and 2. Sources of revenue from the mine that fund community institutions and essential social services would be eliminated after mine closure. These institutions would likely experience further decreases in funding as a result of lower employment rates, lower wages, and the total loss of tax revenue from the mine operation.

Direct socioeconomic impacts on local communities would occur within Rosebud County as a result of employment and economic output from the mine operations (**Table 149**). Indirect and induced impacts (as defined in **Section 4.15, Socioeconomics**) on local populations would be experienced within Rosebud, Treasure and Big Horn Counties, and within the Northern Cheyenne and Crow Reservations (**Table 150** and **Table 151**).

Communities within Rosebud County would be directly and indirectly impacted from the loss of wages and economic activity from mine operations when the mine closes. Rosebud Mine jobs and direct economic output (includes payroll and the purchase of supplies, materials, and services by the Rosebud Mine as a result of the Proposed Action) that support the local economic activity would cease (see **Section 3.16.1.1, Regulatory Framework**). Mine closure would likely result in long-term, moderate to major, adverse impacts.

4.15.2.1 Direct Impacts – All Alternatives

Current Conditions through 2021

The Rosebud Mine is based primarily in Rosebud County and all direct effects are assumed to occur in that county; although the project area is partly located in Treasure County, all other permit areas, the mine office, and associated infrastructure are located in Rosebud County. The Rosebud Mine supports an annual average of approximately 400 direct jobs and $125.5 million in annual direct economic output (including wages and revenue generated from the purchase of supplies, materials, and services by the Rosebud Mine) (**Table 149**); this level of employment and direct economic output would be expected to continue through 2021 for all alternatives. Similarly, based on the Northern Cheyenne Reservation’s share of the Rosebud County economy, the Rosebud Mine provides almost 140 jobs and $25.6 million in annual direct economic output within the Northern Cheyenne Reservation; this level of employment and direct economic output also would be expected to continue through 2021 for all alternatives. The approach of estimating the effects on the Northern Cheyenne Reservation on the basis of the Reservation’s share of the overall Rosebud County economy is the best available method using the IMPLAN model, but may overstate the direct effects on the Reservation. Between 15 and 20 percent of employees at the Rosebud Mine are members of the Tribe (BBC 2017).

The difference among alternatives is which permit area of the Rosebud Mine would supply coal to the Colstrip Power Plant Units 3 and 4. Under the No Action alternative, coal would be supplied by other areas of the Rosebud Mine (see **Section 2.3, Alternative 1 – No Action**), but under Alternatives 2 and 3, coal would be supplied by the project.

Post-Closure of Units 1 and 2

As previously discussed, Colstrip Power Plant Units 1 and 2 are expected to be retired from operation in 2022. Those retirements would likely reduce the Colstrip Power Plant's energy generation by approximately 30 percent. Under all alternatives, the Rosebud Mine would likely continue to provide the coal needed by the Colstrip Power Plant after the retirements, but mine production would decrease from about 10 million tons per year under current conditions to about 7 million tons per year (see **Assumptions** above). The reduction in coal production would reduce mine revenues, employment, and other metrics by approximately 30 percent from 2022 through 2037 (**Table 149**). The difference among alternatives is which permit area of the Rosebud Mine would supply coal to the Colstrip Power Plant Units 3 and 4. Under the No Action alternative, coal would be supplied by other areas of the Rosebud Mine (see **Section 2.3, Alternative 1 – No Action**), but under Alternatives 2 and 3, coal would be supplied by the project. Another difference among alternatives is life of operations. Under the No Action alternative, the Rosebud Mine would be expected to operate until 2030, supporting 280 direct jobs and $87.9 million in annual direct economic output. Under Alternatives 2 and 3, mine life would be extended by 8 years, continuing to support the 280 direct jobs and $87.9 million in annual direct economic output.

Table 149. Rosebud Mine Direct Economic Effects.

Location	Employment Current Conditions through 2021	Total Annual Output Current Conditions through 2021	Employment Post-Closure of Units 1 and 2	Total Annual Output Post-Closure of Units 1 and 2
Rosebud County	400	$125,530,000	280	$87,871,000
Treasure County	0	0	0	0
Bighorn County	0	0	0	0
Total	**400**	**$125,530,000**	**280**	**$87,871,000**
Northern Cheyenne Reservation	140	$ 25,627,000	98	$17,938,900

Source: BBC 2017.

4.15.2.2 Indirect Impacts – All Alternatives

The estimated indirect economic effects on the region from the Rosebud Mine are shown in **Table 150**. Indirect effects likely would continue to occur outside of the three-county analysis area—particularly in Yellowstone County, which includes the City of Billings. Billings is the largest city and the primary regional trade center in southeastern Montana.

Current Conditions through 2021

The Rosebud Mine supports 54 indirect jobs, 17 of which occur within the Northern Cheyenne Indian Reservation (**Table 150)**. This level of indirect employment would be expected to continue through 2021 for all alternatives. The mine also generates approximately $12.9 million annually in indirect economic output in the region. This level of indirect economic output would be expected to continue under all action alternatives (**Table 150)**.

The difference among alternatives is which permit area of the Rosebud Mine would supply coal to Colstrip Power Plant Units 3 and 4. Under the No Action alternative, coal would be supplied by other areas of the Rosebud Mine (see **Section 2.3, Alternative 1 – No Action**), but under Alternatives 2 and 3, coal would be supplied by the project.

Post-Closure of Units 1 and 2

From 2022 through the end of operational mine life, the Rosebud Mine would support 37 indirect jobs and $9 million in annual indirect input (**Table 150)**. The reductions (beginning in 2022) would be due to the anticipated retirements of Colstrip Power Plant Units 1 and 2.

The difference among alternatives is which permit area of the Rosebud Mine would supply coal to Colstrip Power Plant Units 3 and 4. Under the No Action alternative, coal would be supplied by other areas of the Rosebud Mine (see **Section 2.3, Alternative 1 – No Action**), but under Alternatives 2 and 3, coal would be supplied by the project. Another difference among alternatives is life of operations; in the No Action alternative, the Rosebud Mine would be expected to operate until 2030, supporting 37 indirect jobs and $9 million in annual indirect economic output. In Alternatives 2 and 3, mine life would be extended by 8 years, continuing to support the 37 indirect jobs and $9 million in annual indirect economic output over this time.

Table 150. Rosebud Mine Indirect Economic Effects.

Location	Employment Current Conditions through 2021	Total Annual Output Current Conditions through 2021	Employment Post-Closure of Units 1 and 2	Total Annual Output Post-Closure of Units 1 and 2
Rosebud County	49	$12,055,000	34	$8,438,500
Treasure County	3	417,000	2	291,900
Bighorn County	2	420,000	1	294,000
Total	**54**	**$12,892,000**	**37**	**$9,024,400**
Northern Cheyenne Reservation	17	$ 2,461,000	12	$1,722,700

Source: BBC 2017.

4.15.2.3 Induced Effects – All Alternatives

Current Conditions through 2021

Table 151 shows the estimated induced effects of the Rosebud Mine within Rosebud, Big Horn, and Treasure Counties and within the Northern Cheyenne Reservation. For all alternatives, the Rosebud Mine would continue to support approximately 76 induced jobs and $8.3 million in annual induced output across the tri-county analysis area through 2021.

The difference among alternatives is which permit area of the Rosebud Mine would supply coal to the Colstrip Power Plant Units 3 and 4. Under the No Action alternative, coal would be supplied by other areas of the Rosebud Mine (see **Section 2.3, Alternative 1 – No Action**), but under Alternatives 2 and 3, coal would be supplied by the project.

Post-Closure of Units 1 and 2

From 2022 through the end of operational mine life, the Rosebud Mine would support 53 induced jobs and $5.8 million in annual induced input (**Table 151**). The reductions (beginning in 2022) would be due to the anticipated retirements of the Colstrip Power Plant Units 1 and 2.

The difference among alternatives is which permit area of the Rosebud Mine would supply coal to the Colstrip Power Plant Units 3 and 4. Under the No Action alternative, coal would be supplied by other areas of the Rosebud Mine (see **Section 2.3, Alternative 1 – No Action**), but under Alternatives 2 and 3, coal would be supplied by the project. Another difference among alternatives is life of operations. Under the No Action alternative, the Rosebud Mine would be expected to operate until 2030, supporting 53 induced jobs and $5.8 million in annual induced economic output. Under Alternatives 2 and 3, mine life would be extended by 8 years, continuing to support the 53 induced jobs and $5.8 million in annual induced economic output over this time.

Table 151. Rosebud Mine Induced Economic Effects.

Location	Employment Current Conditions through 2021	Total Annual Output Current Conditions through 2021	Employment Post-Closure of Units 1 and 2	Total Annual Output Post-Closure of Units 1 and 2
Rosebud County	76	$8,295,000	53	$5,806,500
Treasure County	0	31,000	0	21,700
Bighorn County	0	36,000	0	25,200
Total	**76**	**$8,362,000**	**53**	**$5,853,400**
Northern Cheyenne Reservation	27	$1,693,000	19	$1,185,100

Source: BBC 2017.

4.15.2.4 Total Economic Effects – All Alternatives

The total regional economic employment and output of the mine is derived by combining the direct, indirect, and induced impacts described in previous sections. The majority of the economic effects would continue to occur at or near the mine; and Rosebud County would continue to experience the largest economic impacts until the end of operational mine life. However, since indirect and induced spending occurs across the larger regional economy, both Big Horn and Treasure Counties would continue to experience some economic effects due to mine operations until the end of operational mine life (**Table 152**).

Table 152. Rosebud Mine Total Annual Economic Effects.

Location	Employment Current Conditions through 2021	Total Annual Output Current Conditions through 2021	Employment Post-Closure of Units 1 and 2	Total Annual Output Post-Closure of Units 1 and 2
Rosebud County	525	$145,880,000	368	$102,116,000
Treasure County	3	$456,000	1	$319,200
Bighorn County	2	$448,000	1	$313,600
Total	**530**	**$146,784,000**	**370**	**$102,748,800**
Northern Cheyenne Reservation	183	$ 29,782,000	128	$ 20,847,400

Source: BBC 2017.

Current Conditions through 2021

The Rosebud Mine supports about 530 direct, indirect, and induced jobs throughout the tri-county analysis area and continues to stimulate $146.8 million in annual economic output (**Table 152**); this level of total employment and annual economic output would be expected to continue through 2021 for all alternatives. About 183 of these jobs and approximately $29.8 million of the annual total output would occur within the Northern Cheyenne Reservation (**Table 152**); this level of total employment and annual economic output would be expected to continue through 2021 for all alternatives. Economic impacts on the Crow Reservation were not calculated given the small economic impacts projected to occur within Big Horn County compared with Rosebud County (BBC 2017).

The difference among alternatives is which permit area of the Rosebud Mine would supply coal to the Colstrip Power Plant Units 3 and 4. Under the No Action alternative, coal would be supplied by other areas of the Rosebud Mine (see **Section 2.3, Alternative 1 – No Action**); under Alternatives 2 and 3, coal would be supplied by the project.

Post-Closure of Units 1 and 2

From 2022 through the end of operational mine life, the Rosebud Mine would support about 370 direct, indirect, and induced jobs throughout the tri-county analysis area and continue to stimulate $102.7 million in annual economic output (**Table 152**). About 128 of these jobs and approximately $20.8 million of the annual total output would occur within the Northern Cheyenne Reservation. The reductions (beginning in 2022) would be due to the anticipated retirements of the Colstrip Power Plant Units 1 and 2.

The difference among alternatives is which permit area of the Rosebud Mine would supply coal to the Colstrip Power Plant Units 3 and 4. Under the No Action alternative, coal would be supplied by other areas of the Rosebud Mine (see **Section 2.3, Alternative 1 – No Action**); under Alternatives 2 and 3, coal would be supplied by the project. Another difference among alternatives is life of operations. Under the No Action alternative, the Rosebud Mine would be expected to operate until 2030, supporting the 370 direct, indirect, and induced jobs and $102.7 million in annual economic output. Under Alternatives 2 and 3, mine life would be extended by 8 years, continuing to support the 370 direct, indirect, and induced jobs and $102.7 million in annual economic output.

4.15.2.5 Impacts on Government Revenues – All Alternatives

Another important component of the mine's economic effects is the resulting fiscal revenues provided to local governments, the state of Montana, and the federal government.

Current Conditions through 2021

Based on the BBC Effects Analysis, the Rosebud Mine would provide approximately $71 million in annual direct revenues to Rosebud County, the state of Montana, and the federal government in 2017 under current conditions (**Table 153**). These revenues would include federal and state payroll and income taxes, severance taxes, resource indemnity trusts, gross proceeds taxes, and property taxes. State and federal royalties would also provide substantial revenue.

As shown in **Table 153**, the Rosebud Mine would directly generate approximately $43.1 million in annual state revenues in 2017 under current conditions. Local governments and the federal government would receive approximately $10.6 million and $17.2 million, respectively, in annual taxes and royalties under current conditions.

Table 153. Direct Annual Governmental Revenues from the Rosebud Mine.

	Local Governments	State of Montana	Federal Government
Taxes	$10,600,000	$34,829,000	$ 8,920,000
Royalties		8,299,000	8,299,000
Total	**$10,600,000**	**$43,128,000**	**$17,219,000**

In addition to the direct fiscal impacts, the indirect and induced economic activity generated by the mine throughout the region produces additional tax revenues from payroll and income taxes, property taxes, and other fees. Induced fiscal effects would be relatively small because there are no sales taxes in Montana that would capture revenues from the induced increase in household spending.

As shown in **Table 154**, the indirect and induced effects, combined with the direct effects would generate approximately $10 million, $44 million, and $18.5 million in annual revenues in 2017 under current conditions for local governments, the state of Montana, and the federal government, respectively. Over the next several years, these revenues would be similar with or without the project.

Table 154. Total Annual Governmental Revenues from Rosebud Mine Operations.

	Local Governments	State of Montana	Federal Government
Indirect	$ 128,000	$ 421,000	$ 785,000
Induced	96,000	315,000	589,000
Subtotal	**$ 224,000**	**$ 735,000**	**$ 1,373,000**
Direct	10,600,000	43,128,000	17,219,000
Total	**$10,178,000**	**$43,863,000**	**$18,592,000**

Post-Closure of Units 1 and 2

Government revenues from Rosebud Mine operations would likely be reduced after 2022 for all alternatives due to the decrease in production at the Rosebud Mine after the retirement of the Colstrip Power Plant Units 1 and 2.

Table 155 depicts the projected government revenues supported by operations of the Rosebud Mine after the retirement of the Colstrip Power Plant Units 1 and 2. The reduction in mine production in 2022 is projected to reduce the mine’s total contribution to present government revenues from about $74 million per year to about $51 million per year.

Table 155. Projected Effects of Mine Operations on Government Revenues (2022-2037).

	Local Governments	State of Montana	Federal Government
Indirect	$ 90,000	$ 294,000	$ 549,000
Induced	67,000	220,000	412,000
Subtotal	**$ 157,000**	**$ 515,000**	**$ 961,000**
Direct	7,400,000	30,189,000	12,053,000
Total	**$7,577,000**	**$30,704,000**	**$13,014,000**

4.16 ENVIRONMENTAL JUSTICE

This section discloses the direct and indirect effects on minority race, minority ethnicity, and low-income populations in the analysis area resulting from the No Action (Alternative 1), the Proposed Action (Alternative 2), and the Proposed Action plus Environmental Protection Measures (Alternative 3); cumulative impacts are disclosed in **Chapter 5**. The analysis area is described in **Section 3.16, Environmental Justice**.

Like the effects analysis for Socioeconomic Conditions (**Section 4.15**), the effects analysis for environmental justice is structured differently than for other resource areas due to the nature of the issue and the methods used for analysis. See **Section 4.15.1, Analysis Methods and Impact and Intensity Thresholds** for additional information.

Factors that may affect environmental justice populations include resource impacts described in other resource sections, such as socioeconomics (**Section 4.15**), as well as public health (**Section 4.5**), which may include impacts from solid and hazardous waste (**Section 4.21**), ground water quality (**Section 4.8**), surface water quality (**Section 4.7**), and air quality (**Section 4.3**).

4.16.1 Analysis Methods and Impact and Intensity Thresholds

4.16.1.1 Analysis Methods

The proportion of the population that identifies as a minority race or a minority ethnicity, or falls below the poverty line, was considered when determining if environmental justice populations were present in the analysis area. The most recent available data from the U.S. Census Bureau (USCB) and from other sources that process and interpret USCB data were used to determine if environmental justice populations are present. All three counties in the analysis area (Rosebud, Treasure, and Big Horn) have identified environmental justice low-income populations. Big Horn and Rosebud Counties have identified environmental justice American Indian populations, which are predominantly Northern Cheyenne and Crow. See **Section 3.16, Environmental Justice** for the demographic characteristics of the analysis area as they relate to environmental justice and additional information regarding the methods used for identifying environmental justice populations in the analysis area.

Socioeconomics (**Section 4.15**) was considered as it relates to environmental justice communities. The assumptions and definitions outlined in **Section 4.15.1.1, Assumptions**, apply to the analysis.

Methods outlined in **Section 4.5, Public Health** apply to this analysis. Potential disproportionately adverse impacts to environmental justice communities' environmental health and well-being are evaluated. Potential effects to environmental health, economics, sensitive subpopulations, and social characteristics that influence health outcomes are analyzed. The analysis focuses on public health effects that could result from exposure to PM, which is the most likely exposure pathway relate to the Proposed Action (see **Section 3.5, Public Health**).

The analysis area has a significant environmental justice population (see **Section 3.16.2, Minority Populations** and **Section 3.16.3, Low-Income Populations**); any potential adverse impacts on humans would be considered to be disproportionate for environmental justice populations.

4.16.1.2 Impact and Intensity Thresholds

The thresholds of change for the intensity of impacts on minority and low-income populations are described in **Table 156** and used to describe impacts (as applicable) in the sections below.

Table 156. Environmental Justice Impact and Intensity Thresholds.

Impact Intensity	Intensity Description
Negligible	The effects would be at low levels of detection and would not have appreciable effects on minority and low-income populations.
Minor	The effects would be detectable and would be of a magnitude that would not have appreciable effects on minority and low-income populations.
Moderate	The effects would be readily apparent and would result in measurable effects on minority and low-income populations.
Major	The effects would be readily apparent, would result in substantial effects on minority and low-income populations, and would be markedly different from existing conditions.

Impacts are also defined as short-term, long-term, or both (see **Section 4.1.1, Definitions**).

4.16.2 All Alternatives – Socioeconomic Impacts

The direct, indirect, and induced socioeconomic effects on environmental justice populations would be the same for all alternatives. As described in **Section 4.15, Socioeconomics**, the reduction in mine production as a result of the retirement of the Colstrip Power Plant Units 1 and 2 in 2022 would occur regardless of the alternative. Direct and indirect socioeconomic impacts on environmental justice populations from the Proposed Action and the Proposed Action plus Environmental Protection Measures would be the result of the life of the mine being extended by 8 years beyond the No Action alternative (see **Section 2.2.3, Life of Operations**). The impacts from the mine closure are discussed below to provide context.

Socioeconomic impacts on environmental justice populations that result from the closure of the Colstrip Power Plant Units 1 and 2 and the closure of the mine are analyzed in **Chapter 5, Environmental Justice**. None of the alternatives would result in changes to the current socioeconomic conditions for environmental justice populations before 2022. The closure of Colstrip Units 1 and 2 would result in reductions to the employment and economic output that contributes to the well-being of environmental justice populations between 2022 and mine closure. The impacts from the mine closure are discussed below to provide context.

Socioeconomic Impacts of Mine Closure on Environmental Justice Communities

When the Rosebud Mine eventually closes (closure year is dependent on selection of the No Action alternative or Alternatives 2 or 3 (see **Section 2.2.3, Life of Operations**). Unemployment rates would likely increase and income would decrease with the loss of jobs. It is possible the analysis area would experience further negative population growth and increased poverty rates compared to both present conditions and conditions post-closure of the Colstrip Power Plant Units 1 and 2 (see **Sections 3.15** and **4.15, Socioeconomics**). Sources of revenue from the mine that fund community institutions and essential social services would be eliminated after mine closure. These institutions would likely experience further decreases in funding as a result of lower employment rates, lower wages, and the total loss of tax revenue from the mine operation.

Direct socioeconomic impacts on environmental justice communities would occur within Rosebud County and on the Northern Cheyenne Indian Reservation, as a result of employment and economic output from the mine operations. Indirect and induced impacts (as defined in **Section 4.15, Socioeconomics**) on environmental justice populations would be experienced within Rosebud, Treasure and Big Horn Counties, and within the Northern Cheyenne Indian and Crow Reservations (see **Section 4.15, Socioeconomic Conditions**).

Both low-income and American Indian environmental justice populations in Rosebud County would be directly and indirectly impacted from the loss of wages and economic activity from mine operations when the mine closes. Rosebud Mine jobs and direct economic output that contribute to the well-being of the Northern Cheyenne Tribe would cease, as well as access to future jobs for Northern Cheyenne tribal members under the Lujan Settlement (see **Section 3.16.1.1, Regulatory Framework**).

The direct and indirect impacts from the mine closure would be disproportionately borne by Northern Cheyenne tribal members, as they are likely to be less mobile than other populations due to family and cultural ties to the reservation and have limited transportation options for commuting to other economic centers. There are limited economic opportunities in the region that would replace the jobs and wages resulting from the mine. Likewise, Northern Cheyenne tribal members may be unlikely to relocate to areas where social services and infrastructure meet their needs. Low-income populations may be restricted as well by lack of transportation and ability to relocate to areas where there are greater economic opportunities and social services. As a result, public health, education, and access to necessary services may decrease, resulting in long-term adverse impacts on these communities, if there is no other economic growth and development in the area that would replace the jobs and wages. Currently, there are limited economic opportunities in the region that would replace the jobs and wages resulting from the mine.

4.16.2.1 Direct Impacts

No Action – Alternative 1

Under current conditions, the Rosebud Mine is a major economic driver within Rosebud County and the Northern Cheyenne Indian Reservation (see **Section 3.15, Socioeconomics**). Under the No Action alternative, the mine would be expected to close in 2030 and all economic activity associated with the mine, including employment and economic output, would cease at that time. After the mine closes, all populations within Rosebud County would be negatively affected, including the substantial environmental justice populations, as discussed above. Jobs at the mine would be eliminated, including those belonging to Northern Cheyenne tribal members. The impacts on environmental justice populations from the mine closure would be those discussed above, and would begin in 2030 (see **Section 4.15, Socioeconomic Conditions**). Because the mine is scheduled to close independent of any of the alternatives, effects on environmental justice populations as a result of the No Action alternative would be long-term, negligible, and adverse.

Alternatives 2 and 3

Under the Proposed Action (Alternative 2) and the Proposed Action plus Environmental Protection Measures (Alternative 3), mining in the project area would allow mine life to be extended by 8 years. Alternatives 2 and 3 would delay the onset of the adverse impacts discussed above, possibly allowing time for other sectors to develop (**Section 4.15, Socioeconomic Conditions**). This would result in a short-term and minor impact since the mine would continue to support local economic activity that contributes to the well-being of environmental justice populations.

4.16.2.2 Indirect and Induced Impacts

No Action – Alternative 1

Under the No Action alternative, jobs and economic output indirectly associated with the mine would be reduced if mine closure occurred in 2030. Indirect impacts would be felt by the counties and the reservations as losses of jobs and wages that are indirectly supported by mine operations, similar to the direct impacts discussed above. Overall, indirect effects on environmental justice populations as a result of the No Action alternative would be long-term, negligible, and adverse.

Alternatives 2 and 3

Under Alternatives 2 and 3, mining in the project area would allow the mine to continue operations (at levels post-closure of the Colstrip Power Plant Units 1 and 2) for an additional 8 years. As with the No Action alternative, after the mine closes, all populations would be negatively affected, including the substantial environmental justice populations. Alternatives 2 and 3 would delay the onset of the adverse impacts discussed under the No Action alternative above, possibly allowing time for other sectors to develop (see **Section 4.15, Socioeconomic Conditions**). This would result in a short-term and minor impact since the mine would continue to support local economic activity that contributes to the well-being of environmental justice populations.

4.16.3 Public Health Impacts

Analysis of public health considers four areas where the Proposed Action's impacts may occur: environment, economy, demographics, and social characteristics (NRC 2011). Public health factors where impacts may be observed include chronic disease rates, infectious disease rates, injury rates, nutrition, and well-being of communities. As discussed in **Section 3.5, Public Health**, potential health impacts associated with the alternatives are most likely from exposures to PM, specifically $PM_{2.5}$. Thus, this discussion focuses on the potential impacts on public health associated with PM emissions from the alternatives. **Section 3.5** and **Section 4.5, Public Health,** give a description of the methodology used to analyze impacts and definitions of the public health factors listed above. This section examines potential impacts on the public health of environmental justice populations described in **Section 3.15, Environmental Justice**. Effects related to the timing of mine closure are dependent on selection of the No Action alternative or Alternatives 2 and or 3 (see **Section 2.2.3, Life of Operations**).

4.16.3.1 No Action –Alternative 1

Under the No Action alternative, there would be no immediate effects on the public health of environmental justice populations (see **Section 4.5, Public Health**). After the mine closes in 2030 (see **Section 2.2.3, Life of Operations**), there may be long-term negligible impacts on overall public health from fugitive dust generated by reclamation activities. As the Rosebud Mine and Colstrip and Rosebud Power Plants reduce operations from current levels, beneficial long-term impacts on air quality may occur (see **Section 4.3, Air Quality** for a detailed discussion). Surface water quality would not be affected (see **Section 3.7, Water Resources – Surface Water**).

After mine closure in 2030, revenues generated by the mine that are used to support public health services for environmental justice populations would cease, resulting in direct and indirect moderate long-term effects on social services and resources. Chronic and infectious disease rates among environmental justice populations are not likely to be affected by the No Action alternative, as poverty, behavioral risk, and lack of social services contribute to poor public health outcomes (see **Section 3.5, Public Health**) (UWPHI 2017).

As discussed above, public health impacts from the mine closure would be disproportionately borne by Northern Cheyenne tribal members and by low income populations, as they are likely to be less mobile and are less likely to relocate due to limited transportation options. Accessing public health services may become more difficult if local services become less available from reduced funding. There are limited economic opportunities in the region that would replace the jobs and wages resulting from the Rosebud Mine. As a result, public health and access to necessary services may decrease, resulting in long-term minor to moderate adverse impacts on these communities (see discussion above for economic impacts).

4.16.3.2 Alternative 2 – Proposed Action

Direct Impacts

The potential impacts on public health, including environmental justice populations, are discussed in **Section 3.5, Public Health** and **Section 4.5, Public Health**. There are no environmental justice populations or individuals living within the vicinity of the project area where air quality or surface water quality would be directly affected by the Proposed Action. The area adjacent to the project area is not used by Crow or Northern Cheyenne tribal members to hunt, fish, or gather food. No recreation activities would take place within the area where there would be risk from incidental exposure to pollutants through surface water or inhalation of PM, fugitive dust, or coal dust.

There may be potential for adverse health risk to environmental justice populations and individuals from incidental exposure to PM, DPM, and coal dust while traveling along public roads adjacent to the project area, and roads connecting the project area to the Rosebud and Colstrip Power Plants. These effects would be negligible and short-term, and not disproportionate relative to the overall population.

The extension of the Rosebud Mine's life by 8 years would sustain revenues that fund social services, including health services, disease prevention and public health programs, nutrition assistance programs, schools, libraries, and other community resources within Rosebud County, where most of the direct revenue and jobs are located (see **Section 4.5, Public Health**). This would result in a moderate short-term beneficial effect for environmental justice populations who use these services within Rosebud County, and for the Northern Cheyenne workers at the Rosebud Mine.

Tribal consultation with the Northern Cheyenne and Crow Tribes has been initiated regarding impacts to culturally-significant resources within the direct effects analysis area and to mitigate impacts on cultural resources that might affect traditional tribal ways of life and well-being (see **Section 6.1.3, Tribal Consultation Process**).

Indirect Impacts

Both the Northern Cheyenne Indian and Crow Reservations fall within the analysis area, and both tribes partake in ranching, hunting, fishing, gathering, and farming in the analysis area. Based on the air quality and water quality impacts analyses (see **Section 4.3, Air Quality** and **Section 4.7, Water Quality – Surface Water**), there would be no measurable impact on air or water quality that would impact the health of tribal members partaking in these activities.

The area's population includes higher rates of chronic disease, including cancer and diabetes (see **Sections 3.5** and **4.5, Public Health**). Because the Colstrip and Rosebud Power Plants' operations and output would not be affected by the Proposed Action, it is not likely that there would be indirect health impacts on members of environmental justice populations that have compromised respiratory or circulatory systems within the analysis area. Air and water quality, as discussed in **Section 4.3**, **Air Quality** and **Section 4.7**, **Water Resources – Surface Water**, are not likely to exceed public health standards or present an elevated risk to public health risk. Therefore, the indirect effects on environmental justice populations from the Proposed Action would be short-term and none to negligible, and not disproportionate compared to the overall population.

The Proposed Action would support continued indirect revenues and jobs within the analysis area, resulting in continued support and access to local health resources and funding of disease prevention, treatment, and response services, including those used by environmental justice populations (see **Section 4.5, Public Health**). About 30 percent of the indirect jobs created from the Rosebud Mine is made up of members of the Northern Cheyenne Tribe. Through 2030, the indirect economic impacts from the Proposed Action would be the same as from the No Action alternative. The Proposed Action would extend the life of the mine by 8 years, resulting in sustained indirect economic support of public health services, income, and availability of health insurance through indirect jobs and revenues. Thus, the Proposed Action would have a short-term, minor, beneficial effect on the public health of environmental justice populations.

4.16.3.3 Alternative 3 – Proposed Action Plus Environmental Protection Measures

The direct and indirect impacts from Alternative 3 on the public health of environmental justice populations would be the same as for the Proposed Action.

4.16.4 Irreversible and Irretrievable Commitment of Resources

There would be no irreversible or irretrievable commitment of socioeconomic resources as they relate to environmental justice populations. Likewise, there would be no irreversible and irretrievable commitments of public health resources as they relate to environmental justice populations as a result of any of the alternatives analyzed in this section.

4.17 VISUAL RESOURCES

This section discloses the direct and indirect effects on visual resources resulting from the No Action (Alternative 1), the Proposed Action (Alternative 2), and the Proposed Action Plus Environmental Protection Measures (Alternative 3); cumulative impacts are disclosed in **Chapter 5**. The analysis area is described in **Section 3.17, Visual Resources**.

4.17.1 Analysis Methods and Impact and Intensity Thresholds

4.17.1.1 Analysis Methods

The method used to determine potential effects on visual resources involved assessing the location of proposed mining operations relative to locations with potential visibility of the proposed operations in the analysis area, and using professional judgment to estimate the resulting noticeable changes. Viewer sensitivity level varies based on the type of user, the number of users, public interest, or adjacent land uses (BLM 1986). Sensitive locations near the project area with views (potential observation points) of the proposed operations include residences, commercial businesses, roads, highways, and recreation sites. Potential visibility of the proposed facilities from observation points was estimated using aerial and ground photographs, Google Earth™ Viewshed analysis, maps, and written descriptions of the existing environment from the permit application. Changes to existing views may include increased visual contrast of color, texture, and form, noticeable obstruction or screening of existing views, and/or reduced opportunities to view scenic resources. Because the length of viewing time and type of viewing determines the significance of effects, effects were evaluated for potential observation points. For example, views from residences and businesses would have long viewing times because the observer is stationary; conversely, views from roads and highways would have shorter viewing times because observers are moving through the area. Other considerations for analyzing visual resource effects include the distance between an observation point and the proposed facilities; the amount of potential contrasts created collectively by vegetation removal, topographic changes, rock removal, and wetland impacts; and the presence of visual obstructions between the observation points and the proposed project.

Potential observation points of the proposed mining operations were identified using Google Earth™, MapQuest™, existing site photos, and USGS 7.5-minute quadrangle maps. The potential observation points are shown in **Figure 113** and include:

- residences within and outside of the city of Colstrip
- commercial businesses within the city of Colstrip, such as the Colstrip Inn and Suites
- recreation areas/parks within the city of Colstrip
- Montana State Highway 39
- Horse Creek Road (County Road 384)

Note that individual locations in Colstrip are not identified on **Figure 113** due to the distance from proposed operations in the project area.

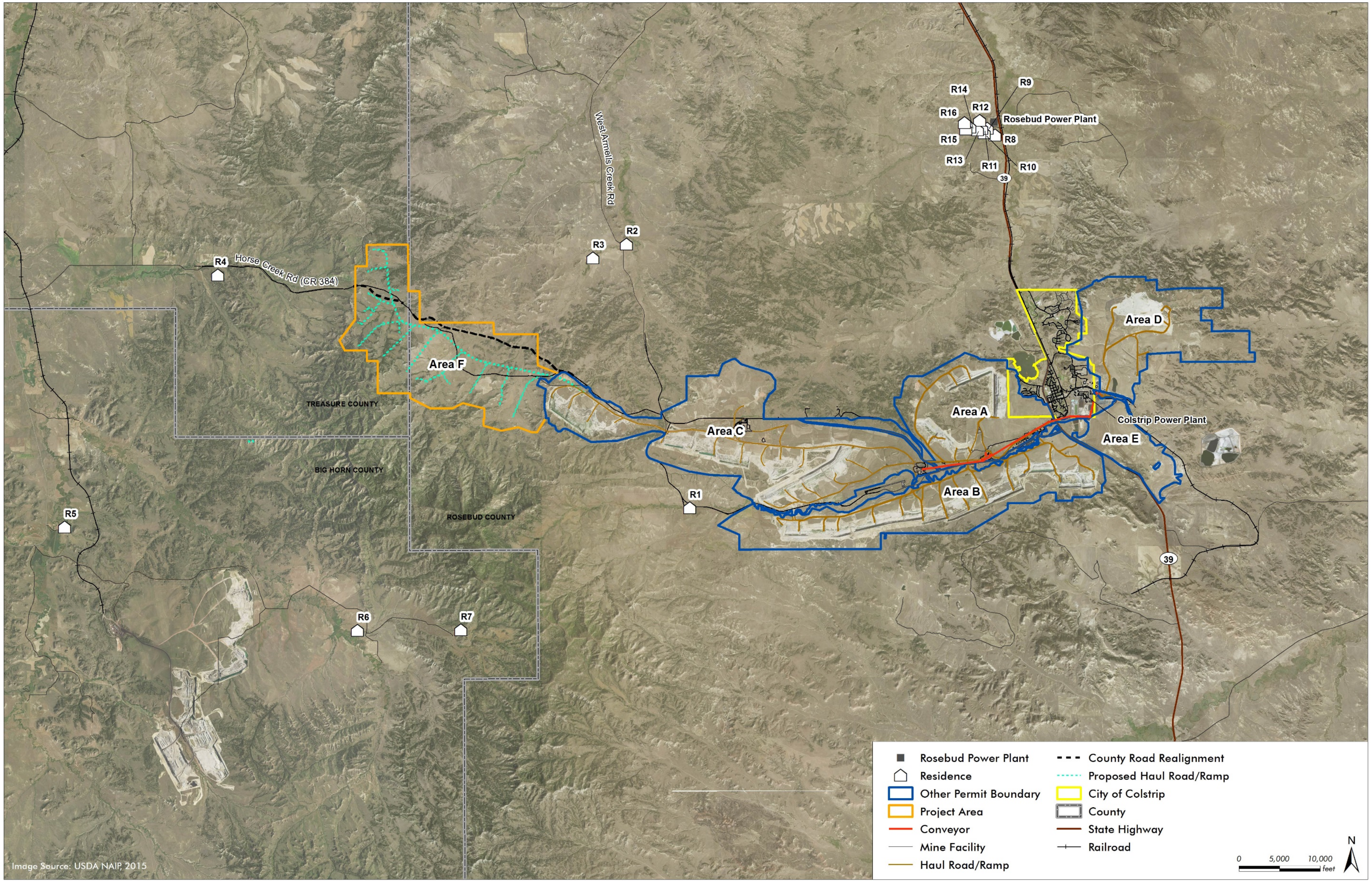

Figure 113. Observation Points with Potential Visibility of Proposed Mining Operations.

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4.17.1.2 Impact and Intensity Thresholds

The thresholds of change for the intensity of impacts on visual resources are described in **Table 157** and are used to describe the impacts in the sections below.

Table 157. Visual Resources Impact and Intensity Thresholds.

Impact Intensity	Intensity Description
Negligible	The action would result in barely perceptible changes to existing views.
Minor	The action would result in slightly detectable changes to views in a small area, or would introduce a compatible human-made feature to an existing developed area.
Moderate	The action would be apparent and would change the character of visual resources in the area. The action may attract attention but would not dominate the view of the casual observer.
Major	The action would be highly noticeable, visible from a considerable distance or over a large area, and would dominate the view. The character of visual resources would change substantially and would be permanent.

Impacts are also defined as short-term, long-term, or both (see **Section 4.1.1, Definitions**).

4.17.2 Alternative 1 – No Action

Under the No Action alternative, Western Energy would not develop the project area. There would be no impact on visual resources described in **Section 3.17, Visual Resources** because none of the disturbances associated with development of the project would occur.

The No Action alternative would not change the status of other areas of the Rosebud Mine that are currently permitted and being mined and/or reclaimed by Western Energy (**Section 2.2, Existing Operations**) nor would it affect development of any other proposed Rosebud Mine areas currently in the permitting process (**Section 5.2.2, Related Future Actions**).

4.17.3 Alternative 2 – Proposed Action

4.17.3.1 Direct Impacts

There would be no direct visual impacts from project area mining operations on Colstrip residences, commercial sites, local recreation areas such as Winchester Park and Castle Rock Lakes, or locations along SH 39 in the analysis area (defined in **Section 3.17.1.2, Analysis Area and Methods**), due to the following conditions:

- the nature of the topography in the area, which includes long, rolling hills and occasional bluffs and excludes views of the project area from Colstrip residences, businesses, and recreation sites, which are about 12 miles east of the project area
- the location of the existing mining operations between the project area and the observation points in Colstrip, local recreation areas, and SH 39
- the relatively small size of the proposed operations visible from observation points due to the relatively long distance between the observation points and proposed operations

There would be short-term, moderate, adverse impacts during the life of the mine on drivers traveling along Horse Creek Road (County Road 384) through the project area. Mining operations would result in increased visual contrast in a small portion of the landscape in the direct effects analysis area, including changes in the color of the landscape from removal of vegetation and exposure of soil, as well as changes to the contour of the landscape. Large equipment may be visible during active mining. However, viewing times would be relatively short (only while driving through the project area) and would be negligible relative to existing mining operations adjacent to the proposed operations in the project area. Also, two segments of Horse Creek Road would be relocated as mining progresses through the project area (see **Section 2.4.3.4**, **Roads** and **Figure 6**). Visual impacts such as ground disturbance and construction activities from relocation of Horse Creek Road would be short-term and limited to two phases of construction—one during initial mine development and another in about year 12 of project mine life.

Residences (observation points) identified in the analysis area outside of Colstrip are listed in **Table 158**. There would be no impact on residences R1, R5, R6, and R7 because topography would screen the view of mining operations, based on a Google Earth Viewshed review (analysis methods are described in **Section 3.17.1.2, Analysis Area and Methods**). Impacts on R2 and R3 would be long-term but minor because active mining may be visible in a small amount of the viewshed of these residences and the project area is adjacent to existing mining areas. Impacts on R4, located directly west of the project area, would be long-term and moderate because no other active mining areas are visible from this residence.

Table 158. Approximate Distances from Residences to Mining Areas.

Label	Location	Direction from Mine	Distance to Area F	Visual Impacts
R1	Airport Road	SE of the project area	4.0	Not visible due to topography – no impact
R2	Armells Creek Road	NE of the project area	2.9	Possibly visible as mining progresses – long-term but minor due to small area visible and existing mining
R3	Armells Creek Road	NE of the project area	2.2	Possibly visible as mining progresses – long-term but minor due to small area visible and existing mining
R4	Horse Creek Road	W of the project area	3.2	Possibly visible as mining progresses – long-term and moderate effect since no other mining activity is visible
R5	Highway 384	SW of the project area	8.0	Not visible due to topography – no impact
R6	Unnamed Rural Road	S of the project area	5.5	Not visible due to topography – no impact
R7	Unnamed Rural Road	S of the project area	4.7	Not visible due to topography – no impact

4.17.3.2 Indirect Impacts

The continued combustion of coal at the Rosebud and Colstrip Power Plants contributes particulate and gaseous air pollutants that contribute to regional haze in the surrounding viewshed. Depending on atmospheric conditions and sources of emissions, haze could continue to reduce the visibility of distant mountains and hills, contribute a “smoky” appearance, and detract from the clarity of the landscape. Quantitative analysis of haze-producing pollutants is provided in **Section 4.3, Air Quality**. The Colstrip and Rosebud Power Plants installed Best Available Retrofit Technology (BART) on combustion units to increase efficiency and reduce emissions, as described in **Section 4.3, Air Quality**. Montana does not currently have an implementation plan for the state to meet federal haze standards.

Visibility effects are expected to emanate up to 300 km from the area surrounding the Colstrip Power Plant, the Rosebud Power Plant, and the Rosebud Mine, based on the modeling for haze-producing pollutants. Six Class I areas (defined in **Section 3.3, Air Quality**) are located within 300 km of the Colstrip and Rosebud Power Plants. The Northern Cheyenne Reservation is the closest Class I area and is 21 km (around 13 miles) away (see **Section 3.3, Air Quality)**. Potential impacts on the Northern Cheyenne Reservation and other Class I areas are discussed in **Section 4.3, Air Quality**.

4.17.4 Alternative 3 – Proposed Action Plus Environmental Protection Measures

The impacts on visual resources from Alternative 3 would be primarily the same as those described under Alternative 2 – Proposed Action. Environmental protection measures included in Alternative 3 for reclamation, such as amending soil to improve revegetation success, would help return the visual landscape to pre-mining conditions faster than Alternative 2. Other environmental protection measures such as designing the postmine topography using 5-foot versus 10-foot contours and identifying prominent rock-outcrop features would return the landscape to its visual pre-mine conditions.

4.17.5 Irreversible and Irretrievable Commitment of Resources

An irreversible and irretrievable commitment of visual resources would occur from the proposed project. Surface mining would be short-term during the life of the mine; the area would be reclaimed after mining is complete. Although the land would be recontoured and revegetated during reclamation, visual changes would include loss of natural rock outcrops, diverse vegetation, and natural drainages, gradually blending into the surrounding landscape over time. Visual changes to the land postmining would be subtle and negligible to some viewers (i.e., viewers in cars traveling on Horse Creek Road through the project area) and minor to moderate to viewers more familiar with the pre-mining landscape (i.e., residences near the project area).

4.18 RECREATION

This section discloses the direct and indirect effects on recreation resulting from the No Action (Alternative 1), the Proposed Action (Alternative 2), and the Proposed Action Plus Environmental Protection Measures (Alternative 3); cumulative impacts are disclosed in **Chapter 5**. The analysis area is described in **Section 3.18, Recreation**.

4.18.1 Analysis Methods and Impact and Intensity Thresholds

4.18.1.1 Analysis Methods

Assessment of direct and indirect impacts on recreation resources was based on the type and amount of disturbance within the analysis area where recreation activities may take place. The magnitude of impact on recreation resources was based on the amount and type of loss, with a major impact defined as one that would permanently remove a recreational opportunity.

4.18.1.2 Impact and Intensity Thresholds

The thresholds of change for the intensity of an impact on recreation resources are described in **Table 159** and are used to describe the impacts in the sections below.

Table 159. Recreation Impact and Intensity Thresholds.

Impact Intensity	Intensity Description
Negligible	Changes in recreational use would be barely perceptible. Recreational users would not likely be aware of the effects associated with the action.
Minor	Recreational users might be aware of the effects associated with the action, but would likely not express an opinion about it.
Moderate	Changes in recreational use would be readily apparent. Recreational users would be aware of the effects associated with the action as there would be a noticeable loss of recreation opportunities within the analysis area.
Major	Changes in recreational use and experience would be readily apparent and severely adverse. Recreational users would be aware of the effects associated with the action as there would be a permanent loss of recreation opportunities within the analysis area.

Impacts are also defined as short-term, long-term, or both (see **Section 4.1.1, Definitions**).

4.18.2 Alternative 1 – No Action Alternative

Under the No Action alternative, Western Energy would not develop the project area. The recreation uses—primarily hunting—described in **Section 3.18, Recreation** would continue because none of the disturbances associated with development of the project would occur.

The No Action alternative would not change the status of other areas of the Rosebud Mine that are currently permitted and being mined and/or reclaimed by Western Energy (**Section 2.2, Existing Operations**) nor would it affect development of any other proposed Rosebud Mine areas currently in the permitting process (**Section 5.2.2, Related Future Actions**).

4.18.3 Alternative 2 – Proposed Action

4.18.3.1 Direct Impacts

During the life of operations, use of the lands within the analysis area would be devoted to mining and associated activities. All current use of the land for recreation (primarily hunting) would be unavailable during mine operations (see **Section 2.2.3, Life of Operations**), displacing some individuals onto other nearby lands for hunting and other recreation opportunities. However, since the analysis area represents less than 0.01 percent of Hunting District 702, the private lands within the project area represent a relatively small portion of the currently accessible public (state) surface lands for recreational opportunity within the respective hunting area.

There would be a loss of recreation opportunities since hunting in the analysis area would not be possible during mining operations. Hunting opportunities on mine-related disturbance areas within the analysis area would be lost until revegetation and forage production are comparable to pre-mining levels associated with adjacent land. Thus, impacts on recreation would be long-term, moderate, and adverse.

Adjacent Recreational Uses

Adjacent recreation uses during mine operations would be affected to some extent; these impacts are described in **Section 4.22, Noise**; **Section 4.17, Visual Resources**; and **Section 4.12, Fish and Wildlife**. There would be no impacts on recreation uses in and immediately surrounding the City of Colstrip or in Southeast Montana.

4.18.3.2 Indirect Impacts

There would be no indirect impacts on recreation other than potential regional haze as described in **Section 4.3, Air Quality**.

4.18.4 Alternative 3 – Proposed Action Plus Environmental Protection Measures

The effects of Alternative 3 on recreation (primarily hunting) would be similar to those described under Alternative 2 – Proposed Action.

4.18.5 Irreversible and Irretrievable Commitment of Resources

No irreversible or irretrievable commitment of recreation resources would occur. Surface mining in the analysis area would be short-term and the land would likely be available for hunting again after mining is complete and the land is reclaimed.

4.19 PALEONTOLOGY

This section discloses the direct and indirect effects that the No Action (Alternative 1), the Proposed Action (Alternative 2), and the Proposed Action with Environmental Protection Measures (Alternative 3) would have on paleontological resources; cumulative impacts are disclosed in **Chapter 5**. The analysis area is described in **Section 3.19, Paleontology**.

4.19.1 Analysis Methods and Impact and Intensity Thresholds

4.19.1.1 Analysis Methods

Impacts on paleontological resources were determined based on PFYC ratings and associated protection measures provided by the BLM project paleontologist.

4.19.1.2 Impact and Intensity Thresholds

The thresholds of change for the intensity of impacts on paleontology are described in **Table 160** and are used to describe impacts in the sections below.

Table 160. Paleontology Impact and Intensity Thresholds.

Impact Intensity	Intensity Description
Negligible	Geologic units that are not likely to contain recognizable fossils would be lost
Minor	Geologic units that are not likely to contain vertebrate fossils or scientifically significant nonvertebrate fossils would be lost
Moderate	Geologic units that have an unknown or moderate fossil potential would be lost
Major	Geologic units containing a high occurrence of significant fossils would be lost

Impacts are also defined as short-term, long-term, or both (see **Section 4.1.1, Definitions**).

4.19.2 Alternative 1 – No Action

Under the No Action alternative, Western Energy would not develop project area. There would be no impact on paleontological resources described in **Section 3.19, Paleontology**, because none of the disturbances associated with development of the project would occur. Paleontological resources would continue to be exposed at the surface over time as the land surface continues to erode.

The No Action alternative would not change the status of other areas of the Rosebud Mine that are currently permitted and being mined and/or reclaimed by Western Energy (**Section 2.2, Existing Operations**), nor would it affect development of any other proposed Rosebud Mine areas currently in the permitting process (**Section 5.2.2, Related Future Actions**).

4.19.3 Alternative 2 – Proposed Action

4.19.3.1 Direct Impacts

Paleontological resources of scientific significance could be present in the analysis area. For the analysis area, BLM classifies the clinker with a PFYC rating of 2, the Quaternary Alluvium a PFYC rating of 2, and all the members of the Fort Union Formation with a PFYC rating of 4 (BLM 2017). Since only the

Fort Union Formation would be removed during mining, paleontological resources not identified or salvaged prior to mining would be permanently lost resulting in a long-term major adverse impact. Paleontological resources are likely to be destroyed during mining operations; however, based on the results of the survey (SWCA 2016) some resources might be recognized before being completely destroyed and, therefore, some may be potentially salvaged.

Paleontological resources belong to the owner of the surface estate (all of which is privately held), and the owners may wish to: (1) donate scientifically significant fossils to a public institution for research and education for the good of everyone, (2) retain the fossils for personal use, or (3) determine to not salvage the fossils and allow them to be destroyed or eroded.

4.19.3.2 Indirect Impacts

There would be no indirect impacts on paleontological resources; all impacts would be direct impacts.

4.19.4 Alternative 3 – Proposed Action Plus Environmental Protection Measures

The UDP required under Alternative 3 (see **Section 2.5.2, Environmental Protection Measures**) would increase the potential that paleontological resources of scientific interest would be discovered in the project area. As noted above, paleontological resources belong to the owner of the surface estate; the same choices presented above under Alternative 2 would apply under Alternative 3 as well. Discovery does not ensure protection, but would help minimize unintentional destruction of paleontological resources.

4.19.5 Irreversible and Irretrievable Commitment of Resources

Removal of the Rosebud Coal and the associated overburden in the project area would be an irreversible and irretrievable impact on paleontological resources.

4.20 ACCESS AND TRANSPORTATION

This section discloses the direct and indirect effects on transportation resulting from the No Action (Alternative 1), the Proposed Action (Alternative 2), and the Proposed Action Plus Environmental Protection Measures (Alternative 3); cumulative impacts are disclosed in **Chapter 5**. The analysis area is described in **Section 3.20, Access and Transportation**. The transportation resource consists of a network of private haul roads owned by Western Energy and public roads owned and maintained by Rosebud and Treasure Counties and the State of Montana that would be used during activities related to the development and mining of the project area.

4.20.1 Analysis Methods and Impact and Intensity Thresholds

4.20.1.1 Analysis Methods

Access and transportation impacts were determined based on the information contained in the PAP. The PAP provided project road categories, construction methods, and transportation network uses.

4.20.1.2 Impact and Intensity Thresholds

The thresholds of change for the intensity of impacts on access and transportation are described in **Table 161**. Impacts are discussed in the sections below.

Table 161. Access and Transportation Impact and Intensity Thresholds.

Impact Intensity	Intensity Description
Negligible	The effects would be at low levels of detection and would not have appreciable effects on access and transportation
Minor	The effects would be detectable and would be of a magnitude that would not have appreciable effects on access and transportation.
Moderate	The effects would be readily apparent and would result in a change in access and transportation that would be noticeable
Major	The effects would be readily apparent, would result in a substantial change in access and transportation in a noticeable manner, and would be markedly different from existing conditions

Impacts are also defined as short-term, long-term, or both (see **Section 4.1.1, Definitions**).

4.20.2 Alternative 1 – No Action

Under the No Action alternative, Western Energy would not develop the project area. Currently-approved mining operations and the associated potential impacts on transportation facilities would continue until about 2030 (see **Section 2.2, Description of Existing Mine and Reclamation**). Transportation impacts related to mining operations at the Rosebud Mine would affect portions of the analysis area only to the extent that they occur under the current mining and reclamation plan for other permit areas. Western Energy would continue to maintain a Fugitive Dust Control Plan as described in **Section 2.4.3.4**, **Roads**. Under the No Action alternative, the haul road from Area C West would likely be decommissioned 15 to 20 years earlier relative to Alternative 2 – Proposed Action. This timeline would facilitate earlier Phase IV bond release for Area C. Phase IV bond release for Area C would be delayed if the project area is permitted (see **Section 1.6.4**, **Bond Release** for a discussion of bond release and reclamation phases).

Horse Creek Road would not be realigned and the maintenance of county roads would not change. The only maintenance that the mine provides on the county road would be to continue assisting with plowing during large snowstorms when the county may be overwhelmed.

4.20.3 Alternative 2 – Proposed Action

4.20.3.1 Direct Impacts

Road Construction Impacts

Road construction proposed under the project is described in **Section 2.4.3.4**, **Roads**. Road-construction impacts would be short-term, negligible, and adverse as they would be limited to the period during mine construction and operations. Western Energy proposes to use BMPs to mitigate environmental quality impacts. Temporary and permanent erosion-control measures would be utilized as necessary during road construction to control sedimentation and minimize erosion (see **Section 2.4.5.2, Surface Water Management and Sediment-Control Measures** for a discussion of sediment BMPs). All cut-and-fill slopes would be re-soiled and revegetated, or otherwise stabilized, at the first seasonal opportunity. Cut slopes would not be greater than 1v:1.5h (vertical rise versus horizontal run) for unconsolidated materials or 1v:0.25h in rock.

Following abandonment, roads would be reclaimed in accordance with the approved reclamation plan (see **Section 2.4.4.11, Special Reclamation Cases** for a detailed discussion). All bridges and culverts would be removed and natural drainage patterns restored to meet the approved postmining topography (see **Section 2.4.4.5, Postmining Topography and Drainage Basin Design**).

Relocation of Horse Creek Road

To accommodate the proposed mine plan, Western Energy would relocate Horse Creek Road in two locations (see discussion in **Section 2.4.3.4**, **Roads**). Specifically, a 4.2-mile segment in the northeast/north-central portion of the permit area and a 1.3-mile segment in the northwestern portion of the permit area would be rerouted (**Figure 114**). The road relocation would be done in two phases: the longer segment, which is located in Rosebud County, would be relocated during initial development of the project: the west end of the realignment, which is located in Treasure County, would occur when mining moves into the northwestern corner of the project area (approximately 12 years later). Any modification of the existing Horse Creek Road alignment would involve the counties' rights-of-way. Prior to any mining activities (other than surveying and monitoring) in the areas involving county road relocation, Western Energy would work with the Rosebud and Treasure County Boards of Commissioners to plan and develop a means for relocating the road per SMCRA at 30 CFR 761.11(d) and MSUMRA, section 82-4-227(7)(d), MCA, and ARM 17.24.1135. Designs for the road relocation would be submitted to DEQ and Rosebud and Treasure Counties for review and approval. Western Energy would be required to provide a public hearing, appropriately noticed, to determine whether the interests of the public and affected landowners would be protected per ARM 17.24.1135(3-4). A written finding based on the information from the public hearing would be produced and submitted to DEQ (ARM 17.24.1135[5]). Each relocation of Horse Creek Road would result in short-term minor adverse impacts on transportation and access.

Haul Roads

No long-term impacts would be expected from construction of haul roads, as effects would be limited to construction and operations of the mine. Western Energy proposes to extend its Area C Haul Road west into the project area (see **Figure 2** and **Figure 114**). Western Energy would use the same haul-road construction technique for the project area that it currently uses in other permit areas. Following active mining, haul roads would be reclaimed as described in **Section 1.4.4.11, Special Reclamation Cases.** The impacts due to haul roads would be short-term, negligible, and adverse because the overall transportation system would not be disrupted.

Ramp Roads

No long-term impacts would be expected from construction of ramp roads, as effects would be limited to construction and operations of the mine. A series of haul-road ramps would be constructed in the project area to connect the active mining and reclamation area pits to the new project area haul road (see **Figure 2** and **Figure 114**). Ramp roads would be moved and/or advanced with the development of each new active mine area within the project area. Western Energy would use the same ramp construction method for the project area that it currently uses in other permit areas of the Rosebud Mine. Temporary and permanent erosion-control measures would be utilized as necessary during road construction to control sedimentation and minimize erosion (see **Section 2.4.5.2, Surface Water Management and Sediment-Control Measures**). Ramp roads would be maintained at a 5-percent or steeper grade and surfaced with road material to provide for all-weather use. Grading adjacent to ramp roads would allow for soiling and revegetation activities to proceed at the first appropriate period favorable for planting, thus minimizing erosion-related impacts. Following active mining, ramp roads would be reclaimed as described in **Section 1.4.4.11, Special Reclamation Cases**. The impacts due to ramp roads would be short-term, negligible, and adverse because the overall transportation system would not be disrupted.

Service Roads

No long-term impacts would be expected from new service roads. Western Energy would consult with DEQ prior to construction of any service road. Temporary and permanent erosion-control measures would be utilized as necessary during road construction to control sedimentation and minimize erosion (see **Section 2.4.5.2, Surface Water Management and Sediment-Control Measures**). Following active mining, service roads would be reclaimed, as described in **Section 1.4.4.11, Special Reclamation Cases.** The impacts due to service roads would be short-term, negligible, and adverse because the overall transportation system would not be disrupted.

Road Material Impacts

Road materials to be used in construction include pit run and crushed and/or screened scoria as described in **Section 2.4.3.4**, **Road Materials**. Roads would not be constructed or surfaced with waste coal or with acid-producing or toxin-producing materials. Impacts on the natural environment from road materials would be short-term, negligible, and adverse.

Transportation Impacts

Traffic

During construction, operation, and reclamation associated with the project, traffic congestion and possible accidents could occur on roads and highways used in the project area. After reclamation, impacts from project traffic would cease and no additional impacts on traffic would be expected. Mine haul traffic would not use the mine access roads, but rather would use the existing and expanded haul roads, consistent with current mine practice.

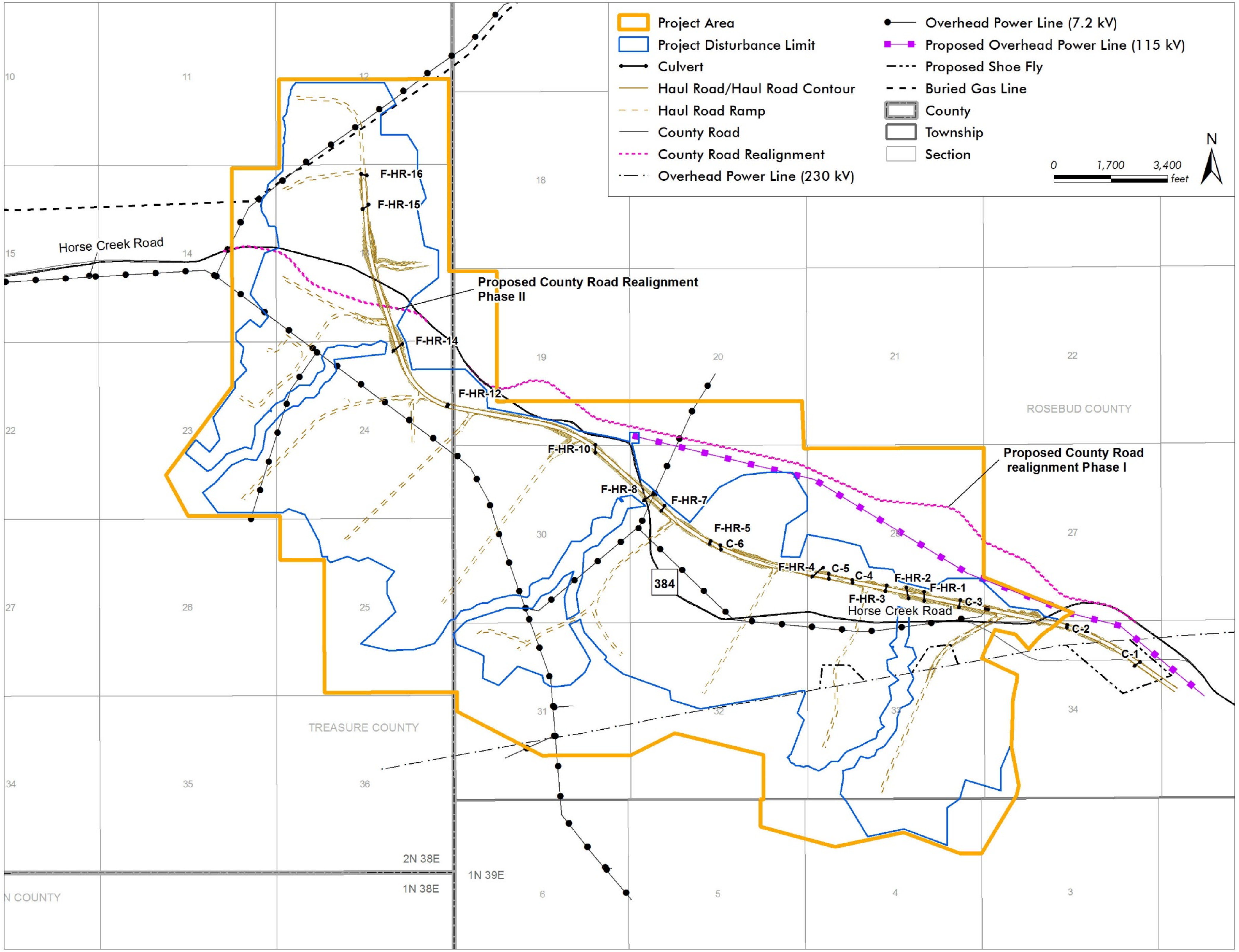

Figure 114. Proposed Horse Creek Road Realignment.

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Project area coal would be transported by haul truck via the new project area haul-road extension to the Area C or Area A truck dumps for crushing and handling. From there, in accordance with Western Energy's contract, most of the coal would be sent via the existing 4.2-mile conveyor to the Colstrip Power Plant (see **Figure 2)**. There would be no additional haul traffic since mining in the project area would reduce current mining in other permit areas (see **Section 2.2, Description of Existing Mine and Reclamation** and **Figure 3**). It is important to note that haul trucks use the haul road that extends from Area C, which does not intersect with public roads. Mine traffic (i.e., employees going to work) would continue to use the county road as an access route.

Coal from the project area with higher sulfur content would be trucked to the Rosebud Power Plant via an existing haul road and SH 39, which is the current practice for other permit areas of the Rosebud Mine (see **Section 3.20.3.1, Highways)**. As project area coal would be replacing coal from other permit Areas (see **Figure 3**), haul truck traffic would not be expected to contribute significantly to the existing volume on SH 39. As with other mine areas, haul truck traffic could cause some minor delays in public travel from time to time. Thus, the impacts due to traffic would be short-term, minor, and adverse.

Road Maintenance Impacts

Existing access roads would continue to be graded and/or maintained as done in other permit areas of the Rosebud Mine resulting in short-term, negligible, adverse impacts on mine access roads. Public access roads such as SH 39 would continue to be maintained for local and regional traffic. No additional maintenance on public access roads is anticipated and therefore, there would be no impact on public access road maintenance.

Ingress and Egress Impacts

Western Energy would not conduct mining activities within 100 feet of the right-of-way line of any public road except where mine access or haul roads join that right-of-way. Agricultural lessees would continue to have road access to most parts of the permit area. Exceptions would include the immediate vicinity of active coal-mining areas and coal-handling facilities and the two periods of time when the Horse Creek Road is relocated (see discussion above). The Proposed Action would have a short-term negligible adverse impact on residents' mobility and access through the local area.

4.20.3.2 Indirect Impacts

Indirect impacts on transportation and access may occur on recreational users or hunters due to mine-related traffic and closures in active mining areas. Employees traveling to and from the Rosebud Mine would contribute to local traffic, but effects would not change from current conditions. Increases in noise, dust, and lights from road construction (haul roads, ramp roads, etc.) traveling through, and to and from, the project area may impact local traffic, residents, recreationists, and hunters. Overall, indirect effects on access and transportation would be short-term, minor, and adverse.

4.20.4 Alternative 3 – Proposed Action Plus Environmental Protection Measures

The effects of Alternative 3 on transportation resources would be the same as those described under Alternative 2 – Proposed Action because no additional environmental protection measures are proposed for this resource.

4.20.5 Irreversible and Irretrievable Commitment of Resources

Both Alternative 2 and Alternative 3 would contribute traffic on the roadways during construction, operations, and reclamation, thereby increasing the amount of fuel used by vehicles beyond that used under the No Action Alternative. Fuel is a non-renewable resource; thus, traffic related to Alternative 2 or Alternative 3 would result in an irreversible commitment of resources.

4.21 SOLID AND HAZARDOUS WASTE

This section discloses the direct and indirect effects related to solid and hazardous waste as a result of No Action (Alternative 1), the Proposed Action (Alternative 2), and the Proposed Action Plus Environmental Protection Measures (Alternative 3); cumulative impacts are disclosed in **Chapter 5**. The analysis area is described in **Section 3.21, Solid and Hazardous Waste**.

4.21.1 Analysis Methods and Impact and Intensity Thresholds

4.21.1.1 Analysis Methods

Solid- and hazardous-waste impacts were determined based on the information contained in Western Energy's PAP, the Solid and Hazardous Waste Management Plan (SHWMP) (Western Energy 2009), and the Spill Prevention Control and Counter Measure Plan (SPCCMP) and Contingency and Emergency Response Plan (CERP) (Western Energy 2017b).

4.21.1.2 Impact and Intensity Thresholds

The threshold of change for the intensity of an impact related to solid and hazardous waste is defined in **Table 162** and are used to describe impacts in the sections below.

Table 162. Solid or Hazardous Waste Impact and Intensity.

Impact Intensity	Intensity Description
Negligible	Releases of hazardous material likely would be below or at a very low level of detection and would not migrate off-site. Any effects on the public or the environment would not be detectable.
Minor	Releases of hazardous material likely would be detectable but would not migrate off-site. The release would not result in off-site effects on the public or the environment.
Moderate	Releases of hazardous material likely would migrate off-site. The release would result in minimal off-site effects on the public or the environment. Changes to localized ecological processes would be limited.
Major	Releases of hazardous material likely would migrate off-site. The release would result in major off-site effects on the public or the environment. Key ecological processes would be altered, and landscape-level changes would be expected.

Impacts are also defined as short-term, long-term, or both (see **Section 4.1.1, Definitions**).

4.21.2 Alternative 1 – No Action

Under the No Action alternative, Western Energy would not develop the project area. There would be no impacts related to the current management of solid and hazardous waste as described in **Section 3.21, Solid and Hazardous Waste** because none of the disturbances associated with development of the project would occur.

The No Action alternative would not change the status of other areas of the Rosebud Mine that are currently permitted and being mined and/or reclaimed by Western Energy (see **Section 2.2, Description of Past and Existing Mine and Reclamation Operations**) nor would it affect development of any other proposed Rosebud Mine permit areas currently in the permitting process (see **Section 5.2.2, Related Future Actions**).

4.21.3 Alternative 2 – Proposed Action

Under the Proposed Action, Western Energy is expected to mine an estimated 70.8 million tons of coal from the project area. The operational life (active mining and development) of project area is expected to be 19 years (**Figure 3**) and would extend the operational life of the Rosebud Mine by 8 years. Coal would be transported via coal haulers on an established haul road to Area A or Area C for crushing. After crushing, most coal from the project area would be transferred via conveyor to the Colstrip Power Plant for use in Units 3 and 4. Rosebud Coal with higher sulfur content and low calorific value (typically the top 1-foot layer and bottom 1 foot) would be trucked to the Rosebud Power Plant.

4.21.3.1 Direct Impacts

Under the Proposed Action, Western Energy does not propose to construct any facilities or storage areas in the project area, since any that would be needed already exist and are available for use in other permit areas (see **Section 3.21, Solid and Hazardous Waste** and **Figure 63**). As for other permit areas, hazardous wastes would be collected in 55-gallon drums at satellite accumulation points within the project area (the number of satellite accumulation points and drums would be based on the waste stream generated); within three days of filling, the waste drums would be transported to the hazardous-waste storage area located in Area A for shipment to a treatment, storage, and disposal facility. Impacts from the potential release of solid or hazardous wastes stored in Area A would be short-term, negligible, and adverse due to the continued implementation of the SHWMP, SPCCMP, and CERP. Given the small quantities that would be collected in project area satellite accumulation points (less than or equal to 55 gallons/accumulation point), potential leaks or releases within the analysis area would be short-term, negligible, and adverse.

Final disposal of non-coal solid wastes, if encountered, would be either at the Rosebud County Landfill or in the mine pits in an approved landfill site for solid wastes. Mining related non-hazardous waste such as non-treated wood, wooden pallets, concrete, and dragline cable and wooden cable spools would be placed in the mine pits in accordance with ARM 17.24.507. On a case-by-case basis, other non-hazardous construction, mining, or agricultural debris would also be placed within the mine pits if approved to do so by DEQ (PAP, ARM 17.24.507). Any waste materials meeting the definition of "hazardous" would be handled in accordance with applicable regulations (see **Section 3.21.1.1, Regulatory Framework)**. Excess waste liquid not used within the Rosebud Mine would be handled under Western Energy's Waste Management Program. Because of these actions, impacts would be short-term, negligible, and adverse.

Under all alternatives, Western Energy would not use bottom ash for any purpose within the project area.

4.21.3.2 Indirect Impacts

Under the Proposed Action, coal combustion residuals (CCR) waste would continue to be generated at both the Colstrip and Rosebud Power Plants in proportion to the amount of coal burned at the plants. Coal from the project area burned at the power plants would add to the amount of CCR generated. In other permit areas of the Rosebud Mine, Western Energy would continue to use bottom ash generated from the Colstrip Power Plant in the construction of parking facilities, as a sanding agent for ramp and haul roads during periods of poor road conditions due to weather, and as tank and culvert bedding. Because use of bottom ash is contingent upon the requirements of the monitoring plan, impacts from boron toxicity related to the receipt and use of bottom ash at the mine would be short-term and negligible and identified prior to the impact having long-term consequences.

Impacts on ground water related to the storage of CCR from the power plants are discussed in **Section 4.8, Water Resources – Ground Water**. Beneficial use of CCR from the power plants would also likely continue into the future, and the CCR generated from project area coal would contribute to the total amount of CCR available for beneficial use in proportion to the amount generated.

4.21.4 Alternative 3 – Proposed Action Plus Environmental Protection Measures

The effects of Alternative 3 would be the same as those described for Alternative 2 – Proposed Action.

4.21.5 Irreversible and Irretrievable Commitment of Resources

There is no irreversible or irretrievable commitment of resources related to solid or hazardous waste because waste is not considered a resource.

4.22 NOISE

This section discloses the direct and indirect noise impacts on residents in the analysis area that may occur as a result of the No Action (Alternative 1), the Proposed Action (Alternative 2), and the Proposed Action Plus Environmental Protection Measures (Alternative 3); cumulative impacts are disclosed in **Chapter 5**. The analysis area is described in **Section 3.22, Noise**.

4.22.1 Analysis Methods and Impact and Intensity Thresholds

4.22.1.1 Analysis Methods

Existing noise levels in Colstrip were estimated using measured noise levels from other similar rural environments (e.g., remote locations, small towns, agricultural areas, etc.), and using predicted noise levels assuming the Colstrip Power Plant operations were the primary nighttime noise source (Bradley 1985). Environmental noise levels were described by the A-weighted noise level (dBA), while overpressure noise levels from blasting were described by the flat-weighted noise level (decibels or dB). These terms are more fully defined in the following section. Because noise is dependent on distance between the source and receiver, the noise-prediction locations were selected to be the nearest residences to the project area, the Colstrip Power Plant, and the Rosebud Power Plant. While other residences were sometimes in the same area as the prediction residence, their predicted noise levels were lower than those residences identified because they were further away. If noise impacts had been found at any residences, additional residences would have been added to the analysis to identify all possible impacted locations.

4.22.1.2 Impact and Intensity Thresholds

The thresholds of change for the intensity of noise impacts are described in **Table 163**. Impacts are discussed in the sections below.

Table 163. Noise Impact and Intensity Thresholds.

Impact Intensity	Intensity Description
Negligible	Noise levels would not be affected, or the effects would be at or below the level of detection and the changes would be so slight that they would not be of any measurable or perceptible consequence to area residents. Noise Levels less than 35 dBA would be considered negligible in terms of effects.
Minor	Changes in noise levels would be detectable, although the effects would be localized, small, and of little consequence to area residents. Noise levels between 35 dBA and 45 dBA would be considered minor in terms of effects.
Moderate	The effects on noise levels would be readily detectable with consequences at the local level. Noise levels between 45 dBA and 55 dBA would be considered moderate in terms of effects.
Major	The effects on noise levels would be obvious and would have substantial consequences to area residents. Noise levels greater than 55 dBA would be considered major in terms of effects.

Impacts are also defined as short-term, or long term, or both (see **Section 4.1.1, Definitions**).

4.22.2 Alternative 1 – No Action

Under the No Action alternative, Western Energy would not develop the project area. The existing noise sources described in **Section 3.22, Noise** would continue since any changes associated with development of the project would not occur.

The No Action alternative would not change the status of other areas of the Rosebud Mine that are currently permitted and being mined and/or reclaimed by Western Energy (see **Section 2.2, Existing Operations**) nor would it affect development of any other proposed Rosebud Mine areas currently in the permitting process (see **Section 5.2.2, Related Future Actions**). Noise generated by ongoing mining operations in Areas A, B, and C and adjacent lands would continue similar to current conditions until all of the coal is removed (around 2020 for Areas A and C and 2030 for Area B; see **Section 2.2, Description of Existing Mine and Reclamation** and **Figure 3**).

4.22.3 Alternative 2 – Proposed Action

Mining noise would eventually shift from the current mining locations in Areas A through C to the project area and would use the same mining equipment for extracting and transporting the coal (see **Section 2.2, Description of Existing Mine and Reclamation** and **Figure 3)**. Reclamation of Areas A through C would be concurrent with mining in the project area. The following describes the direct and indirect noise impacts.

4.22.3.1 Direct Impacts

The primary sources of noise from surface coal-mining include blasting operations and the excavation and hauling of the coal off-site. For blasting air overpressure (noise level), applicable noise limits are a maximum of 120 dB to minimize human annoyance, and 134 dB to protect against damage to residential structures (USDI 1987). For excavating, hauling, and other non-blasting sources EPA recommends an outdoor noise limit of 55 dBA (L_{dn}). This corresponds to a limit of 55 dBA during the daytime hours (7 a.m. to 10 p.m.) and 45 dBA during the nighttime hours (10 p.m. to 7 a.m.) (EPA 1974). Because the mining operations are proposed to occur 24 hours per day and 7 days per week, the constraining guideline is 45 dBA. The following describes the expected noise from each operation and the potential noise impacts on the nearest residences in each direction from the site.

Blasting within the project area is expected to occur with similar frequency to what is ongoing today in Areas A through C, which includes coal blasting one to three days per week and overburden blasting four to six times per month. **Table 164** provides the predicted air overpressure levels at different distances to the largest and most critical expected blast (Marcus 2014). The predicted overpressure limit of 120 dB is reached at a distance of 450 feet from the blast, and dissipates to around 88 dB at the nearest residence 2.2 miles away. Thus, only locations within 450 feet of the blasting are predicted to result in any human annoyance as previously described. These predicted levels are considered to be conservatively high because terrain—which impedes noise propagation—was not taken into account. Thus, no air overpressure impacts are expected from blasting in the project area.

Table 164. Predicted Air Overpressure Levels from Project Blasting.

Distance to Blast (feet)	Distance to Blast (miles)	Pounds per Delay (pounds)	Scaled Distance (feet / pounds $^{1/3}$)	Predicted Audible Air Overpressure (dB)
450	0.09	30,030	15	120
1,242	0.20	30,030	41	110
3,424	0.60	30,030	114	100
9,441	1.80	30,030	314	90
26,030	4.90	30,030	867	80
71,768	14.00	30,030	2,390	70
197,874	37.00	30,030	6,589	60
545,570	103.00	30,030	18,166	50
1,504,220	285.00	30,030	50,086	40

Source: Marcus 2014.

The noise generated from mining in the project area was predicted at the seven nearest known residential receptors, as well as in Colstrip, shown in **Figure 64**. These predictions were made using the SoundPLAN v7.4 software program implementing the Nord2000 General Prediction Method (Delta 2002), which is a proven standard for large sites with substantial terrain. Ground elevations were taken from Google Earth™ and the terrain was modeled as 100-percent reflective in order to be conservative and predict the highest potential noise levels at each receptor. **Table 165** provides the sound power-level input data for each noise source (emission factors) within each frequency band in hertz (Hz) and **Figure 115** shows the relative location of mining noise sources and residences. The 'acoustic center' of each noise source was assumed to be located 10 feet above the ground except the draglines and haul trucks, which were assumed to emit noise from a point 16 feet above the ground. All noise-level predictions at the residences were made at a height of 5 feet above the ground.

Table 165. Sound Power Levels for Mining Operations.

Equipment	31.5 Hz (dB)	63 Hz (dB)	125 Hz (dB)	250 Hz (dB)	500 Hz (dB)	1 kHz (dB)	2 kHz (dB)	4 kHz (dB)	8 kHz (dB)	Overall (dBA)
Dragline	143	143	133	123	123	113	103	100	93	124
Dozer	117	111	116	116	105	107	104	95	84	112
Front end loader / backhoe	125	121	116	103	95	112	103	89	79	113
Moto grader / hydraulic excavator	101	99	110	104	101	110	103	94	89	112
Coal drill	125	128	129	124	125	121	119	114	107	126
Coal haul truck / dump truck	104	117	110	108	102	104	101	95	87	108
Maintenance truck	101	114	107	105	99	101	98	92	84	105

Source: Hankard 2012; FIPR 1996; SoundPLAN 2015; EPA 1971.

As shown in **Figure 115**, the noise model included four haul trucks and five water trucks along the haul road, as well as four clusters of mining operations located as close to each residential receptor as possible. Each mining operation cluster included a dragline, bulldozer, front-end loader, scraper, and drill rig; it was assumed that all sources in all clusters were operating simultaneously. The resulting predicted worst-case noise levels are shown in **Table 167**. As shown, all levels are below the nighttime limit of 45 dBA. This result is not unexpected as most receptors are more than 2 miles from the nearest mining activities. Therefore, the predicted project mining noise levels would be in compliance with EPA guidelines. For mine workers and equipment operators in close proximity to mining noise sources, protective hearing devices would be worn in accordance with MSHA regulations when exposed to loud noise sources. Noise impacts on wildlife are discussed in **Section 4.12, Fish and Wildlife Resources** and **Section 4.13, Special Status Species**.

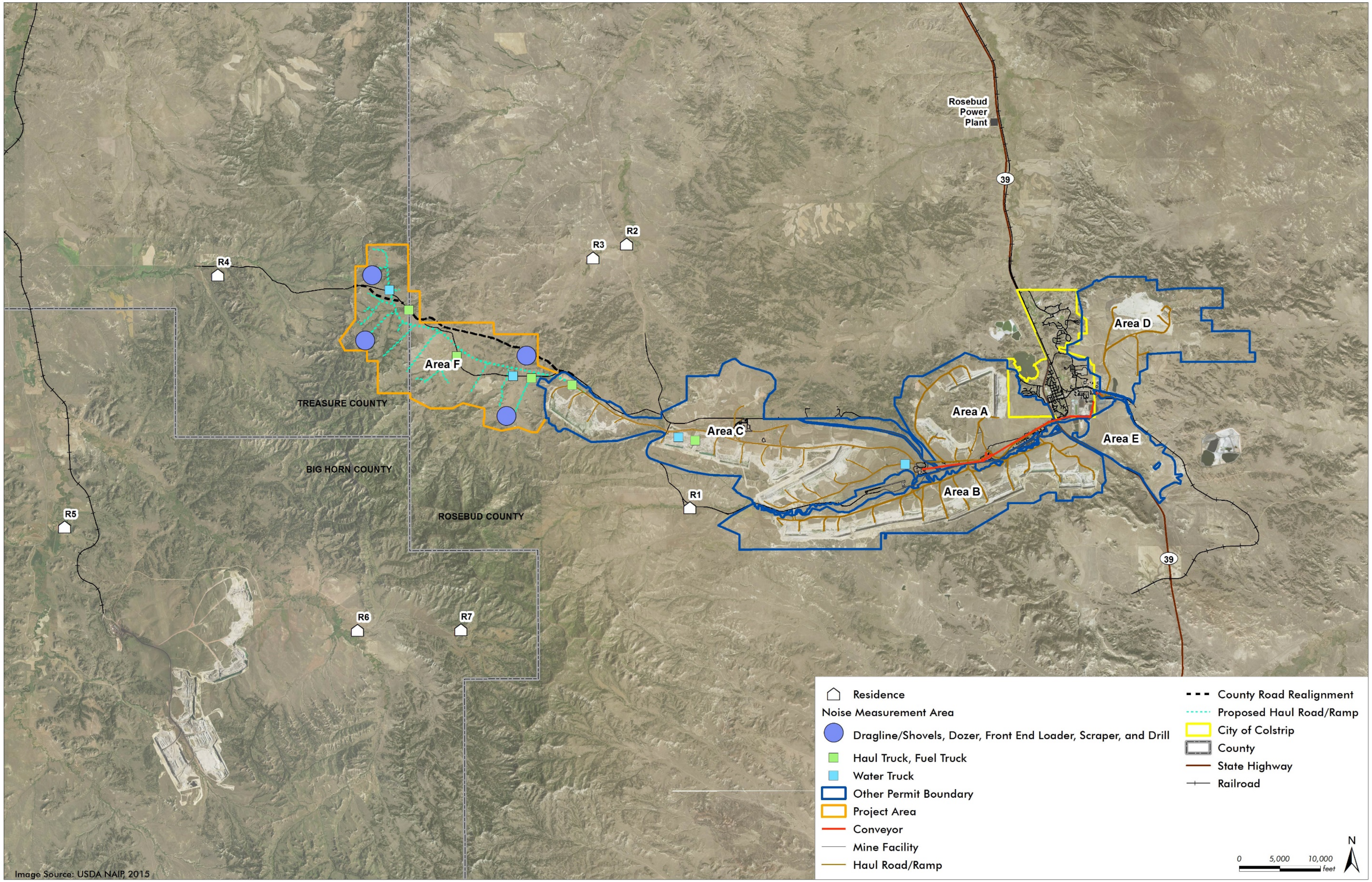

Figure 115. Rosebud Mining Noise Prediction Model Layout.

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Table 166. Predicted Noise Levels from Mining in the Project Area.

Location	Maximum Noise Level (dBA)	Abandoned Property (Yes/No)	Noise Impact and Intensity Threshold
R1	< 40 dBA	No	Minor
R2	41 dBA	No	Minor
R3	42 dBA	No	Minor
R4	41 dBA	No	Minor
R5	< 30 dBA	Unknown	Negligible
R6	< 30 dBA	No	Negligible
R7	< 30 dBA	No	Negligible
Colstrip	< 30 dBA	N/A	Negligible

4.22.3.2 Indirect Impacts

Indirect noise impacts would include noise from the Colstrip Power Plant (Units 3 and 4 after dry-stack conversion) and its associated paste plant, plus the Rosebud Power Plant because coal from the project would be combusted in the power plants. Noise from Colstrip Power Plant Units 1 and 2 is analyzed as cumulative effects in **Chapter 5**, because coal from the project would not be combusted in these units. Noise from the Colstrip Power Plant was estimated based on noise measurements (Hankard 2015) of other power plants and estimations (Bradley 1985). The nearest residences to the Colstrip Power Plant's paste plant are 4 miles west in Colstrip; thus, its noise-level impact is below the intensity threshold and not discussed any further.

The noise from operating Colstrip Power Plant Units 3 and 4 at full capacity is estimated (Bradley 1985) to be 59 dBA at 1,000 feet away. Noise from its associated cooling tower to the west of the plant is estimated at 56 dBA at 1,000 feet. The nearest residences to these two noise sources are in Colstrip about 1,500 feet west of the cooling towers and 2,700 feet from Units 3 and 4. This equates to a total noise level of 54 dBA attributable to the Colstrip Power Plant. A measured level of a similar coal-fired power plant (Hankard 2015) would suggest that this is a reasonable estimate. Based on these estimates, the impact of noise from the Colstrip Power Plant when operating at full capacity would be considered long-term, moderate, and adverse for these nearest Colstrip residences. With regard to the seven residences nearest to the project area (see **Figure 115**), estimated Colstrip Power Plant noise levels would be less than 30 dBA because all residences are at least 9 miles from the Colstrip Power Plant. This would be considered a less-than-negligible impact.

The Rosebud Power Plant, which is about 6.5 miles north of the Colstrip Power Plant, is also a consideration for indirect noise impacts. This single unit produces about 42 MW (DEQ Montana 2014), which is estimated to produce about 45 dBA at 1,000 feet. The noise from the associated air-cooled condenser unit is estimated to produce about 52 dBA at 1,000 feet for a total of 53 dBA at 1,000 feet. The nearest residences (R8 to R17) range from 1,000 to 3,500 feet away (**Figure 116**), which equates to an estimated noise level range of 42 to 53 dBA. This would correlate to a long-term minor to moderate adverse impact. With regard to the estimated Rosebud Power Plant noise levels at the seven residences nearest to the project area and the city of Colstrip (see **Table 167**), they would all be less than 30 dBA because they are all at least 6 miles from the Rosebud Power Plant. This would be considered a less-than-negligible impact.

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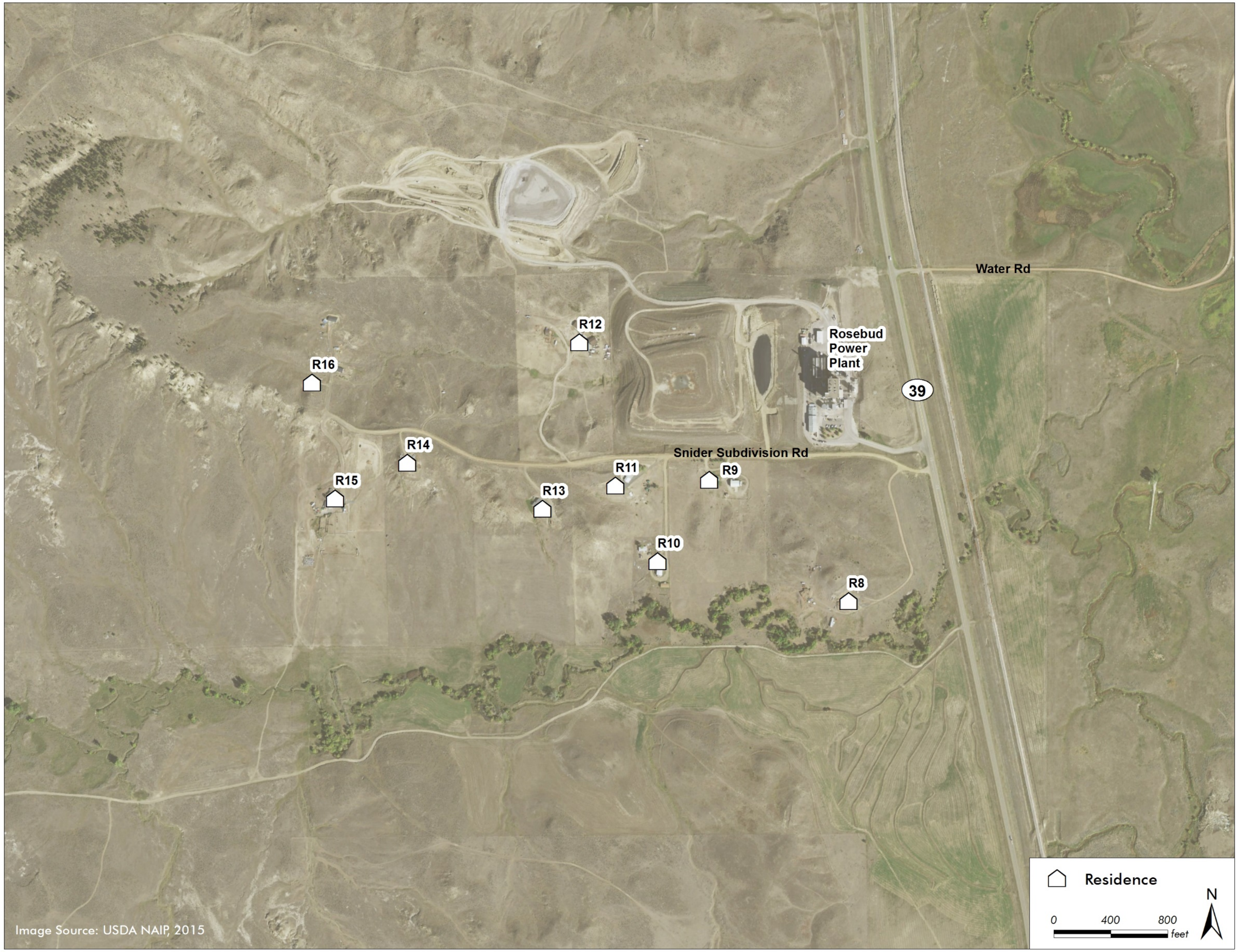

Figure 116. Rosebud Power Plant Noise Prediction Model Layout.

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Table 167. Predicted Noise Levels from Rosebud Power Plant.

Location	Maximum Noise Level (dBA)	Abandoned Property (Yes/No)	Noise Impact and Intensity Threshold
R8	52 dBA	Unknown	Moderate
R9	53 dBA	Unknown	Moderate
R10	49 dBA	Unknown	Moderate
R11	49 dBA	Unknown	Moderate
R12	48 dBA	Unknown	Moderate
R13	46 dBA	Unknown	Moderate
R14	44 dBA	Unknown	Minor
R15	42 dBA	Unknown	Minor
R16	42 dBA	Unknown	Minor
R17	42 dBA	Unknown	Minor

4.22.4 Alternative 3 – Proposed Action Plus Environmental Protection Measures

The noise impacts of Alternative 3 would be the same as those described under Alternative 2 – Proposed Action.

4.22.5 Irreversible and Irretrievable Commitment of Resources

No irreversible or irretrievable commitment of resources would be associated with noise.

4.23 LAND USE

This section discloses the direct and indirect effects on land use resulting from the No Action (Alternative 1), the Proposed Action (Alternative 2), and the Proposed Action plus Environmental Protection Measures (Alternative 3); cumulative impacts are disclosed in **Chapter 5**. The analysis area is described in **Section 3.23, Land Use**. Impacts on recreation land uses are discussed in **Section 3.18, Recreation**.

4.23.1 Analysis Methods and Impact and Intensity Thresholds

4.23.1.1 Analysis Methods

Land-use impacts were determined based on the information contained in the PAP. The PAP provided project area mining areas and land-use areas defined in MSUMRA (82-4-203, MCA) as specific uses or management-related activities.

4.23.1.2 Impact and Intensity Thresholds

The thresholds of change for the intensity of impacts on land use are described in **Table 168**. Impacts are discussed in the sections below.

Table 168. Land Use Impact and Intensity Thresholds.

Impact Intensity	Intensity Description
Negligible	The effects would be at low levels of detection and would not have appreciable effects on land use.
Minor	The effects would be detectable and would be of a magnitude that would not have appreciable effects on land use.
Moderate	The effects would be readily apparent and would result in measurable effects on land use.
Major	The effects would be readily apparent, would result in substantial effects on land use, and would be markedly different from existing conditions.

Impacts are also defined as short-term, long-term, or both (see **Section 4.1.1, Definitions**).

4.23.2 Alternative 1 – No Action Alternative

Under the No Action alternative, Western Energy would not develop the project area. The land uses described in **Section 3.23, Land Use**, would continue because any changes associated with development of the project would not occur. There would be no impact on the utility corridors.

The No Action alternative would not change the status of other areas of the Rosebud Mine that are currently permitted and being mined and/or reclaimed by Western Energy (see **Section 2.2, Existing Operations**) nor would it affect development of any other proposed Rosebud Mine areas currently in the permitting process (see **Section 5.2.2, Related Future Actions**).

4.23.3 Alternative 2 – Proposed Action

During the life of the operation, use of the lands within the direct effects analysis area would be devoted to mining and associated activities. All current land uses within the analysis area would be temporarily disturbed during mine operations based on the timing of the approved mine plan (see PAP, Exhibit A). Western Energy would grade, apply soil, and seed each mine pass within two years of mining (see **Figure**

9); however, this analysis assesses land uses permitted area-wide and does not consider contemporaneous reclamation that would occur during active mining.

4.23.3.1 Direct Impacts

Primary Land Uses

Because most of the lands in the direct effects analysis area are currently managed as grazing land, livestock grazing by Booth Land and Livestock Company would be the land use most impacted by mining operations. Impacts would occur during mine operations (approximately 19 years; see **Section 2.2.3, Life of Operations**) and would extend until the postmining land use, domestic livestock grazing, is achieved through reclamation (see **Section 2.4.4, Reclamation Plan**). Impacts on grazing land would be long-term, moderate, and beneficial. However, Western Energy proposes 3,930 acres of postmine grazing land, which would be an increase of 476 acres over pre-mine conditions, to achieve landowner preference for grazing lands (PAP).

Similarly, impacts on cropland would occur during the period of active mining and would extend until the postmining land use, cropland, is achieved (see **Section 2.4.4, Reclamation Plan**). During active mining, there would be no cropland. Impacts on cropland would be long-term, moderate, and adverse. After reclamation, Western Energy proposes 318 acres of cropland, which would be a 32-percent reduction from pre-mine conditions.

Western Energy does not propose pastureland as a postmining land use, so the 516 acres of existing pastureland that Western Energy proposes to disturb during mining operations would be permanently converted to grazing land. Impacts on pastureland would be long-term, major, and adverse. However, Western Energy and the respective landowners previously agreed upon the change in land use based on the landowners' preference for additional grazing land over cropland (PAP).

Table 169 shows pre-mine and postmine land use and acreages. All the lands within the proposed permit area have a joint land use of wildlife habitat. Fish and wildlife habitat acres included in **Table 169** are wildlife-specific acres—e.g., wetlands. Impacts on fish and wildlife habitat are discussed in detail in **Section 3.12**, **Fish and Wildlife** and **Section 3.13, Special Status Species**.

Table 169. Pre-Mine and Postmine Primary Land Uses and Acreage.

Pre-Mining Land Use	Pre-Mine Permit Acres[1]	Acres to be Disturbed [1]	Postmine Land Use	Postmine Revegetation Target Acres*
Cropland	513	469	Cropland	318
Fish and Wildlife Habitat[1]	12	8	Fish and Wildlife Habitat	9
Grazing Land	5,666	3,229	Grazing Land	3,930
Pastureland	537	516	Pastureland	0

[1]Adapted from Table 313-1 from Western Energy's 8/2016 PAP.
[2]Fish and wildlife habitat acres included are wildlife specific acres (e.g., wetlands).

Other Land Uses

There would be no impacts on forestry or residential land uses as a result of the Proposed Action.

Impacts on developed water resources (i.e., stock ponds) located within the area of disturbance within the project area are discussed in **Section 3.9, Water Resources – Water Rights**.

Industrial or commercial uses would be relatively unaffected. Western Energy would mine around the 230-kV high-voltage transmission line owned by Mid-Yellowstone that bisects the southern portion of the project area, leaving a 300-foot buffer. Likewise, Western Energy would mine around the 1.4 miles of a 12-inch underground natural gas transmission pipeline owned and operated by Westmoreland Power, Inc. in the northern portion of the project area. About 10 miles of 7.2-kV distribution lines within the project area would be relocated (see **Section 2.4.3.3, Utility Corridors in Proposed Permit Area**). To accommodate the proposed mine plan, Western Energy would relocate the Horse Creek Road (see **Section 2.4.3.4, Roads** and **Section 3.20, Access and Transportation**). There would be a temporary disturbance to local traffic during road construction. Impacts on recreation land uses are discussed in **Section 3.18, Recreation**. Impacts on Other land uses would be short-term, minor, and adverse.

Adjacent Land Uses

Adjacent land use during mine operations would be affected to some extent; these impacts are described in **Sections 3.22, Noise**; **3.17**, **Visual Resources;** and **3.12, Fish and Wildlife**. There would be no impacts on land uses in and immediately surrounding Colstrip.

4.23.3.2 Indirect Impacts

The Proposed Action would not create unplanned development or present the potential to open up new off-site areas for development. The Proposed Action would not create improved access to real estate, reduce development restrictions, or substantially induce new development in unanticipated areas. Therefore, there would be no indirect impacts on land use associated with the Proposed Action.

4.23.4 Alternative 3 – Proposed Action Plus Environmental Protection Measures

The effects of Alternative 3 on land use would be similar to those described under Alternative 2 – Proposed Action. Loss of soil productivity and associated loss of cropland/grazing land productivity would vary among the action alternatives with productivity potentially returning to postmine conditions more quickly under Alternative 3 than under the Proposed Action.

4.23.5 Irreversible and Irretrievable Commitment of Resources

Grazing and cropland production on mine-related disturbance areas within the project area would be lost until revegetation and forage production are comparable to pre-mining levels associated with adjacent land. These resources would be irretrievably affected. Western Energy does not propose pastureland as a postmining land use, so the 516 acres of existing pastureland that Western Energy proposes to disturb during mining operations would be permanently converted to grazing land.

4.24 SOIL

This section discloses the direct and indirect effects on soil in the analysis area resulting from the No Action (Alternative 1), the Proposed Action (Alternative 2), and the Proposed Action Plus Environmental Protection Measures (Alternative 3); cumulative impacts are disclosed in **Chapter 5, Cumulative Impacts**. The analysis area is described in **Section 3.24, Soil**.

4.24.1 Analysis Methods and Impact and Intensity Thresholds

4.24.1.1 Analysis Methods

Direct Effects

The soil investigations for the project area conducted for Western Energy in 2007 and 2011 and updated in 2015 (PAP, Appendix G) and the PAP were used to assess the direct impacts on soil. Detailed soil mapping was completed using standard Natural Resources Conservation Service (NRCS) soil-survey methods. The soil investigations provide descriptions of field, laboratory, and interpretation methods (PAP, Appendix G). Laboratory analyses were performed for selected physical and chemical parameters of the soil according to criteria outlined in DEQ guidelines (1998) and include the following: particle size distribution (soil texture), rock content, percentage organic matter, soil pH, electrical conductivity, saturation percentage, sodium adsorption ratio, selenium, boron, and molybdenum. These parameters were used to determine volumes of salvageable soil for use in reclamation of disturbances.

Indirect Effects

There has not been a soil-sampling program to test for trace metals within the analysis area, so there is no direct comparison of trace-metal concentrations within the analysis area to regional trace-metal background concentrations. A USGS geochemical study (Smith et al. 2013) that estimated background concentrations of soil trace metals was used in conjunction with the air quality modeling results (described in **Section 4.3, Air Quality**) and Eco-SSLs of trace metals for plants and soil invertebrates to infer potential indirect impacts from trace-metal emissions on soil within the indirect effects analysis area.

The USGS geochemical study was based on analytical results of 11 surface soil samples (0–5 centimeters) collected in the region of the Colstrip and Rosebud Power Plants, but most were collected outside the 32-km analysis area (two were from within the analysis area) (see **Section 3.24.1.2, Analysis Area** for sample locations). The detailed air-quality modeling methods and results are presented in **Section 4.3, Air Quality**. One purpose of the modeling was to determine the distance from the Colstrip Power Plant at which 1 percent of the 95 percent Upper Confidence Limit on the mean (95-percent UCL) of background concentrations resulting from combustion of project area coal over a 19-year operations period—the years the power plants would combust project area coal—would be reached. The predicted distance thresholds were used to determine the 32-km analysis area (see **Section 3.24.1.2, Analysis Area**).

The Eco-SSLs for plants and soil invertebrates were used for the analysis because soil invertebrates play an important role in nutrient cycling and soil pore space characteristics, and vegetation is an important component in protecting the soil from erosive forces and adds organic matter and nutrients to the soil. As long as a healthy soil invertebrate community and vigorous and diverse vegetative cover exist, soil productivity should remain healthy.

4.24.1.2 Impact and Intensity Thresholds

The thresholds of change for the intensity of an impact on soil are defined in **Table 170** and are used to describe the impacts in the sections below.

Table 170. Soil Impact and Intensity.

Impact Intensity	Intensity Description
Negligible	The effects on soil would be below or at a very low level of detection. Any effects on productivity or erosion potential would be slight.
Minor	The effects on soil would be detectable. The effects would change a soil's profile in a relatively small area but would not appreciably increase the potential for erosion of additional soil.
Moderate	The action would result in a change in quantity or alteration of the topsoil, overall biological productivity, or the potential for erosion to remove small quantities of soil. Changes to localized ecological processes would be limited.
Major	The action would result in a change in the potential for erosion to remove large quantities of soil or in alterations to topsoil and overall biological productivity in a relatively large area. Key ecological processes would be altered, and landscape-level changes would be expected.

Impacts are also defined as short-term, long-term, or both (see **Section 4.1.1, Definitions**).

4.24.2 Alternative 1 – No Action

Under the No Action alternative, Western Energy would not develop the project area. There would be no impact on soil described in **Section 3.24, Soil** because none of the disturbances associated with development of the project area would occur.

The No Action alternative would not change the status of other areas of the Rosebud Mine that are currently permitted and being mined and/or reclaimed by Western Energy (see **Section 2.2, Existing Operations**), nor would it affect development of any other proposed Rosebud Mine areas currently in the permitting process (see **Section 5.2.2, Related Future Actions**).

4.24.3 Alternative 2 – Proposed Action

4.24.3.1 Direct Impacts

Under the Proposed Action, 4,260 acres would be disturbed by mining operations at the project area. Impacts on soil in the disturbance area would determine, in part, the potential success of reclaiming the land to postmining uses.

Western Energy's proposed mine plan (see **Section 2.4.3, Mine Plan**), reclamation plan (see **Section 2.4.4, Reclamation Plan**), and measures to control on-site erosion and sediment transport (see **Section 2.4.5.2, Surface Water Management and Sediment-Control Measures**) would mitigate some disturbance impacts and increase reclamation success; however, some direct effects, which are typical of any operation where soil is removed, would persist.

Some of the soil from the project area disturbance would be direct-hauled, and the rest would be stored and then later respread. Direct impacts on soil would include:

- soil erosion in disturbed areas and of salvageable soil through handling
- changes in physical, chemical, and biological characteristics of soil from salvage, storage, and respreading (leading to reduced soil productivity and decreased soil development)

Soil Erosion

Areas cleared of vegetation would be susceptible to soil erosion from wind and water. Erosion of soil would also occur as a result of soil removal and storage during mine operations and soil exposure during respreading and stabilization. Soil erosion caused by wind and water likely would occur during all phases of the project. Soil erosion on disturbed areas would likely occur until vegetation is established and surfaces are protected from erosive forces. Based on modeled sediment rates at 75 drainages in Areas A, B, C, D, and E at the Rosebud Mine, pre-mining average annual sediment yields range from 0.002 to 2.34 tons/acre/year with a mean of 0.24 tons/acre/year. Once vegetation reaches 60–80 percent canopy cover, average annual sediment yields would range from 0 to 2.01 tons/acre/year with a mean of 0.065 tons/acre/year (Sjolund 2015a). It typically takes about 2 years for vegetation (much of which consists of annual plants) on reclaimed sites to provide a sufficient canopy cover to protect the soil from accelerated erosion (Sjolund 2015b). Some areas such as steep slopes—especially south- and west-facing slopes—may require more time for the ground cover to stabilize reclaimed areas. Western Energy is required under MSUMRA (ARM 17.24.723) to monitor vegetation success in reclaimed areas for a minimum of 10 growing seasons to ensure production, cover, and density meet the approved success standards and that a stable landscape has been established consistent with the approved postmining land use (see **Section 2.4.7.4, Revegetation Monitoring Plan**). Erosion impacts on soil resources would be short-term, minor, and adverse, and would return to pre-mine erosion rates within 2 years once vegetation stabilizes the surface.

Sediment

Existing sediment yield to drainages within the analysis area was estimated by the USDA Water Erosion Prediction Project (WEPP), and postmine sediment yield to drainages within the analysis area was estimated by the Sediment, Erosion, Discharge by Computer Aided Design (SEDCAD) (see **Section 4.7, Water Resources – Surface Water**). Existing annual sediment yields ranged from 0 to 0.871 tons/acre/year and ranged from 0.001 to 0.18 tons/acre/year for postmine conditions once vegetation cover reaches 80 percent. The model estimated that postmine sediment yield would increase in some drainage basins within the direct effects analysis area and decrease in other drainage basins (see **Section 4.7, Water Resource – Surface Water** for discussion of sediment yield in drainage basins).

Other direct effects on soil resources include the potential for sediment to be transported off-site and to impact off-site resources. In general, the larger the disturbance, the greater the potential for soil erosion. This effect would be unlikely because runoff would be directed to sediment storage structures, but it could possibly occur during very heavy storm events where disturbances are unprotected. Approximate disturbances resulting from Alternatives 2 and 3 encompass 4,260 acres (see **Section 2.4.1, Permit and Disturbance Areas**). The disturbance acres would include the mining areas, stockpile areas, scoria pits, haul roads, haul-road ramps, proposed overhead power line, proposed shoefly (high-voltage line), and relocation alignment of Horse Creek Road.

Changes to Physical, Chemical, and Biological Soil Characteristics

Soil characteristics that would be impacted by the Proposed Action include physical and chemical properties and soil biota. Loss of soil structure through mechanical handling followed by tillage to relieve compaction would alter the native soil profile. This soil handling would adversely affect soil/plant interaction due to decreased soil water-holding capacity, loss of aeration and pore space, and increased bulk density (Sharma and Doll 1996). Soil compaction, loss of soil structure, and loss of organic matter due to mixing and storage could lower postmining vegetation vigor and diversity for an extended period of time. Developing root systems, infiltration of biota, climate, and physical processes such as freezing/thawing cycles would restart the soil-forming process and help establish a new natural soil profile over time. However, this process would require decades.

Chemical effects occur in soil stockpiled for prolonged periods. Degradation of chemical properties may include changes in available nutrients, accumulation of ammonium, and the loss of organic carbon through heat and leaching. When the input of organic matter ceases, there is a reduction or loss of nutrient levels (Strohmayer 1999). Changes in biological properties also occur in soil that is stored for prolonged periods—most importantly the loss of soil microorganisms such as mycorrhizal fungi (Abdul-Kareem and McRae 1984). Many plants depend on mycorrhizae, which are important structures that develop when certain fungi and plant roots form a mutually beneficial relationship. They are of great importance to phosphorus nutrition and water uptake in plants (Skujins and Allen 1986). The association of mycorrhizae with plants in southeastern MT is especially critical because of the semiarid climate and naturally low plant-available phosphorus levels in soil (Muir 1971). The loss of microorganisms in soil stored for prolonged periods could lower plant diversity and vigor, but eventually mycorrhizae would invade reclaimed soil (within a few years to more than a decade, depending on soil conditions). Mycorrhizae seem to be sensitive to soil properties such as organic matter, salts, structure, and water-holding capacity, so when respread soil conditions start improving, mycorrhizae would colonize more quickly. Impacts on physical, chemical, and biological soil characteristics would be long-term, minor, and adverse. It would be many years before these soil characteristics return to pre-mine conditions.

4.24.3.2 Indirect Impacts

Trace-Metal Deposition

The modeling results, which were based on 1 percent of the 95-percent UCL of the USGS soil trace-metal background concentrations (see **Section 4.24.1.1**, **Analysis Methods**), showed that the threshold of 0.00016 milligrams/kilogram (mg/kg) mercury dry weight in soil would be reached at a distance of about 32 km from the Colstrip and Rosebud Power Plants after 19 years of coal combustion (see **Table 171** and **Table 172**). The concentration of the 1 percent of the 95-percent UCL of background is referred to as the threshold soil concentration. At less than 32 km, mainly to the northwest and southeast of the Colstrip and Rosebud Power Plants (the prevailing wind directions), mercury deposition over a 15-year period would be greater than the threshold soil concentration; beyond 32 km, mercury deposition would be less than the threshold soil concentration (see **Table 171** and **Table 172**).

The distances for the 1 percent of the 95-percent UCL of background (or buffers) for the other trace metals modeled (antimony, arsenic, cadmium, chromium, copper, lead, and selenium) are less than that for mercury (see **Table 171** and **Table 172**). For example, selenium has the largest buffer area after mercury with a distance of 12.6 km. For the other metals, the buffer distance is 0 km. In other words, the threshold soil concentrations would not be exceeded outside the Colstrip and Rosebud Power Plant site boundaries.

Table 171 and **Table 172** show the predicted maximum deposition over a 19-year operations period for each trace metal and the total expected concentration for each trace metal (background plus the maximum deposition). For all trace metals (those having sufficient data to derive screening levels), the background concentration plus the maximum deposition over 19 years is less than the plant and soil invertebrates SSLs, except for selenium (for plant SSL only). This implies that the increase in soil metal concentrations due to combustion of project area coal over 19 years would not affect plants and soil invertebrates, except selenium could have an adverse impact on plants. The total deposition for selenium (0.032 mg/kg) is 6.2 percent of the Eco-SSL for plants and causes a 14 percent increase of the selenium concentration above the Eco-SSL for plants. The Eco-SSLs, however, are derived to be protective (i.e., the conservative end of the exposure that could affect species distribution) (EPA 2007). In addition, EPA reports that the Eco-

SSL selenium value for plants is lower than the 95th percentile of typical background concentrations of selenium in both western and eastern U.S. soil, and is lower than the 75th percentile for western U.S. soil (EPA 2007). This is the case within the analysis area; the Eco-SSL selenium value for plants is lower than the 95-percent UCL background used in the modeling analysis.

The maximum selenium deposition of 0.032 mg/kg was modeled to be along the Colstrip Power Plant site boundary, about 800 meters south-southeast of Units 3 and 4. At a distance less than 12.6 km, selenium deposition would exceed the threshold soil concentration for selenium, and more than 12.6 km from the Colstrip Power Plant, selenium deposition would be less than the threshold soil concentration for selenium.

Soil selenium levels within the project area (PAP, Appendix G, Addendum A), which is about 20 km west of the Colstrip Power Plant, and in the other mine areas at the Rosebud Mine where selenium levels were determined are lower than DEQ's suitability limit for soil used in reclamation (0.1 mg/kg) throughout the entire soil profile (Calabrese, pers. comm. 2015). The low selenium levels of the soil surface horizon, which is deeper than 5 cm, cannot be directly compared with the USGS samples, which were from 0–5 cm, but they do show that selenium levels in soil surface horizons (the primary root zone) at the project area are significantly lower than the background selenium concentration used in the analysis.

Given that the Eco-SSLs are conservative and the selenium SSL for plants is lower than the selenium 95th percentile of background in typical U.S. soil, and given the low selenium levels found in project area soil, at a distance less than 12.6 km from the Colstrip Power Plant, selenium may have a long-term, minor, and adverse impact on plants and soil resources. Beyond that distance, the impact likely would be negligible.

Table 171 and **Table 172** also show the total concentrations limits, or total original concentrations, of a solid at which EPA would require a Toxicity Characteristic Leaching Procedure (TCLP) test (Method 1311, Section 1.2) (EPA 1992). TCLP is an analytical test to determine the mobility of metals in a solid, such as soil, and if the solid meets the definition of the EPA toxicity level for solid waste (40 CFR 261.24). This test dilutes the sample weight by 20 times. For example, the TCLP limit for arsenic to meet the toxicity level for solid waste is 5 mg/kg, so the original total arsenic concentration of the solid must be at least 100 mg/kg (20 times more than the TCLP limit for soil waste). These total concentration limits range from twice as high for cadmium to over 150 times as high for mercury compared to the total expected concentration (background plus maximum total deposition) within the analysis area. At the extreme end, it would require over 10,000 years at the predicted maximum deposition flux for selenium to reach concentrations that would require TCLP testing for solid waste, and over 200,000 years for arsenic.

Table 171. Trace Metal Background, Total Concentrations, and Ecological SSLs for Plants.

Analyte	Background – 95-Percent UCL	Maximum Deposition over 19-Year Operations Period[1]	Total Expected Concentration (Background + Total Deposition)	EPA Limit for Solid Waste Test	Eco-SSL for Plants	Percent of Deposition Relative to Background	Percent of Deposition Relative to Plant Eco-SSL	Does Deposition + Background Exceed the Plant Eco-SSL? (Yes/No)
	mg/kg, DW	mg/kg, DW	mg/kg, DW	mg/kg	mg/kg, DW	Percent	Percent	
Antimony	0.9	0.005	0.905	None	NA	0.56	NA	No
Arsenic	10.9	0.007	10.907	100	18	0.06	0.04	No
Cadmium	0.3	0.002	0.302	20	32	0.63	0.01	No
Chromium	50.5	0.018	50.518	100	NA	0.03	NA	No
Copper	17.8	0.081	17.881	None	70	0.46	0.12	No
Lead	19.1	0.008	19.108	100	120	0.04	0.01	No
Mercury	0.023	0.001	0.024	4	0.3	3.70	0.28	No
Selenium	0.56	0.032	0.592	20	0.52	5.60	6.10	Yes

NA = Not available. Insufficient data to derive ecological SSLs.
DW = Dry weight.
[1]Assumes an untilled soil mixing depth of 2 centimeters and a soil dry-bulk density of 1.5 g cm-3 as recommended by EPA (2005).

Table 172. Trace Metal Background, Total Concentrations, and Ecological SSLs for Soil Invertebrates.

Analyte	Background – 95-Percent UCL	Maximum Deposition over 19-Year Operations Period[1]	Total Expected Concentration (Background + Total Deposition)	EPA Limit for Solid Waste Test	Eco-SSL for Soil Invertebrates	Percent of Deposition Relative to Background	Percent of Deposition Relative to Soil Invertebrates Eco-SSL	Does Deposition + Background Exceed the Soil Invertebrates Eco-SSL? (Yes/No)
	mg/kg, DW	mg/kg, DW	mg/kg, DW	mg/kg	mg/kg, DW	Percent	Percent	
Antimony	0.9	0.005	0.905	None	78	0.56	1.2	No
Arsenic	10.9	0.007	10.907	100	NA	0.06	NA	No
Cadmium	0.3	0.002	0.302	20	140	0.63	0.2	No
Chromium	50.5	0.018	50.518	100	NA	0.03	NA	No
Copper	17.8	0.081	17.881	None	80	0.46	22.4	No
Lead	19.1	0.008	19.108	100	1,700	0.04	1.1	No
Mercury	0.023	0.001	0.024	4	0.1	3.70	23.9	No
Selenium	0.56	0.032	0.592	20	4.1	5.60	14.5	No

NA = Not available. Insufficient data to derive ecological SSLs.
DW = Dry weight.
[1]Assumes an untilled soil mixing depth of 2 centimeters and a soil dry-bulk density of 1.5 g cm-3 as recommended by EPA (2005).

Sulfur Dioxide and Nitrogen Oxide Deposition

Sulfur and nitrogen oxides emitted from the combustion of coal can be converted into acids (sulfuric acid and nitric acid) in the atmosphere through oxidation and can then return to earth as components of rain and snow. Acidification of the soil through acid deposition can impact microorganisms, leach soil nutrients, and cause aluminum toxicity to plants (Air-quality.org 2017). In turn, this can reduce vegetation vigor and cover, which can increase erosion. Soil that is more alkaline, however, does not suffer the effects from acid deposition as does more acidic soil, because the soil alkalinity buffers the acid rain by neutralizing the acidity in the water flowing through it. This capacity depends on the thickness and chemistry of the soil and the type of bedrock underneath it. In soil with pH conditions above 4.5, and in areas where precipitation is relatively low as in the analysis area, the effects on soil from acid deposition are likely minimal (Air-quality.org 2017).

The soil surface layers in the project area are typically neutral to slightly alkaline (pH 6.6 to 7.8), and the subsoil is typically slightly alkaline to strongly alkaline (pH 7.4 to 9.0) (PAP, Appendix G). In addition, the soil surface layers within the indirect effects analysis area are typically neutral to strongly alkaline, and the subsoil is slightly to strongly alkaline (USDA-SCS 1967, 1975, and 1977). This soil has a capacity to neutralize acid deposition. Given this acid-neutralizing capacity, the relatively low precipitation (15.17 inches annually at Colstrip), the relatively short period of combustion of project area coal (19 years), and the low concentrations modeled of SO_2 and NO_2, which are well below the NAAQS and MAAQS (see **Section 4.3.3.2, Indirect Impacts of Coal Combustion**), impacts on soil within the indirect effects analysis area from acid deposition would be long-term, minor, and adverse.

Given the long-range transport of these gases, however, areas outside the indirect effects analysis area that contain acidic soils could also be impacted by acid deposition (see **Section 3.3.1.2, Air Quality** for a discussion of transport distances). Soil derived from granitic rocks, such as granite and metamorphic rocks derived from granitic parent rocks, is typically acidic and lacks or has little buffering capacity, and therefore, is more vulnerable to acidification (Ecological Society of America 2000). These rocks, however, do not occur within the analysis area, but occur in mountainous areas in WY and western MT. Based on the low concentrations of these gases modeled, impacts on acidic soil also would be long-term, minor, and adverse.

Hazardous Waste

A potential indirect effect on soil resources is from oil and gas spills and releases related to project operations that could occur in other permit areas of the Rosebud Mine. There have not been any known significant hazardous waste releases at the Rosebud Mine in the past, but there have been occasional small oil and gas releases from seal ruptures on large equipment or from overfilling vehicles at fuel islands (Calabrese, pers. comm. 2017). These spills have occurred where the soil had already been stripped and replaced with approved road surfacing material such as rock or spoil. Western Energy has reported spills and releases to DEQ, and the affected material was removed and treated at a land-farm facility (Calabrese, pers. comm. 2017). If minor oil and gas releases or spills occur in undisturbed or reclaimed soil, the impact would be short-term, minor, and adverse. Depending on the characteristics of the released constituent, a major release on undisturbed land could require removing a significant volume of at least the more productive surface soil layer, which would require decades to return to natural productivity. Major releases on undisturbed or reclaimed land, although much less likely than on fueling islands and road surfaces, would have long-term, moderate, and adverse impacts on soil resources.

4.24.4 Alternative 3 –Proposed Action Plus Environmental Protection Measures

The impacts of Alternative 3 on soil resources would be similar to those of Alternative 2, but the intensity would be less due to the following environmental protection measures included in Alternative 3:

- Implement modified reclamation practices related to soil stockpiling, soil redistribution, and seeding in order to better manage water and improve reclamation success (see discussion below in **Section 4.24.4.1, Soil Salvage and Stockpiling)**.
- Incorporate a DEQ-approved, locally available organic amendment such as grass mulch into the upper 4 inches of respread soil (see discussion below in **Section 4.24.4.2, Organic Amendments**).

4.24.4.1 Soil Salvage and Stockpiling

Salvaged soil would be stockpiled (if necessary) and redistributed in a manner consistent with the Wetland Mitigation Plan. Unlike Alternative 2, there would be no loss of wetland soil (and therefore, soil productivity) because soil would be salvaged and either direct-hauled or stockpiled separately and later utilized in wetland-replacement sites.

Stockpiles for all soil types would be contoured to minimize erosion by reducing slope length and increasing water infiltration, thereby promoting vegetation establishment and creating more stable stockpiles. Erosion would be a short-term, minor, and adverse impact on soil resources and would return to pre-mine erosion rates within 2 years once vegetation stabilizes the surface.

4.24.4.2 Organic Amendments

To improve vegetation success on small-acreage problem areas (i.e., areas lacking sufficient organic matter, areas with limited vegetative cover, or areas susceptible to erosion), a DEQ-approved locally available organic amendment such as grass mulch would be incorporated into the upper 4 inches of respread soil to improve nutrient content and the organic-matter level to 1 percent by volume. Grass mulch is already used on other permit areas to mitigate erosion. The use of mulch in isolated areas that show poor vegetation growth would enhance soil productivity in these areas over what would be expected under the Proposed Action.

4.24.5 Irreversible and Irretrievable Commitment of Resources

Some soil would be irreversibly lost under Alternatives 2 and 3 during soil removal and storage, construction and operation of the mine, and reclamation prior to the reestablishment of vegetation. Under Alternative 3, soil stockpiles would be contoured, which would further reduce erosion and provide a more stable stockpile surface. Alternative 3 would also employ tighter postmine topographic control (5-foot contours versus 10-foot contours under the Proposed Action). Tighter elevation control would help minimize runoff and maximize infiltration, and thereby further reduce erosion when compared to Alternative 2.

Under both Alternatives 2 and 3, soil productivity would be irreversibly lost because the Lift 1 soil materials would consist of a mix of topsoil and subsoil. Altering the soil profile would deteriorate soil structure and mix more-fertile topsoil with less-fertile subsoil, which would leave less productive soil in the root zone. Granular soil structure, which occurs mainly in the surface layer, increases water and air movement in the soil; its loss would reduce water and air movement. It would take many years for soil productivity and soil structure to return to pre-mine conditions. This irreversible impact would be magnified in reclaimed areas where respread soil consists of a single-lift salvage of the upper 24 inches (the tree soil salvage class; see **Section 3.24, Soil**). Alternative 3 would utilize mulch in problem areas to improve vegetation success and to minimize erosion. The addition of mulch would improve soil productivity in these areas when compared to Alternative 2.

Irreversible effects on soil productivity would also result from prolonged soil storage in stockpiles and at disturbances that would not be reclaimed until the end of mine life, such as haul roads. These irreversible effects on soil productivity would take many years to return to pre-mine productivity levels.

About 2.9 acres of soil productivity would be irreversibly lost under both Alternatives 2 and 3 along the realignment of Horse Creek Road, which would remain after mine closure. In addition, about 5.1 acres of wetland soil would be permanently lost under the Proposed Action (Alternative 2).

4.25 REGULATORY RESTRICTION OF PRIVATE PROPERTY

In accordance with MCA 75-1-201(1)(b)(iv)(D), state agencies are required to evaluate any regulatory restrictions proposed to be imposed on the proponent's use of private property. This section is included to satisfy this requirement.

Alternatives to the Proposed Action and additional protection measures are designed to further protect environmental, cultural, visual, and social resources, but they can add to the cost of the project. DEQ should, to the degree reasonably practicable, estimate the cost of compliance with any restrictions and the amount of decrease or increase in property value, if any. Some alternatives or measures may be required by federal and state laws and regulation to meet minimum environmental standards, and thus, do not need to be evaluated for extra costs to Western Energy. The federal and state laws that would regulate Western Energy's activities associated with the project are described in **Section 1.4**.

DEQ will perform a final regulatory restrictions analysis when a preferred alternative is selected in the Final EIS.

CHAPTER 5. CUMULATIVE IMPACTS

This chapter assesses the cumulative impacts of the Proposed Action (Alternative 2) and the Proposed Action Plus Environmental Protection Measures (Alternative 3) when analyzed together with past, present, and reasonably foreseeable future actions. Although impacts related to Alternative 2 or Alternative 3 may be minor, when combined with the impacts of past, present, and reasonably foreseeable actions, these impacts may be cumulatively greater.

5.1 INTRODUCTION

Both the Montana Environmental Policy Act (MEPA) and the National Environmental Policy Act (NEPA) require an analysis of cumulative impacts. Under MEPA, cumulative impacts are defined as "the collective impacts on the human environment of the Proposed Action when considered in conjunction with other past and present actions related to the Proposed Action by location or generic type. Related future actions must also be considered when these actions are under concurrent consideration by any state agency through preimpact statement studies, separate impact statement evaluation, or permit-processing procedures as set forth in the Administrative Rules of Montana (ARM) 17.4.603(7). Under Council on Environmental Quality (CEQ) NEPA regulations, cumulative impacts are defined as impacts "on the environment which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" per 40 Code of Federal Regulations (CFR) 1508.7. For purposes of this joint Environmental Impact Statement (EIS), the NEPA definition of cumulative impacts was used.

The sections below identify past, present, and reasonably foreseeable future actions. Actions considered in these analyses were identified by the lead and cooperating agency resource specialists as well as from public scoping comments. Past and present actions, which are described in **Section 5.2.1**, are accounted for as part of the existing, or "baseline," environmental conditions. Both MEPA and NEPA are forward-looking, with analyses focused on the potential impacts of the Proposed Action that the lead agencies are considering.

In general, the cumulative impacts analysis area differs for each resource under consideration. Per EPA guidance regarding consideration of cumulative impacts in NEPA documents, the selection of geographic boundaries for the analysis areas were based on natural boundaries and areas that sustain the resources of concern (EPA 1999). For example, the analysis area for topography is limited to existing and proposed permit areas of the Rosebud Mine, whereas the analysis area for access and transportation is larger, encompassing the local transportation network. For surface water resources, the analysis area is based on watershed boundaries. The analysis area for each resource is described below.

The type and timing of impact for the Proposed Action is key to the cumulative impacts analyses. To be considered for cumulative impacts, other actions must affect the environment in a similar manner and at a similar time as the Proposed Action and alternatives. For these analyses, the time period includes active mining in the project area through completion of reclamation (final bond release). Types of actions include but are not limited to these general categories: agriculture, coal combustion, mining, municipal and industrial water use, rail transport and development, and wildland fire.

The cumulative impacts analyses are organized by resource in **Section 5.3, Resources** below. As noted above, these cumulative impacts analyses evaluate impacts that may be individually minor but have cumulatively greater impacts. Past, present, and reasonably foreseeable actions that are within the vicinity of the project area are shown on **Figure 117**.

5.2 RELATED PAST, PRESENT, AND REASONABLY FORESEEABLE FUTURE ACTIONS

5.2.1 Related Past and Present Actions

The following is a summary of past and present actions with the potential to contribute to cumulative impacts. The list of actions below does not cover all actions used in air quality modeling, which looks at a much larger geographic area than other resources; please see the description of modeling in **Section 3.2, Air Quality** and see **Appendix D-6**. A discussion of past and present actions is included in the cumulative impacts analysis for each resource (**Section 5.3, Resources**).

5.2.1.1 Agriculture

The project area and surrounding areas have been used for agricultural purposes—particularly stock-watering and grazing—for decades, and continue to be used in this manner. Agriculture has historically had and continues to have a substantial effect on land and water use in the three drainages surrounding the project area. Continuous strips of irrigated farmland border the Rosebud Creek, Armells Creek, and Sarpy Creek drainages, with extensive dryland areas between the drainages used primarily for grazing. The source of water for irrigation is predominantly surface water. According to U.S. Department of Agriculture (USDA) 2015 statistics, the largest portion of irrigated farmland is used for hay production, with barley and sugar beets as additional crops (USDA 2015). Irrigated acreage accounts for about 1 percent of the land in the Rosebud, Armells, and Sarpy Creek watersheds (Montana Department of Natural Resources and Conservation 2016).

5.2.1.2 Airport

Rosebud County owns and operates a small public airfield located between Areas B and C of the Rosebud Mine (about 3 miles southwest of Colstrip). The airfield, which is identified as M46 by the Federal Aviation Administration, has operated since 1990 and has two runways open daily from sunrise to sunset. Eleven single-engine aircraft are based at the airfield. The airfield averages 62 flights per week (Airnav.com 2014).

5.2.1.3 Air Pollutant Sources and Emissions

There are a number of existing sources of air pollutants that affect air quality in the analysis area. In the immediate surroundings of the project area, the primary sources of air pollution are the existing permit areas of the Rosebud Mine and the Colstrip and Rosebud Power Plants, while in the larger analysis area there are a number of other major regional point and area sources including other mines and electric generation facilities. The emissions from these sources are quantified and discussed in **Section 3.3, Air Quality**.

5.2.1.4 Coal Combustion

As described in **Section 1.2.2, Coal Combustion**, two coal-fired power plants operate in the Colstrip area (**Figure 2**). Both plants exclusively burn coal from the Rosebud Mine. The two plants are described in detail in **Chapter 1**, and their operations are summarized below.

Colstrip Power Plant

The Colstrip Power Plant is located within the city of Colstrip and currently is operated by Talen Energy. Units 1 and 2, which each have 307 megawatts (MW) of generating capacity, were constructed in 1972 and have been operating since 1975 and 1976, respectively. Units 3 and 4, which each have about 740 MW of generating capacity, started operating in 1984 and 1986, respectively. The Colstrip Power Plant employs about 400 workers and currently supports about $934 million in total annual economic output across the analysis area (includes direct, indirect, and induced impacts; see definitions in **Section 4.15, Socioeconomics**). The Colstrip Power Plant and the operations of its associated facilities (paste plant, ponds, etc.) are governed by a certificate issued by DEQ under the Major Facility Siting Act (MFSA), Section 75-20-101, MCA et seq. (Certificate).

The Rosebud Mine delivers between 7.7 and 9.95 million tons of coal annually to the Colstrip Power Plant primarily by a covered conveyor system (shown on **Figure 3**) and a small amount by truck. Coal from Areas A and B of the Rosebud Mine (see **Coal Mining** below) currently is used in Units 1 and 2 of the Colstrip Power Plant (for a discussion of the future of Units 1 and 2, see **Colstrip Power Plant** below and **Section 1.2.2, Coal Combustion**). Units 3 and 4 were originally limited to burning coal from Areas C, D, and E, but in 2015, DEQ approved an amendment to the Certificate also allowing the use of coal from other permit areas (DEQ 2015a). Currently, only coal from Area C is being burned in Units 3 and 4.

Rosebud Power Plant

The Rosebud Power Plant is a 24-MW coal-fired power plant located about 6 miles north of the city of Colstrip that has been operating since May of 1990. The Rosebud Power Plant was designed to burn low-Btu (British thermal unit) “waste coal” from the Rosebud Mine, which is coal not suitable for use at the Colstrip Power Plant due to the high sulfur content and low calorific value. This waste coal is typically found in the first 1-foot layer of the Rosebud Coal deposit. Coal from all of the active permit areas (A, B, and C) is currently used in the plant. The Rosebud Mine trucks 300,000 tons of coal annually to the Rosebud Power Plant using a fleet of five covered haul trucks (Spang 2013). Three of the five trucks operate daily, with each truck delivering 6.5 loads, for a total of 19.5 total loads daily.

5.2.1.5 Actions by Federal Land Management Agencies

U.S. Department of the Interior – Bureau of Land Management

Although there is no federal surface land within the immediate vicinity of the project area, there is federal mineral estate (see **Section 3.23, Land Use**), which is administered by the Bureau of Land Management (BLM). The BLM’s Miles City Field Office (MCFO) recently revised and combined the Big Dry (1996) and Powder River (1985) Resource Management Plans, as amended, into one document, the Miles City Field Office Approved Resource Management Plan (ARMP). The plan applies to BLM surface and federal mineral estates. The planning area includes all of Carter, Custer, Daniels, Dawson, Fallon, Garfield, McCone, Powder River, Prairie, Richland, Roosevelt, Rosebud, Sheridan, Treasure, and Wibaux Counties as well as portions of Big Horn and Valley Counties; northern Big Horn County is under the Billings Field Office Management Plan.

BLM-authorized actions in the near vicinity of the project area include rights-of-way for powerlines and pipelines, coal leases, mineral material sites, land withdrawals, and land sales and exchanges. Oil and gas leases were issued in the past, but currently none are authorized in the near vicinity of the project area.

USDA Forest Service – Custer Gallatin National Forest

The Custer Gallatin National Forest is located in southeastern Montana (MT). The closest ranger district, the Ashland District, is about 35 miles to the southeast of the project area. With the exception of management activities such as controlled burns, past and present management activities on the Ashland District are not expected to influence or be influenced by the proposed Area F permitting action.

5.2.1.6 Mining

Gravel Quarries

There are eight gravel quarries operating within 25 miles of the project area. These quarries have operating permits through DEQ's Opencut Mining Program. Western Energy has five gravel quarry sites for mining scoria (used on road surfaces within the Rosebud Mine). These quarries are authorized under Western Energy's existing Rosebud Mine operating permits (see **Section 2.2, Description of Existing Mine and Reclamation Operations**).

Coal Mining

Rosebud Mine

Western Energy's past and present operations at the Rosebud Mine are described in **Section 2.2, Description of Existing Mine and Reclamation Operations**. Also see **Figure 3** for an operational timeline.

Other Coal Mines in Southeastern Montana

In addition to the Rosebud Mine, several coal mines currently operate or recently operated in southeastern MT (Rosebud, Big Horn, Yellowstone, and Musselshell Counties) including the Signal Peak, Spring Creek, Big Sky, Absaloka, and Decker coal mines. The Signal Peak, Spring Creek, and Decker (East and West) coal mines are active permits more than 50 miles away and are not expected to influence or be influenced by the proposed Area F permitting action (see **Section 4.3, Air Quality** and **Section 4.4, Climate and Climate Change** for discussions related to those resources). Big Sky (inactive) and Absaloka are located near the Rosebud Mine. Big Sky Mine is a surface coal mine that was operated by Peabody Energy from 1984 to 2003 and is located just south of Area B of the Rosebud Mine. Big Sky Mine is fully graded and revegetated and is now in the 10-year period of responsibility pending evaluation by Peabody Energy and DEQ for Phase IV bond release (the actual time period may be longer than 10 years). Westmoreland Resources currently operates the Absaloka Mine, a 10,427-acre surface coal mine located about 8 miles southwest of the project area in Big Horn County on the Crow Indian Reservation near Hardin. The mine has produced coal since 1974, averaging 5.5 million tons of coal annually. Coal produced in this mine is used in the nearby Hardin Generating Station and shipped out of state to the mine's principal customer in Minnesota. It is shipped via a 38-mile rail spur to the main line of the Burlington Northern Santa Fe Railroad near Hysham, MT.

5.2.1.7 Permitted Discharges for Existing Areas of the Rosebud Mine

As part of its compliance with MT water-quality regulations and standards, Western Energy currently holds one Montana Pollutant Discharge Elimination System (MPDES) permit for the Rosebud Mine. MPDES Permit MT-0023965 (DEQ 1999) covers discharge of mine drainage and drainage from coal preparation areas, coal storage areas, and reclamation areas into 151 outfalls. The receiving waters include East Fork Armells Creek, Stocker Creek, Lee Coulee, West Fork Armells Creek, Black Hank

Creek, Donley Creek, Cow Creek, Spring Creek, and Pony Creek. Western Energy's MPDES permit was issued in 1999 and expired in September 2004. Western Energy submitted an application for MPDES permit renewal in April 2004 and an updated application in April 2011. After a permit renewal process and Environmental Assessment (DEQ 2012), DEQ reissued MPDES Permit MT-0023965 on November 1, 2012 (DEQ 1999). The permit was appealed by Western Energy. A settlement agreement was signed by DEQ on February 21, 2014, and Western Energy submitted a request for permit modification on May 8, 2014. The draft modified permit was advertised for public comment on June 9, 2014 (PN MT-14-18), and the comment period ended on July 10, 2014. On May 23, 2016, Western Energy resubmitted the MPDES application, requesting separate permit coverage for the project area (MT-0031828). DEQ sent a deficiency letter to Western Energy on June 23, 2016, to which Western Energy responded on September 6, 2016. DEQ determined the application to be complete on October 6, 2016. Western Energy submitted its current and complete application to DEQ on May 8, 2017. DEQ is in the process of writing the permit and will tier to the analysis in this EIS to ensure MEPA compliance for the permit. For other permit areas of the Rosebud Mine, following a 2016 District Court ruling on the 2012 issued permit (MT-0023965), the 1999 issued permit (MT-0023965) is the effective MPDES for areas A, B, C, D, and E of the Rosebud Mine (DEQ 1999).

5.2.1.8 Municipal and Industrial Water Uses and Discharges

Rosebud Power Plant

Deep ground water wells provide water to the Rosebud Power Plant. Colstrip Energy Limited Partnership, owner of the Rosebud Power Plant, is permitted under MPDES permit MT-0031780 to discharge water from a storm-water control pond to an unnamed ephemeral tributary to the East Fork Armells Creek. The discharge must meet effluent limitations and conditions. There have been no recent exceedances of discharge limits (EPA 2016f).

Colstrip Power Plant

Water piped from the Yellowstone River is the source of water to the Colstrip Power Plant, which operates as a zero-discharge facility. Process water is contained in ponds on the plant site.

Colstrip Water Treatment Plant

The Colstrip Water Treatment Plant provides potable water from Castle Rock Reservoir to the city of Colstrip. The water supply to Castle Rock Reservoir is piped from the Yellowstone River. Backwash from the potable water treatment plant is discharged back to the reservoir under MPDES permit MT-0030422. Municipal sewage flows via a collection system to the Colstrip Wastewater Treatment Plant, which operates at about 200,000 gallons per day, about one-third of stated capacity (DEQ 2015d). The city of Colstrip is authorized to discharge from its sewage treatment plant to the East Fork Armells Creek pursuant to MPDES discharge permit MT-0022373.

Irrigation – Golf Course

A nine-hole public golf course is located adjacent to the East Fork Armells Creek about 1 mile downstream of Colstrip. Water used to maintain the greens infiltrates into the creek, likely causing undefined changes in water level and water quality. Irrigation water for the golf course comes from the municipal water supply, which is piped from the Yellowstone River.

5.2.1.9 Rail Transport

The Northern Pacific Railway established the city of Colstrip and its associated mine in the 1920s to provide fuel for the railway's steam-locomotive trains. BNSF Railway currently owns and operates a functioning rail spur that runs north-south from Nichols, MT, to the Rosebud Mine (see discussion in **Section 2.2, Description of Past and Existing Mine and Reclamation Operations**). Western Energy has intermittently shipped coal via this line in the past (as recently as 2010) but does not have a current contract to ship coal via railway.

5.2.1.10 Wildland Fire and Prescribed Burns

Wildland fires have historically occurred in the vicinity of the Rosebud Mine. During the 2012 wildland fire season, the McClure Creek and Donley Creek fires burned 221 acres, impacting vegetation and wildlife on and around the southern boundary of Rosebud Mine Areas B, C, and F. Prescribed burns have also occurred from time to time on BLM or USFS lands in southeastern MT.

5.2.2 Related Future Actions

The following is a summary of future actions that are reasonably foreseeable and have the potential to contribute to cumulative impacts. The list of actions below does not cover all actions used in air quality modeling, which looks at a much larger geographic area than other resources; please see the description of modeling in **Section 3.2, Air Quality** and see **Appendix D-6**. A discussion of reasonably foreseeable future actions is included in the cumulative impacts analysis for each resource (**Section 5.3, Resources**).

5.2.2.1 Agriculture

Agricultural operations are expected to continue for the reasonably foreseeable future as described above in **Section 5.2.1.1, Agriculture**.

5.2.2.2 Airport

The M46 airfield is expected to continue to operate for the reasonably foreseeable future as described above in **Section 5.2.1.2, Airport**.

5.2.2.3 Air Pollutant Sources and Emissions

Emissions from sources quantified and discussed in **Section 3.3, Air Quality** are expected to continue as described with the following exceptions.

Per a 2016 consent decree (described in **Section 1.2.2.1, Colstrip Power Plant, 2016 Consent Decree**), Colstrip Units 1 and 2 must cease operations on or before July 1, 2022. New emission limits for nitrogen oxide (NO_x) and sulfur dioxide (SO_2) from these units were also established for the period prior to shutdown.

As described below in **Section 5.2.2.7**, **Mining and Mineral Development**, changes are expected to occur in the operations of the various coal mines within the vicinity of the project area, leading to changes in emissions and emission sources.

5.2.2.4 Climate Change

Climate change is not a reasonably foreseeable future action; however, it may represent a reasonably foreseeable future affected environment. Detailed information on the direct and indirect impacts of the project on greenhouse gas (GHG) emissions is provided and discussed in **Section 4.4, Climate Change**.

5.2.2.5 Coal Combustion

The future operations of both Colstrip-area power plants are described in detail in **Section 1.2.2, Coal Combustion** and summarized below. As noted above, both plants exclusively burn coal from the Rosebud Mine. They will continue to do so as long as coal from the Rosebud Mine is available. This EIS assumes the power plants will find a new source of coal if and when coal from the Rosebud Mine is no longer available; their operations are independent from the operations of the mine.

Colstrip Power Plant

As described in **Chapter 1**, Units 1 and 2 of the Colstrip Power Plant are scheduled to be retired in 2022. After closure of Units 1 and 2, direct employment at the Colstrip Power Plant is expected to drop from about 400 workers to about 280 workers (BBC Research & Consulting (BBC) 2017). Until that time, Units 1 and 2 are expected to burn coal exclusively from Areas A and B of the Rosebud Mine. Units 3 and 4 will continue to operate, burning coal from Area C and then likely from Area B and the project area (if permitted). Area C is expected to be mined until 2022. Area B is permitted through 2030 but may operate through 2043 if Amendment 5 to Area B is approved; see the discussion below under **Section 5.2.2.7, Mining and Mineral Development, Rosebud Mine Operations and Prospecting**. Combustion of project area coal in Units 3 and 4 is analyzed as an indirect effect by resource (as applicable) in **Chapter 4**.

Rosebud Power Plant

The Rosebud Power Plant is expected to continue operations as described in **Chapter 1** and in **Section 5.2.2.5, Coal Combustion**, using waste coal from Areas C and B through 2022 and 2030, respectively. If the Area B amendment is approved (see the amendment discussion below under **Section 5.2.2.7, Mining and Mineral Development, Rosebud Mine Operations and Prospecting**), waste coal from Area B may be used in the plant until 2043. Project area coal would also be combusted in the plant, but its use is analyzed as an indirect effect by resource (as applicable) in **Chapter 4**.

5.2.2.6 Actions by Federal Land Management Agencies

Management actions by federal resource agencies such as BLM and USFS are expected to continue as described above in **Section 5.2.1.5, Actions by Federal Land Management Agencies**.

5.2.2.7 Mining and Mineral Development

Gravel Quarries

Gravel quarry operations are expected to continue for the reasonably foreseeable future as described above in **Section 5.2.1.6, Mining**.

Lease by Modification to Federal Coal Lease MTM 80697

Western Energy has applied to BLM for a lease by modification (LBM) to federal coal lease MTM 80697. The pending LBM includes two tracts within existing permit areas of the Rosebud Mine and would affect 160 acres total. The Area B tract is about 60 acres, and the Area C tract is about 100 acres; both are within the currently approved disturbance boundary but not currently approved for mining. BLM is preparing an Environmental Assessment (EA) that is expected to be issued for public comment in 2017. If the BLM approves the LBM, Western Energy would need to submit an operating permit amendment application to DEQ to cover the change to the permit area boundaries to include the modified federal lease areas. This amendment may include private coal as well.

Rosebud Mine Operations and Prospecting

The reasonably foreseeable future of existing permit areas of the Rosebud Mine is described in **Section 2.2.6, Life of Operations**. The operational life of these existing areas is expected to end in 2030 if no additional amendments or other operational changes occur.

Western Energy submitted an application to amend its permit for Area B (Permit No. C1984003B) along with baseline data to DEQ in February 2017. This proposed 9,000-acre amendment would be the fifth major amendment to the Area B permit area and is called “Area B AM5” or “AM5” in this EIS (note that in the past, this area has also been referred to as Area G or the Area B South Extension). Area B AM5 would be located adjacent to the southern boundary of the existing Area B permit area (**Figure 117** shows the approximate area of the proposed amendment). Like the project area, Area B AM5 would expand the disturbance footprint of the Rosebud Mine but would not increase the amount of coal mined annually because it would be replacing production from permit areas currently in production (see **Section 2.2.6, Life of Operations** for a life-of-mine operations timeline). Area B AM5 would be mined until 2043, and the additional coal contained therein (estimated at 70 million tons) would account for as much as 70 percent of the total production of the Rosebud Mine during the years 2026–2037.

Western Energy has one active prospecting permit for Rosebud County, No. X2004322, which was renewed September 8, 2013, and one active Notice of Intent (NOI) for Rosebud and Treasure Counties, No. N2006005, which was renewed February 15, 2014 (Peterson 2014a).

Coal Mining and Prospecting at Other Locations in the Region

Existing Coal Mines

The active coal mine closest to the Rosebud Mine, the Absaloka Mine described above in **Section 5.2.1.6, Mining** is expected to continue operating at current levels for the reasonably foreseeable future. The mine is located in Big Horn County about 8 miles southwest of the project area.

Three coal mines (Spring Creek, East Decker, and West Decker Mines) currently operating in southeastern MT are expected to expand their operations in the reasonably foreseeable future. As described above in **Section 1.2.1.5, Mining**, all three mines are more than 50 miles from the project area and are not expected to influence or be influenced by the proposed Area F permitting action (see **Section 4.3, Air Quality** and **Section 4.4, Climate and Climate Change** for discussions related to those resources).

The Decker Coal Company submitted an application in November 2016 to DEQ for Major Revision T3 (T3) to its operating permit (#C1983007) for the East Decker Mine to add coal reserves, known as Pit 20. The East Decker Mine is located near Decker in Big Horn County. T3 would not add any land to the permit boundary and is wholly contained within the currently permitted area containing 4,361 acres. DEQ determined that the application for Major Revision TR3 was administratively complete on March 31, 2017, but the application is still in the review phase for technical adequacy. An EA will be completed for the proposed revision.

For the West Decker Mine, which is also located near Decker in Big Horn County, the Decker Coal Company has applied to BLM for an LBM to its current federal coal lease and applied for a new federal coal lease, a process known as lease by application (LBA), for this mine. If the LBM or LBA is approved by BLM, Decker Coal Company would need to submit an operating permit amendment application to DEQ to cover the change to the permit boundary to include the new and modified federal lease areas.

The Spring Creek Mine is operated by Cloud Peak Energy and is located north of Decker in Big Horn County. Cloud Peak submitted an application to DEQ for a minor revision (now a major revision known as TR1) to its operating permit (#C1979012) in November 2013. DEQ determined the application was administratively complete in December 2013, but the application is still in the review phase for technical adequacy. An EA will be completed for the proposed revision. Cloud Peak Energy is also seeking an amendment to its permit to allow construction of the Arrowhead haul road, a proposed transportation corridor between the Spring Creek Mine and its sister mine, the Youngs Creek Mine, in Wyoming. DEQ is currently preparing an EIS for this proposed amendment. Cloud Peak Energy is expected to submit applications to BLM for an LBM and an LBA for federal coal leases associated with this mine in the reasonably foreseeable future. Cloud Peak Energy would need to submit an operating permit amendment application to DEQ to cover any change to the permit boundary to include new and modified federal lease areas.

Proposed Coal Mines

Otter Creek Coal LLC, a subsidiary of Arch Coal Company, had been in the process of seeking a new mine operating permit from DEQ for the proposed Otter Creek Mine, a 7,639-acre surface coal mine that would be located near Ashland, MT, about 35 miles southeast of the project area. On January 11, 2016, Arch Coal Company and its affiliates, including Otter Creek Coal LLC, filed voluntary petitions for relief under Chapter 11 of the Bankruptcy Code. In March 2016, Otter Creek Coal LLC suspended but did not withdraw its application for the Otter Creek Mine; Otter Creek Coal LLC also has a pending MPDES permit application with DEQ. The status of the Otter Creek Mine application and other coal permit applications can be found at http://deq.mt.gov/Public/ea/coal. At this time, the development of the Otter Creek Mine is no longer a reasonably foreseeable future action. In addition, the environmental review for the rail line needed to develop the mine has been discontinued (see **Section 5.2.2.10, Rail Development**).

5.2.2.8 Permitted Discharges

Permitted discharges described above under **Section 5.2.1.7, Permitted Discharges for Existing Areas of the Rosebud Mine**, would continue as described for the reasonably foreseeable future.

5.2.2.9 Municipal and Industrial Water Uses and Discharges

Municipal and industrial water uses and discharges are expected to continue for the reasonably foreseeable future as described above in **Section 5.2.1.8, Municipal and Industrial Water Uses and Discharges**.

5.2.2.10 Rail Development

The Tongue River Railroad Company Inc. (TRRC) intended to construct and operate a rail line between Miles City and Ashland, MT; the initial customer of the rail line would have been the proposed Otter Creek Mine. TRRC's preferred alignment was the 42-mile Colstrip Alternative, which would generally parallel Greenleaf Road (S-447). The Surface Transportation Board's (Board) Office of Environmental Analysis (OEA) has been preparing an EIS pursuant to NEPA since 2012; however, as noted above, the Otter Creek Mine permit application with DEQ was suspended on March 2016. On April 26, 2016, the Board issued a decision dismissing the Tongue River Railroad proceeding without prejudice. As a result, the environmental review for this case has been discontinued (see the project website, http://www.tonguerivereis.com). At this time, the development of the Tongue River Railroad is no longer a reasonably foreseeable future action.

5.2.2.11 Wildland Fire and Prescribed Burns

Wildland fires and prescribed burns have historically occurred in the vicinity of the Rosebud Mine and are expected to occur for the reasonably foreseeable future as described above in **Section 5.2.1.10, Wildland Fire and Prescribed Burns**.

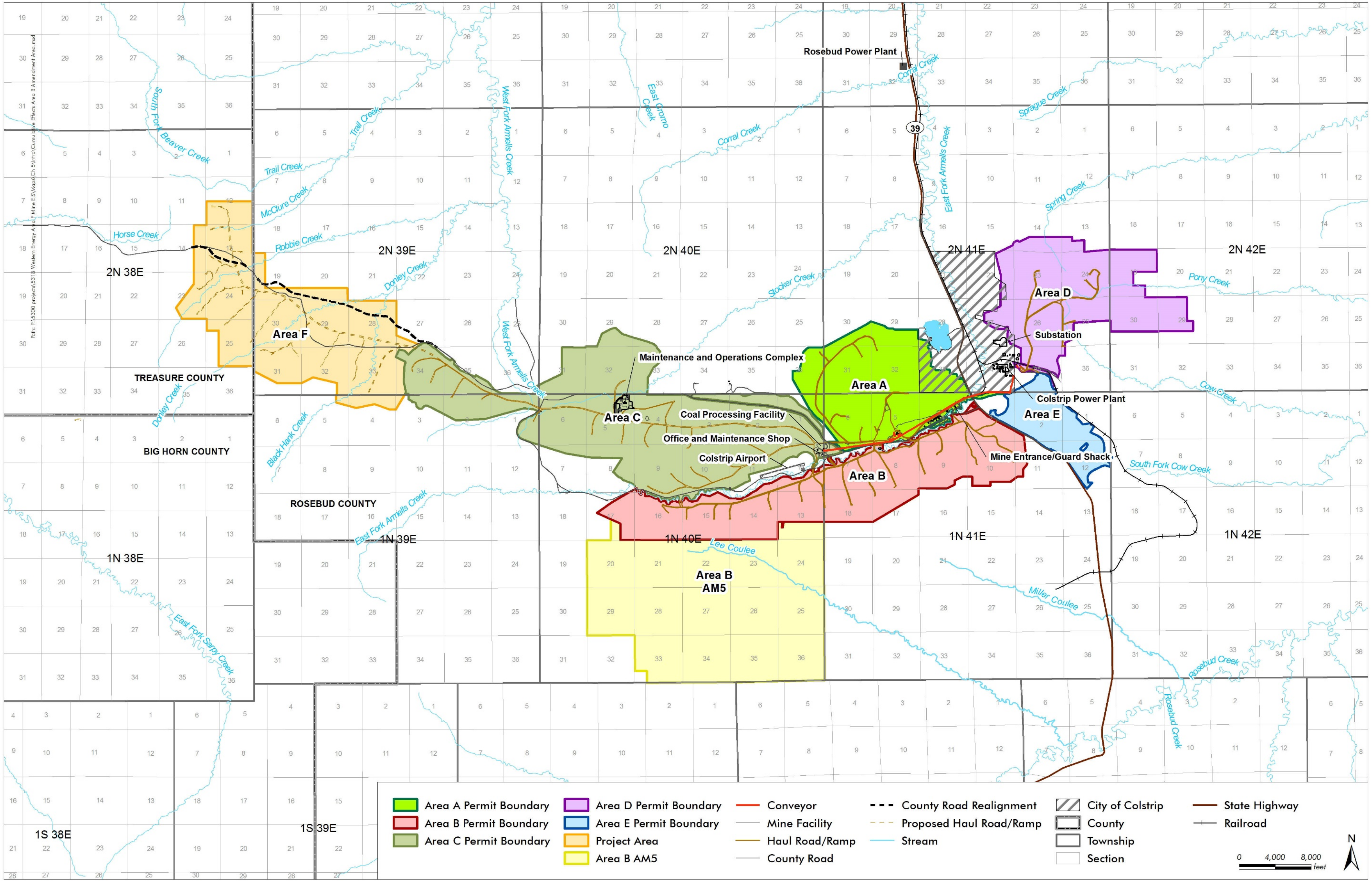

Figure 117. General Area of Cumulative Impacts and Contributing Actions.

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5.3 RESOURCES

5.3.1 Topography

The analysis area for evaluation of cumulative impacts for topography includes all permit areas of the Rosebud Mine, including past and ongoing mining areas and the proposed Area B AM5, which is currently in the permitting process (**Figure 117**).

Related past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts on topography include the following:

- Past, ongoing, and future mining at the Rosebud Mine

Past and ongoing mining at the Rosebud Mine has resulted in minor short-term cumulative impacts during mining activities and minor long-term cumulative impacts on the overall topography due to the removal of geologic outcrops and slight differences in the pre-mine topography versus the postmine topography. Mining in the project area and possible future mining of other sites at the Rosebud Mine would result in additional minor short-term cumulative topographic changes during active mining and minor long-term cumulative topographic changes following reclamation.

5.3.2 Air Quality

The analysis area for cumulative impacts on air quality is the same as that used for the indirect effects for air quality, a rectangular region extending to about 300 km from Colstrip in all directions (see **Section 3.3, Air Quality**). Cumulative impacts have resulted from past and present actions listed in **Section 5.2.1**. Actions that have directly or indirectly affected or will affect air quality include:

- mining
- coal combustion
- construction and operation of the Colstrip Airport
- management of BLM lands
- oil and gas development
- rail transport
- wildland fire
- other sources

The air quality modeling performed for this EIS with the CAMx modeling system as described in **Section 4.3.1, Analysis Methods and Impact and Intensity Thresholds** considers cumulative impacts in addition to direct and indirect impacts.

Energy and mineral development in the region, including coal leases and oil and gas leasing, could result in adverse impacts on air quality. Emissions from current and reasonably foreseeable mineral development and other large regional sources are described in **Section 3.3.4.3, Existing Emissions from Other Regional Sources**, **Section 4.3.2.1, Regional Emissions**, and below in **Section 5.3.2.1**, and included in the air quality modeling performed for the EIS.

Past and current coal mining in Areas A, B, C, D, and E of the Rosebud Mine have contributed to cumulative impacts on local air quality. Similarly, future coal mining in Areas A, B, and C and Area B AM5 (AM5) (if permitted) will contribute to cumulative impacts on air quality. Existing emissions from Areas A, B, C, D, and E have been estimated in **Section 3.3.4.1, Existing Emissions from Rosebud Mine**. Future cumulative emissions from Areas A, B, and C and AM5 are described below in **Section 5.3.2.1** and included in the air quality modeling.

Emissions from all sources in the BLM Montana-Dakotas (BLM-MT/DK) 2025/2032 future year modeling platform (BLM 2016a, 2016b) originally derived from EPA's 2025 projection of the 2011 National Emissions Inventory (NEI) that are within the indirect/cumulative impacts analysis area are included in the CAMx air quality modeling (see **Section 5.3.2.1** for more information). These include the source categories discussed above and several others, some of which are described below.

Past and current airport operation has contributed and continues to contribute to air quality degradation due to increased emissions from aircraft, equipment, and stationary and vehicle sources. Emissions from aircraft are mainly caused by fuel combustion in the engines. Aircraft disturb the atmosphere by changing background levels of trace gases and particles. As stated at the beginning of this chapter, the airfield averages 62 flights per week, which likely results in some cumulative air quality impacts. However, only smaller turboprop planes use the Colstrip Airport, which includes only two short runways. Therefore, air pollution from local airport operation and aircraft use is likely minor because turboprops burn less fuel than jet planes.

Local and regional rail transport contributes to air quality degradation from exhaust emissions, particularly carbon monoxide (CO), oxides of nitrogen (NO_X), and particulate matter (PM). Rail transport emissions are included in the EPA NEI and in the EIS air quality modeling.

Wildland fires can result in substantial air pollution, particularly through the release of fine particles. However, the severity of the impacts depends on the scale and frequency of fires. Periodic wildland fires in the vicinity of the Rosebud Mine could negatively affect local air quality. The air quality modeling for the EIS uses wildland fire data for the year 2012/2013 from the BLM-MT/DK inventory (BLM 2016a) discussed in **Section 4.3.2.1, Regional Emissions**.

Not only does air pollution affect climate change, but the close connection between climate and air quality is also reflected in the impacts of climate change on air pollution levels. Ozone and particle pollution are strongly influenced by shifts in the weather (e.g., heat waves or droughts). Based on projected future climate scenarios, the Intergovernmental Panel on Climate Change (IPCC) projected "declining air quality in cities" into the future as a result of climate change (IPCC 2014). According to Zeng et al. (2008), a hypothetical 50 percent increase in isoprene emissions due to climate change by 2100 could increase ground-level ozone concentrations over the United States by up to 6 parts per billion (ppb), while a hypothetical doubling of soil NOx emissions due to climate change could increase ozone concentrations by up to 5 ppb. Cumulative ozone concentrations could be further exacerbated by climate change on days when weather is already conducive to high ozone concentrations. In the Great Plains Region, average temperatures are already increasing, along with the frequency of extreme heat, droughts, wildland fires, heavy precipitation events, and reduced air quality (Melillo et al. 2014). Because climate represents meteorological conditions over a long period, it is difficult to identify exactly whether emissions reductions from air quality regulations are outpacing cumulative climate impacts. Climate change is discussed further under **Sections 3.4**, **4.4**, and **5.3.3, Climate and Climate Change**.

5.3.2.1 Cumulative Emissions

Criteria Air Pollutant Emissions

In addition to the future direct and indirect emissions discussed in **Section 4.3, Air Quality**, future emissions from existing permitted areas of the Rosebud Mine, the proposed south extension to Area B (AM5), Colstrip Units 1 and 2, and other regional sources were estimated to allow for a determination of the cumulative effects on air quality. Western Energy currently holds Montana Air Quality Permits (MAQP) for Area C (MAQP #1570-08); Areas A, B, D, and E (MAQP #1483-08); and a portable crusher used to crush scoria for road base (MAQP #4436-00). Furthermore, AM5 and the lease modifications of Areas B and C are considered reasonably foreseeable actions and thus are considered in the determination of the cumulative impacts (see **Section 5.2.2**). As in the case of the project area, AM5 and the lease modifications would not increase emissions of Areas A, B, D, and E beyond the currently permitted limits and would instead reduce production from other areas of the mine.

Emissions from the Rosebud Mine and the Portable Crusher

The potential to emit (PTE) for Area C was previously estimated by Western Energy in its application to modify MAQP #1570-06 for the project area based on the maximum permitted coal production of 8 million tons per year (Bison Engineering 2013a, 2013b). Future emissions from Area C were estimated by scaling the PTE using the ratio of the maximum projected Area C coal production during the lifetime of the project (3,483,050 million tons/year; **Table 99**, **Section 4.3.3.1**) to the maximum permitted coal production (8 million tons/year).

A similar approach was used for estimating the maximum potential emissions from the existing Areas A, B, D, and E and proposed AM5 during the lifetime of the project. The estimated PTE provided in MAQP #1483-08 was apportioned using the ratio of area-specific maximum projected coal production during the lifetime of the Proposed Action (**Table 99**, **Section 4.3.3.1, Direct Impacts**) to the total coal production limit of these areas (13 million tons/year) with the exception of the emissions from topsoil removal and wind erosion. Areas D and E are no longer actively mined but still have topsoil handling and wind erosion emissions from ongoing reclamation of the disturbed areas. For this reason, the PTE from these sources was apportioned between each of the areas based on their surface area. The coal production from the lease modifications to Areas B and C is included in the projected annual coal production totals.

However, the PTE in the air quality permit for Areas A, B, D, and E does not provided detailed criteria air pollutant (CAP) emissions for each source but instead only provides the total PM emissions for each source and the sum of gaseous emissions from vehicle exhaust and explosives. To estimate PM_{10} and $PM_{2.5}$ emissions from the total PM, the source-specific ratios of PM_{10}/PM and $PM_{2.5}$/PM from the Area C emission inventory were applied. Similarly, the fractional contributions of Area C gaseous explosive and vehicle exhaust emissions to total gaseous emissions from Area C were used to apportion the total gaseous emissions between these sources in Areas A and B and the proposed AM5. All vehicle exhaust emissions were combined and treated as diesel exhaust.

Western Energy also holds a permit for a portable crusher (MAQP #4436-00) that used to crush scoria for use as road base. Emissions from the portable crusher were estimated by scaling PTE using the maximum scoria process rate in the crusher reported to DEQ between 2010 and 2015.

The estimated emissions for each of the existing areas, the proposed AM5, and the portable crusher are provided in **Table D-6-1, Appendix D-6**.

Colstrip Units 1 and 2

The estimated future annual emissions due to Colstrip Units 1 and 2 (prior to planned retirement in July 2022) are listed in **Table D-6-2, Appendix D-6**. Emissions of NO_x are the largest among the criteria air pollutants, with a total of 5,808 tons/year, followed by SO_2 at 3,758 tons/year. The approach used for calculating these emissions is similar to that used for estimating emissions from Colstrip Units 3 and 4 as discussed in **Section 4.3.3.2, Indirect Impacts of Coal Combustion**.

Other Regional Emissions

Emissions from other regional sources of air pollution will also contribute to the cumulative impacts on air quality in the analysis area. The data for regional emissions from point sources, low-level anthropogenic sources, low-level biogenic sources, and fires were obtained from the BLM-MT/DK 2025/2032 future year modeling platform (BLM 2016a, 2016b) and are briefly described below. Future year emission estimates for oil and gas sources within the BLM-MT/DK planning areas are based on a combination of projections of emissions from existing wells and from reasonably foreseeable development scenarios prepared by the BLM for the planning areas corresponding to each field office in MT, North Dakota, and South Dakota. Emissions from the high oil and gas development scenario in the BLM-MT/DK modeling were applied here. Future year emissions estimates for non-oil and gas sources were primarily based on the EPA future year emission projections for calendar year 2025, which are the farthest forward-looking national emission projections developed to date consistent with the 2011 NEI, with the following exceptions. Biogenic, wildland fire, lightning, and windblown dust emissions corresponded to the 2012–2013 base time period used in BLM-MT/DK modeling for meteorological data. The 2012–2013 base year time period extended from October 1, 2012, through September 30, 2013, in the MT/DK modeling. Biogenic emissions were calculated using the Model of Emissions of Gases and Aerosols in Nature (MEGAN) model (http://lar.wsu.edu/megan) updated for the western United States in a Western Regional Air Partnership (WRAP)[28] study using 2012/2013 meteorological conditions. Fire emissions were based on the Fire Inventory from the National Center for Atmospheric Research (NCAR)

[28] http://www.wrapair2.org/pdf/WGA_BiogEmisInv_FinalReport_March20_2012.pdf

(FINN[29]) inventory for 2012/2013. Lightning emissions were based on the 2012/2013 meteorological data. On-road mobile source emissions were generated using version 2014a of the EPA Motor Vehicle Emissions Simulator (MOVES) model driven by the calendar year 2032 activity data and fleet characteristics. Year 2010 emissions inventories were used for Canada.

Table D-6-3, Appendix D-6 lists the major regional point sources (sources with emissions of any criteria pollutant greater than 100 tons/year) from the inventory described above and applied in the CAMx photochemical air quality modeling for the EIS, as well as the total emissions in the analysis area from both low-level (near-ground) and point sources.

Hazardous Air Pollutant Emissions

Hazardous air pollutant (HAP) emissions from fugitive coal dust and diesel particulate matter (DPM) were estimated for the active permit areas of the mine and the proposed AM5 using the methodology described in **Area F Hazardous Air Pollutant Emissions** in **Section 4.3.3.1**. HAP emissions in fugitive coal dust were estimated using the measured concentrations in coal from each area (PPL Montana 2014) and the total fugitive PM_{10} emissions from coal processing and handling sources in each area (**Table D-6-4, Appendix D-6**). These were estimated for antimony, arsenic, beryllium, cadmium, chromium, copper, lead, manganese, mercury, nickel, and selenium. DPM emissions were estimated as the total $PM_{2.5}$ emissions from diesel exhaust in each area (**Table D-6-5, Appendix D-6**).

5.3.2.2 Cumulative Impacts on Air Quality

Criteria Air Pollutants and Precursors

This section discloses modeled cumulative impacts on air quality. **Figure D-6-1** through **Figure D-6-13** in **Appendix D-6** display spatial distributions of total nitrogen dioxide (NO_2), ozone (O_3), $PM_{2.5}$, PM_{10}, and SO_2 concentrations that show cumulative impacts from all sources as well as source contributions from the proposed AM5 and other regional sources (i.e., regional emission sources other than the Rosebud Mine [including AM5] and the Colstrip and Rosebud Power Plants) in the future year modeling scenario.

The maximum cumulative concentrations of the eighth highest 1-hour daily maximum NO_2 and annual average NO_2 within the indirect/cumulative impacts analysis area (i.e., 4-km modeling domain) are 74.7 ppb and 17.8 ppb, respectively. These impacts are found very far away from the project area (near Gillette in Wyoming) (**Figure D-6-1** and **Figure D-6-2, Appendix D-6**). Contributions from the proposed AM5 to 1-hour and annual average NO_2 are mostly within and near the area of AM5, with modeled spatial maxima of 29.7 ppb and 1.4 ppb, respectively. Contributions from other regional sources share similar spatial patterns with the total cumulative impacts but have slightly smaller magnitudes. No exceedance of National Ambient Air Quality Standards (NAAQS) or Montana Ambient Air Quality Standards (MAAQS) was modeled for NO_2. Thus, cumulative impacts for NO_2 in both the direct and indirect/cumulative impacts analysis areas would be short-term, minor, and adverse.

The maximum cumulative impacts on the second highest 1-hour daily maximum O_3 and fourth highest daily maximum 8-hour O_3 within the indirect/cumulative impacts analysis area are 68.3 ppb and 63.5 ppb, respectively. These impacts are found very far away from the project area (on the border shared by Sublette and Fremont Counties in Wyoming) (**Figure D-6-3** and **Figure D-6-4, Appendix D-6**). The maximum impacts from the proposed AM5 on 1-hour (4.2 ppb) and 8-hour O_3 (2.1 ppb) in the indirect/cumulative impacts analysis area are found near the southern border of AM5. The modeled peak

[29] http://bai.acd.ucar.edu/Data/fire/

cumulative concentrations for 1-hour and 8-hour O_3 are below the MAAQS and NAAQS (100 ppb and 70 ppb, respectively). Thus, cumulative impacts for O_3 in both the direct and indirect/cumulative impacts analysis areas would be short-term, minor, and adverse.

The spatial maxima of the eighth highest daily average cumulative $PM_{2.5}$ (45.2 µg/m^3) and the annual average $PM_{2.5}$ (20.2 µg/m^3) within the indirect/cumulative impacts analysis area occur far away from the project area (in the central-eastern part of Campbell County in northwestern Wyoming) (**Figure D-6-5** and **Figure D-6-6, Appendix D-6**). This is the only area that shows modeled exceedance of NAAQS for daily $PM_{2.5}$ (35 µg/m^3) and one of the two areas not attaining NAAQS for annual average $PM_{2.5}$ (12 µg/m^3), the other area being Big Horn County of MT near the MT-Wyoming border, also far away from the project area. At the latter location, near the border, cumulative modeled annual $PM_{2.5}$ is 13.43 µg/m^3, of which direct and indirect effects contribute negligible amounts: 0.001 and 0.021 µg/m^3, respectively. After 2022, the cumulative annual $PM_{2.5}$ concentration at this location decreases from 13.43 to 13.42 µg/m^3. The maximum spatial impacts from the proposed AM5 in the direct impacts analysis area (i.e., 1-km resolution domain) on daily and annual average $PM_{2.5}$ are 2.6 µg/m^3 and 0.7 µg/m^3, respectively; both are found within the AM5 area. Modeled exceedances of cumulative impacts over the standards are isolated, with none occurring near the mine. In the vicinity of the mine (i.e., in the 1-km resolution modeling domain), the spatial maxima of the cumulative eighth highest daily average cumulative $PM_{2.5}$ and the annual average $PM_{2.5}$ are 12.1 µg/m^3 and 6.0 µg/m^3, respectively, both well below the NAAQS (35 and 12 µg/m^3). Thus, cumulative impacts for $PM_{2.5}$ in the direct impacts analysis area (i.e., 1-km modeling domain) are short-term, minor, and adverse. Cumulative impacts for $PM_{2.5}$ in the indirect/cumulative impacts analysis area are short-term, moderate, and adverse.

The maximum second highest daily cumulative PM_{10} within the indirect/cumulative impacts analysis area (243.7 µg/m^3) is found far away from the project area (in Campbell County, Wyoming, near Gillette, as in the case of $PM_{2.5}$) (**Figure D-6-7** and **Figure D-6-8, Appendix D-6**). Counties with modeled daily PM_{10} exceeding NAAQS and MAAQS (150 µg/m^3) include Campbell, Fremont, Sheridan, and Park in Wyoming, and Bighorn in MT. In particular, at the location in southern Bighorn County near the Wyoming border, the cumulative PM_{10} concentration is 242.8 µg/m^3 with negligible direct and indirect contributions (less than 1x10^{-4} µg/m^3) and most of the PM_{10} due to other regional sources (240.1 µg/m^3) followed by boundary conditions (2.6 µg/m^3). The maximum annual average PM_{10} within the indirect/cumulative impacts analysis area is 82.8 µg/m^3 (compared to the MAAQS of 50 µg/m^3) and is located in Bighorn County near the state border. At this location, the contributions from direct impacts, indirect impacts, other regional sources, and boundary conditions are 0.01, 0.02, 80.19, and 2.25 µg/m^3, respectively. Thus, the contribution of direct and indirect impacts to modeled exceedance at this location is negligible. Counties with modeled annual PM_{10} exceeding the MAAQS (50 µg/m^3) include Campbell, Fremont, Sheridan, and Park in Wyoming, and Bighorn and Gallatin in MT. The spatial maximum impacts from the proposed AM5 on daily and annual average PM_{10} are 12.6 µg/m^3 and 4.0 µg/m^3, respectively, with both found within the AM5 area. The maximum impacts from other regional sources for 24-hour (240.3 µg/m^3) and annual average (80.2 µg/m^3) PM_{10} have similar magnitudes and the same locations when compared to the total cumulative impacts, thereby showing that the peak concentrations are dominated by other regional sources. Cumulative impacts for PM_{10} in the direct impacts analysis area are well below the NAAQS/MAAQS for daily PM_{10} and below the MAAQS for annual PM_{10} (bottom panels of **Figure D-6-7** and **Figure D-6-8, Appendix D-6**) and, therefore, are short-term, minor, and adverse. Cumulative impacts for PM_{10} in the indirect/cumulative impacts analysis area are short-term, moderate, and adverse.

The spatial maxima within the indirect/cumulative impacts analysis area of the fourth highest daily maximum 1-hour SO_2 (87.4 ppb), second highest 3-hour SO_2 (79.2 ppb), second highest 24-hour SO_2 (46.2 ppb), and annual average SO_2 (21.2 ppb) are all found far away from the project area (in the northeastern corner of Fremont County in Wyoming) (**Figure D-6-9, Figure D-6-10, Figure D-6-11,** and

Figure D-6-12, Appendix D-6). The 3-hour and 24-hour maxima are well below the corresponding NAAQS (0.14 ppm for 24-hour and 0.5 ppm for 3-hour) and MAAQS (0.1 ppm for 24-hour); the 1-hour maximum exceeds the corresponding NAAQS (75 ppb) but is well below the corresponding MAAQS (0.50 ppm); the peak annual average is above the corresponding MAAQS (0.02 ppm) but below the NAAQS (0.030 ppm). The maximum AM5 contributions to SO_2 are 15.2 ppb, 9.3 ppb, 1.4 ppb, and 0.1 ppb for 1-hour, 3-hour, 24-hour, and annual average, respectively; these are all relatively small and all found within or near the proposed AM5 area. The maximum other regional source impacts are 87.4 ppb, 79.1 ppb, 46.2 ppb, and 21.1 ppb, and all are found at the same locations as the corresponding maximum cumulative impacts, showing that the peak SO_2 concentrations are dominated by other regional sources. Cumulative impacts for SO_2 in the direct impacts analysis area are well below the NAAQS/MAAQS for the different forms of the SO_2 standards and are, therefore, short-term, minor, and adverse. Cumulative impacts for SO_2 in the indirect/cumulative impacts analysis area are short-term, moderate, and adverse.

The spatial distributions of cumulative impacts on 1-hour and 8-hour CO concentrations are shown in **Figure D-6-13, Appendix D-6**. The spatial maxima of the second highest 1-hour and 8-hour CO are 0.9 ppm and 0.4 ppm, well below the corresponding NAAQS (35 ppm for 1-hour and 9 ppm for 8-hour) and MAAQS (23 ppm for 1-hour and 9 ppm for 8-hour), and are found in Campbell County and Natrona County, Wyoming. Thus, cumulative impacts for CO in both the direct and indirect/cumulative impacts analysis areas are short-term, minor, and adverse.

Table D-6-13, Appendix D-6 presents a comparison of modeled contributions of different sources to future cumulative criteria pollutant concentrations at existing nonattainment/maintenance areas in MT and Wyoming within the indirect/cumulative impacts analysis area. The future (~2025) modeled cumulative 1-hour and 24-hour SO_2 at Laurel and Billings are well below the NAAQS and MAAQS; the predominant source is other regional sources, while impacts from direct sources, indirect sources, Colstrip Units 1 and 2, and the proposed AM5 are almost negligible. Similarly, no future exceedance of NAAQS or MAAQS is modeled at the two PM_{10} nonattainment areas (Lame Deer, MT, and Sheridan, Wyoming). The predominant contributor is other regional sources at both sites. Future modeled cumulative 8-hour O_3 at the five nonattainment sites in the Upper Green River Basin within the analysis area are all less than 60 ppb and are all predominantly due to the background boundary contribution (boundary conditions).

In general, for the various criteria pollutants, the impacts from direct effects, indirect effects, the proposed AM5, and Colstrip Units 1 and 2 have typically relatively small contributions to the occurrences of high cumulative concentrations and to the exceedance of NAAQS or MAAQS in the direct and indirect/cumulative effects analysis areas.

Air Quality Related Values

Nitrogen and Sulfur Deposition

This section discloses cumulative impacts on acidic deposition of nitrogen and sulfur compounds and contributions from some key source groups.

Figure D-6-14 and **Figure D-6-15** in **Appendix D-6** provide the spatial distribution of annual cumulative nitrogen and sulfur deposition within the direct and indirect/cumulative impacts analysis areas, and the contributions from the proposed AM5 and other regional sources (defined as all sources within the analysis area other than direct impacts, indirect impacts, AM5, other mine areas, and Colstrip Units 1 and 2). The spatial maxima of the cumulative annual total nitrogen and sulfur deposition in the indirect/cumulative effects analysis area are 53.1 kg/ha and 11.7 kg/ha, respectively; both occur far away from the project area (in Fremont County, Wyoming). For both nitrogen and sulfur deposition, maximum impacts from other regional sources (52.1 kg/ha and 11.6 kg/ha) are comparable to the maximum cumulative impacts, suggesting that these sources dominate the total deposition. Impacts from the proposed AM5, direct effects (**Section 4.3.3.1, Air Concentrations and Related Values**), indirect combustion (**Section 4.3.3.2, Air Concentrations of Criteria Pollutants**), and other areas at the Rosebud Mine are very small. There are no regulatory thresholds for atmospheric deposition of air emissions.

Cumulative impacts on nitrogen and sulfur deposition at Federal and Tribal Class I areas in the indirect/cumulative effects analysis area are shown in **Table D-6-6, Appendix D-6** (a map of these areas is shown in **Section 3.3.1**).

Annual cumulative nitrogen deposition varies from 1.31 kg/ha to 7.23 kg/ha across all Class I areas when considering the spatial maximum in each area and from 1.02 kg/ha to 4.76 kg/ha when considering the average in each area. The Medicine Lake National Wildlife Refuge (NWR) in northwestern North Dakota is modeled to experience the highest nitrogen deposition due to cumulative impacts across all Class I areas within the indirect/cumulative impacts analysis area. Indirect effects of the Proposed Action contribute less than 0.1 percent of nitrogen deposition at this location (**Section 4.3.3.2, Indirect Impacts of Coal Combustion**), with direct impacts further lower (**Section 4.3.3.1, Direct Impacts**).

Annual cumulative sulfur deposition ranges from 0.29 kg/ha to 2.15 kg/ha across all Class I areas when considering the spatial maximum in each area and from 0.26 kg/ha to 2.09 kg/ha when considering the average in each area. The Lostwood Wilderness Area in northwestern North Dakota is modeled to experience the highest sulfur deposition due to cumulative impacts across all Class I areas within the indirect/cumulative impacts analysis area. Indirect effects of the Proposed Action contribute less than 0.1 percent of sulfur deposition at this location (**Section 4.3.3.2, Indirect Impacts of Coal Combustion**), with direct impacts further lower (**Section 4.3.3.1, Direct Impacts**).

Cumulative modeled deposition fluxes were compared to critical loads of acidity at surface waters in the indirect/cumulative effects analysis area. A critical load is the level of input of a pollutant, such as from atmospheric deposition, below which no harmful ecological effect occurs over the long term (UBA 2004). Deposition of sulfur and deposition of oxidized and reduced nitrogen contribute to acidification. Therefore, two critical loads of acidity are distinguished, the critical load of sulfur-based acidity and the critical load of nitrogen-based acidity. A small deposition rate of nitrogen that can be taken up by vegetation or immobilized is essential for ecosystems. However, deposition of both oxidized and reduced nitrogen that exceeds the critical load for nutrient nitrogen contributes to eutrophication. Critical loads of surface water acidity for nitrogen and sulfur were obtained for 471 lakes and streams in the indirect/cumulative impacts analysis area from the National Atmospheric Deposition Program (NADP) Critical Loads of Atmospheric Deposition database (NADP 2017b).

Figure D-6-16 in **Appendix D-6** presents a comparison of modeled nitrogen deposition from cumulative, direct, and indirect sources with the critical loads of nitrogen-based acidity at the 471 lakes and streams. In general, direct and indirect impacts constitute less than 1 percent and 0.1 percent of the cumulative deposition at these locations. Cumulative nitrogen deposition is below the critical load at all but 16 locations. At these locations, indirect impacts represent less than 0.4 percent of cumulative deposition with direct impacts constituting a smaller, negligible fraction.

Figure D-6-17 in **Appendix D-6** presents a similar comparison of sulfur deposition from cumulative, direct, and indirect sources with the critical loads of sulfur-based acidity. Direct and indirect impacts typically constitute less than 1 percent and 0.01 percent of the cumulative deposition. Cumulative nitrogen deposition exceeds the critical load at 20 locations. At these locations, indirect impacts contribute up to 1.2 percent of cumulative deposition, while direct impacts constitute a negligible fraction.

Visibility and Regional Haze

The change in haze index due to cumulative impacts compared to annual average natural conditions is reported below in terms of the 98th percentile change in haze index (FLAG 2010). The corresponding value due to direct and indirect impacts is reported as a fraction (percentage) of the total value. The number of days where the change in haze index due to direct and indirect impacts exceeded 0.5 or 1.0 at any Class I area is also shown; the latter information was presented in **Air Quality Related Values** in **Section 4.3.3.2, Indirect Impacts of Coal Combustion** and is reproduced here for completeness.

Across the Class I areas in the indirect/cumulative impacts analysis area, the change in haze index due to cumulative impacts varies from 6.0 to 22.2, with the peak values modeled at Medicine Lake NWR and Flathead Indian Reservation (**Table D-6-7, Appendix D-6**). At these two locations, direct and indirect impacts represent up to 0.1 percent and 3.1 percent, respectively, of the cumulative change in haze index. The change in haze index due to direct impacts does not exceed 0.5 or 1.0 on any days at any Class I area except at Northern Cheyenne where it is exceeded two days in the year. The change in haze index due to indirect impacts exceeds 0.5 on fourteen days or less except at Northern Cheyenne where it is exceeded 96 days in the year.

EPA conducted modeling of the Colstrip Power Plant as part of its analysis to determine reasonable progress and Federal Implementation Plan preparation for the Regional Haze Rule (EPA 2012). **Table D-6-9, Appendix D-6** presents the results of EPA's estimation of the change in haze index and the number of days in each area when the 0.5 threshold is exceeded. The estimated number of days at each Class I area when the 0.5 threshold is exceeded by Colstrip Units 3 and 4 is generally consistent with the indirect impacts results from the modeling for this EIS. For example, at the Theodore Roosevelt National Park, EPA modeling shows that Colstrip Units 3 and 4 show exceedance of the 0.5 threshold on 7 days each. For comparison, the CAMx modeling for the EIS estimates that indirect effects (i.e., Colstrip Units 3 and 4 plus the Rosebud Power Plant) show exceedances during 11 days. Differences between the two studies are likely due to differences in methodology, models, and the emission year (2006–2008 in EPA modeling vs. 2025/2032 in this EIS modeling).

Hazardous Air Pollutants

Fugitive Coal Dust and Diesel Particulate Matter

Emissions from other cumulative sources (i.e., the existing and proposed areas of the Rosebud Mine) will contribute to the regional air concentrations and deposition of HAPs. The emissions of HAPs at the mine are primarily from fugitive coal dust and DPM. The estimated future emissions from the project area and the other areas of the mine are presented in **Area F Hazardous Air Pollutant Emissions** in **Section 4.3.3.1, Direct Impacts**, and **Hazardous Air Pollutant Emissions** in **Section 5.3.2.1**, respectively. The cumulative impacts from these emissions on air concentrations and deposition were quantified using CAMx as noted in **Section 4.3.1.1**. The impacts on all areas, including within the mine boundary where the public do not have access, were conservatively modeled. **Table D-6-4 in Appendix D-6** presents the annual average air concentration and deposition of PM_{10} due to the proposed AM5 coal dust emissions and the total coal dust emissions from the Rosebud Mine. The maximum annual average coal dust concentration and annual deposition occurs within the boundaries of AM5 in all cases, which is due to AM5 having the highest predicted coal dust emissions and the localized impacts of fugitive coal dust emissions. The predicted impacts all decrease rapidly with distance from the mine. The maximum air concentrations and deposition of the HAPs whose emissions were described previously (**Section 5.3.2.1, Cumulative Emissions, Hazardous Air Pollutant Emissions**) resulting from the total Rosebud Mine coal dust are shown in **Table D-6-10, Appendix D-6**.

The modeled average annual DPM air concentrations resulting from the proposed AM5 and all Rosebud Mine diesel sources are shown in **Figure D-6-19, Appendix D-6**. The maximum modeled DPM concentration due to AM5 emissions is 0.29 µg/m^3 and occurs within the boundary of the proposed AM5, while the maximum DPM concentration of 0.39 µg/m^3 from all diesel exhaust emissions at the Rosebud Mine occurs within Area C. The maximum DPM occurs in Area C due to the combination of diesel exhaust emissions from haul/water trucks in the project area, which operate on the haul roads between the project area and the coal processing facilities in Area C, and the DPM emissions from the other active mine areas (Areas A, B, C, and AM5). The DPM concentrations resulting from Rosebud Mine emissions are also localized with concentrations falling off rapidly with distance from the mine boundary.

Mercury Deposition

The three forms of atmospheric inorganic mercury (Hg) (Hg^0, Hg^{2+}, and HgP) have different deposition rates and atmospheric lifetimes. Hg^0 undergoes long-range transport across continents because it has a lifetime of the order of several months to a year due to its low reactivity, low solubility, and slow deposition rate (e.g., Lindberg et al. 2007). Hg^{2+} dry deposits rapidly, and Hg^{2+} and HgP are efficiently wet deposited near their sources. Thus, the cumulative deposition of Hg is due to a combination of local, regional, and global sources. Numerous studies have documented the long-range atmospheric transport of mercury from Asia and other continents to the United States resulting in a very large contribution from non-U.S. sources to mercury deposition in the United States (Seigneur et al. 2001; Seigneur et al. 2004; Lindberg et al. 2007; Jaffe and Strode 2008; Selin and Jacob 2008; Corbitt et al. 2011; Vijayaraghavan et al. 2014).

Mercury deposition is a combination of wet and dry deposition. Mercury wet deposition in North America is measured at monitoring stations in the Mercury Deposition Network (MDN) at over 100 sites across the United States and Canada (http://nadp.sws.uiuc.edu/mdn/). The Badger Peak MDN site is located south of Colstrip within the Northern Cheyenne Indian Reservation. The total measured wet deposition of mercury at the Badger Peak MDN site is shown for each of the modeling years (2011–2015) in **Table D-6-11, Appendix D-6**, along with the modeled wet deposition of mercury due to Colstrip Units 3 and 4 and the Rosebud Power Plant, and the relative contribution to the total wet deposition. The mercury wet deposition ranges from 3.8 to 6.6 µg/m^2-y. As discussed in **Section 3.3.5.3, Atmospheric Deposition**, the mercury deposition in the indirect/cumulative impacts analysis area is small relative to most of the United States.

The modeled wet deposition of mercury due to indirect effects (Colstrip Units 3 and 4 and the Rosebud Power Plant) is shown in **Table D-6-12, Appendix D-6**, along with their relative contribution to the total measured wet deposition due to all sources. The average of the modeled deposition at the four receptors located within 1 km of the Badger Peak MDN site was used to determine the contribution of indirect effects. The maximum contribution of Colstrip Units 3 and 4 and the Rosebud Power Plant to the measured wet deposition of mercury is very small: 0.51 percent in 2014. These contributions are likely to be very small in the future as well because operations of Colstrip Units 3 and 4 and the Rosebud Power Plant would be comparable to current operations.

Mercury dry deposition is not measured at MDN sites, so the total deposition cannot be compared to any monitoring data. Also, there are no mercury dry deposition monitors near Colstrip. A prior global modeling study of mercury deposition was used to estimate the contribution of the indirect effects of the Proposed Action to cumulative total (i.e., wet + dry) regional mercury deposition. Corbitt et al. (2011) utilized the global model GEOS-Chem to simulate the relationship between mercury emissions and deposition worldwide and predicted a total mercury deposition of 19 µg/m^2-y in the region of the Proposed Action based on 2005 global mercury emissions. Mercury emissions from Colstrip Units 3 and 4 and the Rosebud Power Plant mercury emissions are predicted at 1.1 percent of the total regional mercury deposition at the Badger Peak MDN site, and 7.6 percent at the location of the maximum mercury deposition anywhere in the modeling domain (**Table D-6-12, Appendix D-6**).

Thus, the contribution of indirect effects to cumulative mercury deposition is relatively small, less than 8 percent in the vicinity of Colstrip, and 1 percent or less farther away. The contribution of direct emissions to cumulative mercury impacts is further smaller because mercury emissions from the project area constitute less than 0.001 lb/year (**Section 4.3.3.1, Direct Impacts**), and emissions from other areas of the Rosebud Mine including the proposed AM5 are less than 0.02 lb/year (**Section 5.3.2.1**).

5.3.3 Climate and Climate Change

GHG emissions sources and trends occur at global, national, state, and regional scales. For this section, the focus is cumulative effects at a regional scale, and the analysis area is the same as that used for cumulative effects for air quality, a rectangular 300-km extent. Actions in the analysis area that have directly and indirectly affected or will affect climate change include:

- agriculture
- mining
- coal combustion
- construction and operation of the Colstrip Airport
- federal land management
- oil and gas development
- rail transport
- wildland fire
- other GHG producing activities

Agricultural development in the area consists mostly of cropland, pastureland, and grazing lands. Continued agricultural development would contribute to local GHG emissions and surface warming due to land-use changes, thus contributing to global warming. About 9 percent of total U.S. GHG emissions in 2015 were produced by agricultural sources—primarily deforestation and loss of native vegetation, the use of fossil fuel–based fertilizers, manure management, and enteric fermentation (EPA 2017f). Agricultural soil management practices and livestock contribute about 26 percent of total MT GHG emissions. The use of pesticides and synthetic fertilizers; fuel and oil for tractors, equipment, trucking, and shipping; and electricity for lighting, cooling, and heating all contribute to emissions. Sustainable and organic agricultural practices can help mitigate the adverse impacts of agricultural development on climate change by sequestering CO_2, for example. Emerging management practices in MT are already moving toward reducing emissions and storing more carbon in soil (sequestering). Consequently, MT agricultural soil is believed to remain positive for carbon sinks, sequestering a net 2.3 million metric tons of carbon dioxide equivalent ($MMtCO_2e$) per year (DEQ 2016g). The increase in carbon sequestration in soil could, to some degree, offset or delay the negative impacts of climate change on natural resources in the region.

As discussed in **Sections 3.4.2.3** and **4.4.2.3**, the impacts of climate change on agriculture will continue. Increases in temperature will result in a longer growing season but will increase both surface water losses and the distribution and number of pests and invasive weeds (Melillo et al. 2014; Whitlock et al. 2017). Increases in winter and spring precipitation will increase soil moisture reserves during the early growing season (Melillo et al. 2014), but decreasing mountain snowpack will result in reductions in stream flow and irrigation capacity during the late growing season (Whitlock et al. 2017). Rising temperatures will worsen the persistent droughts that periodically occur in MT (Whitlock et al. 2017). Continued increases in the number and intensity of rainfall events will result in elevated soil erosion and nutrient runoff.

Airport construction and continued operation has not only resulted in land-use changes and loss of grasslands, but has contributed to changes in atmospheric composition due to GHG emissions from the combustion of fossil fuels. Aircraft disturb the atmosphere by changing background levels of trace gases and particles, including GHGs, and by forming condensation trails. Direct emissions from aircraft accumulate in the atmosphere, change its chemistry and microphysics, and trap heat that would otherwise escape from Earth, contributing to global warming (IPCC 1999). However, only smaller turboprop planes use the Colstrip Airport, which has two short runways. Therefore, emissions from local airport operation and aircraft use are likely minor, as turboprops burn less fuel than jet planes.

The GHG emissions from large regional, national, and non-U.S. (global) sources and climate and climate change impacts are discussed under No Action and Proposed Action in **Section 4.3, Climate and Climate Change**.

Western Energy is anticipating expanding coal mining elsewhere at the Rosebud Mine (specifically AM5) as production from other areas reduces. Projected annual GHG emissions from existing areas (currently mined) at the mine (Areas A, B, and C) and the proposed AM5 are provided in **Section 4.4.2.4, Future GHG Emissions from other Rosebud Mine Permit Areas** and have been reproduced here in **Table 173** and **Table 174**, respectively, for completeness. As discussed in **Section 4.4.2.4,** the future GHG emissions shown here also includes the Area B BLM lease modification. Actual coal production in these areas may be lower than that shown in these tables depending on the split between the various areas of the mine; thus, GHG emissions reported are conservative.

Table 173. Future GHG Emissions from Other Existing Mine Permit Areas (Areas A, B, and C).

Year of Active Mining	Projected Coal Production (MT/year)	Greenhouse Gas Emissions (MT/year)			
		CO_2	CH_4	N_2O	CO_2e
1	5,396,974	27,829	3,624	0.69	129,473
2	5,495,131	28,335	3,689	0.71	131,828
3	4,767,379	24,582	3,201	0.61	114,369
4	4,810,561	24,805	3,230	0.62	115,405
5	2,684,199	13,841	1,802	0.34	64,394
6	1,579,884	8,147	1,061	0.20	37,901
7	1,579,884	8,147	1,061	0.20	37,901
8	695,149	3,584	467	0.09	16,677

MT/year = million tons per year.

Table 174. Future GHG Emissions from Area B Extension AM5.

Year of Active Mining	Projected Coal Production (MT/year)	Greenhouse Gas Emissions (MT/year)			
		CO_2	CH_4	N_2O	CO_2e
3	1,393,220	7,184	935	0.18	33,423
4	1,393,220	7,184	935	0.18	33,423
5	1,741,525	8,980	1,169	0.22	41,779
6	1,741,525	8,980	1,169	0.22	41,779
7	1,741,525	8,980	1,169	0.22	41,779
8	3,483,050	17,960	2,339	0.45	83,558
9	4,876,270	25,144	3,274	0.63	116,981
10	4,876,270	25,144	3,274	0.63	116,981
11	4,876,270	25,144	3,274	0.63	116,981
12	4,876,270	25,144	3,274	0.63	116,981
13	4,876,270	25,144	3,274	0.63	116,981
14	4,876,270	25,144	3,274	0.63	116,981
15	4,876,270	25,144	3,274	0.63	116,981
16	4,876,270	25,144	3,274	0.63	116,981
17	4,876,270	25,144	3,274	0.63	116,981
18	4,876,270	25,144	3,274	0.63	116,981
19	4,876,270	25,144	3,274	0.63	116,981

MT/year = million tons per year.

Colstrip Units 1 and 2 are anticipated to continue to burn coal from existing areas of the mine through July 2022 when those units will be retired. The estimated annual GHG emissions from Colstrip Units 1 and 2 are provided in **Section 4.4.2.5, Future GHG Emissions from Colstrip and Rosebud Power Plant**.

Additional foreseeable future actions include the BLM ARMP Preferred Alternative, which consists of energy and mineral development in the region. Implementation of specific components of the ARMP including identification of additional coal leases and oil and gas leasing could result in land-use changes and loss of vegetation from new infrastructure development. Land-use changes, loss of vegetation, and increased GHG emissions due to ongoing energy and mineral development and the expansion of the project area would contribute to regional cumulative effects on climate change and surface warming, if they occurred. However, the ARMP requires implementation of conservation and habitat protection for wetland and riparian areas as well as grasslands and shrublands associated with the greater sage-grouse, which could limit vegetative loss and mitigate some of the anticipated impacts if energy development occurred.

Fire affects climate change through loss of vegetation and the release of CO_2 and other GHGs into the atmosphere. Large amounts of stored CO_2 are released when vegetation burns, which significantly influences the Earth's atmosphere and climate (Cole 2001; Sommers et al. 2014). Periodic wildland fires would result in negative cumulative effects on climate change.

There is a general scientific consensus that the cumulative effects of GHGs have influenced the ambient environment on a global scale (e.g., IPCC 2014); this is considered a major cumulative effect. Global anthropogenic GHG emissions were about 52 gigatons (Gt)-CO_2e in 2010, and by 2037 (the last year of the period of the Proposed Action) global GHG emissions estimates vary from 30 to 80 Gt-CO_2e across RCP scenarios (IPCC 2014). Because the life of the mine would be extended from mining in the project area, slightly greater cumulative impacts would occur under Alternative 2 and Alternative 3 from increased GHG emissions over the long term. However, the Proposed Action and Alternative 3 are expected to have a very small contribution to cumulative impacts on regional climate change as discussed below.

The total U.S. anthropogenic GHG emissions were about 6,587 MMTCO_2e in 2015, and as discussed in **Section 4.4.3, Direct Impacts**, project area GHG emissions comprise a very small fraction—less than 0.002 percent—of the total 2015 U.S. GHG emissions. GHG emissions from indirect effects due to combustion of project area coal would constitute a small fraction—0.19 percent—of the total 2015 U.S. GHG emissions. The national GHG emissions may decrease further with the ongoing transition to renewable energy sources across the country.

5.3.4 Public Health and Safety

The analysis area for evaluation of cumulative impacts on public health includes Rosebud, Big Horn, and Treasure Counties, and the Northern Cheyenne and Crow Indian Reservations.

Related past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts on public health include:

- agriculture
- past, ongoing, and future mining and mine-related activities at the Rosebud Mine, including the proposed AM5
- coal combustion from the Rosebud and Colstrip Power Plants, including the retirement of Colstrip Units 1 and 2
- coal mining, oil and gas production, and quarrying within the analysis area
- changes to land use patterns and land management
- municipal and industrial water uses and discharges
- wildland fires
- climate change
- other air pollutant sources and emissions

Past, present, and future agricultural production within the analysis area includes production of commodity crops and domestic livestock grazing. While some of these products may be consumed within the analysis area, it is not likely that subsistence farming, hunting and gathering, and gardening comprise a significant part of the overall source of nutrition in the area. As noted in **Section 5.3.3, Climate and Climate Change**, agricultural production would contribute to GHG emissions and to climate change, as well as to changes in land use patterns. Increased GHGs and climate change may adversely impact public health (see below), to which the Proposed Action would contribute negligibly.

The past, ongoing, and future activities at the Rosebud Mine may affect air quality and the socioeconomics of the area, as discussed in **Section 5.3.3, Climate and Climate Change**, **Section 5.3.2, Air Quality**, **Section 5.3.14, Socioeconomics**, and **Section 5.3.15, Environmental Justice**. Cumulative impacts from Rosebud Mine operations may include continued emissions of HAPs and PM that could impact public health, especially among subpopulations with compromised respiratory and circulatory health close to the Rosebud Mine (Stanek et al. 2011; Jenkins et al. 2015). The Rosebud Mine, however, contributes significantly to the area's economy through direct and indirect jobs and revenues. These contribute to the funding and availability of public-health resources and social services and to the community health and well-being of the area through sustained economic resources. As discussed below (**Section 5.3.14, Socioeconomics**), future operations at the mine, including the proposed AM5, would have long- and short-term moderate to major adverse economic impacts on the area, to which the Proposed Action would contribute negligibly.

Likewise, the Colstrip and Rosebud Power Plant activities contribute to the area's public health through environmental and socioeconomic impacts, as discussed in **Section 5.3.3, Climate and Climate Change**, **Section 5.3.2, Air Quality**, **Section 5.3.14, Socioeconomics**, and **Section 5.3.15, Environmental Justice**. Combustion at these plants contributes to the overall environmental status of the area, including air and water quality. While the current environmental quality in the area meets state and federal standards, the local population has higher rates of chronic disease, including respiratory illness and cancer (see **Section 3.5, Human Health and Safety**). It is possible that past and present combustion at these facilities contributes to this and may exacerbate symptoms through incidental and long-term exposure to HAPs in plant emissions (Kelly and Fussell 2011; Ghio et al. 2012). The retirement of Colstrip Units 1 and 2 would reduce the amount of HAP and PM emissions in the area (see **Section 5.3.2, Air Quality**), and may contribute to improve environmental health conditions. Like the Rosebud Mine, however, the Colstrip and Rosebud Power Plants are significant to the area's economy with direct and indirect jobs and revenues contributing to the funding of public health and social services and the economic stability of individuals and households. Therefore, the power plants' contribution to the area's environmental health is long-term, minor to moderate, and adverse, to which the Proposed Action would contribute negligibly. The power plants' contribution to the area's community well-being is long-term, minor to moderate, and beneficial, to which the Proposed Action would contribute negligibly. The closing of Colstrip Units 1 and 2 would result in long-term minor effects on environmental health and long-term moderate adverse effects on community well-being, to which the Proposed Action would not contribute.

Other past, present, and future land uses in the area include other coal mines, oil and gas development, and quarrying. These activities likely adversely affect the environmental health of the area through exposure to PM and HAPs and release of GHGs (see **Section 5.3.2, Air Quality** and **Section 5.3.3, Climate and Climate Change**) while contributing beneficial economic resources that support public-health resources and social services.

Past, present, and future surface water usage and discharges are discussed in **Section 5.3.6, Water Resources – Surface Water**. Cumulative impacts on water resources in the area would be long-term, moderate to major, and adverse. Public health impacts could result if exposure to HAPs and other pollutants becomes likely through incidental contact with water and recreation (swimming, wading, fishing, etc.). Municipal and residential drinking water in the area comes from Castle Rock Lake (filled with water piped from the Yellowstone River) and from a few domestic water wells. MPDES requires discharge permitting, water quality monitoring, and mitigation of point source contamination to protect public and environmental health. With regulation and mitigation, the cumulative impacts on public health from surface water quality would be long-term, minor, and adverse, to which the Proposed Action would contribute negligibly.

Past and future wildland fires may result in short- and long-term adverse effects on environmental health and well-being. As discussed in **Sections 5.3.3, Climate and Climate Change**, and **Section 5.3.6, Water Resources – Surface Water**, wildland fire may contribute to surface water quality and the local effects of climate change. Short-term impacts from wildland fire on air quality may exacerbate the symptoms of respiratory illness among sensitive subpopulations. Wildland fire may have long-term adverse impacts on community well-being within MT through the loss of property, displacement of populations, and cost of response and management (Power and Power 2015). The Proposed Action would not contribute directly to the short- and long-term adverse impacts of wildland fire but could contribute negligibly through climate change (see below).

Climate change threatens public health and well-being in many ways. Increased extreme-weather events, regional drought, wildland fire, decreased air quality, impacts on mental health and culturally significant resources, and exacerbation of the spread of infectious diseases transmitted by food, water, and disease carriers (insects and wildlife) are all anticipated threats to public health from climate change (Luber et al. 2014). The impacts of climate change would vary locally. Anticipated changes to MT's climate include increased year-round temperatures, increased winter precipitation, and decreased summer precipitation (NOAA 2013). Adverse socioeconomic impacts could include losses to sectors of the economy such as agriculture, recreation, and tourism (Power and Power 2015). The impacts of climate change on both environmental health and well-being would be long-term, major, and adverse, to which the Proposed Action would contribute negligibly.

Other air pollution sources include fugitive dust from unpaved roads and wind erosion. The town of Lame Deer is identified as a nonattainment area for PM_{10} under NAAQS due to fugitive dust (DEQ 2017a). Vehicle emissions may contribute marginally to environmental health, although population density in the area is sparse and exposure to emissions is not likely. The cumulative impacts within the area of other air pollution sources would be short- to long-term, minor to major, and adverse, to which the Proposed Action would contribute negligibly.

5.3.5 Geology

The analysis area for evaluation of cumulative impacts for geology includes all permit areas of the Rosebud Mine, including past and ongoing mining areas and the proposed AM5, which is currently in the permitting process (**Figure 117**).

Related past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts on geology include the following:

- past, ongoing, and future mining at the Rosebud Mine

Past and ongoing mining at the Rosebud Mine has resulted in cumulative impacts on the overall geologic formations in the region and the loss of horizontal continuity in geologic beds overlying the coal. Because surface mining of the Rosebud Coal and overlying geologic formation is small relative to the entire Fort Union deposit, mining in the project area and possible future mining of other sites at the Rosebud Mine would result in long-term minor cumulative impacts on geologic resources.

5.3.6 Water Resources – Surface Water

The surface water cumulative impacts analysis area is the same as the indirect effects analysis area and includes the Sarpy Creek, Armells Creek, and Rosebud Creek watersheds. Past, present, and reasonably foreseeable future actions in the analysis area that have directly and indirectly impacted surface water resources or could impact them in the future include:

- past and present agricultural water use
- management of BLM lands under the ARMP
- past, present, and future coal combustion at the Colstrip and Rosebud Power Plants
- use of water in the city of Colstrip
- discharges to surface water from existing areas of the Rosebud Mine, the Rosebud Power Plant, the city of Colstrip Water Treatment Plant, and the Colstrip golf course
- wildland fire
- past, present, and future coal mining by Western Energy in other permit areas of the Rosebud Mine
- past coal mining by the Big Sky Coal Company at the Big Sky Mine
- past, ongoing, and future gravel quarrying
- wildland fires

The past, present, and reasonably foreseeable future actions that have occurred or may occur in the surface water cumulative impacts analysis area were, for the most part, evaluated qualitatively for impacts on stream flows and surface water quality. The impacts on surface water due to climate change, which is a reasonably foreseeable future affected environment, were evaluated quantitatively using numerous climate-change models.

Surface water has been used extensively in the cumulative impacts area for stock-watering and grazing and for irrigation of crops. In some cases, surface water is used at the source, and in others it is diverted for use on nearby land, with return flows from agricultural fields. This alters stream flow and, in some cases, affects surface water quality. Past and ongoing livestock grazing has destabilized stream channels, disturbed spring areas, and degraded water quality in areas where livestock drink.

The Colstrip Power Plant uses a closed-loop process (with respect to water) to minimize impacts on local surface and ground water. Up to 69 cfs of raw water is piped from the Yellowstone River to Castle Rock Lake (Hydrometrics 2015). Water is pumped to the holding tanks on the plant site and then distributed for use in the boilers, cooling towers as makeup water, bottom-ash systems, or the scrubbers. Raw water is treated prior to being directed to the boilers. The majority of water used at the facility is in the cooling-water systems. Local surface and ground water are not used at the plant, and no water is discharged from the power plant to surface or ground water. However, it is estimated that 180 acre-feet per year (0.25 cfs) of water seeps from Castle Rock Lake, increasing the flow of the East Fork Armells Creek and potentially affecting the water quality of the creek (DEQ 2016e).

The use of deep ground water wells as a source of supply for the Rosebud Power Plant does not affect surface water resources. The Rosebud Power Plant, under the facility's MPDES permit, discharges water from a storm-water control pond to an unnamed ephemeral tributary to the East Fork Armells Creek. The discharge must meet effluent limitations and conditions. There have been no recent exceedances of discharge limits in the East Fork Armells Creek watershed (EPA 2017l), so when discharges do occur, they only result in increased flow in the unnamed tributary.

The Colstrip Water Treatment Plant provides potable water from Castle Rock Reservoir. Backwash from the potable water treatment plant is discharged back to the reservoir under the facility's MPDES permit.

There have been recent but resolved violations in effluent limits for dissolved aluminum and total suspended solids (EPA 2017h). These water quality violations have adversely affected the water quality of Castle Rock Reservoir. The city of Colstrip is authorized to discharge from its wastewater treatment plant to East Fork Armells Creek pursuant to its MPDES discharge permit. There have been no recent effluent violations from the wastewater treatment plant to the creek (EPA 2017m), but the treated effluent causes changes in stream flow and water quality. The nine-hole public golf course is located adjacent to East Fork Armells Creek about a mile downstream of the city of Colstrip. Water used to maintain the greens infiltrates into the creek, likely causing undefined changes in water level and water quality.

The BLM ARMP has a goal of maintaining or enhancing the beneficial uses of surface water by supporting natural surface water flow regimes and protecting water resources from point source and nonpoint source pollution.

Past and current coal mining and reclamation by Western Energy at the Rosebud Mine and by Big Sky Coal Company at the Big Sky Mine affect stream flows, spring flows, and water supply, as well as surface water quality. These mines are in various stages of operation, reclamation, or closure. The impacts on water resources due to mining in Areas A through E at the Rosebud Mine and the Big Sky Mine are described in Appendix I of the Written Findings for Area B AM4 (DEQ 2015b). Impacts on stream and spring flow and quality are described for the following watersheds near the city of Colstrip (see **Figure 117**):

- Cow Creek watershed due to mining in Areas D and E
- East Fork Armells Creek watershed due to mining in Areas A, B, C, and D
- Lee Coulee watershed due to mining in Area B and the Big Sky Mine
- Miller Coulee watershed due to the Big Sky Mine
- Pony Creek and Spring Creek watersheds due to mining in Area D
- Rosebud Creek watershed due to mining in Areas B, D, and E (and the Big Sky Mine)
- Stocker Creek watershed due to mining in Areas A and C
- West Fork Armells Creek watershed due to mining in Area C

Impacts on surface water quantity and quality would include:

- alterations in stream and spring flows due to ground water drawdown
- alterations in surface flows from disturbance of the watershed and stream channels
- removal of tributaries during mining
- surface water quality changes due to changes in ground water quality
- changes in storm runoff due to retention of runoff in sediment control ponds
- changes in surface water quality and quantity due to MPDES discharges and mine pit dewatering to streams
- changes in surface water quality due to runoff from mine roads and facilities
- changes in stream flow due to filling of channels with more permeable unconsolidated materials postmining
- changes in the hydrologic balance due to changes in topography postmining

One MPDES permit for the Rosebud Mine allows discharges at 151 outfalls to East Fork Armells Creek, Stocker Creek, Lee Coulee, West Fork Armells Creek, Black Hank Creek, Donley Creek, Cow Creek, Spring Creek, and Pony Creek. Discharges must meet effluent numeric and narrative limits to protect surface water quality and uses. In the past three years, Western Energy had two violations for total suspended solids exceedances at two of the outfalls in 2014 and 2015 (EPA 2016f).

Possible future coal mining and prospecting proposed by Western Energy including the proposed AM5, as well as other prospecting, would have similar impacts on surface water quantity and quality as described for Rosebud Mine Areas A to F and the Big Sky Mine. It is difficult to quantify the level of impact of potential future coal-mining activities, as these actions are speculative at this time.

Other actions that may have contributed to cumulative impacts on surface waters include wildland fire and gravel quarries. Wildland fires can increase runoff and erosion and degrade water quality. Gravel quarries may affect stream flow and surface water quality where located in or along stream channels.

The Proposed Action would contribute long-term adverse cumulative impacts on surface water hydrology that would range from minor to major. This would occur due to changes in stream and spring flows, loss of springs, loss of ponds or reduction in water supply to ponds, and changes in the hydrologic balance. The Proposed Action would contribute short-term and long-term adverse cumulative impacts on surface water quality due to backfilling with spoil, surface disturbances, and changes in the hydrologic balance that would range from minor to major.

5.3.7 Water Resources – Ground Water

The analysis area for cumulative ground water impacts comprises all of the Rosebud Mine, including areas previously and presently mined (see **Figure 117**). A review of ground water-level data from the various mine areas indicates that ground water drawdown resulting from mine dewatering and removal of the Rosebud Coal does not extend any significant distance from each specific mined area. Ground water drawdown does overlap between adjacent mine areas. A possible action that could have cumulative impacts on project area ground water conditions is continued mining in Area C. Ground water drawdown due to mining in Area C would overlap with drawdown created by mining in the project area. Monitoring well WR-231, screened in the project area Rosebud Coal, has shown ground water declines of 10 to 15 feet in the southeastern portion of the project area, likely due to past and current mining in Area C. Because the total drawdown during mining would be limited by the depth of the Rosebud Coal and the coal would eventually be removed from the project area, there would not be any long-term cumulative impacts of overlapping drawdown cones from the two mined areas for what was previously the Rosebud Coal. It is likely there would be long-term (greater than 50 years postmining) cumulative residual drawdown of between 5 and 10 feet in the McKay Coal in the southeast portion of the project area, extending into Area C.

Areas A, B, D, and E, where past and present mining has occurred and is occurring and where an expansion (AM5) has been proposed, are too distant to affect ground water levels in the project area or to overlap off-site ground water drawdown. Any impacts on water quality from resaturating spoil in the other mine areas, including any mine expansion, would be seen in East Fork Armells Creek or in tributaries to Rosebud Creek. Any potential cumulative impact on project area water quality would occur downstream of the confluence of the East and West Forks of Armells Creek. However, at that distance from the mined areas, any effect on baseflow water quality would be long-term but have negligible adverse impacts. There would not be any cumulative ground water quality impacts from project area operations within the Rosebud Creek watershed.

It is possible that as the spoil in Area C and the project area resaturated and began to contribute ground water to the various alluvial channels, the overall total dissolved solids concentrations of baseflow in West Fork Armells Creek would increase with impacts ranging from none to minor.

Other past, present, and future mining activities in southeastern MT, as described in **Section 5.2.1.6, Mining** and **Section 5.2.2.7, Mining and Mineral Development**, are too distant to have any cumulative impact with respect to ground water level changes in the project area.

5.3.8 Water Resources – Water Rights

The cumulative impacts analysis area for water rights is the watersheds in which either direct or indirect impacts on water rights may be expected to occur. These include the Armells Creek, Sarpy Creek, and Rosebud Creek watersheds. The past, current, and future actions that would affect ground water rights include:

- past, present, and future mine activities in the analysis area
- the use of ground water for agricultural purposes, particularly livestock watering

Other mine activities and agricultural use of ground water resulting in ground water drawdown in area wells may result in long-term, negligible to major, adverse impacts on existing ground water rights.

Past, current, and future actions that would affect surface water resources and, consequently, surface water rights, are described in **Section 5.3.6, Water Resources – Surface Water**. These past, current, and future activities include:

- mine activities in the analysis area
- the use of surface and ground water for agriculture

Mine activities and agriculture may affect water availability, either in terms of volume or timing, to existing surface water rights and would be long-term and negligible to major.

5.3.9 Vegetation

The analysis area for evaluation of cumulative impacts on vegetation includes all permit areas of the Rosebud Mine, including past and ongoing mining areas, the proposed AM5, which is currently in the permitting process (see **Figure 117**), and the region surrounding the Rosebud Mine.

Related past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts on vegetation include:

- agriculture
- actions by federal land management agencies
- airport construction
- power plant operation (coal combustion)
- rail transport
- wildland fires
- coal mining

Agricultural development in the area consists mostly of cropland, pastureland, and grazing lands. Continued agricultural development would alter vegetation in areas adjacent to the mine and increase introduced species and noxious weeds to the area.

BLM-authorized actions in the near vicinity of the project area, such as rights-of-way for powerlines and pipelines, coal leases, mineral material sites, land withdrawals, and land sales and exchanges, may result in vegetation loss from new infrastructure development. However, BLM's ARMP includes implementation of conservation measures and protection of wetland and riparian areas for BLM-authorized projects, resulting in a beneficial contribution to vegetation in those areas.

Airport construction, power plant operation (coal combustion), and mining and rail transport have resulted in loss of vegetation due to land disturbances. Loss of vegetation due to the proposed expansion of the project area would contribute to the adverse impacts of vegetation loss from past and future land disturbance associated with construction of infrastructure.

Wildland fire affects vegetation through plant mortality, loss of seed sources, and altering of vegetation communities (including community structure and vegetation patterns). Past wildland fires altered or eliminated vegetation composition in the burn areas and likely reduced tree and shrub cover within those areas. Wildland fires can potentially increase introduced or noxious weed species if a seed source for those invasive species is present. Wildland fires can also remove existing invasive species and allow for an increase in native species or new vegetation communities, such as that of the conifer/sumac complex present in the project area. Fires also can add nutrients to the soil for vegetation and kill insect pests that may be killing native vegetation. Fires are part of the natural ecosystem, and many native plant communities are accustomed to periodic fires. Periodic wildland fires could contribute both beneficial and adverse cumulative impacts on vegetation.

Past and current coal mining and reclamation by Western Energy and coal mining by other companies in southeast MT could affect vegetation in ways similar to those described for the project area. These actions are expected to continue in the foreseeable future and could have adverse impacts on vegetation. Western Energy plans to avoid mining through many drainage bottoms in the project area (Proposed Action). Preservation of these drainage bottoms would create islands of native plants and seed sources within the project area and would reduce the impact on wetland and woody draw communities. Because this approach would be a change from the mining practices in other permit areas of the Rosebud Mine, the project area would be expected to have different impacts on vegetation than past mining activities (in other permit areas). Past and current coal-mining activities have altered the vegetation communities in the region. Vegetation cover and diversity in disturbed areas have decreased. The temporary loss of vegetation, reduction in vegetation diversity, and changes in species composition during mining activities in the project area would contribute to regional cumulative impacts on vegetation.

The Proposed Action would contribute short-term, moderate, adverse cumulative impacts on vegetation from removal of vegetation for mining activities. The Proposed Action would also contribute long-term, minor, adverse cumulative impacts on vegetation due to decreased vegetation vigor and diversity and due to the potential for changes to vegetation communities from the reduced amount of surface and ground water in the area. Overall, when combined with other past, present, and reasonably foreseeable future actions, the Proposed Action would have a long-term, minor to moderate, adverse impact on vegetation.

5.3.10 Wetlands

The analysis area for evaluation of cumulative impacts on wetlands includes all permit areas of the Rosebud Mine, including past and ongoing mining areas, the proposed AM5, which is currently in the permitting process (see **Figure 117**), and the region surrounding the Rosebud Mine.

Related past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts on vegetation include:

- agriculture
- wildland fires
- past, present, and future coal mining

Agricultural development in the area consists mostly of cropland, pastureland, and grazing lands. Past livestock grazing has destabilized stream channels and disturbed spring and wetland areas. Continued agricultural development would alter wetlands in areas adjacent to the mine and decrease the functions and values of surrounding wetlands.

Past and future fires, both wildland fire and prescribed burns, have affected and will affect wetlands mainly through alteration or reduction of wetland habitat, depending on the severity of the fire. During the 2012 wildland fire season, the McClure Creek and Donley Creek fires burned 221 acres on and around the southern boundary of the Rosebud Mine Areas B, C, and F, potentially affecting wetland habitat.

Past and current coal mining and reclamation at the Rosebud Mine, Absaloka Mine, and Big Sky Mine have likely affected wetlands in ways similar to those described for the Proposed Action (see **Section 4.11, Wetlands and Riparian Zones**). These actions are expected to continue into the foreseeable future and would have adverse impacts on wetlands.

The Proposed Action would contribute long-term adverse cumulative impacts on wetlands that would range from minor to moderate. This would occur due to changes in or loss of hydrology, which may adversely affect wetlands. The Proposed Action would also contribute short-term and long-term adverse cumulative impacts on wetlands due to surface disturbances. Overall, when combined with other past, present, and reasonably foreseeable future actions, the Proposed Action would have a long-term, minor to moderate, adverse effect on wetlands.

5.3.11 Fish and Wildlife

The analysis area for evaluation of cumulative impacts on fish and wildlife includes all permit areas of the Rosebud Mine, including past and ongoing mining areas, the proposed AM5, which is currently in the permitting process (see **Figure 117**), and the region surrounding the Rosebud Mine.

Past actions that have directly and indirectly affected wildlife in the region include:

- agriculture
- construction of the airport
- actions by federal land management agencies
- hunting
- mining
- rail transport
- wildland fire

Present and related future actions include:

- agriculture
- hunting
- mining
- coal mining and prospecting

Agricultural development in the area consists mostly of cropland, pastureland, and grazing lands. Continued agricultural development would alter habitat in areas adjacent to the mine. Wildlife is often displaced when native habitat is converted to cropland or pastureland. Grazing also affects wildlife habitat because livestock compete with native herbivores such as deer and elk. Loss of wildlife habitat and displacement of wildlife due to mining operations in the project area would contribute to regional cumulative impacts on wildlife habitat and populations.

BLM-authorized actions in the near vicinity of the project area, such as rights-of-way for powerlines and pipelines, coal leases, mineral material sites, land withdrawals, and land sales and exchanges, may result in habitat loss and fragmentation from new infrastructure development. However, BLM's ARMP also includes implementation of conservation and habitat protection of wetland and riparian areas. Displacement of wildlife from ongoing energy and mineral development and other actions on federally managed lands in the analysis area in combination with the Proposed Action may increase competition in available habitat containing sensitive resources.

Road construction, airport construction, power plant operation (coal combustion), and mining and rail transport have resulted in habitat loss or fragmentation due to land disturbances. Proposed future mining and railroad construction would also contribute to habitat loss from land-clearing activities resulting in surface disturbance. Infrastructure associated with mining including roads and fencing further divides habitat and creates barriers to wildlife movement. Railroad construction results in surface disturbance, increased human presence during construction, and habitat fragmentation. Loss of wildlife habitat and displacement of wildlife due to mining operations in the project area would contribute to habitat losses and displacement impacts from past and future land disturbance associated with construction of infrastructure.

Regulated hunting generally does not significantly impact wildlife populations. Many state and federal agencies use hunting as a management tool to control populations, reduce the spread of disease, produce maximum yield for hunters, reduce intra- and inter-species competition, and reduce damage caused by overpopulation of a species (Conover 2001). Hunting is allowed on inactive areas of the Rosebud Mine. Most large game that are hunted in the area (deer, elk, and pronghorn) appear to have relatively stable populations and have not been reduced in the past by hunting pressure (ICF International (ICF) 2013). Under the Proposed Action, some wildlife would be displaced. The possible shift of movement patterns, especially for large game, may affect the yield from hunting.

Fire affects wildlife mainly through alteration of habitat. The severity of the impacts on wildlife depends on the extent of habitat change from fire. Fires in forested areas usually cause more drastic alterations to habitat and associated fauna than those that occur in grasslands (Smith 2000). Certain studies suggest that direct mortality from fires is relatively low. Large, mobile animals and birds are capable of fleeing rather quickly. Smaller species may seek refuge under debris or in burrows (Kennedy and Fontaine 2009). Smith (2000) suggests that fire "reorganizes" animal communities because of alteration of habitat. Following some fires, generalized species may recolonize the burn area or move to adjacent unburned habitats. Generalist species may simply move to another habitat type that was not affected (i.e., breeding shrubland birds may move to grassland habitat) (Smith 2000). Some predators and raptors may benefit from fires by exposing potential prey.

Past wildland fires likely changed or eliminated habitat components in the burn areas and may have prevented or altered use by certain species. Periodic wildland fires would contribute both positive and negative cumulative impacts on regional wildlife.

5.3.12 Special Status Species

The analysis area for evaluation of cumulative impacts on special status species includes all permit areas of the Rosebud Mine, including past and ongoing mining areas, the proposed AM5, which is currently in the permitting process (see **Figure 117**), and the region surrounding the Rosebud Mine.

Past actions that have directly and indirectly affected all natural resources including special status species in the region include:

- agriculture
- construction of the airport
- actions by federal land management agencies
- hunting
- mining
- rail transport
- wildland fire

Present and related future actions include:

- agriculture
- hunting
- mining
- coal mining and prospecting

Agricultural development in the area consists mostly of cropland, pastureland, and grazing lands. Continued agricultural development would alter habitat in areas adjacent to the mine. Wildlife is often displaced when native habitat is converted to cropland or pastureland. Grazing also affects wildlife habitat because livestock compete with native herbivores such as deer and elk. Loss of wildlife habitat and displacement of special status species due to mining operations in the project area would contribute to regional cumulative impacts on special status wildlife and plant species habitat and populations.

BLM-authorized actions in the near vicinity of the project area, such as rights-of-way for powerlines and pipelines, coal leases, mineral material sites, land withdrawals, and land sales and exchanges, may result in habitat loss and fragmentation from new infrastructure development. However, the BLM's ARMP also includes implementation of conservation and habitat protection of wetland and riparian areas and for the greater sage-grouse, resulting in a beneficial contribution to species that inhabit wetlands and riparian habitat, and to grasslands and shrublands associated with greater sage-grouse habitat. Displacement of natural resources, including special status species, from ongoing energy and mineral development and other actions on federally managed lands in the analysis area and the project area may increase competition in available habitat containing sensitive resources.

Road construction, airport construction, power plant operation (coal combustion), and mining and rail transport have resulted in habitat loss or fragmentation due to land disturbances. Proposed future mining and railroad construction would also contribute to habitat loss from land-clearing activities resulting in surface disturbance. Infrastructure associated with mining including roads and fencing further divides habitat and creates barriers to wildlife movement. Railroad construction results in surface disturbance, increased human presence during construction, and habitat fragmentation. Loss of special status species habitat and displacement of wildlife due to mining operations in the project area would contribute to habitat losses and displacement impacts from past and future land disturbance associated with construction of infrastructure.

Wildland fire affects special status species mainly through alteration of habitat. The severity of the impacts on special status species depends on the extent of habitat change from fire. Fires in forested areas usually cause more drastic alterations to habitat and associated fauna than those that occur in grasslands (Smith 2000). Certain studies suggest that direct mortality from fires is relatively low. Large, mobile animals and birds are capable of fleeing rather quickly versus smaller animals. Smaller species may seek refuge under debris or in burrows (Kennedy and Fontaine 2009). Smith (2000) suggests that wildland fire “reorganizes” animal communities because of alteration of habitat. Following some fires, generalized species may recolonize the burn area or move to adjacent unburned habitats. Some special status predators and raptors may benefit from fires by exposing potential prey. Past fires likely changed or eliminated habitat components in the burn areas and may have prevented or altered use by certain species. Periodic wildland fires would contribute both positive and negative cumulative impacts on regional special status species.

5.3.13 Cultural and Historic Resources

The analysis area for evaluation of cumulative impacts on cultural and historical resources includes all permit areas of the Rosebud Mine, including past and ongoing mining areas and the proposed Area B AM5, which is currently in the permitting process (see **Figure 117**).

Related past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts on cultural and historical resources include:

- past, ongoing, and future mining at the Rosebud Mine
- agricultural operations
- wildland fire and prescribed fire

Past, ongoing, and future mining within the Rosebud Mine may result in adverse cumulative impacts on historic properties. Ground disturbances from mining activities may uncover buried archeological sites and adversely affect known and unknown historic properties. Other potential future development of the Rosebud Mine would also cause ground disturbances, potentially resulting in long-term moderate cumulative impacts on historic properties.

Western Energy applied to BLM for an LBM to federal coal lease MTM 80697. The pending LBM includes two tracts within existing permit areas of the Rosebud Mine and would affect 160 acres total. Approval of the LBM would cause ground disturbances, potentially resulting in long-term cumulative impacts on historic properties. The intensity of these impacts is unknown at this time, but any actions would be subject to Section 106 compliance and the stipulations of the Programmatic Agreement (PA) to consider potential impacts on historic properties. The PA is in **Appendix H** of this EIS.

Past, present, and reasonably foreseeable agricultural development of surrounding lands has the potential to result in ground disturbances and may affect the integrity of buried archeological sites as well as known and unknown historic properties. Past and future wildland fires in and around the project area have had and will continue to have the potential to destroy historic artifacts and properties, resulting in cumulative impacts on cultural resources. Under the Proposed Action, mining within the project area would have long-term, moderate, and adverse cumulative impacts, but these adverse impacts would be resolved through treatment proposed under the Memorandum of Agreement and through continued Section 106 compliance as stipulated in the PA (**Appendix H)**.

5.3.14 Socioeconomics

The analysis area for evaluation of cumulative impacts on socioeconomic resources includes Rosebud, Treasure, and Big Horn Counties.

Related past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts include:

- retirement of Colstrip Power Plant Units 1 and 2
- agricultural operations
- Rosebud Mine operations and prospecting

Retirement of Colstrip Units 1 and 2 is an action considered under cumulative impacts, but specific impacts are discussed in **Section 4.15, Socioeconomics** due to the assumptions made regarding the socioeconomic impacts of the Rosebud Mine and the Colstrip Power Plant. The traditional major industries of coal mining and agriculture (ranching and farming) that have been and are the driving forces of the area's economy would likely continue into the future. Past and ongoing mining at the Rosebud Mine has resulted in the loss of potential agricultural lands and economic productivity associated with agriculture. It should be noted that this loss of potential agricultural lands is temporary, as mined areas are reclaimed and returned to postmine land use. For example, reclaimed areas are available for grazing as soon as the vegetation is established and a management unit is large enough to support appropriate numbers of livestock.

If the proposed AM5 is approved, Area B would be mined until 2043, and the additional coal contained therein would account for as much as 70 percent of the total production of the Rosebud Mine (during the years 2026–2037). The approval of AM5, regardless of alternative, would result in a moderate and short- to long-term impact on the socioeconomic environment, in that it would extend the life of the mine beyond the currently anticipated closure of 2030 to 2043 (see **Section 2.2.6, Life of Operations**) and, therefore, preserve the jobs, income, and economic activity from mine operations within the socioeconomic analysis area. If both the project area (Alternative 2 or Alternative 3) and AM5 were to be approved, there would be a greater short- to long-term and moderate to major impact on the socioeconomic environment, as it would result in greater mine output and revenues and would preserve economic impacts from the mine beyond the anticipated closure of the mine.

5.3.15 Environmental Justice

The analysis area for cumulative impacts on environmental justice includes both the socioeconomic cumulative impacts analysis area (Rosebud, Treasure, and Big Horn Counties) and the Northern Cheyenne and Crow Indian Reservations.

Past, present, and reasonably foreseeable future actions that would contribute to environmental justice cumulative impacts related to socioeconomics include:

- retirement of Colstrip Units 1 and 2
- Rosebud Mine operations and prospecting

Past, present, and reasonably foreseeable future actions that would contribute to environmental justice cumulative impacts related to public health are discussed in depth above in **Section 5.3.4, Public Health and Safety** and include:

- agriculture
- past, ongoing, and future mining and mine-related activities at the Rosebud Mine, including the proposed Area B AM5 expansion
- coal combustion from the Rosebud and Colstrip Power Plants, including the retirement of Colstrip Power Plant Units 1 and 2
- coal mining, oil and gas production, and quarrying within the analysis area
- changes to land use patterns and land management
- municipal and industrial water uses and discharges
- wildland fires
- climate change
- other air pollutant sources and emissions

Colstrip Units 1 and 2 are expected to be retired from operation in 2022, and direct and indirect impacts from the mine (as defined in **Section 4.15, Socioeconomics**)—specifically revenue, employment, and economic output—would be reduced as a result. Retirement of Colstrip Units 1 and 2 is an action considered under cumulative impacts, but specific socioeconomic impacts are discussed in **Section 4.15, Socioeconomics** due to the assumptions made regarding the socioeconomic impacts of the Rosebud Mine and the Colstrip Power Plant. As discussed in **Section 4.15, Socioeconomics**, the Rosebud Mine likely would reduce annual production from about 10 million tons to about 7 million tons. Analysis for this EIS assumed the reduction in coal production (due to decreased demand from the Colstrip Power Plant) would reduce mine revenues, employment, and other metrics by about 30 percent from current conditions (BBC 2017). This is not to say that the mine and power plants are dependent on one another (i.e., the Rosebud Mine could ship its coal to other power plants, and the Colstrip Power Plant could get coal from other mines to produce power); however, for the purposes of this analysis, it is assumed coal production would decrease after retirement of Units 1 and 2.

In terms of direct impacts (as defined in **Section 4.15, Socioeconomics**) to the Northern Cheyenne Indian Reservation, the Rosebud Mine employment and economic output that contributes to the well-being of the Northern Cheyenne Tribe would decrease by about 30 percent (BBC 2017). New jobs at the mine would be reduced, limiting access to future jobs for Northern Cheyenne tribal members under the Lujan Settlement. Unemployment rates would likely increase and household income would decrease in Rosebud County. The percentage of the population that is below the poverty level may increase if there are no additional economic drivers and sectors to replace lost jobs and sustain or improve income levels. Both low-income and American Indian environmental justice populations in Rosebud County would be adversely impacted from the loss of wages and economic activity from mine operations when the mine's production is reduced.

Indirect and induced economic output (as defined in **Section 4.15, Socioeconomics**) would be reduced in the analysis area by about 30 percent, while indirect jobs would be reduced by about 25 percent (BBC 2017). The environmental justice populations in all three counties would bear a disproportionate adverse impact from the indirect economic losses associated with the decrease in the mine's production. Businesses that are both related and unrelated to mine operations within the communities in the three counties may experience economic impacts from decreased clientele due to loss of jobs and wages and to negative population growth. Indirect adverse impacts on these communities would be similar to the direct impacts discussed above on environmental justice populations in Rosebud County, including increases in unemployment and poverty rates and decreases in funding for and access to community institutions and social services. The economies in these counties, however, are less dependent on the mine and the power plants and, therefore, would not be impacted as severely when mine production decreased.

Sources of revenue from the Rosebud Mine that fund community institutions and essential social services would be reduced, both as direct and indirect impacts of the mine's decreased production. These institutions would likely experience decreased funding as a result of lower employment rates, lower wages, and loss of tax revenue from the mine operation. About a quarter of Rosebud County's employment is in social services, education, and health care. Negative population growth and a smaller labor force with lower wages may result in a reduction of services available to environmental justice populations.

If the proposed AM5 is approved, Area B would be mined until 2043, and the additional coal contained therein would account for as much as 70 percent of the total production of the mine (during the years 2026–2037). Approval of AM5 would result in short- to long-term, moderate to major, social and economic impacts on environmental justice populations, as described above under **Socioeconomics**.

Cumulative impacts on the public health of environmental justice populations would result from the same past, present, and reasonably foreseeable future actions that would impact the public health of the overall population (see **Section 5.3.4, Public Health and Safety)**. The environmental health and community well-being of environmental justice populations would be impacted in the same ways as the general population in the analysis area. Impacts would range from short- to long-term and from negligible to major. The Proposed Action would contribute to negligible to moderate impacts.

The environmental justice populations in the area would bear a disproportionate portion of cumulative impacts, as they generally have fewer economic resources and are more vulnerable to adverse impacts on environmental health and well-being (see **Section 5.3.4, Public Health and Safety**). As discussed in **Section 4.16**, environmental justice populations are less likely to be mobile than the general population. They may not have resources to access local public health resources, to travel outside of the area services, or to avoid adverse environmental health effects.

5.3.16 Visual Resources

The analysis area for evaluation of cumulative impacts on visual resources includes all permit areas of the Rosebud Mine, including past and ongoing mining areas and the proposed AM5, which is currently in the permitting process (see **Figure 117**).

Past, present, and future actions that may impact visual resources in the analysis area include:

- past, ongoing, and future mining at the Rosebud Mine
- agricultural operations
- past and future wildland fires and prescribed burns in and around the project area

Mining has resulted in increased visual contrast on the landscape including changes in the color of the landscape from removal of vegetation and exposure of soil, as well as changes to the contour of the landscape. Wildland fire also has impacted visual resources south of the project area in the past by burning the shrubs, grasses, and trees in the area and leaving large swaths of blackish charred areas (about 221 acres) with some burned stumps remaining in the present and future. The visual impacts from wildland fires would continue until the burned areas have become naturally revegetated over the next several years. In combination with the impacts on visual resources from other active mining areas and wildland fires in the analysis area, both Alternatives 2 and 3 would have a short-term minor contribution to cumulative impacts.

5.3.17 Recreation

The analysis area for evaluation of cumulative impacts on recreation includes all permit areas of the Rosebud Mine, including past and ongoing mining areas, and the proposed AM5, which is currently in the permitting process (see **Figure 117**). Past, present, and future actions that may impact recreation in the analysis area include:

- past, ongoing, and future mining at the Rosebud Mine

Depending on the timing of actions associated with these activities, impacts on recreation resources may be cumulatively greater within the analysis area.

Within the permit areas of the Rosebud Mine, there would be short-term cumulative impacts on wildlife land uses and associated hunting opportunities. Mining in the project area is intended to reduce active mining that is occurring on other permit areas of the Rosebud Mine; however, those permit areas may not be completely reclaimed at the time the project area would be developed, leading to additional loss of wildlife habitat and areas associated with hunting opportunities until vegetation is established on reclaimed mine areas. The conversion of the project area to full-scale mining is unlikely to contribute to long-term cumulative impacts on recreation in the area. After reclamation, the project area would revert to wildlife use and potential hunting by permission.

Recreational use in the areas surrounding the Rosebud Mine is unlikely to change substantially given the existing land ownership pattern. The areas surrounding but outside the permit boundary of the Rosebud Mine could continue to be made available (or be made available in the future) for hunting with landowner permission.

5.3.18 Paleontology

The analysis area for evaluation of cumulative impacts on paleontological resources includes all permit areas of the Rosebud Mine, including past and ongoing mining areas and the proposed AM5, which is currently in the permitting process (see **Figure 117**).

Related past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts on paleontological resources include:

- past, ongoing, and future mining at the Rosebud Mine

Past and ongoing mining at the Rosebud Mine has resulted in cumulative impacts on the overall geologic formations in the region, which have the potential to contain significant paleontological resources. Mining in the project area and possible future mining of other sites at the Rosebud Mine would result in additional cumulative surface and subsurface disturbance to geologic materials that have the potential to contain significant paleontological resources. Because the Fort Union Formation is classified as Class 4 (geologic units containing a high occurrence of significant fossils) and these geologic units would be lost, mining within the project area boundary would contribute to major long-term cumulative impacts on paleontological resources.

5.3.19 Access and Transportation

The analysis area for cumulative impacts on access and transportation includes the project area, existing permit areas of the Rosebud Mine (which include the existing haul road and access roads), county roads (e.g., Castle Rock Road and Horse Creek Road), the section of State Highway 39 between the Rosebud Mine and the Rosebud Power Plant, and the Rosebud and Colstrip Power Plants, plus an approximate 0.5-mile buffer area around the power plants (see **Figure 7**).

Related past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts on access and transportation include:

- past, ongoing, and future mining at the Rosebud Mine
- agricultural operations
- airport operations
- recreation activities in the area

Depending on the timing of actions associated with these activities, traffic volumes may be cumulatively greater within the analysis area. Many of the other reasonably foreseeable actions would use the same regional transportation system as the project area.

Western Energy's coal mining and prospecting would likely consist of construction of new roads, road-decommissioning activities, road reconstruction, and implementation of BMPs. The reasonably foreseeable actions and the project could have short-term negligible cumulative impacts by increasing traffic volumes near access roads. However, any additional traffic would not adversely affect the level of service on roads within the analysis area or lead to congestion.

5.3.20 Solid and Hazardous Waste

The analysis area for evaluation of cumulative impacts related to solid and hazardous waste includes all permit areas of the Rosebud Mine, including past and ongoing mining areas, the Rosebud Power Plant, the Colstrip Power Plant and off-site storage areas where coal-combustion residues (CCR) from the Colstrip Power Plant are stored, the Rosebud County Landfill where solid waste would be sent, and the disposal area where hazardous wastes generated would reside. **Figure 117** encompasses the analysis area.

Related past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts related to solid and hazardous waste include:

- past, ongoing, and future mining at the Rosebud Mine
- past, ongoing, and future coal combustion (and the resulting production of CCRs)

Mining of coal at the Rosebud Mine has contributed to the generation of solid and hazardous waste. Mining of coal within the project area would add to the total amount of solid and hazardous waste already generated and would also add to the total amount of CCR already generated and stored at the power plants. Although bottom ash would not be used in the project area, a portion of the bottom ash from burning of project area coal would likely be used in other permit areas of the mine in the construction of parking facilities, as a sanding agent for ramp and haul roads during periods of poor road conditions due to weather, and as tank and culvert bedding.

Solid or hazardous waste as a result of Alternatives 2 and 3 would have a short-term, negligible, and adverse cumulative impact on the landfill and disposal areas receiving solid or hazardous waste from the mine. This is due to the relatively small quantities of these wastes generated relative to past and future amounts received at the disposal areas from other permit areas of the Rosebud Mine. Cumulative impacts as a result of Alternatives 2 and 3 from the use of CCR at the Rosebud Mine would be short-term, negligible, and adverse due to the small quantities used, the monitoring conducted that recognize adverse impacts, and the reclamation that would be conducted in areas where CCR was used. Cumulative impacts as a result of Alternatives 2 and 3 from the combustion of project area coal and the storage of the associated CCR at the power plants and associated storage facilities would be short-term, negligible, and adverse due to the relatively small proportion of project area coal generated CCR relative to the total amount of CCR already generated at the power plants from non–project area coal.

5.3.21 Noise

The analysis area for cumulative impacts on noise includes the city of Colstrip, existing permit areas of the Rosebud Mine, the project area, and a buffer area to the north, south, west, and east that includes portions of Rosebud, Treasure, and Big Horn Counties (including the Colstrip and Rosebud Power Plants).

Related past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts from noise sources include:

- past, ongoing, and future mining at the Rosebud Mine
- agricultural operations
- airport operations
- coal combustion at the Colstrip and Rosebud Power Plants

Noise sources including the Rosebud County airfield located between Areas B and C of the Rosebud Mine, operation of the Colstrip Power Plant, and existing coal mining and/or reclamation of Areas A, B, and C have contributed to the cumulative noise level in the area surrounding the Rosebud Mine. While mining in the project area would result in noise impacts on the immediate area, operations are not expected to contribute cumulatively to regional noise due to the distance from these activities. The only continuous noise source in proximity to any residences is the Colstrip and Rosebud Power Plants. All other cumulative noise sources (e.g., Rosebud County airstrip, mining operations, etc.) are substantially distant from residences.

The nearest residences to the Colstrip Power Plant are in Colstrip and are 1,500 feet west of the two cooling towers and 2,500 feet west of the center of the Colstrip Power Plant. This results in an estimated noise level of 57 A-weighted decibels (dBA) (Bradley 1985) at these residences when continuously operating Units 1 through 4. This estimate is consistent with noise-level measurements conducted at a similar coal-fired power plant (Hankard 2015).

Therefore, noise as a result of Alternatives 2 and 3 would have moderate long-term cumulative impacts on the Colstrip residences directly west of the Colstrip Power Plant, minor long-term cumulative impacts on the other residences in Colstrip, and negligible long-term cumulative impacts on residences more than 2 miles away. All other past, present, and reasonably foreseeable actions identified in this section would have negligible short- and long-term cumulative impacts on noise under Alternatives 2 and 3.

5.3.22 Land Use

The analysis area for evaluation of cumulative impacts on land use includes all permit areas of the Rosebud Mine, including past and ongoing mining areas and the proposed AM5, which is currently in the permitting process (see **Figure 117**).

Related past, present, and reasonably foreseeable future actions that would contribute to cumulative impacts from land-use sources include:

- past, ongoing, and future mining at the Rosebud Mine
- agricultural operations
- airport operations
- recreation activities

Depending on the timing of actions associated with these activities, impacts on land use may be cumulatively greater within the analysis area.

Within the permit areas of the Rosebud Mine, there would be minor short-term cumulative impacts on agriculture and wildlife land uses. Mining in the project area is intended to reduce the active mining that is occurring on other permit areas of the Rosebud Mine; however, those permit areas may not be completely reclaimed at the time the project area would be developed, leading to additional loss of wildlife habitat and active grazing areas until vegetation is established on reclaimed mine areas. The conversion of the project area to full-scale mining is unlikely to contribute to long-term cumulative impacts on land use in the area. After reclamation, the project area would revert back to grazing and agricultural uses.

Land use in the areas surrounding the Rosebud Mine is unlikely to change substantially given that the existing land uses are well-established and consistent with the types of use under the Proposed Action. The areas surrounding but outside the permit boundary of the Rosebud Mine could continue to be grazed or used by the landowners for agricultural purposes.

5.3.23 Soil

The cumulative impacts analysis area for soil is the 32-km radius area described for indirect impacts in **Section 3.24, Soil**.

Related past, present, and reasonably foreseeable future actions that have adversely affected or could adversely affect soil in the analysis area include:

- past, ongoing, and future mining at the Rosebud Mine and other coal-mining operations
- coal combustion at the Colstrip and Rosebud Power Plants
- past, ongoing, and future gravel quarrying
- past, ongoing, and future actions by federal land management agencies
- past, ongoing, and future agricultural operations
- past airport construction

Past and present actions of soil salvage, stockpiling, and replacement at the Rosebud Mine including Areas D and E, which are currently being reclaimed, and Areas A, B, and C, which are still active, have increased erosion rates and reduced soil productivity in comparison to undisturbed portions of the mine site. Soil erosion rates have a short-term minor adverse cumulative impact on soil and begin to return to natural conditions in a couple of years once vegetation stabilizes reclaimed areas, something that is already occurring in many of the reclaimed areas at the Rosebud Mine. Reduction of soil productivity is a minor but long-term adverse cumulative impact, likely requiring decades to return to natural conditions.

Cumulative impacts on soil from another active coal mine, the Absaloka Mine, a 10,427-acre surface mine, and from one inactive coal mine, the Big Sky Mine, both within the analysis area (see **Section 5.2.1.6, Mining**) have also increased erosion rates and reduced soil productivity, resulting in similar impact types as those from the Rosebud Mine. Soil-handling operations at several gravel quarries within the analysis area may also contribute to cumulative impacts on soil, but on a smaller scale.

BLM has authorized actions in the near vicinity of the project area, such as rights-of-way for powerlines and pipelines, coal leases, mineral material sites, land withdrawals, oil and gas leases, and land sales and exchanges. Many of these activities have involved soil removal, and some have likely involved soil stockpiling and replacement. These operations have likely increased soil erosion and reduced soil productivity, and the cumulative impacts from these activities on soil are similar as described above.

Trace-metal deposition from past and present combustion of coal from Areas A, B, C, D, and E at the Colstrip and Rosebud Power Plants may potentially have adverse impacts on soil resources within a 32-km radius around the power plants. The Colstrip Power Plant, which contributes significantly more trace metals through coal combustion than the Rosebud Power Plant (see **Section 4.3, Air Quality**), has been in operation since the mid-1970s. The modeling results of combustion of project area coal at the Colstrip Power Plant have demonstrated that impacts on soil resources from selenium deposition are adverse, long-term, and minor within the analysis area, and deposition from the other trace metals is likely negligible within the analysis area (see **Section 4.24, Soil**). The combustion of coal from Areas A, B, C, D, and E likely has had and will continue to have similar cumulative impacts on soil resources.

Like trace-metal deposition, acid deposition from past and present combustion of coal from Areas A, B, C, D, and E at the Colstrip and Rosebud Power Plants may have adverse impacts on soil throughout the region. Modeling of SO_2 and NO_x gas emissions from the power plants has estimated that these gases have a long-range transport (see **Section 3.3.1.2, Air Quality** for a discussion of transport distances). The magnitude of the cumulative impacts is a function of soil chemistry and bedrock. More alkaline soil, having acid-buffering capacity, is less susceptible to acid deposition, whereas more acidic soil, having little or no acid-buffering capacity, is more sensitive to acid deposition (see **Section 4.24, Soil**). Modeling SO_2 and NO_2, however, has shown cumulative concentrations are below NAAQS and MAAQS (see **Section 5.3.2.2, Cumulative Impacts on Air Quality**). Given this, cumulative impacts on soil with and without acid-buffering capacity would be long-term, minor, and adverse.

Cumulative impacts from past agricultural operations where the surface soil is disturbed by tillage have increased erosion rates, especially during times when there is no crop cover protecting the soil from erosion. Most of this farmland is located along the major drainages (Rosebud, Armells, and Sarpy Creeks) within the analysis area. Cumulative impacts on soil from agricultural operations are a function of the agricultural practices and the number of years the practices have been utilized. If the amount of soil erosion has been severe and ongoing for many years, the cumulative impact on soil would be long-term, moderate, and adverse. But with standard agricultural practices that protect the soil surface from erosion, the cumulative impact on soil likely would be long-term, minor, and adverse. The construction of the Rosebud County Airport contributed to soil erosion within the analysis area, but pre-construction erosion rates likely returned once vegetation stabilized the soil surface. This adverse impact on soil was short-term and minor.

Foreseeable future actions that would have adverse cumulative impacts on soil include those current coal-mining activities, gravel quarries, and other energy developments mentioned above that would likely continue into the future. Additional foreseeable future actions include the potential mining of coal from the 9,000-acre AM5 expansion and the modification to coal lease MTM 80697, another potential 160-acre expansion at the Rosebud Mine. These activities would continue to have the same types of impacts. BLM-authorized actions as described above and agricultural operations are expected to continue for the reasonably foreseeable future with the same types of impacts. Current rates of trace-metal deposition from the power plants would likely continue, although they would be expected to decrease some with the retirement of Colstrip Units 1 and 2. Selenium deposition would continue to have long-term, minor, adverse cumulative impacts on soil. Of the other trace metals at the current deposition rates, mercury deposition would require the fewest years to exceed either the plant or soil invertebrate soil-screening level, which would be over 1,400 years. Therefore, deposition of the other trace metals would continue to have negligible impacts. Acid deposition resulting from coal combustion would also likely decrease, but similar impacts on soil would continue.

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CHAPTER 6. COORDINATION AND CONSULTATION

During the scoping process as well as consultation and coordination throughout the preparation of this Environmental Impact Statement (EIS), formal and informal efforts were made by the Montana Department of Environmental Quality (DEQ) and the Office of Surface Mining Reclamation and Enforcement (OSMRE) to involve other federal and state agencies, local governments, tribes, and members of the public. This consultation and coordination with multiple stakeholders was important to ensure that the most appropriate data was gathered for analysis and to ensure that agency and public interests were considered by decision-makers. This chapter provides a summary of the formal consultation processes that occurred during the preparation of the EIS. This chapter also provides a list of the interdisciplinary team (IDT) members that prepared and contributed to the EIS and provides the distribution list for the EIS.

6.1 CONSULTATION PROCESSES

6.1.1 Public Comment Process

Chapter 1 provides a summary of the public scoping process; see **Section 1.5, Public Scoping Outreach**. A detailed accounting of DEQ and OSMRE scoping processes can be found in the Public Scoping Report (ERO 2013a) and Public Scoping Report II (ERO 2013b), respectively. Both reports are available on the agencies' websites: (DEQ) http://deq.mt.gov/Public/eis and (OSMRE) http://www.wrcc.osmre.gov/initiatives/westernEnergy.shtm.

Chapter 1 also describes the issue identification process and identifies key issues and non-significant issues eliminated from detailed analysis (**Section 1.5.2, Scoping Issue Identification**).

OSMRE and DEQ conducted a 60-day public comment period on the Draft EIS. The initial 45-day public comment period on the Draft EIS began on January 4, 2018 and was noticed in the *Federal Register*, on agency websites, in legal notices, and in local newspapers. At the request of the Northern Plains Resource Council and Montana Environmental Information Center, the comment period was extended by the agencies to March 5, 2018 (a 15-day extension). OSMRE and DEQ jointly hosted a public open house and town hall meeting in Colstrip, Montana, on February 13, 2018. Substantive public comments received during the public comment period and agency responses are included in **Appendix F, Comments on the DEIS and Responses**.

6.1.2 Section 7 Consultation Process with the U.S. Fish and Wildlife Service

The Endangered Species Act (ESA) provides a means for conserving the ecosystems upon which Threatened and Endangered species depend and a program for the conservation of such species. The ESA directs all federal agencies to participate in conserving these species. Specifically, Section 7(a)(1) of the ESA charges federal agencies to aid in the conservation of listed species, and Section 7(a)(2) requires the agencies to ensure that their activities are not likely to jeopardize the continued existence of listed species or adversely modify designated critical habitats. Section 7 of the ESA (16 USC 1531 et seq.) outlines the procedures for federal interagency cooperation to conserve federally listed species and designated critical habitats.

Four federally listed species potentially occur or are affected by projects in Rosebud, Treasure, Big Horn and Powder River Counties, as shown in **Table 175.**

Table 175. Federally Endangered Species Potentially Occurring or Potentially Affected by Projects in Rosebud, Treasure, Big Horn and Powder River Counties.

Common Name	Scientific Name	Status* Federal/State	General Habitat Affinity	Habitat in Analysis Area
Birds				
Whooping crane	*Grus americana*	E	Wet meadows, marshes	None
Mammals				
Black-footed ferret	*Mustela nigripes*	E	Active prairie dog towns or complex > 80 acres in size	None
Northern long-eared bat	*Myotis septentrionalis*	T	Rock cavities and crevices, behind bark in trees, dead hardwood trees	None
Fish				
Pallid sturgeon	*Scaphirhynchus albus*	E	Slow-moving, large rivers	None

*E = Endangered; T = Threatened.

Source: USFWS 2017a.

The U.S. Fish and Wildlife Service (USFWS) was sent a scoping newsletter on August 30, 2013 describing the Proposed Action and requesting comments. OSMRE (Frank Bartlett) contacted the USFWS Ecological Services Montana Field Office (Brent Esmoil) in Helena on June 9, 2014 to discuss the project. USFWS advised that if OSMRE is making a determination of “no effect,” then no further USFWS consultation is needed. OSMRE (Logan Sholar) followed up with Brent Esmoil in 2017 regarding the indirect effects analysis area for the proposed project. Specifically, OSMRE provided information to USFWS on January 31, 2017 disclosing federally listed Threatened and Endangered species that could be present within Rosebud, Treasure, and Big Horn Counties (USFWS 2017a) and any potential effects on the species or habitat that could result from the proposed project. In May 2017, the indirect effects analysis area was expanded from a 29-km radius to a 32-km radius from the Rosebud and Colstrip Power Plants. The 32-km analysis area extended into Powder River County. Therefore, species potentially occurring in Powder River County were included in the Threatened and Endangered species analysis.

Under the Proposed Action (Alternative 2) and Alternative 3 – Proposed Action Plus Environmental Protection Measures (see **Sections 2.4** and **2.5**), a portion of the indirect effects analysis area for special status species falls within the AOI for the northern long-eared bat. OSMRE has complied with the USFWS’s programmatic BO for the January 5, 2016 Northern Long-Eared Bat 4(d) Rule (USFWS 2017a) and fulfilled the Section 7 consultation requirements under the ESA through submission of the streamlined consultation form on June 21, 2017 to the Montana Ecological Field Services Office. There are no effects on the northern long-eared bat beyond those previously disclosed in the USFWS’s BO for the final 4(d) rule. Any taking that may occur incidental to Alternative 2 or 3 is not prohibited under the final 4(d) rule (50 CFR 17.40(o)). This project is consistent with the activities outlined in the programmatic BO, and the 4(d) rule does not prohibit incidental take of the northern long-eared bat that may occur as a result of this project. Therefore, the programmatic BO satisfies the OSMRE responsibilities under Section 7 of the ESA of 1973, as amended, 16 USC l53l et seq., relative to the northern long-eared bat for this project.

Additionally, USFWS and OSMRE were able to conclude that no other federally listed T&E species or their critical habitats exist within the direct and indirect effects analysis areas for special status species (see **Section 3.1, Special Status Species**), and no further USFWS consultation is needed.

6.1.3 Tribal Consultation Process

Section 106 of the National Historic Preservation Act (NHPA) of 1966 as amended and its implementing regulations under 36 CFR 800 require all federal agencies to consider effects of federal actions on cultural resources eligible for or listed on the National Register of Historic Places (NRHP). To comply with Section 106, federal agencies are required to consult with interested parties including Native American tribes who claim cultural affiliation with the affected lands to maintain government-to-government consultation responsibilities.

Traditional cultural properties (TCPs) are protected under Section 106 of the NHPA as historic properties, and when applicable, have additional protections under the American Indian Religious Freedom Act of 1978 and the Native American Grave Protection and Repatriation Act of 1990. A TCP may be eligible for listing in the NRHP. Examples of TCPs include but are not limited to locations where Native Americans have performed ceremonies, traditional locations for resource gathering, and rural community land use patterns such as farming and ranching (see **Section 3.14, Cultural and Historic Resources**).

OSMRE initiated formal tribal consultation with the Northern Cheyenne, Fort Peck Assiniboine and Sioux Tribes, and Crow Tribes regarding the identification and effects on TCPs and archeological sites of significance to the tribes. Consultation was initiated through letters sent to each of the three tribes on April 14, 2014. OSMRE did not receive any communications in response to these letters. Each tribe also was contacted during the two formal public scoping periods (see **Section 1.5, Public Scoping Outreach**). None provided comments during either public scoping period.

OSMRE contacted the Northern Cheyenne, Fort Peck Assiniboine and Sioux Tribes, and Crow Tribes again via letter on January 6, 2015 to inform the tribes of potential adverse effects to four archaeological properties (24RB958, 24RB2334, 24RB2339, and 24RB2438) that would potentially occur within the first 5 years (60 months) of project operations. The letters informed the tribes that a Memorandum of Agreement (MOA) would be prepared for standard data recovery for the four affected sites and invited tribal participation in the MOA. The letter also informed the tribes that a Programmatic Agreement would be developed for the project to implement mitigation measures for effects to known sites and stipulations to treat unanticipated discoveries during mining operations. Comments on the affected sites were solicited and information was requested regarding traditional uses, ethnographic resources, and TCPs in the project area. OSMRE did not receive any communications in response to these letters. The MOA was entered into by Western Energy, SHPO, DEQ, BLM, and OSMRE and would implement mitigation measures for the four archaeological properties (24RB958, 24RB2334, 24RB2339, and 24RB2438) identified in the letters. A Programmatic Agreement has also since been developed among the same parties and was officially executed on March 27, 2017.

On June 2, 2015, OSMRE notified the Northern Cheyenne, Fort Peck Assiniboine and Sioux Tribes, and Crow Tribes via letter that the Black Hank Site (24RB2339) had been determined eligible for the NRHP under Criterion D. Comments on the affected site, as well as the other three sites covered by the MOA, were solicited and information was once again requested regarding traditional uses, ethnographic resources, and TCPs in the project area. OSMRE did not receive any communications in response to these letters.

In response to public comments, OSMRE initiated consultation with additional tribes, including the Apache, Blackfeet Nation, Eastern Shoshone, Kiowa, and Oglala Sioux. The purpose of continuing consultation is to inform the tribes of Stipulation 10 in the PA that allows new stakeholders to request consulting status at any time (**Appendix H).**

Although no TCPs have been identified to date, continued tribal consultation may identify such properties.

6.1.4 Federal, State, and Local Agencies

DEQ and OSMRE consulted the following agencies during the development of this EIS:

Advisory Council on Historic Preservation
Montana Fish, Wildlife and Parks
Montana Natural Heritage Program
Montana State Historic Preservation Officer
USDA Forest Service, Custer and Gallatin National Forests
USDI Bureau of Land Management (see **Section 6.2.3, Bureau of Land Management**)
USFWS (see **Section 6.1.2, Section 7 Consultation Process with the U.S. Fish and Wildlife Service**)

6.2 PREPARERS AND CONTRIBUTORS

6.2.1 Montana Department of Environmental Quality

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6.3 LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM COPIES OF THIS EIS HAVE BEEN DISTRIBUTED

This EIS or its Summary has been distributed to individuals who provided scoping comments on the project or who specifically requested a copy of the document, either in hard or electronic copy. In addition, copies have been sent to the federal agencies, tribal governments, state and local governments, and companies potentially affected by the proposed project. The project mailing list is available upon request from OSMRE and DEQ.

A copy of this EIS can be reviewed at the following locations or via the Internet on the OSMRE web page (https://www.wrcc.osmre.gov/initiatives/westernenergy.shtm) or the DEQ web page (http://deq.mt.gov/eis.mcpx) and at the following locations:

Montana DEQ Headquarters (Lee Metcalf Building)
1520 East 6th Avenue
Helena, MT 59620-0901
Between the hours of 8:00 AM and 5:00 PM Monday through Friday (Closed Saturday and Sunday)

BLM Miles City Field Office
111 Garryowen Road
Miles City, MT 59301
Between the hours of 7:45 AM and 4:30 PM Monday through Friday (Closed Saturday and Sunday)

Rosebud County Library
201 North 9th Avenue
Forsyth, MT 59327-0007
Between the hours of 11:00 AM and 7:00 PM Monday through Thursday; 11:00 AM to 5:00 PM Friday; 10:00 AM to 1:00 PM Saturday(Closed Sunday)

OSMRE, Western Region
1999 Broadway, Suite 3320
Denver, CO 80202
Between the hours of 8:00 AM and 4:00 PM Monday through Friday (Closed Saturday and Sunday)

BLM State Office, Billings, MT
5001 Southgate Drive
Billings, MT 59101
Between the hours of 8:00 AM and 4:00 PM Monday through Friday (Closed Saturday and Sunday)

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CHAPTER 7. REFERENCES

Aaberg, S.A., R.R. Hanna, C. Crofutt, J. Green, and M. Vischer. 2006. Class I Overview of Paleontological & Cultural Resources in Eastern Montana, Volume 1. Prepared by Aaberg Cultural Resource Consulting Service for the U.S. Department of the Interior, Bureau of Land Management, Miles City Field Office Resource Management Plan and Environmental Impact Statement.

Abdul-Kareem, A.W. and S.G. McRae. 1984. "The Effects on Topsoil of Long-Term Storage in Stockpiles." *Plant and Soil*. 76(1):357–363.

ACI Energy. 2014. Available at http://www.aciinc.net/colmacMontana.htm. Accessed April 3, 2014.

Adams, M.D. and J.P. Hayes. 2000. "Use of bridges as night roosts by bats in the Oregon coastal range." *Journal of Mammalogy* 81(2):402–407.

Agriculture and Agri-Food Canada. 2015. Water quality impacts on livestock. Available at www.agr.gc.ca/eng/science-and-innovation/agricultural-practices/water/livestock-watering/water-quality-impacts-on-livestock/?id=1370621201553. October 16.

AirNav.com. 2014. Available at https://www.airnav.com/airport/M46. Accessed March 25, 2014.

Alder, J.R. and S.W. Hostetler. 2013. USGS National Climate Change Viewer. U.S. Geological Survey. Available at https://www2.usgs.gov/climate_landuse/clu_rd/nccv.asp. Accessed April 2017.

American Academy of Pediatrics. 2004. Ambient Air Pollution: Health Hazards to Children. Policy Statement. Committee on Environmental Health. Pediatrics 114(2004):1699-1707.

American Indian Health Profile. 2008a. Northern Cheyenne Reservation. Compiled by Montana Kids Count. Available at http://leg.mt.gov/content/Committees/Interim/2009_2010/State_Tribal_Relations/Publications%20-%20other%20readings/Northern%20Cheyenne%20Tribe.pdf. Accessed June 2017.

American Indian Health Profile. 2008b. Crow Reservation. Compiled by Montana Kids Count. Available at http://leg.mt.gov/content/Committees/Interim/2009_2010/State_Tribal_Relations/Publications%20-%20other%20readings/Crow%20Tribe.pdf. Accessed June 2017.

ARM (Administrative Rules of Montana). 1989–90 and as subsequently amended. Rules and Regulations Governing the Opencut Mining Act. Chapter 17-24, Subchapter 2. Helena, MT.

Association of American Railroads. 2008. Freight Railroads & Greenhouse Gas Emissions. June 2008. Available at http://siteresources.worldbank.org/EXTRAILWAYS/Resources/515244-1268663980770/greenhouse.pdf. Accessed July 10, 2015.

Atwood, S. 2014. Email correspondence between Steve Atwood (FWP) and Chris Yde (DEQ) regarding sage-grouse populations in the Area F expansion site.

Barrett, N.M. 1998. Northern goshawk (*Accipiter gentilis*). pp. 116–117. In Kingery, H. 1998. *Colorado Breeding Bird Atlas*. Colorado Bird Atlas Partnership and Colorado Division of Wildlife. 636 pp.

BBC (BBC Research & Consulting). 2017. IMPLAN Analysis of Economic Effects of the Rosebud Mine with Area F Expansion. Memorandum to ERO Resources Corporation.

Berglund J. and R. McEldowney. 2008. Montana wetland field evaluation form and instructions. Helena, MT. Available at http://www.mdt.mt.gov/other/environmental/external/wetlands/2008_wetland_assessment/2008_mwam_manual.pdf.

Bison Engineering. 2013a. Montana Air Quality Permit Application for Western Energy Co.: Rosebud Mine – Area F Expansion. April 16.

Bison Engineering. 2013b. AQP 1570-06 Permit Modification – Additional Information Request. June 12.

BLM (Bureau of Land Management). 1986. Manual H-8410-1. Visual Resource Inventory. 28 pp.

BLM. 2008. *NEPA Handbook (H-1790-1)*. January 2008. Available from the BLM website: http://www.blm.gov/pgdata/etc/medialib/blm/wo/Information_Resources_Management/policy/blm_handbook.Par.24487.File.dat/h1790-1-2008-1.pdf.

BLM. 2015. Miles City Field Office Approved Resource Management Plan and Final Environmental Impact Statement. Available at https://www.blm.gov/mt/st/en/fo/miles_city_field_office/rmp.html. Accessed February 9, 2017.

BLM. 2016a. PGM Modeling Study – Future Emissions Modeling Methodology/Results. Final. Prepared for BLM Montana/Dakotas State Office. Prepared by Ramboll Environ, Novato, CA and Kleinfelder West, Inc., Littleton, CO. January.

BLM. 2016b. PGM Modeling Study – Final Report. Prepared for BLM Montana/Dakotas State Office. Prepared by Ramboll Environ, Novato, CA and Kleinfelder West, Inc., Littleton, CO. April.

BLM. 2016c. Potential fossil yield classification (PFYC) system for paleontological resources on public lands. July 8.

BLM. 2017. Email communication from Gregory Liggett, Montana State Office Paleontologist. May 2.

BLM and OSMRE. 2014. Memorandum of Understanding for Preparation of an Environmental Impact Statement for Western Energy Company's Rosebud Mine Area F Expansion. March 17, 2014.

Bradley, Wayne E. 1985. Estimating Exterior Noise from Power Plants. Noise-Con 85, pp. 343–346.

Brown, R.W. 1962. Paleocene flora of the Rocky Mountains and Great Plains. United States Geological Survey Professional Paper. 375:1–119.

Buehler, D. and K. Percy. 2012. Coal Mining and Wildlife in the Eastern United States: A Literature Review. University of Tennessee. January 15, 2012.

Calabrese, J. 2015. Julian Calabrese, Soil Scientist/Reclamation Specialist, Montana DEQ. Personal communication with Dave Buscher, soil scientist/ecological engineer, Buscher Soil & Environmental, Inc. regarding selenium levels. October 26, 2015.

Calabrese, J. 2017. Soil Scientist/Reclamation Specialist, Montana DEQ. Personal Communication Via E-mail to Jennifer Lane and Peter Mahrt. April 2017.

Canon, M.R. 1984. Potential effects of surface coal mining on the hydrology of the Circle West coal tracts, McCone County, Eastern Montana. U.S. Geological Survey Water Resources Investigations Report. 84–4181.

CDC (Center for Disease Control and Prevention). 2005. Public Health Assessment Guidance Manual (Update). Available at https://www.atsdr.cdc.gov/hac/phamanual/toc.html. Accessed June 2017.

CDC. 2015. Health of American Indian or Alaska Native Population (2014 Data). Available at https://www.cdc.gov/nchs/fastats/american-indian-health.htm. Accessed June 2017.

Cedar Creek Associates, Inc. 2009. Western Energy Company's Rosebud Mine Area F 2006 Baseline Vegetation Survey. Unpublished Report prepared for Western Energy, Fort Collins, CO. 176 pp.

Cedar Creek Associates, Inc. 2013. Western Energy Company's Rose Mine Wetlands Delineation, Area F. Field Survey completed July-August 2013. Report completed December 2013.

Cedar Creek Associates, Inc. 2014. Western Energy Company's Rosebud Mine Area F 2006 Baseline Vegetation Survey. Unpublished Report prepared for Western Energy, Fort Collins, CO. 176 pp. Updated January 2014.

Center for Climate Strategies. 2007. Montana Greenhouse Gas Inventory and Reference Case Projections 1990-2020. September 2007. Available at http://leg.mt.gov/content/committees/interim/2007_2008/energy_telecom/assigned_studies/co2page/draftgreenhousegas.pdf.

CEQ (Council on Environmental Quality). 1997. Environmental Justice, Guidance Under the National Environmental Policy Act. Executive Office of the President. Washington, D.C. December 10.

CFR (Code of Federal Regulations). 2013. Available from the Government Printing Office website: http://www.gpo.gov/fdsys/browse/collectionCfr.action?collectionCode=CFR.

Chadwick, Robert A. 1973. "Coal: Montana's Prosaic Treasure." Montana: The Magazine of Western History 23(4):18–31.

City of Colstrip. 2008. Comprehensive Growth Policy. Available at <http://cityofcolstrip.com/index.php?option=com_jdownloads&task=download.send&id=162&catid=6&m=0>. Accessed December 9, 2016.

City of Colstrip. 2013. Comprehensive Growth Policy. Available at <http://cityofcolstrip.com/index.php?option=com_jdownloads&task=download.send&id=246&catid=6&m=0>. Accessed December 8, 2016.

Clean Air Task Force. 2010. The Toll from Coal: An Updated Assessment of Death and Disease from America's Dirtiest Energy Source. Available at http://www.catf.us/resources/publications/view/138. Accessed May 18, 2018. September.

Cole, Julia. 2001. Biomass Burning. March 19. Earth Observatory, EOS Project Science Office, NASA. Available at http://earthobservatory.nasa.gov/Features/BiomassBurning/. Accessed April 1, 2016.

Conover, M.R. 2001. "Effect of Hunting and Trapping on Wildlife Damage." *Wildlife Society Bulletin*. 29:521–532.

Corbin, C.B., K. McConnell, G. Le Masurier, D. Corbin, and T. Farrar. 2015. "Climate Change." *Health Opportunities through Physical Education*. Champaign, IL: Human Kinetics.

Corbitt, E.S., D.J. Jacob, C.D. Holmes, D.G. Streets, and E.M. Sunderland. 2011. Global Source—Receptor Relationships for Mercury Deposition Under Present-Day and 2050 Emissions Scenarios. Environmental Science & Technology. 45(24), 10477–10484.

Corps (U.S. Army Corps of Engineers). 2010. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Great Plains Region (Version 2.0). U.S. Army Research and Development Center. Vicksburg, MS.

Corps. 2012. Nationwide Permits Regional Conditions, Omaha District, State of Montana. March 19, 2012.

Corps. 2013. Montana Stream Mitigation Procedure (MTSMP). Available at http://www.nwo.usace.army.mil/Portals/23/docs/regulatory/MT/gen/MTSMP-Revised-February2013.pdf. pp. 57.

Corps. 2014. Isolated Wetlands – Approved Jurisdictional Determination – Area F. Corps File No. NWO-2012-01315-MTB. September 3.

Corps and EPA. 2007. U.S. Army Corps of Engineers Jurisdictional Determination Form Instructional Guidebook. May 30.

Corps, U.S. Office of Surface Mining, U.S. Environmental Protection Agency, and U.S. Fish and Wildlife Service. 2005. Memorandum of understanding for the purpose of providing concurrent and coordinated review and processing of surface coal mining applications proposing placement of dredged and/or fill material in waters of the U.S. February.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep water habitats of the United States. U.S. Fish and Wildlife Service, Office of Biological Services Program. FWS/OBS-79-31.

Criswell, G. 2017. E-mail communication from Gordon Criswell, Talen Energy, to Jen Lane, DEQ. February 8, 2017.

Delta. 2002. Nordic Environmental Noise Prediction Methods. Nord2000 Summary Report. General Nordic Sound Propagation Model and Applications in Source-Related Prediction Methods, AV 1719/01. Delta. June 2002.

DEQ (Montana Department of Environmental Quality). 1998. Soil, Overburden, and Regraded Spoil Guidelines. December 1994. Updated August 1998. MDEQ-Permitting and Compliance Division-Industrial and Energy Minerals Bureau. Helena, MT.

DEQ. 1999. MPDES Permit MT-0023965. Helena, MT.

DEQ. 2000. Guidelines for Vegetative Sampling. DEQ, Permitting and Compliance Division. Helena, MT.

DEQ. 2001. Fish and Wildlife Guidelines for Montana Strip and Underground Mine Reclamation Act. Produced by the DEQ Industrial and Energy Minerals Bureau Coal Program, Helena, MT.

DEQ. 2007. Montana Climate Change Action Plan: Final Report of the Governor's Climate Change Advisory Committee. November 2007. Available at http://deq.mt.gov/ClimateChange/plan.mcpx.

DEQ. 2012. MPDES Permit MT-0023965 Reissuance Environmental Assessment. Helena, MT. March 20, 2012.

DEQ. 2013. Preliminary Determination on Permit Application MAQP 1570-07. Helena, MT. July 22, 2013.

DEQ. 2014. Circular DEQ-12A: Montana Base Numeric Nutrient Standards. Available at http://deq.mt.gov/wqinfo/circulars.mcpx.

DEQ. 2015a. In the Matter of the Application of PPL Montana, LLC to Amend the Colstrip 2 and 4 Certificate of Environmental Compatibility and Public Need. Dated 1/20/2015, Tom Livers, Director, DEQ.

DEQ. 2015b. Written Findings for AM4 Additional 49 Acres, Western Energy Company, Rosebud Coal Mine Area B. Prepared by MDEQ Industrial and Energy Minerals Bureau Coal and Uranium Program. December 4.

DEQ. 2015c. Operating Permit Technical Review Document (TRD0513-13). Montana Department of Environmental Quality, Permitting and Compliance Division. Talen Montana, LLC, Colstrip Steam Electric Station. Colstrip, MT. September 1.

DEQ. 2015d. Information on new spring development post-mining in the Rosebud Mine. Information provided by Pete Schade, DEQ hydrologist, to Barbara Galloway, ERO hydrologist. December 1.

DEQ. 2015e. Big Sky Mine Reclamation. Telephone conference with Martin Van Oort, Pete Schade, Emily Hinz, and Jen Lane at DEQ with Barbara Galloway and Mike Galloway at ERO Resources Corporation. November 4 and 5.

DEQ. 2016a. Alluvial Valley Floor Determination, for Tributaries Intersected by the Proposed Area F Mine Permit Area, Rosebud Coal Mine, in the Upper West Fork Armells Creek Drainage. Coal and Opencut Mining Bureau.

DEQ, 2016b. State of Montana Air Quality Monitoring Network Plan. Montana Department of Environmental Quality. Air Quality Bureau. May.

DEQ. 2016c. Modeling Results for the Initial Designation of the 2010 1-Hour SO_2 Standard Pursuant to the Data Requirements Rule. Colstrip Steam Electric Station, Rosebud County, Montana. October 21, 2016.

DEQ. 2016d. Appendix A: Impaired Waters List for Montana. Available at http://deq.mt.gov/Portals/112/Water/wqpb/CWAIC/Reports/IRs/2016/App_A.pdf.

DEQ. 2016e. Useful Mercury Surface Water and Fish Tissue Data for EIS. Prepared by Darrin Kron, Teri Mavencamp, and Jane Madison for Jen Lane. November 1.

DEQ. 2016g. Climate Change and Agriculture. Available at http://deq.mt.gov/Energy/climatechange/commerce/agriculture. Accessed March 30, 2016.

DEQ. 2017a. Air Quality Non-attainment Information. Available at http://deq.mt.gov/Air/airquality/Planning/AirNonattainment. Accessed June 2017.

DEQ. 2017b. Aquatic macroinvertebrate data collected by DEQ. Provided by Pete Schade, DEQ hydrologist, to Barbara Galloway, ERO hydrologist. March 30, 2017.

DEQ. 2017c. Circular DEQ-7, Montana Numeric Water Quality Standards. Montana Department of Environmental Quality, Water Quality Division, Water Quality Planning Bureau, Water Quality Standards and Modeling Section. Helena, MT. May.

DEQ. 2018. De minimis Notification Scrubber Flow Distribution Plates – Units 3 & 4. August 27.

DEQ and OSMRE. 2013. Memorandum of Understanding for Preparation of a Joint Environmental Impact Statement for Western Energy Company's Rosebud Mine Area F Expansion. December 31, 2013.

DNRC (Montana Department of Natural Resources and Conservation). 1975. Final Environmental Impact Statement on the Proposed Montana Power Company, Puget Sound Power & Light Company, Portland General Electric Company, Pacific Power and Light Company, and Washington Water Power Company Colstrip Electric Generating Units 3 &4, 500 Kilovolt Transmission Lines from Colstrip to Hot Spring, Montana, and Associated Facilities. Available from https://archive.org/details/177031B1-9308-48F9-9559-BAD48C19B04C. Accessed April 7, 2017.

Ecological Society of America. 2000. Acid Deposition. Available at http://www.esa.org/esa/wp-content/uploads/2012/12/aciddeposition.pdf. Accessed July 10, 2017.

EIA. 2011. Table 7.1 Coal Overview, Selected Years, 1949-2011. Annual Energy Review 2011. Available at www.eia.gov/totalenergy/data/annual/pdf/sec7_5.pdf

EIA. 2013. Table 9: Major U.S. Coal Mines, 2013. Available at http://www.eia.gov/state/print.cfm?sid=MT.

EIA. 2015. Annual Coal Report 2013. Available at www.eia.gov/coal/annual/pdf/acr.pdf. April 2015.

EIA. 2016a. Annual Coal Report 2014. Available at https://www.eia.gov/coal/annual/archive/05842014.pdf. March 2016.

EIA. 2016b. Annual Coal Report 2015. Available at www.eia.gov/coal/annual/pdf/acr.pdf November 2016.

EIA. 2017. Annual Energy Outlook 2017: Interactive Table Viewer. Available at https://www.eia.gov/outlooks/aeo/pdf/0383(2017).pdf. Accessed May 2017.

Elison, Mark. 2018. Personal communication between Mark Elison, Manager, Montana Water Rights Bureau, Billings, MT, and Barbara Galloway, ERO Resources Corporation, regarding Montana water rights. March 29 and May 8.

Elphick, J.R., K.D. Bergh, and H.C. Bailey. 2011. "Chronic toxicity of chloride to freshwater species: effects of hardness and implications for water quality guidelines." *Environmental Toxicology and Chemistry*. 30:1 239–246.

Environmental Laboratory. 1987. Corps of Engineers Wetland Delineation Manual, Technical Report Y-87-1, U.S. Army Engineer Waterways Experiment Station. Vicksburg, MS.

EPA (U.S. Environmental Protection Agency). 1971. Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances. December.

EPA. 1974. Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety. Available at http://www.nonoise.org/library/levels74/levels74.htm. Office of Noise Abatement and Control. March.

EPA. 1978a. Guidelines for Determining Best Available Control Technology (BACT). Office of Air, Noise, Radiation and Office of Air Quality Planning and Standards. December.

EPA. 1978b. Protective Noise Levels – Condensed Version of EPA Levels Document, EPA 550/9-79-100. Office of Noise Abatement & Control. Washington, DC 20460. November.

EPA. 1992. July. SW-846 Test Method 1311: Toxicity Characteristic Leaching Procedure. Available at www.epa.gov/hw-sw846-test-method-1311-toxicity-characteristic-leaching-procedure. Accessed April 19, 2017.

EPA. 1995a. Appendix B.2: Generalized Particle Size Distributions. In: Compilation of Air Pollutant Emission Factors. Volume I: Stationary, Point and Area Sources (Fifth Edition). Office of Air Quality Planning and Standards. pB.2-1–B.2-22., January. Available at http://www.epa.gov/ttn/chief/ap42/appendix/appb-2.pdf. Accessed June 2017.

EPA. 1995b. Policy for Risk Characterization. Appendix A in EPA's Risk Characterization Handbook (2000). Available at https://www.epa.gov/risk/risk-characterization-handbook. Accessed June 2017.

EPA. 1998. Final Guidance For Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analyses, April 1998. Available at http://www.epa.gov/compliance/ej/resources/policy/ej_guidance_nepa_epa0498.pdf. Accessed March 30, 2015.

EPA. 2001. Development Document for Final Effluent Limitations Guidelines and Standards for the Western Alkaline Coal Mining Subcategory. Available at http://www2.epa.gov/sites/production/files/2014-08/documents/coal_mining_dd_western_subcategory_2001.pdf

EPA. 2002. Health Assessment Document for Diesel Engine Exhaust [EPA/600/8-90/057F]. National Center for Environmental Assessment, Office of Research and Development. May.

EPA. 2004. Methane Emissions from Abandoned Coal Mines in the United States: Emission Inventory Methodology and 1990–2002 Emissions Estimates. April 2004. U.S. EPA Coalbed Methane Outreach Program. Available at https://www3.epa.gov/cmop/docs/amm_final_report.pdf. Accessed December 6, 2016.

EPA. 2005a. U.S. Surface Mines Emissions Assessment. U.S. EPA Coalbed Methane Outreach Program. Available at https://www.epa.gov/sites/production/files/2016-03/documents/us_surface_coal_mines_markets-update_feb2015.pdf. Accessed January 2017.

EPA. 2005b. Ecological Soil Screening Level (Eco SSL) Guidance and Documents. Available at https://www.epa.gov/risk/ecological-soil-screening-level-eco-ssl-guidance-and-documents.

EPA. 2005c. Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities, Final. EPA520-R-05-006. Office of Waste-Hazardous Waste – Treatment & Disposal.

EPA. 2006. Fact Sheet: New Source Review (NSR). Available at https://www.epa.gov/sites/production/files/2015-12/documents/nsrbasicsfactsheet103106.pdfEPA. 2007. Ecological Soil Screening Levels for Selenium. Office of Solid Waste and Emergency Response. July.

EPA. 2007. U.S. EPA. Ecological Soil Screening Levels for Selenium. Office of Solid Waste and Emergency Response. July.

EPA. 2008a. U.S. EPA Region 8 Climate Change Strategic Plan. Public Comment Draft. August 20, 2008. Available at http://www2.epa.gov/sites/production/files/documents/r8climatechangestrategicplanpubliccommentdraft20aug2008.pdf.

EPA. 2008b. Appendix B: Summary of State Greenhouse Gas Emissions Inventories in EPA Region 8. U.S. EPA Region 8 Climate Change Strategic Plan.

EPA. 2008c. U.S. Surface Coal Mine Methane Recovery Project Opportunities. EPA430-R-08-001. June 10, 2008. Coalbed Methane Outreach Program. Available at http://www.epa.gov/cmop/docs/cmm_recovery_opps_surface.pdf.

EPA. 2008d. Ecological Soil Screening Levels for Chromium. Office of Solid Waste and Emergency Response. April.

EPA. 2009. Integrated Science Assessment for Particulate Matter (Final). RTP Division, Office of Research and Development, National Center for Environmental Assessment (NCEA). EPA/600/R-08/139F. 2,228 pp., December. Available at http://www.epa.gov/ncea/pdfs/partmatt/Dec2009/PM_ISA_full.pdf. Accessed June 2017.

EPA. 2012. 40 CFR Part 52 – Approval and Promulgation of Implementation Plans; State of Montana; State Implementation Plan and Regional Haze Federal Implementation Plan [EPA-R08-OAR-2011-0851; FRL-9719-9]. September 18.

EPA. 2014a. EPA Region 8 Climate Change Adaptation Implementation Plan. June 30, 2014. Available at https://www3.epa.gov/climatechange/Downloads/Region8-climate-change-adaptation-plan.pdf. Accessed February 2017.

EPA. 2014b. Climate Change: Basic Information. Updated March 18, 2014. Available at http://www.epa.gov/climatechange/basics/. Accessed May 12, 2015.

EPA. 2014c. Methane Recovery at Surface Mines in the U.S. Coalbed Methane Outreach Program. Available at http://www.epa.gov/methane/cmop/docs/CMOP-Methane-Recovery-Surface-Mines-March-2014.pdf.

EPA. 2015a. Factsheet: Overview of the Clean Power Plan: Cutting Carbon Pollution from Power Plants. Available at http://www.epa.gov/sites/production/files/2015-08/documents/fs-cpp-overview.pdf. Accessed 23 February 2016. Website currently being updated.

EPA 2015b. Region 4 Ecological Risk Assessment Supplemental Guidance. https://www.epa.gov/risk/region-4-ecological-risk-assessment-supplemental-guidance. Accessed March 9, 2017.

EPA. 2016a. National Ambient Air Quality Standards (NAAQS). Available at https://www.epa.gov/criteria-air-pollutants/naaqs-table.

EPA. 2016b. 2014 National Emissions Inventory. Available at https://www.epa.gov/air-emissions-inventories/2014-national-emissions-inventory-nei-data.

EPA. 2016c. Climate Change Indicators in the U.S., 2016. Fourth Edition [EPA 430-R-16-004]. Available at https://www.epa.gov/climate-indicators.

EPA. 2016d. How To Evaluate Alternative Cleanup Technologies For Underground Storage Tank Sites - A Guide For Corrective Action Plan Reviewers. Chapter V – Land-farming. EPA 510-B-16-005. November.

EPA. 2016e. EPA Fact Sheet: Social Cost of Carbon. December, 2016. Available at https://www.epa.gov/sites/production/files/2016-12/documents/social_cost_of_carbon_fact_sheet.pdf.

EPA. 2016f. Enforcement and Compliance History Online: Detailed Facility Report for Rosebud County Western Energy Mine, Colstrip, MT. Available at https://echo.epa.gov/detailed-facility-report?fid=110040987536.

EPA. 2017a. What is Acid Rain? Available at https://www.epa.gov/acidrain/what-acid-rain.

EPA. 2017b. Clean Air Status and Trends Network (CASTNET). Clean Air Markets Division, United States Environmental Protection Agency. Available at www.epa.gov/castnet.

EPA. 2017c. Climate Change: Basic Information. Updated January 17, 2017. Available at https://www.epa.gov/climatechange/climate-change-basic-information. Accessed January 2017.

EPA. 2017d. Overview of Greenhouse Gases. Updated February 14, 2017. Available at https://www.epa.gov/ghgemissions/overview-greenhouse-gases. Accessed February 2017.

EPA. 2017e. Clean Air Act Permitting for Greenhouse Gases. Available at https://www.epa.gov/nsr/clean-air-act-permitting-greenhouse-gases. Accessed March 2017.

EPA. 2017f. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2015 [EPA 430-P-17-001]. Available at https://www.epa.gov/sites/production/files/2017-02/documents/2017_complete_report.pdf. Accessed May 1, 2017.

EPA. 2017g. Greenhouse Gas Reporting Program Facility Level Information on GHGs Tool (FLIGHT). https://ghgdata.epa.gov/.

EPA. 2017h. STOrage and RETrieval and Water Quality eXchange. Available at https://www.epa.gov/waterdata/storage-and-retrieval-and-water-quality-exchange.

EPA. 2017i. Definition of a hazardous waste. Available at https://www.epa.gov/hw/defining-hazardous-waste-listed-characteristic-and-mixed-radiological-wastes. Accessed February 27, 2017.

EPA. 2017j. Information on the beneficial use of CCR. Available at https://www.epa.gov/coalash/coal-ash-reuse. Accessed February 27, 2017.

EPA. 2017k. Toxic Release Inventory data queries for TRI IDs: 59323MNTNPWILLO and 59323RSBDPPOBOX. Available at https://www.epa.gov/enviro/tri-search. Accessed February 16, 2017.

EPA. 2017l. PPL Colstrip Rosebud Power Plant Detailed Facility Report. Enforcement and Compliance History Online (ECHO). Available at https://echo.epa.gov/detailed-facility-report?fid=110041886144.

EPA. 2017m. Colstrip WWTP Detailed Facility Report. Enforcement and Compliance History Online (ECHO). Available at https://echo.epa.gov/detailed-facility-report?fid=110011046974.

EPA. 2017n. Understanding Global Warming Potentials. Updated February 14, 2017. Available at https://www.epa.gov/ghgemissions/understanding-global-warming-potentials. Accessed February 2017.

EPA. 2017o. City of Colstrip WTP Detailed Facility Report. Enforcement and Compliance History Online (ECHO). Available at https://echo.epa.gov/detailed-facility-report?fid=110011046714.

EPRI (Electric Power Research Institute). 2009. Updated Hazardous Air Pollutants (HAPs) Emissions Estimates and Inhalation Human Health Risk Assessment for U.S. Coal-Fired Electric Generating Units. Electric Power Research Institute Report 1017980.

EPRI. 2011. Multi-Pathway Human Health and Ecological Risk Assessment for a Model Coal-Fired Power Plant. Electric Power Research Institute Report 1024496.

EPRI. 2014. Emission Factors Handbook: Guidelines for Estimating Trace Substance Emissions from Fossil-Fuel-Fired Steam Electric Power Plants. Electric Power Research Institute Report 3002003848.

ERM (Environmental Resources Management). 2015. Area F Aquatic Survey Rosebud and Treasure County, Montana. October 27.

ERO (ERO Resources Corporation). 2013a. Public Scoping Report, Western Energy Company Area F Rosebud Mine EIS. Colstrip, Montana. February 4.

ERO. 2013b. Public Scoping Report II, Western Energy Company Area F Rosebud Mine EIS Colstrip, Montana. December 23.

FEMA (Federal Emergency Management Agency). 2015. Floodplain maps for Rosebud and Treasure counties. Available at https://msc.fema.gov/portal/.

Fenn, M.E., J.S. Baron, E.B. Allen, H.M. Rueth, K.R. Nydick, L. Geiser, W.D. Bowman, J.O. Sickman, T. Meixner, D.W. Johnson, and P. Neitlich. 2003. Ecological Effects of Nitrogen Deposition in the Western United States. *BioScience*. 53(4):404-420.

Ferreira, R.F. 1984. Simulated Effects of Surface Coal Mining and Agriculture on Dissolved Solids in Rosebud Creek, Southeastern Montana. U.S. Geological Survey Water-Resources Investigations Report 84-4101.

FIPR (Florida Institute for Phosphate Research). 1996. Noise and Ground Vibration Monitoring Related to Dragline Operations in Phosphate Mining.

Fitzgerald, J.P., C.A. Meaney, and D.M. Armstrong. 1994. *Mammals of Colorado*. Denver Museum of Natural History and University Press of Colorado.

FLAG. 2010. Federal Land Managers' Air Quality Related Values Work Group (FLAG) – Phase I Report – Revised (2010). Natural Resource Report NPS/NRPC/NRR – 2012/232. Available at http://nature.nps.gov/air/pubs/pdf/flag/FLAG_2010.pdf).

Fletcher, R.H. 1960. *Free Grass to Fences: The Montana Cattle Range Story*. New York University.

Forbs, S.H. and J.T. Hogg. 1999. "Assessing population structure at high levels of differentiation: microsatellite comparisons of bighorn sheep and large carnivores." *Animal Conservation.* 2(3): 223–233.

Foresman, K.R. 2001. "The Wild Mammals of Montana." Special Publication No. 12, American Society of Mammalogists, Allen Press Inc. 278 pp.

Fredlund, L.B. 1980. Cultural Resources Inventory and Assessment: Mining Area C Extension and One-Mile Buffer. Prepared for Western Energy Company by the Cultural Resources Division, Mineral Research Center, Montana Tech Alumni Foundation, Butte, MT.

Fritzen. D.E. 1995. Ecology and Behavior of Mule Deer on the Rosebud Coal Mine. Montana State University: Bozeman, MT.

Fuchsman, P.C., L.E. Brown, M.H. Henning, M.J. Bock, and V.S. Magar. 2017. Toxicity Reference Values for Methylmercury Effects on Avian Reproduction: Critical Review and Analysis. Environmental Toxicology and Chemistry, Vol. 36, No. 2, pp. 294–319.

FWP (Montana Fish, Wildlife and Parks. 2011. Antelope. Available at http://fwp.mt.gov/fishAndWildlife/management/antelope/. Accessed May 22, 2018.

FWP. 2014. Montana Statewide Comprehensive Outdoor Recreation Plan (SCORP), 2014 to 2018. Available at http://stateparks.mt.gov/about-us/scorp.html. Accessed December 8, 2016.

GCM Services, Inc. 2015. National Register of Historic Places Statement for Black Hank Site 24RB2339. Prepared for Western Energy Company, Colstrip, Montana by GCM Services, Inc. Butte, MT.

Ghio, A.J., M. Bassett, T. Montilla, E.H. Chung, C.B. Smith, and W.E. Cascio. 2012. Case report: Supraventricular Arrhythmia After Exposure to Concentrated Ambient Air Pollution Particles. Environmental Health Perspectives 120:275–277.

Guarnieri, M. and J.R. Balmes. 2014. Outdoor Air Pollution and Asthma. Lancet 383(9928):1581-1592.

Hankard (Hankard Environmental Inc.). 2012. Compilation of sound level data based on measurements, experience, and other published data.

Hankard. 2015. Far-Field Noise Measurements of the Homer City Generating Station.

Harris Miller & Hanson, Inc. 2011. Basic Aircraft Noise Terminology. PowerPoint presentation. Available at http://www.lawa.org/uploadedFiles/lax/noise/presentation/noiseRT_090311_Noise%20101%20Presentation.pdf. Accessed February 2, 2015.

Hendryx, M, and M.M. Ahern. 2008. Relations Between Health Indicators and Residential Proximity to Coal Mining in West Virginia. *American Journal of Public Health* 98(4): 669–671.

Hesterberg, T., P. Valberg, and C. Long. 2010. What Studies are Appropriate to Use to Estimate Health Impacts from Specific Sources Such as DPM? White paper prepared for the California Air Resources Board. Available at https://www.navistar.com/StaticFiles/navistar/whoweare/research/Hesterberg%202010c.pdf. Accessed June 2017.

Hinds, W.C. 1999. Aerosol Technology: Properties, Behavior, and Measurement of Airborne Particles (Second Edition). John Wiley & Sons, New York. 483 p.

Holl, K.D. 2002. "Long-Term Vegetation Recovery on Reclaimed Coal Surface Mines in the Eastern USA. *Journal of Applied Ecology*." 39: 960–970.

Hostetler, S.W. and J.R. Alder. 2016. Implementation and evaluation of a monthly water balance model over the U.S. on an 800 m grid. Water Resources Research, 52. 9600–9620. doi:10.1002/2016WR018665.

Hydrometrics, Inc. 2015. PPL Montana, LLC Colstrip Stream Electric Station Administrative Order on Consent Plant Site Report. Prepared for PPL Montana, LLC. Revised July 2015.

ICF (ICF International). 2011. Appendix F: Rosebud Mine, Area F Tract. 2011 Wildlife Baseline. October (ICF 00060.11). Gillette, WY. Prepared for Western Energy Company.

ICF. 2013. Rosebud Mine 2012 Wildlife Monitoring. Gillette, WY. Prepared for Western Energy Company. February.

ICF. 2014. Rosebud Mine 2013 Wildlife Monitoring. Gillette, WY. Prepared for Western Energy Company. February.

ICF. 2016. Rosebud Mine 2015 Wildlife Monitoring Report. February.

ICMM (International Council on Mining and Metals). 2010. Good Practice Guidance on Health Impact Assessments. Available at http://www.icmm.com. Accessed June 2017.

IMPROVE (Interagency Monitoring of Protected Visual Environments. 2017. Available at http://vista.cira.colostate.edu/Improve/.

Institute for Health Metrics and Evaluation (IHME), U.S. County Profiles for Montana. Seattle, WA: IHME, 2016. Available at http://www.healthdata.org/us-county-profiles. Accessed May 18, 2018.

International Agency for Research on Cancer. 2014. World Cancer Report. Available at http://publications.iarc.fr/Non-Series-Publications/World-Cancer-Reports/World-Cancer-Report-2014. Accessed July 2017.

Iowa DNR (Iowa Department of Natural Resources). 2009. Water Quality Standards Review: Chloride, Sulfate, and Total Dissolved Solids. http://www.fwspubs.org/doi/suppl/10.3996/052013-JFWM-033/suppl_file/patnodereference+s8.pdf.

IPCC (International Panel on Climate Change). 1999. Aviation and the Global Atmosphere, A Special Report of IPCC Working Groups I and III in Collaboration with the Scientific Assessment Panel to the Montreal Protocol on Substances that Deplete the Ozone Layer (J. E. Penner, D. H. Lister, D. J. Griggs, D. J. Dokken, and M. McFarland).

IPCC. 2001. Summary for Policymakers: A Report of Working Group I of the Intergovernmental Panel on Climate Change. Available at https://www.ipcc.ch/ipccreports/tar/vol4/english/pdf/wg1spm.pdf.

IPCC. 2007. IPCC Fourth Assessment Report: Climate Change. Available at http://www.ipcc.ch/publications_and_data/publications_and_data_reports.htm.

IPCC. 2014. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (Core Writing Team, R.K. Pachauri and L.A. Meyer [Eds.]). IPCC: Geneva, Switzerland. 151 pp.

Jaffe, D. and S. Strode. 2008. Sources, fate and transport of atmospheric mercury from Asia. Environ. Chem. 5 (2), 121.

Jenkins, W.D, W.J. Christian, G. Mueller, and K.T. Robbins. 2013. Population Cancer Risks Associated with Coal Mining: A Systematic Review. PLoS ONE 8(8):no page. Available at https://doi.org/10.1371/journal.pone.0071312.

Jenkins. W.D., W.J. Christian, G. Mueller, and K.T. Robbins. 2013. Population Cancer Risk Associated with Coal Mining: a Systematic Review. PLoS ONE 8(8): e71312. Available at https://doi.org/10.1371/journal.pone.0071312.

KC Harvey (KC Harvey Environmental, LLC). 2012. Area F Environmental Information Volume Water Resources. October 23.

Kelly, F.J. and J.C. Fussell. 2011. Air Pollution and Airway Disease. Clinical & Experimental Allergy 41:1059-1071.

Kennedy, P. and J. Fontaine. 2009. Synthesis of knowledge on the effect of fire and fire surrogates on wildlife in U.S. Dry Forests. Special Report 1096. Extension and Experiment Station Communications, Oregon State University.

Kolman, J. 2012. The Exemption: To Change or Not to Change? A Study of Water Wells Allowed Without a Permit. Montana Legislative Services Division, Helena, MT. October. Available at http://leg.mt.gov/content/Publications/Environmental/2013-exempt-wells.pdf.

Kooistra-Manning, A.; S. Deaver; and T. Quirt. 1993. Ethnographic Overview of Five Tracts Proposed for Coal Development Near Colstrip and Decker, Montana. Prepared for the Bureau of Land Management, Montana State Office. Billings, MT: Ethnoscience.

Kornfeld, M., G.C. Frison, and M.L. Larson. 2010. *Prehistoric Hunter-Gatherers of the High Plains and Rockies, Third Edition*. Left Coast Press, Walnut Creek, CA.

Larson, T.A. 1978. History of Wyoming (2nd edition) 99–106. University of Nebraska Press: Lincoln, NE.

Lindberg, S., R. Bullock, R. Ebinghaus, D. Engstrom, X. Feng, W. Fitzgerald, N. Pirrone, E. Prestbo, and C. Seigneur. 2007. A synthesis of progress and uncertainties in attributing the sources of mercury in deposition, Ambio, 36, 19–32.

LANL (Los Alamos National Laboratory). 2012. ECORISK Database package #186. Environmental Restoration Project, Los Alamos National Laboratory, Lost Alamos, NM.

Los Angeles World Airports. 2011. Van Nuys Airport Updated 14 CFR Part 150 Noise Exposure Maps. December 2011. Available at http://www.lawa.org/uploadedFiles/VNY/Part150/final_vny_nem%20signed.pdf. Accessed February 2, 2015.

Luber, G., K. Knowlton, J. Balbus, H. Frumkin, M. Hayden, J. Hess, M. McGeehin, N. Sheats, L. Backer, C.B. Beard, K.L. Ebi, E. Maibach, R.S. Ostfeld, C. Wiedinmyer, E. Zielinski-Gutiérrez, and L. Ziska. 2014. Ch. 9: Human Health. Climate Change Impacts in the United States: The Third National Climate Assessment, J. M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, Eds., U.S. Global Change Research Program, 220–256.

Mahrt, P. 2017. Personal communication via E-mail to Jen Lane regarding Rosebud Mine rail loadout. April 3, 2017.

Mapel, W.J. and V.E. Swanson. 1977. Part A: Geology and mineral resources. *In*: Summary of the geology, mineral resources, landscape geochemistry, and engineering geologic characteristics of the Northern Powder River coal region, Montana. U.S. Geological Survey Open File Report. 77–292.

Marcus, M. 2014. Blast Prediction Model. Ninyo & Moore. November 26.

Marietta Canty, LLC and Neptune and Company, LLC. 2017. Revised Cleanup Criteria and Risk Assessment Report. Prepared for Hydrometrics, Inc., Billings, MT. November 13.

MCA (Montana Code Annotated). 2013. Available from the Montana Legislature website: http://leg.mt.gov/bills/mca_toc/index.htm.

MEQC (Montana Environmental Quality Council). 1985. A Guide to the Montana Major Facility Siting Act. Available at http://leg.mt.gov/content/Publications/Environmental/1985facilitysiting.pdf.

MDA. 2015. Montana Noxious Weed List. July. Available at http://agr.mt.gov/Portals/168/Documents/Weeds/Weeds_2015NoxiousWeedList.pdf?ver=2016-10-25-161056-667&timestamp=1485902867010.

MDHHS (Montana Department of Health and Human Services). 2011. Community Health Data. Available at http://dphhs.mt.gov/publichealth/Epidemiology/OESS-CHD.aspx. Accessed June 2017.

MDHHS. 2013. The State of the State's Health. Available at http://dphhs.mt.gov/Portals/85/publichealth/documents/Epidemiology/StateOfTheStatesHealth.pdf. Accessed June 2017.

MDSL (Montana Department of State Lands). 1977. Draft Environmental Impact Statement for the Proposed Expansion of Western Energy Company's Rosebud Mine into Area A and E. Submitted pursuant to the Montana Environmental Policy Act Section 69-6504(6)(3): Helena, MT.

MDT (Montana Department of Transportation) Planning Division. 2011. Vehicle Class Count, Rosebud County, Station 7-001.

MDT Planning Division. 2015. Vehicle Class Count, Rosebud County, Station 7-001.

Melillo, J.M., T.C. Richmond, and G.W. Yohe, Eds. 2014: Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program, 841 pp. doi:10.7930/J0Z31WJ2.

Meyer, G. 2010. A Class III Cultural and Paleontological Resource Inventory of the Area F Study Area, Rose Bud and Treasure Counties, Montana. Prepared for Western Energy Company, Colstrip, Montana. BLM Fieldwork Authorization Number M99245. October.

Meyer, G. and D. Ferguson. 2012. A Class III Cultural and Paleontological Resource Inventory of Western Energy Company's Area F Extension, Rosebud and Treasure Counties, Montana. Prepared for Western Energy Company, Colstrip, Montana. BLM Fieldwork Authorization Number M99245. January.

Meyer and Ferguson. 2013. National Register of Historic Places Evaluations of 46 Archaeological Properties, Western Energy Company's Area F. Prepared for Western Energy Company, Colstrip, MT. November 11.

Miller B., R.P. Reading, and S. Forrest. 1996. Prairie night: black-footed ferrets and the recovery of endangered species. Smithsonian Institute Press. Washington DC. 320 pp.

Mills, N.L., N.R. Miller, A.J. Lucking, J. Beveridge, L. Flint, A.J. Boering, P.H. Fokkens, N.A. Boon, T. Sandstrom, A. Bloomberg, R. Duffin, K. Donaldson, P.W. Hadoke, F.R. Cassee, and D.E. Newby. 2011. Combustion-derived nanoparticulate induces the adverse vascular effects of diesel exhaust inhalation. *European Heart Journal* 32(21):2660-71.

Missouri Census Data Center. 2016. ACS Profile Report: 2010–2014 (5-year estimates). Available at http://census.missouri.edu/acs/profiles/. Accessed December 5, 2016.

Montana Department of Commerce, Census and Economic Information Center. 2012a. Population of Counties in Montana, 1890 to 2000. Available at http://ceic.mt.gov/Demog/historic/Censuscounty1890-2000.pdf. Accessed November 6, 2012.

Montana Department of Commerce, Census and Economic Information Center. 2012b. Population of Incorporated Places (Cities/Towns) in Montana, 1890 to 2000. Available at http://ceic.mt.gov/Demog/historic/Censusplace18902000.pdf. Accessed November 6, 2012.

Montana Department of Commerce, Census and Economic Information Center. 2012c. Census 2010 – State and County Population Summary. Available at http://ceic.mt.gov/2010 Census Data/State&CountySummary.xls. Accessed November 6, 2012.

Montana Department of Labor & Industry. 2016. Research and Analysis: Local Area Unemployment Statistics. Available at http://lmi.mt.gov/. Accessed April 5, 2016.

MNHP (Montana Natural Heritage Program). 2014a. Map of Sharp-tailed Grouse Distribution in Montana. Available at http://fieldguide.mt.gov/RangeMaps/GenObsMap_ABNNF11020_FS.jpg. Updated March 2014. Accessed November 20, 2014.

MNHP. 2014b. Map of Black-footed Ferret Distribution in Montana. Available at http://fieldguide.mt.gov/RangeMaps/GenObsMap_ABNNF11020_FS.jpg. Updated March 2014. Accessed November 20, 2014.

MNHP. 2014c. Map of Pallid Sturgeon Distribution in Montana. Available at http://fieldguide.mt.gov/RangeMaps/GenObsMap_ABNNF11020_FS.jpg. Updated March 2014. Accessed November 20, 2014.

MNHP. 2014d. Database query for species of concern within 15 miles of the Rosebud Mine. Provided by M. Miller. December 1 and 4.

MNHP. 2015. Plant Species of Concern Report for Rosebud and Treasure Counties. Available at http://mtnhp.org/SpeciesOfConcern/. Accessed January 5, 2015.

MNHP. 2017. Natural Heritage Map Viewer. Montana Ecological Systems – Land Cover Report Rosebud County. Retrieved on February 2, 2017. Available at http://mtnhp.org/mapviewer/LandcoverReport.aspx?x=820148.794130141&y=195727.41453883034&v=0.

MNHP and Montana Fish, Wildlife and Parks (FWP). 2013. Montana Field Guide. Available at http://FieldGuide.mt.gov/detail. Accessed November 6, 2013.

MNHP and FWP. 2014. Montana Field Guide. Available at http://FieldGuide.mt.gov/detail. Accessed November 6, 2014.

MNHP and FWP. 2017. Montana Field Guide. Available at http://FieldGuide.mt.gov/detail. Accessed August 14.

Montana Environmental Quality Council. 1985. A Guide to the Montana Major Facility Siting Act. Available at http://leg.mt.gov/content/Publications/Environmental/1985facilitysiting.pdf.

Montana Legislative Fiscal Division. 2015. 2017 Biennium Fiscal Report. Revenue Estimate Profile, Coal Severance Tax. Available at http://leg.mt.gov/fbp-2017.asp. Accessed March 19, 2016.

Montana Wetland Council. 2013. DEQ. Priceless Resources, A Strategic Framework for Wetland and Riparian Area Conservation and Restoration in Montana 2013 - 2017. Available at http://deq.mt.gov/Portals/112/Water/WPB/Wetlands/StategicFramework2013-2017.pdf. Accessed April 4, 2016.

MSGWG (Montana Sage-Grouse Working Group). 2005. Management Plan and Conservation Strategies for Sage-Grouse in Montana, Final.

MSU (Montana State University). 2014a. Suitability of Water for Livestock Fact Sheet. Montana State University Extension Water Quality Program, Department of Land Resources and Environmental Sciences. Available at http://www.precision-labs.com/wp-content/uploads/2015/02/Livestock-Suitability-Fact-Sheet.pdf.

MSU. 2014b. Livestock Water Quality. Fort Keogh Livestock & Range Research Laboratory, Montana Agricultural Experiment Station. Available at http://www.ars.usda.gov/SP2UserFiles/Place/30300000/Research/WATERQUALITYMKP6-09.pdf.

MSU. 2015. Beef Briefs: Water Quality and Guidelines for Livestock. Montana State University Extension Service.

Muir, M.K. 1971. Nutrient Status of the Yellowstone Drainage of Montana. Montana State University, Montana Agricultural Experiment Station, Bulletin 642. Bozeman, MT.

NADP (National Atmospheric Deposition Program). 2017a. NADP Program Office, Illinois State Water Survey, University of Illinois. Champaign, IL 61820. Available at http://nadp.sws.uiuc.edu/. Accessed November 2016.

NADP. 2017b. CLAD U.S. Critical Loads of Sulfur and Nitrogen Access Database. NADP Program Office, Illinois State Water Survey, University of Illinois. Champaign, IL 61820. Available at http://nadp.sws.uiuc.edu/committees/clad/db/. Accessed March 2017.

National Park Service. 1998. "Guidelines for Evaluating and Documenting Traditional Cultural Properties." *National Register Bulletin*. U.S. Department of the Interior.

National Research Council. 2005. Mineral Tolerance of Animals. Committee on Minerals and Toxic Substances in Diets and Water for Animals, Board on Agriculture and Natural Resources, Division on Earth and Life Sciences. The National Academies Press, Washington, DC. Second Revised Edition.

Nicklin Earth & Water, Inc. 2015. 2014 Annual Hydrology Report (October 2013 - September 2014). Prepared for Western Energy Company – Rosebud Mine. January 23.

Nicklin, M. 2017. In the Matter of: Appeal Amendment AM4, Western Energy Company, Rosebud Mine Area B, Permit No. C1984003B. Intervenor-Respondents' Expert Witness Disclosure of Michael Nicklin. June 30.

NIOSH (National Institute for Occupational Safety and Health). 2011. Coal Mine Dust Exposure and Associated Health Outcomes: a Review of Information Published since 1995. Available at https://www.cdc.gov/niosh/docs/2011-172/pdfs/2011-172.pdf. Accessed July 2017.

NOAA (National Oceanic and Atmospheric Administration). 2013. Regional Climate Trends and Scenarios for the U.S. National Climate Assessment: Part 4. Climate of the U.S. Great Plains. NOAA Technical Report NESDIS 142-4. January.

NOAA. 2017a. Record of Climatological Observations for Colstrip, MT, Station GHCND:USC00241905. National Environmental Satellite, Data, and Information Service. Available at https://www.ncdc.noaa.gov/cdo-web/search?datasetid=GHCND.

NOAA. 2017b. State Annual and Seasonal Time Series. National Climatic Data Center, National Oceanic and Atmospheric Administration. Available at https://www.ncdc.noaa.gov/temp-and-precip/state-temps/.

Noise Help. 2015. Noise Level Chart. Available at http://www.noisehelp.com/noise-level-chart.html.

NPA Data Services, Inc. 2008. Montana Population Projections. Available at http://ceic.mt.gov/Demog/project/proj_mt_pop_total_08.pdf. Accessed November 6, 2012.

Nyenhuis, James. 2011. Area F Soils Resources Report. Unpublished report prepared for Western Energy Company, Fort Collins, CO.

OEPC (U.S. Department of the Interior, Office of Environmental Policy and Compliance). 2012. Environmental Justice Strategic Plan 2012–2017.

Oklahoma State University (OSU). 2015. Livestock need good quality drinking water. Rory Lewandowski. Available at https://www.drovers.com/article/livestock-need-good-quality-drinking-water. June 22.

OSHA (Occupational Safety and Health Administration). 1974. Regulations (Standards – 29 CFR). Available at https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9735. Accessed July 2017.

OSMRE (Office of Surface Mining Reclamation and Enforcement). 1989. *Handbook on Procedures for Implementing the National Environmental Policy Act. Directive 490*. Retrieved from the OSMRE website: http://www.osmre.gov/lrg/docs/directive490_NEPAHandbook.pdf.

OSMRE. 2014a. Determination on whether Proposed Action and Colstrip Power Plant are connected actions. Letter from Jeff Fleischman (OSMRE, Denver Field Division/Casper Area Office) to Nicole Bauman (ERO). April 24, 2014.

OSMRE. 2014b. Four Corners Power Plant and Navajo Mine Energy Project Biological Assessment. August.

OSMRE. 2015. Annual Evaluation Report for the Regulatory Program Administered by the Department of Environmental Quality – Industrial and Energy Minerals Bureau of Montana. September 2015. Office of Surface Mining Reclamation and Enforcement. Available at http://odocs.osmre.gov/.

OSMRE. 2018. Citizen Complaint Alleging Violations Related to Reclamation Activities at Coal Mining Operations in the Powder River Basin. Letter from Jeffrey W. Fleischman (OSMRE, Denver Field Division/Casper Area Office) to Jeremy Nichols (WildEarth Guardians). June 6.

OSMRE. 2018. Montana's Response to Ten Day Notices #X18-010-549-001, #X18-010-549-002, #X18-010-549-003, and WildEarth Guardians Citizen's Complaint – Hydrologic Protection and Clean Water Standards at Rosebud Mine in Montana. Letter from Jeff Fleischman (OSMRE, Denver Field Division/Casper Area Office) to Edward Coleman (DEQ Coal and Opencut Mining Bureau). July 12.

OSMRE. 2018. Request for Federal Inspection and Enforcement Action. Letter from Jeff Fleischman (OSMRE, Denver Field Division/Casper Area Office) to Shannon Hughes (WildEarth Guardians). July 12.

Parrett, C. and D.R. Johnson. 2004. Methods for Estimating Flood Frequency in Montana Based on Data through Water Year 1998. U.S. Geological Survey Water-Resources Investigations Report 03-4308. February. Report Available at http://pubs.usgs.gov/wri/wri03-4308/pdf/wrir03_4308.pdf. Online calculations available at http://wy-mt.water.usgs.gov/freq?page_type=gen_stats_1.

Patel, M.M. and R.L. Miller. 2009. Air Pollution and Childhood Asthma: Recent Advances and Future Directions. Current Opinion in Pediatrics 21(2):235–242.

Peterson. D. 2014a. Personal communication via email to Emily Corsi. March 21, 2014.

Peterson. D. 2014b. Personal communication via email to Emily Corsi. March 25, 2014.

Peterson. D. 2016a. Personal communication via email to Jen Lane regarding Rosebud Mine annual coal production rate forecast for each Area. October 21, 2016.

Peterson, D. 2016b. Personal communication via email to Emily Corsi regarding Rosebud Mine operational life, October 28, 2016.

Peterson, D. 2016c. Personal communication via email to Jen Lane regarding questions and preliminary assumptions for Western Energy Mine and Colstrip Power Plant analyses, November 14, 2016.

Peterson, D. 2017. Personal communication via email to Jen Lane regarding total tons coal mined by permit area. March 27, 2017.

Pless-Mulloli, T.D. Howel, A. King, I. Stone, J. Merefield, J. Bessell, and R. Darnell. 2000. Living Near Opencast Coal Mining Sites and Children's Respiratory Health. *Journal of Occupational Environmental Medicine* 57:145-151.

Pless-Mulloli, T.D. Howel and H. Prince. 2001. Prevalence of Asthma and Other Respiratory Symptoms in Children Living Near and Away from Opencast Coal Mining Sites. *International Journal of Epidemiology* 30:556-563.

Power, T.M. and D.S. Power. 2015. The Impact of Climate Change on Montana's Outdoor Economy. White paper prepared for the Montana Wildlife Federation. Available at http://montanawildlife.org/wp-content/uploads/2015/12/Impact-of-Climate-Change-on-the-Montana-Outdoor-Economy-Dec-2015-Final-Report.pdf. Accessed June 2017.

PPL Montana. 2014. Notice of Major Facility Siting Act Certificate Amendment for Colstrip Units 3 and 4 Consumption of Rosebud Mine Coal. December 19.

Reher, C.A. 1979. The Western Powder River Basin Survey, Report of Survey Findings. Prepared for the Bureau of Land Management by the Office of the Wyoming State Archaeologist.

Roberts, S.B., E.M. Wilde, G.S. Rossi, D. Blake, L.R. Bader, M.S. Ellis, G.D. Stricker, G.L. Gunther, A.M. Ochs, S.A. Kinney, J.H. Schueunemeyer, and H.C. Power. 1999. Chapter PC: Colstrip coalfield, Powder River basin, Montana: geology, coal quality, and coal resources. *In*: Resource assessment of selected Tertiary coal beds and zones in the Northern Rocky Mountains and Great Plains region, U.S. Geological Survey Professional Paper. 1625-A.

Rose, S.K., D. Turner, G. Blanford, J. Bistline, F. de la Chesnaye, and T. Wilson. Understanding the Social Cost of Carbon: A Technical Assessment. EPRI, Palo Alto, CA: 2014. Report #3002004657.

Sawyer, H., F. Lindzwy, and D. McWhirter. 2005. "Mule deer and pronghorn migration in western Wyoming." *Wildlife Society Bulletin*. 33: 1266–1273.

Seigneur, C., P. Karamchandani, K. Lohman, K. Vijayaraghavan and R.L. Shia. 2001. Multiscale modeling of the atmospheric fate and transport of mercury. J. Geophys. Res., 106, 27795–27809.

Seigneur, C., K. Vijayaraghavan, K. Lohman, P. Karamchandani, and C. Scott. 2004. Global source attribution for mercury deposition in the United States. Environ. Sci. Technol., 38, 555–569.

Selin, N.E. and D.J. Jacob. 2008. Seasonal and spatial patterns of mercury wet deposition in the United States: Constraints on the contribution from North American anthropogenic sources. *Atmos. Environ.* 42(21), 5193.

Settlement Agreement. 1991. Northern Cheyenne Tribe, Plaintiff, v. Lujan, et al., Defendants, Cause No. CV-82-116-BLG-JFB.

Shafer, M., D. Ojima, J.M. Antle, D. Kluck, R.A. McPherson, S. Petersen, B. Scanlon, and K. Sherman. 2014. Ch. 19: Great Plains. Climate Change Impacts in the U.S. The Third National Climate Assessment, J.M. Melillo, Terese (T.C.) Richmond, and G.W. Yohe, Eds., U.S. Global Change Research Program, 441-461. doi:10.7930/J0D798BC.

Sharma, P.P. and E.C. Doll. 1996. Planning, Rehabilitation and Treatment of Disturbed Lands. Reclamation Research Unit Publication No. 9603. Seventh Billings Symposium. March 17–23, 1996. Billings, MT.

Shelanski, H. and M. Obstfeld. 2015. Estimating the Benefits from Carbon Dioxide Emissions Reductions. https://obamawhitehouse.archives.gov/blog/2015/07/02/estimating-benefits-carbon-dioxide-emissions-reductions.

Sjolund, M. 2015a. Technical Coordinator/MPDES Permit Coordinator, Montana DEQ. Personal communication with Dave Buscher, soil scientist/ecological engineer, regarding postmine and post-reclamation erosion rates. Buscher Soil & Environmental, Inc. September 29, 2015.

Sjolund, M. 2015b. Technical Coordinator/MPDES Permit Coordinator, Montana DEQ. Personal communication with Dave Buscher, soil scientist/ecological engineer, regarding years required to meet 60–80-percent vegetation cover. Buscher Soil & Environmental, Inc. October 1, 2015.

Skujins, J. and M.F. Allen. 1986. "Use of Mycorrhizae for Land Rehabilitation." *MIRCEN Journal*. 2: 161–176.

Slagle, S.E. and Others. 1983. Hydrology of Area 49, Northern Great Plains and Rocky Mountain Coal Provinces, Montana and Wyoming. U.S. Geological Survey Water-Resources Investigations Open-File Report 82-682.

Smith, J. Ed. 2000. Wildland fire in ecosystems: effects of fire on fauna. Gen. Tech. Report RMRS-GTR-42-vol1. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Smith, D.B., W.F. Cannon, L.G. Woodruff, F. Solano, J.E. Kilburn, and D.L. Fey. 2013. Geochemical and Mineralogical Data for Soils of the Conterminous United States: U.S. Geological Survey Data Series 801. Available at http://pubs.usgs.gov/ds/801/

Sommers, W.T., R.A. Loehman, and C.C. Hardy. 2014. "Wildland fire emissions, carbon, and climate: Science overview and knowledge needs." *Forest Ecology and Management 317* (2014) 1-8. Available at http://www.fs.fed.us/rm/pubs_other/rmrs_2014_sommers_w001.pdf. Accessed April 6, 2016.

Soucek, D.J., T.K. Linton, C.D. Tarr, A. Dickinson, N. Wickramanayake, C.G. Delos, and L.A. Cruz. 2011. "Influence of water hardness and sulfate on the acute toxicity of chloride to sensitive freshwater invertebrates." *Environmental Toxicology and Chemistry*. 30:4. 930–938.

SoundPLAN 7.3 Software, 2015, System Database C9.2 Tracked Mobile Drilling Rig.

Spang. 2013. Personal communication from Rich Spang via email to Jeffrey Herrick. January 29, 2013.

Stanek, L.W., J.D. Sacks, S.J. Dutton, and J.J.B. Dubois. 2011. Attributing Health Effects to Apportioned Components and Sources of Particulate Matter: An Evaluation of Collective Results. *Atmospheric Environment* 45(32):5655-5663.

Stroeve, J.C., V. Kattsov, A. Barret, M. Serreze, T. Pavlova, M. Holland, and W.N. Meier. 2012. Trends in Arctic sea ice extent from CMIP5, CMIP3 and observations. *Geophysical Research Letters* 39, 16.

Strohmayer, P. 1999. "Soil Stockpiling for Reclamation Activities and Mining and Construction." *Restoration and Reclamation Review*. Vol. 4, No. 7. Spring 1999. Department of Horticultural Science. University of Minnesota: St. Paul, MN.

SWCA Environmental Consultants (SWCA). 2016. Paleontological Assessment for the Rosebud Coal Mine Area F Expansion, Treasure and Rosebud Counties, Montana. Prepared for Western Energy Company and Bureau of Land Management. June.

Thrasher, B., J. Xiong, W. Wang, F. Melton, A. Michaelis, and R. Nemani. 2013. New downscaled climate projections suitable for resource management in the U.S. Eos, Transactions American Geophysical Union. 94, 321-323. doi:10.1002/2013EO370002.

Tigner, J. 2011. 2011 Bat Surveys – Rosebud Mine, Area F, Rosebud and Treasure Counties, Montana. Batworks, LLC: Rapid City, SD.

Timpano, A., S.H. Schoenholtz, C.E. Zipper, and D.J. Soucek. 2010. Isolating Effects of Total Dissolved Solids on Aquatic Life in Central Appalachian Coalfield Streams. Proceedings of the National Meeting of the American Society of Mining and Reclamation. Available at http://www.prp.cses.vt.edu/Reports_10/Timpano-IsolatingTDS-2010.pdf.

USCB (U.S. Census Bureau). 2016. Population Estimates. Available at https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml.

USDOT (U.S. Department of Transportation). 2015. Appendix G: Coal Dust Analysis. In: Draft Environmental Impact Statement, Tongue River Railroad Company, Construction and Operation of a New Rail Line in Southeastern Montana. Surface Transportation Board (STB). 47 p. Available at http://www.stb.dot.gov/decisions/readingroom.nsf/UNID/E7DE39D1F6FD4A9A85257E2A0049104D/$file/AppG_Fugitive+Coal+Dust+Analysis.pdf. Accessed June 2017.

USC (United States Code). 2013. Available from the Government Printing Office at http://www.gpo.gov/fdsys/browse/collectionUScode.action?collectionCode=USCODE.

USDA (United States Department of Agriculture). 2015. Montana Annual Bulletin 2015. Available at https://www.nass.usda.gov/Statistics_by_State/Montana/Publications/Annual_Statistical_Bulletin/2015/Montana_Annual_Bulletin_2015.pdf.

USDA-SCS (U.S. Department of Agriculture-Soil Conservation Service). 1967. Soil Survey of Treasure County, Montana.

USDA-SCS. 1975. Soil Survey of Rosebud County Area and Part of Big Horn County.

USDA-SCS. 1977. Soil Survey of Big Horn County Area, Montana.

USDA-NRCS (United States Department of Agriculture-Natural Resources Conservation Service). 2006. *Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin.* U.S. Department of Agriculture Handbook 296.

USDI (U.S. Department of the Interior). 1987. *Blasting Guidance Manual*. Available at http://www.osmre.gov/lrg/docs/directive315.pdf. Office of Surface Mining Reclamation and Enforcement. March.

USFWS (U.S. Fish and Wildlife Service). 1993. Management of prairie dog complexes for the reintroduction of the black-footed ferret. Fort Collins, CO, Arlington, VA, and Washington, DC.

USFWS. 2012. Whooping Crane (*Grus americana*) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Aransas National Wildlife Refuge, Austwell, TX and Corpus Christi Ecological Service Field Office, TX.

USFWS. 2015. Endangered, Threatened, Proposed and Candidate Species, Montana Counties. Available at http://www.fws.gov/montanafieldoffice/Endangered_Species/Listed_Species/countylist.pdf. Last updated August 2012. Accessed November 15, 2012.

USFWS. 2017a. Endangered, Threatened, Proposed and Candidate Species. Montana Counties. Available at https://ecos.fws.gov/ipac/location/index. Accessed August 14.

USFWS. 2017b. National Wetlands Inventory website. U.S. Department of the Interior, Fish and Wildlife Service, Washington, DC. Available at http://www.fws.gov/wetlands/. Last updated May 1 2017. Accessed May 8, 2017.

USGS (U.S. Geological Survey). 1962. Geology of the Powder River Basin Wyoming and Montana with Reference to Subsurface Disposal of Radioactive Wastes. Trace Elements Investigations Report 823. February.

UWPHI (University of Wisconsin Population Health Institute). 2017. 2016 County Health Rankings Arizona. Available at http://www.countyhealthrankings.org. Accessed June 2017.

Van Voast, W.A., R.B. Hedges, and J.J. McDermott. 1977. Hydrologic conditions and projections related to mining near Colstrip, southeastern Montana. Montana Bureau of Mines and Geology Bulletin 102. 43p.

Van Voast, W.A. and J.C. Reiten. 1988. Hydrologic responses: twenty years of surface coal mining in southeastern Montana. Montana Bureau of Mines and Geology Memoir 62. 30p.

Vijayaraghavan K.L., L. Levin, G. Parker, G. Yarwood, and D. Streets. 2014. Response of fish tissue mercury in a freshwater lake to local, regional, and global changes in mercury emissions. *Environ Toxicol Chem.* 33:1238–1247.

Vuke, S.M., E.L. Heffern, R.N. Bergantino, and R.B Colton. 2001. Geologic map of the Lame Deer 30' x 60' quadrangle, eastern Montana. Montana Bureau of Mines and Geology: Open-File Report 428, 8 p., 1 sheet(s), 1:100,000. US.

Waldman, C. 1985. *Atlas of the North American Indian*. Facts on File, Inc. New York.

Western Energy (Western Energy Company). 2009. Solid and Hazardous Waste Management Plan. Revision IV. December 7.

Western Energy. 2013. Montana Air Quality Permit Application for Western Energy Company Rosebud Mine – Area F Expansion. April 16.

Western Energy. 2017a. Rosebud Mine Permit Area Disturbance Boundaries. January.

Western Energy. 2017b. SPCC Spill Prevention Control and Counter Measure Plan and CERP Contingency and Emergency Response Plan. February.

Whitlock, C., W. Cross, B. Maxwell, N. Silverman, and A.A. Wade. 2017. The Montana Climate Assessment: stakeholder driven, science informed. Public Comment Draft. Available at http://montanaioe.org/sites/default/files/resources/montana_climate_assessment_public_comment_draft.pdf.

Whittington, D.M. and G.T. Allen. 2008. Guidelines for Raptor Conservation in the Western United States. U.S. Fish and Wildlife Service, Region 9, Division of Migratory Bird Management: Washington DC.

Wijayratne, U., S. Scoles-Sciulla, and L. Defalco. 2009. Dust Deposition Effects on Growth and Physiology of the Endangered *Astragalus jaegerianus* (Fabaceae). Madrono, Volume 56.

Woods, A.J., J.M. Omernik, J.A. Nesser, J. Shelden, J.A. Comstock, and S.H. Azevedo. 2002. Ecoregions of Montana, 2nd edition (color poster with map, descriptive text, summary tables, and photographs). Map scale 1:1,500,000.

WRI (World Resources Institute). 2017. World Resources Institute Climate Analysis Indicators Tool (CAIT). Available at http://cait.wri.org.

WWC Engineering. 2010. Write Area Coal Lease Applications Final Environmental Impact Statement. Bureau of Land Management High Plains District Office, Casper, WY.

Yde, C. 2012. DEQ letter: Round I Completeness Deficiency for Rosebud Coal Mine Area F. January 10.

Yde, C. 2014. Personal communication between Chris Yde (DEQ) and Clint Henke (ERO) regarding moose and big horn sheep occurrences near Rosebud Mine. November 24.

Yde, C. 2015. Personal communication between Chris Yde (DEQ) and Clint Henke (ERO) regarding sharp-tailed grouse and raptors near Rosebud Mine. March 19.

Zeng, G., J.A. Pyle, and P.J. Young. 2008. Impact of climate change on tropospheric ozone and its global budgets. *Atmos. Chem. Phys.*, 8, 369–387.