Prepared for:

DEQ Montana Department of Environmental Quality

Black Butte Copper Project Draft Environmental Impact Statement

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GLOSSARY AND ACRONYMS

Terms are defined within the context of this Environmental Impact Statement.

algal bloom: A sudden eruption of algae or cyanobacteria growth in water, which usually results from an excess of certain nutrients (e.g., nitrogen, phosphorous).

background: Refers to views beyond 1,500 feet and to the horizon

chert: A fine-grained sedimentary rock that was often used as a raw material for prehistoric stone tools

deciview: the unit of visibility deterioration is the deciview (dV), with one dV being equivalent to a 10-fold change in atmospheric clarity

foreground: Refers to views from zero to approximately 500 feet

gossan: Intensely oxidized, weathered, or decomposed rock, usually the upper and exposed part of an ore deposit or mineral vein

Isopleth: Model simulations using the AERMOD system produce diagrams that show the distribution of dispersed pollutants at ground level. These diagrams, termed “isopleth maps,” depict the distributions as a series of overlaid irregular contours onto a regional map. Isopleth maps somewhat resemble the effect of a topographic contour map, with outlines of the specific concentration levels serving the similar purpose as outlines of specific ground elevation on a topographic map.

mesic shrubs: Require a moderate amount of water to grow.

midden: A collection of branches, twigs, grasses, or leaves surrounding a nest.

middle-ground: Refers to views from approximately 500 to 1,500 feet.

mucking: Removing broken material from blast rounds.

Net Precipitation Transfer: This is made up of the net precipitation and runoff water, which together would be routed from the Process Water Pond to the mill. The net precipitation transfer would be treated at the Water Treatment Plan.

plugs: Massive concrete blocks confined by bulkheads at both ends used to completely fill a short segment of an open mine working. Grouting may accompany plug installation to minimize fracture flow around the plug and at the plug/bedrock interface.

Species of Concern: Species that are either known to be rare or declining, or declining due to the lack of basic biological information.

sub-wave base: Refers to below the wave base (i.e., the maximum depth at which a water wave’s passage causes significant water motion. For water depths deeper than the wave base, bottom sediments and the seafloor are no longer stirred by the wave motion above).

tailings: A fine-grained waste product from the mill.

void: The space from which the ore was removed.

°F	degree Fahrenheit
°C	degree Celsius
µg/m3	microgram(s) per cubic meter
a.m.	ante meridian (morning and before noon)
AADT	annual average daily traffic
ABA	acid-based accounting
AES	Aquatic Ecological System
Al	aluminum
AMA	Agency Modified Alternative
amsl	above mean sea level
ANFO	ammonium nitrate/fuel oil (explosive)
AP	acid potential
ARD	acid rock drainage
ARM	Administrative Rules of Montana
As	arsenic
ASTM	ASTM International
Ba	barium
$Ba_3(AsO_4)_2$	barium arsenate
BACI	Before, After, Control (upstream and offsite reference) and Impact (within and downstream)
BACT	Best Available Control Technology
BBF	Black Butte Fault
Be	beryllium
bgs	below ground surface
BHP	Broken Hill Proprietary Company Limited
Big Sky Acoustics	Big Sky Acoustics, LLC
BLM	U.S. Bureau of Land Management
BMP	best management practice
C	Coon Creek code in sampling site
Ca	calcium
$CaCO_3$	calcium carbonate

CAA	Clean Air Act
CAI	Cominco American Inc.
CAPS	Crucial Areas Planning System
Cd	cadmium
CFR	Code of Federal Regulations
cfs	cubic feet per second
CH_4	methane
Cl	chlorine
Co	cobalt
CO	carbon monoxide
CO_2	carbon dioxide
CO_{2e}	carbon dioxide equivalents
COC	contaminants of concern
Cr	chromium
Cr_2O_3	chromium(III) oxide
CTF	Cemented Tailings Facility
Cu	copper
$Cu_3(As,Sb)S_8$	chalcopyrite and tennantite
$CuFeS_2$	chalcopyrite
CWA	Clean Water Act
CWP	Contact Water Pond
dB	decibel(s)
dBA	A-weighted decibel(s)
dBC	C-weighted decibel(s)
DEQ	Montana Department of Environmental Quality
DNRC	Montana Department of Natural Resources and Conservation
DO	dissolved oxygen
DS, D/S	downstream
E. Coli	*Escherichia coli*
EBT	juvenile brook trout
EIS	Environmental Impact Statement

EPT	Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies)
F	fluorine
Fe	iron
FeS_2	Pyrite and/or marcasite
FLM	federal land manager
FR	Forest Road
FWP	Fish, Wildlife & Parks
G	gossan
gal	gallon
GHG	greenhouse gas
gpm	gallons per minute
H_2SO_4	sulfuric acid
HAP	hazardous air pollutants
HBI	Hilsenhoff Biotic Index
HDPE	High Density Polyethylene
HELP	Hydrologic Evaluation of Landfill Performance
Hg	mercury
hhs	human health standard
HNO_3	nitric acid
hp	horsepower
HRMIB	Hard Rock Mining Impact Board
HSU	hydrostratigraphic unit
I-90	Interstate 90
ICP	inductively coupled plasma
IG	Igneous Dykes
ILF	In-Lieu Fee Program
IPaC	Information for Planning and Consultation
JD	Jurisdictional Determination
K	hydraulic conductivity
K	potassium

Km	kilometer
kW	kilowatt
lb	pound(s)
LCZ	Lower Copper Zone
L_d	daytime sound level
L_{dn}	day-night average sound level
LECO	Laboratory Equipment Corporation
L_{eq}	equivalent noise levels
L_{eq}(h)	existing peak hour sound level
L_n	nighttime sound level
LOS	Level of Service
L_{peak}	unweighted instantaneous peak noise level
LS	Little Sheep Creek Code
LSA	Local Study Area
LST	Little Sheep Creek Tributary Code
LSZ	Lower Sulfide Zone
LZ FW	lower sulfide zone footwall
MAAQS	Montana Ambient Air Quality Standards
MAQP	Montana Air Quality Permit
MARS	Montana Aquatic Resources Services
MBAC	Montana Business Assistance Connection
MCA	Montana Code Annotated
MDT	Montana Department of Transportation
MEPA	Montana Environmental Policy Act
Mg	magnesium
mg/kg	milligrams per kilogram
mg/L	milligram per liter
mg/m^2	milligram per square meter
mm	millimeter
MMI	multi-metric indices
MMRA	Metal Mine Reclamation Act

Mn	manganese
MO	Moose Creek code
MOP	Mine Operating Permit
MPDES	Montana Pollutant Discharge Elimination System
mph	miles per hour
MRL	Montana Rail Link
MT	metric tonne
MTNHP	Montana Natural Heritage Program
MVE	million vehicles entering
N	nitrogen
N/D	non-detect
Na	sodium
NA	not applicable
NAAQS	National Ambient Air Quality Standards
NAG	net acid generation
NCWR	Non-Contact Water Reservoir
NESHAP	National Emission Standards for Hazardous Air Pollutants
Ni	nickel
$[Ni,Co]_3S_4$	siegenite
NO	nitric oxide
NO_2	nitrogen dioxide
NO_3	nitrate, nitric acid
NOx	nitrogen oxides
NP	neutralization potential
NR	not reported
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSPS	New Source Performance Standards
NSR	New Source Review
P	phosphorus
p.m.	post meridian (afternoon and evening)

PAH	polycyclic aromatic hydrocarbons
Pb	lead
PFC	Proper Functioning Condition
pH	potential hydrogen
PHREEQC	pH-Redox-Equilibrium
PIT	passive integrated transponders
PM	particulate matter
PM_{10}	particulate matter up to 10 micrometers in diameter
$PM_{2.5}$	particulate matter up to 2.5 micrometers in diameter
ppb	parts per billion
ppm	parts per million
Project	Black Butte Copper Project
Proponent	Sandfire Resources America Inc.
PSD	Prevention of Significant Deterioration
PWP	Process Water Pond
RICE	reciprocating internal combustion engine
RM	river miles
RO	reverse osmosis
RSA	Regional Study Area
RV	recreational vehicle
RW	riparian and wetland
s.u.	standard unit (pH)
Sandfire	Sandfire Resources America Inc. (formally Tintina Resources Inc.)
Sb	antimony
SC	Sheep Creek code
Se	selenium
SH	Sheep Creek code
SHPO	State Historic Preservation Office
Si	silicon
SIL	significant impact level
SM	Smith River code

SM	stream mile
SO2	sulfur dioxide
SO_4	sulfate
SOC	Species of Concern
SP	undeveloped spring
SPLP	synthetic precipitation leachability procedure
Sr	strontium
$SrCO_3$	strontianite
$SrSO_4$	celestine
SW	surface water
T&E	threatened and endangered
Tgd	tertiary sill-form granodiorite intrusive rocks
Tl	thallium
TMDL	total maximum daily load
TN	Tenderfoot Creek code
TOC	total organic compound
tph	tons per hour
tpy	tons per year
TWSP	Treated Water Storage Pond
U	uranium
U.S.	United States
UCZ	Upper Copper Zone
UG	underground workings
UIG	Underground Infiltration Gallery
UMOWA	Upper Missouri Watershed Alliance
US, U/S	upstream
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USZ	Upper Sulfide Zone

VOC	volatile organic compound
VVF	Volcano Valley Fault
WEG	wind erodibility group
WESTECH	WESTECH Environmental Services, Inc.
WRS	Waste Rock Storage
WTP	Water Treatment Plant
WW	wetted width
Ynl	Lower Newland Formation subunit
Ynl A	Upper Newland Formation subunit above the USZ
Ynl B	Lower Newland Formation subunit below the USZ
Ynl Ex	bedrock zones of the Lower Newland Formation
Ynu	Upper Newland Formation subunit
yr	year
Zn	zinc

1. INTRODUCTION

This Executive Summary provides an overview of the contents of the Environmental Impact Statement (EIS) for the proposed Black Butte Copper Project (the Project). The Department of Environmental Quality (DEQ) has prepared the Draft EIS prior to taking state action on applications for permits or other state authorizations submitted by Tintina Montana, Inc. (the Proponent). The Draft EIS describes the area, people, and resources potentially affected by the proposed mining activities.

This Executive Summary does not provide all details contained in the Draft EIS. Please refer to the Draft EIS, its appendices, or referenced reports for more information. The Draft EIS presents the purpose and need for the proposed Project (Chapter 1); descriptions of the No Action Alternative, Proposed Action, and Agency Modified Alternative (AMA) (Chapter 2); descriptions of the affected environment and environmental consequences for all potentially affected resources (Chapter 3); an analysis of potential cumulative impacts for various resources (Chapter 4); a comparison of the Project alternatives (Chapter 5); and a list of the consultation and coordination efforts undertaken as part of the EIS development (Chapter 6).

2. PROJECT BACKGROUND

The Project is located approximately 15 miles north of White Sulphur Springs in Meagher County, Montana (see **Figure ES-1**). The Project area consists of 1,888 acres of privately owned ranch land under lease to the Proponent, with associated buildings and a road network throughout. The Proponent intends to construct, operate, and reclaim a new underground copper mine over 19 years, and thereafter monitor and close the site. Surface disturbances to private land would total approximately 311 acres.

The Proponent acquired mineral rights lease agreements to mine the property via underground mining in May 2010 and has conducted surface exploration activities under Exploration License No. 00710 since September 2010. The Proponent submitted an application to amend their exploration license on November 7, 2012, in order to construct an exploration decline into the upper Johnny Lee zone. DEQ conducted an environmental review related to that exploration license amendment application, issuing a Final Mitigated Environmental Assessment in January 2014. DEQ selected the Agency Mitigated Alternative during this review. However, the Proponent subsequently chose not to construct the exploration decline and withdrew the proposed exploration project. The Proponent submitted a Mine Operating Permit (MOP) Application and revisions to DEQ on December 15, 2015; May 8, 2017; and July 14, 2017.

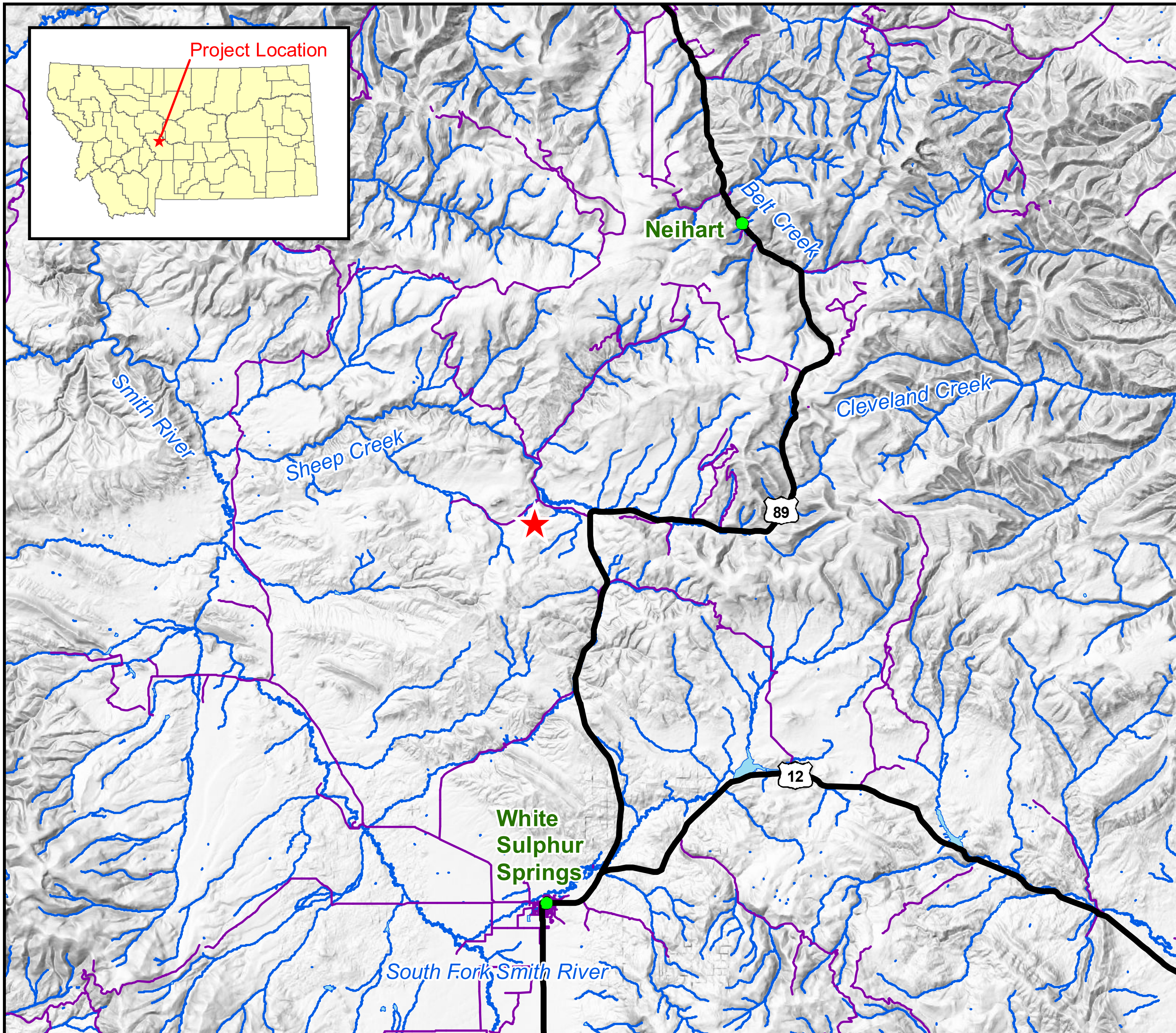

Figure ES-1
Black Butte Copper Project
Project Location
Meagher County, Montana

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3. PURPOSE AND NEED

The Montana Environmental Policy Act (MEPA) and its implementing rules require that EISs prepared by state agencies include a description of the purpose and benefits of the proposed project. The purpose of the Project is to mine the Johnny Lee Deposit by underground mining methods, process the copper-enriched rock on site into a salable copper concentrate, and ship the concentrate for sale. Benefits of the Project include the production of copper to help meet public demand, and increased employment and tax payments in the Project area (see Section 3.9, Socioeconomics, of the EIS).

The Project purpose and need for DEQ is described in Section 1.2.1 of the EIS. The Project purpose and need for the Proponent is described in Section 1.2.2 of the EIS.

4. PUBLIC PARTICIPATION

On August 15, 2017, DEQ issued a press release stating that the MOP Application was complete and the environmental review was set to begin (DEQ 2017a). DEQ issued a second release on September 18, 2017, indicating the review had begun under MEPA (DEQ 2017b).

DEQ established a public comment scoping period from October 2 to November 16, 2017 (i.e., 46 calendar days). During this time, DEQ held four public meetings in Montana (DEQ 2017c and 2017d):

1. October 30 at the Civic Center in Great Falls;
2. November 1 at the White Sulphur Springs High School gymnasium in White Sulphur Springs;
3. November 6 at the Radisson Hotel in Helena; and
4. November 7 at the Park County High School Gymnasium in Livingston.

During this public scoping process, written and oral comments were submitted via email, by mail, or at public meetings. DEQ prepared a Scoping Report that includes a summary of all comments received, organized by issue (Appendix J).

5. ALTERNATIVES

Alternatives fully evaluated in the Draft EIS include the No Action Alternative, Proposed Action, and Agency Modified Alternative. Several additional alternatives were evaluated but eliminated from further consideration due to several factors; see Section 2.4 of the EIS for more information.

5.1. No Action Alternative

Under the No Action Alternative to the Project, there would be no mine as proposed. DEQ would not approve the Proponent’s application for (1) an Operating Permit under the Metal Mines Reclamation Act, (2) a Montana Pollutant Discharge Elimination System Permit, or (3) an Air Quality Permit. The No Action Alternative recognizes that the Proponent could continue surface exploration activities at the Project site under its existing Exploration License No. 00710.

5.2. Proposed Action

The Proposed Action would allow the Proponent to mine the Johnny Lee Deposit by underground mining methods. The Proposed Action would have a mine life of 19 years, including 2 years for construction, 13 years for active mining, and 4 years for reclamation and closure. The Project’s major components would include a portal and underground mine workings and utilities, as well as a processing plant that includes a crusher, grinding mills, a flotation circuit, tailings thickener, a paste tailings plant, a Water Treatment Plant (WTP), concentrate storage facility, parking, and two laydown areas. Other surface facilities would include a Process Water Pond (PWP), Contact Water Pond (CWP), Non-Contact Water Reservoir (NCWR), Treated Water Storage Pond (TWSP), wet well and pipeline, buried drainpipes, roads, a waste rock stockpile, an ore stockpile, three overburden stockpiles, power line, ditches, and fencing.

The proposed operation would mine approximately 15.3 million tons of material, including 14.5 million tons of copper-enriched rock (with an average grade of 3.04 percent copper) and 0.8 million tons of waste rock. The Proposed Action would utilize the drift-and-fill mining method to access the rock. This method allows the entire deposit to be mined while incrementally backfilling the mined-out voids[1] with fine-grained cemented tailings paste. All copper-enriched rock mined would be hauled by articulated underground haul trucks either to the surface crusher or to the ore stockpile.

Crushed copper-enriched rock would travel to a surge bin through a series of three grinding mills (a semi-autogenous grinding mill, ball mill, and tower mill) in the processing plant that would progressively reduce the size of the rock. The finely crushed copper-enriched rock would then enter a flotation circuit where copper would be separated from non-copper bearing rock through chemical and physical processes. The flotation circuit also would include a concentrate re-grind mill. The resulting copper concentrate would then be thickened and pressed to remove water and shipped in sealed containers via truck off site. About 440 tons of copper-rich concentrate would be produced daily and transported in closed shipping containers by, on average, 18 trucks per day. The closed shipping containers would minimize or avoid potential leakage or spillage during transport.

The road system that would be used to transport mine concentrates between the Project site and the Livingston and Townsend railheads includes portions of Sheep Creek Road, U.S. Route 89, U.S. Route 12, I-90, and local roads in Livingston and Townsend. Rail facilities used to haul mine concentrates include Montana Rail Link rail yards at Livingston and Townsend, Montana,

[1] A “void” is the space from which the ore was removed.

Rail Link mainline tracks serving these railheads, and Burlington Northern Santa Fe Railroad mainline tracks in Montana.

Approximately 12.9 million tons of tailings would be produced over the life of the Project. The tailings would be thickened and sent to a paste plant where cement, slag, and/or fly ash could be added to the tailings as a binder. The product, called cemented paste tailings, would be piped either to the underground mine to backfill workings or to a double-lined tailings basin called the Cemented Tailings Facility (CTF). Approximately 55 percent of the cemented tailings paste produced by the Project would be stored in the CTF, with the remaining 45 percent used to backfill production workings during the sequential mining of drifts.

The Proponent would employ approximately 240 workers, with an additional 24 contract miners and 130 associated support workers at the site during the first 4 years of mining. Construction of mine facility and surface support structures during the initial 30 to 36 months would require a maximum of approximately 173 sub-contracted employees.

Closure and reclamation would focus on removal of surface infrastructure and exposed liner systems, and covering exposed tailings. No waste rock would be left on the surface in closure. Reclamation plans include removal of all buildings and their foundations and surface facilities including the portal pad, copper-enriched rock stockpile pad, PWP, CWP, plant site, TWSP, and NCWR. The reclamation plan also requires re-contouring the landscape, subsoil and soil replacement, and revegetating all the sites with an approved seed mix.

Mine closure would include the backfilling of some primary and secondary access drifts with fine-grained, low permeability, cemented paste tailings. The decline and access ramps would not be backfilled.

Mine workings would be sequentially flooded at closure with groundwater. Prior to flooding a particular portion of the mine, the walls of the workings within that zone would be rinsed to remove oxidation products. Rinse water would be collected, pumped, and treated as necessary. The zone would then be flooded with groundwater and a hydraulic barrier would be installed. In all, 14 hydraulic barriers—both plugs and walls, which are masses of concrete—would be installed in the underground workings. Five of the hydraulic barriers would be installed at the main access ramps, eight in the four ventilation raises (an upper and lower barrier in each raise), and one plug at the mine portal. The primary purpose of the hydraulic barriers is to segment the mine workings based upon sulfide content to facilitate rinsing and improve water management.

Closure objectives would be expected to be attained by water treatment within 1 year after mining and milling is completed, and once initial facility closure activities have been sufficiently implemented. Monitoring would continue after closure to ensure no unforeseen impacts were occurring. Monitoring would continue until DEQ determines that the frequency and number of sampling sites for each resource can be reduced or that the closure objectives have been met and monitoring can be eliminated.

5.3. Agency Modified Alternative: Additional Backfill of Mine Workings

The AMA includes all elements from the Proposed Action with one replacement component: backfilling additional mine workings, including the final stopes and portions of the decline, access ramps, and ventilation shafts that are located within sulfide zones.

The AMA proposes to backfill certain voids (i.e., access openings) with a low hydraulic conductivity material consisting of cemented paste tailings generated from mill processing of the stockpiled ore and/or waste rock at the end of operations. Cemented paste tailings would only be used to backfill certain mineralized mine voids to avoid the potential of degrading groundwater quality in non-mineralized geologic units (DEQ 2018). The upper section of the access decline (within the Ynl A geologic unit) and a lower section of the access tunnel (within the Ynl B geologic unit) would not be backfilled because these units have better baseline groundwater quality and are more permeable than deeper geologic units. All mine voids located within the Upper Sulfide Zone and the Lower Sulfide Zone would be backfilled with cemented paste tailings. Hydraulic plugs would be used to separate the backfilled and open areas of the access decline.

Approximately 106,971 cubic yards of cemented tailings would be needed to backfill the access tunnels and ventilation raises (Tintina 2018). The backfill material would be mixed with cement in a manner that achieves a similar low hydraulic conductivity as is proposed for backfilling of the mined stope areas. Since this volume of stockpiled ore source would exceed the proposed volume of the Copper-Enriched Rock Stockpile, this Project modification would also need to utilize the temporary WRS pad until the end of operations and backfilling of interior mine surfaces.

6. ENVIRONMENTAL CONSEQUENCES

The following discussion provides a summary of the impacts of implementing each alternative on each resource area. Proposed mining activities were found to have minimal-to-no impact on air quality, cultural resources, noise, and vegetation. These resource areas are not discussed further in this summary. Detailed impacts analyses for each alternative and topic area are found in Chapter 3 of this EIS. **Table ES-1** summarizes and compares the impacts of the three alternatives considered in detail.

6.1. Groundwater Hydrology

Under the Proposed Action, mine dewatering would substantially lower groundwater levels around the mine, somewhat reducing base flow in nearby creeks and impacting some springs and seeps within the area where groundwater levels are lowered. Operation of an alluvial Underground Infiltration Gallery (UIG) would increase groundwater discharge, partially compensating for the decreased base flow caused by mine-dewatering. The NCWR would recharge groundwater beneath this pond, partially compensating for the mine-dewatering caused decrease in base flow. Contact groundwater in post-mine voids would migrate via shallow bedrock toward discharge zones mixing with non-contact groundwater. Transport of chemicals dissolved in contact groundwater would be retarded by the process of adsorption, and groundwater discharging to Sheep Creek would not affect its water quality.

Impacts to groundwater quantity and quality would be similar under the AMA. Complete backfill of the Upper and Lower Sulfide Zones with cemented paste tailings would return hydraulic parameters within these bedrock zones to conditions similar to the pre-mining state, eliminating the potential for development of new groundwater flow paths through these areas.

6.2. Surface Water Hydrology

Under the Proposed Action, less than 1 percent of the Sheep Creek watershed area would be affected, resulting in a negligible impact on surface water runoff or flows in Sheep Creek. Coon Creek would be affected by an estimated 70 percent reduction in steady state base flow due to mine dewatering intercepting groundwater that might otherwise have discharged into Coon Creek. To mitigate the reduction, water from the NCWR would be pumped into the headwaters of Coon Creek to augment flows within 15 percent of the average monthly flow. Process water discharged to surface waters via UIGs would be treated and would not impact water quality in Sheep Creek. Therefore, no adverse impacts related to water quality are anticipated.

Impacts on surface water quantity and quality would be similar under the AMA.

6.3. Land Use and Recreation

Under the Proposed Action, there would be approximately 311 acres of direct land use impacts due to surface disturbances from the Project, which would be reclaimed after 19 years of mine life. There would be no direct impacts on recreation, hunting, or fishing in the proposed disturbance footprint as this area consists of private ranch lands.

Impacts on land use and recreation would be similar under the AMA.

6.4. Visuals and Aesthetics

Under the Proposed Action, impacts to visual resources during construction (caused by removal of existing vegetation, temporary fencing, grading, construction of roads and mine structures, and increased construction vehicle traffic) would be short term, medium frequency, local in scope, and partially reversible. Impacts to visual resources would be similar during operations, but would persist for a longer time period. Impacts to visual resources after closure and reclamation would be long term, medium frequency, and local in scope.

Impacts on visuals and aesthetics would be similar under the AMA.

6.5. Socioeconomics

Under the Proposed Action, Project construction would require an estimated workforce of 70 to 115 contractors during a given year. Once operational, the Project would require an estimated workforce of 386 individuals (i.e., 235 employees, 24 contractors, and 127 associated support workers). During reclamation, the estimated workforce would range from 337 people to 86 people. Meagher County and particularly the city of White Sulphur Springs are expected to experience the greatest population growth. Housing impacts could come in the form of increased demand and costs for housing due to population influx.

Potential adverse impacts to public infrastructure are expected, including a demand for services that exceeds the available capacity or degradation that exceeds the county or city's ability to perform repairs. The Project has the potential to impact local healthcare capacity as a result of associated population influx.

A potential positive impact is expected from employment and income effects. In addition, government units would benefit from the additional tax revenues generated by the mine. The White Sulphur Springs School District #8 would receive all of the added mineral development taxable value, projected to be $8,235,000 at peak copper production. The City of White Sulphur Springs would receive 20 percent of the new taxable valuation to assess its mill levies against, and Meagher County would be able to levy 100 percent of its mills for all funds except those that are not levied within the city limits of White Sulphur Springs.

Impacts on socioeconomics would be similar under the AMA.

6.6. Soils

Under the Proposed Action, approximately 563,692 cubic yards of soil would be salvaged and stockpiled long-term for reclamation activities associated with mine closure, and approximately 304,773 cubic yards would be temporarily stored and replaced on site for reclamation of construction activities, including grading, slope stabilization, drainage control, topsoil and subsoil placement, and seeding. There would be short-term soil compaction and biological impacts within the salvaged soils. The loss of soil development and the time required to rebuild a new soil profile would be unavoidable long-term Project impacts given the long-term storage of soil.

Impacts on soils would be similar under the AMA.

6.7. Transportation

Under the Proposed Action, Project construction would generate an average of 160 daily vehicle movements (i.e., one trip to or from the Project site), along with 8 supply truck round trips per day. Project operations would generate up to 477 employee vehicle movements per day, 36 concentrate haul truck movements per day, and 12 other truck movements per day. Traffic generated by Project construction and operations would not meaningfully impact traffic capacity on analysis area roads. As a result, traffic congestion is a low-likelihood event during both construction and operations. Project traffic could increase the chance of traffic incidents, degradation of roadways, and other risks to road safety, but Proponent-recommended road and intersection improvements would minimize impacts on road safety. Impacts on transportation during reclamation would be similar to those anticipated for construction.

Under the AMA, additional backfilling would marginally increase truck traffic compared to the

Proposed Action over a 4-year period. However, these additional trips would not meaningfully change the traffic impacts described for the Proposed Action.

6.8. WETLANDS

Under the Proposed Action, there would be approximately 0.85 acre of permanent direct impacts to wetlands due to the construction of access/service roads, the CTF, and the wet well for the Sheep Creek water diversion. Impacts to jurisdictional wetlands would require both a U.S. Army Corps of Engineers 404 and DEQ 401 Water Quality Certification permit prior to Project initiation. The Proponent submitted permit applications for both and received authorization in January 2017. To compensate for the 0.9 acre of direct wetland impacts and functional assessment areas, the Proponent would be required to purchase 1.3 acres of wetland mitigation credits from an approved wetland mitigation bank or In-Lieu Fee program. No secondary impacts are expected due to wetland fragmentation, hydrology changes, or water quality changes.

Impacts on wetlands would be similar under the AMA.

6.9. WILDLIFE

Under the Proposed Action, approximately 311 acres of wildlife habitat would be removed, to be reclaimed to similar habitat types after mine closure (i.e., 19 years); however, forest habitats would not reach the same functionality as existing conditions for decades. There would be a low likelihood of direct mortality (e.g., wildlife-vehicle collisions) for threatened and endangered species, and a medium likelihood for some big game species; however, no population-level impacts are anticipated for any species. Wildlife species could be disrupted by construction and operational noise within 1 to 2 miles of the Project. No adverse impacts related to water quantity or quality are anticipated.

Impacts on wildlife would be similar under the AMA.

6.10. AQUATIC BIOLOGY

Under the Proposed Action, aquatic biota may be affected by stream crossings and sedimentation, thermal changes, and the NCWR wet well intake pipeline. The two crossings combined would affect 0.1 acre of riparian wetlands, 85 feet of Little Sheep Creek, and 69 feet of the Brush Creek tributary to Little Sheep Creek. If stream flow were to be augmented via direct discharge from the NCWR, the temperature would be monitored, and discharges limited as necessary, in order to prevent impacts to aquatic life. Aquatic biota (i.e., macroinvertebrates) in the natural channel of Coon Creek may be impacted by changes in hydrology and sedimentation from construction activities. Aquatic biota could be impacted by the installation of the NCWR wet well intake, and potential impacts could include: entrainment and impingement of fishes and invertebrates; alteration of natural flow rates when water is pumped, which would only be done when the flow in Sheep Creek exceeds 84 cubic feet per second; degradation of shoreline and riparian habitats; and alteration of aquatic community structure and diversity.

Impacts on aquatic biology would be similar under the AMA.

Table ES-1
Comparison of Project Impacts by Alternative

Resource Area / Impact [a]	No Action Alternative	Proposed Action	Agency Modified Alternative
Air Quality			
Ambient Air Quality Standards	No change from current condition.	Predicted impacts for criteria pollutants at all offsite locations comply with health-based Montana and federal primary standards, which are protective of ambient air quality.	Same as Proposed Action. Emissions from extended production of cemented tailings to backfill more of the mined areas are a small fraction of emissions from the Proposed Action, and likely to have little impact on the air quality resource.
Regional Haze/Visibility	No change from current condition.	Project emissions of haze precursor pollutants are sufficiently below regulatory thresholds to not warrant evaluation of haze/visibility impacts.	Same as Proposed Action.
Chemical Deposition	No change from current condition.	Predicted impacts from Project emissions comply with Montana and federal secondary air standards, which are protective with respect to chemical deposition impacts.	Same as Proposed Action.
Cultural/Tribal/Historic Resources			
Historic Properties	No change from current condition.	Historic properties would be avoided or would be mitigated with a SHPO-approved treatment plan.	Same as Proposed Action.
Groundwater Hydrology			
Groundwater Quantity	No change from current condition.	Mine dewatering would extensively lower groundwater levels around the mine, somewhat reducing base flow in nearby creeks; potentially impacting springs and seeps within the cone of depression. Operation of UIG would increase groundwater discharge, partially compensating mine-dewatering caused by decreased base flow. Operation of a NCWR would potentially increase groundwater discharge, partially compensating the mine-dewatering caused decrease in base flow.	Same as Proposed Action.
Groundwater Quality	No change from current condition.	The contact groundwater from post-mine voids [b] would migrate via shallow bedrock toward discharge zones mixing with non-contact groundwater; transport chemicals dissolved in contact groundwater would be retarded by process of adsorption; groundwater discharging to Sheep Creek would not affect its water quality.	Same as Proposed Action.
Surface Water Hydrology			
Runoff Surface Disturbance	No change from current condition.	Surface disturbance is less than 1% of local watershed area. Best management practices and the relatively small percentage of the total area (<1%) of stream and wetland features would be impacted through surface disturbance during construction.	Same as Proposed Action.
Stream Flows	No change from current condition.	Diversion of water to the NCWR falls within existing leased water rights along Sheep Creek (pending review and approval by the DNRC).	Same as Proposed Action.
		Secondary impacts on base flow of Sheep Creek as a result of mine dewatering and disposal of treated water to the UIG are expected to be insignificant and to partially offset one another. A more significant impact upon base flow would be possible for Coon Creek (70% reduction) during mine dewatering and recovery and pending approval by the DNRC it would require an agreement with the water rights holder. No other creeks are present within the area of a 10-foot drawdown of the water table, as computed by the groundwater model.	Same as Proposed Action.

Resource Area / Impact [a]	No Action Alternative	Proposed Action	Agency Modified Alternative
Water Quality	No change from current condition.	Process water discharged to surface waters via UIG would be treated and therefore not impact water quality in Sheep Creek. Post-closure exceedances of Montana Numeric Water Quality Standards (DEQ-7 Circular, May 2017) in underground water are expected to be attenuated and diluted by the time underground water migrates to Sheep Creek where more dilution occurs.	Same as Proposed Action.
Land Use and Recreation			
Existing Land Use	No change from current condition.	A total of 311 acres of existing land use would be impacted, which would be reclaimed back to existing uses after mine closure (i.e., 19 years).	Same as Proposed Action.
Hunting, Fishing, and Boating	No change from current condition. Recreational opportunities and use levels, patterns, and growth trends would be expected to continue at current rates.	No direct impacts on hunting opportunities would occur. There is abundant adjacent habitat for big game species surrounding the Project area. No secondary impacts on fishing or boating would occur from surface water.	Same as Proposed Action.
Population Increase	No change from current condition.	Recreational resource demands may be higher during construction and operations given the increase in local population from construction workers and mine operators; however, given the number and abundance of regional recreational opportunities, it is not expected that mine employee recreational resources use would significantly deprive other regional recreationists from enjoying the same resources.	Same as Proposed Action.
Visual and Aesthetics			
Visual Resources	No change from current condition.	Impacts to visual resources during construction caused by removal of existing vegetation, temporary fencing, grading, construction of roads and mine structures, and increased construction vehicle traffic would be short term, medium frequency, local in scope, and partially reversible. Impacts to visual resources after reclamation would be long term, medium frequency, and local in scope.	Same as Proposed Action.
Socioeconomics			
Population Increase	No change from current condition. Current population and use trends would continue.	The Proponent expects to hire up to 200 contractors during construction and employ an operating workforce of 235 employees. The associated population influx (i.e., the number of in-migrating workers and their family members) would be distributed across area county and town populations. Growth in population due to Project workforce would mean increased demand for and use of socioeconomic resources, such as housing, public infrastructure, and services. The nature and extent of these impacts would depend on where in-migrating populations choose to reside, the ability of public service providers to serve fluctuating populations, and the ability of area residents to adjust to (and accept) changes in life style.	Same as Proposed Action.
Employment, Income, and Tax Revenues	No change from current condition. Current employment, income and tax revenues trends would continue.	In addition to employment and income impacts, affected government units would benefit from the additional tax revenues generated by the mine.	Same as Proposed Action.
Soils			
Soil Loss	No change from current condition. Erosion and sedimentation would occur at current rates along the existing roads. Loss of soil development characteristics would be limited to new disturbances planned in the Project area in the reasonably foreseeable future.	A total of 283.7 acres of soils would be disturbed as part of the Project in areas of stockpiled and non-stockpiled soils. Total soil volumes of about 563,692cubic yards would be salvaged and stockpiled long-term, and approximately 304,773 cubic yards of soils would be temporarily stored and replaced on site.	Same as Proposed Action.
Physical, Biological, and Chemical Characteristics	No change from current condition. Physical, biological, and chemical changes to soils would be minimized and limited to new disturbances planned in the Project area in the reasonably foreseeable future.	Short-term soil compaction impacts would occur as part of the Proposed Action. Biological impacts would occur in salvaged soils. No changes to soil pH values are expected from Project construction or operations.	Same as Proposed Action.

Resource Area / Impact [a]	No Action Alternative	Proposed Action	Agency Modified Alternative
Reclamation Impacts	No change from current condition.	The soils in the analysis area are generally suitable for salvage and reclamation. The majority of soils would be salvaged using a two-lift method, which improves reclamation success. The loss of soil development and the time required to rebuild a new soil profile would be unavoidable long-term Project impacts given the long-term storage of soil.	Same as Proposed Action.
Noise			
Sound Levels at Residential Receptors	No change from current condition.	Construction, operation, and mine closure could result in some audible noise at nearby residential receptors.	Same as Proposed Action.
Sound Levels at Recreational Receptors	No change from current condition.	Temporary blasting associated with mine construction could result in some audible noise at nearby recreational receptors in the Smith River area.	Same as Proposed Action.
Transportation			
Traffic Congestion	No change from current condition.	Project construction would generate an average of 160 employee daily vehicle movements (i.e., one trip to or from the Project site), along with 8 supply truck round trips per day. Project operations would generate up to 477 employee vehicle movements per day, 36 concentrate haul truck movements per day, and 12 other truck movements per day. Traffic generated by Project construction and operations would not meaningfully impact traffic capacity on analysis area roads. As a result, traffic congestion is a low-likelihood event during both construction and operations.	Same as Proposed Action. Additional backfilling would marginally increase truck traffic over a 4-year period. These additional trips would not meaningfully change the traffic impacts described for the Proposed Action.
Road Safety	No change from current condition.	During Project construction and operations, Project traffic could increase the chance of traffic incidents, degradation of roadways, and other risks to road safety. Non-Project drivers are likely to be already accustomed to varying road and weather conditions, as well as the presence of heavy truck traffic on analysis area roads. Proponent-recommended road and intersection improvements would further minimize impacts on road safety.	Same as Proposed Action. Additional traffic would not meaningfully change the traffic impacts described for the Proposed Action.
Vegetation			
Vegetation	Ongoing exploration and ranching activities may disturb vegetation within the Project area.	A total of 311 acres of vegetation would be disturbed, which would be reclaimed after mine closure (i.e., 19 years). No impacts to T&E species.	Same as Proposed Action.
Wetlands			
Wetland Fill, Hydrology, and Quality	Ongoing ranching activities may slightly disturb wetlands within the Project area.	A total of 0.85 acre of permanent direct impacts to wetlands would occur due to access/service roads, CTF, and the wet well for the Sheep Creek water diversion. No secondary impacts expected due to fragmentation, hydrology changes, or water quality.	Same as Proposed Action.
Wildlife			
Habitat	Continued exploration activities and agricultural use of Project site could affect habitat.	A total of 311 acres of habitat removal, to be reclaimed after mine closure (i.e., 19 years).	Same as Proposed Action.
Direct Mortalities	Ongoing potential for wildlife-vehicle collisions due to private recreational and agricultural use of the land.	Low likelihood of wildlife-vehicle collision for T&E species. Medium likelihood for big game species and other species of concern. No population-level impacts anticipated.	Potential increased adverse impact compared to Proposed Action. Potentially a slight increase in mortalities as more vehicle traffic onsite associated with additional backfilling. Fencing would limit potential impacts to birds and small mammals.
Displacement	Wildlife occasionally disrupted by exploration activities or recreational use.	Wildlife likely disrupted within 1 to 2 miles of the Project throughout the life of the mine.	Same as Proposed Action.
Water Quality and Quantity	No change from current condition.	Process water discharged to surface waters via the UIG would be treated to avoid impacts to wildlife. Potential contamination for avian species ingesting water from CWP brine pond. There would be no adverse impacts related to water quantity.	Same as Proposed Action.

Resource Area / Impact [a]	No Action Alternative	Proposed Action	Agency Modified Alternative
Aquatic Biology			
Stream Crossings and Sedimentation	Ongoing potential for increased sedimentation from continued exploration activities, ranching, and fishing activities.	The two crossings combined would affect 0.1 acre of riparian wetlands, 85 feet of Little Sheep Creek, and 69 feet of the Brush Creek tributary to Little Sheep Creek, disturbing aquatic habitat and potentially introducing sediment into the aquatic system and affecting spawning fish.	Same as Proposed Action.
Changes in Water Quantity	Aquatic biota may be impacted by exploration and ranching activities when water is withdrawn for use. Otherwise, no change from current condition.	Aquatic biota, particularly in Coon Creek, could be impacted by changes in hydrology due to mine dewatering during operations. The Proponent proposes to augment flows with water from the NCWR.	Same as Proposed Action.
NCWR Wet Well and Pipe	No change from current condition.	Aquatic biota could be impacted by the installation of the intake pipe. Further impacts likely due to the presence of the intake pipeline include entrainment and impingement of fishes and invertebrates; alteration of natural flow rates when water is pumped (when the flow in Sheep Creek exceeds 84 cubic feet per second); degradation of shoreline and riparian habitats; and alteration of aquatic community structure and diversity.	Same as Proposed Action.
Changes in Water Quality	No change from current condition.	Process water discharged to surface waters would be treated to avoid impacts to wildlife.	Same as Proposed Action.
Thermal Impacts	No change from current condition.	The assumption is that the temperature of the UIG discharge would equilibrate to the ambient groundwater temperature prior to discharging to any surface water resources. If stream flow were to be augmented via direct discharge from the NCWR, the temperature would be monitored, and discharges limited as necessary, in order to prevent impacts to aquatic life.	Same as Proposed Action.

CTF = Cemented Tailings Facility; CWP = Contact Water Pond; MPDES = Montana Pollutant Discharge Elimination System; NCWR Non-Contact Water Reservoir; PWP = Process Water Pond; SHPO = State Historic Preservation Office; T&E = threatened and endangered; UIG = Underground Infiltration Gallery

Notes:

[a] Impacts include direct and secondary impacts, as well as severity, probability, and duration of impact.

[b] A “void” is the space from which the ore was removed.

7. REFERENCES

DEQ (Montana Department of Environmental Quality). 2017a. Mine Application Deemed Complete and Environmental Review to Begin. DEQ Press Releases. August 15, 2017. Accessed: August 2017. Retrieved from: http://deq.mt.gov/Public/PressRelease/mine-application-deemed-complete-and-environmental-review-to-begin

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_____. 2017d. Additional Scoping Meeting Announced for Environmental Impact Statement of Proposed Mine. State of Montana Newsroom. October 24, 2017. Accessed: October 2017. Retrieved from: https://news.mt.gov/additional-scoping-meeting-announced-for-environmental-impact-statement-of-proposed-mine

Tintina (Tintina Montana, Inc.). 2018. Email Interview. Project Manager (Edward J. Surbrugg) with Tetra Tech personal communication with Craig Jones, Project Manager, Hard Rock Section, Montana Department of Environmental Quality, Helena, Montana. August 15, 2018.

1. PURPOSE AND NEED

1.1. INTRODUCTION

The Montana Environmental Policy Act (MEPA) requires state agencies to prepare an Environmental Impact Statement (EIS) prior to taking a state action significantly affecting the quality of the human environment (§ 75-1-201(1)(b)(iv), Montana Code Annotated [MCA]). The Department of Environmental Quality (DEQ) has prepared this Draft EIS prior to taking state action on applications for permits or other state authorizations submitted by Tintina Resources Inc. (the Proponent) for the proposed Black Butte Copper Project (the Project).

The Proponent has submitted applications to DEQ for an operating permit under the Metal Mine Reclamation Act (§ 82-4-301, *et seq*., MCA), a Montana Pollutant Discharge Elimination System (MPDES) permit under the Montana Water Quality Act (§ 75-5-101, *et seq.*, MCA), and a Montana Air Quality permit under the Clean Air Act of Montana (§ 75-2-101, *et seq*., MCA).

1.2. PURPOSE AND NEED

This section describes the purpose and need to which each agency or company is responding for the proposed Project. MEPA and its implementing rules require that EISs prepared by state agencies include a description of the purpose and benefits of the proposed project; this EIS was written to fulfill those requirements. The Project purpose and need is in Section 1.2.1, Department of Environmental Quality, and in Section 1.2.2, the Proponent. Benefits of the Project include the production of copper to help meet public demand. The Project would also increase employment and tax payments in the Project area (see Section 3.9, Socioeconomics).

1.2.1. Department of Environmental Quality

DEQ's purpose and need in conducting the environmental review is to act upon the Proponent's applications to obtain state permits authorizing underground mining of the Johnny Lee Deposit at the proposed Black Butte Copper mine site approximately 15 miles north of White Sulphur Springs, Montana. DEQ's actions on the permit applications must be in accordance with applicable state law. The permits that the Proponent are applying for and the governing state laws include: (1) an operating permit in compliance with the Metal Mine Reclamation Act (MMRA); (2) an integrated Montana Pollutant Discharge Elimination System (MPDES) permit in compliance with the Montana Water Quality Act; and (3) a Montana Air Quality permit in compliance with the Clean Air Act of Montana.

1.2.2. The Proponent

The Proponent's purpose is to develop and mine the Johnny Lee Deposit by underground mining methods with the expectation of making a profit. The Proponent's need is to receive all necessary governmental authorizations to construct and operate the proposed underground mine and to reclaim disturbances associated with the underground mine, including associated infrastructure and other incidental facilities.

1.3. PROJECT LOCATION AND HISTORY

The Project area is approximately 15 miles north of White Sulphur Springs in Meagher County, Montana (see **Figure 1.3-1**). The Project area is located in Sections 24, 25, and 36 in Township 12N, Range 6E, and in Sections 19, 29, 30, 31, and 32 in Township 12N, Range 7E (Tintina 2017). The Project area is accessed from United States (U.S.) Highway 89, by traveling west along 1.5 miles of well-maintained gravel county road (County 119; Sheep Creek Road). The Project area consists of privately owned ranch land, with associated buildings and a road network throughout.

Mineral exploration started in the Project area in 1894 with small-scale underground copper mineralization development projects. When the focus switched to iron resources in the 1900s, R&S Mining Company started mining iron ore from Iron Butte, west of the Project area. Iron ore continues to be mined from this area (Operating Permit No. 00071) as an ingredient for cement production at a facility in Trident, Montana. Homestake Mining Company started exploring for non-ferrous metals in the Project area in 1973 and 1974. Cominco American Inc. resumed exploration in the district in 1976 and joint ventured the property with Broken Hill Proprietary Company Limited in 1985 (Tintina 2017). It was this joint venture that drilled the discovery hole for the Johnny Lee Deposit (named after the former homesteader and miner). The joint venture completed approximately 66 exploration core holes in the current Project area.

The Proponent acquired mineral rights lease agreements to mine the property via underground mining in May 2010, and has conducted surface exploration activities since September 2010. Under Exploration License No. 00710, the Proponent used surface drilling methods to complete 229 exploration drill holes (including metallurgical and geotechnical test holes) in the Project area to assess the feasibility of mining the deposit. The Proponent has hydraulically plugged all of these exploration drill holes to avoid aquifer cross-contamination in accordance with Administrative Rules of Montana (ARM) 17.24.106. Additionally, 23 monitoring wells, 28 piezometers, and 15 pump wells currently remain open. Surface disturbances related to exploration (e.g., drill holes, drill pads, test pits, and access roads) have totaled approximately 9 acres to date, most of which have been reclaimed.

The Proponent submitted an application to amend their exploration license on November 7, 2012, in order to construct an exploration decline into the upper Johnny Lee zone. DEQ conducted an environmental review in regard to that exploration license amendment application, issuing a Final Mitigated Environmental Assessment in January 2014. DEQ selected the Agency Mitigated Alternative during that review. However, the Proponent subsequently chose not to construct the exploration decline. The Proponent then submitted an application for a Mine Operating Permit (MOP) and revisions to DEQ on December 15, 2015; May 8, 2017; and July 14, 2017, which is the subject of this environmental review. An additional update memorandum was submitted on October 26, 2018.

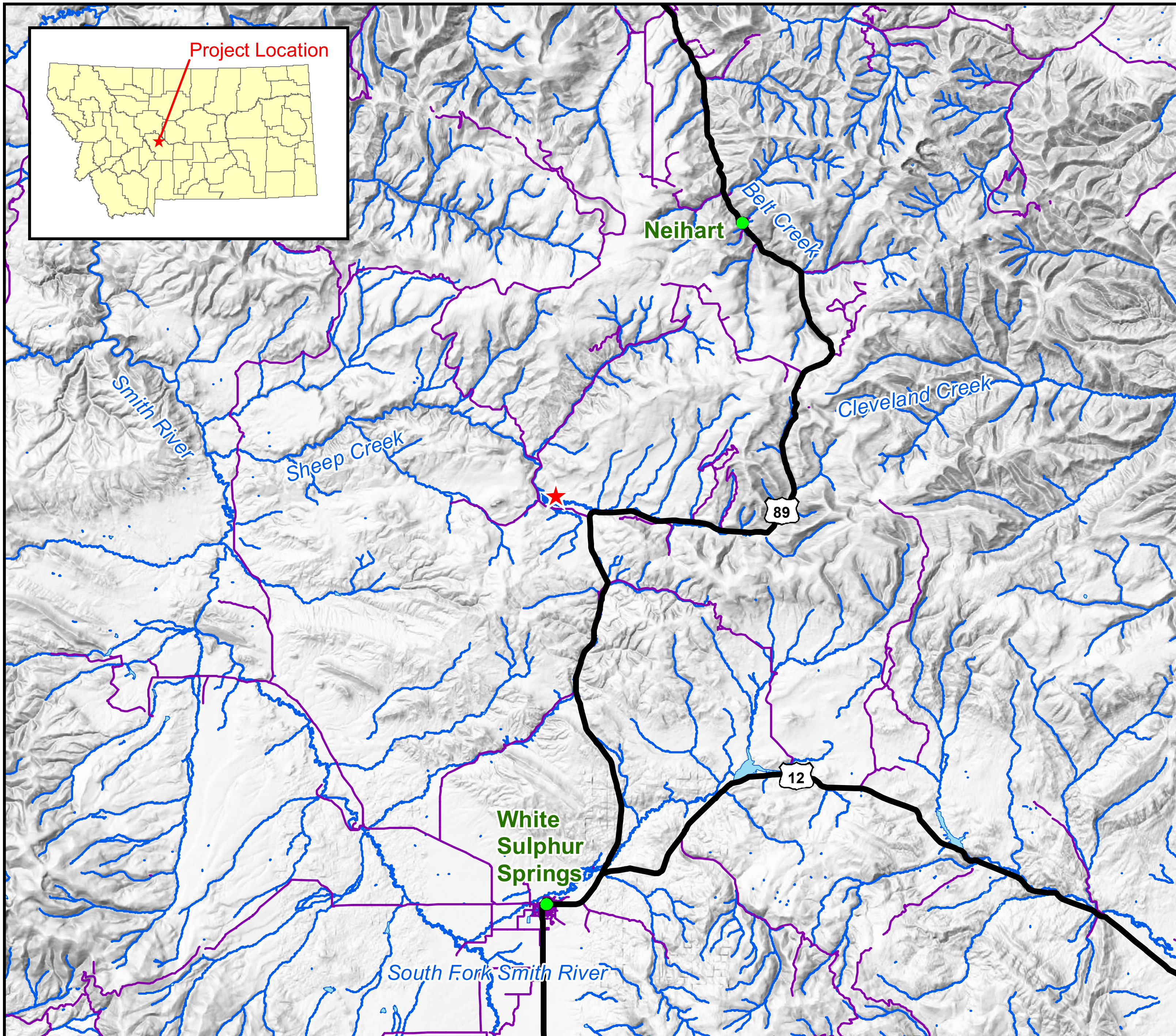

Figure 1.3-1
Black Butte Copper Project
Project Location
Meagher County, Montana

Project Location
City
U.S. Route
Local Road
Stream
Lake

N
W E
S

0 1 2 3 4 5
Miles

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1.4. SCOPE OF THE DOCUMENT

DEQ has prepared this Draft EIS in compliance with MEPA. This Draft EIS describes the potential direct, secondary, and cumulative environmental impacts that could result from the No Action, Proposed Action, and other alternatives considered in detail. This document is organized into nine chapters:

- Chapter 1. Purpose and Need: Chapter 1 includes information about the Project and the purpose of and need for the Project. This chapter also summarizes how DEQ informed the public of the Project and how the public responded.
- Chapter 2. Description of Alternatives: Chapter 2 provides a detailed description of the No Action Alternative, Proposed Action, and other action alternatives considered in detail. These alternatives were developed based on key issues raised by the public and, as required by MEPA, in consultation with the Proponent.
- Chapter 3. Affected Environment and Environmental Consequences: Chapter 3 describes the current environment and the potential direct and secondary impacts resulting from the No Action Alternative, the Proposed Action, and the other alternatives considered in detail. This analysis is organized by resource.
- Chapter 4. Cumulative Impacts, Unavoidable Adverse Impacts, Irreversible and Irretrievable Commitments of Resources: Chapter 4 describes the cumulative impacts, unavoidable adverse impacts, and irreversible and irretrievable commitments of resources associated with the Proposed Action and other action alternatives.
- Chapter 5. Comparison of Alternatives and DEQ’s Preferred Alternative: Chapter 5 provides an identification of DEQ’s preferred alternative, its reasons for the preference, and the tradeoffs among the alternatives considered.
- Chapter 6. Consultation and Coordination: Chapter 6 provides a listing of other agencies, groups, or individuals who were contacted or contributed information.
- Chapter 7. List of Preparers: Chapter 7 provides a list of preparers for the Draft EIS.
- Chapter 8. References: Chapter 8 provides a list of the source materials that were used in preparation of the EIS.
- Chapter 9. Index: Chapter 9 provides a list of key terms used and where they can be found in the EIS.

Appendices: The following appendices provide detailed information to support the analyses presented in the Draft EIS:

- Appendix A. Technical Memo 1: Increasing Cement Content in Tailings
- Appendix B. Technical Memo 2: Raising Impoundment above the Water Table
- Appendix C. Technical Memo 3: Full Sulfide Separation Prior to Tailings Disposal

- Appendix D. Technical Memo 4: Additional Hydrologic Plugs for Limiting Groundwater Flow at Closure
- Appendix E. Technical Memo 5: In-Situ Treatment or Metal Attenuation through Use of Organics in the Underground Workings
- Appendix F. Technical Memo 6: Additional Source Controls to Limit Oxidation during Operations
- Appendix G. Technical Memo 7: Alternative Water Treatment Technologies
- Appendix H. Technical Memo 8: Analysis of End of Mine Flushing of Underground Workings
- Appendix I. Baseline Surface Water Quality
- Appendix J. Scoping Report
- Appendix K. Preliminary Determination on Air Quality Permit Application

1.5. Agency Roles and Responsibilities

DEQ is the agency responsible for the analysis of the Project. This EIS is being prepared to provide a comprehensive analysis of potential environmental impacts. Before construction and operation of the Project could begin, other permits, licenses, or approvals may be required from federal, state, and local agencies.

1.5.1. State and County Agencies

The state agencies listed in **Table 1.5-1** have relevant permits or reviews that would potentially be required for the Project. There are no relevant county permits or approvals required for the Project.

Table 1.5-1
State Agencies–Potential Requirements

Potential Permits or Reviews Required (Statutory Reference)	Purpose of Permit or Review
Montana Department of Environmental Quality	
Montana Environmental Policy Act, Analysis of Impacts (§ 75-1-102, MCA)	MEPA requires DEQ to prepare an environmental impact statement prior to taking state action for any projects that significantly affect the quality of the human environment.
Metal Mine Reclamation Act, Operating and Reclamation Plans (§ 82-4-303, MCA)	Mining must comply with state environmental laws and administrative rules. The MMRA has established reclamation standards for lands disturbed by mining, generally requiring that they be reclaimed to comparable stability and utility as that of adjacent areas. Reclamation must provide sufficient measures to ensure public safety and to prevent the pollution of air or water and the degradation of adjacent lands.

Potential Permits or Reviews Required (Statutory Reference)	Purpose of Permit or Review
Montana Water Quality Act, Montana Pollutant Discharge Elimination System (§ 75-5-101, MCA)	Establishes effluent limits and treatment standards, and regulates point source discharges of pollutants into state surface waters or to groundwater hydrologically connected to state surface waters through MPDES permits. State water quality standards, including the nondegradation standards, specify the allowable changes in surface water or groundwater quality. An MPDES permit may also authorize discharges of construction storm water and would require the development of a storm water pollution prevention plan.
Montana Public Water Supply Act (§ 75-6-101, MCA)	Regulates public water supply and sewer systems that regularly serve at least 25 persons daily for a period of at least 60 calendar days a year. DEQ must approve plans and specifications for water supply wells in addition to water systems or treatment systems and sewer systems.
Montana Clean Water Act, Section 401 (§ 75-5-401, MCA)	Federal permits related to discharges to state waters must also obtain certification from the state that discharges comply with state water quality standards. On January 19, 2017, DEQ certified that the Project would not violate water quality standards under Section 401.
Clean Air Act of Montana, Air Quality Permit (§ 75-2-Parts 1-4, MCA)	An Air Quality permit is required for the construction, installation, and operation of facilities and equipment that may cause or contribute to air pollution.
Montana Hazardous Waste Act (§ 75-10-401, MCA) and the Solid Waste Management Act (§ 75-10-201, MCA)	The acts regulate the storage and disposal of hazardous and solid wastes.
Montana Hard Rock Mining Impact Board	
Hard Rock Mining Impact Act, Hard Rock Mining Impact Plan, (§ 2-15-1822, MCA)	This Act is overseen by the Hard Rock Mining Impact Board (HRMIB), which is part of the Montana Department of Commerce. The HRMIB consists of five members: (1) a representative of the hard-rock mining industry; (2) a representative of a major financial institution in Montana; (3) a person who, at the time of appointment, is an elected school district trustee; (4) a person who, when appointed, is an elected county commissioner; and (5) a member of the public-at-large. A Hard Rock Mining Impact Plan is submitted to the HRMIB for consideration and approval. If a local government (i.e., city, county, etc.) disagrees with any portion of the Hard Rock Mining Impact Plan, the governing body may file an objection with the HRMIB during a 90-day review period.
Montana Department of Transportation	
Construction Permit (§ 61-1-1 *et seq.*, MCA)	The Montana Department of Transportation (MDT) is responsible for approving road approaches onto state-owned highways. A construction permit may be required for modifying the approach onto Highway 89 from County Road 119.

Potential Permits or Reviews Required (Statutory Reference)	Purpose of Permit or Review
Approach Permit (§ 61-1-1 *et seq*., MCA)	The MDT is responsible for approving road approaches onto state-owned highways. An approach permit may be required for load out areas if accessing them via a highway.
Heavy or Oversize Loads Permit (§ 61-1-1 *et seq*., MCA)	The MDT is responsible for safe operation of state-owned highways, including US Highway 89 near the Project area and the roadways as part of the proposed haul routes. Appropriate permits for heavy or oversize loads (if any) may be required.
Montana Department of Natural Resources and Conservation	
Montana Water Use Act, Beneficial Water Use Permit (§ 85-2-311, MCA)	The Montana Department of Natural Resources and Conservation (DNRC) is responsible for administering water rights in Montana, and would decide on issuance of a beneficial water use permit. A beneficial water use permit would be required before constructing new infrastructure for appropriations of groundwater or surface water.
Montana Fish, Wildlife & Parks	
NA	Montana Fish, Wildlife & Parks (FWP) is responsible for protecting fish, wildlife, and natural resources for recreational activities. FWP would approve and designate a licensed collector for monitoring, mitigation, and transplanting of fish species within the Project area, if necessary.
Montana State Historic Preservation Office	
NA	The State Historic Preservation Office (SHPO) advises state agencies when a project could affect cultural resources that are eligible or potentially eligible for the National Register of Historic Places (NRHP). Sites that are eligible or potentially eligible to the NRHP are considered Historic Properties. After consultation, SHPO may concur if the Project could have (1) no impact; (2) no adverse impact; or (3) adverse impact on Historic Properties. If SHPO does not concur with DEQ's determination, then DEQ may request the Proponent to conduct additional cultural work. If SHPO concurs that the Project would have no impact or no adverse impact, then the Project could move forward. If DEQ determines and SHPO concurs that the Project could have adverse impacts on Historic Properties, then DEQ would request the Proponent to implement protection, mitigation, and monitoring as approved by SHPO.

MCA = Montana Code Annotated; NA = not applicable

1.5.2. Federal Agencies

The federal agency listed in **Table 1.5-2** requires a permit for the Project, which has been obtained.

Table 1.5-2
Federal Agencies–Potential Requirements

Potential Permits or Reviews Required (Statutory Reference)	Purpose of Permit or Review
U.S. Army Corps of Engineers	
Clean Water Act, Section 404 Permit (33 Code of Federal Regulations Section 1344) Permit No. NWO-2013-01385-MTH	The U.S. Army Corps of Engineers (USACE) has responsibilities under Section 404 of the Clean Water Act (CWA), and has the authority to take reasonable measures to inspect Section 404-permitted activities. Construction of certain Project facilities in Waters of the United States, including wetlands and special aquatic sites, would constitute disposal of dredged or fill materials. The USACE also requires Section 401 certification from DEQ (see Table 1.5-1 above). The Proponent submitted a Section 404 permit application to the USACE for the Project for impacts to Brush Creek and adjacent wetlands. The USACE issued a Department of the Army permit (NWO-2013-01385-MTH) for discharge of fill into Waters of the United States on November 27, 2017.

1.6. Development of Alternatives

This section describes the process and outcomes of considering reasonable alternatives to the Project. This could include alternatives with different processes or designs that would minimize environmental impacts of the Project. The sources of potential alternatives were public scoping comments, the MOP Application including DEQ's comments, ERM Subject Matter Expert input, and internal DEQ deliberations and analysis including technical memos (see Appendices A through H). Approximately 60 ideas were identified and screened for potential inclusion in the EIS by DEQ.

1.6.1. Public Participation

On August 15, 2017, DEQ issued a press release stating that the MOP Application was complete and the environmental review was set to begin (DEQ 2017a). DEQ issued a second release on September 18, 2017, indicating the review had begun under MEPA (DEQ 2017b). Additionally, DEQ issued a press release on October 3, 2017, disclosing the times and locations of three public scoping meetings, as well as information about the EIS and permit application (DEQ 2017c). A fourth press release was issued on October 23, 2017, due to the addition of a fourth and final public scoping meeting (DEQ 2017d). Each of these releases was also submitted via email to national, state, and local news outlets on the respective release dates. The press releases requested public comment on the Project until November 16, 2017.

DEQ established a public comment scoping period from October 2, 2017, to November 16, 2017 (i.e., 46 calendar days). During this time, DEQ received written and oral comments from the public that were submitted via email, mail, or public meetings. On October 30, 2017, a public meeting was held at the Civic Center in Great Falls, Montana. On November 1, 2017, a second meeting was held at the White Sulphur Springs High School gymnasium in White Sulphur

Springs, Montana. The third meeting was held at the Radisson Hotel in Helena, Montana, on November 6, 2017. The final public meeting was held November 7, 2017, in Livingston, Montana, at the Park County High School Gymnasium.

1.6.2. Issues of Concern

Based on comments received during the public scoping process, DEQ prepared a Scoping Report (see Appendix J) that included a summary of all comments received, organized by issue. These comments were separated into "non-substantive" and "substantive" categories. Non-substantive comments were identified by DEQ as those (1) outside the scope of the Project analysis; (2) irrelevant to the decisions to be made; (3) conjectural and not supported by scientific or factual evidence; or (4) those that MEPA does not allow for certain analysis. Substantive comments pertained to the analysis and contained information or suggestions to be carried forward into the alternative development process.

DEQ identified 13 different topic issues to be considered in more detail in the EIS. The issues of concern identified during scoping are listed below.

1.6.2.1. Air Quality

The EIS should evaluate the Project's potential impact on climate change and how this impact would affect local natural resources. Fugitive dust and its impacts to natural resources should be evaluated. This issue is discussed in Section 3.2.

1.6.2.2. Alternatives

The EIS should provide an alternative analysis informed by other tailings impoundments that reduces the risk of environmental impacts including liner degradation, impoundment location, and design. The EIS should evaluate the use of tanks instead of ponds to retain process water. The EIS should evaluate alternative truck transportation routes. The EIS should evaluate a wetland treatment system for a long-term water treatment solution. Under the Proposed Action, there is potential for groundwater contamination within the mine workings caused by not backfilling the access tunnels and ventilation shafts. Federal Clean Water Act (CWA) guidelines for mineral processing facilities discourages the discharge of treated mine process water to surface waters of the United States, including wetlands such as those that occur near the Proposed Action alluvial Underground Infiltration Gallery (UIG). This issue is discussed in Chapter 2.

1.6.2.3. Aquatic Species

The EIS should collect fisheries baseline data that includes Calf Creek, Sheep Creek, the South Fork of Sheep Creek, Coon Creek, Moose Creek, and the Smith River. This analysis and subsequent impact analysis should consider climate change, species composition, size distribution, spawning, fish densities, seasonal migration behavior, macroinvertebrates, amphibians, mollusks, waterway physical characteristics, metal concentrations in fish tissue, and impacts from changes to water temperature, flow, and quality. Sources of water to streams and rivers via groundwater and surface water including wetlands should be evaluated for potential impacts. Potential for acid mine drainage to develop and affect fisheries should be evaluated. This issue is discussed in Section 3.16.

1.6.2.4. Cultural Resources

The EIS should evaluate the impacts on archaeological features of the Smith River. The EIS should evaluate cultural and archaeological resources and cultural landscapes that could be affected by the Project, including those near the mine site. This issue is discussed in Section 3.3.

1.6.2.5. Cumulative Impacts

The EIS should evaluate current water withdrawals from Sheep Creek and Smith River in combination with the potential impacts of the Project. The EIS should consider the combined impacts of truck traffic from new industrial activity along the Missouri River Corridor and truck traffic from the Project. A mining district of multiple Projects should be evaluated. Cumulative impacts to fisheries should be evaluated. This issue is discussed in Chapter 4.

1.6.2.6. Geotechnical Stability

The impacts of earthquakes and heavy rains on the mine should be studied in relation to geotechnical stability. The evaluation and certification of the Cemented Tailings Facility (CTF) stability should be disclosed in the EIS. This issue is discussed in Section 3.6.

1.6.2.7. Land Use, Recreation, and Visual Resources

The EIS should evaluate mitigation to maintain the scenery along Kings Hill Scenic Byway (U.S. Highway 89). Recreation and use of the Smith River must be evaluated. The EIS should evaluate the impacts on the recreation and agricultural industry. These issues are discussed in Sections 3.7 and 3.8.

1.6.2.8. Noise and Vibration

Noise impacts on people and wildlife in the vicinity of the Smith River should be evaluated. The EIS needs to evaluate noise impacts on the Little Moose Subdivision located 3 miles from the proposed mill site. This issue is discussed in Section 3.11.

1.6.2.9. Socioeconomics

Population, urban growth, and demographic change in White Sulphur Springs as a result of mining should be studied. The EIS should evaluate the impact on rural life by the introduction of the mine. The EIS should evaluate the impacts of a boom and bust mining cycle on White Sulphur Springs, including the costs of building infrastructure that would be temporary, such as schools. The EIS should evaluate how many jobs could be provided to local residents. Environmental justice must be included in the EIS. The EIS should consider the loss of state tax dollars if the Smith River is impacted. The EIS should include a detailed economic analysis of Meagher County. This issue is discussed in Section 3.9.

1.6.2.10. Vegetation

The EIS should evaluate the spread of weeds on lands adjacent to the Project site and adopt mitigation measures. This issue is discussed in Section 3.13.

1.6.2.11. Water Resources

The EIS should perform a review of potential long-term impacts on the Smith River and its watershed. The EIS needs to address the dynamic aquifer and springs. The EIS should evaluate the durability and longevity of proposed water treatment as well as contingencies. The EIS should evaluate surface water and groundwater quantity and quality and the potential for acid mine drainage. This issue is discussed in Sections 3.4 and 3.5.

1.6.2.12. Wetlands

The EIS should examine the impact of filled wetlands on cold-water storage during low-water periods on Sheep Creek and the impacts on the Smith River. This issue is discussed in Section 3.14.

1.6.2.13. Terrestrial Wildlife

The EIS should disclose the specifics of the wildlife baseline data collection efforts, as the surveys for many species were inadequate. The EIS impacts analysis should evaluate potential impacts to wildlife including migration patterns due to traffic, dust, noise, and increased human populations. This issue is discussed in Section 3.15.

1.6.3. Issues Considered but Not Studied in Detail

It was determined that a number of resources and issues raised during the scoping process would not be affected by the Project and thus would not be discussed further in the EIS. The resource areas and rationale for the determination are listed below.

1.6.3.1. Alternatives

The EIS does not evaluate sourcing metals from another ore body as that would not satisfy the purpose and need of the Project.

1.6.3.2. Aquatic Species

The aquatic species analysis does not include baseline information or impacts on the Missouri River. Impact analyses do not indicate that there would be a potential impact on the Missouri River as a result of the Project because the Project would not likely have any direct or secondary impacts on aquatic life in the Smith River, which is significantly upstream from the confluence with the Missouri River.

1.6.3.3. Cumulative Impacts

The EIS does not evaluate the possible contributions of Superfund sites in the area of Great Falls, Montana, in combination with the Project's potential impacts on the Missouri River. Impact analyses do not indicate that there would be a potential impact on the Missouri River as a result of the Project. The EIS does not evaluate the combined impact of the Project potentially contaminating the already-contaminated Livingston rail State Superfund site as the shipping containers would be sealed and thus would be unexpected to contribute to existing contamination.

1.6.3.4. Financial Assurance

The EIS does not disclose reclamation bonding costs and calculations of the reclamation and closure bond; DEQ calculates a reclamation bond only after issuing a Record of Decision approving an application for an operating permit or exploration license.

1.6.3.5. General Topics

The EIS does not evaluate the impacts on and response to unforeseen events. It is not necessary for the EIS to evaluate speculative events or unlikely failures. The EIS does disclose the most likely outcomes, which are based on actual designs and processes supported by engineering.

1.6.3.6. Project Description

The EIS does not address the potential for mine expansion or assume that open-pit mining techniques would be used, as neither of those options is currently proposed, nor do they meet the purpose and need of the Project.

1.6.3.7. Prime or Unique Farmlands

No prime or unique farmlands would be affected by any of the alternatives, and so they are not considered in this EIS.

1.6.3.8. Water Resources

This EIS does not evaluate algal blooms[1] on the Smith River. Impacts on surface water quantity or quality in Sheep Creek are expected to be minor and, therefore, potential impacts on water quantity or quality in the Smith River would be insignificant. Chapter 3 discusses potential impacts to the Smith River.

1.6.3.9. Water Rights

The consumptive use of water by the Project would be offset by the water rights acquired under lease agreements with landowners. The Proponent's water rights mitigation plan would be designed to offset all of the stream depletion in Sheep Creek and Coon Creek. See Section 3.5, Surface Water Hydrology, for more information on potential stream depletion amounts. This EIS does not evaluate impacts on existing water rights.

[1] A sudden eruption of algae or cyanobacteria growth in water, which usually results from an excess of certain nutrients (e.g., nitrogen, phosphorous).

1.6.3.10. Wild and Scenic Rivers

No Wild and Scenic Rivers would be affected by any of the alternatives. There are two river systems that are classified as Wild and Scenic in Montana. The Upper Missouri National Wild and Scenic River section starts at Fort Benton, Montana, approximately 75 miles northeast of the Project area. The North Fork, Middle Fork, and South Fork of the Flathead River are designated, and the closest reach (i.e., South Fork) is located approximately 120 miles northwest of the Project area.

1.6.3.11. Wilderness

No wilderness, wilderness study, or inventoried road-less areas would be affected by any of the alternatives. The Bob Marshall and Scapegoat wilderness areas are closest to the Project area, and are approximately 80 miles northwest.

1.6.3.12. Human Health and Safety

The Proponent is regulated by the Mine Safety and Health Administration. This issue has not been carried forward in the analysis as it is outside the scope of this EIS.

1.6.3.13. Recreation

Comments were received on the potential secondary impacts to regional recreational activities due to a change in the public perception of the area with the addition of the proposed mine. Interest in floating the Smith River has steadily increased over the past 10 years, with nearly double the amount of people applying for permits than permits were issued in 2017. Given this history, it is unlikely that the construction and operations of the Project would cause there to be fewer people applying for float permits than permits that are available in a given year.

2. DESCRIPTION OF ALTERNATIVES

The purpose of this EIS is to analyze the potential environmental impacts of the Proposed Action and the No Action Alternative, as well as the potential environmental impacts of reasonable alternatives to the Proposed Action, so that DEQ can make an informed permitting decision. This chapter describes the No Action Alternative and the Proposed Action. In addition, this chapter describes the process of identifying and screening ideas that could potentially be incorporated into an alternative. This screening process resulted in development of the Agency Modified Alternative (AMA). Finally, this chapter describes other alternatives that were identified in the screening process that were considered, but not carried forward for detailed analysis.

2.1. NO ACTION ALTERNATIVE

The No Action Alternative is the baseline upon which potential impacts can be measured due to the Project. Under the No Action Alternative, DEQ would not approve the Proponent's application for an operating permit under MMRA, an MPDES Permit, or Air Quality Permit. The Proponent would not be able to construct and operate the proposed mine. Land within the Project area would remain largely as it is today (see Affected Environment sections of Chapter 3) with the potential exception of current and additional exploration activity.

2.2. PROPOSED ACTION

The following documents collectively provide the basis for the Proposed Action:

- MOP Application, Revision 3 (Tintina 2017), dated July 14, 2017, and appendices (management plans);
- MOP Application Update (Tintina 2018b), dated October 26, 2018;
- Memorandum: Update to Proposed Rail Load Out Facilities for Shipment of Containerized Copper Concentrates, from DEQ to Tintina, dated January 30, 2018 (DEQ 2018b);
- Memorandum: Update to Proposed Treated Water Disposition, from Tintina to DEQ, dated January 11, 2018 (Tintina 2018c);
- DEQ responses to MOP Application comments:
  - MOP Application, Revision 3 (Tintina 2017), Section 9, Responses to Comments; and
  - MOP Application Comments and Responses (DEQ 2018c).
- Integrated Discharge Permit Application Narrative (Hydrometrics, Inc. 2018b), revised February 15, 2018;
- Addendum to Integrated Discharge Permit Application for the Black Butte Copper Project, dated October 29, 2018 (Zieg 2018); and
- Black Butte Copper Mine Traffic Impact Study (Abelin Traffic Services 2018), dated April 2018.

2.2.1. Proposed Action Overview

The Proponent's purpose for the Project is to mine the Johnny Lee Deposit by underground mining methods, to process the copper-enriched rock on site into a salable copper concentrate, and to ship the concentrate to a load out facility from where it would be shipped to a purchaser.

The Proponent intends to construct, operate, and reclaim a new underground copper mine over 19 years, followed by monitoring and closure of the site. There is no history of industrial development on the site. The site is located about 15 miles north of White Sulphur Springs in Meagher County, Montana. The Project area is in Sections 24, 25, and 36 in Township 12N, Range 6E, and in Sections 19, 29, 30, 31, and 32 in Township 12N, Range 7E. All operations would occur within a permit boundary encompassing approximately 1,888 acres of privately owned ranch land under lease to the Proponent (see **Figure 2.2-1**). Surface disturbances would occur on private land and total approximately 310.9 acres (see **Table 2.2-1**).

The Project would mine approximately 15.3 million tons of copper-enriched rock and waste rock from the Johnny Lee Deposit. This includes 14.5 million tons of copper-enriched rock with an average grade of 3.04 percent copper and 0.8 million tons of waste rock. Mineralization in this ore body consists of an upper copper zone and lower copper zone. The upper copper zone lies at a depth of approximately 90 to 625 feet below ground surface (bgs), and the lower copper zone is at a depth of approximately 985 to 1,640 feet bgs. The Proponent would employ approximately 240 workers, with an additional 24 contract miners and 130 associated support workers working at the site during the first 4 years of mining. Construction of mine facility and surface support structures during the initial 30 to 36 months would require a maximum of approximately 173 sub-contracted employees.

The Proponent plans to access the deposit through a single 17-foot wide by 17-foot tall mine portal at the surface. A decline ramp would provide access for all personnel, mine equipment, and materials to the underground working areas. Approximately 18,800 feet of access ramp and level access drifts would be developed beyond the surface portal for mining. Four ventilation raises constructed to surface would also be collared above the regional groundwater table. One of these ventilation raises would be constructed as a secondary emergency escape way.

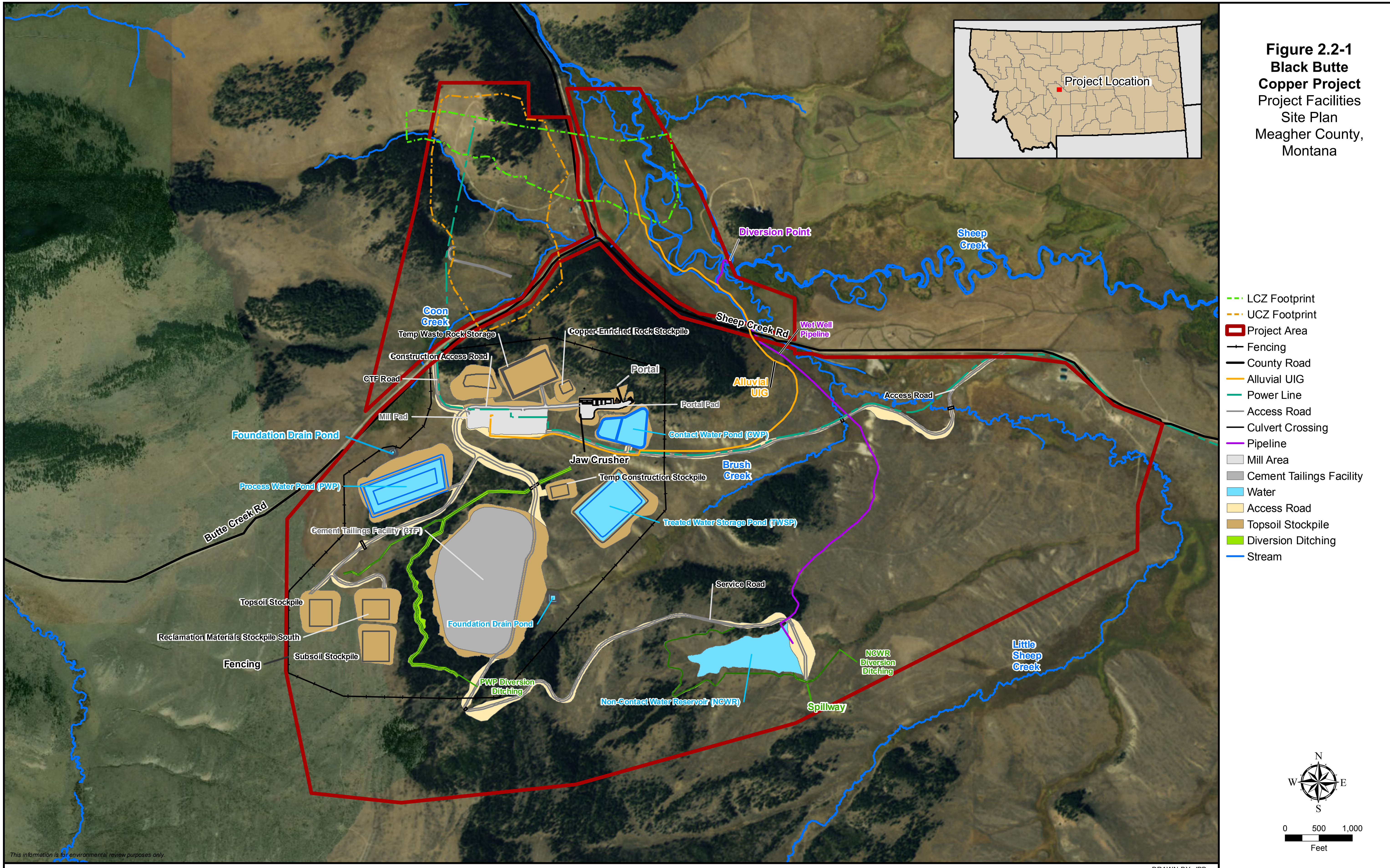


Figure 2.2-1
Black Butte Copper Project
Project Facilities Site Plan
Meagher County, Montana

Table 2.2-1
Surface Disturbances in the Project Area

Facility or Activity	Linear Feature (lineal feet)	Construction Disturbance Width (feet)	Surface Disturbance (acres)
		New Access Roads Sub-total	**57.7**
Main Access Road to Mill Site	7,973	84	15.4
Contractor Access Road Butte Creek Road to CTF Road	1,178	98	3.5
CTF Road – Portal to CTF	4,223	164	11.8
Powerline Corridor Parallel to Main Access Road (overlap with main access road removed)	7,256	20	4.5
Truck Road to WRS Pad	305	98	0.7
Service Road – Truck Road to Soil Stockpiles (Includes Road to PWP)	4,490	98	7.7
Service Road – Main Access to CWP	Already disturbed		
Service Road – CTF to NCWR	6,594	98	13.4
Ventilation Raises New Access Roads	1.081	49	0.7
		Direct Underground Mine Support Sub-total	**7.9**
Portal Pad, Including Support Facilities	984	410	6.9
Ventilation Raise Collar Areas (4) (100 x 100’, 0.3 acres each) 6-foot Chain Link Fence	100	100 (x4)	0.9
Pumping Lines to Portal to PWP	992 undisturbed	5	0.1
Pumping Lines to Portal to WTP	2300	5	Already disturbed
		Temporary Waste Rock Storage (WRS) Sub-total	**12.1**
Temporary WRS	820	591	10.2
Copper-enriched Rock Storage Pad	295	295	1.9
Drainage Piping WRS to CWP	550	20	Already disturbed
		Contact Water Pond (CWP) Sub-total	**9.0**
CWP	656	656	8.9
CWP Pump-back Piping to WTP	2,328	5	Already disturbed
CWP Pump-back Piping to PWP	989 undisturbed	5	0.1
CWP 8-foot Wildlife Fence	2600	5	included
		Mill/Plant Site Sub-total	**9.8**
Plant Site (includes Mill, Laydown Area, Substation, Truck/Shop/Admin, Paste Backfill Plant, and Water Treatment Facilities, etc.)	1,312	492	9.8
Primary Crusher and Conveyor	NA	NA	included

Facility or Activity	Linear Feature (lineal feet)	Construction Disturbance Width (feet)	Surface Disturbance (acres)
Process Water Pond (PWP) Sub-total			**28.7**
PWP	NA	NA	23.9
PWP Foundation Drain Pond	NA	NA	0.4
Pump Back Piping to PWP[1]	50	20	0.0
PWP Diversion Channel	NA	NA	3.7
Piping PWP to Mill	1,548	20	0.7
PWP 8-foot Wildlife Fence	NA	NA	included
Cemented Tailings Facility (CTF) Sub-total			**82.5**
CTF	NA	NA	71.9
CTF Foundation Drain Pond	NA	NA	0.7
CTF Foundation Drain Pond to WTP [a]	420 2,350	20 20	0.2 already disturbed
CTF Pump-back Piping to PWP [a]	2,628	20	1.2
Tailings Pumping Supply Mill to CTF	4,423	20	2.0
CTF Diversion Channel	1,002	20	6.5
CTF 8-foot Wildlife Fence	NA	NA	included
Non-Contact Water Reservoir (NCWR) Sub-total			**7.6**
NCWR	NA	NA	4.7
NCWR Diversion Channel	1,252	NA	2.1
NCWR Spillway Channel	286	NA	0.5
NCWP Piping to Spillway Channel	738	20	0.3
Wet Well and Pipeline Sub-total			**2.4**
Wet Well	NA	NA	<0.1
Discharge Pipeline within UIG Pipeline Excavation	1,970	20	Already disturbed
Discharge Pipeline	5,181	20	2.4
8-foot Wildlife Fence	NA	NA	included
Treated Water Storage Pond (TWSP) Sub-total			**20.2**
TWSP	NA	NA	19.6
TWSP Foundation Drain Infiltration Pond	NA	NA	0.1
TWSP Pump Back to Piping to WTP (undisturbed)	1,232	5	0.5
TWSP 8-foot Wildlife Fence	3,879	5	included
Water Supply Sub-total			**6.3**
Public Water Supply Well and Pipeline (100 x 100' Pad, 0.3 Acres Includes Water Tank)	NA	NA	0.3
Pipeline Well to WTP	5,913	20	2.7

Facility or Activity	Linear Feature (lineal feet)	Construction Disturbance Width (feet)	Surface Disturbance (acres)
Powerline Well PW-6 to substation	Same as above	NA	2.7
Water Tanks (Mill) Distribution Lines	1,320	20	0.6
Underground Infiltration Gallery (UIG) Sub-total			**5.4**
UIG to Sheep Creek Alluvium	NA	NA	5.4
Stockpiles Sub-total			**32.4**
Top Soil	492	525	8.0
Subsoil	1,083	558	7.0
Excess Reclamation Stockpile (North)	623	492	7.10
Excess Reclamation Stockpile (South)	NA	NA	7.5
Temporary Construction Stockpile	NA	NA	2.8
Other/ Miscellaneous Sub-total			**0.6**
Septic System	NA	NA	0.2
Temp. Powder Magazine	NA	NA	0.4
8-foot Chain Link Fence	NA	NA	included
Barbed Wire Fencing of Active Mine	NA	NA	included
New Monitor well and Piezometer Sites	NA	NA	included
Subtotal			**282.6**
Construction Buffer Zone/Miscellaneous [b] (10% of subtotal, and includes a 25-foot perimeter around all facilities)			28.3
Disturbance Acres Total			**310.9**

Source: Modified from Tintina 2017; Tintina 2018b

CTF = Cemented Tailings Facility; CWP = Contact Water Pond; NA = not applicable; NCWR = Non-Contact Water Reservoir; PWP = Process Water Pond; TWSP = Treated Water Storage Pond; UIG = Underground Infiltration Gallery; WRS = Waste Rock Storage; WTP = Water Treatment Plant
Notes:
[a] Much of this pipeline is constructed on ground disturbed by a facility; the amount shown is additional disturbance.
[b] Examples include chain link and barbed wire fences, monitor wells and piezometer locations, storm water ponds, storm water ditches outside of disturbed areas, rock roll and erosion control berms.

2.2.2. Construction (Mine Years 0–2)

Early Project activities would include the clearing of vegetation to allow for the construction of Project surface facilities and infrastructure. Pre-construction treatments may include mechanical means (e.g., mowing, brush clearing, tree harvesting). Noxious weeds would be controlled prior to soil stripping and soil redistribution to the extent feasible and herbicide application may be used, depending on the vegetation species present and size of the population. The total area of surface disturbance required for construction would be approximately 310.9 acres. Once the ground surface has been properly prepared, construction would commence. The Project's major components would include a portal and portal pad, temporary initial mine support facilities on the portal pad, permanent underground mine workings and utilities, and an electrical substation. In addition, construction would include a processing plant (including a crusher, grinding mills, a flotation circuit, and tailings thickener), a paste tailings plant, a Water Treatment Plant (WTP), a concentrate storage facility, a truck shop, an office complex parking, and two construction materials laydown areas. Other surface facilities include a Process Water Pond (PWP), a Cemented Tailings Facility (CTF), a Contact Water Pond (CWP), a Treated Water Storage Pond (TWSP), Non-Contact Water Reservoir (NCWR), a wet well, buried pipelines, roads, a Waste Rock Storage (WRS) pad facility, an ore stockpile, three overburden stockpiles, powerline, ditches, and fencing. A temporary access road would also be built to aid in construction and be replaced by a more substantial road operationally. With the exception of the CTF and the mill that need to be completed prior to production in Mine Year 3 through 4, other facilities are expected to be largely completed during the initial 2-year construction period.

Approximately 315,238 cubic yards of topsoil and 248,454 cubic yards of subsoil would be stockpiled (Tintina 2018b). This organic loamy material would be removed from proposed disturbance areas prior to construction and would be stored in separate topsoil and subsoil stockpiles of 8 and 7 acres, respectively. The amount of subsoil removed would be limited to that required by excavations for the facilities. A separate northern 7.1-acre excess excavation (reclamation) material stockpile would also be constructed and be used in Mine Year 2 or 3 to reclaim the WRS pad facility after all waste rock has been relocated to the CTF. A southern (7.5 acre) excess excavation (reclamation) material stockpile would also be constructed to store excess material from major facility construction for use in final mine reclamation. In addition, a temporary construction material stockpile would be constructed to store processed (crushed and screened) material for specific uses in the construction of major facilities.

During the construction period, development mining would take place. Development mining consists of excavating the portal, declines, and access drifts in preparation for production mining of copper-enriched rock. During the initial years of mining, two 6,000-gallon water tanks would be constructed at the east end of the portal pad for supplying water required by underground mining. In the first 2 years of construction, underground development mining would produce approximately 453,642 tons of waste rock. This waste rock would be placed on a lined Waste Rock Storage (WRS) pad temporarily while the CTF embankments and liner system were constructed. During Year 3, this waste rock would be used to construct the interior (above the liners) basin drain system of the CTF. The maximum design capacity of the 12.1-acre temporary WRS pad is 551,155 tons.

The PWP would store water that is recycled for use in the operation of the mill to minimize consumptive use of water by the Project. The CTF would store a portion (about 55 percent) of the fine-grained rock material from the mill (tailings) once copper-enriched minerals have been extracted. The remainder of the tailings (45 percent) would be used operationally and in closure to backfill mine production workings. Both the PWP and CTF impoundments would be double-lined. Each of the two liner layers would be constructed of 0.1-inch High Density Polyethylene (HDPE) geomembrane with a 0.3-inch high flow geonet layer sandwiched between the geomembrane layers. Any seepage through the upper geomembrane layer into the geonet would be directed via gravity to a sump and pump reclaim system at a low point in the PWP or CTF basin, and would be pumped back into the PWP. In addition to the liner system, the CTF also has an internal (above the liners) basin drain system to remove any liquids present in the cemented tailings facility to the basin drain for treatment and/or disposal. Finally, the foundation drain system would collect groundwater flows below the PWP and CTF liner systems and convey them to a foundation drain collection pond downstream of the facilities. Water collected in these ponds would be pumped back to the PWP or directly to the WTP for treatment and disposal in the alluvial Underground Infiltration Gallery (UIG). The PWP is operationally designed to never be more than half full. The CTF is designed to have no surface water storage on the facility except following rainfall events. Both facilities are designed to contain the probable maximum flood event.

Early in the 2-year construction period, the lined CWP would be completed to capture surface water run-off from potentially contaminated constructed facility footprint materials (i.e., mill pad facility and haul roads) and facility seepage (i.e., waste rock and copper-enriched stockpile pads) prior to being pumped to the WTP for treatment and disposal. The CWP would also be used to store excess water from the underground mine prior to treatment and disposal, and initially (prior to completion of the PWP) for brines generated from the reverse osmosis (RO) WTP in a segmented brine cell within the CWP. The CWP is designed operationally to have a minimal amount of water stored on the facility.

Additionally, a TWSP would be constructed southeast of the WTP. It would store treated water from the WTP if effluent from the WTP does not meet seasonal effluent limits for total nitrogen (between July 1 to September 30) in the MPDES permit (Tintina 2018b). Treated water from the WTP would be pumped through a 6-inch diameter HDPE pipeline to the TWSP for storage during this time. The TWSP is designed to store up to 53.7 million gallons of treated water to provide enough temporary storage of treated water at an average flow rate of 405 gallons per minute (gpm). The pond would be lined with a 60-mil[1] HDPE geomembrane liner installed over a 12 ounces per square yard non-woven geotextile cushion.

The NCWR would also be constructed during the construction period and would be used to store surface water diverted from Sheep Creek during spring runoff, when flows are greater than 84 cubic feet per second, protecting the total existing appropriated water rights on Sheep Creek downstream of the diversion (Hydrometrics, Inc. 2018a; Tintina 2018b). According to the MOP Application (Tintina 2017), water stored in the NCWR could be used to augment flows to wetlands and mitigate potential indirect wetland impacts by discharging to the alluvial UIG, which would infiltrate to wetlands. NCWR water could also offset consumptive use of groundwater by the milling and mining operation (about 220 gallons per minute), as per Montana Department of Natural Resources and Conservation (DNRC) requirements (DNRC 2012).

The point of diversion would be a wet well that consists of an 8-foot concrete manhole, which is connected to Sheep Creek through a 22-inch HDPE intake pipe. The intake pipe would be extended approximately 6.5 feet into Sheep Creek and would be a solid pipe buried beneath the ground surface at an elevation equal to or slightly below the streambed elevation. When the flow in Sheep Creek exceeds 84 cfs, water would be pumped from the wet well, using a vertical turbine pump, through approximately 7,150 feet of 20-inch HDPE transfer pipeline to the

NCWR. The transfer pipeline would be placed on the ground surface along the access road within a hay meadow and would remain on the surface except where it crosses the Sheep Creek County Road 119. The pipeline would cross Brush Creek in an area with narrow wetland fringe areas and be suspended above the wetlands and stream channel.

Noise associated with construction activities could be reduced by implementing the noise mitigation measures described below to minimize disruption of humans and wildlife (Tintina 2017).

- On all diesel-powered construction equipment, replace standard back-up alarms with approved broadband alarms that limit the alarm noise to 5 to 10 A-weighted decibels (dBA) above the background noise.
- Install high-grade mufflers on all diesel-powered equipment.
- Reduce the noise of the underground haul trucks by enclosing the engine.
- Restrict the surface and outdoor construction and operation activities to daytime hours (7:00 a.m. to 7:00 p.m.).
- Combine noisy operations to occur for short durations concurrently.
- Turn idling equipment off.

2.2.3. Operations (Mine Years 3–15)

During the first 4 years of operations, ramps would be constructed down to the deposit and cross-cuts would be developed to access the mining stopes. This mine access construction would continue during the first year or two of operations. After approximately 2.5 years, the Proponent would progressively mine larger amounts of copper-enriched rock from the production drifts until reaching the average design production rate (3,640 tons per day). Within the mine, ground control stabilizing support would be installed in the tunnel backs and ribs, and electrical, water, compressed air, and ventilation utilities would be established. Grouting to stem the flow of water into the mining access drifts could be completed in major water bearing fractures or faults as they are encountered. The mining cycle would consist of advancing mine headings or tunnels by drilling face blast rounds, loading the rounds with explosives comprised of either emulsion or ammonium nitrate/fuel oil, using detonators to blast the rounds, mucking (removing broken material from the round), and then installing ground support so that the next cycle could continue. Production mining proposes to use the drift-and-fill mining method in actual mining stopes to extract copper-enriched rock. This method allows the entire deposit to be mined while incrementally backfilling the mined-out voids between stopes with fine-grained cemented tailings paste. This backfilling creates a safe underground working environment for the miners. This pattern of drifting and backfilling continues both laterally and vertically until the entire resource is mined out.

Pumps would remove groundwater via underground sumps to the surface and a portion would be used for makeup water in the mill process circuit and cemented tailings paste plant. The remaining portion of the underground sourced water would be treated with RO at the WTP prior to discharge to the alluvial UIG. During its life, the Project would mine a total of approximately 14.5 million tons of copper-enriched rock. The overall mine production rate would be approximately 1.3 million tons per year during the peak years of active mining. The design average production rate of 3,640 tons per day requires mining in approximately 18 active mining stopes. All copper-enriched rock mined would be hauled by articulated underground haul trucks either to the surface crusher supplying the mill or to the ore stockpile.

In the mill, crushed copper-enriched rock would travel to a surge bin through a series of three grinding mills (a semi-autogenous grinding mill, ball mill, and tower mill) in the processing plant that would progressively reduce the size of the rock. A dust control system would control fugitive dust emissions from the crushing operation. The finely crushed copper-enriched rock would then enter a flotation circuit where copper would be separated from non-copper bearing rock through chemical and physical processes. The flotation circuit also would include a concentrate re-grind mill. The resulting copper concentrate would then be thickened and pressed to remove water and shipped in sealed containers via truck off site to a railhead. About 440 tons of copper-rich concentrate would be produced daily and transported in closed shipping containers by, on average, 18 trucks per day. The closed shipping containers would minimize or avoid potential leakage or spillage during transport and eliminate dust potential and spills.

The road system that would be used to transport mine concentrates between the Project site and the Livingston and Townsend railheads includes portions of Sheep Creek Road, U.S. Route 89, U.S. Route 12, I-90, and local roads in Livingston and Townsend. Rail facilities used to haul mine concentrates include Montana Rail Link rail yards at Livingston and Townsend, Montana, Rail Link mainline tracks serving these railheads, and Burlington Northern Santa Fe Railroad mainline tracks in Montana. All onsite mine haul roads would require berms of one-half axle height or greater for the largest truck using the road as per Mine Safety and Health Administration safety requirements. Similar berms would be constructed along the main mine access road, if determined to be necessary by the Mine Safety and Health Administration.

Tailings, a fine-grained waste product from the mill, would total 12.9 million tons over the life of the Project. The tailings would be thickened and sent to a paste plant where cement, slag, and/or fly ash may be added to the tailings as a binder. The product, called cemented paste tailings, would be pumped in pipes either to the underground mine where it is used to backfill workings, or to a double-lined tailings basin called the CTF. The CTF was designed to hold 4.7 million cubic yards of cemented tailings, 703,606 cubic yards of waste rock, and 400,000 cubic yards of storm water from a probable maximum flood event. Approximately 55 percent of the cemented tailings paste produced by the Project would be stored in the CTF, with the remaining 45 percent used to backfill production workings during the sequential mining of drifts. As operations proceed, opportunities to increase the tailings used for underground mine backfill would be sought. For example, additional backfill could be placed in primary and secondary access drifts in the lower copper zone and the lower zone mine access ramps.

During operations, the PWP would also receive water from direct precipitation and runoff, the CTF, the WTP, and the mill. Water from the PWP would be sent either to the mill for reuse or to the WTP. The WTP would receive water from underground mine dewatering, the PWP, the

TWSP, and the CTF foundation drain. The WTP then delivers water to the mill, to an alluvial UIG, or to the freshwater tank. Any seepage from the temporary waste rock and mill feed storage pads, and contact water from the portal pad, mill facility, and onsite haul roads would travel by pipeline and lined ditch to the CWP for treatment and discharge (or alternatively used as make-up water in the mill). From October 1 to June 30, treated water stored in the TWSP would be pumped back to the WTP via a 6-inch diameter HDPE pipeline, where it would be mixed with other WTP effluent. The blended water would be sampled prior to being discharged per the MPDES permit. The TWSP would be operational prior to dewatering the mine workings.

The Proposed Action groundwater model predicts approximately a 70 percent reduction in stream base flow in lower Coon Creek. To augment this flow reduction, water from the NCWR could be routed to either a direct discharge to Coon Creek, or to the new alluvial UIG adjacent to Coon Creek. The discharged water would be required to meet non-degradation criteria per the Project MPDES permit. This augmentation would only be implemented when drawdown impacts are detected at the monitoring sites in the vicinity of Coon Creek. Water stored in the NCWR would also be used to offset potential hydrologic impacts to wetlands at the head of Brush Creek (Tintina 2017).

Waste rock, estimated to total 0.8 million tons, would be generated for the duration of construction and operations. Waste rock stored on the temporary WRS pad during construction would be transferred to the CTF upon completion of the CTF. All future waste rock would be placed directly into the CTF along with the mill tailings. The temporary WRS facility would be completely reclaimed in Mine Year 3. No mined waste rock would be left on the surface after closure. The CTF construction would use crushed and screened granodiorite and/or alternatively excavated Ynl Ex (near-surface Lower Newland shale) and a 12-ounce/square yard non-woven geotextile fabric as a protective layer under its double HDPE liners. Alternatively, development mining waste rock may be used as bedding material on top of the liner package internally in the CTF for the basal layer in the basin drain system.

Operational monitoring would be conducted. Groundwater monitoring wells would be installed downgradient from water-bearing facilities to allow quarterly sampling of water quality. The results of the sampling would be used to confirm that impacts to groundwater are not occurring.

Water encountered in the underground workings would be pumped to underground settling ponds, and then to the CWP or WTP. If monitoring identifies the need, hydrocarbon booms or oil skimming methodologies would be used to remove any hydrocarbon contamination from the underground settling ponds (Tintina 2017).

Wetlands would also be monitored in the Project area and at reference wetlands outside of the Project area to compare changes to water levels or vegetation. Air emissions would be monitored for fugitive dust to comply with the Montana Air Quality Permit (MAQP). Noise levels would be monitored during construction and operations, and could be reduced by implementing the noise mitigation measures described in Section 3.11 to minimize disruption of humans and wildlife. Additionally, reclamation monitoring would occur to compare the stability and utility of reclaimed areas to pre-mining conditions. For example, management of noxious weeds would occur if one or more of the following three criteria are met: (1) a new noxious weed population is confined to the Project area; (2) a noxious weed population is expanding because of Project activities; and/or (3) a noxious weed population is impeding revegetation establishment. Refer to the MOP Application (Tintina 2017) for additional information about these operational monitoring procedures.

2.2.4. Water Treatment Plant

A WTP would be used during construction, operations, and closure. Each phase would have different design flows and raw water quality. The treatment processes would include an oil and grease skimmer, clarifier, filtration, and RO system to remove contaminants. The concentrated RO reject (i.e., water that does not pass through RO membranes for treatment; also called brine) would be stored in the CWP brine cell during construction. During operations, brine would be stored in the PWP and used in the tailings thickener and/or hauled off site. Liquid and solid treatment residuals (i.e., materials or constituents that are filtered out by the RO membranes) would be disposed onsite using the PWP and CTF, respectively.

The RO permeate (i.e., water that passes through RO membranes or filters for treatment) that meets discharge requirements would be discharged to an alluvial UIG system or reused. The UIG would be functional at the onset of mine development and before the dewatering of mine workings begins. The shallow groundwater alluvial UIG (5.4-acre surface disturbance) would be located adjacent to Sheep Creek and receive an average of approximately 398 gallons per minute of treated water from the WTP if the treated water meets the total nitrogen effluent limit as described in the Integrated Discharge Permit Application Narrative (Hydrometrics, Inc. 2018b). However, if the total nitrogen concentration is greater than the effluent limit, the treated water would be discharged to the TWSP from July 1 to September 30. Starting October 1, the stored water would be routed back to the WTP and blended with the WTP effluent prior to discharge to the alluvial UIG, with an average discharge of 530 gallons per minute (Tintina 2018b). The depth to the groundwater table in the UIG area once the mine has been developed would be approximately 8 to 13 feet. The UIG would be located outside of all wetland areas, and its length would be oriented perpendicular to the groundwater flow direction.

2.2.5. Roads

An approximately 8,000-foot-long, two-lane gravel road (15.4-acre surface disturbance) would provide vehicle access from the county road to and from the mine site. This access road would have storm water drainage controls, culverts, sediment control basins, and potentially berms. A CTF road (11.8-acre surface disturbance) would run from the portal pad north of the mill pad and then southeast to the CTF. There would be short branch roads from the CTF to the temporary WRS and ore stockpile. The CTF road and these later two roads would be considered haul roads for ore from the copper-enriched rock storage stockpile and mine wastes back to the CTF and would have storm water collected from the road and piped to the CWP for treatment and discharge. Service roads would allow access to the PWP, NCWR, CWP, and topsoil and subsoil storage areas. Roads would have water drainage conveyances and controls. All roads were engineered to reduce the horizontal distances between individual facilities. This reduces the disturbance footprint, the length of haul roads, and the length of pipelines between facility sites.

New road construction would disturb approximately 57.7 acres within the Project area (see **Table 2.2-1**).

2.2.6. Pipelines and Ditches

The Project would include several pipelines. An 18-inch HDPE pipeline would convey the flows from the PWP to the mill reclaim tank. Contact water would be delivered to the CWP during operations via a rock-lined drainage channel underlain with a 0.03-inch HDPE liner or in HDPE pipelines. The Project also includes a brine pipeline to the PWP and to the CWP brine section, a pipeline to the WTP, pipelines to convey seepage from the foundation drain beneath the CTF to the foundation drain collection pond, and drainage piping from the WRS to the CWP. The CWP would have pipes to convey water to the WTP and PWP. The WTP would have a 6-inch HDPE pipeline to convey water to and from the TWSP (Tintina 2018b). Additionally, a 22-inch HDPE intake pipeline would extend into Sheep Creek to convey water to an adjacent wet well, which would ultimately convey water to the NCWR via a 20-inch HDPE transfer pipeline (Hydrometrics, Inc. 2018a; Tintina 2018b).

During construction, it is anticipated that a contractor would be responsible for foundation preparation, basin shaping, liner bedding placement, geomembrane installation, and the installation of instrumentation, sumps, pumps, and pipelines. Prepared materials used for drainage gravel in the construction of the CTF and PWP drainage sumps, foundation drains, and sub-grade bedding material used above and below HDPE liners for all facilities would be sourced from suitable non-acid generating rock material present in a minable configuration in the CTF and PWP excavation footprints.

Ditches and best management practices (BMPs) would be used to manage non-contact storm water on site and convey it to a discharge location. BMPs may include revegetation, mulching, rolled organic matter, silt fencing, and sediment basins, among other options. These measures would be used during both construction and operations, and as necessary during reclamation and closure.

2.2.7. Power and Miscellaneous Facilities

It is estimated that 9 to 12 megawatts of electricity would be necessary to power the mine. This would be delivered by overhead powerlines and connected through an onsite substation during operations. However, two diesel EPA Tier 3 certified and compliant generator sets (545 kilowatts and 320 kilowatts) would provide power to the portal pad in support of underground development mining prior to the substation coming online. The 9 to 12 megawatts power requirement would necessitate upgrading the existing powerlines and the construction of a new powerline to the mine site. The primary source of electricity to the site during operations would be by outside feed provided by either Fergus Electric Cooperative or NorthWestern Energy using above ground, overhead powerlines. The most critical power loads are required for fire/equipment and pumps, thickener rakes, reagent agitators/pumps, emergency lighting, ventilation exhaust fans, and electrical heaters. Other (320 to 1,800 kilowatts) trailer-mounted mobile generators would be used around the mine site to support specific construction projects.

Operationally, backup emergency power would be provided by two, 1-megawatt diesel generators.

Other Project-related facilities include a truck shop and administration building; fuel storage and fueling area; lube and oil storage and dispensing; construction laydown areas and container storage; supply tanks for process, fresh, and potable water; and parking.

2.2.8. Reclamation and Closure (Mine Years 16–19)

The purpose of the closure and reclamation plan for the Project is to:

- Reclaim disturbances to the approved post-mine land use;
- Assure the physical and chemical stability of all facilities; and
- Maintain water quality and quantity.

No mined waste rock would be left on the surface in closure. Closure and reclamation would focus on removal of surface infrastructure and exposed liner systems, and covering exposed tailings. The reclamation plan requires removal of all buildings and their foundations and surface facilities including the portal pad, copper-enriched rock stockpile pad, PWP, CWP, plant site, and NCWR. The reclamation plan also requires re-contouring the landscape, subsoil and soil replacement, and revegetating all the sites with an approved seed mix. The revegetation would also work toward the stabilization of disturbed areas using erosion and sediment control BMPs as well as achieving measures to prevent air and water pollution. Downstream silt fences would be installed if necessary to prevent the release of sediment outside of permitted soil storage areas. In tandem with revegetation, noxious weed control would also be a component of the closure process. Any reestablished vegetative cover, if appropriate, would meet county standards for noxious weed control in accordance with § 82-4-336(8), MCA.

Mine closure and reclamation would remove, treat, and dispose of all water from the CTF (if any is present), the PWP, and the CWP until the facilities are empty and could be reclaimed. The CTF would be capped with a 0.1-inch HDPE geomembrane, which would then be covered with a minimum of 5.2 feet of non-reactive fill material. The fill material would consist of 2 feet of crushed and screened granodiorite at the base overlying the HDPE membrane, and the upper layer would include rock fill (from excess reclamation materials stockpiles), 20.5 inches of subsoil, and 7 inches of topsoil). Grading of the cap system would create a self-draining topographic surface for closure. Water produced from the CTF internal basin drain system in closure (if any) would go directly to the WTP. This would continue into closure while water quality and water levels are monitored, with gradually decreased monitoring until sufficient data are available to support a conclusion that final closure objectives have been met. Water may continue to flow from the CTF foundation drain system in closure, but require no treatment if all discharge criteria are met. The PWP and PWP foundation drain pond would be dewatered and the liners would be buried by an estimated 9,888,107 cubic feet of embankment fill (an approximate depth of 30 feet above the liners). After water monitoring concludes that final closure objectives have been met, the CWP would be closed by treating all remaining water stored and then discharging it to the alluvial UIG. The remaining brine (in the brine cell) would be hauled offsite for disposal. The liners would then be removed and hauled offsite for disposal or recycling, and the embankment material would be regraded and reclaimed.

The TWSP would remain operational during closure until the discharge to the UIG is discontinued (Tintina 2018b). Once storage of treated water is not necessary, the TWSP liner would be removed and hauled offsite for disposal or recycling. Embankment material would be used to re-shape and reclaim the TWSP disturbance footprint. The footprint would be ripped to relieve compaction, the site would be regraded, soil would be placed, and the site would then be seeded.

Mine closure would include the backfilling of some primary and secondary access drifts with fine-grained, low permeability, cemented paste tailings. Vent raises are proposed to be closed with continuous backfill with non-acid generating excess construction materials from bottom to top, and closure includes a hydraulic plug above the upper sulfide ore zone (separating it from the shallow groundwater aquifer, Ynl A) and one near the surface at the top of the regional water table. The decline access ramp and some primary and secondary mining stope access drifts would not be backfilled.

Mine workings would be sequentially flooded by segments based on sulfide content at closure with groundwater. Prior to final flooding a particular segment of the mine, the walls of the workings within that zone would initially be flooded and rinsed with RO treated water to remove sulfide oxidation by-products from the mine walls. Rinse water would be collected, pumped, and treated as necessary. The zone would then be flooded with groundwater and a hydraulic barrier would be installed at the top of the segment. In all, 14 hydraulic barriers—both plugs and walls, which are masses of concrete installed in the adit with adjacent grouting of the bedrock formation—would be installed. Five of the hydraulic barriers would be installed in the main access ramps, eight in the four ventilation raises (an upper and lower barrier in each raise), and one plug at the mine portal. The primary purposes of installing the hydraulic barriers would be to segment the mine workings based upon sulfide content to facilitate rinsing, minimize flow past the plug and between stratigraphic units, and improve water management and quality in closure. If post-closure groundwater quality monitoring indicates potential contamination or water quality degradation above groundwater nondegradation criteria, additional monitoring wells could be installed to determine the full extent of the impact and contingency pumping wells would capture the impacted water. The Proponent would continue to treat water until groundwater nondegradation criteria are attained.

The NCWR would be used for mitigation of depletion in surface waters for approximately 20 years after the end of mine dewatering (Hydrometrics, Inc. 2018a). Once it is further unnecessary, the wet well, intake pipeline into Sheep Creek, and transfer pipeline to the NCWR would be removed and reclaimed.

Closure objectives would be expected to be attained by water treatment within approximately 1 year after mining and milling is completed and facility closure activities have been sufficiently implemented. Monitoring would continue after closure to ensure no unforeseen impacts were occurring. Monitoring would continue until DEQ determines that the frequency and number of sampling sites for each resource could be reduced or that the closure objectives have been met and monitoring could be eliminated.

2.3. Agency Modified Alternative: Additional Backfill of Mine Workings

This section describes the Project modifications to be incorporated into the AMA. The potential environmental impacts of the AMA are evaluated for each resource in Chapter 3.

The AMA proposes to backfill additional mine voids as part of mine closure, as compared to the Proposed Action. The AMA proposes to backfill certain voids (i.e., access openings) with a low hydraulic conductivity material consisting of cemented paste tailings generated from mill processing of the stockpiled ore and/or waste rock at the end of operations.

Cemented paste tailings would only be used to backfill certain mineralized mine voids to avoid the potential of degrading groundwater quality in non-mineralized geologic units (DEQ 2018a). The upper section of the access decline (within the Ynl A geologic unit) and a lower section of the access tunnel (within the Ynl B geologic unit) would not be backfilled because these units are non-mineralized, and they have better baseline groundwater quality than the Upper Sulfide Zone (USZ) and the Lower Sulfide Zone (LSZ). All mine voids located within the USZ and the LSZ would be backfilled with cemented paste tailings. Hydraulic plugs would be used to separate the backfilled and open areas of the access decline. This proposed configuration of backfilling is aimed at more effectively separating rock zones that are: (1) mineralized vs. non-mineralized, and (2) more permeable vs. less permeable.

Approximately 106,971 cubic yards of cemented tailings would be needed to backfill the access tunnels and ventilation raises (Tintina 2018a). The backfill material would be mixed with cement in a manner that achieves a similar low hydraulic conductivity as is proposed for backfilling of the mined stope areas. Since this volume of stockpiled ore source would exceed the proposed volume of the Copper-Enriched Rock Stockpile, this Project modification would also need to utilize the temporary WRS pad until the end of operations and backfilling of interior mine surfaces. The backfilling schedule would be coordinated with activities elsewhere in the mine, so as not to interfere with necessary access, ventilation, and safety for other operations.

To implement this Project modification, a revised mine schedule may be necessary to more efficiently backfill the lowest mine workings during concurrent mining operations, followed by upper mine workings, and lastly certain access tunnels and ventilation shafts at closure.

2.4. Alternatives Considered but Dismissed from Detailed Analysis

An additional 12 scoping alternatives were considered for detailed analysis. The 12 scoping alternatives and the rationale for dismissing the alternatives from detailed analysis are presented in the following sections.

2.4.1.1. Alternative Tailings Impoundment Locations

Scoping Alternative: Review alternative tailings impoundment locations (CTF sites) that could reduce potential acid rock drainage (ARD) and water quality impacts.

This alternative was proposed during public scoping and by DEQ. The scoping alternative meets the Project purpose and need, and is potentially technically and economically feasible.

The 2017 MOP Application (Appendix Q, Tailings Management Alternatives Evaluation) and Technical Memorandum 2 (Appendix B of this EIS) analyzed four potential locations for the CTF and concluded that the Proposed Action site (Tintina 2017) would result in the least environmental impacts. For example, the alternative Central, West, and East Impoundments were found to impact larger acreages of catchment areas, wetlands, and drainages when compared to the proposed CTF facility location. Based on the analysis set forth in Technical Memorandum 2, alternative locations for the tailings impoundment were not carried forward for detailed analysis.

2.4.1.2. Source Copper from Another Ore Body

Scoping Alternative: Source copper from another ore body or mine to avoid all impacts at the proposed mine location.

The alternative was proposed during the public scoping process. It does not meet the purpose and need for this environmental review, which is for DEQ to take action on the Proponents' application for an operating permit to authorize underground mining of the Johnny Lee Deposit, found in the location described in Section 2.2.1. Furthermore, as defined by MEPA in Section 75-1-220(1), MCA, "alternatives analysis" means "an evaluation of different parameters, mitigation measures, or control measures that would accomplish the same objectives as those included in the proposed action by the applicant . . . it does not include an alternative to the proposed project itself." Thus, the environmental consequences of sourcing copper from another ore body or mine was not reviewed, as this scoping alternative does not meet the purpose and need of the environmental review and is not properly part of the alternatives analysis to be conducted under MEPA.

2.4.1.3. Retain Process Water in Tanks

Scoping Alternative: Retention of process water in tanks rather than lined ponds to reduce the potential for impacted water to seep into groundwater. This alternative was proposed during public scoping.

It is estimated that the Project would require the capacity to store approximately 135 million gallons of impacted water. This includes approximately 111 million gallons of impacted water that would be stored in the PWP under the Proposed Action and 24 million gallons of impacted water that would be stored in the CWP under the Proposed Action. Water that would be stored in the TWSP under the Proposed Action was not included in this analysis as it is a contingency system designed to contain treated water that does not meet discharge standards for nitrogen in the summer months (Zieg 2018).

If the Project used 1-million-gallon tanks (i.e., approximately 51 feet long, wide, and high), which would have to be constructed on site, 135 tanks would be required to contain the impacted water. Surface disturbance for the PWP and CWP are estimated at approximately 29 and 9 acres, respectively, for a total of 38 acres of disturbance. Surface disturbance for 135 1-million-gallon tanks may be less than 38 acres. However, the surface disturbance would depend on the final design of the tank farm to accommodate piping, secondary containment, and space for travel and maintenance around the tanks. Construction and disposal of 135 1-million-gallon tanks would also likely produce additional traffic impacts outside of the Project area.

Managing potential seepage of impacted water from storage ponds by the use of an engineered seepage collection system is a common best practice throughout the mining industry. The PWP and the CWP would have multiple liners and leak detection systems between the liners. The proposed liners and leak detection systems are expected to adequately prevent the seepage of impacted water into groundwater. The PWP and the brine cell of the CWP would both be constructed using two 100-mil HDPE geomembranes separated by a geonet layer that would be instrumented to detect seepage through the upper liner and a sump pump system designed to extract this seepage. In the event of leakage through the lower liner, PWP design and construction would also include a foundation drain system that would intercept groundwater and/or seepage beneath the double liner system and route it to a collection sump from which it could be pumped back to containment.

The CWP is designed to retain runoff from the portal and mill site as well as water pumped from underground mine development. This water would be treated via RO and discharged in accordance with the MPDES permit. Brine produced as a byproduct of RO treatment would be retained in a separate brine cell of the CWP. The CWP would normally store only a minimal volume of water during mine operations. Once the PWP has been constructed (i.e., prior to start-up of mining and milling operations), brine that had been stored in the CWP brine cell would be transferred to the PWP.

Storing process water in tanks is not common practice in mining due to several factors. Tanks do not provide a greater level of protection to groundwater, in part, due to increased potential risks associated with failing valves, piping, and secondary containment. The tank farm would require extensive piping systems, increasing potential leak locations.

There is a concern that birds and other wildlife may come into contact with impacted water stored in ponds. Under the Proposed Action, the PWP and CWP would be within the fenced facility area, eliminating the possibility for wildlife to come in contact with the impacted water. Geochemical modeling indicated that the quality of water stored in the CWP and PWP would not present a hazard to terrestrial wildlife or to waterfowl that may land on these ponds. The brine cell would contain concentrated waste water, and is proposed to be covered with bird netting to prevent waterfowl from landing on the pond.

A tank farm would cause a significant increase in visual impacts relative to the proposed PWP and CWP.

For these reasons, storing impacted water in tanks was not considered to have significant environmental benefit as compared to the Proposed Action (storing process water in ponds). Therefore, an alternative requiring storage of impacted water in tanks was not carried forward for detailed analysis.

2.4.1.4. Alternative Truck Transportation Routes to Rail Load Out Site

Scoping Alternative: Evaluate alternative truck transportation routes to rail load out sites to further reduce potential environmental and safety risks along the proposed route.

Initially, the Proponent proposed five options for offsite copper concentrate load out facilities (i.e., rail load out sites) in Livingston, Townsend, Harlowton, Raynesford, and Belt. Section 1 of the MOP Application states that, “The company’s final decision will be based on economic considerations at the time of shipping.” In January 2018, the Proponent modified the MOP Application (which was accepted by DEQ) to reduce the proposed rail load out locations to two: Townsend and Livingston (DEQ 2018b). The routes to these two proposed rail load out locations are the most direct routes. Any other routes would be significantly longer.

The next shortest route from the mine to Townsend is to travel north on Highway 89, over King’s Hill, then west on Highway 3 through the city of Great Falls, then south on Interstate 15 adjacent to the Missouri River, through Wolf Creek Canyon, through Helena, then south on Highway 287 to Townsend. The next shortest route from the mine to Livingston (without going through Townsend) is to travel to just northeast of White Sulphur Springs, east on Highway 12 to Harlowton, south on Highway 191, cross the Yellowstone River at Big Timber, then west on Interstate 90 along the Yellowstone River to Livingston.

Further, a traffic study (Abelin Traffic Services 2018) was completed to assess the traffic and safety along the two routes to the proposed load out locations: Highway 89 to east of Livingston and Highways 89 and 12 to Townsend, and local roads within Townsend. Local roads in Livingston were not evaluated, as the exact rail load out location had not yet been determined. During operations, there would be 18 truck round trips (36 one-way trips) per day to rail load out sites in Livingston and/or Townsend. For these highway segments evaluated, the traffic study concluded that Project impacts on traffic congestion and safety were comparable on the highways between the two proposed load out locations and that actual Project-related traffic volume increases would be small compared to the capacity of the roadways. The environmental consequences of the Project on transportation routes are presented in this EIS in Section 3.12, Transportation. Alternative truck transportation routes to rail load out sites would not offer an environmental benefit because they would be longer, and could potentially increase environmental and safety risks versus the two proposed routes.

2.4.1.5. Use Wetlands as Part of the Water Treatment System

Scoping Alternative: Use a passive wetland treatment system to reduce the dependency on active water treatment methods if long-term water treatment would be required.

This alternative was proposed during public scoping. A public comment questioned whether the wastewater treatment plant could be maintained in "operating order" and suggested passive wetland treatment as a potential long-term solution.

While there is no basis for the concern that an active treatment plant cannot be maintained for as long as it is needed, this scoping alternative was evaluated to determine whether the addition of a wetland treatment system could provide an environmental benefit over the Proposed Action.

Wetlands are effective at removing certain water quality constituents, but are not considered an alternative to primary treatment. Wetlands are usually effective only as a "polishing" step to active water treatment methods. Therefore, wetlands would not be able to remove all of the contaminants expected in the Project wastewater, and thus would not be able to achieve the effluent standards required under the MPDES discharge permit. In addition, wetland systems require effort in ongoing monitoring and maintenance, particularly in northern climates. Further, the MOP Application states that water quality closure objectives (meeting non-degradation criteria) are expected to be met within 2 to 4 years post-closure and thus no water treatment would be required long-term (see MOP Application Section 1; and Section 3.5.3.2, Surface Water Quality Impact Assessment, in this EIS).

2.4.1.6. Increase Cement Content in Tailings

Scoping Alternative: Increase the cement content in the tailings to further reduce potential ARD and water quality impacts.

Both the 2017 MOP Application and Technical Memorandum 1 (see Appendix A of this EIS) show that cement contents proposed for both the surface CTF (0.5 to 2 percent cement) and the cemented tailings backfill (4 percent cement) of the underground mine are sufficient to achieve necessary strength and water quality protection. It was also determined that increasing the cement content in either would not provide additional environmental benefits.

2.4.1.7. Elevate the CTF above the Water Table

Scoping Alternative: Elevate the CTF above the water table to further reduce potential for groundwater quality impact.

Analysis presented in Technical Memorandum 2 (see Appendix B of this EIS) shows there would be no environmental benefit to water quality or flow by elevating the CTF, compared to the CTF elevation in the Proposed Action. Groundwater intercepted by the CTF would be diverted beneath the composite liner system and/or captured by the foundation drains. In either case, these are considered diversions, not removals from or degradation to, the overall baseline water system. Additionally, an elevated CTF would have a larger footprint (with greater wetland impacts), additional geotechnical stability requirements, and greater visibility impacts than the Proposed Action design. For example, the visual impact would expand as the CTF increases in elevation, with concomitant embankment extension downslope to the north, east, and south. A lift of 30 feet would be visible from portions of Highway 89.

2.4.1.8. Separate Sulfide Prior to Tailings Disposal

Scoping Alternative: Fully separate sulfide from the tailings prior to tailings disposal to further reduce potential for long term ARD formation in the CTF.

There is no net environmental benefit to full sulfide mineral separation prior to tailings disposal, when compared to the Proposed Action. Analysis presented in Technical Memorandum 3 (see Appendix C of this EIS) concludes that while full sulfide mineral separation from tailings may have some environmental benefits (e.g., reduced risk of ARD formation) over the Proposed Action, other issues such as appropriate onsite or offsite long-term storage and disposal would be challenging. Special management methods for the sulfide concentrate would have to be developed for onsite long-term storage to prevent ARD formation and/or spontaneous combustion. Development and implementation of such special management methods may not be technically feasible. DEQ could not find active mineral processing operations in Montana or other western states that accept sulfide concentrates for disposal or use as combustion fuels produced at other mines (i.e., so that the mine would not have to store its sulfide mineral concentrate on site). Additionally, transporting the sulfide mineral concentrate for offsite disposal or use would further increase the truck traffic on roads.

2.4.1.9. Tunnel Operations: Add Water Source Controls to Limit Oxidation during Operations

Scoping Alternative: Add additional water source controls to the tunnel operations to further limit oxidation and potential for ARD formation during operations.

Groundwater inflow would supply the water for the mine operation, although only 40 percent of the predicted inflow would actually be needed. Under the Proposed Action, several methods are proposed to limit inflow and groundwater contamination. Proposed measures include: grouting of major water bearing fractures or faults; using pilot holes drilled into areas scheduled for mining to identify and pressure grout water-bearing geological structures; collecting and treating groundwater inflow to non-degradation standards; and backfilling certain features with cemented tailings. Technical Memorandum 6 (see Appendix F of this EIS) reviewed several additional potential methods for controlling groundwater inflow and contamination during operations, including using asphalt, synthetic spray-on covers, or wax barriers on tunnel surfaces. While these applications could be used to limit oxidation on tunnel surfaces, they would be subject to degradation and would not be practical for underground mining. Therefore, Technical Memorandum 6 concluded that other water source control options would be no more effective than the best practice methods in the Proposed Action.

2.4.1.10. Use Alternative Water Treatment Processes other than Reverse Osmosis

Scoping Alternative: Use alternative water treatment technologies rather than RO to increase water treatment efficiency and effectiveness.

The Proposed Action includes the use of RO for treatment of groundwater collected during dewatering of the underground workings from construction Year 2 through closure. DEQ initially had concerns regarding the ability of an RO system to effectively treat the water in all phases of mine operation to non-degradation standards, particularly for nitrates; and the ability to dispose the large volume of waste brine generated from the RO system. Given this concern, Technical Memorandum 7 (Appendix G) reviewed the proposed RO system (and associated measures), as well as three other water treatment technologies used for mining operations: ion exchange, electrodialysis, and mechanical (vapor compression) evaporators. The memo concluded that (1) RO should be able to effectively treat the water to non-degradation standards, given the proposed pre-treatment methods, and (2) none of the other water treatment technologies would be more effective than RO. Because RO would effectively treat the collected groundwater and none of the other water treatment technologies offered any environmental benefit, alternatives involving the use of the non-RO water treatment technologies were not carried forward for detailed analysis.

2.4.1.11. Construct Two Side-by-Side Declines and Eliminate Ventilation Shafts

Scoping Alternative: Construct two side-by-side declines (one for ventilation and utilities) and eliminate the four proposed ventilation shafts to reduce surface disturbance.

DEQ determined that eliminating the four proposed ventilation shafts by constructing a decline for ventilation and placement of utilities parallel to the access decline did not present an environmental benefit and likely increased health and safety risks. While it is technically feasible to construct two side-by-side declines rather than the four proposed ventilation shafts, doing so would not reduce surface disturbance and would produce more waste rock. More importantly, maintaining proper ventilation for safe working conditions would be more difficult with two declines rather than the proposed single access decline and four ventilation shafts. The ventilation shafts are designed to intercept specific underground mine areas and at differing depths in order to more effectively maintain safe conditions for workers. Additionally, the Mine Safety and Health Administration requires mines to maintain an escape shaft for workers in case the main access is not useable. An obstruction or fire in one decline could potentially obstruct the other, which would eliminate its use as an escape shaft. For these reasons, an alternative requiring construction of two declines rather than the four proposed ventilation shafts was not carried forward for detailed analysis.

2.4.1.12. Maintain Wet Tailings in the CTF

Scoping Alternative: Maintain tailings in the CTF in a wet condition to reduce the potential for ARD formation in the CTF.

DEQ determined that there is no overall benefit to storing the tailings in a wet storage facility, relative to the CTF design in the Proposed Action. Maintaining saturated or sub-aqueous tailings in the proposed CTF would limit tailings oxidation within the facility, but it would add further complexity to operations and reclamation plans, and may not provide other environmental benefits. This alternative would require higher and wider embankments to maintain geotechnical stability to contain both tailings and water (which would result in increased embankment material sourcing impacts and increased visual impacts), water balance management (resulting in additional collection and treatment), and an increased timeline for pond and pore water drainage and treatment prior to facility capping and closure. For these reasons, an alternative requiring maintenance of the CTF in a wet condition was not carried forward for detailed analysis.

2.5. PREFERRED ALTERNATIVE

ARM 17.4.617(9) requires an agency to state a preferred alternative in the draft EIS, if one has been identified, and to give its reasons for the preference. DEQ has identified the Agency Modified Alternative as the agency's preferred alternative.

The Agency Modified Alternative revises the Proposed Action by requiring the Proponent to completely backfill the Upper and Lower Sulfide Zones with cemented paste tailings. Complete backfill would return hydraulic parameters within these bedrock zones to conditions similar to the pre-mining state, eliminating the potential for development of new groundwater flow paths through these areas. The Agency Modified Alternative minimizes exposed reactive surfaces and potential water quality impacts within the mine workings at closure.

3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1. INTRODUCTION

This chapter describes the affected environment and potential impacts of the Proposed Action, the No Action Alternative, and the AMA. The affected environment is the portion of the existing natural and human environment that could be impacted, and serves to describe the baseline condition of the site prior to construction. Environmental consequences are also referred to as potential impacts. Impacts may be either direct or secondary. A direct impact is one that is caused by the proposed action and occurs at the same time and place. A secondary impact is a further impact to the human environment that may be stimulated or induced by, or otherwise result from, a direct impact of the action. Resource topics were identified through scoping; the discussions in this chapter are limited only to those resources that could be subject to potential impacts:

- Air Quality (Section 3.2)
- Cultural and Tribal Resources (Section 3.3)
- Groundwater Hydrology (Section 3.4)
- Surface Water Hydrology (Section 3.5)
- Geology and Geochemistry (Section 3.6)
- Land Use and Recreation (Section 3.7)
- Visuals and Aesthetics (Section 3.8)
- Socioeconomics (Section 3.9)
- Soils (Section 3.10)
- Noise (Section 3.11)
- Transportation (Section 3.12)
- Vegetation (Section 3.13)
- Wetlands (Section 3.14)
- Wildlife (Section 3.15)
- Aquatic Biology (Section 3.16)

3.1.1. Location Description and Study Area

The MOP Application Boundary encompasses approximately 1,888 acres of privately owned ranch land under lease to the Proponent, with associated buildings and a road network throughout. The Project location and associated study area include all lands and resources in the MOP Application Boundary, plus those additional areas identified in each resource-specific analysis area that are beyond the MOP Application Boundary. The analysis area for each resource is defined with its respective subsection in this chapter.

3.1.2. Impact Assessment Methodology

The Project team used information and data from desktop analysis, field surveys, and professional judgment to identify potential environmental consequences of the Project for each resource area. The Project and alternatives were then evaluated to assess their potential impacts on resources. Potential impacts were characterized in terms of impact magnitude, duration, and extent. The consistent application of the impact assessment methodology as part of the analysis allows the comparison and prioritization of impacts, which can inform the development of measures to help avoid, minimize, and mitigate potential impacts. Consistent use of an impact methodology can also increase the analytical rigor of the impact analysis included in an EIS.

The environmental consequences sections that follow describe potential impacts from the Project or alternatives during construction, operation, and reclamation and closure phases. These potential impacts may be beneficial or adverse. Furthermore, potential impacts may be direct or secondary. Direct impacts are those that occur at the same time and place as the action that triggers the impact. Secondary impacts are further impacts to the human environment that may be stimulated or induced by, or otherwise result from, a direct impact of the action. Residual impacts are those that are not eliminated by mitigation. Cumulative impacts are those collective impacts on the human environment of the Project when considered in conjunction with other past and present actions related to the Project 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. Mitigations are actions that are not a part of the Project as proposed but may be added to reduce potential impacts.

The significance of the potential impact is based on two elements: (1) the severity of the potential impact, and (2) the likelihood that the impact would occur. The severity is a function of its geographic reach, magnitude, duration, reverse-ability, and if it surpasses an environmental threshold such as a water quality or air quality standard. **Table 3.1-1** provides a summary of impact assessment criteria for environmental and social resources.

The likelihood of a potential impact occurring is comprised of the following categories:

- Low likelihood—Rare (e.g., few or no occurrences in the hard-rock mining industry);
- Medium likelihood—Uncommon (e.g., documented occurrences in the hard-rock mining industry); and
- High likelihood—Common (e.g., occurs within the hard-rock mining industry).

Table 3.1-1
Impact Significance Criteria

<table>
<tr><th colspan="5">Environmental Impact Criteria</th></tr>
<tr><th>Severity</th><th colspan="2">Duration/Frequency</th><th colspan="2">Description</th></tr>
<tr><td>Low</td><td colspan="2">Short term (up to 1 year)
Low frequency</td><td colspan="2">Affects environmental conditions, water, resources, air quality, species, and habitats over a short period of time. The impact is localized and reversible. Environmental standards would not be exceeded.</td></tr>
<tr><td>Medium</td><td colspan="2">Medium term (1 to 7 years)
Medium or intermittent frequency</td><td colspan="2">Affects environmental conditions, water, resources, air quality, species, and habitats in the short to medium term. Ecosystem integrity would not be adversely affected in the long term, but the impact would likely be significant in the short or medium term to some species or receptors. The area/region may be able to recover through natural regeneration and restoration. The geographic extent may be local or regional.</td></tr>
<tr><td>High</td><td colspan="2">Long term (more than 7 years)/Irreversible
Constant frequency</td><td colspan="2">Affects environmental conditions, water resources, air quality, species, and habitats for the long term, may substantially alter the local and regional ecosystem and natural resources. Regeneration to its former state would not occur without intervention. Impacts may not be irreversible. An environmental standard would be exceeded.</td></tr>
<tr><th colspan="5">Social Impact Criteria</th></tr>
<tr><th>Severity</th><th>Duration/Frequency</th><th>Extent</th><th>Ability to Adapt</th><th>Social Outcome</th></tr>
<tr><td>Low</td><td>Short term (up to 1 year)
Low frequency</td><td>Individual/ Household</td><td>Those affected would be able to adapt to the changes with relative ease and maintain pre-impact livelihoods, culture, and quality of life.</td><td>Inconvenience but with no consequence on long-term livelihoods, culture, quality of life, resources, infrastructure, and services.</td></tr>
<tr><td>Medium</td><td>Medium term (1 to 7 years)
Medium or intermittent frequency</td><td>Small number of households</td><td>Those affected would be able to adapt to change with some difficulty and maintain pre-impact livelihoods, culture, and quality of life, but only with a degree of support.</td><td>Direct and secondary impacts on livelihoods, culture, quality of life, resources, infrastructure, and services.</td></tr>
<tr><td>High</td><td>Long term (more than 7 years)/Irreversible
Constant frequency</td><td>Large part or entirely</td><td>Those affected would not be able to adapt to changes and continue to maintain pre-impact livelihood.</td><td>Widespread and diverse direct and secondary impacts would likely be impossible to reverse or compensate for.</td></tr>
</table>

The overall rating of potential impacts is ultimately a combination of severity and likelihood. It should be noted that this methodology acts as a guide and there may be situations where rigid application is inappropriate. In general, the level of assessment is proportionate to its potential impacts (in other words, the greater the potential impact, the greater the depth of analysis). Potential direct impacts are described for every resource area; secondary impacts are described where they exist, and residual impacts are described where mitigation has been identified.

The process of impact assessment, or evaluation of potential environmental consequences resulting from actions associated with each alternative, is completed through a series of steps. In general, these steps are as follows:

1. Characterize the existing conditions before the Project is undertaken.
2. Describe the Project components throughout the Project lifespan construction, operations, and reclamation and closure.
3. Identify alternatives to the Project that could be carried forward for analysis in the EIS. Screen these alternatives to determine which if any are carried forward for further analysis in the EIS.
4. Based on the description of the Project alternatives, identify sources of impacts and describe the potential impacts for each resource area using the impact assessment criteria, including direct, secondary, cumulative and as necessary residual impacts.
5. Identify appropriate mitigation measures. This could result in revising the actions that are proposed under an alternative or result in the development of new alternatives.
6. Describe potential impacts after mitigation to understand residual impacts.

3.2. AIR QUALITY

The proposed Project would be developed in an area that meets USEPA ambient air quality standards. Primary issues of concern in this region include dust transport and the potential deposition of particulates within the Project area.

Federal and Montana laws define regulated pollutants and the emission sources that will be addressed in Project air permitting and in this EIS. As described in this section, the Proposed Action includes a variety of air pollutant emission sources consisting of diesel-fueled stationary engines, gas-fired heaters, mined material handling equipment, fugitive dust sources, and vehicle operation. The copper ore mining activities would be completely underground and the mine is mechanically vented at three locations to maintain a safe working atmosphere. These vents would be sources of air emissions, primarily combustion gases from explosives, vehicle exhaust and from gas-fired vent air heaters. Particulate matter (PM) from underground operations is not expected to exit from the vents at significant rates. Aboveground material handling activities would also cause air emissions, primarily fugitive dust and emissions from combustion of motor fuels (diesel and gasoline) used to operate mining vehicles (e.g., haul trucks), stationary equipment, portable equipment, and support vehicles.

Quantitative modeling was conducted by the Proponent to evaluate the potential air quality impacts of the Proposed Action, including the impacts of underground and aboveground stationary sources. Air dispersion modeling was performed primarily to quantify concentrations of regulated pollutants resulting from stationary and fugitive source emissions, and these results were compared to federal and Montana ambient air quality standards. This modeling analysis encompassed a domain extending 9.3 miles (15 kilometers), and 12.4 miles (20 kilometers) from the Project site boundary to assess PM and gaseous pollutant impacts, respectively. While outside of the modeling domain, the analysis provides information regarding the potential for dust and pollutants transported to the Smith River basin.

3.2.1. Regulatory Framework

Under the federal Clean Air Act (CAA), initially promulgated by Congress in 1970, the USEPA sets National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. The CAA Amendments of 1990 represented a substantial expansion in the scope of the federal clean air requirements. Among many other provisions, the 1990 amendments created the Title V permit program for major sources of criteria air pollutants and expanded the hazardous air pollutants (HAPs) regulatory program to address specific industrial source categories of toxic air pollutants.

The Clean Air Act of Montana implements the federal CAA (§ 72-2-101 *et seq.*, MCA) and allows development of local air pollution control programs to administer strategies to improve local air quality. Agencies, primarily Montana DEQ, develop and maintain air pollution control plans, which are frequently referred to as State Implementation Plans. These control plans explain how an agency will protect against air pollution to achieve compliance with the NAAQS. In addition to DEQ, seven counties currently operate local air pollution control programs that encompass the communities of Billings, Butte, Great Falls, Helena, the northern Flathead Valley, Libby, and Missoula.

The USEPA has set NAAQS for six criteria pollutants: carbon monoxide (CO); lead; nitrogen dioxide (NO_2); particulate matter with an aerodynamic diameter less than or equal to 10 and 2.5 microns (PM_{10} and $PM_{2.5}$, respectively); ozone; and sulfur dioxide (SO_2) (USEPA 2018a). The federal CAA established two types of standards for criteria pollutants. Primary standards set limits to protect public health, including the health of sensitive populations, such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings (USEPA 2018b). In 2012, the USEPA reduced the annual $PM_{2.5}$ standard to 12 micrograms per cubic meter ($\mu g/m^3$; USEPA 2012).

Individual states have the option to adopt more stringent standards and to include additional regulated pollutants. Under Montana’s implementation of the CAA, Montana established Montana Ambient Air Quality Standards (MAAQS) for criteria and other ambient air pollutants (ARM 17.8 Subchapter 2). These state standards may be more stringent (lower concentrations) in some instances, and for those pollutants and averaging times, conformance must be demonstrated with the Montana standard. The NAAQS and MAAQS are presented in **Table 3.2-1.**

An area is designated as attainment for a given criteria pollutant and averaging time standard when existing concentrations, as determined by air monitoring, are below the NAAQS. Likewise, an area is designated as nonattainment when existing concentrations of one or more regulated pollutant/averaging time combination are above the NAAQS. The Project site would be in an area designated as either *attainment* or *attainment or unclassifiable* for all regulated pollutants. Generally, an unclassifiable designation applies when adequate data has not been collected to demonstrate attainment, but due to the location and/or lack of emission sources, the area is expected to be in attainment of the standard.

Table 3.2-1
National and Montana Ambient Air Quality Standards

Pollutant and Averaging Time	Primary Standard-Federal NAAQS	Primary Standard-Montana MAAQS	Secondary Standards
CO, 8-hour	9 ppm [a]	9 ppm [b]	NA
CO, 1-hour	35 ppm [a]	23 ppm [b]	NA
Pb, Rolling 3-months	0.15 µg/m^3 [c]	NA	Same as Primary
Pb, Quarterly	1.5 µg/m^3 [c]	1.5 µg/m^3 [c]	Same as Primary
NO_2, Annual	53 ppb [e]	0.05 ppm[f]	Same as Primary
NO_2, 1-hour	100 ppb [d] (188.679 µg/m^3)	0.30 ppm [b]	NA
PM_{10}, 24-hour	150 µg/m^3 [i]	150 µg/m^3 [i]	Same as Primary
PM_{10}, Annual	NA	50 µg/m^3 [j]	NA
PM $_{2.5}$, Annual	12.0 µg/m^3 [l]	NA	15.0 µg/m^3 [m]
PM $_{2.5}$, 24-hour	35 µg/m^3 [k]	NA	Same as Primary
Ozone, 8-hour	0.070 ppm [i]	NA	Same as Primary
Ozone, 1-hour	NA	0.10 ppm [g]	NA
SO_2, 1-hour	75 ppb [m] (195 µg/m^3)	0.50 ppm [n] (1,300 µg/m^3)	NA
SO_2, 3-hour	NA	NA	0.5 ppm [a] (1,309 µg/m^3)
SO_2, 24-hour	0.14 ppm [a]	0.10 ppm [b] (262 µg/m^3)	NA
SO_2, Annual	0.030 ppm [c]	0.02 ppm [f] (52 µg/m^3)	NA

Source: USEPA 2018a; ARM 17.8 Subchapter 2

µg/m^3 = micrograms per cubic meter; CO = carbon monoxide; MAAQS = Montana Ambient Air Quality Standards; NA = No applicable standard; NAAQS = National Ambient Air Quality Standards; NO_2 = nitrogen oxide; Pb = lead; $PM_{2.5}$ = particulate matter less than or equal to 2.5 microns in diameter; PM_{10} = particulate matter less than or equal to 10 microns in diameter; ppb = parts per billion; ppm = parts per million; SO_2 = sulfur dioxide

Notes:

[a] Federal violation when exceeded more than once per calendar year.

[b] State violation when exceeded more than once over any 12 consecutive months.

[c] Not to be exceeded (ever) for the averaging period as described in either state or federal regulation. Pb is a 3-year assessment period for attainment.

[d] Federal violation when the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitoring site exceeds the standard.

[e] Federal violation when the annual arithmetic mean concentration for a calendar year exceeds the standard.

[f] State violation when the arithmetic average over any four consecutive quarters exceeds the standard.

[g] Applies only to NA areas designated before the 8-hour standard was approved in July 1997. Montana has none.

[h] Federal violation when the 3-year average of the annual 4th-highest daily maximum 8-hour concentration exceeds the standard.

[i] State and federal violation when more than one expected exceedance per calendar year at each monitoring site exceeds the standard.

[j] State violation when the 3-year average of the arithmetic means over a calendar year at each monitoring site exceed the standard.

[k] Federal violation when the 3-year average of the 98th percentile 24-hour concentrations at each monitoring site exceeds the standard.

[l] Federal violation when the 3-year average of the annual mean at each monitoring site exceeds the standard.

[m] Federal violation when the 3-year average of the 99th percentile of the daily maximum 1-hour average at each monitoring site exceeds the standard.

[n] State violation when exceeded more than 18 times in any 12 consecutive months.

The following regulated air contaminants comprise the criteria pollutants covered by NAAQS and MAAQS:

- **Ozone**: Ground-level ozone is a secondary pollutant formed in the atmosphere by a series of complex chemical reactions and transformations in the presence of sunlight. The emitted pollutants nitrogen oxides (NOx) and volatile organic compounds (VOCs) are the principal precursors in these reactions. Thus, regulation and control of NOx and VOC emissions is a means to reduce the formation of ground-level ozone. In relatively high concentrations, ozone is a powerful oxidant capable of destroying organic matter, including human lung and airway tissue (VCAPCD 2003).
- **Nitrogen dioxide**: NO_2 can be emitted directly from combustion sources such as power plant boilers and internal combustion engines, which are the largest source categories for nitric oxide (NO) and NO_2, collectively termed NOx. NO_2 is also formed in the atmosphere primarily by the rapid reaction of the colorless gas, nitric oxide, with atmospheric oxygen. At significant concentrations, NO_2 is a reddish-brown gas with an odor similar to that of bleach. NO_2 participates in the photochemical reactions that result in ozone formation. Over longer-term exposures, NO_2 can irritate and damage the lungs, cause bronchitis and pneumonia, and lower resistance to respiratory infections such as influenza (VCAPCD 2003).
- **Carbon monoxide**: CO is a colorless, odorless, and potentially toxic gas. It is produced by natural and anthropogenic pathways (caused by human activity) such as combustion processes. The major source of CO is incomplete combustion of carbon-containing fuels (primarily gasoline, diesel fuel, natural gas, and coal). However, it also results from combustion of vegetation such as forest fires and agricultural burning. When inhaled, CO does not directly harm the lung tissue. The potential health impact from CO is that it can inhibit the oxygenation of the entire body. CO combines chemically with hemoglobin, the oxygen-transporting component of blood. This diminishes the ability of blood to carry oxygen to the brain, heart, and other vital organs, which especially affects sensitive populations and those with respiratory or heart disease (VCAPCD 2003).
- **Sulfur dioxide**: SO_2 is a colorless gas with a sharp, irritating odor. It reacts with moisture in the atmosphere to produce sulfuric acid and sulfates, which contribute to acid deposition and atmospheric visibility reduction. Sulfates can further react to form $PM_{2.5}$, which contributes to haze formation. Most of the SO_2 emitted into the atmosphere is from sources burning sulfur-containing fossil fuels.. At longer exposures to low concentrations, SO_2 causes constriction of the airways and poses a respiratory tract infection hazard to sensitive individuals, such as asthmatics and children (VCAPCD 2003).
- **Respirable particulate matter**: PM_{10} consists of airborne particulate matter, fine dusts, and aerosols that are 10 microns or smaller in diameter. The primary sources of PM_{10} include combustion processes, dust from paved and unpaved roads, and earthmoving construction operations. Lesser sources of PM_{10} include wind erosion, agricultural operations, residential wood combustion, vehicle tailpipe emissions, and industrial processes. As a regulated pollutant, PM_{10} encompasses different constituents and, therefore, varying impacts on health. Airborne particles can also absorb toxic substances that can be inhaled and lodged in the

lungs. PM_{10} particles can accumulate in the upper portion of the respiratory system, affecting the bronchial tubes, nose, and throat (VCAPCD 2003).

- **Fine particulate matter**: $PM_{2.5}$ is a mixture of very fine particulate dusts and condensed aerosols that are 2.5 microns or smaller in aerodynamic diameter. $PM_{2.5}$ particles are emitted from activities such as industrial and residential combustion processes, wood burning, and from diesel- and gasoline-powered vehicles. They are also formed in the atmosphere by reactions of "precursor" gases such as SO_2, NOx, ammonia, and VOCs that are emitted from combustion activities, which then become discrete particles as a result of chemical transformations in the air (secondary particles).

$PM_{2.5}$ can enter the deepest portions of the lungs where gas exchange occurs between the air and the blood stream. Therefore, these fine particles are more dangerous because the throat and lungs have no efficient mechanisms for removing them. Certain condensate $PM_{2.5}$ particles are soluble in water, and these can pass into the blood stream. Fine particles not soluble in water can be retained deep in the lungs permanently. This increases the risks of long-term disease including chronic respiratory disease, cancer, and increased and premature death.

3.2.1.1. Federal Prevention of Significant Deterioration New Source Review Program

The federal program that applies to larger sources seeking air quality permitting is Prevention of Significant Deterioration (PSD) New Source Review (NSR), and applies to areas in attainment of the NAAQS. First promulgated in 1977, the PSD program is designed to protect public health and welfare, and authority to issue PSD permits is usually delegated to state agencies by USEPA. In part, the PSD program also serves to protect visibility and limit regional haze in pristine areas referred to as Class I areas, including national parks and wilderness areas. Sources subject to PSD level permitting are those that have maximum annual emissions of 250 tons per year (tpy) or more, of any one of the regulated criteria pollutants. For certain industrial source categories, not including metallic mineral mining, this threshold is reduced to 100 tpy. For PSD applicability determinations, point source and fugitive emissions associated with operation of stationary source installations (e.g., fugitive haul road or material handling) are counted in quantifying annual maximum emissions.

Since the Project would be in a NAAQS attainment area for all criteria pollutants, PSD/NSR potentially applies to new or increased emissions of NOx, CO, SO_2, PM_{10}, $PM_{2.5}$, and lead (USEPA 2018c). However, it should be recognized that the estimated maximum criteria pollutant emissions from the Project during mine construction and operations phases are not high enough to qualify as a major source subject to PSD/NSR requirements.

3.2.1.2. Title V Permits

Title V of the CAA 1990 amendments (2 United States Code 7661 et seq.) authorized a program for major source operating permits that are legally enforceable documents that contain all applicable requirements as identified by permitting authorities. Title V major source thresholds are dependent on the NAAQS attainment status of the jurisdiction, with progressively lower (more stringent) thresholds in moderate, serious, severe, and extreme nonattainment areas. The

Title 40 of the Code of Federal Regulations (CFR), Section 70 permits are issued by state and local (county or district) permitting authorities, such as DEQ.

Based on emissions estimates during mine construction and peak production as described in the Project application for an MAQP, the Project would be considered a major source under the Title V applicability determination. If the Proponent does not submit a modification to their initial MAQP, they will need to submit an application for a Title V operating permit within 12 months of commencing operations. Total potential emissions from Project stationary point sources, excluding fugitive sources, are estimated to be greater than 100 tpy for NOx and CO. However, the Project would not be a major source of HAP emissions, with maximum annual emissions less than 10 tpy for any single HAP, and less than 25 tpy for total HAPs.

The Title V permitting process for the Project is in progress. The Project's permit application was initially submitted to DEQ in February 2018, and a follow-up application was provided in April 2018. DEQ first issued a Preliminary Determination on the permit application on June 5, 2018, and a revised Preliminary Determination incorporating public input was subsequently issued in March 2019 (see Appendix K). This latter Preliminary Determination proposes a number of operational limits and work practice requirements that would limit the Project's air pollutant emissions. DEQ will issue a decision on the MAQP application within 30 days after the release date of the Final EIS. If approved, DEQ would issue an MAQP covering the operation and construction phases of the Project.

3.2.1.3. Other Federal Air Quality Programs

New Source Performance Standards

The USEPA has promulgated a large number of New Source Performance Standards (NSPS) at 40 CFR 60 that provide emissions standards, along with operating practices, monitoring, recordkeeping, and reporting requirements, for many industrial categories of new or modified sources. In addition to the general provisions in 40 CFR 60, Subpart A, the Project would be subject to two NSPS regulations:

- Standards of Performance for Metallic Mineral Processing Plants (40 CFR 60, Subpart LL) was first promulgated in 1984, and was revised in 2014. The provisions of NSPS Subpart LL are applicable to affected facilities at metallic mineral processing plants, except that facilities located in an underground mine are exempt. Certain surface facilities planned for the Project would involve the handling or processing of waste rock and ore, and these would be subject to this NSPS. Affected sources would include crushers and screens, bucket elevators, conveyor belt transfer points, storage bins, enclosed storage areas, and truck loading/unloading stations.
- Standards of Performance for Stationary Compression Ignition Internal Combustion Engines (40 CFR 60, Subpart IIII) applies to reciprocating internal combustion stationary engines produced after June 2006. For such engines included in the Project, such as diesel-fueled engines that drive emergency generators and fire water pumps, this NSPS sets engine

performance standards to limit pollutant emissions, limits of annual operating times, and work practice standards for engine maintenance.

National Emission Standards for Hazardous Air Pollutants

Toxic air pollutants are those airborne chemicals that cause or may cause cancer or other serious health impacts, such as reproductive impacts or birth defects, or adverse environmental and ecological impacts. HAPs are a defined subset of toxic air pollutants, and are subject to special regulatory status under Title III of the CAA 1990 amendments.

As directed by Title III, the USEPA has promulgated National Emissions Standards for Hazardous Air Pollutants (NESHAP) for over 100 industrial source categories. Most of these NESHAP regulations apply to sources termed major sources of HAP, which are those that can emit 10 tpy of any single HAP, or over 25 tpy of all HAP emissions combined. Primary copper smelters and foundries are among the regulated categories under NESHAP. However, as these affected types of facilities are not included in the Project, the NESHAP regulations for primary copper smelters and foundries are not applicable. In addition to the general provisions in NESHAP Subpart A, two NESHAP regulations are anticipated to be applicable to equipment and operations included in the Project:

- NESHAP for Stationary Reciprocating Internal Combustion Engines (RICE) (40 CFR 63, Subpart ZZZZ) applies to engine-driven equipment produced prior to June 2006. The proposed mine and processing facilities may include such gasoline and/or diesel-fired portable and mobile source engines, for which this NESHAP regulation establishes standards to limit pollutant emissions, limits of annual operating times, and work practice standards for engine maintenance.
- NESHAP for Source Category: Gasoline Dispensing Facilities (40 CFR 63, Subpart CCCCCC) is applicable to facilities that are not major HAP sources, and would apply to a gasoline fuel tank and dispensing facilities included in the Project.

Mandatory Greenhouse Gas Reporting Rule

The USEPA established a program in October 2009 for Mandatory Reporting of Greenhouse Gases (GHG) for over 40 source categories (40 CFR 98). The requirements for emission calculation, recordkeeping, and annual reporting apply if individual facility annual emissions exceed 25,000 metric tonnes (MT) of GHG (as computed in carbon dioxide [CO_2] equivalent MT, or CO_2e), and this is expected to apply to the Project. For fuel combustion sources described in 40 CFR 98, Subpart C, the gases covered by the rule are CO_2, methane (CH_4), and nitrous oxide. Emissions of GHG from the underground mine workings for the Project must be accounted for, since fuel diesel-combustion equipment would operate underground. For the planned schedule of production under the Proposed Action, the aboveground diesel-engine-powered generators and propane-fired heaters for mine air intake vents would have annual aggregated GHG emissions that would exceed 25,000 MT CO_2e. Therefore, the Mandatory Reporting Rule is expected to apply to the Project under the Proposed Action. Stationary, fossil-fuel-fired equipment, with the exceptions of emergency and portable equipment, is subject to 40 CFR 98, Subpart C, General Stationary Fuel Combustion Sources.

Mobile Source Regulations

The USEPA regulates mobile sources of air pollution in Montana through federal mobile source standards. Surface operations at the Project site would be subject to mobile source emissions standards. A surface haul truck, with hydraulic operation of the dumping mechanism, is an example of equipment affected by the federal engine performance standards.

The initial federal Tier 1 standards for off-road diesel engines were adopted in 1995. More stringent federal Tier 2 and Tier 3 standards were adopted in 2000, and selectively apply to the full range of diesel off-road engine power categories for more recent model years. These standards set maximum emissions per unit horsepower for NOx, CO, PM, and total organics. Both Tier 2 and Tier 3 standards include durability requirements to ensure compliance with the standards throughout the useful life of the engine (40 CFR 89.112).

On May 11, 2004, the USEPA signed the final rule implementing Tier 4 emission standards, which were phased in over the period of 2008 to 2015 (69 *Federal Register* 38957-39273, June 29, 2004). The Tier 4 standards required that emissions of PM and NOx be further reduced by about 90 percent. Such emission reductions for off-road industrial vehicles can be achieved with the use of advanced control technologies, similar to those required by the 2007 to 2010 federal standards for highway diesel engines. New engines for equipment and vehicles at the Project site would be subject to these most recent standards.

In 2001, the USEPA identified 21 HAPs as air toxics specifically related to vehicle engine sources, 6 of which are designated priority pollutants (66 *Federal Register* 17235): acetaldehyde, acrolein, benzene, 1,3-butadiene, diesel exhaust (PM and organic gases), and formaldehyde. Diesel PM is considered a carcinogenic air toxic. A USEPA assessment concluded that long-term (i.e., chronic) inhalation exposure is likely to pose a lung cancer hazard to humans, as well as damage the lung in other ways depending on exposure. Short-term (i.e., acute) exposures can cause irritation and inflammatory symptoms of a transient nature, these being highly variable across the population (USEPA 2002). However, no specific emission standard exists for diesel PM or the toxics released in engine exhaust.

3.2.1.4. Montana State Air Quality Requirements

The Clean Air Act of Montana requires a permit for the construction, installation, and operation of equipment or facilities that may cause or contribute to air pollution. The Montana state air quality program is administered by DEQ, in accordance with rules set forth in the Administrative Rules of Montana, Title 17, Chapter 8, Air Quality. Several specific emissions standards for Montana would apply to the Project sources; however, in cases for which Montana rules would be less stringent than comparable federal standards, the federal standards would supersede. Among the DEQ regulations that apply to the permitting process for the Project, several stipulate emission limits on PM sources:

- ARM 17.8.304 restricts emissions to the atmosphere to no more than 20 percent opacity averaged over 6 consecutive minutes, but excludes motor vehicles, or sources for which a different visible emissions standard has been promulgated.
- ARM 17.8.308 prescribes that the production, handling, transportation, or storage of any material must include reasonable precautions to control emissions of airborne PM. Further, such emissions of airborne PM from any stationary source must not exhibit opacity of 20 percent or greater averaged over 6 consecutive minutes. ARM 17.8.309 and 17.8.310 provide PM emission standards that apply to fuel-burning equipment (e.g., boilers and process heaters), and to industrial processes, respectively. These would be generally applicable to the new stationary sources included in the Project, such as the propane-fueled heaters, and emission limits for individual sources would be based on the fuel usage or material throughput level (i.e., pound (lb)/hour).
- ARM 17.8 Subchapter 7 contains provisions for obtaining an MAQP for new and modified facilities with maximum annual emissions less than the thresholds for PSD permits. The Project would be required to obtain an MAQP as a Title V major source (a Title V Operating Permit) because the operating facility would have the potential to emit more than 100 tpy of one or more criteria air pollutants. The Project's permit application number is 5200-00, and was initially submitted to DEQ in February 2018 with a follow-up application in April 2018. DEQ first issued a Preliminary Determination on the permit application on June 5, 2018, which initiated a public comment period. A revised Preliminary Determination incorporating the public input was subsequently issued in March 2019 (see Appendix K). DEQ will issue a decision on the MAQP application within 30 days after the release date of the Final EIS. If approved, DEQ would issue an MAQP that would cover the operation and construction phases of the Project.

3.2.2. Analysis Methods

3.2.2.1. Analysis Area

The analysis area for direct and secondary impacts is the geographic area in the vicinity of the Project site in which air emissions would occur, and that could potentially have increases in ambient air concentrations attributable to the Project. The facilities that could have appreciable air emissions are the mine vents, surface crusher and conveyance systems, stockpiles of ore, waste rock and other dry materials, and truck loading facilities. During construction, the preparation of site roads, transmission lines, and the surface groundwork for the mill and other facilities would contribute engine emissions and fugitive dust.

Past and current actions in the analysis area (the general vicinity of Meagher County), described in detail in Section 3.1, as well as a future related action in the analysis area, described in detail in Section 3.3, were considered qualitatively in the cumulative impacts analysis. The list of activities considered in the cumulative impacts analysis was taken from the Proponent's Schedule of Proposed Actions and from local program managers.

Ambient Air Quality Modeling

Extensive modeling was conducted to assess the potential impacts on air quality. The modeling was conducted to support the Proponent's application for an MAQP. This includes a near-field ambient air modeling study (Tintina 2018) for the area surrounding the Project site. A summary of the methodology of the modeling studies is provided below. A discussion of the modeling and results are provided in Environmental Consequences, Section 3.2.4.

Dispersion Modeling Methodology for Near-Field Analyses

Dispersion modeling analyses were conducted to assess the potential impacts of air pollutant emissions and to determine whether criteria emissions from the Project would cause or contribute to an exceedance of a NAAQS or MAAQS (Tintina 2018). This modeling was based on procedures referenced in the USEPA Guideline on Air Quality Models, which is contained in 40 CFR 51, Appendix W (USEPA 2017). The guidelines assert that the suitability of an air quality dispersion model for a particular application is dependent on several criteria, which include:

- Stack height relative to nearby structures
- Dispersion environment
- Local terrain
- Availability of representative meteorological data

Based on a review of these factors, the latest version of AERMOD available at the time of the application modeling work (version 16216r)[1] was used to assess ambient air impacts. More recently, a new AERMOD version has been released (version 18081); however, DEQ policy is to accept use of the version available at the time the modeling protocol is approved.

Off-Site Emissions Sources

In general, large emission sources (e.g., with emissions exceeding 100 tpy for any pollutant) and within approximately 31 miles (50 kilometers) from the Project site boundary would be considered near-vicinity offsite sources and would be included in an AERMOD modeling analysis. By these criteria, there are no large emission sources in the near-vicinity of the Project site. The Graymont Indian Creek Lime Plant, located approximately 46 air miles southwest of the Project site, is the nearest large source facility. The town of White Sulphur Springs, which does not have substantial industrial development or emissions sources, is 15 miles south of the Project site. The nearest larger population centers that would contribute to pollutant concentrations due to vehicle traffic and industrial development are Great Falls, Helena, and Bozeman, which are 50, 54, and 76 air miles distant, respectively, from the Project site. Consequently, no individual offsite facilities were included in the modeled roster of emission sources in AERMOD. To evaluate overall air quality impacts, modeled concentrations for the

[1] American Meteorological Society/Environmental Protection Agency Regulatory Model

Project sources were combined with representative monitored background concentrations to compare total impacts with the NAAQS and MAAQS (Tintina 2018).

3.2.2.2. Assessment of Direct and Secondary Impacts

Significance thresholds for evaluating air quality impacts regarding criteria pollutants are defined in the CAA. According to the regulatory definition (40 CFR 51.166(23)(i)), a "significant emission" means a net emissions increase at an existing source or the potential emissions of a new source to emit a given air pollutant in an amount that would equal or exceed a set threshold in tons per year." For the purposes of this EIS, if modeled emissions would result in an exceedance of NAAQS or MAAQS when considered in combination with background sources, then those adverse impacts are considered to be significant. After it is demonstrated that modeled emissions impacts do not exceed NAAQS and MAAQS an MAQP can be issued for the Project.

With regard to visibility, significance thresholds have been defined by federal land managers (FLMs) with jurisdiction over Class 1 areas, wilderness areas, and other regions in which air quality is to be preserved. Significance of a specific project with respect to regional haze impacts typically depends on several factors, which are considered by the FLMs on a case-by-case basis. The generally-accepted significance threshold for visibility impairment in a Class I area is 5 percent deciview[2] increase predicted for a single project above the FLM–established baseline visibility conditions (FLAG 2010). Predicted visibility impairment levels resulting from a project shown to be below the 5 percent criterion would be minor.

No significance thresholds are defined with regard to deposition of air emissions. However, the USDA Forest Service, National Park Service, and U.S. Fish and Wildlife Service (USFWS), collectively called the FLMs, issued interagency guidance for nitrogen and sulfur deposition analysis in 2011 summarizing current and emerging deposition analysis tools applicable to Class I and Class II areas for evaluating the impact of increased nitrogen or sulfur deposition on air quality related values (USDA et al. 2011). In this guidance, the FLMs established deposition analysis thresholds to use as screening level values for new or modified major sources. A deposition analysis threshold is defined as the additional amount of nitrogen or sulfur deposition within an area, below which estimated impacts from a proposed new or modified source are considered negligible.

Visibility and chemical deposition impacts in nearby Class I areas are normally evaluated as part of air quality permitting to obtain an MAQP. The Gates of the Mountains Class I area, located approximately 38 miles northwest of the Project site, is the closest Class I area. As part of the DEQ permitting process, a dispersion modeling analysis was submitted by the Proponent that included consideration of the influences of prevailing winds and pollutant transport. As discussed for the Proposed Action in Section 3.2.4.2, (refer to Ambient Air Dispersion Modeling Analysis Results) this analysis included review of the 5-year wind rose illustrating the prevailing wind pattern with respect to the Gates of the Mountains Class I area.

[2] The unit of visibility deterioration is the deciview (dV), with 1 dV being equivalent to a 10-fold change in atmospheric clarity. The significance guideline for a project's impact on regional haze is a source whose 98th percentile value of modeled haze index is greater than 0.5 dV, which corresponds to approximately a 5 percent increase in light extinction.

This evaluation of the regional meteorology and direction of prevailing winds at the Project site indicated that emissions would tend to not be transported in the direction of the Gates of the Mountains.

3.2.3. Affected Environment

3.2.3.1. Climate and Vegetation Characteristics

The Project area vicinity is categorized as a humid continental zone, with warm summers and no significant differences in precipitation between seasons (Plantmaps 2018). These climatic areas occur in temperate zones and usually are found in continental interiors, remote from oceans or large bodies of water, and may include elevated mountainous areas. This climate zone is characterized by relatively warm summers and cold winters, and is subject to wide temperature fluctuation between night and day. Average daily temperatures during the colder months (November through March) are typically below freezing. Total precipitation is generally less than 20 inches per year.

Review of meteorological data from the region supports this characterization of the locale. The Proponent has operated a monitoring station in the Project area since April 2012 at an elevation of 5,699 feet to support air dispersion modeling for the DEQ MAQP, and other baseline studies. **Table 3.2-2** summarizes overall annual climate data from the White Sulphur Springs station from 1981 to 2010, operated under the auspices of the National Oceanic and Atmospheric Administration (NOAA 2017).

Table 3.2-2
Climate Data for the Project Vicinity – White Sulphur Springs, Montana

Month	Maximums °F	Minimums °F	Averages °F	Precipitation inches
January	33.8	13.7	23.7	0.39
February	36.5	14.6	25.6	0.38
March	44.6	21.3	32.9	0.78
April	53.8	27.7	40.7	1.38
May	63.0	35.3	49.2	2.08
June	71.3	42.7	57.0	2.29
July	81.0	48.2	64.6	1.46
August	81.1	46.6	63.8	1.24
September	69.7	38.3	54.0	1.15
October	56.8	29.4	43.1	0.83
November	41.3	20.5	30.9	0.50
December	32.5	12.3	22.4	0.51
Annual average temperature Annual total precipitation	55.5	29.2	42.3	13.0

Source: NOAA 2017; "1981-2010 Normals"
°F = degrees Fahrenheit

3.2.3.2. Existing Air Quality

No air pollution monitoring stations are proximate to the Project site. The two closest monitoring stations that actively collect data that may be considered representative are the Sieben Flats station, located approximately 54 miles west-northwest of the site and the Helena-Rossiter station located approximately 53 miles west of the site. **Tables 3.2-3 and 3.2-4** provide ambient air data collected in recent years in the region, as indicators of existing air quality. The values in these tables do not exclude exceptional events, which are unusual meteorological conditions that tend to exaggerate the monitored pollutant concentrations. If such events were excluded from the daily values and annual averages, the monitored concentrations in these tables would likely be lower. These stations are operated or overseen by DEQ to verify that the stations meet federal requirements for monitoring installations to assess air quality status with respect to the NAAQS. Descriptions of four regional monitoring stations used in this EIS to evaluate the affected air quality environment are provided in **Table 3.2-5** (USEPA 2018d). At least one location monitors each of the criteria pollutants; however, ambient air lead concentrations have not been monitored in western Montana for over 10 years.

Notably, most of Montana is in attainment or unclassifiable for criteria pollutants, with the exception of PM_{10} in several areas primarily in the northwest portion of the state, and two areas that are nonattainment for SO_2 standards. The closest nonattainment area to the Project site is the East Helena SO_2 nonattainment area that encompasses part of Lewis and Clark County. This area is approximately 50 miles west of the Project site. An area of PM_{10} nonattainment is also in Silver Bow County, encompassing Butte, Montana, and it is approximately 100 miles west of the Project site. Although the area was designated as nonattainment in 1990 for violations in the late 1980s, there has not been an exceedance or violation of the standard since 1990. Monitoring data presented in the following tables show the occurrence of ambient concentrations versus the NAAQS.

3.2.3.3. Atmospheric Deposition and Regional Haze

Atmospheric deposition transfers air pollutants such as toxic organic compounds, toxic metals, and inorganic acids from the air to the earth’s surface and affects water quality due to precipitation runoff into waterbodies. Once in water, mercury is converted to methyl mercury, a chemical form that can become concentrated in fish and can harm the health of individuals who consume these fish, particularly children. Further, acid rain threatens certain aquatic ecosystems, especially in high-altitude mountain lakes and streams with limited buffering capacity (NAPAP 2011; GAO 2013).

Table 3.2-3
Historical Regional Trends, Gaseous Criteria Pollutants, 2012–2016

Basis and Monitored Year [a]	**CO, 1-Hour Primary**	**CO, 8-Hour Primary**	**Ozone, 1-Hour Primary**	**Ozone, 1-Hour Primary**	**Ozone, 8-Hour Primary**	**Ozone, 8-Hour Primary**	**NO_2, 1-Hour Primary**	**NO_2, Annual Primary**	**SO_2, 1-Hour Primary**	**SO_2, 3-Hour Secondary**
Monitoring Station	Sieben Flats	Sieben Flats	Sieben Flats	Lewistown	Sieben Flats	Lewistown	Lewistown	Lewistown	Sieben Flats	Sieben Flats
NAAQS Standard	35 ppm	9 ppm	NA	NA	0.070 ppm	0.070 ppm	100 ppb [b]	53 ppb	0.075 ppm [d]	0.5 ppm
MAAQS Standard	23 ppm	9 ppm	0.10 ppm	0.10 ppm	NA	NA	300 ppb [c]	50 ppb	0.5 ppm [e]	NA
Exceedance Criterion	NAAQS - Not more than once per year. MAAQS - Not more than once per 12 consecutive months	NAAQS - Not more than once per year. MAAQS - Not more than once per 12 consecutive months	Only in Nonattainment Areas predating 8-hour standard [a, f]	Only in Nonattainment Areas predating 8-hour standard [a, f]	Not more than once per calendar year [g]	Not more than once per calendar year [g]	See footnotes indicated above [h]	NAAQS –Calendar year mean average MAAQS – Average over 4 consecutive quarters [i]	See footnotes indicated above [j]	Not more than once per year [k]
Year	Monitored Criteria Pollutant Data (ppb)									
2012	0.59	0.5	0.056	0.039	0.053	0.036	16, 17	0.69	1.8	2.9
2013	0.37	0.3	0.058	0.058	0.055	0.056	14, 17	0.71	1.9	1.8
2014	0.7	0.6	0.065	0.066	0.06	0.059	13, 18	1.43	1.6	2.2
2015	1.1	0.9	0.063	0.060	0.06	0.060	12, 15	1.31	1.7	1.7
2016	0.84	0.6	0.060	0.059	0.056	0.057	9, 14	0.49	2.0	2.0
Meeting standards?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Sources: USEPA 2018d, Air Quality System Data See **Table 3.2-** for the descriptions of the individual stations.

CO = carbon monoxide; MAAQS = Montana Ambient Air Quality Standards; NA = no applicable standards; NAAQS = National Ambient Air Quality Standards; NO_2 = nitrogen oxide; ppb = parts per billion; ppm = parts per million; SO_2 = sulfur dioxide

Notes:

[a] The primary 1-hour ozone standards for Montana apply only in ozone nonattainment areas that predate the 8-hour federal standard. However, there are no such areas currently in the state.
[b] Federal violation if the 3-year average of the 98th percentile of the daily maximum 1-hour averages exceeds the standard at a monitoring station
[c] State violation if the standard is exceeded more than once during any 12 consecutive months
[d] Federal violation if the 3-year average of the 99th percentile of the daily maximum 1-hour averages exceeds the standard at a monitoring station
[e] State violation if the standard is exceeded more than 18 times in any 12 consecutive months
[f] 98th percentile of 1-hour measurements listed
[g] Second maximum 8-hour measurement is listed, exceedance if the standard is exceeded more than once per year.
[h] Values listed are the 98th percentile of 1-hour values for the federal standard, and second maximum 1-hour measurement for state standard not to be exceeded more than once per year.
[i] Values listed are calendar year averages as reported for that station.
[j] Values listed are the 99th percentile of 1-hour values for the federal standard, which approximately equals 18 occurrences per 12 months of 1-hour values for the state standard.
[k] Values listed are the second highest 3-hour measurement for the federal standard not to be exceeded more than once per year.

Table 3.2-4
Historical Regional Trends, Particulate Criteria Pollutants, 2012–2016

Basis and Monitored Year[a]	PM_{10}, 24-Hour Primary and Secondary	PM_{10}, Annual Secondary	PM_{10}, 24-Hour Primary and Secondary	PM_{10}, Annual Secondary	$PM_{2.5}$, 24-Hour Primary	$PM_{2.5}$, 24-Hour Primary	$PM_{2.5}$, 24-Hour Primary	$PM_{2.5}$, 24-Hour Primary	$PM_{2.5}$, Annual Primary	$PM_{2.5}$, Annual Primary	$PM_{2.5}$, Annual Primary	$PM_{2.5}$, Annual Primary
Monitoring Station	Lewistown	Lewistown	Butte-Greeley School	Butte-Greeley School	Sieben Flats	Lewistown	Helena-Rossiter	Butte-Greeley School	Sieben Flats	Lewistown	Helena-Rossiter	Butte-Greeley School
NAAQS Standard	150 $\mu g/m^3$	NA	150 $\mu g/m^3$	NA	35 $\mu g/m^3$ [b]	35 $\mu g/m^3$ [b]	35 $\mu g/m^3$ [b]	35 $\mu g/m^3$ [b]	12 $\mu g/m^3$	12 $\mu g/m^3$	12 $\mu g/m^3$	12 $\mu g/m^3$
MAAQS Standard	150 $\mu g/m^3$	50 $\mu g/m^3$	150 $\mu g/m^3$	50 $\mu g/m^3$	NA	NA	NA	NA	NA	NA	NA	NA
Exceedance Criterion	Not more than once per calendar year [c]	3-year mean of 24-hour averages [d]	Not more than once per calendar year [c]	3-year mean of 24-hour averages [d]	See footnotes indicated above [e]	See footnotes indicated above [e]	See footnotes indicated above [e]	See footnotes indicated above [e]	3-year running average of annual means [f]	3-year running average of annual means [f]	3-year running average of annual means [f]	3-year running average of annual means [f]
2012	20	5.0	136	27.8	20.8	10.0	27.8	47.9	4.9	2.6	8.5	11.4
2013	37	7.8	77	22.1	10.3	10.5	24.4	34.8	3.6	3.6	7.2	10.3
2014 [g]	37	7.4	57	20.3	9.5	15.8	23.7	38.2	2.3	4.3	6.7	8.3
2015 [g]	93	9.1	115	19.3	48.4	40.1	37.3	36.9	4.5	5.7	8.2	10.1
2016	45	9.3	51	17.0	10.2	13.6	26.0	23.2	2.2	3.7	6.4	7.7
Meeting standards?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Sources: USEPA 2018d, Air Quality System Data; See **Table 3.2-3** for the descriptions of the individual stations.

$\mu g/m^3$ = microgram per cubic meter; MAAQS = Montana Ambient Air Quality Standards; NA = no applicable standards; NAAQS = National Ambient Air Quality Standards; PM = particulate matter; $PM_{2.5}$ = particulate matter less than or equal to 2.5 microns in diameter; PM_{10} = particulate matter less than or equal to 10 microns in diameter

Notes:

[a] Basis for data comparisons are the federal and state ambient air quality standards.
[b] Federal violation if the 3-year average of the 98th percentile of the 24-hour averages exceeds the standard
[c] Second maximum reading shown; an exceedance occurs if the standard is exceeded more than once per year.
[d] Annual mean of 24-hour measurements is listed; state exceedance occurs if the 3-year running average of these means exceeds the standard.
[e] Annual 98th percentile of the 24-hour averages is listed; a federal exceedance occurs if the 3-year average of the 98th percentile of the 24-hour averages exceeds the standard.
[f] Annual mean of 24-hour measurements is listed; a federal exceedance occurs if the 3-year running average of these means exceeds the standard.
[g] DEQ has submitted exceptional events data for two years in which the monitored 24-hour average $PM_{2.5}$ was higher than the standard. The area is in attainment of the standard after non-representative exceptional events data is excluded.

Table 3.2-5
State or Local Air Monitoring Stations Operating in the Region of the Project Site

Site ID Code	Location	North Latitude (degrees)	West Longitude (degrees)	Monitor Elevation, feet	Approximate Distance and Direction to Project Site	Criteria Pollutant Monitors for O_3	Criteria Pollutant Monitors for NO_2	Criteria Pollutant Monitors for SO_2	Criteria Pollutant Monitors for CO	Criteria Pollutant Monitors for PM_{10}	Criteria Pollutant Monitors for $PM_{2.5}$
30-049-0004	Sieben Flats	46.85049	-111.98727	3,918	54 miles WNW	X	No	X	X	No	X
30-027-0006	Lewistown	47.04854	-109.45532	4,110	70 miles NW	X	X	No	No	X	X
30-093-0005	Butte-Greeley School	46.00240	-112.50089	5,518	88 miles SW	No	No	No	No	X	X
30-049-00026	Helena-Rossiter	46.6588	-112.0131	3,737	53 miles W	No	No	No	No	No	X

Source: USEPA 2018d

CO = carbon monoxide; ID = identification; No = no monitors present for this pollutant; NO_2 = nitrogen dioxide; NW = northwest; O_3 = ozone; $PM_{2.5}$ = particulate matter less than or equal to 2.5 microns in diameter; PM_{10} = particulate matter less than or equal to 10 microns in diameter; SO_2 = sulfur dioxide; SW = southwest; W = west; WNW = west-northwest; X = monitors present for this pollutant

During airborne transport, NOx react with moisture and oxygen in the atmosphere to form nitric acid, nitrates (NO_3-), and NO_2. Similarly, SO_2 reacts to form sulfuric acid, sulfates (SO_4=), and sulfites (SO_3). Most of these chemicals are soluble in water, and would add to the sulfur and nitrogen loading in surface waters. Other toxic inorganic pollutants that can contribute to atmospheric deposition impacts include toxic metals such as aluminum, antimony, arsenic, beryllium, boron, cadmium, chromium, cobalt, copper, lead, manganese, mercury, molybdenum, nickel, silver, selenium, and zinc. Some of these pollutants are carcinogenic, along with organic airborne pollutants that can include polychlorinated biphenyls and polycyclic aromatic hydrocarbons (PAH), both of which are generally carcinogenic.

There are sparse data resources for deposition in the region of the Project. The closest atmospheric deposition site to the Project area is the National Atmospheric Deposition Program site near Helena, approximately 40 miles west. At that location between 2012 and 2016, total annual sulfate deposition averaged 0.00021 lb per acre, and ranged between 0.00016 and 0.00025 lb per acre. Total annual inorganic nitrogen deposition for that same period averaged 0.00023 lb per acre, and ranged between 0.00015 and 0.00028 lb per acre (NADP 2018).

Regional haze is generally observed as impairment of visibility across the landscape. In general, it is caused by multiple sources and activities that emit fine particles and chemical precursors of haze and that are distributed across a broad geographic area. Fine PM and condensed aerosols including sulfates, nitrates, organic carbon, elemental carbon, and soil dust impair visibility by scattering and absorbing sunlight. These phenomena reduce the “visual range,” which is a measure of atmospheric clarity. The IMPROVE (Interagency Monitoring of Protected Visual Environments) monitoring network in Class I areas collects aerosol samples at monitors throughout the country. The data serve to establish baseline visibility conditions and to track changes over time, helping scientists understand the causes of haze and trends in visibility (CIRA 2011).

Absent anthropogenic (caused by human activity) air pollution, maximum natural visual range in the western United States is about 120 miles and about 80 miles in the Eastern United States. Sulfates, including ammonium sulfate, comprise about 70 percent of visibility impacts in the East and about 30 percent in the West. Due to photochemistry, the visibility impacts of nitrates tend to be highest during the winter (less sunlight) and lowest during the summer (more sunlight) (CIRA 1999).

Visibility in the vicinity of the Project site is usually high, except during times of forest fires or controlled burning. The University of Montana provides an interactive website with information on federal wilderness areas in Montana (UMT 2018). Three U.S. Forest Service designated wilderness areas are within 60 miles of the Project site: Gates of the Mountains (34 miles west), Lee Metcalf (56 miles south-southwest), and Absaroka-Beartooth (50 miles south). Visibility data is available from an IMPROVE station that operates in the Gates of the Mountains Wilderness Area, which is the closest Class 1 area to the Project site. The most recently available IMPROVE data for the period 2011-2015 show improvement in visibility at Gates of the Mountains reflected in a reduction in average deciview levels for the clearest days of 65 percent, compared to baseline conditions in 2000-2004. The haziest days at Gates of the Mountains exhibited an increase of 3 percent in average deciview levels over the same time span. Overall, visibility conditions in the western Montana wilderness areas were reported to be improving (DEQ 2017).

3.2.4. Environmental Consequences

Environmental consequences related to air quality are generally evaluated by comparison to objective standards, as discussed in this section. The assessment of potential air quality impacts relies on a quantification of the emissions from the construction and operations phases of the Proposed Action. Estimated mining and processing emissions are presented in detail in the application for an MAQP, based on projected maximum levels of construction and copper production (Tintina 2018).

For the criteria pollutants, the DEQ application also describes the results of dispersion modeling analyses that demonstrate conformance with ambient air standards. In addition to criteria pollutants, estimated future emissions of non-criteria HAPs are based on maximum operation of diesel-fueled vehicles and stationary engines.

This review of environmental consequences includes air dispersion modeling results that consider the impacts due to fugitive dust on natural resources. A related area of this evaluation is examination of possible dust transport impacts on the Smith River basin.

3.2.4.1. No Action Alternative

With respect to air quality, the No Action Alternative is the baseline upon which potential impacts of Project sources can be measured. Under the No Action Alternative, DEQ would not approve the Proponent's MOP Application (Tintina 2017), and the mine and processing plant described in the application for an MAQP would not be constructed. The No Action Alternative recognizes that the Proponent could continue any surface exploration activities at the Project site under its Exploration License No. 00710. The operations within the Project site would not exceed the current level, which corresponds to the potential for air emissions related to the permitted exploratory activities.

3.2.4.2. Proposed Action

Under the Proposed Action, the Proponent plans to mine copper-enriched rock from the upper and lower Johnny Lee Deposit mining zones, which would involve a variety of sources of air pollutant emissions. Total surface disturbance required for construction and operations of all mine-related facilities, which in part defines the level of Project emissions, comprises approximately 311 acres. The northwest sector of the mine property area would contain mine ventilation raises, from which emissions from underground activities would be released. The southern property sector would contain the mine surface operations and air emission sources including the mine portal, milling, and material processing facilities, two emergency backup RICE generators, a CTF, and material stockpiles.

Different air emission sources are related to mine construction and operations phases. The expected life of the mine is approximately 19 years including a 2-year development phase consisting of construction and development mining, approximately 13 years of active mine operations and milling, and 4 years of reclamation and closure. Mining would occur at a rate of approximately 1.3 million tpy or roughly 3,640 tons per day of copper-enriched rock averaged over the life of the mine. During the development phase, waste rock could be processed up to 6,000 tons per day. The air emissions are proportional to ore production rates, and relevant control measures differ for the Project phases, as described in the following sections.

Air Quality Permitting

The Proponent has applied for a new MAQP, pursuant to major source Title V requirements, following the procedures prescribed by DEQ. Under federal and Montana regulations, fugitive emissions for mines are not included in determining applicability of Title V permitting. The new MAQP must be obtained before starting construction at the site, and would specify the applicable state and federal air quality requirements. The issuance of the MAQP demonstrates that the operating facility would not exceed state or federal ambient air quality standards. Within 12 months after commencing operations, the Proponent would be required to submit an application for a Title V Operating Permit. The conditions in the MAQP would specify the monitoring, recordkeeping, and reporting requirements that apply to the Project.

The regulated air pollutants that would be emitted from the Project would include:

- NO_X
- PM
- PM_{10}
- $PM_{2.5}$
- SO_2
- VOCs
- CO
- HAP
- [3] GHG expressed as CO_2e

The sources identified for inclusion in the MAQP are listed as criteria pollutant point sources and fugitive particulate sources in **Table 3.2-6** and **Table 3.2-7**, respectively. By including both construction and operations phase emission units in the MAQP would allow flexibility during the transition between construction and copper production activities. Contracted equipment may be on site during construction and operations, such as a temporary construction crusher or a temporary concrete batch plant, but associated permitting would be the responsibility of that particular contractor. As part of the process to transfer temporary operations onto the site, the required agency notifications would be submitted for the permitted equipment.

[3] Greenhouse Gases (GHG) are federally regulated pollutants that will be emitted by some Project sources, but levels are expected to be below thresholds for regulatory requirements, including mandatory annual reporting.

Table 3.2-6
Roster of Proposed Action Stationary Point Sources

Source ID	Name	Constr. Phase [a]	Oper. Phase [b]	PM tpy	PM_{10} tpy	$PM_{2.5}$ tpy	SO_2 tpy	NOx tpy	CO tpy	VOC tpy
P1	250 tph Portable conical crusher	X	N/A	1.31	0.59	0.11	--	--	--	--
P2	325 hp Portable diesel engine/generator	X	N/A	0.47	0.47	0.47	0.17	9.36	8.19	3.52
P3	2 Portable screens (400 tph each)	X	N/A	7.71	2.59	0.18	--	--	--	--
P4	131 hp Portable diesel engine/generator	X	N/A	0.28	0.28	0.28	0.07	3.77	4.72	1.42
P5	545 kW/914 hp Portable diesel engine/generator	X	X	1.32	1.32	1.32	0.49	42.10	23.02	9.88
P6	320 kW/536 hp Portable diesel engine/generator	X	X	0.77	0.77	0.77	0.03	15.45	13.52	5.80
P7	2 1000 kW/1675 hp Diesel emergency generator	N/A	X	0.28	0.28	0.28	0.10	8.81	4.82	2.07
P8	100 hp Diesel engine/generator – emergency evacuation hoists	N/A	X	0.02	0.02	0.02	<0.005	0.19	0.21	0.06
P9	50 hp Diesel fire pump – emergency	X	X	0.01	0.01	0.01	< 0.0 05	0.10	0.10	0.03
P10A	23 MMBtu/hr Propane-fired heater – intake vent for upper copper zone	N/A	X	0.45	0.45	0.45	0.03	8.33	4.80	0.64
P10B	52 MMBtu/hr Propane-fired heater – intake vent lower copper zone	N/A	X	1.01	1.01	1.01	0.08	18.83	10.86	1.45
P11	3 Temporary diesel heaters at portal (1.2 MMBtu/hr total)	X	N/A	0.05	0.05	0.05	0.08	0.75	0.19	0.02
P12	3,640 tpd jaw crusher	N/A	X	3.19	3.19	3.19	--	--	--	--
P13A	Mill Building (mill, lime storage, etc.)	N/A	X	0.19	0.19	0.19	--	--	--	--
P13B	Mill Building (lime area/slurry mix tank)	N/A	X	1.24	1.24	1.24	--	--	--	--
P14	Surge bin discharge	N/A	X	1.88	1.88	1.88	--	--	--	--
P15	Water treatment plant lime area	N/A	X	1.24	1.24	1.24	--	--	--	--

Source ID	Name	Constr. Phase [a]	Oper. Phase [b]	PM tpy	PM_{10} tpy	$PM_{2.5}$ tpy	SO_2 tpy	NOx tpy	CO tpy	VOC tpy
P16A	Backfill Plant cement/fly ash hopper	X	X	0.23	0.23	0.23	--	--	--	--
P16B	Backfill Plant cement/fly ash silo	X	X	0.45	0.45	0.45	--	--	--	--
P17	4 Portable diesel engine/generator (400 hp total)	X	X	1.15	1.15	1.15	0.21	13.54	14.40	4.33
P18	Air Compressor - 275 hp diesel engine	X	N/A	0.40	0.40	0.40	0.15	7.92	6.93	2.98
F26	14-hp Portable diesel-powered light plants (11 Constr., 4 Oper.)	X	X	1.48	1.48	1.48	0.008	20.91	4.51	1.67
F27	500 gal Gasoline storage tank	X	X							0.07
F28	Temp. LPG-fired heaters (37.8 MMBtu/hr total) (9 Constr., 3 Oper.)	X	X	1.27	1.27	1.27	0.10	23.57	13.60	1.81
UG	ANFO underground explosive	X	X	0.11	0.06	<0.005	1.55	13.19	51.97	--
	TOTAL POINT SOURCES			26.49	20.60	17.65	3.07	186.82	161.83	35.74

Source: Tintina 2018

Dashes "---" indicate that a specific pollutant is not emitted from that source; ANFO = ammonium nitrate/fuel oil (explosive); CO = carbon monoxide; Constr. = Construction; gal = gallon; hp = horsepower; kW = kilowatt; LPG = liquefied petroleum gas; MMBtu = million British thermal units; N/A indicates a given source is not present in the construction or operations phase; NO_X = nitrogen oxides; Oper. = Operations; PM = particulate matter; $PM_{2.5}$ = PM less than 2.5 microns diameter; PM_{10} – PM less than 10 microns diameter; SO_2 = sulfur dioxide; Temp. = temporary; tpd = tons per day; tph = tons per hour; tpy = tons per year; VOC = volatile organic compounds

Notes:

[a] The period of construction phase emissions is defined as mine operating Years 0 through 2.

[b] The period of operations phase emissions is defined as mine operating Years 2 through 16.

Table 3.2-7
Roster of Proposed Action Fugitive Dust Sources

ID	Name	Constr. Phase	Oper. Phase	PM tpy	PM_{10} tpy	$PM_{2.5}$ tpy
F1	Road dust, mine operating year 0 to 1	X	N/A	152.70	38.92	3.90
F2	Road dust, operating Year 1 to 2	X	N/A	56.42	14.38	1.44
F3	Road dust, operating Year 2 to 15, annual average	N/A	X	17.79	4.53	0.45
F4	Road dust, operating Year 16 and 17, annual average	N/A	X	73.80	18.81	1.88
F5	Road dust, operating Year 18	N/A	X	11.68	2.98	0.30
F6	Material transfer to temporary stockpile, operating Year 0 to 1.5	X	N/A	3.13	0.91	0.30
F7	Temporary construction stockpile	X	N/A	0.36	0.18	0.03
F8	Embankment construction, operating Year 0 to 1.5	X	N/A	3.13	0.91	0.30
F9	Backfill, NCWR embankment material to CTF, operating Year 16 to 18	N/A	X	1.78	0.52	0.17
F10	Material transfer to south stockpile, operating Year 0 to 1	X	N/A	1.49	0.43	0.14
F11	Excess reclamation stockpile (south)	X	X	0.08	0.04	0.01
F12	Material transfer from south stockpile, operating Year 16 to 17	N/A	X	1.49	0.43	0.14
F13	Material transfer to north stockpile, operating Year 0 to 1	X	N/A	2.13	0.62	0.20
F14	Excess reclamation stockpile (north)	X	X	0.17	0.08	0.01
F15	Material transfer from north stockpile, operating Year 16 to 18	N/A	X	0.82	0.24	0.08
F16	Soil removal and stockpiling, operating Year 0 to 1	X	N/A	4.99	1.45	0.47
F17	Topsoil pile	X	X	0.08	0.04	0.01
F18	Subsoil pile	X	X	0.44	0.22	0.03
F19	Soil return, operating Year 16 to 18	N/A	X	4.17	1.21	0.39
F20	Copper-enriched rock drop to stockpile, operating Year 2 to 3	X	N/A	0.16	0.06	0.06
F21	Copper-enriched rock stockpile (mill feed)	N/A	X	<0.005	<0.005	<0.001
F22	Waste rock drop at WRS Pad, operating Year 0 to 1.5, at CTF, operating Year 1.5 to 4, and 8	X	X	0.87	0.35	0.35
F23	Temporary WRS	X	N/A	0.019	0.010	0.001
F24	Waste rock transfer from WRS to CTF, operating Year 2 to 3	X	N/A	1.39	0.56	0.56

ID	**Name**	**Constr. Phase**	**Oper. Phase**	**PM tpy**	**PM_{10} tpy**	**$PM_{2.5}$ tpy**
F25	WRS pad reclamation, operating Year 3	N/A	X	1.65	0.48	0.16
F29	Road dust, construction access road, Year 0-2 average	X	N/A	0.90	0.23	0.02
F30	Road dust, main access road, Year 2-15 average	X	X	102.19	26.05	2.61
IEU1	Diesel storage tanks (250 gal, 500 gal, 10,000 gal)	X	X	--	---	---
	TOTAL FUGITIVE PARTICULATE SOURCES			340.77	88.38	11.38

Source: Tintina 2018

Dashes "---" indicate that a specific pollutant is not emitted from that source; Constr. = Construction; CTF = Cemented Tailings Facility; gal = gallon; N/A indicates a given source is not present in the construction or operations phase; NCWR = Non-Contact Water Reservoir; Oper. = Operations; PM = particulate matter; $PM_{2.5}$ = PM less than 2.5 microns diameter; PM_{10} = PM less than 10 microns diameter; tpy = tons per year; WRS = waste rock storage

Notes:

[a] The period of construction phase emissions is defined as mine operating Years 0 through 2.

[b] The period of operations phase emissions is defined as mine operating Years 2 through 16.

Mine Construction Phase Emission Sources

As listed in **Tables 3.2-6** and **3.2-7**, sources that comprise the mine construction activities are temporary engine-driven generators, portable conical crusher and screens, temporary diesel-fired heaters, and an engine-driven air compressor. Point sources such as diesel-engine-driven generators and propane heaters emit primarily the pollutants PM_{10}, CO, and NO_X. These sources were included as discrete point sources in the dispersion modeling supporting the air permitting for the Project. The fugitive sources related to mine construction would be haul, access, and construction road dust from vehicle travel during the first 2 mine operating years, earth-moving equipment, material transferred and stored in several temporary construction stockpiles, top soil and subsoil piles, and WRS piles. The use of ammonium nitrate/fuel oil (ANFO) explosives underground is also considered a mine construction phase source. Annual emissions for these sources are listed in **Tables 3.2-6** and **3.2-7**, based on emission calculation methods summarized in the following Project Air Emission Inventory section.

Some construction phase emissions listed in **Tables 3.2-6** and **3.2-7** would be slightly higher due to construction of the planned TWSP, an activity that is not explicitly included in the tabulated emission estimates. The added emissions would consist of PM during earthmoving to construct the impoundment and surrounding berm enclosure. These particulate emission increases (PM_{10}) are estimated at less than 1 ton per year. This small increase does not significantly impact the modeling results in comparison to the PM_{10} 24-hour ambient air quality standard, which was previously modeled at 80 percent of the standard. This change would result in a less than 1 percent increase in the modeled 24-hour PM_{10} results. Therefore, the minor PM_{10} emissions increase associated with the TWSP construction does not materially change the modeled PM_{10} 24-hour concentration. Further, these emissions would be transient in nature, and would not extend into the operations phase of the Project.

Future waste rock from ongoing mine development would be placed into the CTF along with the mill tailings. A temporary WRS facility would be constructed between the mine portal and the Mill Building to receive waste rock generated until construction of the CTF is completed. These material transfer activities represent fugitive dust emissions that were estimated and included in the dispersion modeling to characterize the potential impacts from the Project.

Operations Phase Surface Operation Emission Sources

The point sources for the operations phase, generally beyond operating Year 2, include many of the same sources that would be used during mine construction. Operations phase emission sources are listed in **Tables 3.2-6 and 3.2-7**, for point and fugitive sources, respectively. Added sources beyond the construction phase would consist of portable and stationary engine-driven generators, two propane-fired heaters for intake vent air, the primary jaw crusher system, and the Mill Building sources described in a preceding section. For years beyond Year 2, these operations phase sources were incorporated in the 2018 air dispersion modeling performed to support the air quality analysis.

As part of the overall dust mitigation for the Project, permanent processing facilities would have enclosed conveyors, or conveyors enclosed within buildings, and high-efficiency dust collectors to minimize particulate emissions. The Mill Building and mill area would contain the following processes: grinding, flotation, regrinding, concentrate dewatering and handling, reagent handling, paste backfill mixing, and tailings thickening. A dust collection system would capture fugitive dust from various areas inside the Mill Building, but generally, the fine milling and separation steps are wet processes and require little dust collection. Temporary crushers and portable screens would use enclosures and water sprays for dust control.

Two permanent, RICE emergency backup generators would be located near the Mill Building and would be available in the event of a power outage during the operations phase. Other smaller portable engine-driven generators would be installed at various locations across the site during mine and facility construction activities.

A paste plant in the mill complex would mix fine-grained tailings from the milling process with a binder (the binder is a combination of cement and fly ash) for deposition both underground and in the CTF. Dust sources included in the paste plant would be controlled by enclosed conveyors and dust collectors. The use of cemented tailings inhibits dust formation from the tailings impoundment, and provides added surface crust strength.

Minimal PM emissions would result from fine ore grinding and concentrate loadout activities. Ore grinding operations at the semi-autogenous grinder (SAG) in the Mill Building would be fully enclosed and wet; therefore, the mill would not be a source of air emissions. Moist concentrates would be stored at the loadout inside an enclosed building with truck access. The facility would be covered to substantially eliminate fugitive dust emissions. The mitigation measures for air emissions described in the MOP Application (Tintina 2017) provide several methods associated with loadout activities, which would be effective in minimizing emissions.

Five main material stockpiles would be used for reclamation material (excavated bedrock, two stockpiles), topsoil, subsoil, and temporary construction material. Stockpiles would be wind-fenced and/or treated with water or chemical dust suppressants as necessary to maintain compliance with reasonable precautions requirements. Soil and subsoil stockpiles would be revegetated in place prior to their use in mine closure.

Underground Operations Emission Sources

Four 16-foot diameter raises (surface vents), which are considered air emission point sources, would be constructed from the mining zones to the surface to provide ventilation of the underground operations. These airways clear fumes from blasting and diesel equipment and also provide fresh air to the underground work areas. The entire Project would use two intake ventilation raises and two exhaust raises. The two exhaust raises, in addition to the portal, constitute sources of air pollution from underground activities and are accounted for in the modeling to support the MAQP application.

The underground vent raises include the two types of emissions described above and emissions from the direct-fired, propane-fueled heaters. The vent heaters provide seasonal heat to the intake vents and, as such, are limited in usage from October to April (212 days or 5,088 hours of operation per year). The vent heaters and blasting emissions are included in both potential emissions estimates for permitting and regulatory applicability as well as their contributions to the modeled vent emissions. Underground mobile source diesel equipment is exempt from permitting but is included in the ambient air quality impacts analysis only as those emissions exit through the vents.

Explosives, primarily ANFO, would be used for underground mining, and this operation would result in the release of gaseous (NO_2, SO_2, and CO) and particulate (PM, PM_{10}, and $PM_{2.5}$) emissions. ANFO is a common bulk industrial explosive mixture that accounts for roughly 80 percent of explosives used annually in North America. The mixture provides a reliable explosive that is relatively easy to use, highly stable until detonation, and low in cost. While blasting seemingly generates large amounts of dust, the operation occurs infrequently and is confined to the underground mine areas; therefore, it would not be a significant contributor to total annual emissions of PM_{10} and other pollutants.

Project Air Emissions Inventory

Criteria Pollutants

The emission factors for the criteria pollutant inventory used in this analysis were primarily obtained from three sources:

- The USEPA document, Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources (AP-42), Fifth Edition (USEPA 1996, 2008).
- Manufacturer's specifications for control equipment.
- Regulatory requirements for emissions (for USEPA Tier 3 stationary engines, for example).

Surface and underground mobile source emissions were calculated based on engine category data, manufacturer's Tier 3 certifications, MOBILE6 (a USEPA mobile source emissions estimation tool), and engineering estimates where appropriate. Sulfur content in diesel fuel was based on current regulatory specification of 15 parts per million (ppm) maximum sulfur content, which became effective in 2007. Emissions for stationary engines were based on the estimated daily operating schedule of each piece of equipment and the USEPA NONROAD estimation tool for non-road equipment emissions (USEPA 2008). The results of the emission calculations for each permitted source are tabulated in **Tables 3.2-6** and **3.2-7**. More details for the emission inventory calculations are provided in the application for the MAQP (Tintina 2018).

For each fugitive emission source, the year in which emissions are highest (i.e., the year in which the most material is moved) is the year used for emissions estimates that were modeled across the entire period during which the emission activity would occur. The emissions for underground mobile sources were calculated to quantify emissions exiting from the portal and two exhaust raises, which are relevant for the ambient air quality modeling. Fugitive particulate emissions from mobile sources movement in the underground mine would be negligible due to the high moisture content of traveled surfaces underground, low air circulation speeds underground, and containment in the mine itself.

Hazardous Air Pollutants

Total HAPs emissions resulting from diesel fuel combustion are considered fugitive sources, and consist of surface and underground mobile sources, as well as stationary and portable engine-driven equipment. Fuel economy and compliance with appropriate USEPA Tier emissions performance for these engines would reduce HAP emissions.

The maximum fuel consumption rate during the peak operating Years 4 through 13 as provided by the Proponent would be 2,210 gallons of diesel used per day. Overall HAP emissions for mobile sources are estimated using this maximum diesel fuel consumption rate and the emission factor for total HAPs from published USEPA values pertaining to gasoline and diesel industrial engines (USEPA 1996). On this basis, total HAP emissions from mobile sources are estimated to be 0.37 tpy (Tintina 2018).[4]

In addition to mobile source HAP emissions, trace metals are present in ore, tailings, and concentrate. During mining, handling, and processing of these materials, emissions of these metals, some of which are identified as HAPs, may occur as a fraction of the PM emitted from these operations. The primary trace metals found in the Project site solids are arsenic, cadmium, copper, lead, and zinc (copper and zinc are not included on USEPA's HAPs list under Section 112 of the Clean Air Act). The regional soil Background Threshold Values from DEQ for arsenic, cadmium, and lead are 22.5, 0.7, and 29.8 mg/kg, respectively, so that total regional background for these metals is 53 mg/kg. Conservatively assuming the soils at the Project site were twice as high as the Background Threshold Values, this corresponds to a total of 106 mg/kg, equivalent to 0.212 lb/ton of the three toxic metals. On this basis, the estimated total toxic metals emissions are 0.03 tpy (Tintina 2018).[5]

As a result, the total estimated amount of HAPs emitted from the fuel and ore processing would be 0.40 tpy. At this level, the Project would be classified by DEQ as a minor or "area source" with respect to HAPs.

Air Emission Mitigation Measures

Montana air regulations (ARM 17.8.752) require that new or modified sources implement the maximum degree of air pollution reduction that is technically and economically available and feasible. This level of emissions reduction is referred to in regulatory terms as "best available control technology" (BACT) and is a case-by-case agency decision that considers energy, environment, and economic impacts. Achieving a BACT emission level can require either add-on control equipment or modifications to production processes depending on the emissions source. It may also involve a process design, work practice, operational standard, or addition of

[4] The amount of fuel used each year was converted from a gal/yr basis to an MMBtu/yr basis using a diesel heat content of 0.137 MMBtu/gal (EPA 1996). The resulting annual heat input to diesel engines is:

Fuel usage operating Years 4–13 = 806,384 gal/yr x (0.137 MMBtu/gal) = 110,474 MMBtu/yr

Total HAP emissions = (110,474 MMBtu/yr x 0.0067 lb HAP/MMBtu)/2000 lb/ton = 0.37 tons/yr

[5] Taking the product of the factor 0.212 lb metals/ton emitted with the amount of particulate emitted site-wide would be (both construction and operations phases, point/fugitive combined):

Total toxic metals emissions = (0.212 lb/ton x 320 tons of particulate emitted/yr)/2000 lb/ton = 0.33 tons/yr control equipment. In addition to BACT measures, the Proponent would implement a range of dust emission mitigation measures that would reduce emissions from fugitive dust sources.

Surface Mine Operations and Material Handling

As described in the MAQP application, the Proponent would operate all equipment to provide for maximum air pollution control for which it was designed (Tintina 2018). The mitigation measures for process and fugitive sources have been described in a prior section for the individual PM that are included in the MAQP for the Project.

Contemporaneous reclamation of disturbances would be a priority during the mine construction phase to reduce the potential for fugitive dust. Surface disturbances related to cut and fill slopes associated with roads, ditches, embankment faces, and the disturbed perimeter of facility footprints would be reclaimed immediately where possible after final grades have been established (Tintina 2017). Reclamation includes grading, slope stabilization, drainage control, topsoil and subsoil placement, and seeding. Based on requirements in the DEQ Air Operating Permit, these reclaimed areas would need to be fully revegetated within two years following construction, and these areas would no longer generate windblown dust.

Temporary waste rock and life-of-mine, copper-enriched rock storage areas would be watered as necessary to minimize dust while loading or unloading material. Dust control from the CTF is not expected to be problematic because the material would be moist (20 percent) and would be stabilized with cement additions to provide a non-flowable mass. Other components of the dust control plan considered as reasonable precautions within the MAQP and presented as BACT conditions include (Tintina 2017):

- Minimizing exposed soil areas to the extent possible by prompt revegetation of reclaimed areas;
- Establishing temporary vegetation on inactive soil and subsoil stockpiles that would be in place for 1 year or more;
- Minimizing drop heights to minimize dust production from material transfer;
- Using water and chemical dust suppression products to stabilize access and trucking road surfaces (with additional water application during dry periods); and
- Covering/enclosing conveyor belts.

Underground Explosives

Explosives used for underground mining would result in the release of gaseous (NO_2, SO_2, and CO) and particulate (PM, PM_{10}, and $PM_{2.5}$) emissions. Because the imposition of an emission standard is infeasible for this operation, the Proponent has proposed that BACT for reducing blasting emissions is a set of work practices involving proper blasting techniques, proper explosive and application of explosives, and the use of best operating practices (Tintina 2018):

- Optimize drill-hole size. Optimizing drill-hole size would result in effective blasting and reduce the number of blasts needed to achieve the desired impact.

- Optimize drill hole placement and utilization of sequential detonation. Optimizing drill hole placement would ensure that all material is successfully detonated, and additional explosives are not needed in order to achieve complete fragmentation.
- Optimize usage of explosives. Proper usage of explosives prevents the detonation of unnecessary, excess explosives and resulting excess emissions.
- Mine planning practices such that blasting conducted in a manner that prevents overshooting and minimizes the area to be blasted.

Mine and Facility Roadways

Particulate emissions from fugitive road dust would result from vehicle and equipment travel on roadways within the Project site. A large portion of the traffic on unpaved mine roads would consist of haul trucks and other heavy machinery that tend to degrade road surfaces. Consequently, surface improvement control techniques using asphaltic concrete are both economically impractical and potentially hazardous.

A combination of surface treatments and vehicle restrictions are proposed to reduce fugitive road dust emissions. The primary measures would be water treatment for all mine roads and along the side berms of mine roads, with chemical dust suppressants considered as necessary (particularly on high traffic areas near private ranch buildings). Water sprays applied several times daily would increase the moisture content of mine surface material to promote conglomerate particles and to reduce the likelihood of fine dust becoming airborne. Further vehicle restrictions, such as limiting vehicle speed, would be also be enforced as necessary to control fugitive emissions from mine access road travel (Tintina 2017, 2018).

Fuel-Combustion Equipment

Proposed emission controls for fuel-combustion equipment would meet or exceed BACT emission levels. For the Project, proper design and implementation of good combustion practices for the two propane-fired vent heaters and temporary portable propane and diesel-fired heaters was identified as BACT for NO_X, CO, and VOC. Review of additional add-on controls, such as selective catalytic reduction (SCR) indicated that such controls would be cost-prohibitive for the relatively small heaters. The proposed BACT conforms to previous BACT determinations made by DEQ (Tintina 2018).

The Proponent is proposing to use a variety of diesel engines/generators from light plants powered by 14 horsepower (hp) diesel engines to 1,000-kilowatt emergency backup generators. These are subject to USEPA non-road engine standards, as described in 40 CFR 89 and/or 1039, as well as NSPS Subpart IIII for RICE (see Section 3.2.1, Regulatory Framework for air quality). The proposed BACT conforms to previous BACT determinations made by DEQ for similar-sized diesel engines. With respect to using the most recent (and lowest emitting) engines available, NSPS regulations (40 CFR 60.4208) require owners and operators to install recently manufactured engines that meet the non-road engine standards.

Ambient Air Dispersion Modeling Analysis Results

Montana’s air quality rules require an applicant for a stationary source air quality permit to demonstrate compliance with ambient air quality standards designed to limit environmental impacts from air pollution emissions. For the Project, the proposed emission levels warranted a demonstration of compliance with ambient standards using approved air dispersion modeling techniques.

The air dispersion analysis methodology was designed in accordance with the State of Montana “Modeling Guidance for Air Quality Permit Applications” (DEQ 2007) and federal modeling guidelines provided in Appendix W, 40 CFR 51, “Revisions to the Guideline on Air Quality Models” (USEPA 2017). Ambient background concentrations were added to modeled concentrations for the Project to obtain total concentration impacts for comparison to the NAAQS and MAAQS. Complete details regarding the model analysis methods and model inputs are provided in the modeling discussion included in the MAQP application (Tintina 2018).

In summary, the model conservatively overestimates facility-wide emission rates by simultaneously modeling the processes occurring during both the mine construction and operations phases, even though many such sources would not occur at the same time. Certain earthwork activities during mine construction would occur at different times throughout multiple areas of the mine. The model overestimates these operations by assuming that the identified earthmoving activities within the construction phase would occur simultaneously. Road dust fugitive emissions have also been included in the model for haul road and access road traffic in both construction and operations phases.

Total Modeled Impacts Compared to NAAQS

Monitored offsite background concentrations, combined with modeled Project impacts, were used to provide a cumulative NAAQS air impact modeling analysis. Ambient background concentrations are added to modeled impacts to demonstrate compliance with applicable NAAQS and MAAQS. DEQ guidance indicates that if ambient monitoring does not exist on site, then ambient data should be utilized from a monitoring station in an area of similar characteristics of the modeling domain.

In this analysis, the Proponent used criteria pollutant background concentrations collected at the Sieben Flats monitoring station and the Lewistown monitoring station, as summarized in **Table 3.2-8**. The Sieben Flats station monitors background air quality to support scientific research in public health, atmospheric science, and ecological science. The monitoring station resides approximately 17.7 miles north-northeast of Helena, Montana, in an area of rural, agricultural land characteristic to the region surrounding the Project site. Monitoring data from the Sieben station was used for all criteria pollutants except for NO_2. The Lewistown station provides another set of monitoring data characteristic of the Project vicinity and this data set was used for NO_2 and PM_{10} background concentration values.

Table 3.2-8
Selected Monitored Background Concentrations for NAAQS/MAAQS Analysis

Pollutant	Averaging Period	Background [a] Concentration ($\mu g/m^3$)	Monitoring Station
PM_{10} [b]	24-hour	30.3 [c]	Lewistown
$PM_{2.5}$ [b]	24-hour	10	Sieben Flats
	Annual	2.5	Sieben Flats
SO_2	1-hour	5.24 [d]	Sieben Flats
CO	1-hour	0.9 [c]	Sieben Flats
NO_2	1-hour	20.7 [e]	Lewistown
	Annual	1 [f]	Lewistown

Source: Tintina 2018

$\mu g/m^3$ = microgram per cubic meter; CO = carbon monoxide; MAAQS = Montana Ambient Air Quality Standards; NAAQS = National Ambient Air Quality Standards; NO_2 = nitrogen dioxide; $PM_{2.5}$ = particulate matter less than 2.5 microns diameter; PM_{10} =particulate matter less than 10 microns diameter; ppb = parts per billion; SO_2 = sulfur dioxide

Notes:

[a] NAAQS design values provided in 2017 Network Plan produced by Montana DEQ.

[b] Values exclude DEQ-defined exceptional events.

[c] NAAQS design values derived from EPA Monitoring Values Data Report.

[d] Concentration represents 2 ppb.

[e] Concentration represents 11 ppb.

[f] Concentration represents 0.5 ppb. Value not a regulatory calculated value. Internally calculated arithmetic mean provided in 2017 Network Plan. This value is used in lieu of monitored NO_2 Annual NAAQS Design Value.

A summary of the maximum predicted single-location pollutant concentrations predicted by modeling are shown in **Table 3.2-9** (Tintina 2018). Applicable total impacts with the modeled Project impacts added to the background concentration are compared in **Table 3.2-9** to the relevant ambient standards and indicate that the Project would comply with NAAQS and MAAQS. The 1-hour average NO_2 and SO_2 modeling for the Project point sources was performed to demonstrate compliance with the standards promulgated in 2011. The maximum NO_2 concentrations would occur in the mine construction phase, when generators would operate 24 hours/day for 365 days/year. The maximum SO_2 concentration would occur during the operations phase.

As indicated by this analysis, Project impacts related to emissions of CO, SO_2, NO_2, PM_{10}, and $PM_{2.5}$ do not cause or contribute to an exceedance of the relevant MAAQS and NAAQS. Complete details of the refined modeling analysis and results are provided in the MAQP application (Tintina 2018).

Table 3.2-9
Comparison of Total Criteria Pollutant Impacts and Ambient Air Standards

Pollutant	Avg. Period	Modeled Conc. (µg/m^3)	Background Conc. (µg/m^3)	Ambient Conc. (µg/m^3)	NAAQS (µg/m^3)	% of NAAQS	MAAQS (µg/m^3)	% of MAAQS
PM_{10}	24-hour	89.7 [a]	30.3	120	150	80%	150	80%
$PM_{2.5}$	24-hour	12.0 [b]	10	22.0	35	63%	------	------
	Annual	4.25 [c]	2.5	6.75	12	56%	------	------
NO_2	1-hr	131 [d]	20.7	151.7	188	81%	564	36% [e]
	Annual	11.7 [c]	1	12.7	100	13%	94	13%
SO_2	1-hr	5.8 [e]	5.24	11.03	196	6%	1,309	1%
CO	1-hr	1,890 [f]	0.9	1,891	40,000	5%	26,450	7%

Source: Tintina 2018

µg/m^3 = microgram per cubic meter; Avg. = averaging; CO = carbon monoxide; Conc. = concentration; hr = hour; MAAQS = Montana ambient air quality standards; NAAQS = national ambient air quality standards; NO_2 = nitrogen dioxide; $PM_{2.5}$ = particulate matter less than 2.5 microns diameter; PM_{10} =particulate matter less than 10 microns diameter; SO_2 = sulfur dioxide

Notes:

[a] Modeled concentration is the high-6th-high modeled over a 5-year concatenated meteorological period.

[b] Modeled concentration is the high-8th-high modeled over a 5-year concatenated meteorological period.

[c] Modeled concentration is the highest annual average over the modeled 5-year period.

[d] Modeled concentration is the high-8th-high modeled over a 5-year concatenated meteorological period.

[e] Modeled concentration is the high-4th-high modeled impact over a 5-year concatenated meteorological period. High-2nd-high concentration is 184 µg/m^3 and was not included in the table. With the addition of the 20.7 µg/m^3 background value, the ambient impact is 36 percent of the MAAQS.

[f] Modeled concentration is the high-2nd-high modeled over a 5-year concatenated meteorological period.

The impacts from 24-hour PM_{10} and 1-hour NO_2 begin to approach the NAAQS or MAAQS, with maximum levels amounting to 81 percent of the standards. However, it is important to note the very conservative approach in modeling a scenario that is an over-estimation of realistic short-term emissions from mine activity. The construction and operations phase activities were modeled concurrently and the activities within each phase were modeled for the years with the highest throughput or associated impacts. Additionally, the various construction activities and operations of the full roster of portable generators were modeled as though occurring simultaneously, rather than depicting the dynamic nature of the mine construction both spatially and temporally. Even with this conservative emissions scenario, the modeling of mine processes during the construction and operations phases were shown to not cause or contribute to an exceedance of the relevant MAAQS and NAAQS.

The modeled $PM_{2.5}$ impacts for the emergency generators were evaluated separately, as shown in **Table 3.2-10**. The entire roster of criteria pollutants were modeled for the emergency generators, only the 1-hour NO_2 results were higher than the significant impact levels (SILs). Therefore, predicted impacts would not contribute to NAAQS exceedances. Due to the unpredictable nature of emergency operations, the potential fine particulate impacts for these generators were modeled to simulate operation for 2 consecutive but arbitrary hours per day. This scenario provides an overestimation of emergency operations since it totals 728 hours of operation a year, compared to the regulatory allowable schedule of 500 hours per year.

Table 3.2-10
Comparison of Emergency Generator Impacts to Ambient $PM_{2.5}$ NAAQS

Pollutant	Averaging Period	Max. Modeled Concentration [a] (μg/m^3)	Background Concentration (μg/m^3)	Ambient Concentration (μg/m^3)	NAAQS (μg/m^3)	% of NAAQS
NO_2	1-hour	139.26[a]	20.7	15996	188	85%

Source: Tintina 2018
μg/m^3 = microgram per cubic meter; NAAQS = national ambient air quality standards; $PM_{2.5}$ = particulate matter less than 2.5 microns diameter
Note:
[a] Modeled concentration is the high-8th-high modeled over a 5-year concatenated met period

Hazardous Air Pollutant Impact Assessment

Total HAPs emissions for diesel fuel combustion were estimated for the Proposed Action, and consist of surface and underground mobile sources, as well as stationary and portable engine-driven equipment. Overall HAP emissions for mobile sources are estimated using this maximum diesel fuel consumption rate, and published USEPA emission factors pertaining to gasoline and diesel industrial engines (USEPA 1996). On this basis, total HAP emissions from mobile sources are estimated to be up to 0.37 tpy, a very low level of HAP emissions.

Various metals would be present in ore, tailings, waste rock, concentrate, and road dust. Some of the metals are considered HAPs. Among the toxic constituents may be arsenic, antimony, cadmium, chromium, and lead. As presented in a prior section, the estimated emissions of toxic metals from the Project sources are approximately 0.03 tpy. The Project is not explicitly required by Montana air quality regulations (ARM 17.8 Subchapter 7) to assess human health risks from HAP emissions. No Montana risk assessment guidance exists for this source type, so a full risk assessment was beyond the scope of this analysis.

Visibility and Deposition Impacts

As discussed in the Section 3.2.3, Affected Environment, visibility in the vicinity of the Project site is usually high, except during times of forest fires or controlled burning. Overall, visibility conditions in the western Montana wilderness areas were reported to be improving (DEQ 2017). The Project emissions of haze precursors (NOx, SO_2, VOC) are well below the regulatory thresholds for which an assessment of visibility impacts are required for new or modified projects.

With respect to deposition, under the federal and Montana Clean Air Acts, impacts on vegetation and wildlife are addressed under the secondary federal and Montana standards as defined in the NAAQS and MAAQS. The secondary standards are “welfare standards” that, in some cases, are less stringent than the primary “health-based standards.” Before issuance of an MAQP, the applicant must demonstrate compliance with primary and secondary air quality standards. The criteria pollutant modeling analysis results presented in a prior section show compliance with the primary/health based NAAQS and MAAQS.

The dispersion model results also demonstrate that a negligible level of PM would be conveyed to the Smith River basin from point source and fugitive dust emission sources. As discussed in more detail in the Smith River Assessment below, predicted concentrations are less than the significant impact levels in the basin, and therefore well below the NAAQS or MAAQS that are considered protective. Taken together, these results demonstrate that the Project would comply with the secondary air quality standards listed in **Table 3.2-1,** which are considered protective of agricultural resources and natural resources.

Visibility and chemical deposition impacts in nearby Class I areas are normally evaluated as part of air quality permitting to obtain an Air Quality Operating Permit. The Gates of the Mountains Class I area, located approximately 38 miles northwest of the Project site, is the closest Class I area. As part of the DEQ permitting process, a modeling analysis was conducted to assess the influences of prevailing winds and pollutant transport. A 5-year wind rose illustrating wind data collected at the Project site is shown in **Figure 3.2-1**. As shown on the wind rose, winds from the site blowing toward the northwest occur approximately 5 percent of the time. Winds from the southeast and from the west are far more prevalent. This indicates that Project emissions would tend to not be transported in the direction of the Gate of the Mountains.

Smith River Assessment

An analysis of air quality impacts within the Smith River basin was completed (Tintina 2018). As shown in this section, the distribution of modeled concentrations can be compared to stringent SILs used for PSD modeling assessments for PM_{10}, and $PM_{2.5}$. The impacts of airborne dust and fine particulates are of potential concern for the basin, due to fugitive mining sources and venting of underground emissions. However, modeled concentrations were predicted to be less than the regulatory SIL at all locations within the basin. As discussed in this section, a negligible level of PM would be conveyed to the Smith River basin from point source and fugitive dust emission sources.

Figures 3.2-2 and **3.2-3** illustrate the distribution of PM_{10} 24-hour and annual average concentrations, respectively, in the area surrounding the Project site to the location of the Smith River. The isopleth[6] lines of the same average concentration extent are plotted down to the regulatory SIL, which are 5 μg/m^3 for the 24-hour average, and 1 μg/m^3 for the annual average. Areas outside the largest isopleth envelope would have maximum predicted concentrations less than the respective SIL. As shown in **Figure 3.2-2**, the highest 24-hour average concentrations extend to approximately 8 miles from the Project area. The extent is greatest toward the west, but that level does not approach the Smith River basin. Annual PM_{10} results in **Figure 3.2-3** are more limited in extent, reaching less than 3 miles from the Project area.

[6] Model simulations using the AERMOD system produce diagrams that show the distribution of dispersed pollutants at ground level. These diagrams, termed "isopleth maps," depict the distributions as a series of overlaid irregular contours onto a regional map. Isopleth maps somewhat resemble the impact of a topographic contour map, with outlines of the specific concentration levels serving the similar purpose as outlines of specific ground elevation on a topographic map.

Comparable results for fine particulates ($PM_{2.5}$) are shown in **Figures 3.2-4** and **3.2-5**, which illustrate the distribution of $PM_{2.5}$ 24-hour and annual average concentrations, respectively, surrounding the Project site. The SILs are 1.2 µg/m^3 for the 24-hour average, and 0.3 µg/m^3 for the annual average results. As shown in **Figure 3.2-4**, the highest 24-hour average concentrations for fine particulates extend to approximately 4.3 miles from the Project area. The extent is greatest toward the northwest, but that level does not approach the Smith River basin. Annual $PM_{2.5}$ results in **Figure 3.2-5** are more limited in extent, reaching less than 2.5 km from the Project area.

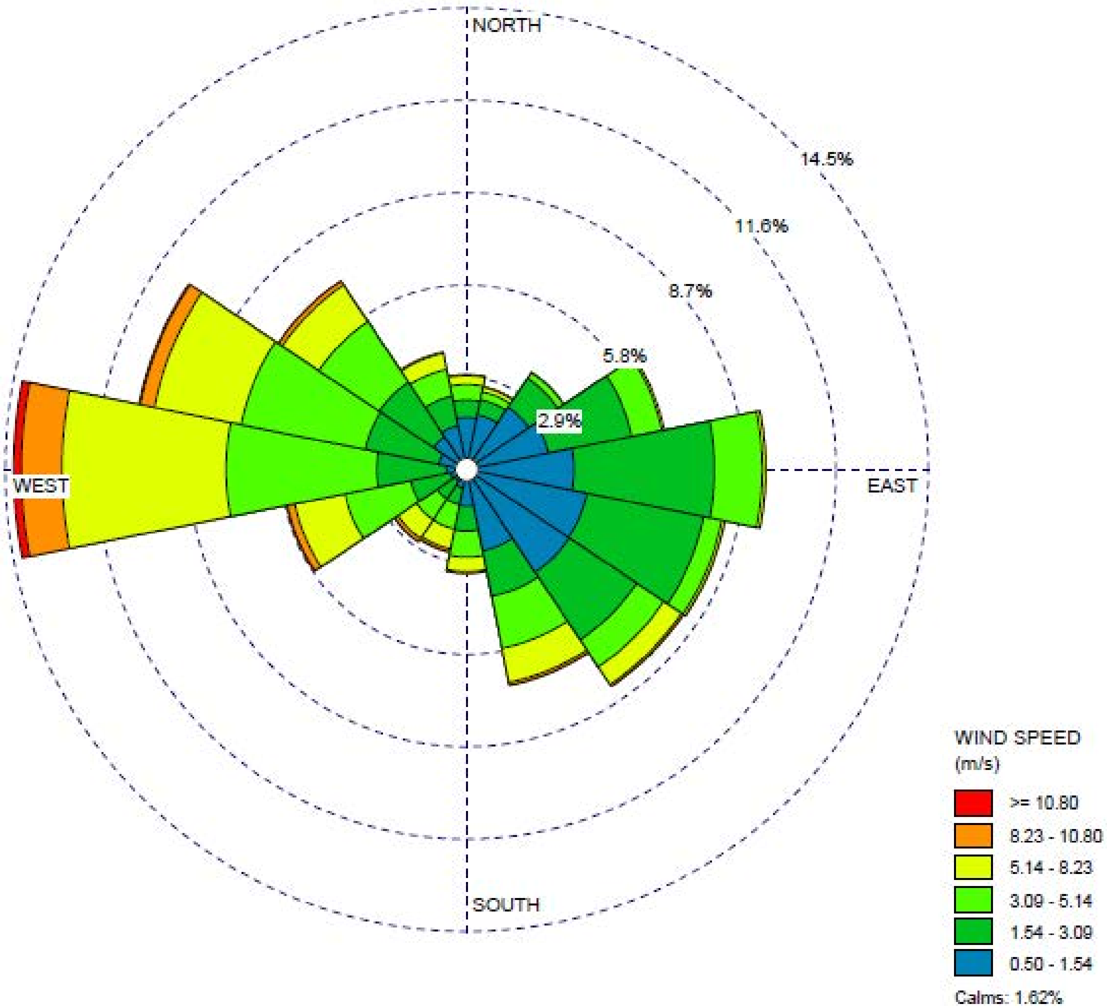
3.2.4.3. Agency Modified Alternative

The modifications identified would result in impacts similar to those described for the Proposed Action, with the following exception. Additional air quality impacts are anticipated for the AMA modifications to backfill additional mine workings with cemented tailings at the end of operations. Air emissions in addition to those analyzed for the Proposed Action would occur to produce approximately 106,971 cubic yards of cemented tailings to be placed as backfill within the access tunnels and ventilation shafts. Air emissions for the AMA would be generated from reclaiming, transport, and mill processing of the stockpiled ore and/or waste rock. The AMA assumes that milling of stockpiled waste rock and ore, paste making, and backfilling would be conducted in the same manner described for backfilling of the mined stopes in the Proposed Action. Therefore, the additional air emissions resulting from this modification can be estimated based on the emission inventory for the later years of mine and mill operation.

Air Emissions Assessment

To conservatively estimate that maximum air emissions for the modification to backfill additional mine workings, it was assumed that the sources related to the production of cemented tailings would remain in operation an additional six months after the projected end of the operations. To characterize the added air emissions, several sources that were quantified in the Air Quality Permit Application for the Proposed Action (Tintina 2018) were assumed representative of the operations for this alternative:

- Material transfer from the North Stockpile;
- Material transfer from the South Stockpile;
- Haul traffic on existing mine roads from stockpiles to Mill;
- Fugitive windblown dust from Ore Rock Stockpile and Waste Rock Stockpile;
- Jaw Crusher Building, controlled by dust collector; and,
- Backfill Plant Cement/Fly Ash Hopper and Silo, controlled by dust collectors.



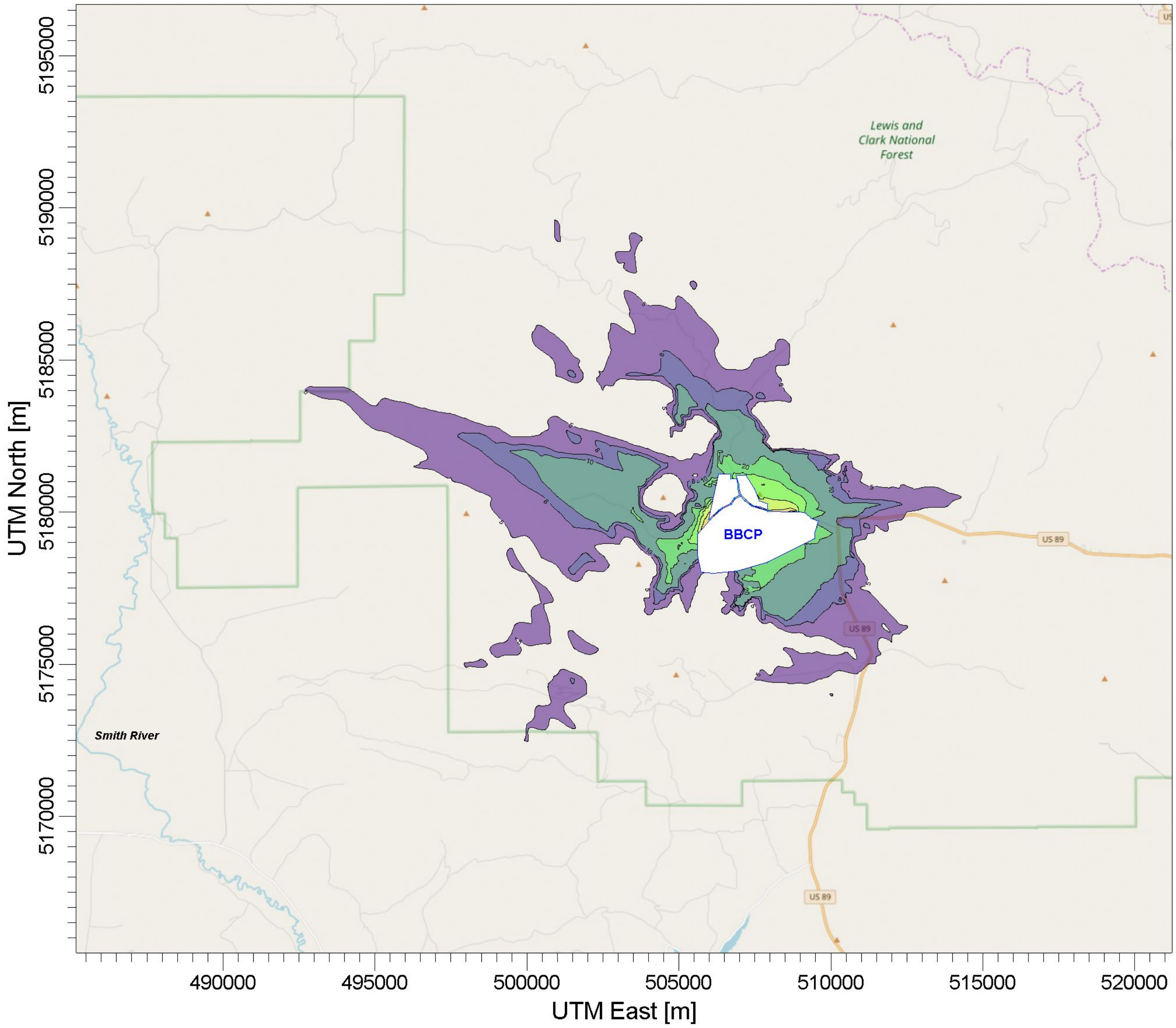
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
Indicates wind direction (blowing from) and wind speed (m/s) from the BBCP on-site meteorological station.	**Start Date: 5/1/2012 - 00:00** **End Date: 5/1/2017 - 23:59**	**Bison Engineering, Inc.**	
		MODELER: **Brian Murphy**	
	CALM WINDS: **1.62%**	TOTAL COUNT: **43759 hrs.**	
	AVG. WIND SPEED: **3.13 m/s**	DATE: **7/31/2018**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

This information is for environmental review purposes only.

Source: Bison Engineering 2018

Figure 3.2-1
Black Butte Copper Project
Wind Rose 5-Year Average
Meagher County, Montana



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 145 [ug/m^3] at (508779.50, 5180006.80)

5 8 10 20 30 50 75 100 125

SCALE: 1:226,750

0 5 km

This information is for environmental review purposes only.

COMMENTS:

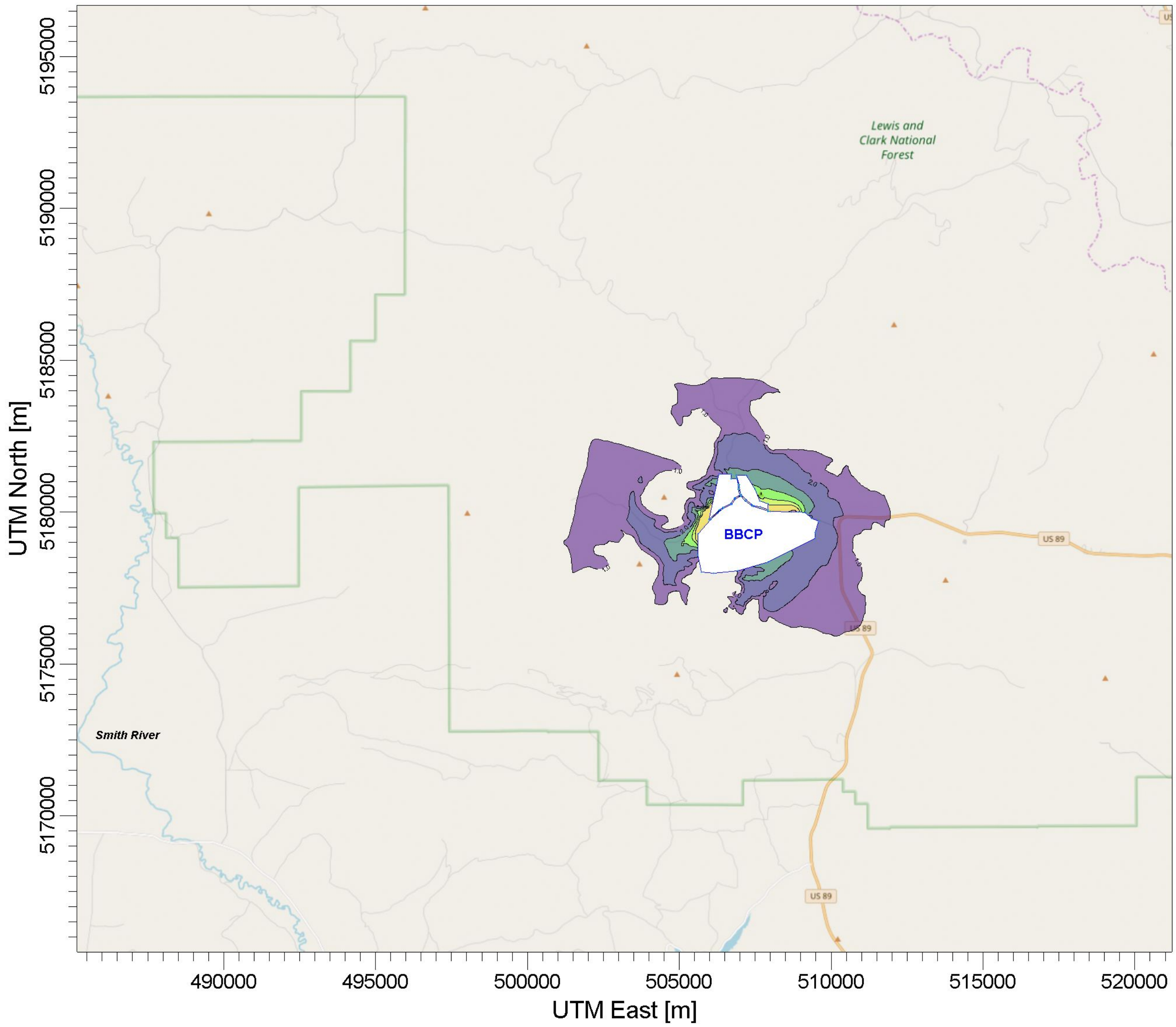
Illustrates modeled concentrations exceeding the Significant Impact Level (SIL) in relation to the Smith River.
PM10 24-Hour SIL = 5 ug/m3 Concentrations do not include ambient background.

Black Butte Copper Project (BBCP) displayed as white parcels with blue border.

Figure 3.2-2
Black Butte Copper Project
PM_{10} 24-Hour Average
Meagher County, Montana

ERM

DRAWN BY: MPLS GIS



PLOT FILE OF ANNUAL VALUES AVERAGED ACROSS 1 YEARS FOR SOURCE GROUP: ALL

ug/m^3

Max: 40.9 [ug/m^3] at (508779.50, 5180006.80)

SCALE: 1:226,745

0 5 km

This information is for environmental review purposes only.

COMMENTS:

Illustrates modeled concentrations exceeding the Significant Impact Level (SIL) in relation to the Smith River.

PM10 Annual SIL = 1 ug/m3 Concentrations do not include ambient background.

Black Butte Copper Project (BBCP) displayed as white parcels with blue border.

Figure 3.2-3

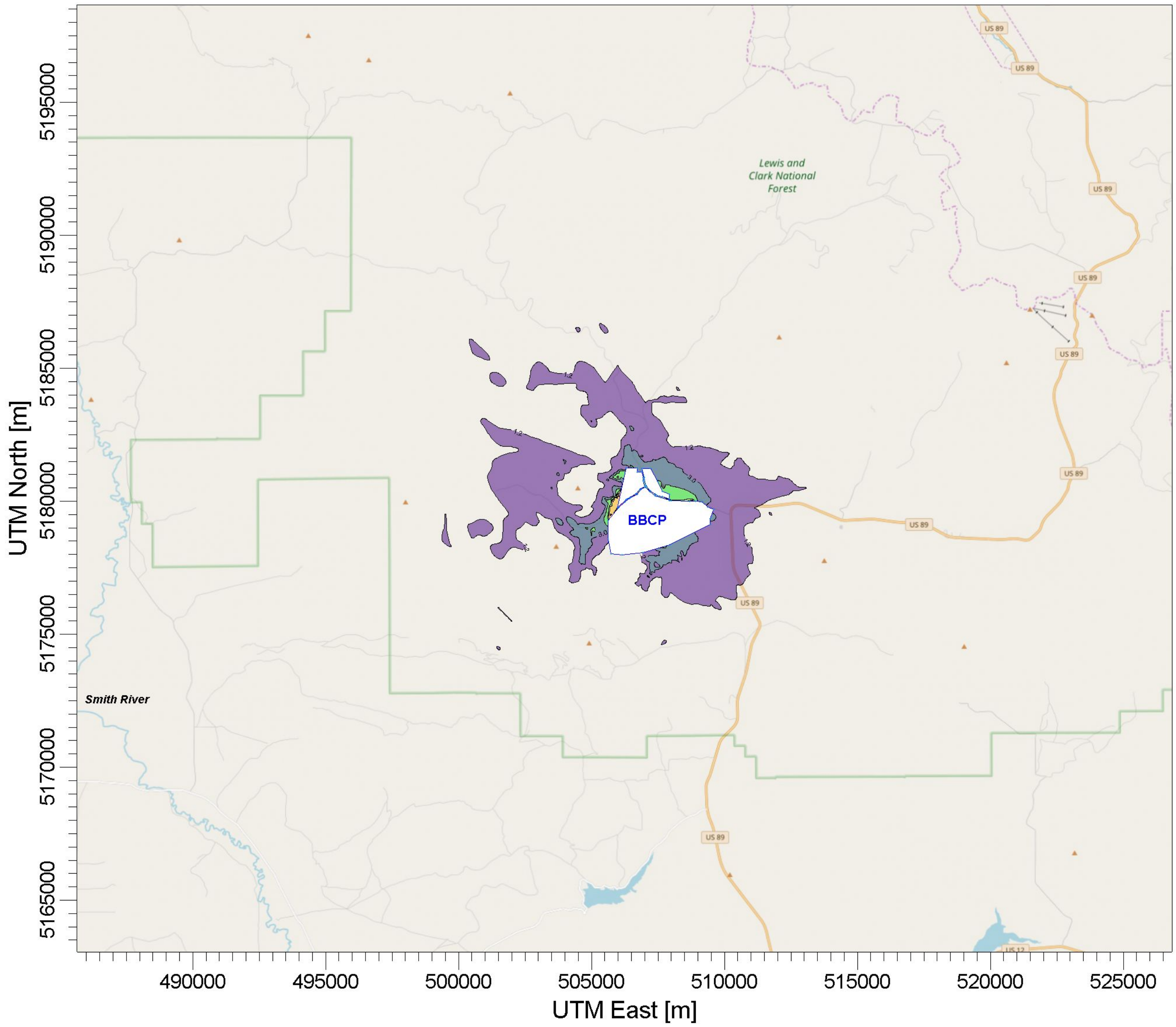
Black Butte Copper Project

PM_{10} Annual Average

Meagher County, Montana

ERM

DRAWN BY: MPLS GIS



PLOT FILE OF 1ST-HIGHEST MAX DAILY 24-HR VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ug/m^3

Max: 16.5 [ug/m^3] at (506229.10, 5179937.80)

1.2 3.0 5.0 8.0 10.0 13.0

SCALE: 1:259,020

0 10 km

This information is for environmental review purposes only.

COMMENTS:

Illustrates modeled concentrations exceeding the Significant Impact Level (SIL) in relation to the Smith River.

PM2.5 24-Hour SIL = 1.2 ug/m3 Concentrations do not include ambient background.

Black Butte Copper Project (BBCP) displayed as white parcels with blue border.

Figure 3.2-4

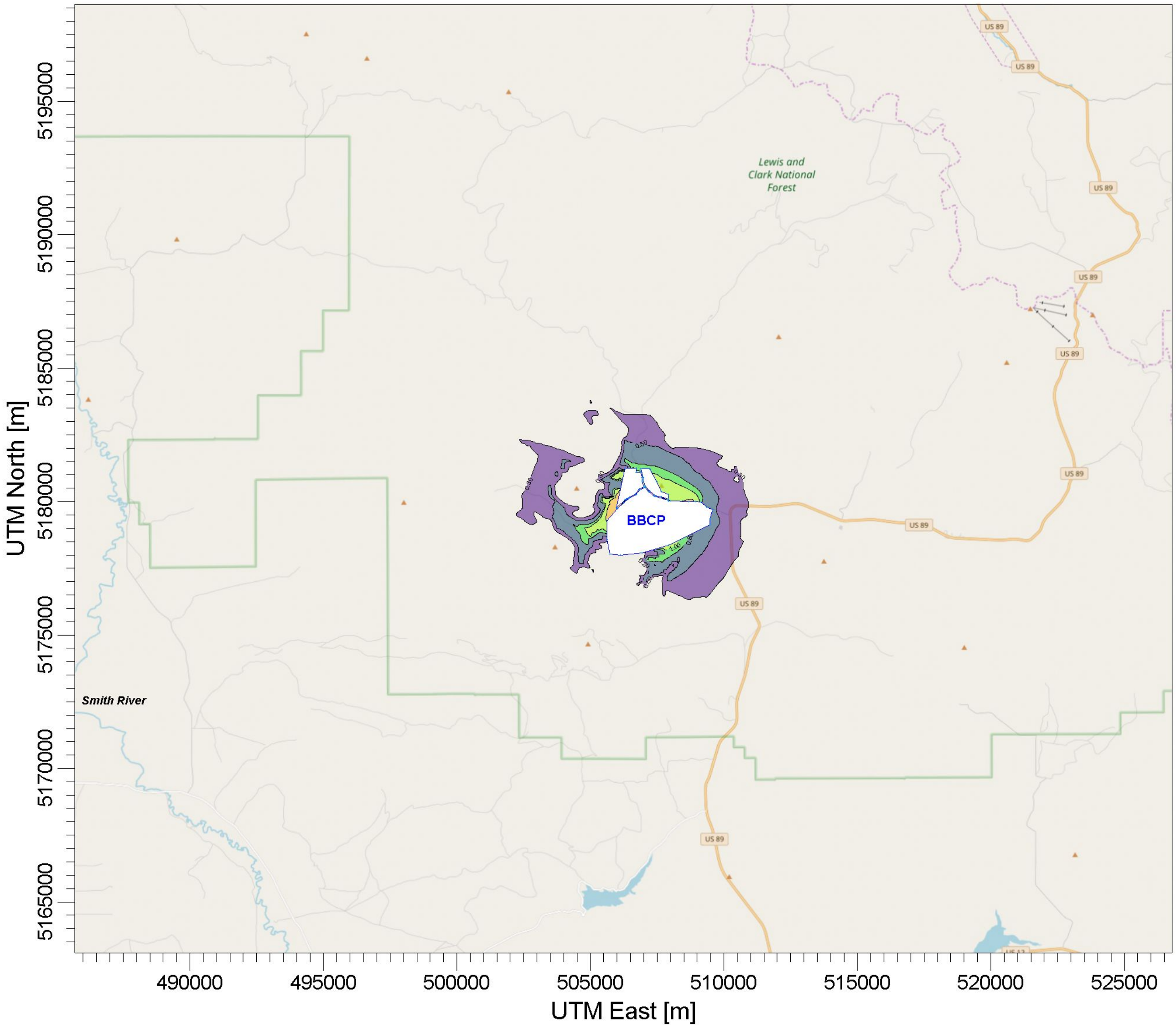
Black Butte Copper Project

$PM_{2.5}$ 24-Hour Average

Meagher County, Montana

ERM

DRAWN BY: MPLS GIS



PLOT FILE OF ANNUAL VALUES AVERAGED ACROSS 5 YEARS FOR SOURCE GROUP: ALL

ug/m^3

Max: 4.37 [ug/m^3] at (508779.50, 5180006.80)

0.30 | 0.50 | 0.80 | 1.00 | 2.00 | 4.00

SCALE: 1:258,456

0 — 10 km

This information is for environmental review purposes only.

COMMENTS:

Illustrates modeled concentrations exceeding the Significant Impact Level (SIL) in relation to the Smith River.

PM2.5 Annual SIL = 0.3 ug/m3 Concentrations do not include ambient background.

Black Butte Copper Project BBCP) displayed as white parcels with blue border.

Figure 3.2-5

Black Butte Copper Project

$PM_{2.5}$ Annual Average

Meagher County, Montana

ERM

DRAWN BY: MPLS GIS

For this AMA, the operations and air emissions of the haul traffic and fugitive sources listed above would most closely resemble the pattern that would be in place for mine reclamation activities corresponding to Mine Operating Year eighteen. The emissions from the Jaw Crusher Building and Backfill Plant operations were conservatively characterized as equaling the potential to emit emission scenario. The handling of the cemented tailings material would have negligible emissions, due to its high moisture content. Total estimated air emissions are listed in **Table 3.2-11** for the modification to backfill remaining underground mine workings after the end of operations.

Table 3.2-11
Project Source Air Emissions for the AMA of Full Backfill of Mine Workings

AMA Emission Source [a]	**PM (tons/AMA)**[b]	**PM_{10} (tons/AMA)**[b]	**$PM_{2.5}$ (tons/AMA)**[b]
Material transfer from the North Stockpile;	0.41	0.12	0.04
Material transfer from the South Stockpile;	0.75	0.22	0.07
Haul traffic on existing mine roads from stockpiles	5.84	1.49	0.15
Fugitive windblown dust from Ore Rock Stockpile	0.01	0.005	0.0007
Jaw Crusher Building, controlled by dust collector;	1.60	1.60	1.60
Backfill Plant Cement/Fly Ash Hopper and Silo, controlled by dust collectors	0.34	0.34	0.34
Total emissions for the AMA	8.94	3.76	2.20
Percent of total project emissions for Proposed Action [c]	2.4	3.5	7.6

Source: Tintina 2018

AMA = Agency Modified Alternative, MOY = mine operating year; PM = particulate matter, PM_{10} = particulate matter less than 10 microns diameter; $PM_{2.5}$ = particulate matter less than 2.5 microns diameter
Notes:
[a] A subset of the emission sources included in the Air Quality Permit Application are assumed to operate, in a manner resembling MOY 18 for the AMA to backfill additional mine underground volume after the end of operations.
[b] Estimated emissions for the listed sources, assuming a duration of 6 months for this AMA.
[c] Proposed Action emissions, as modeled for the Air Quality Permit Application, are listed in **Tables 3.2-6** (point sources) and **Table 3.2-7** (fugitive sources)

Ambient Air Impact Assessment

The air emissions related to the modification to backfill additional mine workings with cemented tailings are small, compared to the peak activity year for the Proposed Action modeled by the Proponent (Tintina 2018). As shown in **Table 3.2-11**, the total emissions of PM for the duration of this modification activity are between 2.4 and 7.6 percent of the modeled emissions for the peak year of the Proposed Action. Air dispersion modeling results, summarized in **Table 3.2-9**, show that the peak emissions scenario resulted in maximum particulate concentrations between 56 and 80 percent of the NAAQS, so that the resulting impacts for the maximum emission case are judged to be below adverse levels. The impacts for this modification would be in proportion to the corresponding total emissions, therefore even smaller in extent and magnitude.

Smith River Assessment

As discussed in Section 3.2.4.2, the impacts of airborne dust and fine particulates are of potential concern for the Smith River basin, due to fugitive mining sources and venting of underground emissions. However, modeled concentrations for the Proposed Action were predicted to be less than the regulatory SIL at all locations within the basin. Consequently, those impacts were judged to be negligible in extent and magnitude for the Proposed Action. The modification to backfill additional mine workings after the close of operations would increase total emissions for the Project by approximately 3.5 percent for PM_{10} and 7.6 percent for $PM_{2.5}$. Short term emissions would be even lower than these values, since a small subset of Project emission sources would remain in operation for the duration of this modification. Therefore, the impacts on the Smith River Basin for this modification would also be negligible.

3.3. CULTURAL/TRIBAL/HISTORIC RESOURCES

This section addresses the affected environment and potential impacts to cultural resources within the area surveyed for the proposed Project, which includes the MOP Application Boundary (approximately 1,888 acres) and associated access roads (see **Figure 3.3-1**). Cultural resources include the locations of human activity, occupation, or usage of the environment that contains sites, features, structures, objects, or landscapes that may have important tribal, historic, or archaeological values.

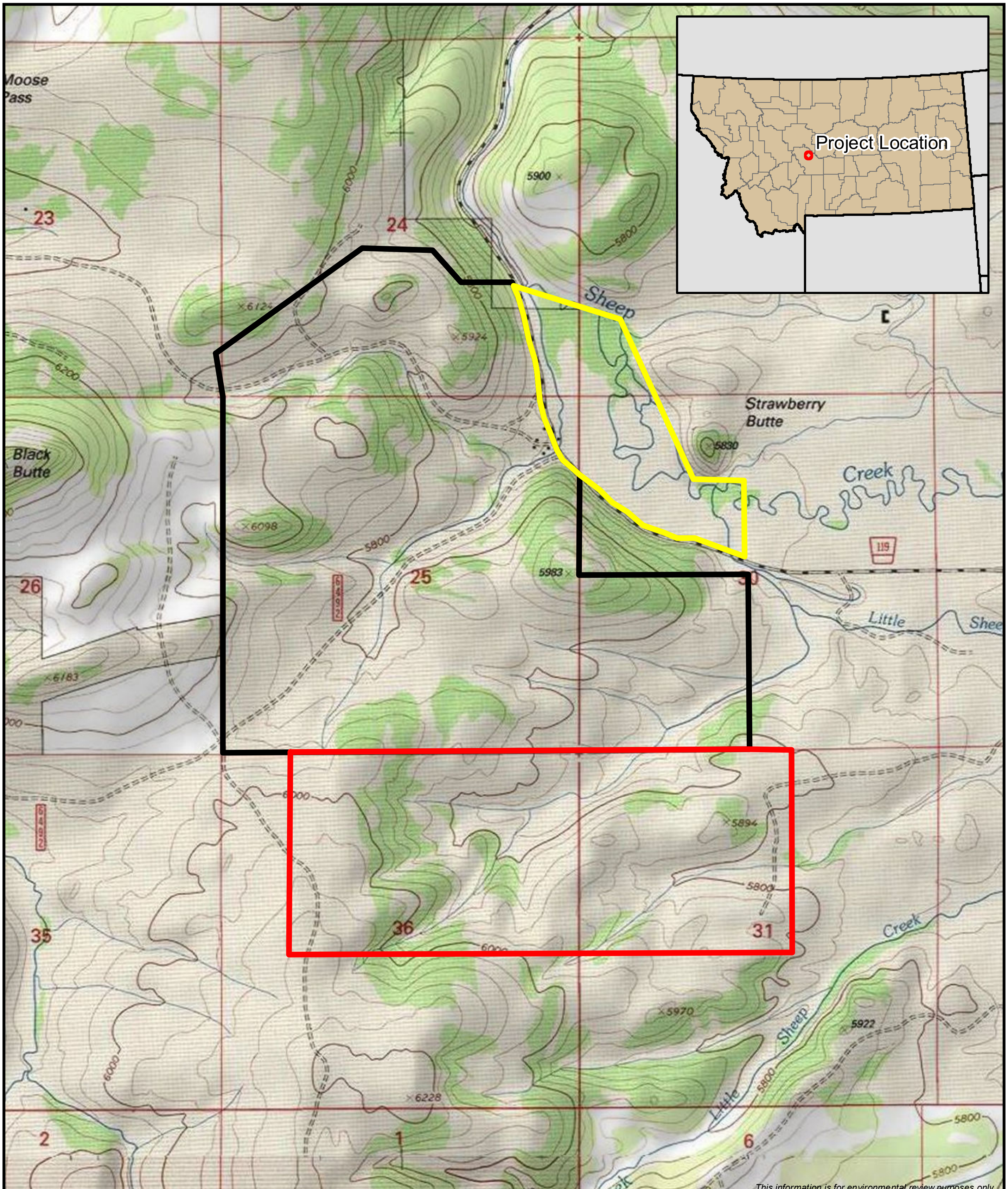
The Project is located on private land and there is no federal regulatory involvement; therefore, the federal laws relating to the protection of cultural resources (e.g., Section 106 of the National Historic Preservation Act) do not apply. The Montana Antiquities Act, which applies to activities conducted on state-owned land, also does not apply. MEPA requires identification of known cultural resources within a project area and a disclosure of what the potential impacts might be to those resources. This consists of a summary of the results of a file search conducted with the Montana SHPO. In addition to the file search, the Proponent conducted cultural resource inventories to identify cultural resources that may be eligible for listing in the NRHP. The inventories were conducted under the same standards as required by federal law and followed guidelines provided by the SHPO. The SHPO concurred with the methods and site recommendations in the survey reports in letters dated February 11, 2013, October 29, 2015, and August 30, 2018.

3.3.1. Analysis Methods

The Proponent conducted the following cultural resources surveys and literature searches for the Project:

Three cultural resource surveys that examined 1,633 acres within and adjacent to the Project area (Tetra Tech 2013a, 2013b, 2015, 2018) (see **Figure 3.3-1**). This includes an intensive pedestrian survey of 970 acres in 2011, 20 acres in 2012, 510 acres and 1.25 miles of access roads in 2015, and 133 acres in 2018.

- A background file and literature search for the entire current Project area. This background search identified two previously recorded cultural resources (Butte Creek Road [24ME936] and Sheep Creek Road [24ME925]), both of which were recommended as not eligible for listing under the NRHP.
- Evaluative testing on one archaeological site (24ME163) in 2012 to determine its eligibility for listing in the NRHP.



2011-2012 Inventory Area
2015 Inventory Area
2018 Inventory Area

1:24,000
0 1,000 2,000 Feet

Figure 3.3-1
Black Butte Copper Project
Cultural Resources Survey Area
Meagher County, Montana

MPLS M:\Clients\M-O\MTDEQ\BlackBute_Copper_ArcGIS\2018\03\EIS_Inventory_Areas_EIS_Inventory_Areas_2.mxd | REVISED: 09/13/2018 | SCALE: 1:24,000 DRAWN BY: MBG

3.3.2. Affected Environment

The Project is located on private land in the Little Belt Mountains, with general elevations that range between 5,600 and 6,100 feet above mean sea level. The topography is moderately sloped with open woodland consisting of Douglas fir on the ridgetops and aspen and willow along the drainages. The total surface disturbance of the Project would impact approximately 311 acres.

The Project is located within the prehistoric cultural subarea known as the Northwestern Plains, a region that extends from central Alberta to southern Wyoming and from western North Dakota to western Montana. Prehistoric site types common to the region included campsites, rock shelters, rock structures (e.g., hunting blinds), lithic quarries, stone rings, stone cairns, stone alignments, ceramic remains, rock art, bison processing areas, and lithic reduction areas. Historic cultural resources identified in the vicinity of the Project include homesteads, ranches, and refuse dumps.

A total of 24 cultural resources (21 archaeological sites, one historic district, and two isolates) were documented during the three surveys conducted in 2011, 2012, and 2015 (Tetra Tech 2013a; 2013b; 2015) (see **Table 3.3-1**). Evaluative testing was conducted on one prehistoric site (24ME163) (Tetra Tech 2013b). The archaeological sites consist of 13 prehistoric sites (all lithic scatters) and eight historic sites (a log structure, mining structural remains, two roads, a homestead, a historic cairn, and two irrigation ditches). The historic district is a prehistoric stone quarry district that includes the 13 lithic scatters and a thin veneer of isolated flaking debris. The two isolates consist of historic prospect pits.

Seven historic sites and the two isolated finds were recommended as not eligible, two sites (one prehistoric and one historic) and the stone quarry district were recommended as eligible, and 12 prehistoric sites remain unevaluated for listing in the NRHP. SHPO concurred with all eligibility recommendations of sites identified in the survey reports.

Table 3.3-1
Cultural Resources Identified within the Survey Area

Site Number	Site Type	Potential Impacts	NRHP Recommendation	Report Source
Isolate 1	Prospect Pit	Avoided	Not eligible	Tetra Tech 2013a
Isolate 2	Prospect Pit	Avoided	Not eligible	Tetra Tech 2013a
24ME0158	Historic Log Structure	Avoided	Not eligible	Tetra Tech 2013a
24ME0159	Historic Mining	Avoided	Not eligible	Tetra Tech 2013a
24ME0160	Lithic Scatter	Avoided	Unevaluated; further testing required to determine eligibility	Tetra Tech 2013a
24ME0161	Lithic Scatter	Avoided	Unevaluated; further testing required to determine eligibility	Tetra Tech 2013a
24ME0162	Lithic Scatter	Avoided	Unevaluated; further testing required to determine eligibility	Tetra Tech 2013a

Site Number	Site Type	Potential Impacts	NRHP Recommendation	Report Source
24ME0163	Lithic Scatter	Avoided	Eligible under Criterion D	Tetra Tech 2013a, Tetra Tech 2013b
24ME0164	Lithic Scatter	Impacted	Unevaluated; further testing required to determine eligibility	Tetra Tech 2013a
24ME0165	Lithic Scatter	Impacted	Unevaluated; further testing required to determine eligibility	Tetra Tech 2013a
24ME0166	Lithic Scatter	Avoided	Unevaluated; further testing required to determine eligibility	Tetra Tech 2013a
24ME0925	Historic Road-Sheep Creek	No Impact	Not eligible	Tetra Tech 2015
24ME0936	Historic Road-Butte Creek	No Impact	Not eligible	Tetra Tech 2013a
24ME0940	Historic Homestead	Avoided	Not eligible	Tetra Tech 2013a
24ME1104	Historic Sheepherder's Cairn	Avoided	Eligible under Criterion C	Tetra Tech 2015
24ME1105	Lithic Scatter	Avoided	Unevaluated; further testing required to determine eligibility	Tetra Tech 2015
24ME1106	Lithic Scatter	Avoided	Unevaluated; further testing required to determine eligibility	Tetra Tech 2015
24ME1107	Lithic Scatter	Avoided	Unevaluated; further testing required to determine eligibility	Tetra Tech 2015
24ME1108	Lithic Scatter	Avoided	Unevaluated; further testing required to determine eligibility	Tetra Tech 2015
24ME1109	Lithic Scatter	Impacted	Unevaluated; further testing required to determine eligibility	Tetra Tech 2015
24ME1110	Lithic Scatter	Impacted	Unevaluated; further testing required to determine eligibility	Tetra Tech 2015
24ME1111	Sheep Creek Surface Stone Quarry District	Impacted	Eligible under Criterion D	Tetra Tech 2015
24ME1135	Coon Creek Irrigation Ditch	Impacted	Not eligible	Tetra Tech 2018
24ME1136	Sheep Creek Irrigation Ditch	Avoided	Not eligible	Tetra Tech 2018

3.3.3. Environmental Consequences

3.3.3.1. No Action Alternative

Under the No Action Alternative, the Project would not be permitted or constructed and there would be no additional ground disturbance with the potential to disturb cultural resources associated with proposed activities in the MOP Application. Existing disturbances include land that was previously approved for exploration facilities under Exploration License No. 00710. Existing resources would continue to degrade over time.

3.3.3.2. Proposed Action

One historic site (24ME1104) was recommended as eligible under Criterion C, one prehistoric site (24ME0163) was recommended as eligible under Criterion D, and seven historic sites (24ME0158, 24ME0159, 24ME925, 24ME0936, 24ME940, 24ME1135, 24ME1136) and two isolated finds were recommended as not eligible for listing in the NRHP. Project activities would avoid eligible sites 24ME1104 and 24ME0163. Avoidance was recommended or, if avoidance is not possible, additional testing to determine the eligibility of the 12 unevaluated sites. The Sheep Creek Surface Stone Quarry District (District) (24ME1111) encompasses all of the prehistoric sites and a thin veneer of isolated flaking debris. The results of evaluative testing at the archaeological sites could contribute to the eligibility recommendation of this District.

As currently designed, the Project would avoid eight of the unevaluated prehistoric sites (24ME0160, 24ME0161, 24ME0162, 24ME0166, 24ME1105, 24ME1106, 24ME1107 and 24ME1108) and no further work is recommended at these sites. If there are design changes that would impact these sites, then additional testing is recommended. Additional testing was recommended for the four unevaluated prehistoric sites that the Project is likely to impact (24ME0164, 24ME0165, 24ME1109, and 24ME1110) to determine their eligibility for listing in the NRHP.

A proposal for mitigation of the District (24ME1111) and archaeological testing of sites 24ME164, 24ME165, 24ME1108, 24ME1109, and 24ME1110 was developed (Tetra Tech 2016). Mitigation of 24ME111 would be through chert [1]chemical analyses in an effort to identify a chemical fingerprint of the Sheep Creek cherts. Chert samples would be collected across the quarry area and several of the lithic scatters. These samples would be subjected to neutron activation analysis to identify the chemical makeup of the Sheep Creek cherts and determine if a unique chemical signature exists. The results would add to southwest Montana's chert database to provide data for future chert sourcing projects and research concerning prehistoric lithic procurement and lithic technology.

Construction will avoid any cultural resources eligible for listing in the NRHP.

[1] Chert is a fine-grained sedimentary rock that was often used as a raw material for stone tools.

Smith River Assessment

There would be no ground-disturbing activities associated with the Project conducted between the Smith River and the Project area. Therefore, there would be no potential impacts to known cultural resources along the Smith River.

3.3.3.3. Agency Modified Alternative

The potential impacts of the AMA on cultural resources would be the same as described for the Proposed Action. There would be no additional ground-disturbing activity within the MOP Application Boundary due to the backfilling of additional mine workings. Therefore, there would be no change to impacts on cultural resources.

Smith River Assessment

There would be no ground-disturbing activities associated with the AMA conducted between the Smith River and the Project area. Therefore, there would be no potential impacts to known cultural resources along the Smith River.

3.4. GROUNDWATER HYDROLOGY

This section describes the potential impacts that the proposed Project (Proposed Action) might have on groundwater. This section also provides an evaluation of such impacts in case the Project is executed following an AMA.

3.4.1. Analysis Methods

Analyses of the potential Project impacts on groundwater were completed considering (1) Project design, (2) regulatory framework, (3) baseline monitoring, (4) hydraulic testing, (5) tracer studies, and (6) groundwater modeling analysis.

3.4.1.1. Regulatory Context of the Analysis

The following groundwater-related acts, regulations, required permits/certificates, and enforcing agencies are relevant and applicable to the Project:

- Federal Clean Water Act – USEPA, U.S. Army Corps of Engineers (USACE);
- Montana Water Quality Act – Montana Department of Environmental Quality, Water Quality Division, Water Protection Bureau;
- Montana Pollution Discharge Elimination System – Montana Department of Environmental Quality, Water Quality Division, Water Protection Bureau;
- Montana Groundwater Pollution Control System – Montana Department of Environmental Quality, Water Quality Division, Water Protection Bureau;
- Certificate of Water Rights/Groundwater Appropriations – DNRC;
- Public Water Supply Act/Permit – Montana Department of Environmental Quality, Public Water and Subdivisions Bureau; and
- Montana Water Use Act – DNRC.

3.4.1.2. Spatial Boundaries of the Analysis

The impacts assessment evaluated the groundwater system within spatial boundaries of a watershed-scale Conceptual Model Domain, which includes the Local Study Area (LSA) and, the Regional Study Area (RSA). The LSA is defined here as an area where direct impacts of the Project on groundwater could occur; beyond the LSA boundary, direct impacts are not expected. The area covered by **Figure 3.4-1** represents the LSA. The RSA is defined as an area where secondary impacts of the Project could occur (e.g., groundwater impacts to surface water); beyond the RSA boundary, no Project-related groundwater impacts are expected. The RSA is described here as an area that could experience groundwater drawdown of more than 2 feet due to mine dewatering, as computed by the groundwater model. Two feet of drawdown is within the typical range of seasonal groundwater level fluctuations observed in the monitoring wells of the Project area. Such a defined RSA also covers all of the Project infrastructure that has the potential to impact groundwater. **Figure 3.4-2** shows the Project area and the extent of the RSA, which are both contained within the Conceptual Model Domain.

3.4.1.3. Temporal Boundaries of the Analysis

Predictive analyses based on numerical and analytical groundwater modeling were carried out for the periods of mine construction, operations, and post-closure. These analyses are described in Section 3.4.1.2, Spatial Boundaries of the Analysis, and Section 3.4.3.2, Proposed Action. Section 3.4.3.1 below states that the No Action Alternative would not result in any changes to baseline groundwater conditions.

Below is a summary of methods used to complete the groundwater-focused tests, studies, and analyses.

3.4.1.4. Baseline Monitoring, Aquifer, and Permeability Tests

Extensive analyses have been carried out to characterize quantity and quality of groundwater around the proposed mine site, the results of which inform this section of the EIS. The following paragraphs summarize the scope and methodology used for each study.

Monitoring Wells, Seeps, and Springs

Water resource baseline monitoring and hydrologic investigations for the Project have been carried out since 2011 and are ongoing. Most of this information is presented in Appendix B of the MOP Application (Tintina 2017). Monitoring has involved measurements of surface water flow, groundwater-level elevations, and water temperatures. In addition, surface and groundwater samples have been collected and chemically analyzed following protocols described in the “Actual Water Resource Sampling and Analysis Plan” (Hydrometrics, Inc. 2016b). The groundwater part of this monitoring program involves quarterly (or in some cases less frequent) measurements of water levels in 34 monitoring wells and piezometers, and collection of water samples from 29 monitoring wells and piezometers. The locations of these wells and piezometers are shown on **Figure 3.4-1**. **Table 3.4-1** lists chemical parameters, methods, and detection limits used for baseline groundwater monitoring. Water quality sampling and analytical methods for the Project are summarized in the “Water Resources Monitoring Field Sampling and Analysis Plan” (Hydrometrics 2016b), which is included as Appendix U of the MOP Application (Tintina 2017).

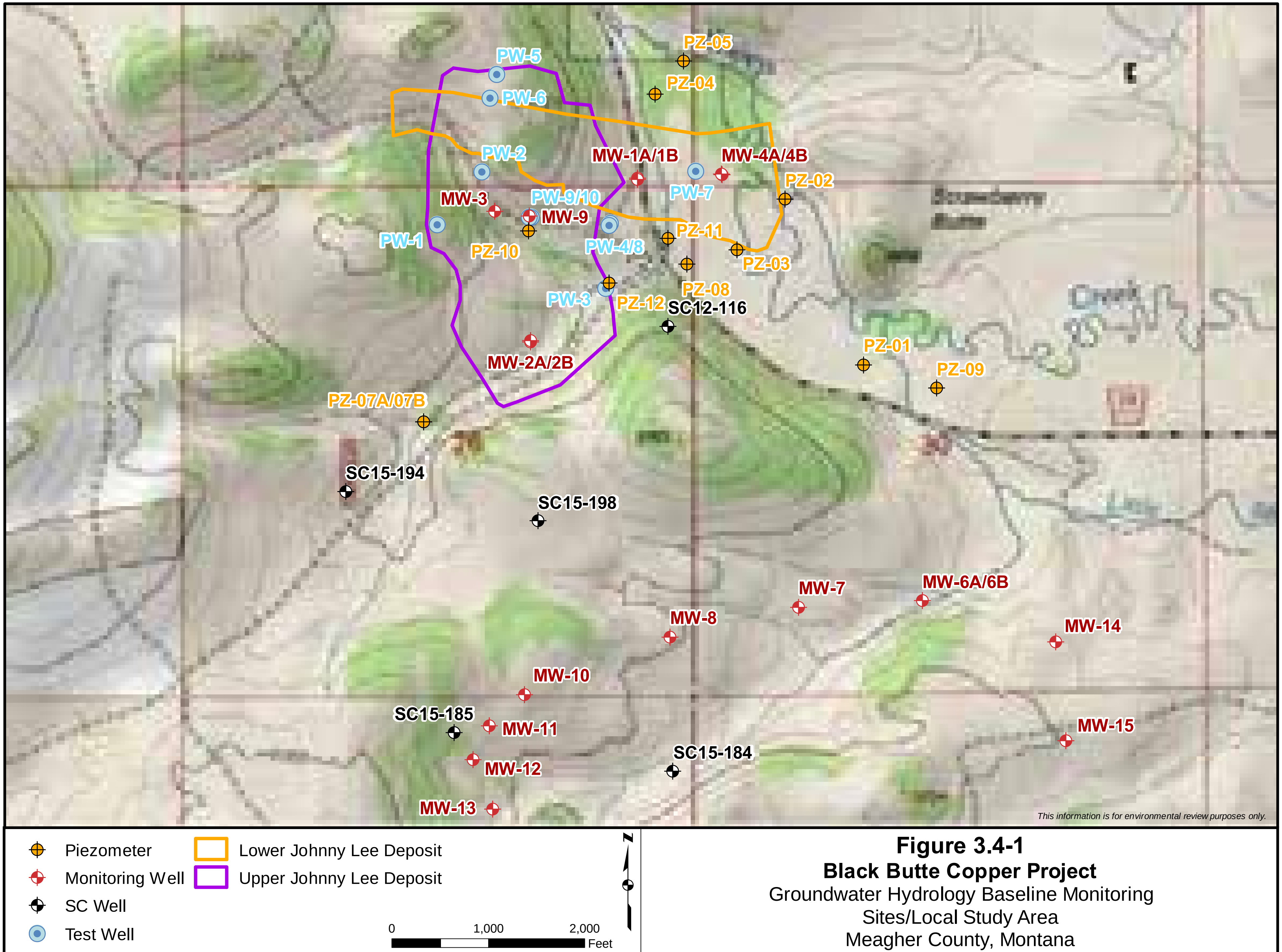


Figure 3.4-1
Black Butte Copper Project
Groundwater Hydrology Baseline Monitoring
Sites/Local Study Area
Meagher County, Montana

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Source: Hydrometrics, Inc. 2015a

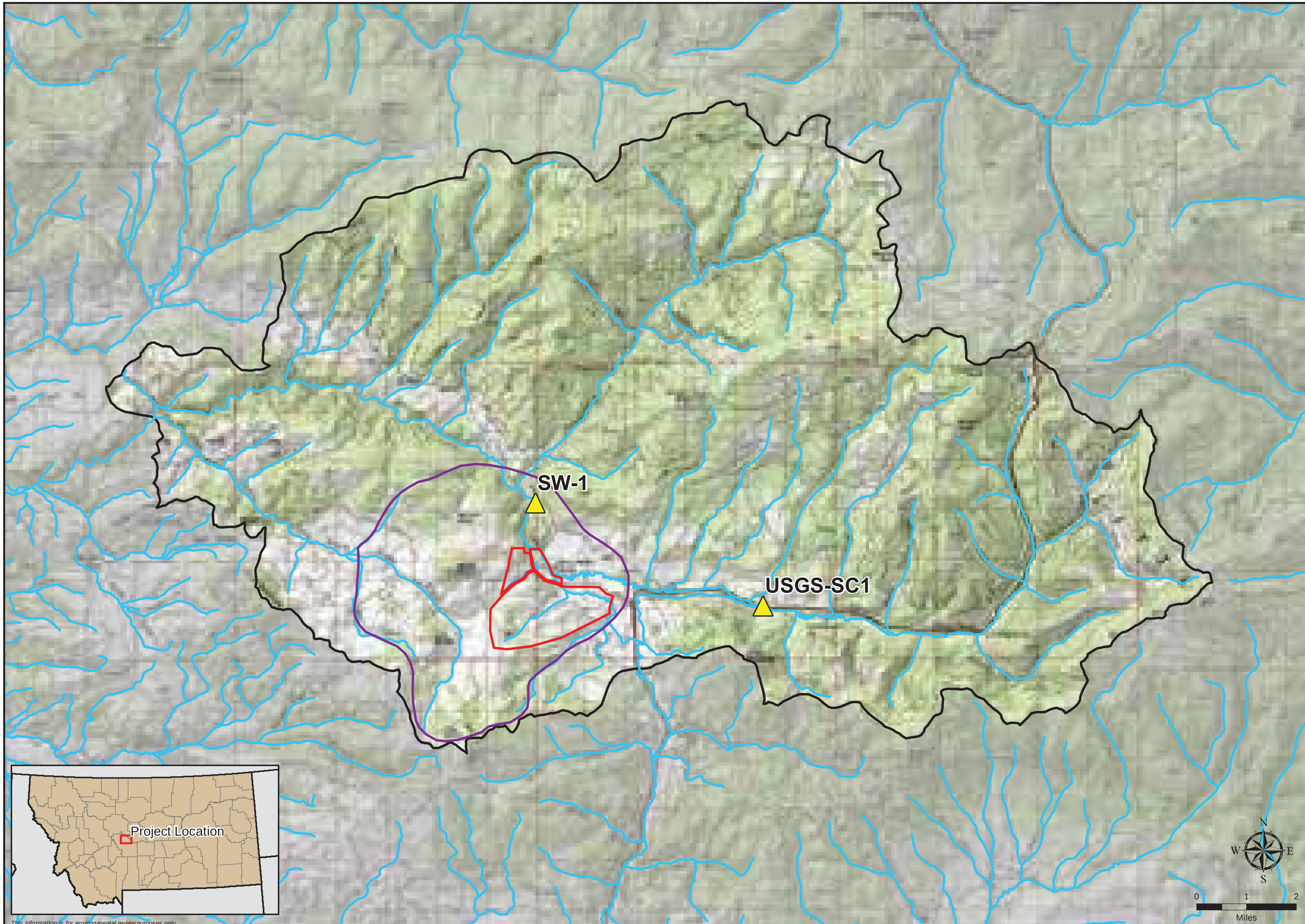

Figure 3.4-2
Black Butte Copper Project
Groundwater Hydrology Conceptual Model Area & Regional Study Area
Meagher County, Montana

Sheep Creek Gaging Site
Project Area
Groundwater Regional Study Area (RSA)
Rivers and Streams
Conceptual Model Domain

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Source: Hydrometrics, Inc. 2015b

Table 3.4-1
Parameters, Methods, and Detection Limits for Baseline Groundwater Monitoring

Parameter	Analytical Method[a]	Project-Required Detection Limit (mg/L)
Physical Parameters		
Total Dissolved Solids	SM 2540C	10
Total Suspended Solids	SM 2540C	10
Common Ions		
Alkalinity	SM 2320B	4
Sulfate	300.0	1
Chloride	300.0/SM 4500CL-B	1
Fluoride	A4500-F C	0.1
Calcium	215.1/200.7	1
Magnesium	242.1/200.7	1
Sodium	273.1/200.7	1
Potassium	258.1/200.7	1
Nutrients		
Nitrate+Nitrite as N	353.2	0.01
Trace Constituents (Dissolved)[b]		
Aluminum (Al)	200.7/200.8	0.009
Antimony (Sb)	200.7/200.8	0.0005
Arsenic (As)	200.8/SM 3114B	0.001
Barium (Ba)	200.7/200.8	0.003
Beryllium (Be)	200.7/200.8	0.0008
Cadmium (Cd)	200.7/200.8	0.00003
Chromium (Cr)	200.7/200.8	0.01
Cobalt (Co)	200.7/200.8	0.01
Copper (Cu)	200.7/200.8	0.002
Iron (Fe)	200.7/200.8	0.02
Lead (Pb)	200.7/200.8	0.0003
Manganese (Mn)	200.7/200.8	0.005
Mercury (Hg)	245.2/245.1/200.8/SM 3112B	0.000005
Molybdenum (Mo)	200.7/200.8	0.002
Nickel (Ni)	200.7/200.8	0.001
Selenium (Se)	200.7/200.8/SM 3114B	0.0002
Silver (Ag)	200.7/200.8	0.02
Strontium (Sr)	200.7/200.8	0.0002
Thallium (Tl)	200.7/200.8	0.0002
Uranium	200.7/200.8	0.008
Zinc (Zn)	200.7/200.8	0.002

Parameter	Analytical Method[a]	Project-Required Detection Limit (mg/L)
Field Parameters		
Stream Flow	HF-SOP-37/-44/-46	NA
Water Temperature	HF-SOP-20	0.1 °C
Dissolved Oxygen (DO)	HF-SOP-22	0.1 mg/L
pH[c]	HF-SOP-20	0.1 s.u.
Specific Conductance (SC)	HF-SOP-79	1 µmhos/cm

Source: Hydrometrics, Inc. 2015a (Table 3)

°C = degree Celsius; mg/L = milligram per liter; NA = not applicable; s.u. = standard unit (pH); µmhos/cm = micro mho per centimeter
Notes:
[a] Analytical methods are from "Standard Methods for the Examination of Water and Wastewater" or the U.S. Environmental Protection Agency's "Methods for Chemical Analysis of Water and Waste" (1983).
[b] Samples were field-filtered through a 0.45 micrometer filter and analyzed for dissolved constituents.
[c] The pH scale is a logarithmic scale used to measure the acidity or alkalinity of a system. Distilled or pure water has a neutral pH of 7. Liquids with a pH less than 7 are acidic (gastric acid, pH=1; orange juice, pH=3), while liquids with a pH greater than 7 are alkaline, or basic (ammonia, pH=11; bleach, pH=13). Rainfall that is not affected by air pollutant emissions typically has a pH of 5.3 to 5.6 in the western United States.

Monitoring wells and test wells completed within the shallow and deep hydrostratigraphic units (HSU's described in Section 3.4.2.3) allow characterization of baseline water levels, groundwater flow directions, and groundwater quality within the LSA. Seeps and springs are expressions of groundwater discharging to surficial environments. Nine seeps and 13 springs near the Project were identified and mapped, and some were sampled for water quality and flow as a part of an inventory completed in 2011. A second series of flow measurements and water quality samples was conducted in July 2012 (Hydrometrics, Inc. 2015a).

Aquifer and Permeameter Tests

Aquifer tests were conducted at the site, which included both slug tests and pumping tests to characterize the hydraulic conductivity (K) of the principal HSUs. Five samples of gouge material from the Volcano Valley Fault (VVF) zone were collected from three separate exploration cores and tested in the laboratory for hydraulic conductivity using a Flexible Wall Permeameter (Hydrometrics, Inc. 2015a).

3.4.1.5. Groundwater Modeling

Regional Groundwater Flow Model

In 2015, Hydrometrics on behalf of Tintina, developed a three-dimensional numerical groundwater flow model using the MODFLOW-USG program to characterize existing conditions. The model extent covered the area shown as the Conceptual Model Domain (**Figure 3.4-2**), which includes the RSA and LSA (Hydrometrics, Inc. 2015b). The Conceptual Model Domain encompasses the upper two thirds of the Sheep Creek watershed, which extends from the headwaters of Sheep Creek downstream to the confluence of Black Butte Creek. The model was subsequently refined and used to assess potential impacts of the proposed mine on groundwater and surface water resources.

Using the numerical model, Hydrometrics performed a series of predictive simulations to evaluate the following for the Proposed Action:

- Groundwater inflow (dewatering) rates to mine workings;
- Changes in surrounding groundwater levels (drawdowns) caused by mine dewatering;
- Potential location and magnitude of stream depletion impacts; and
- Time required for post-mining groundwater levels to recover.

The reliability of the model predictions was assessed considering data limitations and results of a model sensitivity analysis (Hydrometrics, Inc. 2015b).

Water Quality Model

Water quality models were developed to evaluate water chemistry in the underground workings and in vicinity of the other Project facilities. These evaluations are reported in Appendix N (Enviromin 2017) of the MOP Application (Tintina 2017) and Technical Memorandum on the Black Butte Copper Project Water Quality Model of Agency Modified Closure Alternative (Sandfire Resources America, Inc. 2018). Among other tools and methods, the minteq.dat thermodynamic database option in the U.S. Geological Survey equilibrium model, PHREEQC, and published sulfide sorption isotherm data, were used to predict mineral precipitation, metal sorption, and resulting water quality. The focus of the modeling was to estimate chemical concentrations in the post-mine contact groundwater. The analyses considered equilibrium solubility and sorption constraints.

Sheep Creek Alluvial Flow Model

Hydrometrics developed a smaller scale, three-dimensional numerical groundwater flow model to evaluate the impacts of operating the Alluvial Underground Infiltration Gallery (UIG). The model domain encompasses the Sheep Creek valley from about 3,300 feet east of the confluence of Little Sheep Creek and Sheep Creek to where Sheep Creek enters the narrow part of the valley (**Figure 3.4-1**). The modelers utilized the results of field infiltration tests to evaluate the recharge capacity of the UIG (Hydrometrics, Inc. 2017d).

The model objectives were to:

- Estimate the groundwater mounding associated with UIG recharge to groundwater;
- Provide data that could be combined with the dewatering simulations to evaluate where groundwater would discharge to surface water during operations; and
- Provide a tool to assess the alluvial system for potential future evaluations (Hydrometrics, Inc. 2017c).

Sheep Creek Mixing Zone Evaluations for Total Nitrogen

Hydrometrics used a Source Specific Mixing Zone Application to complete calculations related to mixing of the UIG water discharge with groundwater of the alluvial aquifer within the Sheep Creek valley. The calculation was done to evaluate the potential impact the expected elevated concentration of total nitrogen might have upon Sheep Creek and Coon Creek (Hydrometrics, Inc. 2018a, 2018b). However, based on the results of the analysis, the MPDES permit will not authorize a mixing zone.

3.4.1.6. Hydrological Studies Focused on the Areas of Various Proposed Project Facilities

In addition to groundwater hydrology studies for the entire Conceptual Model Domain (including the RSA and LSA), several additional focused studies were conducted to characterize smaller areas in the vicinity of specific Project facilities.

Hydrological Assessment of Proposed Cement Tailings Facility

This study was performed to characterize the groundwater system beneath the proposed CTF, and is included as Appendix B-1 (Hydrometrics, Inc. 2016c) of the MOP Application (Tintina 2017). The study involved installation of four monitoring wells to the lowest depth of the planned CTF excavation, slug testing these wells, groundwater level monitoring, and collection and analysis of groundwater samples. Calculations were performed to estimate the flow rate of the underlying groundwater system, and inflow rates to the designed CTF underdrain system using the AQTESOLV program. Evaluation of this facility's planned construction design features and their impact on predicted seepage analysis during operations and closure of the facility are provided in Geomin Resources, Inc. (2018). The potential impacts of this Facility on groundwater are discussed in Section 3.4.3.2.

Hydrogeologic Investigation of the Initially Proposed Eastern Upland Underground Infiltration Gallery

In earlier stages of Project planning, Tintina considered the development of an Upland UIG for discharging excess mine water, and conducted a field investigation to evaluate this option. While Tintina elected not to include the Upland UIG in the MPDES permit application (Tintina Resources Inc. 2018a), the data collected during the investigation are relevant to the overall environmental impacts assessment. This study is included as Appendix B-2 (Hydrometrics, Inc. 2017a) of the MOP Application (Tintina 2017). It was aimed at (1) characterizing the groundwater system beneath the eastern part of the proposed upland UIG, (2) determining the depth to the local water table, (3) assessing the potential connection between the infiltrated water and nearby surface waterbodies, and (4) establishing baseline groundwater quality around the eastern part of the upland UIG. The study involved installation of two monitoring wells, slug testing in these wells, infiltration testing, and pulse addition of a tracer. Approximately 12 months after injection, the tracer was detected at several monitoring points near Little Sheep Creek. Because of this relatively rapid travel time, the upland UIG was not considered further.

Hydrogeologic Investigation of the Sheep Creek Alluvial Aquifer Underground Infiltration Gallery

This field study involved infiltration testing at nine trenches excavated in the Sheep Creek alluvium to evaluate the recharge capacity of the proposed Alluvial UIG. The investigators excavated trenches, installed three new piezometers, pumped water into the trenches, and monitored recharge flow rates and nearby groundwater levels. Monitoring continued until water levels recovered to within 10 percent of the initial water level (Hydrometrics, Inc. 2017d).

Temporary WRS Facility Percolation (HELP) Model

This modeling study was carried out to evaluate hydraulic behavior at the proposed temporary WRS facility, and is included as Appendix M-1 (Hydrometrics, Inc. 2016a) of the MOP Application (Tintina 2017). The study was performed using the Hydrologic Evaluation of Landfill Performance (HELP) model, version 3.07. The primary purpose of the modeling was to estimate the rate of downward water percolation through the waste rock. It was assumed in the analysis that all percolating water reaching the bottom of the waste rock would be collected and conveyed laterally by bedding material and piping on top of the bottom liner. The collected seepage would be channeled into an outlet pipe at the south edge of the WRS. The average discharge flow rate from the facility was estimated to be less than 1 gpm. The evaluation did not consider the possible impacts of liner failure.

Facility Embankment Percolation (HELP) Model

This modeling study evaluated hydraulic behavior of embankment areas, and is included as Appendix M-2 (Hydrometrics, Inc. 2016d) of the MOP Application (Tintina 2017). The analyzed embankments included those located at the (1) CTF, (2) PWP, (3) mill pad, (4) temporary WRS, (5) portal pad, and (6) CWP. The analyses were carried out using the HELP model, version 3.07. The analyses predicted percolation rates through compacted gravels placed on top of liners and the flow rates that would be collected and either used for mine operations or treated and discharged via the UIG. While the study did not consider the impacts of liner defects, the estimated rates represent an upper limit of percolation to the underlying water table in the unlikely event of a complete liner failure.

Evaluation of Open Access Ramps and Ventilation Raises in Closure

This study focused on estimating the potential impacts of open (non-backfilled) mine workings (e.g., access tunnels and ventilation shafts) on the groundwater system during the Project post-closure phase, and is included as Appendix M-3 (Hydrometrics, Inc. 2017b) of the MOP Application (Tintina 2017). The results of this evaluation supplemented the regional numerical groundwater flow model discussed in Section 3.4.1.2. Analytical models were developed to evaluate (1) the potential for water table mounding above the access decline and (2) upward flow from deeper to shallower HSU’s via open ventilation shafts. These post-closure analyses assumed that the groundwater table was fully recovered in the three shallowest HSUs.

Evaluation of Tunnel and Shaft Plugs for Controlling Groundwater Flow at Closure

This analysis evaluated the merit of installing plugs in post-mine tunnels and shafts that would not be backfilled, and is included as Appendix D of this EIS. Plugs are concrete blocks, 10 to 30 feet long, which selectively seal mine workings that are otherwise open. Open tunnels and shafts could provide conduits for upward flow of contact groundwater, bypassing the containment afforded by the natural (undisturbed) geologic materials. The sealing provided by plugs in otherwise open tunnels and shafts was considered an important closure issue for this EIS. The hydraulic analysis of a hypothetical plug in a ventilation shaft was performed using an analytical model.

3.4.2. Affected Environment

The various methods and tools described in Section 3.4.1 were used to characterize baseline (pre-mining) conditions in the groundwater system that could be affected by the Project. The following sections provide a summary of the pre-mining conditions.

3.4.2.1. Conceptual Model Domain and Regional Study Area

The Project's groundwater Conceptual Model Domain encompasses the upper two thirds of the Sheep Creek watershed on the southern edge of the Little Belt Mountains, which extends from the headwaters of Sheep Creek downstream to the confluence of Black Butte Creek (**Figure 3.4-2**). Sheep Creek is a perennial stream that originates in the eastern part of the model domain at an elevation of about 7,400 feet above mean sea level (amsl), flows through the RSA and Project area (LSA) and exits the model domain on its western boundary at an elevation of about 5,000 feet amsl.

Sheep Creek continues west to where it flows into the Smith River at an elevation of 4,380 feet amsl. The Project area is approximately 19 river miles above the confluence with the Smith River.

Sheep Creek has a number of named and unnamed tributaries. Little Sheep Creek and Black Butte Creek (the latter also referred to as Big Butte Creek or Butte Creek) are two of the larger perennial tributaries in the immediate Project area. Little Sheep Creek is located southeast of the Project area and converges with an unnamed tributary (referred to here as Brush Creek) before flowing into Sheep Creek in the lower Project area at Sheep Creek meadows. Black Butte Creek lies southwest and west of the Project area and joins Sheep Creek near the western edge of the regional model domain (Hydrometrics, Inc. 2015b). As shown on **Figure 3.4-2**, Sheep Creek surface water gaging station USGS-SC1 is located upstream of the Project site and gaging station SW-1 is located downstream of the Project site.

Only a portion of the Conceptual Model Domain's area is evaluated in the groundwater impact analysis. This sub-area is set as the RSA, which is defined in Section 3.4.1.2 above.

3.4.2.2. Geological Settings

This subsection provides a summary description of geological settings within the Conceptual Model Domain, which includes the RSA and LSA. See Section 3.6, Geology and Geochemistry, for more details of the area geology.

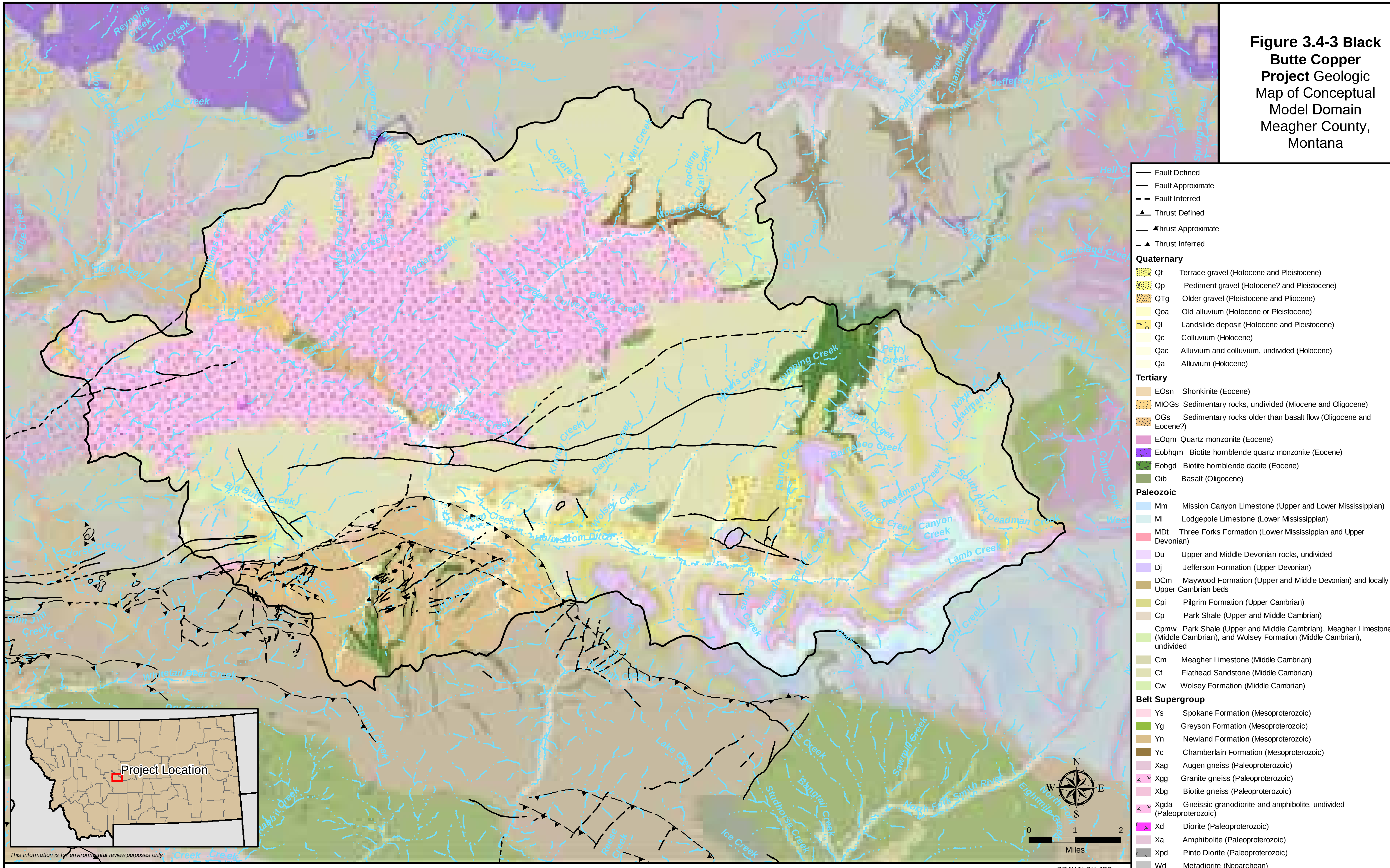
The prominent east-west trending fault (VVF) runs through the southern part of the Sheep Creek drainage. The geology to the south of the VVF consists largely of Precambrian Lower Newland Formation shales (see **Figure 3.4-3**), which extend to the southernmost boundary of the Sheep Creek drainage. The Lower Newland Formation is often greater than 2,500 feet thick and consists mainly of gray dolomitic and non-dolomitic shales that dip gently to the south-southwest. North of the VVF is the younger Flathead Sandstone, which unconformably overlies strata that are older than the Lower Newland Formation.

Bedded pyrite horizons within dolomitic shale of the Lower Newland Formation host tabular sheets of copper mineralization. Exploration drilling delineated two separate lenses containing copper resources: the Johnny Lee Deposit Upper Copper Zone (UCZ) and the Johnny Lee Deposit Lower Copper Zone (LCZ) (Tintina 2017). The cross-sections on **Figure 3.4-4** illustrate the positions of the UCZ and LCZ relative to geologic formations and structures. Both deposits are located close to the VVF; the UCZ just south of the fault and the LCZ just north of the fault. The LCZ is bounded to the north by the older Buttress Fault, which appears to be cut by the VVF and does not extend to ground surface.

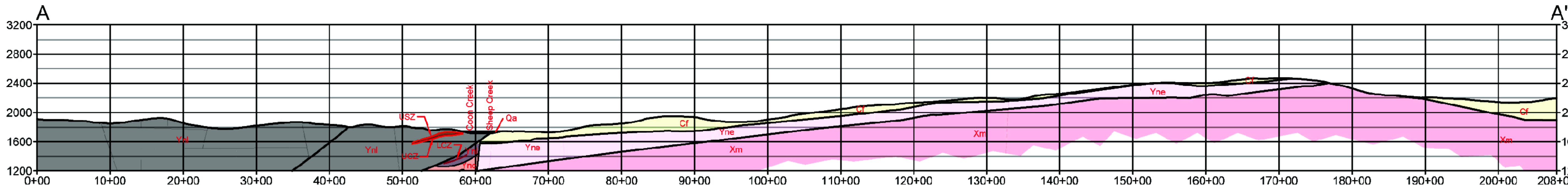
Unconsolidated surficial deposits within the Conceptual Model Domain include alluvial deposits present along the axis of the major drainages and older (Quaternary/Tertiary) basin-fill sediments that form terraces flanking these drainages in a few areas (see **Figure 3.4-3**). The most prominent alluvial deposits are present in the middle reach of the Sheep Creek drainage where the valley is comparatively wide. Significant portions of the upper and lower reaches of Sheep Creek cut through narrow bedrock canyons where surficial deposits are minor or absent (Hydrometrics, Inc. 2015b).

3.4.2.3. Hydrostratigraphic Units

Major HSUs identified for the Conceptual Model Domain, RSA, and LSA generally coincide with the principal geologic units, but also include fault zones. Hydraulic properties of the important LSA units have been determined through aquifer testing and are detailed in technical reports (see Section 3.4.1.4, Baseline Monitoring, Aquifer, and Permeability Tests). The hydraulic properties of units outside of the LSA have been estimated considering values quoted in literature for similar formations. **Figure 3.4-5** diagrammatically shows the spatial relationships between the HSUs, copper ore zones, and nearby faults. **Table 3.4-2** summarizes the hydraulic properties of all the HSUs described in this section.

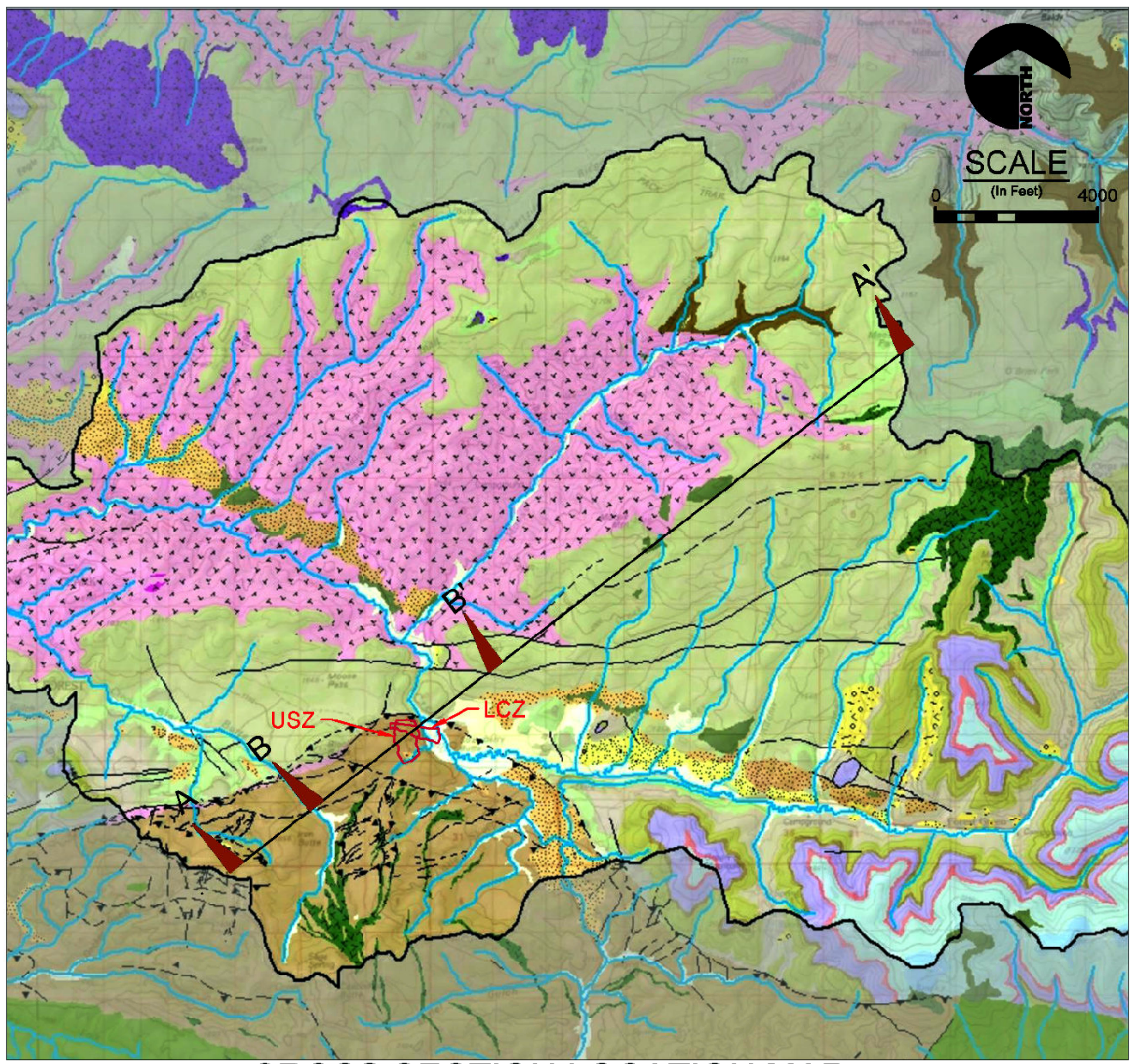


Source: Hydrometrics, Inc. 2015b

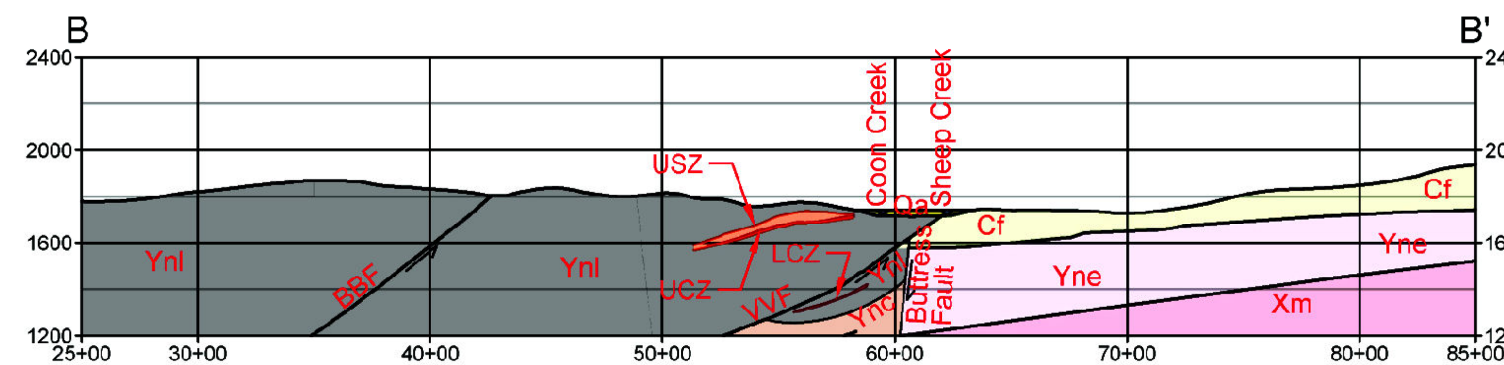


CROSS SECTION A - A'

1"=1400'



CROSS SECTION LOCATION MAP



CROSS SECTION B - B'

1"=800'

LEGEND

Qal	Quaternary Alluvial Deposits
Cf	Flathead Sandstone
Ynl	Lower Newland Shales
USZ	Upper Sulfide Zone
UCZ	Upper Copper Zone
LCZ	Lower Copper Zone
Yc	Chamberlain Shale
Yne	Neihart Quartzite
Xm	Crystalline Bedrock
VVF	Volcano Valley Fault
BBF	Black Butte Fault

Figure 3.4-4
Black Butte Copper Project
Geologic Cross Sections of Conceptual Model Domain
Meagher County, Montana

This information is for environmental review purposes only.

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Source: Hydrometrics, Inc. 2015b

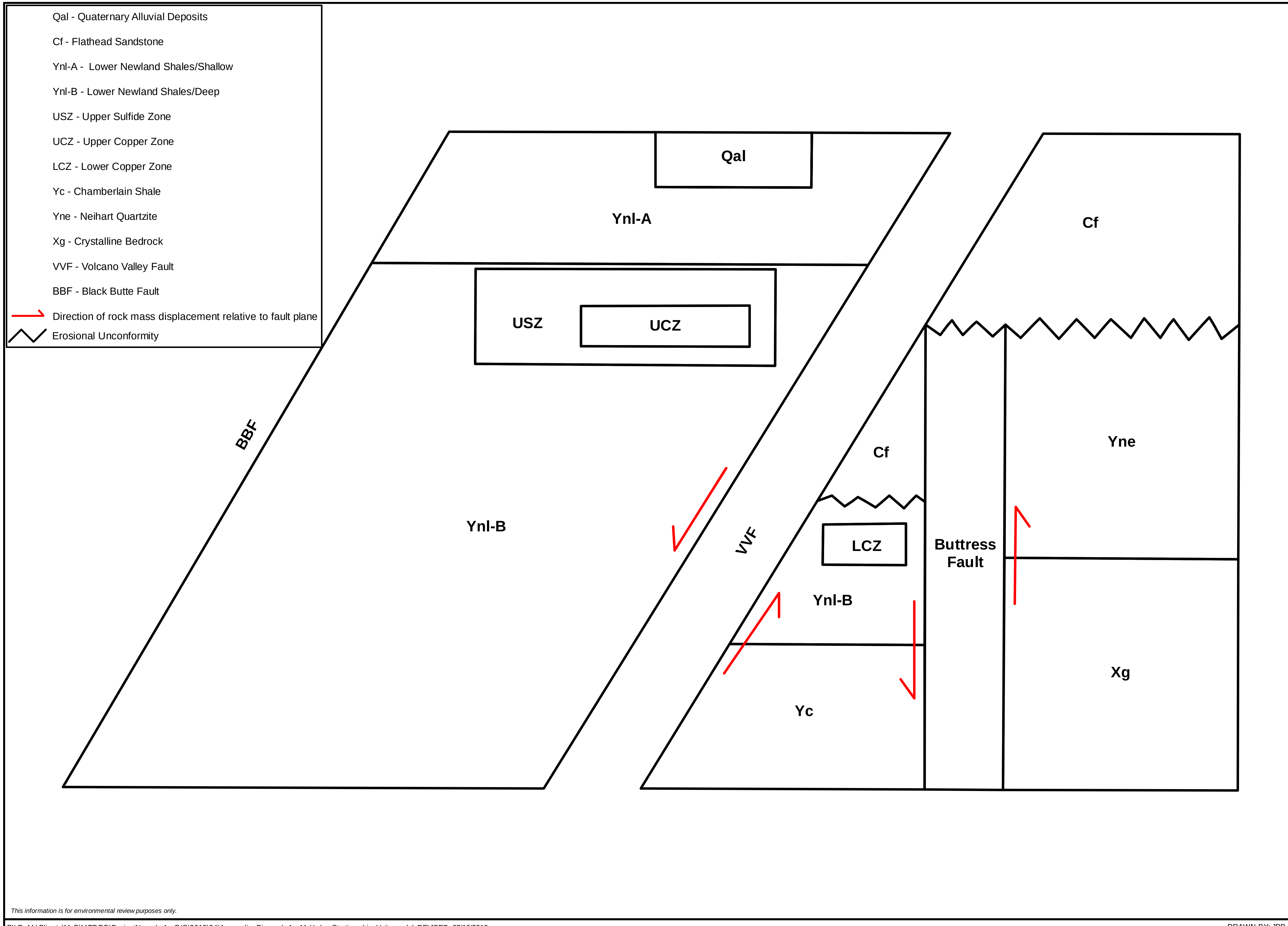

Figure 3.4-5
Black Butte Copper Project
Hydro-Stratigraphic Units
Meagher County, Montana

Source: Hydrometrics, Inc. 2015b

Table 3.4-2
Hydraulic Properties of Hydrostratigraphic Units

Unit	Description	Thickness (ft)	Hydraulic Conductivity (ft/day)	Storage Coefficient	Source of Hydraulic Properties
Geologically-Based Hydrostratigraphic Units					
Quaternary Deposits (QaL)	coarse-grained sand and gravel alluvium	17	200	0.2 to 0.35	slug test; literature
Lower Newland Formation shallow (Ynl A)	calcareous and non-calcareous shale and siltstone bedrock	30-50	1 to 2.3 GM: 1.5	1×10^{-4} to 8×10^{-6}	pumping test
Upper Sulfide Zone (USZ)	highly mineralized zone	30-150	0.01 to 0.7 GM: 0.08	6×10^{-5} to 9×10^{-5}	pumping test
Upper Copper Zone (UCZ)	Shallower copper ore zone (within USZ)				
Lower Copper Zone (LCZ)	Deeper copper ore zone	30-50	1.9×10^{-4}	NA	pumping test
Lower Newland Formation deep (Ynl B)	dolomitic and non-dolomitic shale and siltstone bedrock	150 north of the VVF; up to 2,000 south of the VVF	0.001 to 0.007	NA	pumping test
Flathead Sandstone (Cf)	sandstone bedrock	100	10^{-5} to 1.5	NA	literature
Chamberlain Formation Shale (Yc)	siliceous, locally arenaceous shale	500	0.001 to 0.007	NA	assumed
Neihart Formation Quartzite (Yne)	recrystallized sandstone	800	low; NA	NA	assumed
Crystalline Bedrock (Xbc)	metamorphic crystalline rock	to depth	10^{-3} to 10^{-1}	NA	literature
Structurally Defined Hydrostratigraphic Units					
Volcano Valley Fault (VVF)	fault; clay gouge core; variable associated fracturing	150	1.5×10^{-5} to 7.1×10^{-4} GM: 2.8×10^{-5}	NA	lab permeameter tests
Black Butte Fault		10 - 14			assumed
Buttress Fault		5			
Brush Creek Fault		44			

Source: Adapted from Tintina 2017 (Table 4-1)

GM = geometric mean value (typically used when property values range over more than one order of magnitude); ft = foot; ft/day = foot per day; FW = footwall; NA = not available or not applicable; VVF = Volcano Valley Fault
Notes:
[a] hydraulic conductivity (K) values determined from the aquifer testing.

Quaternary Deposits (Qal)

This unit corresponds to the alluvial sand and gravel deposits that lie along the axes of the major drainages. Slug-testing of MW-4A completed in sand and gravel of the alluvial aquifer in Sheep Creek Meadow yielded a hydraulic conductivity of 200 feet per day. None of the proposed underground workings penetrate alluvial deposits; however, the alluvium is used as a water supply source for mine operations and as a medium for discharge of treated water via the UIG. The storage coefficient (specific yield) of this unconfined HSU is estimated to range from 0.20 to 0.35 based on literature values.

Shallow Lower Newland Shales (Ynl A)

The shallow Lower Newland Formation subunit (Ynl A) typically consists of calcareous and non-calcareous shale and siltstone with discrete weathered intervals that exhibit oxidized surfaces within the upper 130 to 150 feet. The base of the Ynl A is at the contact with the USZ. Boreholes that penetrated the Ynl A produced yields of 5 to 30 gpm within discrete zones during drilling. Pumping tests conducted in wells completed in this unit yielded K values ranging from 1 to 5.8 feet per day, and the geometric mean hydraulic conductivity is taken to be 1.5 feet per day. Storativity results obtained from one pumping test ranged from 8×10^{-6} to 1×10^{-4}.

Within the mineralized shales of the USZ and UCZ, well yields are typically low. K values range from 0.01 to 0.7 foot per day and two measured values of the storage coefficient are 6×10^{-5} and 9×10^{-5}.

Deep Lower Newland Shales (Ynl B)

The deeper bedrock in the Lower Newland Formation subunit (Ynl B) consists of dolomitic and non-dolomitic shales and siltstones similar to the Ynl A unit. However, the deeper bedrock typically produces lower well yields than the shallower Ynl A. The Ynl B is more than 2,000-feet thick south of the VVF. In general, wells penetrating the lower Ynl B unit produced little water. The measured K values ranged from 0.001 to 0.007 foot per day. No storage coefficient estimates are available for this unit.

Within the mineralized LCZ, a K value of 1.9×10^{-4} was estimated from a pumping test.

Flathead Sandstone (Cf)

Flathead Sandstone is present north of the VVF and is composed of fine- to medium-grained sand that is generally well cemented, but the degree of cementation can vary locally. This unit is approximately 100-feet thick where it has been encountered in exploration boreholes next to the VVF. There are no test wells within the Flathead sandstone in the Project area to establish hydraulic parameters for this unit. Literature values for hydraulic conductivity of sandstone show a large potential range, with reported K values for sandstone ranging from 10^{-5} to 1.5 feet per day. Hydraulic conductivity values set in the calibrated groundwater model for this unit range from 0.0003 foot per day to 3.85 feet day.

Chamberlain Shale (Yc)

Chamberlain shale underlies the Ynl B and has only been encountered in exploration boreholes on the north side of the VVF where it appears to be up to 500-feet thick. There are no test wells that penetrate the Chamberlain shale. It is assumed that the Chamberlain shale has hydraulic conductivity similar to the deep Lower Newland shales (0.33 to 1 foot per day). None of the proposed mine workings intercept the Chamberlain Shale.

Neihart Quartzite (Yne)

Neihart quartzite is up to 800-feet thick. Quartzites are recrystallized sandstones that typically have low hydraulic conductivity except in highly fractured zones. No quantitative data were collected to characterize hydrologic properties of this unit; however, it generally exhibited low permeability characteristics when encountered in exploration holes. Somewhat higher permeabilities were suggested in localized zones of fracturing adjacent to the Buttress Fault. In the numerical groundwater model, the unit was assigned a bulk hydraulic conductivity values ranging from 0.0003 to 1.31 feet per day. None of the proposed mine workings intercept the Neihart Quartzite.

Crystalline Bedrock (Xg)

Precambrian metamorphic crystalline bedrock forms the core of the Little Belt Mountains and is present at ground surface north of the VVF (**Figure 3.4-4**). Since crystalline rocks have negligible primary porosity, groundwater is only present within joints and fractures in the rock. The permeability of the joints and fractures typically decreases rapidly with depth due to the combined impact of the weight of the overlying rock and the tendency for weathering and surface disturbances to penetrate only a short distance into the bedrock. Representative K values for crystalline rock are on the order of 10^{-3} to 10^{-1} foot per day with values for weathered crystalline rocks ranging up to several orders of magnitude higher. It is assumed that the K values of crystalline basement rocks decrease with depth by approximately three orders of magnitude in the upper 300 feet. None of the proposed underground workings penetrate the crystalline bedrock.

Structurally Defined Hydrostratigraphic Units

Fault zones that bound the Johnny Lee Deposit influence groundwater flow through the Project area. The BBF and VVF bound the upper orebody (UCZ) to the north, south, and west. The LCZ is bounded to the south and north by the VVF and Buttress Fault, respectively, and above by the VVF. Exploration drilling has indicated that fault zones generally contain gouge, which is finely pulverized rock that typically alters to clay and exhibits low permeability. Thus, fault zones are considered lateral barriers to groundwater flow and do not operate as conduits for enhanced flow. The only quantitative data come from lab permeameter tests of five gouge samples taken from exploration core. The measured hydraulic conductivities ranged from 1.5×10^{-5} to 7.1×10^{-4} foot per day. The geometric mean of these values (2.8×10^{-5} foot per day) is applied to the core of all major fault zones in the LSA.

In hard brittle rocks, low permeability gouge may exist in the core of a fault zone, but rocks with enhanced fracturing and higher permeability may be present on either side of the gouge zone. While this situation is unlikely in shale formations (Ynl A and Ynl B), it could be present in the Neihart quartzite adjacent to the Buttress Fault. In the spring of 2015, the well PW-6 was deepened into the Neihart Formation adjacent to the Buttress Fault (renaming it PW-6N). Air-lift pumping of the open borehole produced more than 500 gpm and confirmed that there are high permeability fractures in the Neihart Formation quartzite adjacent to the fault (Tintina 2017).

3.4.2.4. Groundwater Flow Conditions

The groundwater potentiometric map shown for the Conceptual Model Domain on **Figure 3.4-6** is a generalized interpretation generated from the regional numerical groundwater flow model that was calibrated to groundwater levels measured in wells or indicated by perennial streams. In addition to the Tintina monitoring well network, water level data outside of the Project area were obtained from a search of Montana's Groundwater Information Center database maintained by the Montana Bureau of Mines and Geology. The search identified 20 wells with water level data reported in their well logs at the time of well completion; 13 in bedrock and 7 in alluvium. The stage elevations of perennial streams reflect the groundwater levels adjacent to the stream channels. The potentiometric contours on **Figure 3.4-6** indicate that recharge takes place in upland areas and groundwater flow converges toward the major drainages, including Sheep Creek, Moose Creek, Little Sheep Creek, and Black Butte Creek (Hydrometrics, Inc. 2015b). It is also interpreted that groundwater no-flow boundaries generally coincide with the major surface water drainage divides.

A more detailed potentiometric map of the LSA (**Figure 3.4-7)** was developed using water level data collected from the network of monitoring wells and piezometers installed by Tintina (Hydrometrics, Inc. 2015b). **Figure 3.4-7** depicts the bedrock potentiometric surface in the Lower Newland Formation, as well as elevations of the water table in the shallow alluvial system. Groundwater flow in bedrock is topographically controlled and converges toward Sheep Creek. Groundwater flow in the alluvium is roughly parallel to the stream but converges toward Sheep Creek at the northern end of the Sheep Creek meadows where the alluvium pinches out as Sheep Creek enters a narrow bedrock canyon (Hydrometrics, Inc. 2015b).

Most paired wells show upward hydraulic gradients, with the exception of wells MW-1A/1B and piezometers PZ-07A/07B. The downward gradient at MW-1A appears to reflect the presence of a shallow perched groundwater body within the clayey gravel terrace deposits that overlie the shale bedrock in this area. The downward gradient at PZ-07A and PZ-07B suggest that the springs feeding the headwaters of Coon Creek are also likely a perched system. In the areas of lower elevation, the wells tend to show upward gradients between the deeper bedrock and shallower units, which is consistent with the interpretation of groundwater converging and discharging to the stream channels (Hydrometrics, Inc. 2015b).

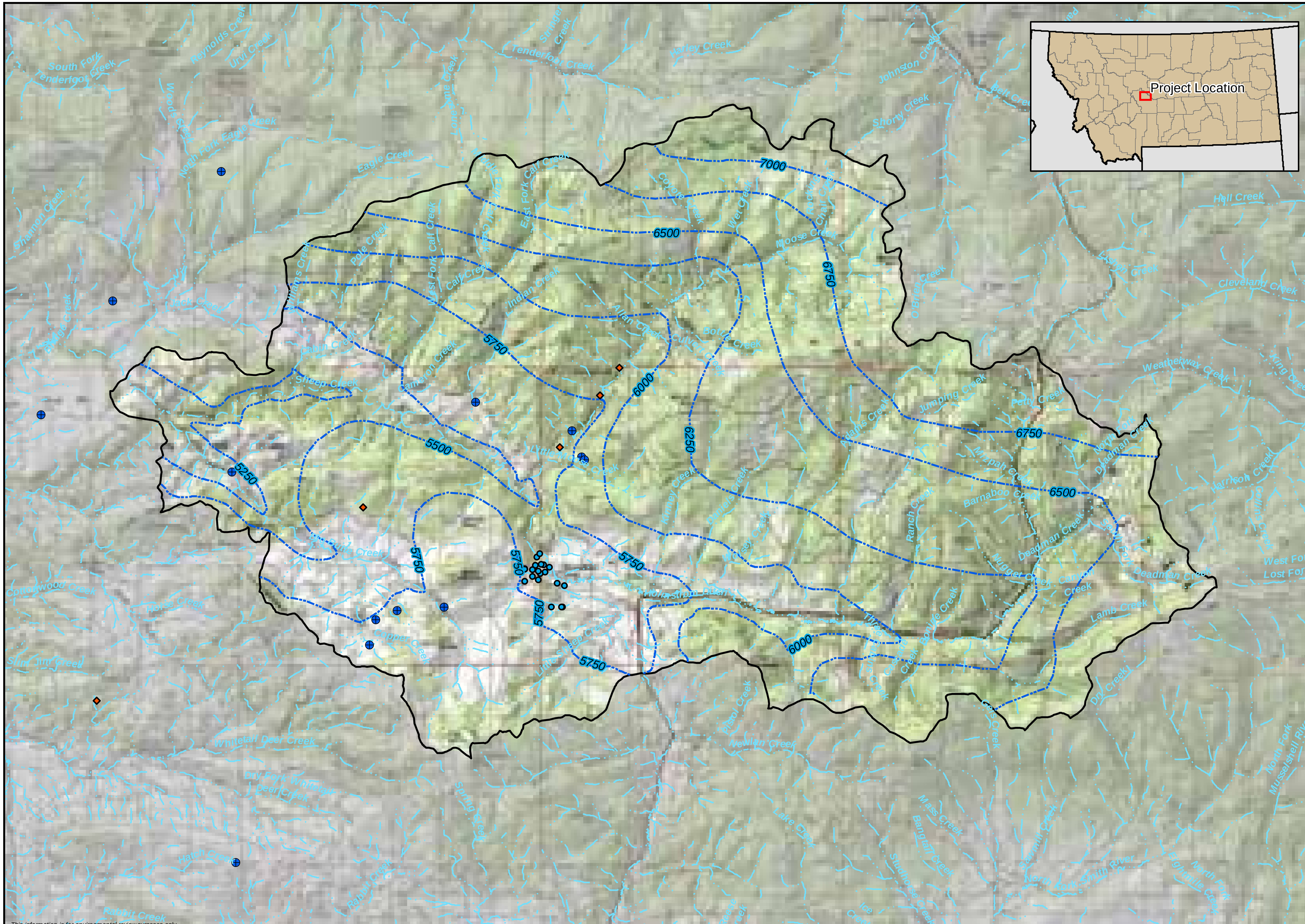

Figure 3.4-6
Black Butte
Copper Project
Groundwater
Potentiometric Map for
Conceptual Model Domain
Meagher County, Montana

- GWIC Bedrock Well
- Alluvial Wells
- WRM Site Elevation
- Regional Potentiometric Contour
- Stream

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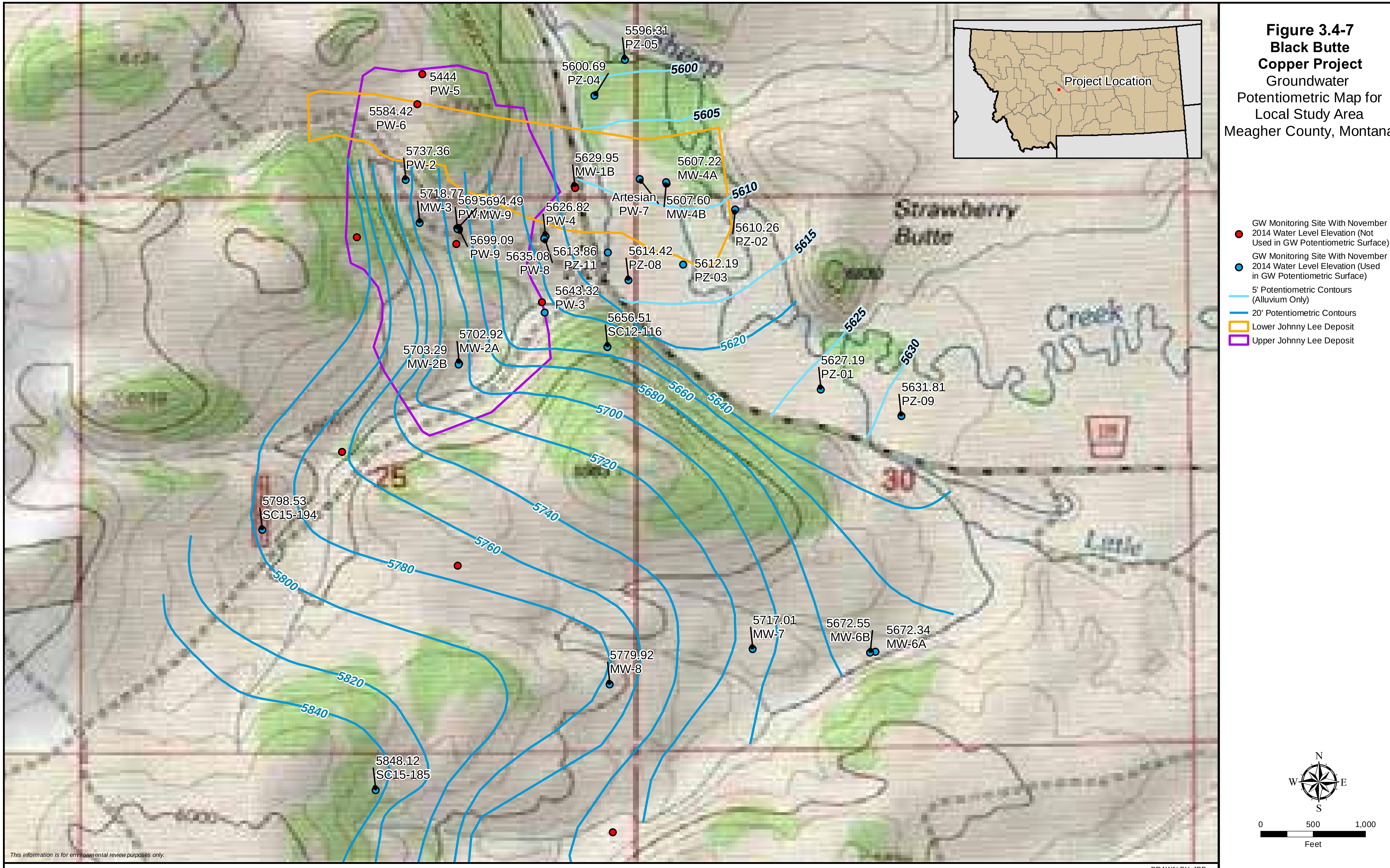
Source: Hydrometrics, Inc. 2015b



Source: Hydrometrics, Inc. 2015b

Groundwater levels typically show seasonal fluctuations in the bedrock wells of 1 to 3 feet, peaking in early June and declining through the summer months. The levels continue to decrease at a slower rate through the fall and winter months and reach seasonal lows in February and March. The shallow alluvial system fluctuates 1 to 1.5 feet seasonally with similar seasonal trends, except the early June spike tends to be more pronounced, building up and tailing off more rapidly compared to the bedrock system (Hydrometrics, Inc. 2015b).

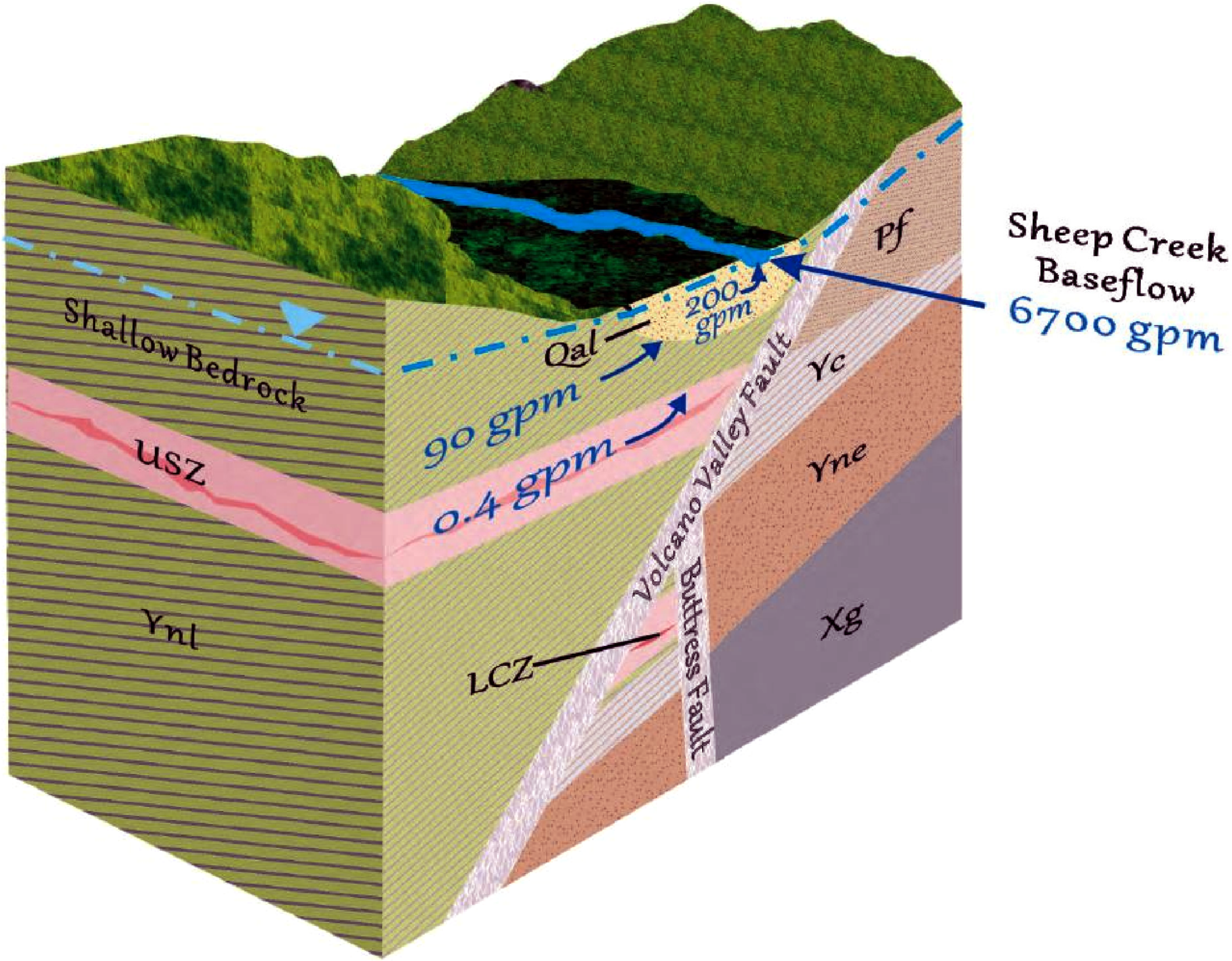
Water levels indicate confined or leaky confined conditions in the bedrock aquifers and unconfined conditions in the shallow alluvial system. Low permeability shale layers appear to produce confined or semi-confined conditions in the Lower Newland Shale group (Hydrometrics, Inc. 2015b).

Figure 3.4-8 shows the results of simple Darcy's Law calculations estimating groundwater flow rates through shallow bedrock units within the footprint of the upper orebody, and through the downgradient alluvial system towards Sheep Creek. Within this area, groundwater flow through the USZ is estimated to be 0.4 gpm, and flow in the adjacent shallow bedrock (Ynl A) is estimated to be 90 gpm. Estimated flow through the Quaternary Alluvial Deposits (Qal) is 200 gpm. Due to upward hydraulic gradients, it is assumed that all flow in shallow bedrock (including the USZ) eventually discharges to the alluvium. The calculations estimate that flow through the shallow bedrock accounts for about 45 percent of the alluvial groundwater flow, but flow through the USZ is only 0.44 percent of the alluvial flow.

Deeper bedrock (Ynl B), including the lower ore body (LCZ), is interpreted to have significantly lower hydraulic conductivity compared to shallower units. The flow through deeper bedrock is very small and estimated to account for less than 0.2 percent of the alluvial groundwater flow. Groundwater flow through the lower ore body (LCZ) is essentially negligible when compared to the alluvial flow.

Groundwater in the mine-area alluvium eventually discharges to Sheep Creek surface water and adds to the stream base flow (the typical annual minimum flow derived exclusively from groundwater). As shown on **Figure 3.4-8**, the Sheep Creek base flow in the mine area is 6,700 gpm (Hydrometrics, Inc. 2015b), so groundwater flow in the mine-area alluvium is about 3 percent of the base flow that accumulates in the stream channel. The rest of the base flow originates from areas in the watershed that are upstream of the mine area. The groundwater flow through shallow bedrock contributes less than half (45 percent) of the alluvial groundwater component of base flow, and the flow through the ore bodies (USZ and LCZ) is negligible when compared to the Sheep Creek base flow (about 0.2 percent of the alluvial groundwater component of base flow in the Sheep Creek).

Figure 3.4-8
Black Butte Copper Project
Block Groundwater Flow Diagram
Meagher County, Montana



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Source: Hydrometrics, Inc. 2015b

3.4.2.5. Groundwater – Surface Water Interactions

Groundwater within the Sheep Creek alluvium is in direct hydraulic communication with the Sheep Creek stream channel. Where alluvium is not present, the stream is in direct or indirect hydraulic communication with bedrock. Except for peak stream levels during May and June, the Sheep Creek water level is typically lower than groundwater levels in the adjacent alluvium and bedrock, and thus acts as a sink for groundwater discharge. Most of the time, the alluvial sands and gravels receive groundwater from adjacent and underlying bedrock systems, and also from alluvial systems in tributary drainages (Hydrometrics, Inc. 2015b). Due to these processes, Sheep Creek is generally a gaining stream within the watershed, with significant base flow supported by groundwater discharge. Except for its uppermost reaches, Sheep Creek is perennial throughout the Conceptual Model Domain.

The upper reaches of some of the tributary drainages have small springs that are likely fed by perched groundwater systems. This water commonly re-infiltrates the ground within the alluvium-filled stream valleys, and re-emerges as groundwater discharge to streams. Many of the tributary streams are ephemeral in their upper reaches and perennial in their lower reaches before flowing into Sheep Creek.

Groundwater discharging to Sheep Creek at the mine site constitutes only 3 percent of the Creek's base flow and deeper bedrock (subject to mining) contributes only about 0.1 percent of that water—see discussion in Section 3.4.2.4 above (Hydrometrics, Inc. 2015b).

3.4.2.6. Groundwater Quality

Groundwater chemistry data for the LSA is compiled in Hydrometrics (2015a) for water samples collected from 2011 through 2015. DEQ's third-party contractor performed a review of more recent data collected during 2016 and 2017. The review for this EIS of newer water chemistry data showed no substantial differences with the earlier data compiled by Hydrometrics except at one well (PW-7). Monitoring wells are grouped according to the primary HSUs:

- Alluvial/Overburden wells (Qal)
- Shallow bedrock wells (Ynl A)
- Upper sulfide ore zone wells (USZ/UCZ)
- Lower copper zone (LCZ)

Table 3.4-3 provides a summary of groundwater quality in each group of wells, while **Table 3.4-3a to Table 3.4-3d** present more detailed information about chemistry for wells representative of each of those groups.

Alluvial/Overburden Wells

Groundwater in the shallow alluvial and unconsolidated overburden wells (MW-1A, MW-2A and MW 6A) is a calcium/magnesium bicarbonate type with near neutral pH of 6.24 to 7.66 standard units (s.u.), moderately low total dissolved solids of 176 to 302 mg/L, and low to non-detected concentrations of dissolved metals (Hydrometrics, Inc. 2015a).

Samples from MW-1A exhibited variable water quality with a small number of samples having concentrations of arsenic, barium, lead, and thallium above Montana human health standards (hhs) (DEQ 2017), and a small number of samples exceeding the secondary (non-health) standards for iron and manganese. MW-1A is screened in fine-grained sediments and has exhibited high turbidity in many water samples. The results from monitoring events showing metals at higher concentrations could reflect the breakthrough of particulates through the sampling filters due to high turbidity (Hydrometrics, Inc. 2015a).

Shallow Bedrock Wells

Wells completed in shallow bedrock above the USZ include MW-1B, MW-2B, MW-4B, MW-6A, MW-6B, MW-7, MW-8, MW-9, MW-10, MW-11, MW-12, MW-13, MW-14, MW-15, SC15-184, SC15-185, SC15-194, SC15-195, SC15-198, and test wells PW-1, PW-2, PW-3, PW-8, PW-9, and PW-10 (see **Figure 3.4-1**). Groundwater samples from these wells tend to have chemistry similar to alluvial groundwater. The shallow bedrock groundwater is a calcium/magnesium bicarbonate type with near neutral pH of 6.02 to 8.27 s.u. and moderately low total dissolved solids of 54 to 548 mg/L. Dissolved trace constituents that are present at detectable concentrations in the shallow bedrock wells include arsenic, barium, iron, manganese, strontium, thallium, and uranium. **Table 4.3-2** shows exceedances of groundwater quality standards in some wells for antimony, arsenic, iron, lead, manganese, strontium, and thallium All other trace constituents in the shallow aquifer met applicable regulatory standards.

MW-1B is a shallow bedrock well with an anomalous water chemistry. It has a calcium/magnesium sulfate water type, pH of 6.02 to 6.51 s.u., and exceeds the secondary drinking water standard for manganese. MW-1B water samples have arsenic in the reduced (III) form, which might be expected in groundwater that interacts with sulfide mineralization under reducing conditions. Concentrations of thallium at MW-1B (0.0145 mg/L) also exceed the Montana human health groundwater standard (0.002 mg/L). Water quality at MW-1B is similar to MW-3 and test well PW-4, both of which are completed in the sulfide ore zone (Hydrometrics, Inc. 2015a). Although completed in shallow bedrock, MW-1B has water that is chemically more similar to that of the USZ.

Upper Sulfide Ore Zone Wells

Wells completed in sulfide ore zone include MW-3, PW-4, and PW-9. Groundwater around those wells is a calcium/magnesium sulfate type with near neutral pH (6.11 to 7.33 s.u.) and somewhat higher total dissolved solids (380 to 607 mg/L). These wells generally have higher concentrations of total dissolved solids and sulfate compared to the shallow bedrock and alluvial wells.

Dissolved trace constituents that were present at detectable concentrations include antimony, arsenic, barium, iron, lead, manganese, mercury, molybdenum, nickel, strontium, thallium, uranium, and zinc. All of the ore zone wells exceed the secondary drinking water standard for iron, and PW-4 exceeds the secondary drinking water standard for manganese (Hydrometrics, Inc. 2015a). Thallium is detected in MW-3 and PW-4, but the concentrations do not exceed the Montana human health standard of 0.002 mg/L (DEQ 2017). Strontium concentrations at MW-3, PW-4, and PW-9 are elevated (8.08 to 16.2 mg/L), exceeding the Montana human health standard of 4 mg/L (DEQ 2017). Arsenic concentrations at the same wells range from 0.054 mg/L to 0.09 mg/L, also exceeding the Montana human health standard of 0.010 mg/L. Arsenic speciation in samples from MW-3 indicated that the most of arsenic is present in the reduced (III) form (Hydrometrics, Inc. 2015a).

Lower Copper Zone

The analytical results from PW-7, the only well completed in the LCZ, indicate a sodium/potassium bicarbonate type water with relatively high pH (8.07 to 11.58 s.u.) and total dissolved solids (317 to 359 mg/L). Compared to other wells at the mine site, PW-7 has higher concentrations of chloride (5.9 to 52 mg/L) and sulfate 12 to 45 mg/L). Detected trace constituents include aluminum, antimony, arsenic, barium, molybdenum, selenium, strontium, and zinc. Dissolved aluminum concentrations (0.187 to 1.03 mg/L) were much higher than observed at other wells on the site. Antimony (0.0077 mg/L) is the only trace constituent that exceeds the Montana human health standard of 0.006 mg/L (DEQ 2017). Iron and manganese exceeded the secondary drinking water standards in samples collected during the June 2017 sampling event.

3.4.2.7. Spring Flow Rates and Water Quality

Springs are expressions of groundwater discharging to surficial environments and are discussed in this Section, Groundwater Hydrology. Locations of springs present around the proposed mine site are presented on **Figure 3.5-3** of Section 3.5, Surface Water Hydrology.

Flow rates observed at the springs ranged from less than 1 gpm to over 100 gpm (Hydrometrics 2015a). Detailed spring flow rates are presented in **Table 3.5-3** of Section 3.5, Surface Water Hydrology. In total, 237 water samples were collected at spring sites: SP-1, SP-2, SP-3, SP-4, SP-5, SP6, SP-7, DS-1, DS-2, DS-3, and DS-4, which surround the proposed mine site. These samples were collected during 41 sampling events conducted from May 2011 to December 2017. The springs generally exhibited slightly acidic to slightly alkaline pH (5.46 to 8.87 s.u.) and moderate to high alkalinities (17 to 240 milligram per liter [mg/L]). Background nitrate concentrations were relatively low (<0.1 to 0.68 mg/L) at all the spring sites. Metals concentrations were below water quality standards with the following exceptions:

- Aluminum was measured in 31 out of 237 collected samples at concentrations exceeding the Aquatic Life Chronic Standard of 0.087 mg/L (DEQ 2017) at the following sampling locations: DS-3, DS-4, and SP-3; and
- Iron was measured in 23 out of 237 collected samples at concentrations exceeding the Aquatic Life Chronic Standard of 1 mg/L at the following sampling locations: DS-3, DS-4, and SP-3 (the same locations as aluminum exceedances).

Table 3.4-3
Summary of Existing Groundwater Quality

Grouping	Geology	General Water Type	Wells	pH	Total Dissolved Solids	Exceedances	Comments
Alluvium / Overburden	Qal	Calcium/ magnesium bicarbonate	MW-1A, MW-2A, MW-4A	6.24 to 7.66	176 to 302 mg/L	• Arsenic, barium, iron, lead, manganese, and thallium above hhs in MW-1A. • Thallium above hhs in MW-2A.	• High turbidity in MW-1A may be responsible for elevated metals concentrations in this well. • Sulfate concentrations are relatively low (from 8 to 51 mg/L).
Shallow Bedrock	Ynl A Ynl B above USZ	Calcium/ magnesium bicarbonate	MW-1B, MW-2B, MW-4B, MW-6A, MW-6B, MW-7, MW-8, MW-9, MW-10, MW-11, MW-12, MW-13, MW-14, MW-15, PW-1, PW-2, PW-3, PW-8, PW-9 PW-10, SC15-184, SC15-185, SC15-194, SC15-195, SC15-198	6.02 to 8.27	54 to 548 mg/L	• Antimony above hhs in MW-08. • Arsenic above hhs in MW-1B, MW-2B, MW-9, PW-8, PW-9. • Iron above secondary standard in MW-1B, MW-2B, MW-9, MW-10, MW-11, PW-1, PW-2, PW-3, PW-9. • Lead above hhs in PW-8. • Manganese above secondary standard in MW-1B, MW-6B, MW-7, MW-8, MW-9, MW-10, MW-11, PW-1, PW-3, PW-8, PW-10, SC15-185. • Strontium above hhs in PW-10. • Thallium above hhs in MW-1B, MW-2B, MW-9, PW-8.	Sulfate concentrations range from 1 to 247 mg/L.

hhs = human health standards (for water quality)

Table 3.4-3a
Groundwater Quality Summary Statistics - MW-4A (Well completed in Alluvium)

Parameters	Units	No. of Measurements	No. of Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
Field Parameters										
Depth To Water	Feet	34	NA	3.36	6.02	4.90	4.46	4.97	5.51	0.76
pH - Field	s.u.	22	NA	6.24	7.53	7.22	7.17	7.26	7.37	0.28
Field Specific Conductivity	umhos/cm	22	NA	481	551	510	490	512	525	20
Water Temperature	Deg C	22	NA	4.3	8.5	6.4	4.7	6.9	7.6	1.5
Dissolved Oxygen	mg/L	22	NA	0.01	3.57	1.00	0.27	0.84	1.37	0.92
Physical Parameters										
Total Dissolved Solids	mg/L	24	24	270	302	287	278	288	296	9
Total Suspended Solids	mg/L	20	1	<4	23	NA	NA	NA	NA	NA
Major Constituents - Common Ions										
Alkalinity as CaCO3	mg/L	24	24	250	290	269	260	270	280	11
Bicarbonate as HCO3	mg/L	4	4	330	360	342	330	340	357	15
Carbonate as CO3	mg/L	4	0	<1	<1	NA	NA	NA	NA	NA
Chloride	mg/L	24	24	2	4	2.	2	2	3	0.5
Fluoride	mg/L	24	24	0.1	0.2	0.1	0.1	0.1	0.2	0.05
Sulfate	mg/L	24	24	8	21	14	12	14	15	3
Hardness as CaCO3	mg/L	24	24	253	292	277	272	279	282	10
Calcium (DIS)	mg/L	24	24	70	80	76	74	76	78	3
Magnesium (DIS)	mg/L	24	24	19	23	21	20	21	22	0.9
Potassium (DIS)	mg/L	24	24	1	2	1	1	1	2	0.5
Sodium (DIS)	mg/L	24	24	2	3	3	3	3	3	0.3
Nutrients										
Kjeldahl Nitrogen as N	mg/L	1	0	<0.5	<0.5	NA	NA	NA	NA	NA
Nitrate + Nitrite as N	mg/L	24	2	<0.01	0.02	0.01	0.01	0.01	0.01	0.002
Total Persulfate Nitrogen	mg/L	1	0	<0.04	<0.04	NA	NA	NA	NA	NA

Parameters	Units	No. of Measurements	No. of Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
Phosphorus (TOT)	mg/L	2	1	<0.006	0.01	NA	NA	NA	NA	NA
Metals - Trace Constituents										
Aluminum (DIS)	mg/L	24	3	<0.009	0.087	0.015	0.009	0.009	0.009	0.017
Antimony (DIS)	mg/L	24	0	<0.0005	<0.003	NA	NA	NA	NA	NA
Arsenic (DIS)	mg/L	24	0	<0.001	<0.003	NA	NA	NA	NA	NA
Barium (DIS)	mg/L	24	24	0.17	0.203	0.1844	0.181	0.185	0.189	0.007
Beryllium (DIS)	mg/L	24	0	<0.0008	<0.001	NA	NA	NA	NA	NA
Cadmium (DIS)	mg/L	24	0	<0.00003	<0.00008	NA	NA	NA	NA	NA
Chromium (DIS)	mg/L	24	0	<0.001	<0.01	NA	NA	NA	NA	NA
Cobalt (DIS)	mg/L	24	0	<0.01	<0.01	NA	NA	NA	NA	NA
Copper (DIS)	mg/L	24	0	<0.001	<0.002	NA	NA	NA	NA	NA
Iron (DIS)	mg/L	24	18	<0.02	0.16	0.037	0.022	0.03	0.04	0.028
Lead (DIS)	mg/L	24	1	<0.0003	0.0005	NA	NA	NA	NA	NA
Manganese (DIS)	mg/L	24	24	0.057	0.291	0.195	0.171	0.187	0.239	0.054
Mercury (DIS)	mg/L	24	1	<0.000005	0.00001	NA	NA	NA	NA	NA
Molybdenum (DIS)	mg/L	24	0	<0.001	<0.005	NA	NA	NA	NA	NA
Nickel (DIS)	mg/L	24	0	<0.001	<0.01	NA	NA	NA	NA	NA
Selenium (DIS)	mg/L	24	0	<0.0002	<0.001	NA	NA	NA	NA	NA
Silicon (DIS)	mg/L	1	1	13.3	13.3	NA	NA	NA	NA	NA
Silver (DIS)	mg/L	24	0	<0.0002	<0.0005	NA	NA	NA	NA	NA
Strontium (DIS)	mg/L	24	24	0.163	0.2	0.172	0.167	0.170	0.173	0.009
Thallium (DIS)	mg/L	24	1	<0.0002	0.0003	NA	NA	NA	NA	NA
Uranium (DIS)	mg/L	24	5	<0.0004	0.008	0.0064	0.008	0.008	0.008	0.003
Zinc (DIS)	mg/L	24	1	<0.002	0.01	NA	NA	NA	NA	NA

DIS = dissolved concentrations; mg/L = milligram per liter; NA = not analyzed or not applicable; PCTL = percentile
Note:
The reporting period for this table is May 2012 to December 2017.

Table 3.4-3b
Groundwater Quality Summary Statistics - MW-4B (Well completed in Shallow Bedrock)

Parameters	Units	No. of Measurements	No. of Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
Field Parameters										
Depth To Water	Feet	35	NA	3.02	7.26	4.56	4.09	4.47	5.075	0.924
pH - Field	s.u.	22	NA	6.84	7.76	7.45	7.413	7.50	7.59	0.228
Field Specific Conductivity	umhos/cm	22	NA	419	510	460.41	446	459	473.9	23.22
Water Temperature	Deg C	22	NA	5.3	6.86	6.18	5.9	6.15	6.5	0.351
Dissolved Oxygen	mg/L	22	NA	0.03	3.39	0.55	0.16	0.31	0.51	0.78
Physical Parameters										
Total Dissolved Solids	mg/L	24	24	217	275	250.3	244	249.5	259.8	12.9
Total Suspended Solids	mg/L	19	0	<4	<10	NA	NA	NA	NA	NA
Major Constituents - Common Ions										
Alkalinity as CaCO3	mg/L	24	24	220	270	242.5	230	240	250	14.5
Bicarbonate as HCO3	mg/L	5	5	300	330	316.0	300	320	330	15.2
Carbonate as CO3	mg/L	5	0	<1	<1	NA	NA	NA	NA	NA
Chloride	mg/L	24	24	1	2	1.8	1.7	2	2	0.41
Fluoride	mg/L	24	24	0.1	0.2	0.1	0.1	0.1	0.1	0.02
Sulfate	mg/L	24	24	11	26	14.9	13	14	16.8	3.6
Hardness as CaCO3	mg/L	24	24	167	265	244.9	237	250	257	20.6
Calcium (DIS)	mg/L	24	24	59	70	65.4	62	66	68	3.31
Magnesium (DIS)	mg/L	24	24	19	23	20.8	20	21	22	1.13
Potassium (DIS)	mg/L	24	24	1	2	1.19	1	1	1	0.385
Sodium (DIS)	mg/L	24	24	2	3	2.21	2	2	2	0.415
Nutrients										
Kjeldahl Nitrogen as N	mg/L	1	0	0.5	<0.5	NA	NA	NA	NA	NA
Nitrate + Nitrite as N	mg/L	24	18	<0.01	0.06	0.03	0.01	0.03	0.058	0.02
Total Persulfate Nitrogen	mg/L	1	1	0.05	0.05	NA	NA	NA	NA	NA

Parameters	Units	No. of Measurements	No. of Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
Phosphorus (TOT)	mg/L	2	1	0.004	0.01	NA	NA	NA	NA	NA
Metals - Trace Constituents										
Aluminum (DIS)	mg/L	24	1	<0.009	0.03	NA	NA	NA	NA	NA
Antimony (DIS)	mg/L	24	0	<0.0005	<0.003	NA	NA	NA	NA	NA
Arsenic (DIS)	mg/L	24	0	<0.001	<0.003	NA	NA	NA	NA	NA
Barium (DIS)	mg/L	24	24	0.117	0.147	0.1278	0.123	0.127	0.131	0.008
Beryllium (DIS)	mg/L	24	0	<0.0008	<0.001	NA	NA	NA	NA	NA
Cadmium (DIS)	mg/L	24	0	<0.00003	<0.00008	NA	NA	NA	NA	NA
Chromium (DIS)	mg/L	24	0	<0.001	<0.01	NA	NA	NA	NA	NA
Cobalt (DIS)	mg/L	24	0	<0.01	<0.01	NA	NA	NA	NA	NA
Copper (DIS)	mg/L	24	0	<0.001	<0.002	NA	NA	NA	NA	NA
Iron (DIS)	mg/L	24	0	<0.02	<0.03	NA	NA	NA	NA	NA
Lead (DIS)	mg/L	24	0	<0.0003	<0.0005	NA	NA	NA	NA	NA
Manganese (DIS)	mg/L	24	3	<0.002	0.006	0.0049	0.005	0.005	0.005	0.001
Mercury (DIS)	mg/L	24	1	<0.000005	0.000012	NA	NA	NA	NA	NA
Molybdenum (DIS)	mg/L	24	0	<0.001	<0.005	NA	NA	NA	NA	NA
Nickel (DIS)	mg/L	24	0	<0.001	<0.01	NA	NA	NA	NA	NA
Selenium (DIS)	mg/L	24	0	<0.0002	<0.02	NA	NA	NA	NA	NA
Silicon (DIS)	mg/L	1	1	10.6	10.6	NA	NA	NA	NA	NA
Silver (DIS)	mg/L	24	0	<0.0002	<0.0005	NA	NA	NA	NA	NA
Strontium (DIS)	mg/L	24	24	0.161	0.2	0.177	0.17	0.173	0.184	0.011
Thallium (DIS)	mg/L	24	4	<0.0002	0.0004	0.0002	0.0002	0.0002	0.0002	0.000
Uranium (DIS)	mg/L	24	5	<0.0007	0.008	0.0065	0.008	0.008	0.008	0.003
Zinc (DIS)	mg/L	24	0	<0.002	<0.01	NA	NA	NA	NA	NA

DIS = dissolved concentrations; hhs = human health standards; mg/L = milligram per liter; NA = not analyzed or not applicable; PCTL = percentile
Note:
The reporting period for this table is May 2012 to December 2017.

Table 3.4-3c
Groundwater Quality Summary Statistics - MW-3 (Well completed in Sulfide Ore Zone)

Parameters	Units	No. of Measurements	No. of Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
Field Parameters										
Depth To Water	Feet	28	NA	26.74	46.13	38.72	32.33	40.63	43.42	5.82
pH - Field	s.u.	24	NA	6.77	7.31	7.07	6.99	7.06	7.16	0.115
Field Specific Conductivity	umhos/cm	24	NA	769	883	835	817	834	857	29.9
Water Temperature	Deg C	24	NA	8.1	10.3	9.29	8.82	9.45	9.80	0.60
Dissolved Oxygen	mg/L	24	NA	0	2.09	0.34	0.11	0.255	0.348	0.464
Physical Parameters										
Total Dissolved Solids	mg/L	28	28	535	607	577	555	580	598	22
Total Suspended Solids	mg/L	21	0	<4	<10	NA	NA	NA	NA	NA
Major Constituents - Common Ions										
Alkalinity as CaCO3	mg/L	28	28	210	230	217.5	210	220	220	5.2
Bicarbonate as HCO3	mg/L	7	7	260	290	271	270	270	270	9
Carbonate as CO3	mg/L	7	0	<1	<1	NA	NA	NA	NA	NA
Chloride	mg/L	28	28	1	2	1.25	1	1	1.2	0.407
Fluoride	mg/L	28	28	0.6	0.8	0.74	0.7	0.7	0.8	0.063
Sulfate	mg/L	28	28	219	280	257.39	242	260	278	20.01
Hardness as CaCO3	mg/L	28	28	375	523	428.89	407	430	440	28.01
Calcium (DIS)	mg/L	28	28	71	124	82.96	77.25	82.5	84	9.71
Magnesium (DIS)	mg/L	28	28	48	58	53.61	51	54	55.75	2.67
Potassium (DIS)	mg/L	28	28	3	4	3.21	3	3	3	0.42
Sodium (DIS)	mg/L	28	28	14	18	15.96	16	16	16	0.881
Nutrients										

Parameters	Units	No. of Measurements	No. of Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
Kjeldahl Nitrogen as N	mg/L	2	0	<0.5	<0.5	NA	NA	NA	NA	NA
Nitrate + Nitrite as N	mg/L	28	3	<0.01	0.02	0.01	0.01	0.01	0.01	0.002
Total Persulfate Nitrogen	mg/L	1	1	0.07	0.07	NA	NA	NA	NA	NA
Phosphorus (TOT)	mg/L	3	3	<0.006	0.01	0.009	NA	0.009	NA	NA
Metals - Trace Constituents										
Aluminum (DIS)	mg/L	28	0	<0.009	<0.03	NA	NA	NA	NA	NA
Antimony (DIS)	mg/L	28	0	<0.0005	<0.003	NA	NA	NA	NA	NA
Arsenic (DIS)	mg/L	28	28	0.062	0.078	0.0675	0.0653	0.068	0.07	0.004
Barium (DIS)	mg/L	28	28	0.01	0.013	0.0110	0.01	0.011	0.011	0.001
Beryllium (DIS)	mg/L	28	0	<0.0008	<0.001	NA	NA	NA	NA	NA
Cadmium (DIS)	mg/L	28	0	<0.00003	<0.00008	NA	NA	NA	NA	NA
Chromium (DIS)	mg/L	28	0	<0.001	<0.01	NA	NA	NA	NA	NA
Cobalt (DIS)	mg/L	28	0	<0.01	<0.01	NA	NA	NA	NA	NA
Copper (DIS)	mg/L	28	0	<0.001	<0.002	NA	NA	NA	NA	NA
Iron (DIS)	mg/L	28	28	1	1.23	1.114	1.033	1.125	1.2	0.082
Lead (DIS)	mg/L	28	0	<0.0003	<0.0005	NA	NA	NA	NA	NA
Manganese (DIS)	mg/L	28	28	0.018	0.035	0.024	0.02	0.023	0.026	0.005
Mercury (DIS)	mg/L	28	1	<0.000005	0.00001	NA	NA	NA	NA	NA
Molybdenum (DIS)	mg/L	28	1	<0.001	0.005	NA	NA	NA	NA	NA
Nickel (DIS)	mg/L	28	6	<0.001	0.01	0.002	0.001	0.001	0.001	0.003
Selenium (DIS)	mg/L	28	0	<0.0002	<0.001	NA	NA	NA	NA	NA
Silicon (DIS)	mg/L	1	1	8.3	8.3	NA	NA	NA	NA	NA
Silver (DIS)	mg/L	28	0	<0.0002	<0.0005	NA	NA	NA	NA	NA
Strontium (DIS)	mg/L	28	28	13	16.2	14.3	13.7	14.2	15	0.800

Parameters	Units	No. of Measurements	No. of Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
Thallium (DIS)	mg/L	28	28	0.0003	0.0006	0.0004	0.0004	0.0004	0.0004	0.000
Uranium (DIS)	mg/L	28	7	<0.001	0.008	0.006	0.003	0.008	0.008	0.003
Zinc (DIS)	mg/L	28	1	<0.002	0.01	NA	NA	NA	NA	NA

DIS = dissolved concentrations; mg/L = milligram per liter; NA = not analyzed or not applicable; PCTL = percentile
Note:
The reporting period for this table is November 2011 to November 2017.

Table 3.4-3d
Groundwater Quality Summary Statistics – PW-7 (Well completed in in Lower Copper Zone)

Parameters	Units	No. of Measurements	No. of Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
Field Parameters										
Depth To Water	Feet	1	NA	51.93	51.93	NA	NA	NA	NA	NA
pH - Field	s.u.	5	NA	8.7	11.58	9.97	9	9.5	11.175	1.17
Field Specific Conductivity	umhos/cm	5	NA	525	842	622.2	537.5	557	739.5	129.8
Water Temperature	Deg C	5	NA	5.3	13.36	10.63	7.4	12	13.18	3.34
Dissolved Oxygen	mg/L	4	NA	0.08	0.39	0.19	0.085	0.15	0.343	0.142
Physical Parameters										
Total Dissolved Solids	mg/L	5	5	317	359	326.8	317.5	319	340	18.1
Total Suspended Solids	mg/L	5	1	<10	19	NA	NA	NA	NA	NA
Major Constituents - Common Ions										
Alkalinity as CaCO3	mg/L	5	5	170	290	244	175	290	290	63
Bicarbonate as HCO3	mg/L	0	NA	<NA	NA	NA	NA	NA	NA	NA
Carbonate as CO3	mg/L	0	NA	<NA	NA	NA	NA	NA	NA	NA
Chloride	mg/L	5	5	5.9	52	20.4	6.0	6.1	42	20.9
Fluoride	mg/L	5	5	1.4	1.6	1.5	1.4	1.5	1.6	0.071
Sulfate	mg/L	5	5	12	45	20.4	12	12	33	14.3

Parameters	Units	No. of Measurements	No. of Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
Hardness as CaCO3	mg/L	5	4	<7	91	59.2	15.5	86	89.5	40.4
Calcium (DIS)	mg/L	5	5	1	10	7.2	4.5	8	9.5	3.6
Magnesium (DIS)	mg/L	5	3	<1	16	10.0	1	16	16	8.2
Potassium (DIS)	mg/L	5	5	8	25	14.0	8	9	22.5	8.0
Sodium (DIS)	mg/L	5	5	93	113	99.4	94	95	107	8.2
Nutrients										
Kjeldahl Nitrogen as N	mg/L	0	NA	<NA	NA	NA	NA	NA	NA	NA
Nitrate + Nitrite as N	mg/L	5	0	<0.01	<0.01	NA	NA	NA	NA	NA
Total Persulfate Nitrogen	mg/L	0	NA	<NA	NA	NA	NA	NA	NA	NA
Phosphorus (TOT)	mg/L	0	NA	<NA	NA	NA	NA	NA	NA	NA
Metals - Trace Constituents										
Aluminum (DIS)	mg/L	5	2	<0.009	1.03	0.25	0.01	0.01	0.61	0.44
Antimony (DIS)	mg/L	5	2	<0.0005	0.0077	0.0026	0.00	0.0005	0.01	0.0032
Arsenic (DIS)	mg/L	5	3	<0.001	0.004	0.002	0.001	0.001	0.003	0.001
Barium (DIS)	mg/L	5	4	<0.003	0.219	0.089	0.006	0.075	0.18	0.091
Beryllium (DIS)	mg/L	5	0	<0.0008	<0.0008	NA	NA	NA	NA	NA
Cadmium (DIS)	mg/L	5	0	<0.00003	<0.00003	NA	NA	NA	NA	NA
Chromium (DIS)	mg/L	5	0	<0.005	<0.01	NA	NA	NA	NA	NA
Cobalt (DIS)	mg/L	5	0	<0.005	<0.01	NA	NA	NA	NA	NA
Copper (DIS)	mg/L	5	0	<0.002	<0.002	NA	NA	NA	NA	NA
Iron (DIS)	mg/L	5	4	<0.02	1.01	0.40	0.03	0.30	0.83	0.43
Lead (DIS)	mg/L	5	0	<0.0003	<0.0003	NA	NA	NA	NA	NA
Manganese (DIS)	mg/L	5	3	<0.001	0.097	0.052	0.003	0.074	0.09	0.045
Mercury (DIS)	mg/L	5	0	<0.000005	<0.000005	NA	NA	NA	NA	NA
Molybdenum (DIS)	mg/L	5	5	0.003	0.033	0.01	0.00	0.01	0.03	0.01
Nickel (DIS)	mg/L	5	0	<0.001	<0.001	NA	NA	NA	NA	NA
Selenium (DIS)	mg/L	5	2	<0.0002	0.0006	0.0003	0.0002	0.0002	0.0004	0.0002
Silicon (DIS)	mg/L	0	0	0.002	<0.033	NA	NA	NA	NA	NA

Parameters	Units	No. of Measurements	No. of Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
Silver (DIS)	mg/L	5	0	<0.0002	<0.0002	NA	NA	NA	NA	NA
Strontium (DIS)	mg/L	5	5	0.0119	0.342	0.175	0.0153	0.208	0.319	0.154
Thallium (DIS)	mg/L	5	0	<0.0002	<0.0002	NA	NA	NA	NA	NA
Uranium (DIS)	mg/L	5	0	<0.0002	<0.0002	NA	NA	NA	NA	NA
Zinc (DIS)	mg/L	5	5	0.0119	0.342	0.175	0.0153	0.208	0.319	0.154

DIS = dissolved concentrations; mg/L = milligram per liter; NA = not analyzed or not applicable; PCTL = percentile
Note:
The reporting period for this table is August 2014 to June 2017.

3.4.2.8. Water Balance for the Conceptual Model Domain Area

Groundwater Recharge

Infiltration of precipitation and snow melt are the primary sources of recharge to the groundwater system. Hydrologists typically assume aerially distributed recharge rates of 10 to 15 percent of mean annual precipitation in numerical groundwater models of inter-montane basins in western Montana. Hydrometrics provides a more thorough discussion of groundwater recharge over the Conceptual Model Domain (Hydrometrics, Inc. 2015b). Based on measured base flows in Sheep Creek at gaging stations USGS-SC1 and SW-1, average recharge used in the regional numerical groundwater model is about 2.59 inches per year, equivalent to 10 percent of mean annual rainfall (see **Table 3.4-4**).

Widespread irrigation can be a major source of recharge to shallow groundwater systems. There is some irrigated acreage adjacent to Sheep Creek in the middle reach of the watershed; however, it represents a very small fraction of the watershed area (<2 percent). Hydrographs do not indicate that return flows contribute significantly to stream base flow in the late winter/early spring. Given the limited acreage that is under irrigation and the timing of irrigation returns, irrigation is unlikely to be a significant factor in simulating regional groundwater flow conditions during base flow periods (Hydrometrics, Inc. 2015b). Irrigation in areas close to the Project would likely cease, once the mining operations start.

Groundwater Discharge

Groundwater flow within the shallow and deeper groundwater systems is topographically controlled, with groundwater divides coinciding with surface water drainage divides and discharge occurring along perennial streams. Base flow at a stream location is considered to represent the groundwater discharge rate exiting from the associated upstream watershed. Where not directly measured, it is assumed that base flow at a stream location is equal to 10 percent of mean annual rainfall multiplied by the associated upstream watershed area. For selected stream locations, calculated base flow (groundwater discharge) values are provided in **Table 3.4-5**.

Table 3.4-4
Observed Base Flow and Calculated Groundwater Recharge

Sheep Creek Gaging Stations	**USGS-SC1**	**SW-1**
Watershed Area (acres)	27,676	50,162
Watershed Area (m^2)	1.12E+08	2.03E+08
Average Annual Precipitation (in/yr) [a]	28.3	26.4
Average Annual Precipitation (m/yr) [a]	0.72	0.671
Volume (ac-ft/yr)	6.53E+04	1.10E+05
Volume (m^3/yr)	8.06E+07	1.36E+08
Base Flow observed (cfs)	9.1	15
Base Flow observed (m^3/day)	22,300	36,700

Sheep Creek Gaging Stations	USGS-SC1	SW-1
Recharge as percent of precipitation (%)	10.1%	9.8%

Source: Adapted from Tintina 2017 (Table 4-3)

% = percent; ac-ft/yr = acre-foot per year; cfs = cubic foot per second; in/yr = inch per year; m/yr = meter per year; m2 = square meter; m3/yr = cubic meter per year

Notes:
a These average values were calculated from a 30-year average PRISM model. PRISM Climate Data (http://prism.oregonstate.edu/) provides estimates of the spatial distribution of precipitation. The estimates are obtained with the use of a PRISM (Parameter-elevation Relationships on Independent Slopes Model – Daly et al. 2008).

Table 3.4-5
Groundwater Discharge (Base Flow) Estimates for Selected Sheep Creek Watershed Areas

Watershed	Watershed Area (acres)	Estimated Average Annual Precipitation within the Watershed [a] (ft/yr)	Measured Base Flow (cfs)	Estimated Base Flow [b] (cfs)
Sheep Creek at USGS-SC1	27,700	2.36	9.1	9.0
Sheep Creek at SW-1	50,200	2.2	15	15.3
Sheep Creek at confluence of Black Butte Creek	112,000	2.1		32.3
Moose Creek	23,200	2.41		7.7
Black Butte Creek	14,700	1.57		3.2
Calf Creek	6,470	2.3		2.1
Adams Creek	4,730	2.55		1.7

Source: Estimated values adapted from Tintina 2017 (Table 4-4)

ac-ft/yr = acre-foot per year; cfs = cubic foot per second; ft/yr = foot per year
Note:
a Elevation dependent

b Calculated as 10% of annual precipitation multiplied by the watershed area and converted to cfs.

3.4.3. Environmental Consequences

This section discusses potential impacts of the Project on groundwater resources of the area.

3.4.3.1. No Action Alternative

The No Action Alternative would result in no change to groundwater levels, groundwater flow paths, and stream base flows when compared to baseline conditions. As such, the No Action Alternative would not have any impacts on groundwater resources and would not alter baseline conditions discussed in Section 3.4.2, Affected Environment.

3.4.3.2. Proposed Action

The Project MOP Application (Tintina 2017) describes in detail the Project-planned operations that have the potential to affect groundwater quantity and quality. These Project operations include:

- Dewatering of the underground workings (access decline and tunnels, ventilation shafts, and stopes);
- Groundwater pumping for mine water supply, potable water supply, and wet well for water diversion (note: three separate water supply systems consisting of a process water supply, fresh water supply, and potable water supply would be used to meet the water supply needs of the Project; make-up water would be provided directly by dewatering of the mine, or from the WTP; fresh water (for the fresh / fire water tank) would be obtained from the WTP, and would be used for other milling purposes; and potable water would be derived from a public water supply);
- Disposal of excess (treated) mine water to the alluvial UIG;
- Ore stockpiles (copper-enriched rock stockpile);
- Tailings disposal facility (CTF);
- Waste rock facilities (WRS);
- Treated Water Storage Pond (TWSP); and
- Non-Contact Water Reservoir (NCWR).

Of these, dewatering of the underground workings will have the greatest impacts on the groundwater system. Construction and operation of other facilities and elements of Project infrastructure, such as the mill facility or roads, are not likely to affect groundwater resources in a measurable way.

The following subsections discuss the potential Project impacts on groundwater resources organized by each of the planned operations.

Dewatering Associated with Underground Mine Operations

Groundwater Inflow Rates

Tintina applied the numerical groundwater model to estimate mine inflow and evaluate its impacts on water resources throughout the life of the mine and during the post-mining period (Hydrometrics, Inc. 2015b). A series of predictive simulations were used to assess different phases in the mine development:

- Phase I (Year 1) – Surface Decline construction to UCZ;
- Phase II (Years 2-4) – Lower Decline construction to LCZ, further construction of access tunnels and ramps, first full year of mining in the UCZ;
- Phase III (Years 5-15) – Mining of the UCZ and LCZ: dewatering to progressively greater depths; and
- Phase IV (Years 16+) – Post-Mining: rinsing of mine workings, installation of plugs, re-fill of underground workings, and mine flooding followed by a long-term groundwater level recovery.

Table 3.4-6 presents the simulation results showing projected groundwater inflows to the underground workings (dewatering rates). Estimated average inflow to the Surface Decline at the end of Phase I is 223 gpm, with over 90 percent coming from Ynl A. The simulated inflows increase during Phase II to approximately 497 gpm in Year 4, at which time approximately 80 percent comes from Ynl A and the USZ/UCZ, which is expected because these HSU's have higher permeabilities compared to deeper units (Hydrometrics, Inc. 2015b). During Phase III, the mine inflows progressively decrease to 421 gpm as the shallower geologic units are depressurized and mined stopes are backfilled with low-permeability cemented tailings. At the end of mining (Year 15), approximately 80 percent of the flow comes from Ynl A and the USZ/UCZ, and 20 percent comes from Ynl B and LCZ. Of the simulated 421 gpm inflow rate at the end of mining, it is estimated that 213 gpm would come from the USZ/UCZ and only 1 gpm would come from the LCZ, reflecting the large hydraulic conductivity contrast between these ore-bearing (mined out) HSUs.

Lowering of Groundwater Levels

Mine dewatering would result in lowering groundwater levels within the Project area (LSA). **Figures 3.4-9** and **3.4-10** show model-predicted drawdowns in the shallow and deeper HSU's at mine Years 4 and 15, respectively.

For shallow HSUs (Alluvium, Ynl A, and UCZ), simulations predict that the greatest drawdowns occur in Year 4 corresponding to the initial mining stage when the model predicts the highest inflows to the upper mine workings. At Year 15, the drawdowns are comparable, but somewhat less because the dewatering rate decreases due to backfilling of the stopes. Regardless of the time period, the higher-end drawdowns adjacent to the mine workings appear to be on the order of 100 to 200 feet. The maximum water-table drawdown directly over the center of the mine area is predicted to be approximately 290 feet (Hydrometrics, Inc. 2015b). The 10-foot drawdown contour is predicted to extend approximately 8,000 feet southwest of the mine area and does not appear to be greatly affected by the presence of faults. Northeast of the mine area, the 10 feet contour extends a distance of only about 1,000 feet, and is situated within and oriented parallel to the Sheep Creek alluvium. This configuration suggests that perennial Sheep Creek operates as a fixed head boundary to the Alluvium, Ynl A, and UCZ, and would provide some recharge to these units during the mining period. While visually less apparent, **Figures 3.4-9** and **3.4-10** suggest that the extent of the ten-foot contour may be limited by perennial Black Butte Creek to the southwest and an unnamed tributary of Little Sheep Creek to the southeast.

The RSA shown in **Figure 3.4-2** is defined as an area that could experience groundwater drawdown of more than 2 feet due to mine dewatering, as computed by the groundwater model. Two feet of drawdown is within the typical range of seasonal groundwater level fluctuations observed in the monitoring wells of the Project area (see discussion in Section 3.4.1.2 above).

Table 3.4-6
Groundwater Model- Simulated Annual Average Inflow to Mine Workings

Mining Progress	**Phase I: Surface Decline to UCZ**	**Phase II: Lower Decline to LCZ, additional access tunnels and ramps, 1 year of mining in UCZ**			**Phase III: Mining in UCZ and in LCZ to progressively greater depths**										
Project Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Mine Structure	**Inflow (gpm)**														
Surface Decline Total	**223**	**159**	**106**	**105**	**108**	**106**	**110**	**110**	**110**	**111**	**113**	**111**	**110**	**113**	**125**
Surface Decline (Ynl A)	203	146	97	96	98	97	101	101	101	102	103	101	101	104	116
Surface Decline (UCZ)	20	12	9	9	9	9	9	9	9	9	9	9	9	9	9
Upper Access and Stopes Total	**0**	**141**	**279**	**292**	**262**	**272**	**249**	**248**	**247**	**244**	**238**	**240**	**239**	**233**	**215**
UCZ Access/Stopes (USZ/UCZ)	0	129	268	282	251	261	238	237	236	233	227	229	228	222	204
UCZ Access (Ynl B)	0	12	12	10	11	11	11	11	11	11	11	11	11	11	11
Lower Decline Total	**0**	**83**	**84**	**85**	**83**	**80**	**79**	**78**	**78**	**77**	**77**	**76**	**75**	**75**	**75**
Lower Decline (Ynl B)	0	83	84	85	83	80	79	78	78	77	77	76	75	75	75
Lower Access and Stopes Total	**0**	**0**	**2**	**15**	**12**	**9**	**8**	**8**	**7**	**7**	**7**	**7**	**7**	**6**	**6**
LCZ Access/Stopes (LCZ)	0	0	0	5	4	3	2	2	2	2	2	2	2	2	1
LCZ Access (Ynl B)	0	0	2	10	7	6	6	6	5	5	5	5	5	5	5
Total Mine Inflow	**223**	**382**	**472**	**497**	**465**	**467**	**447**	**445**	**442**	**439**	**434**	**433**	**431**	**427**	**421**

Source: Hydrometrics, Inc. 2015b (Table 5-1)

For the deep HSUs (as indicated by LCZ), **Figures 3.4-9** and **3.4-10** show drawdowns on the order of 500 feet at the perimeter of the mine workings. Compared to shallow HSUs, greater drawdown is expected in the deeper units because the LCZ is dewatered to a greater depth below ground surface. At Year 4, the 10-foot drawdown contour is predicted to extend 1,000 to 2,100 feet from the mine workings, which is explained in part by the limited excavation of the LCZ stopes at that time. At Year 15, the 10-foot contour is predicted to expand to 3,200 to 5,600 feet from the workings. Compared to the shallow HSU's, transient lateral expansion of the drawdown cone in the deeper HSU's is expected to be slower due to the lower hydraulic conductivity of the deeper units.

Spring and Seep Flows

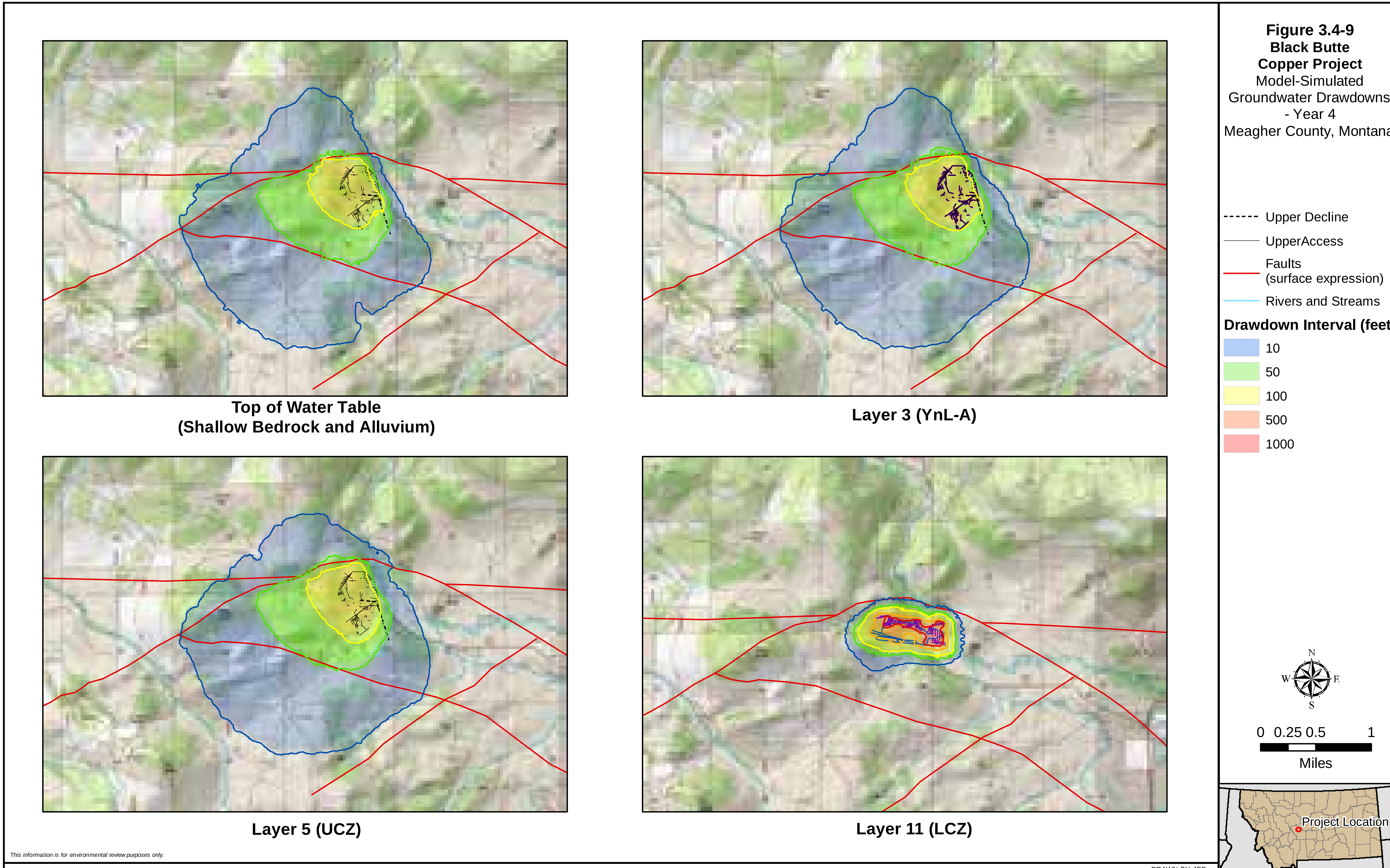
Baseline investigations identified nine seeps and 13 springs in the Project area, and some of the sites are located within the area that could be affected by the mine drawdown cone, including springs developed for stock use (**Figure 3.5-3** of Section 3.5, Surface Water Hydrology). Some springs and seeps located within the mine drawdown cone might experience decreased flow, and some might dry up. Many of the springs and seeps appear to be connected to perched groundwater bodies and, also, may only flow seasonally; these would not likely be directly affected by creation of the deeper groundwater drawdown cone. The Proponent would have to provide replacement water for any springs that are being put to beneficial use and are depleted by dewatering (§ 82-4-355, MCA). Vegetation and wildlife may be affected at the springs or seeps depleted by dewatering. Spring flow would be anticipated to reestablish when shallow groundwater recovers to baseline conditions, within 2 years after the cessation of dewatering. See further discussion in Section 3.5, Surface Water, and Section 3.15, Wildlife.

Base Flow in Nearby Creeks

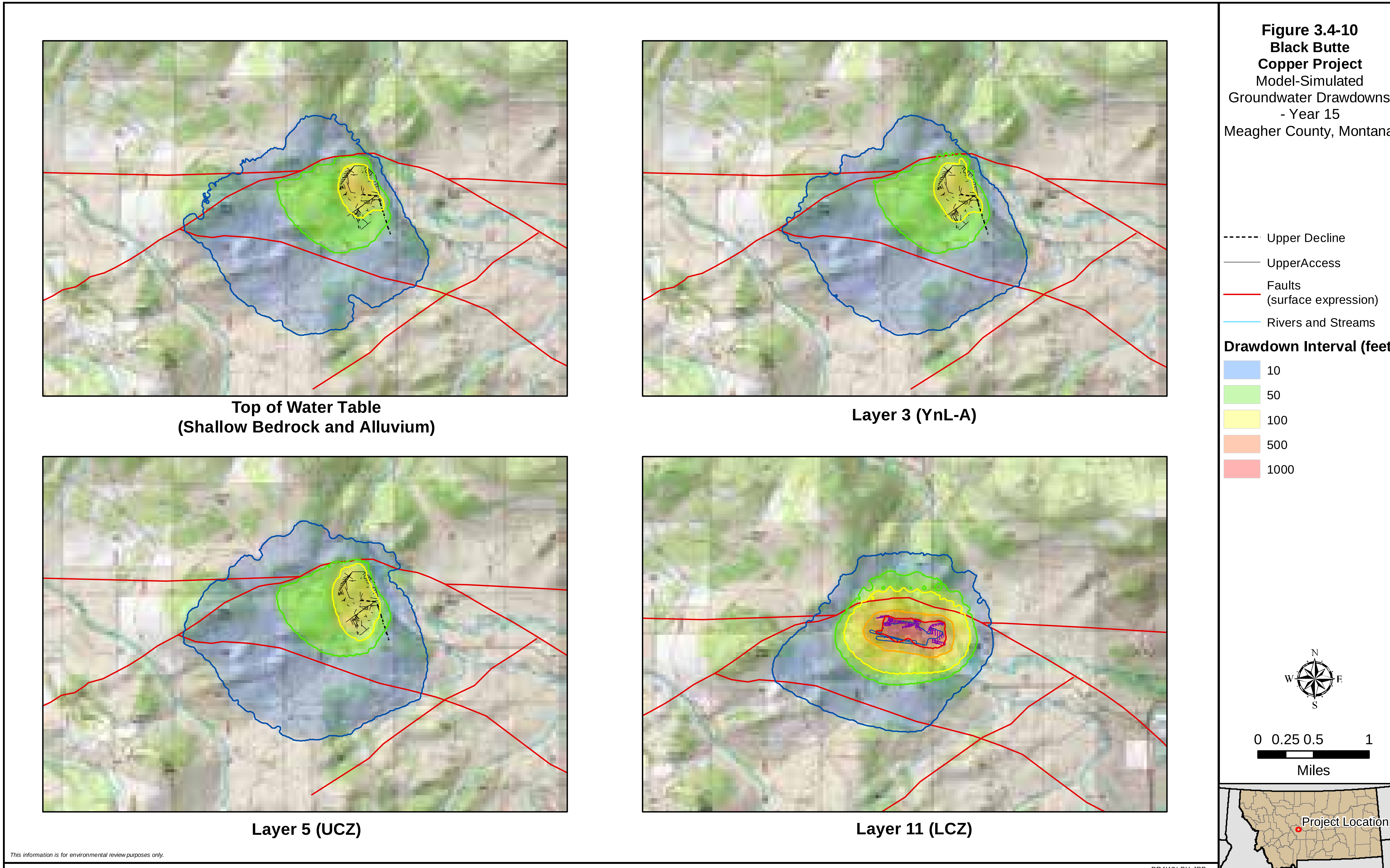
During mining, the cone of depression associated with the upper HSUs would capture some groundwater that currently reports to perennial streams as base flow. The captured portion of the current base flow would become part of the mine dewatering discharge and this would lead to a reduction in stream base flow compared to baseline conditions. **Table 3.4-7** presents the model-simulated groundwater discharges to surface waters over mine Years 0 to 15.

A discussion of the impacts that dewatering would have on the base flow of nearby streams is provided in Section 3.5.3.1 (see the subsection titled "Dewatering Associated with Underground Mine Operations"). Groundwater model simulations indicate that only Coon Creek could potentially be significantly affected by mine dewatering.

Dewatering of the mine would result in a consumptive use of water by the Project. This use would be offset by water rights acquired under lease agreements with landowners (Tintina 2017). Tintina submitted a Water Right Application Package to the DNRC on September 7, 2018. This package included applications for a new groundwater beneficial use permit for water put to use in the mining and milling process, a new high season flow surface water beneficial use permit and six change applications.



Source: Hydrometrics, Inc. 2015b



Source: Hydrometrics, Inc. 2015b

The new high season flow surface water beneficial use permit and six change applications would be used to mitigate potential adverse impacts from the consumptive use of groundwater in the mining and milling process and mitigate potential indirect impacts to wetlands.

Water for mitigation would be diverted from Sheep Creek through a wet well (constructed adjacent to the creek). That well would be pumped only during the high flow season when flow in Sheep Creek is greater than 84 cubic feet per second (cfs). That particular flow threshold for pumping was established because the 84 cfs flow is equal to the total flow of the appropriated water rights on Sheep Creek downstream of the diversion (where the wet well would operate). Water would be pumped from the wet well and transferred via a pipeline to the NCWR.

Water stored in the NCWR would be used for mitigation of residual depletion in surface waters during operations and for approximately 20 years after the cessation of mine dewatering (Tintina Montana, Inc. 2018c). In particular, water from the NCWR would be pumped into the headwaters of Coon Creek to augment its flow such as to maintain it to within 15 percent of the average monthly flow determined for baseline conditions, as determined by the creek (Hydrometrics 2018a). Coon Creek is often fully diverted during the irrigation season and frozen during the winter months. The Proponent has an agreement with the water right holder for Coon Creek to utilize the water right if necessary (change in water use would be dependent on approval by the DNRC). The analyst concluded that reduction in Coon Creek’s flow itself would not have a substantive effect on water resources in the area (as discussed in Section 3.5.3.1, subsection titled “Dewatering Associated with Underground Mine Operations”).

Post-Closure Recovery of Groundwater Levels

Figure 3.4-11 shows the model-predicted groundwater level recovery after the mine ceases dewatering operations at the end of mine Year 15 (Hydrometrics, 2015b). After one additional year of rinsing, plugging, and decommissioning the workings, water levels in the Ynl A, USZ/UCZ, and Ynl B would recover very quickly and approach pre-mining conditions within a few years. Due to the low hydraulic conductivity of the LCZ, the groundwater level recovery in this deep HSU (hydraulic conditions that only marginally affect surface waters) would be slower and not approach the pre-mining level until about 100 years after closure.

Table 3.4-7
Model-Simulated Groundwater Discharge to Surface Waters

Mining Progress		**Pre-Mining/Steady State Calibration**	**Surface Decline**	**Declines and Access Ramps**			**Mining**										
Project Year		**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Basin	**Observed Current Base Flow (cfs)**	**Simulated Groundwater Discharge to Surface Water (cfs)**															
Sheep Creek Upstream of SW-1	6.2	5.76	5.70	5.44	5.47	5.49	5.46	5.45	5.44	5.43	5.43	5.42	5.42	5.42	5.41	5.41	5.41
Black Butte	2.6 to 3.2	2.40	2.40	2.35	2.31	2.29	2.29	2.29	2.29	2.29	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Moose Creek	7.7	8.08	8.08	8.08	8.08	8.08	8.08	8.08	8.08	8.08	8.08	8.08	8.08	8.08	8.08	8.08	8.08
Model Domain	23.2	24.02	23.96	23.66	23.64	23.64	23.61	23.60	23.59	23.59	23.59	23.58	23.58	23.58	23.57	23.57	23.57

Source: Hydrometrics, Inc. 2015b (Table 5-3)

cfs = cubic foot per second

In addition to the numerical modeling analysis, Hydrometrics developed analytical models to evaluate the potential impacts that the open mine workings (declines, access ramps, ventilation raises) could have on groundwater after water-level recovery (Hydrometrics, Inc. 2017b). These steady-state analyses assumed that the water table is fully recovered, which is a condition under which the potential impacts of open mine workings would be the greatest. The results of the analyses indicated the following:

- Possible groundwater mounding associated with the Surface Decline would not result in any surface seepage of groundwater via new springs and seeps (above what normally occurs in the natural system).
- In the absence of tunnel/shaft plugs, upward groundwater flow through open mine workings could cause contact water from the UCZ and/or LCZ to migrate into the Ynl A and ultimately into the Sheep Creek Alluvium. However, the upward flow rate of this contact water would be low: likely less than a total of 1 or 2 gpm for the Surface Decline and four ventilation shafts.

These analyses are judged to be conservative (that is, overestimating the impacts) because they considered fully open mine workings. The analyses did not consider the strategically placed tunnel and shaft plugs that are specified in the Proposed Action. Based on this analysis, the open mine workings are not predicted to have significant impacts on groundwater availability and surface water flow rates.

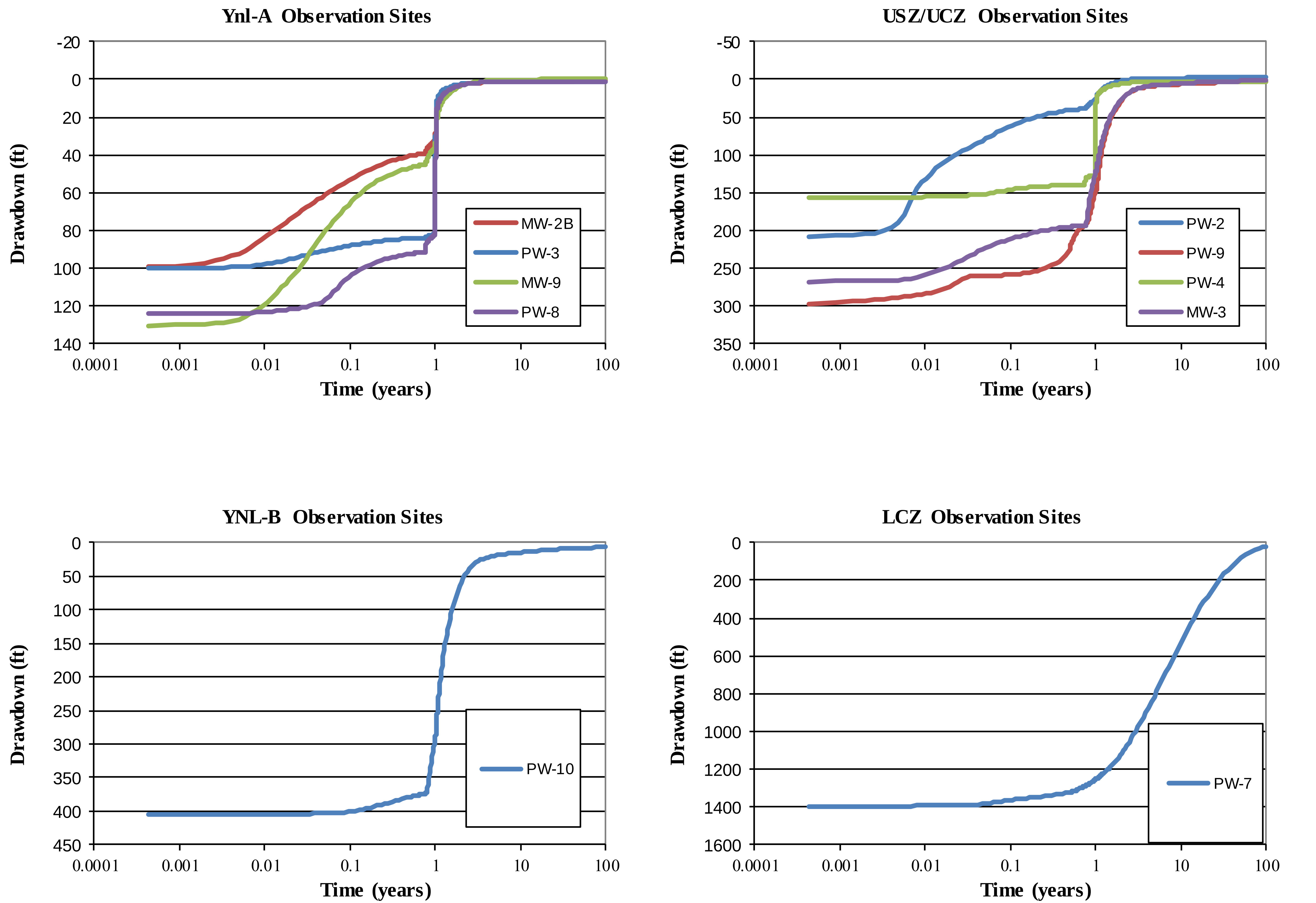
The analysis did not evaluate the chemical impacts that upward migrating contact water could have on the shallow HSUs. However, considering long groundwater travel time and a range of attenuating processes, such impacts are judged negligible (see discussion provided in subsection "Post-Closure Groundwater Quality" below).

Underground Infiltration Galleries

Excess water not used in the milling or mining process would be discharged back to the groundwater system using alluvial UIGs. The UIGs are designated as the MPDES outfall (Outfall 001). As specified in the MOP Application (Tintina 2017) and in the MPDES permit application (Hydrometrics Inc. 2018a; Tintina 2018a), all water would be treated to meet applicable discharge standards (except total nitrogen) prior to groundwater recharge. Anticipated average and maximum total flow rate to the UIG is 398 gpm (Hydrometrics 2018a, Response to Comment 3, Form 2D, Part III.A). The Alluvial UIG is designed for maximum total discharge of 575 gpm (Hydrometrics 2018a, Appendix F).

Infiltration testing reported in Hydrometrics (2018a, Appendix E) (**Figure 3.4-12b**) showed that the Sheep Creek alluvial aquifer exhibits moderate spatial variability, but had generally consistent infiltration rates for 7 of the 9 test trenches. The median infiltration rate was approximately 2 feet per day (representing an infiltration capacity of 0.4 gpm per foot of trench. For this infiltration capacity, a minimum 1,450 feet of trenching would be necessary to discharge the design maximum discharge flow rate of 575 gpm through the Alluvial UIG system (Hydrometrics, Inc. 2017d).

Figure 3.4-11
Black Butte Copper Project
Groundwater Model-Simulated Water Level Recovery - Post Mining
Meagher County, MT



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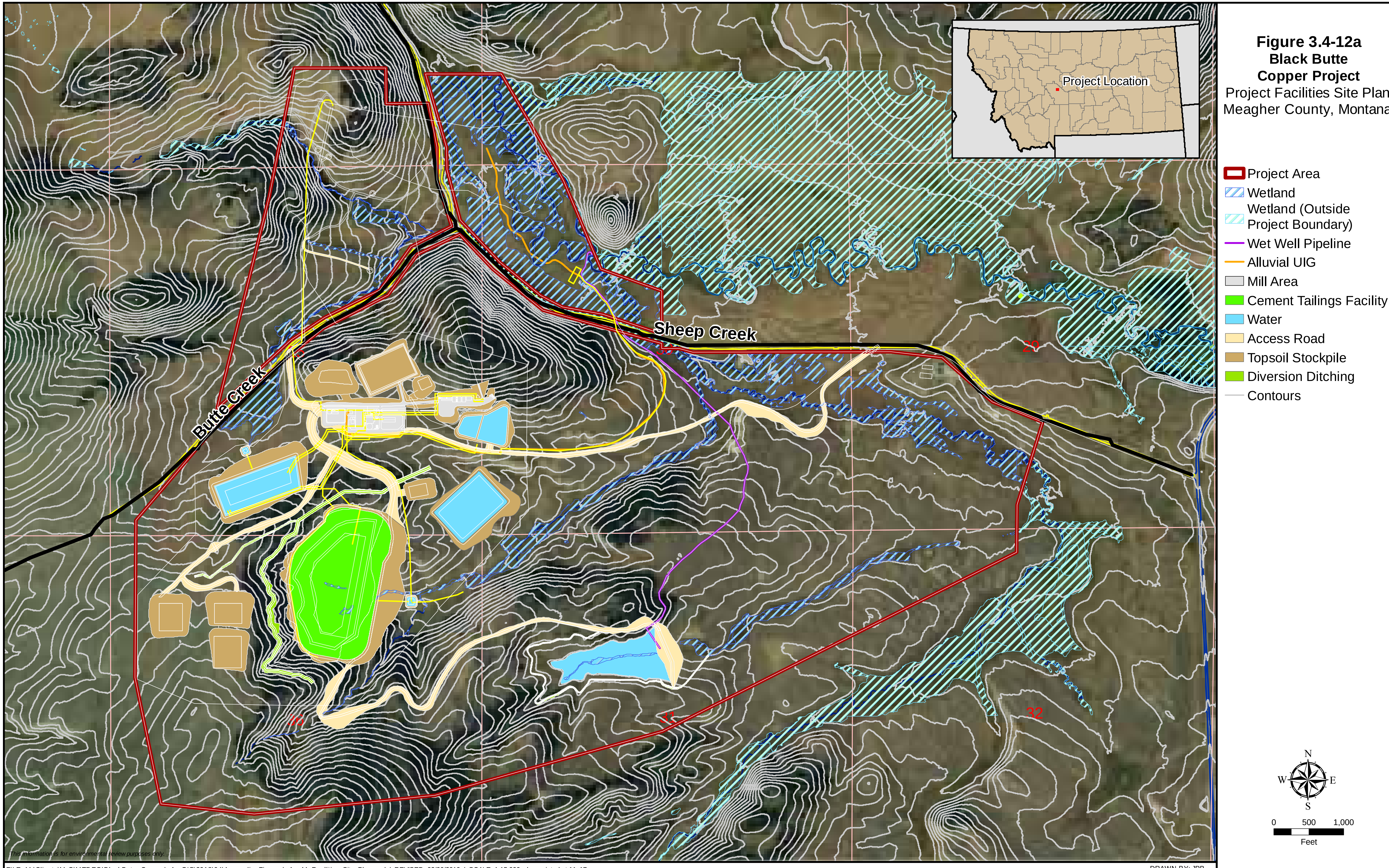
Source: Hydrometrics, Inc. 2015b

Hydrometrics developed a separate groundwater model for analysis of the proposed Alluvial UIG design, which included a series of trenches excavated in the Sheep Creek alluvium (Hydrometrics 2017d). The model was calibrated using measured groundwater levels and results of the alluvium infiltration testing program. The analyses simulated the maximum design discharge rate (575 gpm) distributed evenly within the proposed infiltration trenches shown on **Figure 3.4-12c**. The simulation showed there could be up to 3.9 feet of groundwater mounding directly below the trenches, but the mounding would mostly dissipate over short distances to the east towards Sheep Creek and to the west towards Coon Creek. Near the central area of the UIG system, the simulated mound is less than 1 foot high approximately 300 feet southwest of Sheep Creek and 0.5 feet high adjacent to Sheep Creek.

The analyses predict that operating the alluvial UIG would not result in negative impacts on groundwater and surface water quality in the vicinity of Sheep Creek, except total nitrogen. The UIG discharged water could occasionally exceed the seasonal surface water quality nutrient criterion for total nitrogen. The maximum concentration would be 0.57 mg/L, which is higher than the 0.09 mg/L— non-degradation criterion set for Sheep Creek (Hydrometrics 2018a, Table 3-2: Receiving Water Quality). This criterion would be in effect every year between July 1 and September 30 to prevent nuisance algal growth in surface waters. For this reason, water released from the WTP during that period would be directed to the TWSP and not to the alluvial UIG. The water accumulated in the TWSP would then be discharged via the alluvial UIG when the criterion is not in effect (see a brief discussion provided in the subsection below, “Surface Facilities”).

UIG recharge would partially compensate for the loss of base flow in Sheep Creek caused by mine dewatering. Without UIG recharge, the groundwater model predicts a 160 gpm decrease in groundwater discharge to Sheep Creek (see the difference between the model-simulated groundwater discharge to Sheep Creek Upstream of SW-1 during the pre-mining period and mining Year 15 in **Table 3.4-7**); however, the average UIG recharge to the Sheep Creek Alluvium via the UIG would be about 398 gpm (increased to 531 gpm from October to June each year, by release of water stored in the TWSP during that period), and most of that water would eventually become streamflow (Hydrometrics, Inc. 2017d). The net increase in Sheep Creek flow downstream of the UIG would be about 240 gpm or less, as some of the UIG-discharged water might be intercepted by the cone of depression from dewatering and migrate downward toward the mine. Such flow compensation from the UIG would be too far away to benefit the base flow in Black Butte Creek, which would also be affected by mine dewatering. However, the model-simulated depletion of base flow in Black Butte Creek is a modest 3 percent to 4 percent of the steady state base flow in the stream (Hydrometrics 2015b).



Source: Tintina 2017

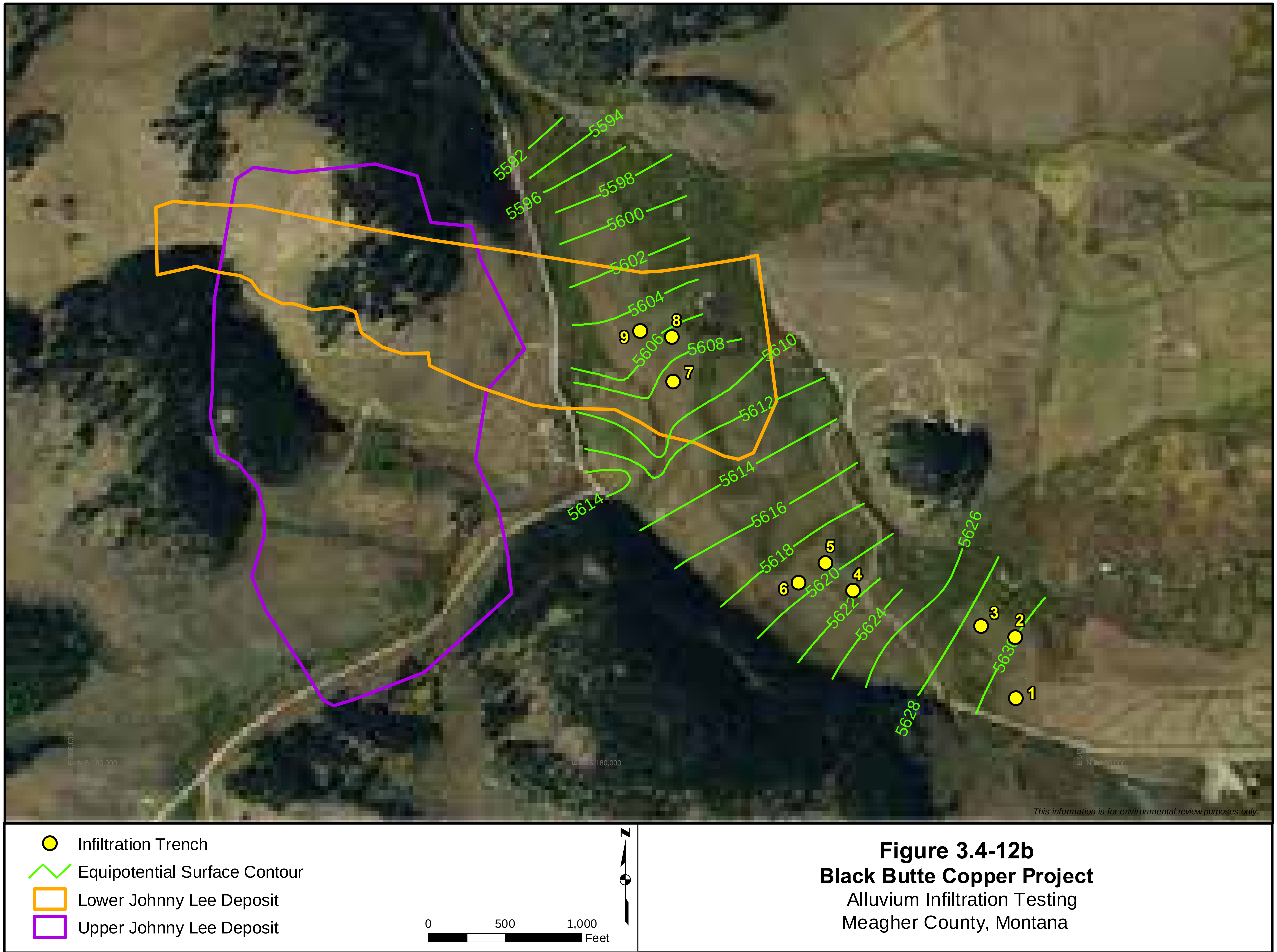


Figure 3.4-12b
Black Butte Copper Project
Alluvium Infiltration Testing
Meagher County, Montana

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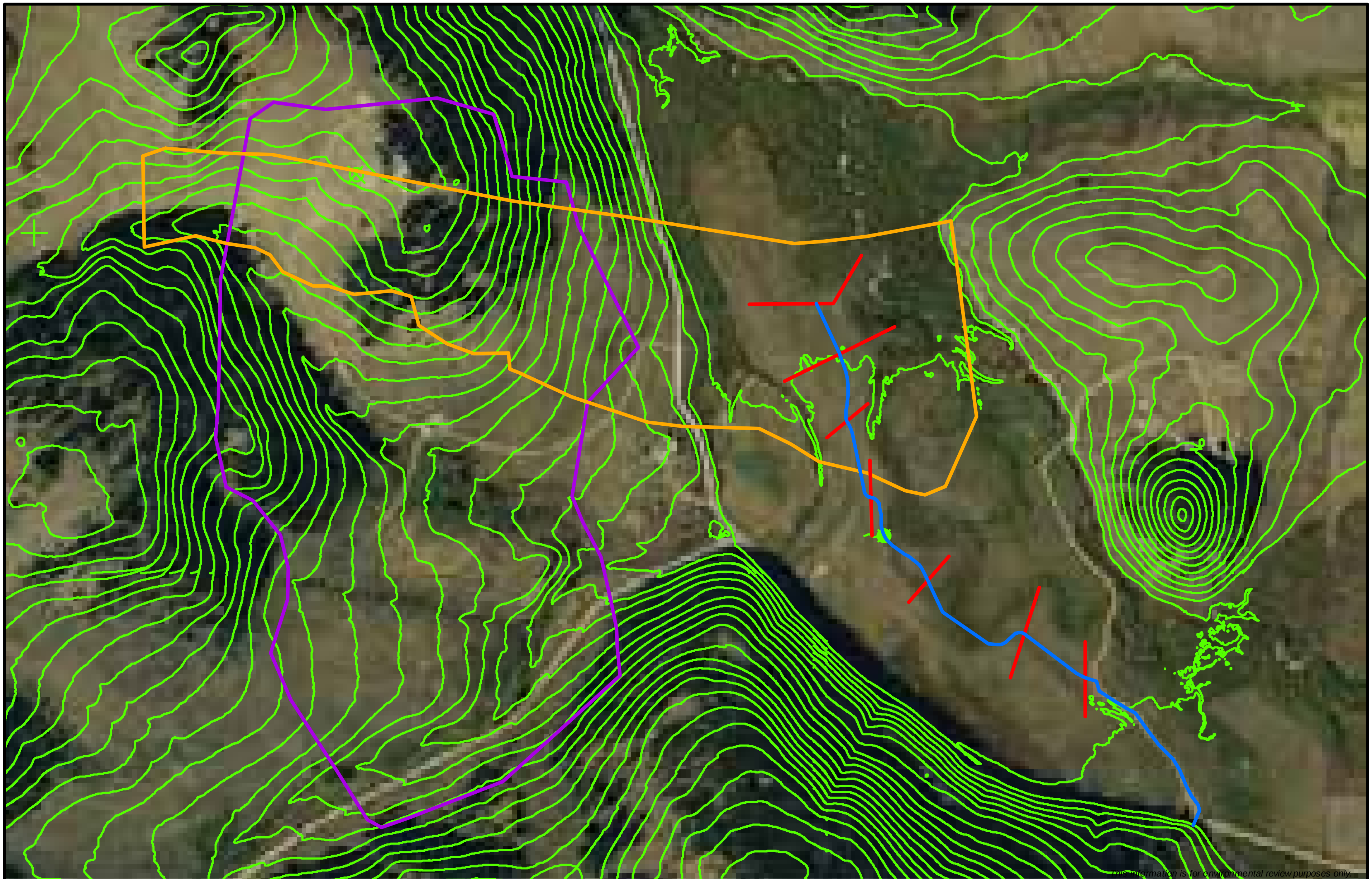
Source: Hydrometrics, Inc. 2017d



Distribution Pipe
Infiltration Trench
Equipotential Surface Contour
Lower Johnny Lee Deposit
Upper Johnny Lee Deposit

N

0 500 1,000 Feet

Figure 3.4-12c
Black Butte Copper Project
Alluvial Underground Infiltration Gallery
Meagher County, Montana

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Source: Hydrometrics, Inc. 2017c

Surface Facilities

The MOP Application (Tintina 2017) describes construction of the following proposed surface facilities for storing water, waste rock, tailings, and various other materials: NCWR, PWP, CWP, CTF, WRS, and TWSP (for storing treated water that would not be released from July to September). All of these facilities have the potential to produce seepage that could migrate downward to groundwater.

Water stored in the NCWR would be allowed to seep through its unlined bottom to groundwater and the downstream catchment. Seepage from the NCWR is expected and is intended to offset a portion of mine site water consumptive use. Analyses indicate an average seepage rate of less than 50 gpm. Because the reservoir would contain non-contact water, it would not have the potential to chemically degrade groundwater. The seepage water would mix with shallow groundwater present in highly weathered shale below the NCWR (Tintina 2017). Saturated conditions would likely be present directly beneath the NCWR.

The PWP would be double-lined, with a leak detection system consisting of a 0.3-inch, high-flow geonet layer sandwiched between two 0.1-inch (100 mil) HDPE liners. Any seepage through the upper liner into the geonet would be directed via gravity to a sump and pump reclaim system at a low point in the PWP basin. This flow (if any) would be pumped back into the PWP. Any seepage below the lower liner would be collected by a foundation collection drain and conveyed by gravity to a lined toe pond, and this water would be pumped back to the PWP. Experience with similar ponds suggest that, if the system is properly constructed, seepage below the facility would be minimal, or non-measurable.

The CWP would be constructed with an HDPE liner placed over a 1 foot (300 mm) thick protective layer of granodioritic sub-grade bedding material. The portion of the CWP storing brine would be double-lined with a leak detection system (as described for the PWP). Seepage from the base of this system is expected to be minimal or non-measureable.

The base of the CTF would have a double liner system with leak detection (as described for the PWP), and this liner system would extend up the upstream embankment face. Above the double liner would be a permeable bedding layer comprised of crushed waste rock. The bedding layer would collect downward seepage through the tailings material and convey this flow laterally to a sump. An important function of the bedding layer is to maintain low head on the liner, thereby minimizing the potential for seepage through the liner. Seepage below the double liner system is expected to be minimal to non-measureable (Geomin Resources, Inc. 2018).

After closure, several construction steps will be executed prior to beginning the placement of the final cover package on the CTF, including: (1) hardening of the final upper layers of cement paste; (2) dewatering by pumping back any water from the geonet/liner sump and the basin drain water reclaim sump to the PWP; (3) ground shaping and/or filling of the final upper surface of the tailings; and (4) installation of protective sub-grade bedding layer below the proposed HDPE cover. The analysis indicates that seepage from the CTF during both operational and post-closure phases would be negligible (Geomin Resources, Inc. 2018).

While performing HELP analysis of the WRS pad (see Section 3.4.1.6), the analyst assumed placement of a bedding material and piping on top of the bottom liner. Seepage reaching the bottom of the waste rock would collect and flow on top of the upper liner to an outlet pipe on the south side of the facility. Flow from the outlet pipe would be sent to the WTP and either disposed via the UIG, or temporarily stored in the TWSP. Based on climate and properties of waste rock and cover materials, the HELP model was used to estimate downward percolation of meteoric water into the WRS. The facility-wide percolation flow rate was estimated to be less than 1 gpm (Hydrometrics, Inc. 2016a).

Hydraulic analyses using the HELP model were also performed for the embankment areas of the CTF, PWP, CWP, mill pad, WRS, and portal pad (Hydrometrics, Inc. 2016d). The estimated annual percolation through the embankments ranged from 1.68 to 2.47 in/yr, or 9 to 13 percent of mean annual precipitation. Considering the footprint areas of these embankments, the total percolation rates would be no more than a few gpm. Most of that flow would be intercepted by drains and re-routed to the WTP.

Operations Groundwater Quality

Predictive geochemical analyses were completed for the mixed water that would be collected in sumps and pumped from the underground mine in Year 6 of operations. Modeling showed that the water would be near neutral, with a pH of about 6.7, abundant alkalinity (183 mg/L), and a moderately elevated (above background conditions) sulfate content (up to 304 mg/L) (Enviromin 2017, Table 4-4). The highest local contributions of acidity, metals, and sulfate would come from the LCZ. However, the rate of groundwater flow from the LCZ would be low, so the net contribution of that water to the overall mixed water would be minor.

Modeling predicted that the following minerals would precipitate from the mixed mine water: alunite, barium arsenate ($Ba_3(AsO_4)_2$), chromium(III) oxide (Cr_2O_3), ferrihydrite, and quartz. Formation of these minerals and the subsequent sorption of metals and solutes to the mineral surfaces would remove some mobile constituents from the water. Analysis of the humidity cell testing data and additional sensitivity analyses predicted that the following metals would sorb to ferrihydrite: barium, beryllium, zinc, copper, lead, and arsenic.

The modeling work included several sensitivity analyses of the predicted underground water quality, addressing uncertainty in model inputs for: (1) All humidity cell testing data (i.e., all data vs. weeks 1 to 4 data), (2) fracture density, (3) fracture zone thickness, (4) estimated surface area, and (5) sulfide oxidation rate (see Enviromin 2017, Table 4-4). In general, the assumptions about fracture density and reactive-zone thickness were found to have the greatest impact on predicted metal release from rock surfaces. Also, inclusion of all weekly humidity cell testing data was found to have the greatest impact on the estimated pH.

Alkalinity was found to be abundant in all sensitivity scenarios, including the analysis of several upper bound estimates of rim thickness, sulfide oxidation rated, and fracture density. Together those estimates resulted in a conservative evaluation of the reactive mass. Predicted pH ranges from 4.87 to 6.68, and sulfate ranges from 262 to 672 mg/L across the various sensitivity analyses (see Enviromin 2017, Table 4-4). Nitrate, arsenic, and uranium were predicted to exceed the DEQ groundwater quality standards in the operational base case as well as in several sensitivity scenarios (see Enviromin 2017, Table 4-4). Antimony, strontium, and thallium were predicted to exceed the groundwater standard only under select scenarios evaluated by sensitivity analyses, including conservative (upper bound) estimates of input parameters. All the mixed water that would be pumped from the underground mine (subject to the analysis discussed above) would be sent to WTP for treatment.

Post-Closure Groundwater Quality

There are two sources that could provide chemicals to the shallow HSUs and affect groundwater chemistry:

- Upward migration of LCZ and UCZ contact groundwater through open mine workings that flows into the Ynl A.
- Downward seepage from the bottom of surface facilities that reaches the Ynl A water table.

Water quality modeling and analysis completed for the proposed mine underground workings (Enviromin 2017) indicate that all the contaminants of potential concern (COCs) would be dissolved in post-mine contact groundwater at concentrations below the Estimated Groundwater Non-degradation Criteria (Hydrometrics 2016e). Thallium was predicted to exceed the DEQ groundwater standard of 0.002 mg/L by a factor of less than 2.0 (see discussion in Section 3.5, Surface Water, subsection 3.5.3.2 titled “Underground Mine”, post-closure); however, the non-degradation limit for thallium in the USZ would be higher than the standard because the average ambient (baseline) thallium concentration (0.0039 mg/L) in groundwater in the USZ also exceeds the standard. Consequently, migration of the post-mine contact groundwater from the LCZ to the UCZ might lower the concentrations of some chemicals in the UCZ.

As such, migration of the post-mine contact groundwater toward surface environments would not result in any impacts. This would be the case even if no attenuation processes (such as dispersion, mixing, or retardation) were to operate on such contact groundwater, which is highly unlikely.

The combined groundwater flow rate from the surface mine facilities (acting as potential chemical sources) during both mine operations and post-closure periods are expected to be on the order of a few gallons per minute. Referring to **Figure 3.4-8**, the groundwater flow rate in Ynl A within the mine area is estimated to be about 90 gpm, while groundwater flow in that area within the Sheep Creek alluvium is about 200 gpm. The alluvial groundwater eventually becomes groundwater discharge to Sheep Creek, which has an average base flow rate of 6,700 gpm. Complete mixing of the chemical source water with Sheep Creek surface water would dilute the original COC concentrations by a factor of 1,000 or more. Discharges of the groundwater potentially affected by the surface mine facilities to Coon Creek might undergo a substantially lesser mixing, compared to Sheep Creek. However, a potential of any groundwater impacts from the surface facilities would further decrease during a post-mine period.

In summary, the completed analyses indicates that impacted water from the mine's surface facilities is unlikely to cause adverse impacts to ambient groundwater in the Ynl A, Sheep Creek Alluvium, or Sheep Creek surface waters.

Water Supply

Project operations would require three separate water supply systems: (1) process water supply, (2) fresh water supply, and (3) potable water supply. Recycled water from the PWP to the process water tank would be the primary water source for mill operations. Additional water would be provided by mine dewatering and from the WTP. Fresh water (from the fresh/fire water tank) would be obtained from the WTP and used for other milling purposes. Finally, the Project could obtain water from a public water supply well (PW-6; see the northwest corner of **Figure 3.4-7** and discussion provided below) and treat it, as necessary, for human consumption (Tintina 2017).

The Proponent would need to supply potable water for drinking, showers, and restroom facilities for 145 people at a rate of about 30 gallons per person per day. As such, the daily potable water demand would be 4,350 gallons (equivalent to an average flow rate of about 3 gpm). To meet this demand, the Proponent would either pump the PW-6 test well, or install a new well drilled in the vicinity. Initial water quality samples collected from PW-6 showed that all the chemical constituents met human health standards. In the future, the Proponent would collect and analyze PW-6 water quality samples to comply with permitting this well for use as a Public Water Supply (Tintina 2017).

In the spring of 2015, the well PW-6 was deepened into the Neihart Formation quartzite adjacent to the Buttress Fault (renaming it PW-6N). Air-lift pumping of the open borehole at this location produced more than 500 gpm and confirmed that there are high permeability fractures within the Neihart Formation quartzite adjacent to the Buttress Fault (Tintina 2017). As such, pumping this, or an adjacent new well to produce water at an average rate of 3 gpm for the Project Public Water Supply would have a negligible impact on the associated groundwater system.

In addition to the three water supplies discussed above, the wet well constructed adjacent to Sheep Creek (discussed in Section 3.4.3.2, subsection: Base Flow in Nearby Creeks) would be pumped only during the creek's high season flow to supply water to the NCWR during high flow conditions (Tintina Resources Inc. 2018c). Considering the limited capacity of any well completed in the alluvial aquifer and Sheep Creek's flow/discharge during high flow conditions, pumping from that well would have a negligible impact on that flow.

Grouting Access Declines and Tunnels During Construction

The Proposed Action indicates that the walls of access tunnels and declines may be grouted during their initial construction. Depending on subsurface conditions, the process could include pressure grouting via boreholes drilled into the tunnel wall or application of shotcrete to the wall surface. The decision to perform grouting would mostly depend on groundwater inflows and rock stability observed during the initial excavation of the mine openings. The extent of grouting could range from spot applications to control inflows and rock stability at discrete fault/facture zones, to application along substantial lengths of tunnels if inflow and rock stability issues are pervasive. Note that mine stopes would be backfilled with cemented tailings, so wall grouting is not planned for these excavations.

While grouting would mainly be performed to address underground construction issues, it could also provide long-term benefits in reducing hydrologic impacts to the groundwater system. If mine inflows are reduced, one would expect (1) the magnitude and extent of groundwater drawdowns to decrease and (2) smaller reductions in stream base flows associated with the Project.

To study the impacts that grouting might have on mine inflows and stream base flows, Hydrometrics performed a subsidiary groundwater model evaluation for the extreme case where the entire Surface Decline was grouted. The Surface Decline was selected for this evaluation because it would be excavated mostly through Ynl A, which has much higher hydraulic conductivity compared to deeper bedrock units. For this model simulation, it was assumed that grouting would be conducted as the Surface Decline is advanced and the hydraulic conductivity along the wall would be 2.8×10^{-4} feet per day, or two orders of magnitude lower than undisturbed bedrock (Hydrometrics, Inc. 2015b). In the model, this was accomplished by adjusting the conductance values for drain cells used to simulate dewatered mine workings. It is assumed that grouting would not be performed in deeper low-permeability unit (Ynl B, LCZ).

The model simulation predicted that grouting would reduce the inflow to the Surface Decline by an order of magnitude during Phase I (from 220 gpm without grouting to 22 gpm with grouting). Total mine inflow rates would be sharply reduced only during the first 2 years of mine development. In subsequent years the relative impact of grouting would be less pronounced as the mine workings are deepened and Ynl A is depressurized/dewatered adjacent to the Surface Decline. It is estimated that after the mine Year 2, the grouted decline would have the impact of reducing the mine dewatering rate by 66 to 84 gpm, or about 15 to 25 percent of the predicted total dewatering rate without grouting (Hydrometrics, Inc. 2015b).

During construction of the Surface Decline, reduced inflows associated with grouting would decrease the initial drawdown in Ynl A to less than 10 feet. However, during Phases II and III when the dewatered underground workings are extended and deepened, the drawdown in bedrock would be similar to decline construction without grouting.

Drawdown in the alluvium near Coon Creek and reduction in the creek base flow would be somewhat less throughout the mine life if grouting was implemented (Hydrometrics, Inc. 2015b).

The groundwater model predicts that with grouting there would be no substantive base flow changes in the larger perennial streams (Sheep Creek and Black Butte Creek) when compared to the Proposed Action without grouting (Hydrometrics, Inc. 2015b).

Installation of Plugs in Declines and Shafts

The Proponent proposes to install 14 cement plugs at strategic locations in the surface decline, deeper access ramps, and four ventilation shafts. The stated primary purpose of the plugs would be to segment the mine at certain elevations so the mine can be more efficiently pumped and rinsed during closure (Tintina 2018b). One plug would be installed at the portal of the surface decline to prevent human access, rather than to create a hydraulic barrier, as groundwater levels are expected to always be below the portal during the post-closure period.

While the decision to install plugs is dictated mainly by operational issues, the plugs could provide environmental benefits by reducing the flow of contact water through open tunnels and shafts. Baseline data indicate the general presence of upward hydraulic gradients, which would provide for an upward flow of the post-mine contact groundwater toward the surface environments. Open tunnels and shafts could create high permeability conduits that covey this flow at higher rates compared to the upward flow that would occur through the undisturbed, natural system. In this sense, the open tunnels and shafts could be viewed as potentially "short-circuiting" the natural groundwater flow system.

To evaluate the impact of plugs on post-closure mine flow, a scoping-level calculation was performed for a hypothetical plug installed in a vertical shaft near the contact between Ynl A and Ynl B using current baseline groundwater levels (Appendix D). The calculation considered the presence of a disturbed zone adjacent to the shaft having hydraulic conductivity equal to or greater than the hydraulic conductivity of undisturbed rock.

The calculation predicted that flow up the shaft would be mostly controlled by the hydraulic properties of the penetrated rock materials above and below the plug location, rather than the high permeability nature of the shaft itself. If no plug were present (i.e., the shaft operating essentially as a vertical pipe), the computed upward flow is only 0.27 gpm, which is the same value predicted by a similar calculation presented in the MOP Application (Tintina 2017). Calculations predicted that this flow rate could be reduced by installing a plug if the disturbed zone adjacent to the shaft did not have unrealistically high hydraulic conductivity. However, because the flow rate for the no-plug case is low to begin with, presence or absence of a plug is largely irrelevant from an environmental impact perspective. The decision to install plugs in the Proposed Action rests mostly on operational considerations and not on impacts relevant to the EIS.

3.4.3.2.1 Smith River Assessment

The water released to the alluvial aquifer via the UIG during the Mine Construction and Production Phases would be treated to assure compliance with groundwater standards and non-degradation criteria per the MPDES permit (Hydrometrics Inc. 2018a; Tintina 2018a). As discussed in previous sections, it is highly unlikely that chemical source water generated at the site (mine contact water and surface facility seepage) would lead to the concentration of any constituent exceeding its estimated groundwater non-degradation standards in shallow groundwater or surface water. There is no direct hydrogeologic connection between groundwater in the Project area and the Smith River or its alluvium. All the potentially Project-affected shallow groundwater would be discharging to Sheep Creek and Coon Creek either within boundaries of the LSA, or a short distance downgradient (with regard to Sheep Creek's direction of flow) from the LSA.

The only chemical pathway from the site to the Smith River is via Sheep Creek surface water, a river distance of 19 miles from the mine site. Since the proposed Project would not cause Sheep Creek surface water to exceed water quality standards, the mine would also not cause standards to be exceeded in the Smith River (see discussion presented in Section 3.5, Subsection 3.5.3.2, Smith River Assessment).

3.4.3.3. Agency Modified Alternative

The modifications identified in the AMA would result in impacts similar to those described for the Proposed Action. Modifications to the Proposed Action include an additional backfill of mine workings component, which was evaluated to alter the groundwater impacts assessment discussed above for the Proposed Action.

This project modification is to backfill additional mine workings with a low hydraulic conductivity material (see **Figure 3.4.13**). Approximately 106,971 cubic yards of cemented tailings would be needed to backfill the mine workings and access tunnels (except the upper portion of the access decline crossing Ynl A).

The regional groundwater model constructed to evaluate the proposed mine (Hydrometrics, Inc. 2015b) was used to simulate backfilling of the mined-out stopes only. Drain cells were used to simulate the hydraulic impacts of dewatered open mine workings during the mining period. The model however did not simulate the impacts of flooded open mine workings (declines, ramps, and shafts) during post-closure period. The structure of a regional model would make such simulations impractical. For the post-closure period, the Proponent’s model essentially assumed that the tunnels and shafts contained the same geologic material existing adjacent to the openings (mostly Ynl A and Ynl B). There was no accounting for delayed flooding of the mine due to the volume of water required to saturate the open mine workings.

Two more scenarios were evaluated by Enviromin (2018). The first of those scenarios assumed the walls of unfilled mining stopes would be composed of paste backfill instead of bedrock. A version of the water quality model used to evaluate this scenario is called the Revised Base Case with Cement Walls, and it represents a 52.5 percent net increase in reactive surface area (exposed wall rock) compared to the original Base Case. The second of those scenarios assumed the previously un-backfilled zones would be backfilled with cemented paste and represents a 7.7 percent net increase in the reactive surface area of the backfill from the original Base Case. The results of analyzing those scenarios showed only slight increases (if any) for most dissolved constituents compared to the original Base Case. According to the analysis, all concentrations would meet Montana groundwater standards and non-degradation criteria in post-closure groundwater (Enviromin 2018).

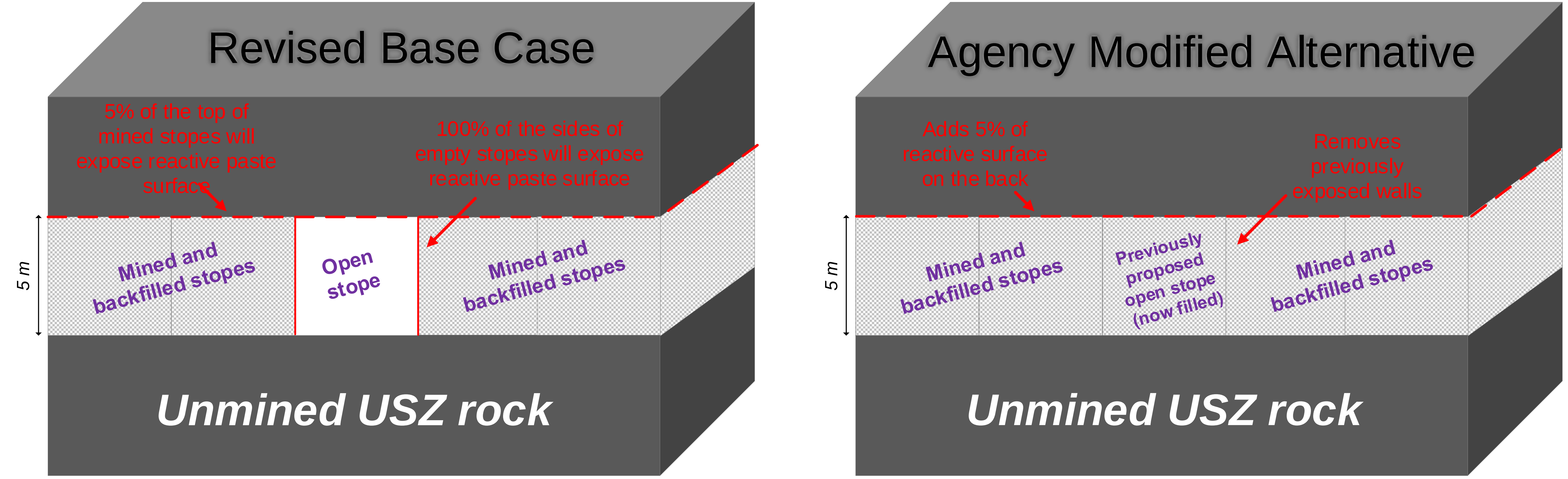

Figure 3.4-13
Black Butte Copper Project
Schematic Comparison of Revised Base Case (Proposed Action) and Agency Modified Alternative
Meagher County, Montana

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Source: Enviromin 2018

Calculations performed in the MOP Application by Tintina (2017) and Enviromin (2018) predict that it is unlikely that the mine would affect shallow groundwater water quality or Sheep Creek surface water quality regardless of whether:

- The access tunnels/shafts are backfilled, plugged, or left completely open;
- The walls of unfilled mining stopes would be composed of paste backfill instead of bedrock; or
- The previously un-backfilled zones would be backfilled with cemented paste.

The reason for considering the additional backfill option is that it would (1) provide an additional level of assurance for not degrading water quality, (2) be more consistent with how the Proponent's model simulated the post-closure period, and (3) lower the rate of post-mine period migration of the deep groundwater to shallower bedrock (Ynl A). For several chemicals, groundwater non-degradation criteria are lower for the Ynl A groundwater than for the LCZ and UCZ groundwater.

3.4.3.3.1 Smith River Assessment

Implementation of the AMA would offer more protection of water resources compared to the Proposed Action. However, as concluded in Section 3.4.3.2.1 above, it is highly unlikely that the Proposed Action in and of itself would have any measurable impact on water quality in the Smith River. Consequently, implementing the AMA would not be required to ensure that Smith River water quality is not impacted.

3.4.3.4. Summary

Table 3.4-8 provides a summary assessment of the potential consequences with regard to groundwater quantity and quality. The only adverse impact on groundwater would be caused by mine dewatering. Such dewatering would create a large cone of depression around the mine workings, reaching into surficial environments for many years. As **Figures 3.4-9** and **3.4-10** illustrate, the water table cone of depression would expand thousands of feet around the mine workings in all directions, touching a segment of the Sheep Creek alluvium near the proposed mine. Groundwater levels within the cone of depression would result in a decrease of stream base flow by up to a few percent. Some springs and seeps located within the cone of depression might experience decreased flow, and some might dry up. The maximum impacts are predicted to occur at the end of the initial mine construction (mine Year 4), but impacts would persist to the end of mining (mine Year 15).

After mine dewatering ends (mine Year 16), shallow groundwater levels would likely recover to within 1 to 2 feet of baseline (pre-mining) levels within a few years. Decreases in the Sheep Creek base flow would almost disappear 2 years after mine dewatering stops. However, some of the springs and seeps within the LSA might be permanently affected. No alternative actions being considered would significantly decrease such impacts, except for the No Action Alternative.

Table 3.4-8
Project Potential Consequences with regard to Groundwater Quantity and Quality

Project Phase	Project Activities	Potential Impacts	
		Change in Groundwater Quantity (Water Levels, Flow Patterns)	**Change of Groundwater Quality due to Seepage of Contact Groundwater**
Mine Construction and Operation, Phases I - III	Mine Dewatering	Would extensively lower groundwater levels around the mine, somewhat reducing base flow in nearby creeks, impacting springs and seeps within the cone of depression	Would not affect groundwater quality
	Underground Infiltration Galleries (UIGs)	Would increase groundwater discharge, partially compensating mine-dewatering caused by decreased base flow	Would not affect groundwater quality (based upon following conditions of the MPDES permit for the alluvial UIGs)
	Process Water Pond (PWP)	Would not appreciably affect groundwater system	Unlikely to affect groundwater quality
	Treated Water Storage Pond (TWSP)	Would not appreciably affect groundwater system	Unlikely to affect groundwater quality
	Cemented Tailings Facility (CTF)	Would not appreciably affect groundwater system	Unlikely to affect groundwater quality
	Non-Contact Water Reservoir (NCWR)	Would potentially increase groundwater discharge - partially compensating mine-dewatering caused decrease in base flow	Would not affect groundwater quality
	Waste Rock Storage (WRS)	Would not appreciably affect groundwater system	Unlikely to affect groundwater quality
	Copper-enriched Rock Stockpile	Would not appreciably affect groundwater system	Unlikely to affect groundwater quality
	Contact Water Pond (CWP)	Would not appreciably affect groundwater system	Unlikely to affect groundwater quality
	Material Stockpiles	Would not appreciably affect groundwater system	Unlikely to affect groundwater quality

Project Phase	Project Activities	Potential Impacts	
		Change in Groundwater Quantity (Water Levels, Flow Patterns)	**Change of Groundwater Quality due to Seepage of Contact Groundwater**
	Public Water Supply System	Would not appreciably affect groundwater system	Would not affect groundwater quality
Post-Mine Period (Mine Closure and Post-Closure; Phase IV)	Mine Dewatering	Shallow groundwater levels would recover to within 1 - 2 feet of baseline conditions within a few years after mine dewatering stops; recovery of loss to base flow would be almost complete 2 years after mine dewatering stops; contact water would slowly migrate to surficial environments undergoing mixing; some springs might be permanently affected	Post-mine voids (the space from which the ore was removed) contact groundwater would not contain COCs dissolved at concentrations above the estimated groundwater non-degradation criteria. In addition, while migrating via shallow bedrock toward discharge zones, that contact groundwater would be mixing with non-contact groundwater; transport of chemicals dissolved in contact groundwater would be retarded by process of adsorption; groundwater discharging to Sheep Creek would not affect its water quality
	Underground Infiltration Galleries (UIGs)	Would increase groundwater discharge, partially compensating mine-dewatering caused by decreased base flow during closure phase; would be inactive during post closure phase	Would not affect groundwater quality (based upon following conditions of the MPDES permit for the alluvial UIGs) during closure phase; would be inactive during post closure phase
	Process Water Pond (PWP)	Would not appreciably affect groundwater system; would be inactive later during post closure phase	Unlikely to affect groundwater quality; would be inactive later during post closure phase
	Cemented Tailings Facility (CTF)	Would not appreciably affect groundwater system	Unlikely to affect groundwater quality
	Non-Contact Water Reservoir (NCWR)	Would be inactive	Would be inactive
	Treated Water Storage Pond (TWSP)	Would not appreciably affect groundwater system	Unlikely to affect groundwater quality
	Waste Rock Storage (WRS)	Would not appreciably affect groundwater system; any potential small impacts would	Unlikely to affect groundwater quality; any potential small impacts would further

Project Phase	**Project Activities**	**Potential Impacts**	
		Change in Groundwater Quantity (Water Levels, Flow Patterns)	**Change of Groundwater Quality due to Seepage of Contact Groundwater**
		further decrease with time during the closure and post closure phases	decrease with time during the closure and post closure phases
	Copper-enriched Rock Stockpile	Would not appreciably affect groundwater system; groundwater would recover to pre-mine conditions a few years after the mine closure	Unlikely to affect groundwater quality; groundwater would recover to pre-mine conditions a few years after the mine closure
	Contact Water Pond (CWP)	Would not appreciably affect groundwater system; would be reclaimed later during the post closure phase	Unlikely to affect groundwater quality; would be reclaimed later during the post closure phase Would be inactive
	Material Stockpiles	Would not appreciably affect groundwater system; groundwater would recover to pre-mine conditions a few years after the mine closure	Unlikely to affect groundwater quality; groundwater would recover to pre-mine conditions a few years after the mine closure
	Public Water Supply System	Would not appreciably affect groundwater system	Would not affect groundwater quality

After groundwater levels recover to near pre-mining conditions, mine contact water could start migrating up the open tunnels and shafts toward surficial environments. However, water quality modeling indicates that COCs would be dissolved in that water at concentrations below the estimated groundwater non-degradation criteria. In addition, this water would have a very low flow rate and would experience strong dilution by non-impacted shallow bedrock groundwater and Sheep Creek alluvial groundwater. Given the contrast in flows, there is little to no potential for mine contact water to impact groundwater and surface water quality. The dilution that occurs when shallow groundwater discharges to Sheep Creek surface water is very large. Thus, there is no realistic potential for surface water quality to be impacted in Sheep Creek or the Smith River. However, to verify that impacts do not occur, the Proponent proposes to implement a long-term groundwater and surface water monitoring plan (Tintina 2017).

Below and downgradient of surface facilities (ponds, tailings storage, waste rock storage), there is little potential for chemical impacts to shallow groundwater or Sheep Creek surface water. The total seepage flow rate would be at most a few gpm, and this flow would be greatly diluted by groundwater in the shallow bedrock and in the Sheep Creek alluvium. As with mine contact water, there is virtually no likelihood that facilities seepage could impact Sheep Creek or Smith River surface water quality.

Operation of UIGs could have some mitigating impacts on groundwater quantity and partially compensate for the loss of groundwater discharge to surface waters resulting from the mine dewatering. No impacts on groundwater or surface water quality are expected as water discharged to the UIGs would be treated and retained seasonally in the TWSP to meet non-degradation standards under an MPDES permit. Still, the Proponent proposes to monitor the WTP operation and the chemistry of water sent to the UIG from the WTP and TWSP (between July and September) to ensure that it meets non-degradation criteria for groundwater and surface water (Tintina Resources Inc. 2018a).

Section 6 of the MOP Application provides information regarding the proposed monitoring plan (Tintina 2017).

3.5. SURFACE WATER HYDROLOGY

This section describes the affected environment and addresses potential surface water quantity and quality impacts from the proposed Project. The Project is located in the upper portion of the Sheep Creek drainage (see **Figure 3.5-1**). Sheep Creek, a fifth-order stream, flows out of the Little Belt Mountains and discharges into the Smith River, which in turn is a tributary to the Missouri River. Sheep Creek drains an area of 194 square miles and runs approximately 34 river miles from its headwaters down to the Smith River. The Project area is approximately 19 river miles above the confluence with the Smith River. Sheep Creek flows in a meandering channel through a broad alluvial valley upstream of the Project site and enters a constricted bedrock canyon just downstream of the Project site (Hydrometrics 2017a).

A number of named and unnamed tributaries flow into Sheep Creek, including Little Sheep Creek and Coon Creek in the immediate vicinity of the Project (see **Figure 3.5-2**). The Holmstrom Ditch is another feature in the vicinity of the Project. This diversion ditch was constructed in 1935 to divert water from Sheep Creek for irrigation, and continues to operate seasonally (Hydrometrics 2017a).

3.5.1. Analysis Methods

3.5.1.1. Regulatory Context of the Analysis

The following relevant and applicable water acts, regulations, required permits/certificates, and enforcing agencies were identified for the Project:

- Federal Clean Water Act: USEPA, USACE
- Montana Water Quality Act: Montana DEQ, Water Quality Division, Water Protection Bureau
- MPDES: Montana DEQ, Water Quality Division, Water Protection Bureau
- Total Maximum Daily Load (TMDL): Montana DEQ, Water Quality Division, Water Protection Bureau
- Public Water Supply Act/Permit: Montana DEQ, Public Water and Subdivisions Bureau
- Montana Water Use Act: Montana DNRC

3.5.1.2. Surface Water Quantity

The Proponent initiated water resources baseline monitoring for the Project in 2011. Surface water quantity data from May 2011 through July 2015 is provided in the "Baseline Water Resources Monitoring and Hydrogeologic Investigations Report" (Hydrometrics 2017a). Additional data were collected after the Baseline Water Resources Monitoring and Hydrogeologic Investigations Report was completed and are available through to December 2017 (Hydrometrics 2018b).

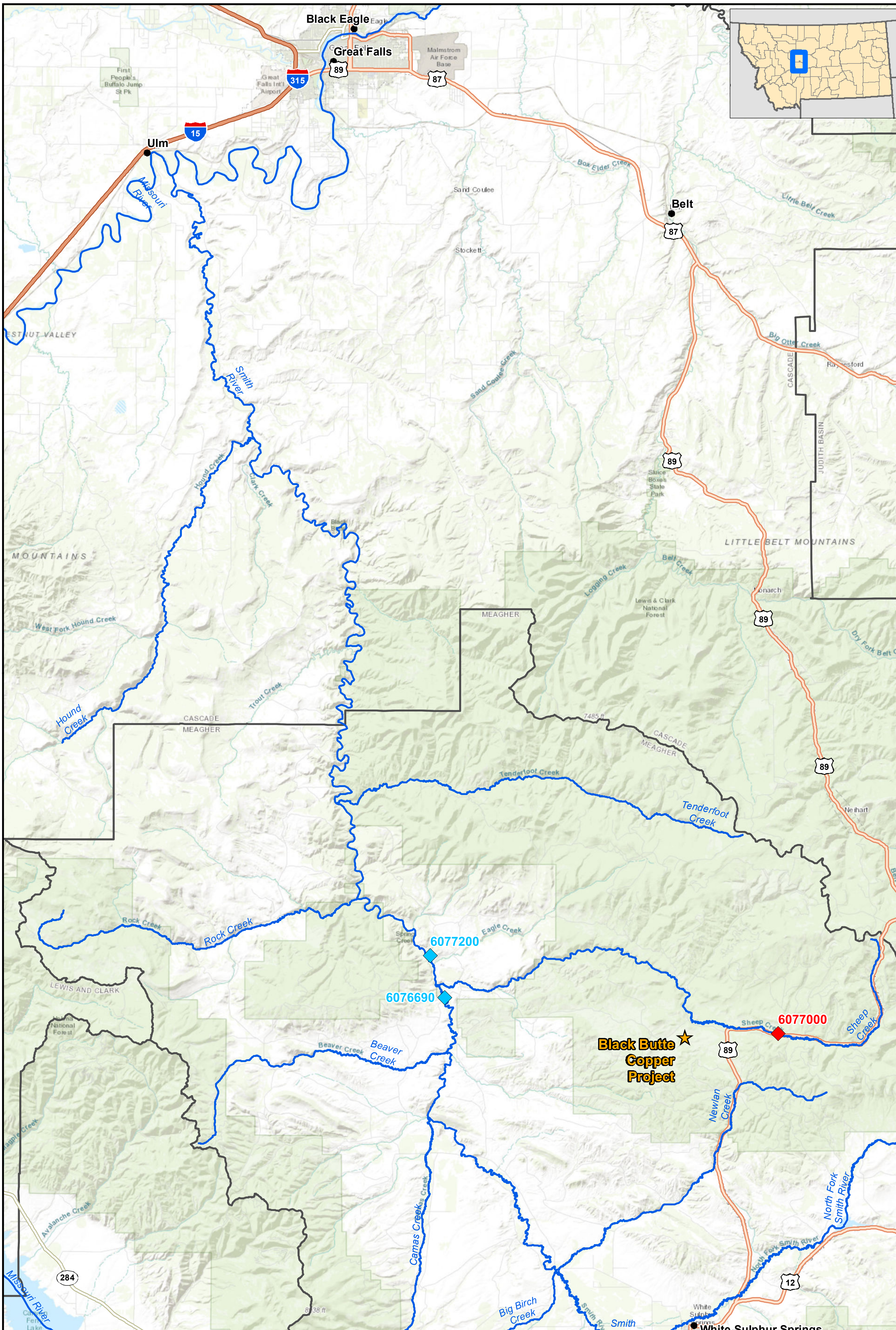
Surface water monitoring was established at 11 sites to characterize the stream flow for the Project area (see **Figure 3.5-2**). Quarterly flow and stage monitoring have been conducted at these sites since 2011. Since 2014, additional monthly flow measurements have been collected at the two surface water sites along Sheep Creek (SW-1 and SW-2). The Sheep Creek Gaging Station (see **Figure 3.5-2**) was installed at SW-1 in November 2012 to record detailed seasonal baseline data. A stage-discharge rating curve was developed for SW-1 and was used to generate a discharge hydrograph. Beginning in May 2014, additional monthly flow measurements have been conducted at a former U.S. Geological Survey (USGS) gaging site (06077000) along Sheep Creek upstream of the baseline monitoring sites. Concurrent flow measurements between the upstream USGS station and SW-1 and SW-2 were used to correlate stream flow between the sites.

The Holmstrom Ditch (see **Figure 3.5-2**) was constructed in 1935 to divert water from Sheep Creek for irrigation use. The diversion occurs to the east of the Project area near USGS gauging site 06077000, which is approximately 1.9 miles upstream of SW-2. Flow is diverted toward the south to irrigated lands near Newlan Creek, and does not return to Sheep Creek. Baseline flow monitoring for the Project along Sheep Creek occurred below the diversion and thus it is a component of the baseline conditions of the affected environment.

In addition to the stream flow monitoring, baseline investigations identified nine seeps and 13 springs in the Project area (see **Figure 3.5-3**). Generally, the sites consisted of small springs or seeps in the ephemeral headwater channels of small tributary streams. These formed small boggy areas with limited flow that generally re-infiltrated into the channels within a few hundred feet. Of the identified springs, five were developed springs for stock watering to feed livestock watering tanks (see **Figure 3.5-3**). A series of flow measurements were obtained to characterize the discharge from the seeps and springs.

3.5.1.3. Surface Water Quality

Surface water quality sampling was conducted at 14 surface water sites (see **Figure 3.5-2** and **Table 3.5-1**). Baseline surface water monitoring for the Project has been conducted since 2011 (Hydrometrics 2017a; Tintina 2017).



★ Black Butte Copper Project
● Cities
◆ Active USGS Gaging Station
◆ Inactive USGS Gaging Station
— Streams & Rivers
□ Counties

1:300,000

0 2 4 6 8
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Figure 3.5-1
Black Butte Copper
Project Location
Meagher County, Montana

ERM

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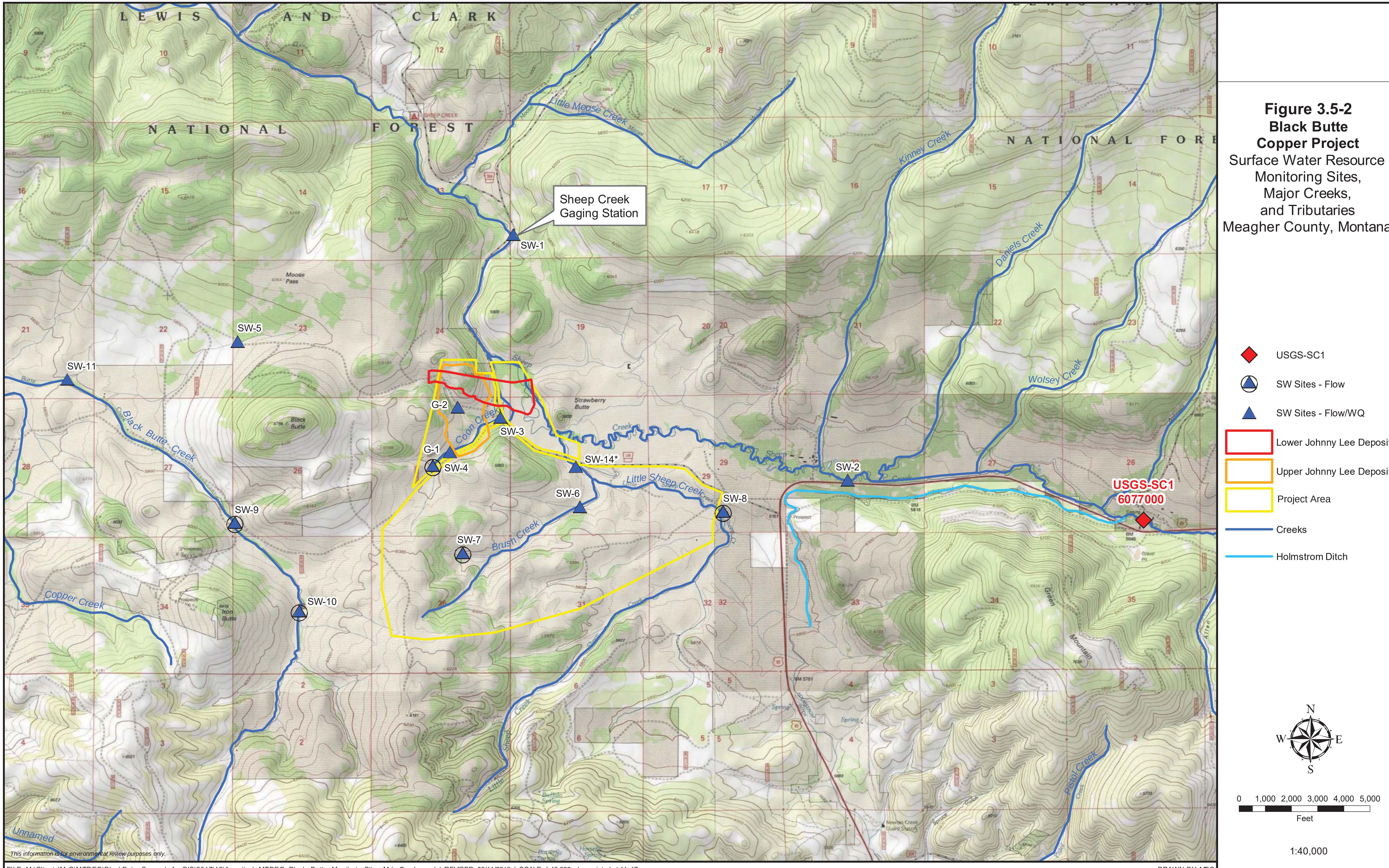
Source: Tintina 2017



Source: Tintina 2017

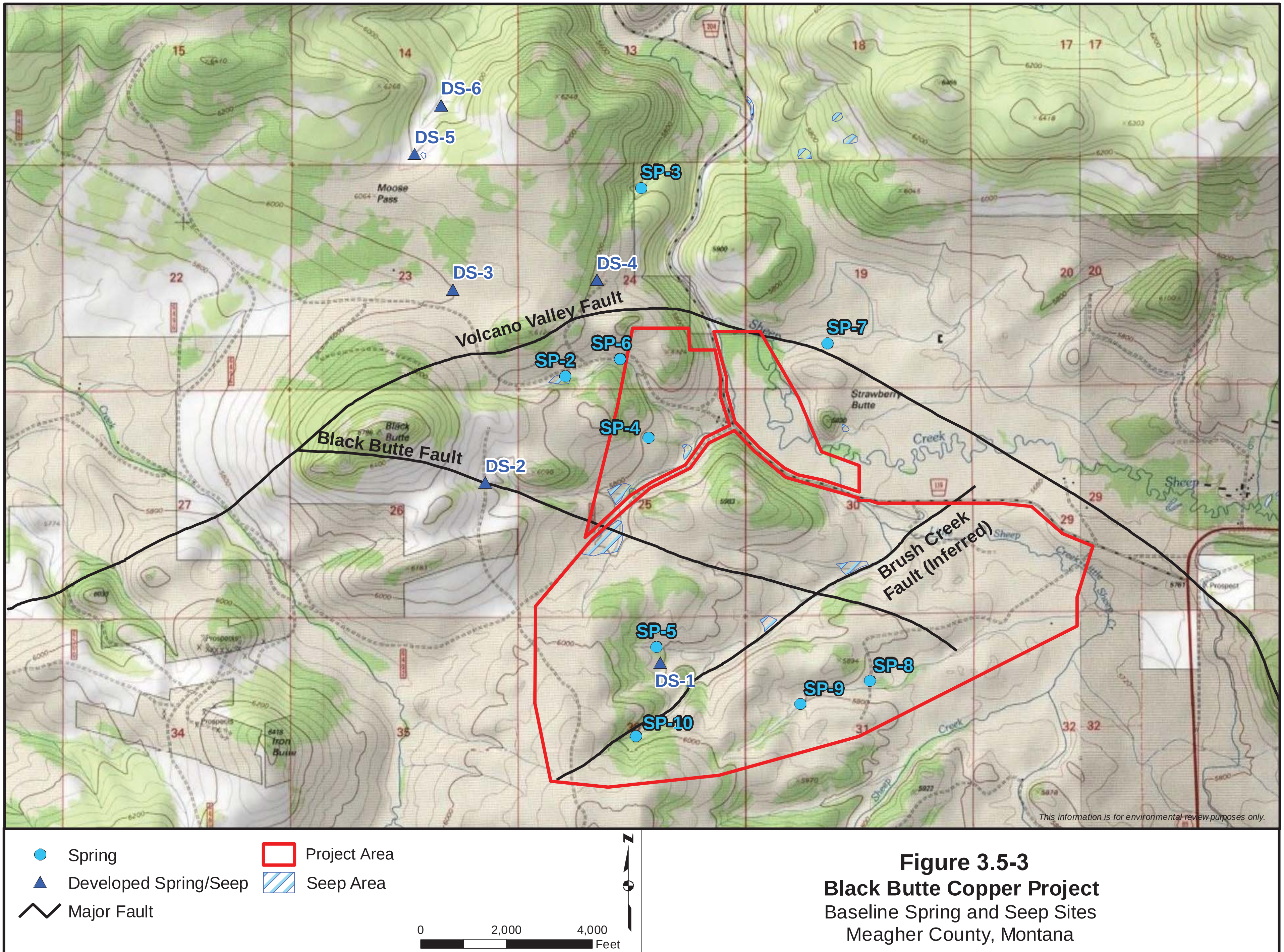


Figure 3.5-3
Black Butte Copper Project
Baseline Spring and Seep Sites
Meagher County, Montana

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Source: Hydrometrics 2017a

Table 3.5-1
Sampling Summary for Baseline Surface Water Quality Monitoring

Monitoring Site	Monitoring Frequency	Period of Record	Field Parameters	Lab Parameters	Comments
SW-1	Monthly	2011-2017	X	X	
SW-2	Monthly	2011-2017	X	X	
SW-3	Quarterly	2011-2017	X	X	
SW-4	Quarterly	2011-2017	X	not analyzed	
SW-5	Quarterly	2011-2017	X	X	Typically dry
SW-6	Quarterly	2011-2017	X	X	
SW-7	Quarterly	2011-2017	X	2012, 2015	
SW-8	Quarterly	2011-2017	X	not analyzed	
SW-9	Quarterly	2011-2017	X	not analyzed	
SW-10	Quarterly	2011-2017	X	2015	Added lab WQ for TMDL
SW-11	Quarterly	2011-2017	X	X	
SW-14	Monthly	2016-2017	X	X	
USGS-SC1	Monthly	2014-2017	X	X	
G-1	Single Event	July 2011	X	X	Data collected once only in July 2011
G-2	Single Event	July 2011	X	X	Data collected once only in July 2011

G = gossan; SC = Sheep Creek; SW = surface water; TMDL = total maximum daily load; USGS = U.S. Geological Survey; WQ = water quality; X = analyzed

Water quality sampling and analytical methods for the Project are summarized in the “Water Resources Monitoring Field Sampling and Analysis Plan” (Hydrometrics 2016a), which is included as Appendix U of the MOP Application (Tintina 2017).

3.5.2. Affected Environment

3.5.2.1. Surface Water Quantity

The existing surface water conditions for the Project area are described in the “Baseline Water Resources Monitoring and Hydrogeologic Investigations Report” (Hydrometrics 2017a). Stream flows have been monitored at various locations since 2011 as described in Section 3.5.1.2. Monitored streams ranged from small seasonal streams where the highest measured flow was 0.3 cfs, to Sheep Creek where the highest flow was estimated at 613 cfs. The range of measured flows for each of the sites is provided in **Table 3.5-2**.

Table 3.5-2
Stream Flow Ranges from 2011–2017

Monitoring Station	Stream	Dec - Apr	May - Jun	Jul - Nov
		Measured Stream Flow (cfs)		
SW-1	Sheep Creek	NF (Ice) -103	21–613[a]	NF (Ice)–64
SW-2	Sheep Creek	31-82	14–250	NF (Ice)-47
SW-3	Coon Creek	NF (Ice)-0.22	0.03–4.9	NF (Ice)–0.34
SW-4	Coon Creek	NF (Ice)-0.23	0.02–2.0	0.004–0.04

Monitoring Station	Stream	Dec - Apr	May - Jun	Jul - Nov
		Measured Stream Flow (cfs)		
SW-6	Brush Creek	NF (Ice)-0.26	0.11–4.1	0.04–0.33
SW-7	Brush Creek	NF (Ice) – 0.4	0–0.3	0.001–0.01
SW-8	Little Sheep Creek	NF (Ice) - 1.7	0.48–9.1	0.09–1.1
SW-9	Black Butte Creek	0.32–2.5	0.67–13	0.28–0.83
SW-10	Black Butte Creek	NF (Ice)- 1.5	0.48–15	0.15–0.54
SW-11	Black Butte Creek	1.0–2.9	0.61–21	NF (Ice) –1.1
SW-14	Little Sheep Creek	NF (Ice) -4.0	1.5-12	0.40-1.9

Source: Hydrometrics 2018b

cfs = cubic feet per second; NF (Ice) = not flowing (ice to ground); SW = surface water
Notes:
[a] High flows estimated, not measured due to depths and velocities being too high to accurately measure

The discharge hydrograph generated for monitoring site SW-1 on Sheep Creek, presented on **Figure 3.5-4,** illustrates the seasonal stream flow pattern across the monitoring period. The highest stream flows at SW-1 occur from mid-May through mid-June, when flows exceeded 100 cfs. Annual peak flows captured in the data record ranged from over 200 cfs in 2015 to just above 800 cfs in 2014, going above the measured/estimated flows observed during the site visits. Following the high-flow period, flows receded to an average monthly flow of 15 to 30 cfs by late summer. Winter base flow was determined to be approximately 15 cfs across the monitoring period (Hydrometrics 2017a). DEQ calculated additional low flow statistics for the MPDES Permit. The annual 7-day 10-year low flow (7Q10) and summer 14-day 5-year low flow (14Q5) values were determined for the proposed discharge point located on Sheep Creek less than 2 miles upstream of SW-1. Methods for determining low flow statistics generally followed DEQ standards (DEQ 2017) and are detailed in the document, "DEQ Low Flow Stats Calculations for the Black Butte Copper Project MPDES Permit" (DEQ 2018). The 7Q10 value for the Sheep Creek discharge point was determined to be 5.67 cfs, and the 14Q5 was determined to be 11.8 cfs.

Spring flow rates in the Project area ranged from no flow during certain dry or frozen periods in the year to greater than 100 gpm. Minimum, maximum, and average flow rates from 15 baseline spring monitoring sites in the Project area are summarized in **Table 3.5-3**.

3.5.2.2. Surface Water Quality

Updated data for each of the surface water quality monitoring sites, including detailed summary statistics by parameter, are compiled in Appendix I. Surface water quality summary statistics for SW-1 are presented in Appendix I, **Table 1**.

Surface water results show slightly acidic to slightly alkaline pH values (5.3 to 8.7), and low to moderate specific conductance (49 to 497 micro mhos per centimeter). Isolated field pH measurements less than 6.5 were attributed to cold winter conditions affecting the probe, which is susceptible to error at low temperatures.

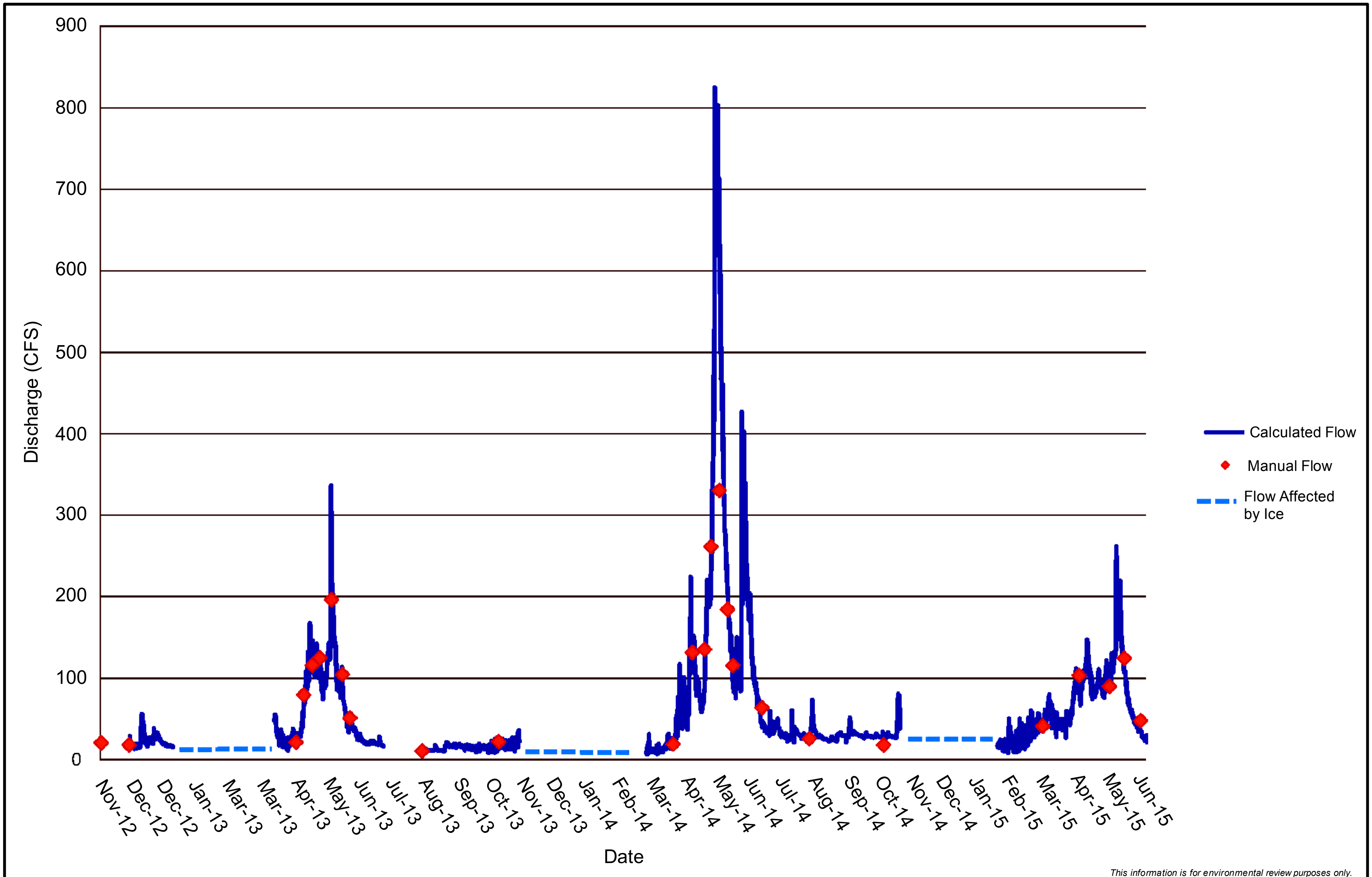


Figure 3.5-4
Black Butte Copper Project
Hydrograph of SW-1 Sheep Creek
Monitoring Site
Meagher County, Montana

FILE: M:\Clients\M-O\MTDEQ_ArcGIS\2018\04\Appendix_Figures_AppB_Hydrograph_Sheep_Creek.mxd | REVISED: 06/25/2018 | SCALE: 1:14,275 DRAWN BY: JPB

Source: Hydrometrics 2017a

Table 3.5-3
Spring Flow Ranges from 2011–2017

Site Name	Flow Rate (gpm)		
	Minimum	Maximum	Average
SP-1	NF	65	13.8
SP-2	NF	9.4	3.2
SP-3	NF	5.4	1.3
SP-4	0.18	27	6.1
SP-5	NF	128	8.0
SP-6	NF	3.0	0.84
SP-7	6.7	112	23.9
SP-8	0.6	8.1	5.4
SP-9	1.9	15	6.3
SP-10	NF	8.1	3.4
DS-1	NF	35	7.5
DS-2	NF	1.79	0.38
DS-3	NF	22	4.8
DS-4	NF	20	1.8
DS-5	NF	18	3.8
DS-6	NF	18	3.8

Source: Hydrometrics 2018a

DS = developed spring; gpm = gallons per minute; SP = undeveloped spring; NF = not flowing

Calcium and bicarbonate dominate the major ion chemistry of surface waters. With the exception of SW-5, which only has flow during spring runoff, hardness (not measured for SW-4, SW-8, SW-9, SW-12 and SW-13) ranges from approximately less than 7 mg/L to 267 mg/L (as $CaCO_3$). Metals data show some infrequent values above DEQ-7 water quality standards (DEQ 2012, 2017) for selected metals. Samples collected from gossan[1] sites G-1 and G-2 were similar to the long-term water quality monitoring sites and; therefore, they were not added to the long-term baseline water resource monitoring program.

Surface water standard (DEQ 2017) exceedances were observed for the following constituents (Appendix I):

- Total recoverable iron exceedances of the chronic aquatic criterion of 1 mg/L were recorded at all sites except for SW-10 and SW-14 (not measured in SW-4, SW-8, SW-9, SW-12 and SW-13). The exceedances often occurred during peak runoff periods but were occasionally unrelated. Exceedances coincidental with low flow periods (winter and summer) were also observed upon occasion.
- Dissolved aluminum concentrations (not measured in SW-4, SW-8, SW-9, SW-12 and SW-13) often exceeded the chronic aquatic criterion of 0.087 mg/L during periods of high runoff in Sheep Creek (SW-1, SW-2), and in Black Butte Creek (SW-11). The guideline was consistently exceeded at SW-5.

[1] A gossan is an intensely oxidized, weathered, or decomposed rock, usually the upper and exposed part of an ore deposit or mineral vein.

Sheep Creek is included in DEQ's 303(d) list of impaired streams for dissolved aluminum and *Escherichia coli* (*E. coli*), with sources listed as grazing in riparian zones, disturbances associated with human activities, and natural sources. DEQ published a document in 2017 specifically focused on the TMDL for *E. coli* and a framework water quality improvement plan for Sheep Creek in the Sheep Creek TMDL Project Area (DEQ 2017). The iron and aluminum exceedances are likely related to increased turbidity during periods of snowmelt and high runoff (with some exceptions), as the exceedances occur during peak runoff periods when turbidity is high. Elevated dissolved aluminum values associated with high turbidity have been observed in many different geographic areas during high-flow events (e.g., Moose Creek on 303(d) list, tributary to Sheep Creek below the Project area).

DEQ conducted a broad monitoring program in the Sheep Creek drainage for further data collection. The data DEQ collected is being used to develop an aluminum TMDL. The TMDL is necessary as a result of § 75-5-702, MCA, the discharge permit application and the aluminum impairment determination (303[d] list). DEQ conducted a broad water quality monitoring program in the Sheep Creek drainage that was used to update baseline data and existing impairment determinations for several streams, including Sheep Creek. The data were used to complete an *E. coli* TMDL and will be used for an aluminum TMDL. The completion schedule for the aluminum TMDL is linked to the MPDES surface water permit completion schedule to ensure internal DEQ consistency. The aluminum water quality standard is identified in the State of Montana Water Quality Standards (DEQ 2017), and the aquatic life aluminum standards were set at 0.75 mg/L and 0.087 mg/L for acute and chronic standards, respectively.

3.5.3. Environmental Consequences

This section describes the potential impacts of the Project on surface water quantity and quality. Groundwater quality is described in section 3.4.

3.5.3.1. Surface Water Quantity

No Action Alternative

Under a No Action Alternative, there would be no environmental consequences to surface water quantity in the Project area. Without the mine, the timing and magnitude of stream and spring flow would be unchanged from the existing conditions of the affected environment.

Proposed Action

The Proposed Action outlined in the Project's MOP Application (Tintina 2017) describes operations that could potentially affect surface water quantity though construction, operations, reclamation, and closure phases. Planned operations and facilities that could have direct or secondary impacts on surface water quantity are listed below:

- Surface disturbance by major facilities that could result in the interception and storage of surface water;
- Diversion of stream flow to the NCWR using the wet well during high-flow conditions;

- Dewatering associated with underground mine operations (access tunnels, ventilation shafts, mining stopes); and
- Operation of the Sheep Creek Alluvium UIG.

The following discussion of the Project's potential impacts on surface water quantity is organized by each of the planned operations.

Interception and Storage of Surface Water

Construction and operations of the mine would result in areas of surface disturbance that may result in changes to surface runoff patterns. Mining operations would also store and treat contact water prior to being discharged to the environment. **Table 2.2-1** lists the Project's facilities, features, and access roads and presents the measured acres of disturbance associated with each facility (Tintina 2017).

The total disturbed surface area is 310.9 acres, including a 10 percent construction buffer zone that would potentially affect the pattern and volume of surface runoff. Storm water runoff would be collected from the mill area, areas of direct underground mining support, WRS pad, copper-enriched rock storage pad, and the CTF, which would cover an area of approximately 112.3 acres (see **Table 2.2-1**). Contact storm water runoff from these facilities would be collected and stored in a CWP. Water from the CWP would be treated via the PWP and the WTP and released to the environment through the alluvial UIG. To reduce the volume of contact storm water runoff in the disturbance area, storm water control and management BMPs would be implemented as required for the Storm Water Pollution Prevention Plan. BMPs are provided in the MOP Application (Tintina 2017) and include the construction of surface water diversion ditches to convey the non-contact water around the Project facilities.

The disturbed surface area (310.9 acres) is a relatively small area within the overall Sheep Creek watershed, which drains a total of 124,160 acres at its mouth. The disturbed area is also a small area relative to the total drainage area monitored by surface water gaging station SW-1, located just greater than 1 mile downstream of the Project area (50,162 acres). The percent disturbance (including a 10 percent buffer zone) is less than 1 percent of both the entire Sheep Creek drainage area and of the watershed area associated with station SW-1. Based on the small percentage of disturbed area, it is not expected that surface runoff would change; therefore, impacts on surface water quantity in the affected watershed would not be adverse.

Several tributaries to Sheep Creek are in the immediate vicinity of the Project including Coon Creek and Little Sheep Creek, which converges with Brush Creek southeast of the Project. Surface runoff in these smaller drainages could potentially be affected due to surface disturbance, but impacts would not extend outside the immediate area and therefore are considered low within the greater Sheep Creek watershed.

Within the jurisdictional study and lease boundary area from USACE (**Figure 3.14-1**), a total of 327.4 acres of wetlands and 16.3 miles of streams were identified. A variety of locations were considered for proposed facilities to identify a practicable alternative with minimal impacts to wetlands and streams. The Proposed Action would disturb only 1.32 acres of the wetlands and

696 lineal feet of the streams, which account for less than 1 percent of the total area of each of these surface water features. Additionally, BMPs would be implemented to reduce impacts on these features including the use of half-culverts spanning the channels of Brush Creek and Little Sheep Creek where the main access road intersects them and the use of a directional utility installation drill to avoid impacts on streams and wetlands during the installation of underground pipelines. Impact on surface water quantity in the streams and wetlands due to surface disturbance are insignificant based on the proposed BMPs detailed in the MOP Application (Tintina 2017) and the relatively small percentage of the total area of these features that would be impacted through construction disturbance.

Diversion of Stream Flow to the Non-Contact Water Reservoir

The purpose of the design and operation of the NCWR is to address depletion of surface water flow in the affected watersheds associated with consumptive use of groundwater during operations. The conceptual plan (pending review and approval from the DNRC) outlined that water to fill the NCWR could be pumped from one of several diversion points based on existing leased water rights along Sheep Creek. Existing surface water rights would allow the NCWR to be filled during the 5-month irrigation period of the year (May 1 through September 30). Water would be diverted at a maximum flow rate of 5 cfs through the period with a total annual volume of 71.7 acre-feet. A second high-flow water rights application package was submitted to the DNRC on September 7, 2018, resulting in an update to the MOP Application for the Project. The update proposes to fill the NCWR using a wet well with the point of diversion located approximately 60 feet west of the private road in the hay meadow adjacent to Sheep Creek (NW ¼, SE ¼, NW ¼, Section 30, Township 12N, Range 07E depicted on **Figure 2-1**). Water from the wet well would be pumped to the NCWR during high-flow period between April 1 and June 30, and only when flow in Sheep Creek exceeds 84 cfs, which is equal to the total flow of the appropriated water rights on Sheep Creek downstream of the diversion. Water would be diverted at a maximum flow rate of 7.5 cfs during the high-flow period with a maximum total annual volume of 291.9 acre-feet. Water from the NCWR would then be available for release to affected watersheds (e.g., Coon Creek watershed; see subsection below) during the non-irrigation portion of the year to offset impacts on base flow due to groundwater drawdown associated with mine dewatering. Additionally, seepage from the NCWR is intended to offset a portion of the mine's consumptive groundwater use.

Potential impacts due to the diversion of streamflow to fill the NCWR would be nominal, as it is based on using existing leased water rights along Sheep Creek (pending review and approval by the DNRC). Water diversion would be limited to the irrigation period of the year when water is available and leased water rights permit water withdrawal.

Dewatering Associated with Underground Mine Operations

Drawdown caused by dewatering (especially in the upper HSUs) would capture water that would otherwise ultimately report to surface water. This capture would result in decreasing the base flow and impacts in downgradient surface water resources. As described in Section 3.4.3.2, Proposed Action in Groundwater Hydrology, model simulations show that the greatest drawdowns of the shallow groundwater (groundwater in shallow bedrock and in the alluvium) would occur in Year 4 and would correspond to the initial mining stage when the model predicts the highest inflow to the mine workings. As **Figure 3.4-10** shows, the 10-foot drawdown contour would extend into the Black Butte Creek watershed, and to the north close to Coon Creek. The maximum model-computed drawdown of the water table is approximately 290 feet in model layer 1. However, the 10-foot drawdown contour only extends into a small portion of the Sheep Creek alluvial groundwater system along the margin of Sheep Creek Meadows between the upland bedrock area and Coon Creek. (Hydrometrics 2016b).

The predictive model simulations estimated the following impacts of mine dewatering on base flow in the nearby creeks:

- Moose Creek (shown on **Figure 3.5-2** north of SW-1): Model simulations show no measurable change in streamflow in Moose Creek from mine dewatering.
- Black Butte Creek (shown on **Figure 3.5-2** southwest of SW-1): The estimated steady state base flow at the mouth of Black Butte Creek ranges from 2.6 to 3.2 cfs. The model simulations show a decrease of approximately 0.1 cfs (i.e., 3 to 4 percent of steady state base flow) in Black Butte Creek. The decrease starts to occur in Year 2 and reaches its peak in Year 4.
- Coon Creek (shown at the center of **Figure 3.5-2**): The mine dewatering simulations show a reduction of 0.12 cfs in the lower reach of Coon Creek. The total reduction in Coon Creek is estimated to be approximately 70 percent of the steady state base flow observed in the stream (0.2 cfs at the confluence with Sheep Creek). Water from the NCWR would be pumped into the headwaters of Coon Creek to augment flows within 15 percent of the average monthly flow (Hydrometrics 2018c). Additionally, Coon Creek is often fully diverted during the irrigation season and frozen during the winter months. The Proponent has an agreement with the water right holder for Coon Creek to utilize the water right if necessary (change in water use would be dependent on approval by the DNRC). Based on these factors, and pending the approval by the DNRC, the reduction in flow to Coon Creek itself would not have a substantive impact on water resources in the area.

  Sheep Creek: The Sheep Creek watershed upstream of SW-1 has the highest potential to incur dewatering impacts, as it is the closest to the Project of any of the streams except Coon Creek. Sheep Creek has an estimated average base flow of 15.3 cfs. Model simulations at the end of mining show a decrease in the 0.35 cfs (157 gpm) groundwater flow to Sheep Creek from the model domain. The simulated depletion is approximately 2 percent of the total base flow in Sheep Creek at this location upstream of SW-1. Predicted depletion of 0.35 cfs (157 gpm) is less than the quantity of water that would be returned to Sheep Creek alluvium through the UIG, which would be an average of 530 gpm from the WTP (from October through June). When the UIG is not likely to be in operation (July through September), the decrease in stream flow would be less than the limit established in nondegradation rules. Under the rare 7Q10 low flow conditions, Sheep Creek flow is calculated to be 5.67 cfs (2,545 gpm). In those conditions, nondegradation rules limit a decrease in flow to less than

255 gpm. The predicted decrease in flow (157 gpm) does not account for additions to base flow from seepage from the NCWR.

Simulated stream depletions resulting from groundwater drawdown during mine dewatering for all streams in the assessment area with the exception of Coon Creek are within 10 percent of the measured base flows and therefore are expected to be nominal (Tintina 2017). For Coon Creek, a reduction of approximately 70 percent is estimated. To mitigate the reduction, water would be pumped into the headwaters to maintain flows within 15 percent of the average monthly flow, and pending approval by the DNRC, an agreement with the water right holder for Coon Creek to obtain the water right would be utilized. As required in closed basins by the DNRC, the water rights mitigation plan would offset all the stream depletion in Sheep Creek (and Black Butte Creek if necessary) by mitigating flows via groundwater at a rate equal to the consumptive use of the Project (Tintina 2017).

Operation of the Underground Infiltration Gallery

Contributions of treated water back to the groundwater system would have a secondary impact on surface water. Water not used in the milling or mining process would be treated and discharged back to the groundwater system through an alluvial UIG. The alluvial UIG would be located in non-wetland areas beneath the floodplain of Sheep Creek southwest of Strawberry Butte. The capacity and designed usage of the UIG is detailed in Section 3.4.3.2.

It is unlikely that operating the UIG would result in any negative secondary impacts on surface water quantity. Instead, it would partially compensate for the potential loss of base flow in Sheep Creek.

Impact Assessment

The combined impacts on surface water quantity based on the Proposed Action outlined in the Project description of this document are expected to be minor:

- Minimal surface disturbance would result in insignificant impacts on surface runoff.
- Diversion of water to the NCWR falls within existing leased water rights (pending review and approval of the DNRC).
- Secondary impacts on base flow of Sheep Creek as a result of mine dewatering and disposal of treated water to the UIG are expected to be insignificant and to partially offset one another. A more significant impact upon base flow would be possible for Coon Creek, with the total reduction in Coon Creek estimated to be approximately 70 percent of the steady state base flow. Impacts to Coon Creek would be mitigated by pumping water from the NCWR into the headwaters of Coon Creek to augment flows within 15 percent of the average monthly flow (Hydrometrics 2018c). Nominal impacts are expected for Black Butte Creek, with a predicted reduction of 3 to 4 percent of steady state base flow. No other creeks are present within the area of a 10-foot drawdown of the water table, as computed by the groundwater model.

A summary of the Project's impact on surface water quantity is presented in **Table 3.5-4.**

Table 3.5-4
Project's Potential Consequences Regarding Surface Water Quantity

Project Phases	Project Facilities/Activities	Notes
Mine Construction (Phases I and II; Project Years 1-4)	Surface disturbance affecting runoff	Surface disturbance is less than 1% of local watershed area. Best management practices and the relatively small percentage of the total area (<1%) of stream and wetland features would be impacted through surface disturbance during construction.
	Diversion of stream flow to the NCWR	Based on existing leased water rights along Sheep Creek (pending review and approval by the DNRC).
	Mine dewatering	Simulated base flow depletion for all stream except Coon Creek within surface base flow measurement error (± 10%). Coon Creek base flow reduction would be offset with water from the NCWR and through an agreement with the water rights holder to utilize the water rights (pending approval with the DNRC).
	Underground infiltration gallery	Partially compensates for the potential loss of base flow in Sheep Creek.
Mine Production (Phase III; Project Years 5 - 15)	Surface disturbance affecting runoff	Surface disturbance is less than 1% of local watershed area.
	Diversion of stream flow to the NCWR	Based on existing leased water rights along Sheep Creek.
	Mine dewatering	Simulated base flow depletion within surface base flow measurement error (± 10%).
	Underground infiltration gallery	Partially compensates for the potential loss of base flow in the Sheep Creek.
Post-Mine Period (Mine Closure and Post-Closure; Phase IV)	Surface disturbance affecting runoff	Surface disturbance is less than 1% of local watershed area.
	Diversion of stream flow to the NCWR	Not required after consumptive use of groundwater stops.
	Mine dewatering	Base flow depletion is expected to cease within 2 years after dewatering stops.
	Underground infiltration gallery	No discharge to UIG after underground mine is closed and water treatment no longer necessary.

Smith River Assessment

The Smith River is located approximately 19 river miles downstream of the Project and is the receiving waters for Sheep Creek. Two active USGS gaging stations (USGS 06076690 and 06077200) are located upstream and downstream of the confluence with Sheep Creek. Average monthly flows at the upstream station (06076690) range from 18 to 3,200 cfs, and downstream of Sheep Creek (06077200), they range from 30 to 3,800 cfs (Hydrometrics 2017a). The percentage of flow that Sheep Creek contributes to the Smith River cannot be directly quantified using the two USGS stations, as another tributary discharges between them (Eagle Creek). An inactive USGS station 06077000 (data from 1941 to 1972) on Sheep Creek upstream of the Project reported monthly average flows ranging from 9 to 115 cfs, which provides an approximation of the flow in Sheep Creek near the Project relative to the Smith River upstream of the confluence (from 30 percent during base flow periods to 4 percent during high-flow periods). Several tributaries merge with Sheep Creek downstream from the Project site, before its confluence with the Smith River (e.g., Coon Creek, Moose Creek, Indian Creek, Cameron Creek, Calf Creek, and Black Butte Creek).

The contributions of Sheep Creek to the Smith River provide the context to understand how impacts of the Proposed Action may translate downstream. As discussed in the previous section, based on the Proposed Action description, impacts on surface water quantity in Sheep Creek are expected to be minor, and therefore potential impacts on water quantity in the Smith River would be insignificant. The Smith River is included in DEQ's 303(d) list of impaired streams for flow regime modification due to agricultural irrigation, from the North and South Forks to the mouth at the Missouri River. Those activities which impact surface water quantity are not associated with the Project and are likely to continue in the future.

Agency Modified Alternative

The modifications identified in the AMA would result in impacts similar to those described for the Proposed Action. Modifications to the Proposed Action include an additional backfill of mine workings component. Additional backfill of the mine workings with low hydraulic conductivity material would help prevent air and groundwater flow within certain mine workings. Hydraulic simulations in the predictive groundwater models showed that if grouting of the declines was implemented (Proposed Action) there would not be any reduction in the impacts to steady state base flow in the larger watersheds and the depletion of base flow in Coon Creek would be reduced by only 4 gpm through reducing drawdown in the alluvium. Similarly the additional backfill of mine workings would be expected to have a positive but very minimal impact on base flow reduction.

Smith River Assessment

The impacts of the AMA on water quantity in the Smith River would be the same as described for the Proposed Action. As described previously based on the Proposed Action description, impacts on surface water quantity in Sheep Creek are expected to be minor, and therefore potential impacts on water quantity in the Smith River would be negligible.

3.5.3.2. Surface Water Quality

No Action Alternative

The No Action Alternative would not introduce additional loads to receiving surface waters compared to baseline conditions. No impacts on surface water quality are anticipated. However, the baseline impacts to water quality noted in Section 3.5.2.2 are anticipated to continue.

Proposed Action

The Proponent has used hydro-geochemical monitoring, hydrogeological modeling, and geochemical testing data to design its underground workings (UG), temporary WRS pad, CTF, PWP, CWP, WTP, and TWSP to minimize potential impacts on water quality. Apart from groundwater in the underground workings (UG) at the end of the closure phase, water from all facilities would be collected and treated to meet nondegradation criteria prior to discharge (Hydrometrics 2016c).

The Proponent has developed water quality model predictions for key facilities during operations and at closure (Enviromin 2017a, which is included as Appendix N of the MOP Application [Tintina 2017]). Models predict future water quality and calculate uncertainty based on sensitivity analyses for the four locations discussed below.

- UG: Water quality is predicted at Year 6 of mining operations and again under post-closure conditions, when the water table has recovered to near pre-mining conditions (Section 3.4).
- WRS: Seepage from the WRS would be collected and transported to the CWP. Water quality is predicted at the end of Year 2, at the beginning of dismantling the WRS pad that would provide material for the tailing impoundment interior protective layer and interior basin drain system on top of a liner.
- CTF: No process water is to be discharged, but it may be routed to a separate WTP circuit from which it reports back to the mill circuit as make-up water. Water quality is predicted for Year 6 of tailings production and at the start of closure, before placing the cover designed to eliminate subsequent infiltration and seepage.
- PWP: Updated water quality predictions were generated for the PWP, based on CTF and RO brine predictions in Year 6 of production.

Model Methods and Results

To develop a mass-load calculation of water quality for each facility under base case and sensitivity scenarios, the operational plans described in Section 3 of the MOP Application (Tintina 2017) were combined with the following data:

- Groundwater quality data (Hydrometrics 2017a), which are included as Appendix B of the MOP Application (Tintina 2017);
- Geochemical test results (Enviromin 2017b), which are included as Appendix D of the MOP Application (Tintina 2017);

- Hydrogeological modeling results (Hydrometrics 2016b), which are included as Appendix M of the MOP Application (Tintina 2017); and
- Water treatment design data (Amec Foster Wheeler 2017), which are included as Appendix V of the MOP Application (Tintina 2017).

These data are described in detail in Appendix N (Enviromin 2017a) of the MOP Application (Tintina 2017).

Conceptual models, assumptions, and modeling details unique to each of the four models are described in the following sections including the model results.

Underground Mine

The access tunnels, decline, access drifts, and stope workings would transect various rock types in the subsurface, as shown in **Figure 3.4-5** (Section 3.4 of the EIS, Groundwater Hydrology) and in **Figure 3.6-3** (Section 3.6 of the EIS, Geology & Geochemistry). Detailed modeling methods and results are provided in Section 4 of Appendix N (Enviromin 2017a) of the MOP Application (Tintina 2017). To be consistent with groundwater flow data (Hydrometrics 2017a), the underground model was divided into seven HSUs as shown in **Figure 3.4-6** (Section 3.4 of the EIS, Groundwater Hydrology) and **Figure 3.6-3** (Section 3.6 of the EIS, Geology & Geochemistry). Mine water would be collected during dewatering operations for treatment, so the predicted chemistry after closure is the most important from an environmental perspective because water from the UG would no longer be treated. Each of the units was assigned a total flow, a surface area (based on operational plans), and a rock type that correlates with kinetic test data. For the model, each unit can be conceptually viewed as a large kinetic test and scaled based on surface area and flow rate. Further detail is provided in Section 4.3.3 of Appendix N (Enviromin 2017a) of the MOP Application (Tintina 2017). The mixed solution incorporated inflow from all seven units and was allowed to reach geochemical equilibrium, using the USGS PHREEQC[2] software to calculate mineral precipitation and metal sorption, with an analytical model of metal attenuation by sulfides in the exposed bedrock (Parkhurst and Appelo 1999). Removal of solutes via mineral precipitation and sorption allows calculation of final water quality for the mine sump, which is then collected for treatment to meet water quality standards and nondegradation criteria (Hydrometrics 2016c).

Model predictions for underground water are described in detail in Appendix N (Enviromin 2017a) of the MOP Application (Tintina 2017). Operational exceedances of DEQ groundwater quality standards were identified to include nitrate, uranium, strontium, and thallium. However, because all water would be collected for treatment to meet groundwater and surface water nondegradation criteria, the identified operational exceedances would not affect downgradient water. A TWSP would be in place to store WTP effluent during periods when total nitrogen in the treated water (estimated to be 0.57 mg/L) exceeds nondegradation effluent limits (0.097 mg/L). The total nitrogen effluent limit is only in effect 3 months per year (July 1 to September 30). During that time period, treated water from the WTP would be pumped through a

[2] Original acronym was defined as: pH-REdox-EQuilibrium, written in the C programming language. The program is a widely used public-domain geochemical modelling software available from the USGS.

6-inch (150mm) diameter HDPE pipeline to the TWSP. Water would be stored in the TWSP until the total nitrogen effluent limit is no longer in effect, and then it would be pumped back to the WTP via a 6-inch (150mm) diameter HDPE pipeline, where it would be mixed with the WTP effluent. The blended water would be sampled prior to being discharged to the alluvial UIG per the MPDES permit (Zeig et al. 2018).

At mine closure, much of the UG would be backfilled and the open portions of the workings would be flooded with unbuffered RO permeate (treated water), to dissolve and rinse soluble minerals from mine surfaces. This contact water would then be pumped out of the mine and treated at the WTP, and additional RO permeate would be injected into the mine again. Nondegradation criteria within the UG openings are expected to be achieved after repeated flooding/rinsing, which is conservatively estimated to take between six to ten cycles. Until that time (estimated to take 7 to 13 months), water from the UG would continue to be captured and treated. Treatment of water from the underground mine would likely occur late in the closure phase. The total closure period (during which the months of rinsing would occur) is 2 to 4 years. Upon confirmation that the quality of contact groundwater meets the proposed groundwater nondegradation criteria, the contact water would no longer be pumped and treated, and the WTP would shut down as part of the post-closure phase (Hydrometrics 2016c). At that time, all inflow to the workings would consist of groundwater recovering to pre-mining elevations, and the workings would remain flooded.

The predicted post-closure underground water quality is presented in **Table 3.5-5** (from Appendix N [Enviromin 2017a] of the MOP Application [Tintina 2017]). Compared to operations, higher pH (6.79), slightly lower alkalinity (145 mg/L), sulfate (120 mg/L), and metal concentrations are predicted in post-closure, as sulfide oxidation would be inhibited in the flooded workings. The predicted changes to water quality after closure (see **Table 3.5-5**) are minor relative to background water quality (pH of 6.97, with alkalinity of 193 mg/L and sulfate of 111 mg/L). Only thallium would be dissolved in contact groundwater at concentrations exceeding DEQ Groundwater Standards by a factor of two, but dissolved thallium would be at concentrations below the estimated groundwater nondegradation criteria (Hydrometrics 2016c).

The post-closure contact groundwater would be unlikely to affect surface water quality – on its way toward surficial environments it would be subject to mixing and retardation (see discussion in Section 3.4.3). **Figure 3.4-8** included in Section 3.4, Groundwater Hydrology, provides an indication of the magnitude of mixing the contact water would have with other waters (the rates of groundwater flow within the mine footprint: 0.4 gpm contact water, 90 gpm shallow bedrock groundwater, 200 gpm alluvial aquifer groundwater, and 6,700 gpm Sheep Creek base flow).

The limited variation between the base case and sensitivity scenarios reflects the robust design and plan for management of the UG, including the following:

- Open stope areas would be limited through concurrent backfilling with a low transmissivity material;
- Water would be treated during operations and closure;
- Lower workings would be flooded with RO treated water at closure; and

- Upper and lower workings would be isolated using hydraulic plugs.

These measures serve to reduce the impact of flushed oxidation products as the underground mine is flooded.

Table 3.5-5
Model Predictions for Underground Water Quality after Closure

		Underground model predictions at closure, after PhreeqC			
		Proposed Action	**Agency Modified Alternative**	**Groundwater Standards (MT DEQ-7)**	**Estimated Groundwater Non-degradation Criteria**
pH	s.u.	6.79	6.8	na[a]	6.0-7.8
Aluminum	mg/L	0.016	0.015	na	0.058
Alkalinity	mg/L $CaCO_3$	145	144	na[a]	na
Arsenic	mg/L	0	0	0.01	0.064
Barium	mg/L	0.0163	0.0168	1	0.1928
Beryllium	mg/L	0.0003	0.0002	na[b]	0.00095
Calcium	mg/L	68	65	NA	NA
Cadmium	mg/L	0.000042	0.000042	0.005	0.0008
Chloride	mg/L	1.8	1.7	NA[a]	NA
Chromium	mg/L	0.0005	0.00049	0.1	0.025
Copper	mg/L	0.0002	0.0002	1.3	0.197
Fluoride	mg/L	0.38	0.37	4	1.2
Iron	mg/L	0	0	NA[b]	NA
Mercury	mg/L	0.000006	0.000006	0.002	0.00001
Potassium	mg/L	3.4	3	NA	NA
Magnesium	mg/L	21.5	22	NA	NA
Manganese	mg/L	0.054	0.053	NA[b]	NA
Nitrate	mg/L as N	3.3	3.3	10	7.5
Sodium	mg/L	5	4.8	NA	NA
Nickel	mg/L	0.0053	0.005	0.1	0.025
Phosphorus	mg/L	0.001	0.001	NA	NA
Lead	mg/L	0.00001	0.00001	0.015	0.0028
Sulfate	mg/L	120	115	NA[b]	250[b]
Antimony	mg/L	0.0019	0.0015	0.006	0.002
Selenium	mg/L	0.001	0.0009	0.05	0.0085

		Underground model predictions at closure, after PhreeqC			
		Proposed Action	Agency Modified Alternative	Groundwater Standards (MT DEQ-7)	Estimated Groundwater Non-degradation Criteria
Silicon	mg/L	1.55	1.55	NA	NA
Strontium	mg/L	2.2	2.1	4	6.48
Thallium	mg/L	0.0037	0.0037	0.002	0.0039
Uranium	mg/L	0.00507	0.00504	0.03	0.008
Zinc	mg/L	0.02	0.018	2	0.317

$CaCO_3$ = calcium carbonate; DEQ = Department of Environmental Quality; mg/L = milligrams per liter; MT = Montana; N = nitrogen; NA = not applicable; pH = potential hydrogen; PHREEQC = geochemical modelling software–pH-REdox-EQuilibrium in the C programming language; s.u. = standard unit
Notes:
[a] narrative standards may exist
[b] secondary standard
Prediction of endpoint, not based on modeling.

Waste Rock Storage Facility

Waste rock would be stockpiled at the temporary WRS facility for approximately 2 years before it can be co-disposed with tailings in the CTF. The waste rock has some potential for acid generation and metal leaching (Appendix D [Enviromin 2017b] of the MOP Application [Tintina 2017]). A liner would collect all seepage from the WRS facility and discharge to an outlet pipe on the south edge of the WRS pad.

Water quality predictions for the WRS at Year 2 of mining were based on precipitation inflow rates into the stockpile and steady-state seepage estimates from the HELP model (Section 3.4.1.6). The predicted flow rate (0.9 gpm) is very low in relation to the size of the WRS facility, so it is unreasonable to assume that all of the waste rock surfaces would be saturated or exposed to infiltration. Using data from humidity cell tests, the most probable chemical and physical properties of the waste rock were used to predict water quality for the “base case”. Modeling incorporated calculations for the surface area and mass of the rock that could react with infiltrating water. The base case scenario is considered to be a conservative estimate because the humidity cell test data were obtained from samples with higher surface areas and higher water:rock ratios than what would be encountered in the WRS.

The base case water quality in Year 2 of mining is predicted to be moderately acidic (pH 5.80) and high in sulfate (2,212 mg/L), with some elevated metals (see **Table 3.5-6**). Sensitivity analyses were conducted to evaluate other hypothetical scenarios in which the changes to the model’s numeric inputs may be interpreted a few ways. The scenario that doubled the mass of reactive rock also represents the effects from doubling the reactive surface area, increasing the amount of infiltration, or decreasing the assumed porosity. The scenario that halved the mass of reactive rock also represents the effects from halving the reactive surface area, decreasing the amount of infiltration, or increasing the assumed porosity.

Mineral solubility limits were also considered for the base case and the sensitivity analysis scenarios, with the understanding that if particular solutes increase beyond the solubility limit, minerals would precipitate from the water and result in decreased solute concentrations. Precipitation of alunite ($KAl_3(SO_4)_2(OH)_6$), barite ($BaSO_4$), celestite ($SrSO_4$), and jarosite ($KFe^{3+}_3(OH)_6(SO_4)_2$) are predicted, but with no further solute sorption assumed due to lack of ferrihydrite precipitation. Sensitivity analyses show that the model is sensitive to the rock-to-water ratio and surface area (reactive mass) assumptions that influence predicted water quality. The model scenario with double the reactive mass predicts a slightly lower pH of 5.48 and a higher sulfate concentration of 3,811 mg/L. In contrast, the model scenario with half the reactive mass predicts a pH of 6.10 and a sulfate concentration of 1,111 mg/L.

During operation of the WRS, the seepage collected on the liner would discharge to an outlet pipe on the south edge of the WRS pad and would be conveyed for water treatment. The WRS would be removed prior to Year 3, with the waste rock being co-disposed with tailings in the CTF; hence, no closure evaluation was needed past this Project year.

Table 3.5-6
Year 2 Results for Waste Rock Storage Facility

		Model Predictions for WRS at Year 2			Groundwater Standards (MT DEQ-7)
			Model Sensitivities		
		Base Case	Reactive Mass Doubled (e.g., 1-year infiltration OR double surface area OR 20% porosity)	Reactive Mass Halved (e.g., 3-month infiltration OR half surface area OR 80% porosity)	
pH	s.u.	5.80	5.48	6.10	NA[a]
Aluminum	mg/L	0.065	0.172	0.008	NA
Alkalinity	mg/L $CaCO_3$	24	48	12	NA[b]
Arsenic	mg/L	0.0038	0.0075	0.0019	0.01
Barium	mg/L	0.0022	0.0018	0.0031	1
Beryllium	mg/L	0.0011	0.0022	0.0006	0.004
Calcium	mg/L	333	417	167	NA
Cadmium	mg/L	0.00031	0.00061	0.00015	0.00500
Chloride	mg/L	5	9.86	2.47	NA[a]
Chromium	mg/L	0.014	0.028	0.006	0.1
Copper	mg/L	0.032	0.065	0.016	1.3
Fluoride	mg/L	1.43	2.51	0.71	4
Iron	mg/L	0.0026	0.0018	0.0043	NA[b]

		Model Predictions for WRS at Year 2			Groundwater Standards (MT DEQ-7)
		Base Case	Model Sensitivities		
			Reactive Mass Doubled (e.g., 1-year infiltration OR double surface area OR 20% porosity)	Reactive Mass Halved (e.g., 3-month infiltration OR half surface area OR 80% porosity)	
Mercury	mg/L	0.0010	0.0020	0.0005	0.0020
Potassium	mg/L	30	60	15	NA
Magnesium	mg/L	407	748	237	NA
Manganese	mg/L	3.4	6.7	1.7	NA[b]
Nitrate	mg/L as N	344	344	344	10
Sodium	mg/L	12	24.3	6.1	NA
Nickel	mg/L	0.072	0.144	0.036	0.1
Phosphorus	mg/L	0.008	0.014	0.004	NA
Lead	mg/L	0.0034	0.0068	0.0017	0.0150
Sulfate	mg/L	2212	3811	1111	NA[b]
Antimony	mg/L	0.0022	0.0044	0.0011	0.006
Selenium	mg/L	0.009	0.017	0.004	0.05
Silicon	mg/L	0.62	1.13	0.31	NA
Strontium	mg/L	12.0	9.9	10.5	4
Thallium	mg/L	0.083	0.165	0.041	0.002
Uranium	mg/L	0.0012	0.0025	0.0006	0.03
Zinc	mg/L	0.021	0.042	0.011	2

Source: Enviromin 2017a

$CaCO_3$ = calcium carbonate; DEQ = Department of Environmental Quality; mg/L = milligrams per liter; MT = Montana; N = nitrogen; NA = not applicable; pH = potential hydrogen; s.u. = standard units; WRS = Waste Rock Storage

Notes:

[a] narrative standards may exist

[b] secondary standard

Prediction of endpoint, not based on modeling

Supersaturated phases in base case: alunite, barite, celestite, jarosite

Results include precipitation of supersaturated phases and sorption.

Cemented Tailings Facility

As described above, the Proposed Action includes placing cemented paste tailings (0.5 to 2 percent cement) together with waste rock into a double-lined CTF. The conceptual design of the CTF is presented on Figure 4.20 of the MOP Application (Tintina 2017).

The use of cemented paste tailings in a surface tailings facility provides mitigation against surface water impacts on the environment because:

- Cemented paste tailings are a stable, non-flowable (after placement), low-strength solid when consolidated. This precludes the risk of liquefaction or widespread release of tailings in response to impoundment failure or seismic events;
- Cemented paste tailings establish a 1-2^{o} slope towards the sump, allowing for internal drainage to the CTF sump; and
- Cemented paste properties provide extremely low hydraulic conductivity to tailings on the facility (water flows through at a rate of about 1.6×10^{-6} centimeters per second which is less than 0.05 feet per day).

All mined waste rock would be encapsulated in cemented paste tailings in the lined CTF impoundment, because each of the waste rock units has some, if not significant, potential to generate acid or release concentrations of metals in excess of groundwater quality standards. Furthermore, for MPDES compliance, all water from the CTF and PWP would be recycled in the milling circuit rather than discharged (except that precipitation on the PWP in excess of a 10-year 24-hour storm event may be treated and discharged in order to maintain the water balance, in accordance with Federal Effluent Limitation Guidelines). Potential for impacts on surface and groundwater is therefore low.

Although water would not be stored on the facility, rain and snow would react with the weathered cemented tailing surface, dissolving oxidation products including acidity, sulfate, and metals. This water would mix with water produced during consolidation of cemented paste tailings and react with the deposited waste rock, the ramp, and the rock drain prior to collecting in the wet well sump. Geochemical source terms and modeling assumptions are detailed in Appendix N (Enviromin 2017a) of the MOP Application (Tintina 2017).

Like the WRS modeling described above, the most probable chemical and physical properties for tailings and waste rock in the CTF were used to predict water quality under the Proposed Action as the “base case”. For the CTF, water quality predicted for the base case at Year 6 of mining is acidic (pH 4.13) with 765 mg/L sulfate and elevated metal concentrations (see **Table 3.5-7**). More acidity and metals are contributed by the surface of cemented tailings than from the co-deposited waste rock or access ramp/rock drain, while most sulfate comes from the wet paste and the waste rock contribution. The minerals predicted by PHREEQC to precipitate during operations include alunite, barite, jarosite, and quartz.

Sensitivity analyses were conducted to evaluate other hypothetical scenarios in which the changes to the model’s numeric inputs were used to represent changes to the surface area of co-disposed waste rock, the surface area of cemented paste tailings, and doubling the binder content of the cemented paste (from 2 percent up to 4 percent). Water quality predictions for the CTF are sensitive to the calculated surface area, implying that the surface area should be managed to limit weathering through frequent placement of fresh lifts of paste tailings. Cemented paste would be discharged into the facility in thin lifts with the upper surface of these lifts being exposed for up to 30 days (average range 7 to 15 days) before a new lift is deposited over the top. Higher concentrations of cement (e.g., 4 percent) could be used to reduce disaggregation of the surface if a delay in operations prevents frequent placement of fresh lifts. The drain should also be designed to avoid plugging with secondary minerals. However, the drain is unlikely to be fully saturated with the predicted flow of seepage, leaving multiple paths for water flow.

Table 3.5-7
Predicted Water Quality in the Cemented Tailing Facility Sump at Year 6, Including Sensitivity Analyses

		Model Predictions for CTF at Year 6 of Mining					Groundwater Standards (MT DEQ-7)
		Base Case	Model Sensitivities				
			Waste Rock Surface Area Doubled	Paste Cement Surface Area Doubled	Paste Cement Surface Area Halved	4% binder Paste Cement Surface	
pH	s.u.	4.13	4.11	3.80	4.38	5.28	NA[a]
Aluminum	mg/L	17.73	16.18	38.26	4.80	0.08	NA
Alkalinity	mg/L $CaCO_3$	97	92	92	86	111	NA[a]
Arsenic	mg/L	0.031	0.033	0.048	0.016	0.017	0.01
Barium	mg/L	0.004	0.003	0.003	0.005	0.015	1
Beryllium	mg/L	0.0051	0.0051	0.0102	0.0026	0.0008	0.004
Calcium	mg/L	132	137	246	75	42	NA
Cadmium	mg/L	0.00141	0.00142	0.00281	0.00071	0.00005	0.0050
Chloride	mg/L	34.3	34.3	38.0	32.4	31.7	NA[a]
Chromium	mg/L	0.012	0.013	0.023	0.007	0.006	0.1
Copper	mg/L	61.3	0.0	121.8	31.0	0.7	1.3
Fluoride	mg/L	0.68	0.73	1.24	0.40	0.24	4
Iron	mg/L	0.573	0.463	1.955	0.497	0.022	NA[b]
Mercury	mg/L	0.000127	0.000141	0.000240	0.000071	0.000066	0.002000
Potassium	mg/L	0.00003	0.00005	0.00000	0.00004	3.46125	NA
Magnesium	mg/L	95	100	148	68	2	NA
Manganese	mg/L	2.68	2.73	5.30	1.36	0.06	NA[b]
Nitrate	mg/L as N	34.4	34.4	34.4	34.4	34.4	10
Sodium	mg/L	13	13.6	15.9	12.1	12.6	NA
Nickel	mg/L	8.5	8.5	17.1	4.3	0.0	0.1
Phosphorus	mg/L	0.26	0.26	0.50	0.05	0.02	NA
Lead	mg/L	0.027	0.028	0.030	0.025	0.025	0.015

		Model Predictions for CTF at Year 6 of Mining					Groundwater Standards (MT DEQ-7)
		Base Case	Model Sensitivities				
			Waste Rock Surface Area Doubled	Paste Cement Surface Area Doubled	Paste Cement Surface Area Halved	4% binder Paste Cement Surface	
Sulfate	mg/L	765	797	1481	406	97	NA[b]
Antimony	mg/L	0.015	0.015	0.016	0.014	0.014	0.006
Selenium	mg/L	0.003	0.003	0.005	0.002	0.001	0.050
Silicon	mg/L	0.001	1.142	1.129	0.74	0.12	NA
Strontium	mg/L	2.62	2.92	4.67	1.59	0.86	4
Thallium	mg/L	0.016	0.017	0.030	0.009	0.003	0.002
Uranium	mg/L	0.019	0.015	0.021	0.008	0.003	0.03
Zinc	mg/L	0.826	0.826	1.650	0.413	0.010	2

Source: Enviromin 2017a

$CaCO_3$ = calcium carbonate; CTF = Cemented Tailings Facility; DEQ = Department of Environmental Quality; mg/L = milligrams per liter; MT = Montana; N = nitrogen; NA = not applicable; pH = potential hydrogen; s.u. = standard units
Notes:
[a] narrative standards may exist
[b] secondary standard
Estimate - most nitrate removed by flotation
Supersaturated phases in base case: alunite, barite, jarosite, quartz
Results include precipitation of supersaturated phases.

The CTF foundation drain system has the following three components:

- Drains on the CTF Basin Floor;
- Drains beneath CTF Embankments (areas of fill); and
- Outlet drain to the foundation drain collection pond.

The foundation drain collection pond is a small facility requiring only a 0.7 acre construction footprint and is located at the downstream toe of the CTF embankment (Figure 3.35 of the MOP Application [Tintina 2017]). Collected water would be pumped directly to the WTP or alternatively transferred to the PWP as shown in Figure 3.43 of the MOP Application (Tintina 2017).

The CTF closure model accounts for the increased surface area of the cemented paste and removes the contribution from dewatered paste. However, the Proponent proposes sealing the entire CTF upon closure. The CTF would be covered with a welded HDPE cover, followed by regraded fill, subsoil, topsoil (at a slope designed to preclude standing water), and revegetated. This plan would eliminate long-term exposure to oxygen and water, and precluding hydraulic head inside the double-lined facility should eliminate seepage from the cemented tailings mass.

This measure is important for minimizing the risk of acid generation from material stored within the CTF.

The CTF wet well sump would continue to be pumped in closure until water can no longer be effectively removed from the sump and minimum volume objectives are met. The time estimate for the CTF sump pumping in closure is expected to be approximately 30 days since the CTF is designed to contain mostly solids (e.g., cemented paste tailings and waste rock) and only minor volumes of water. However, the pump and piping for dewatering the sump would remain in place as necessary until agreement is reached with DEQ that it can be removed. The closure predictions shown here thus represent water quality at the end of tailing production, prior to cover placement, when the entire surface remains exposed to oxygen and water. After placement of the cover, there would be no more water in the CTF. The mass loads for each input source are shown with results in **Table 3.5-8**.

Table 3.5-8
Predicted Water Quality in the CTF Sump at Closure, Including Sensitivity Analyses

		Model Predictions for CTF at Closure				Groundwater Standards (MT DEQ-7)
		Base Case	Model Sensitivities			
			Waste Rock Surface Area Doubled	Paste Cement Surface Area Doubled	Paste Cement Surface Area Halved	
pH	s.u.	4.95	4.95	4.65	5.25	NA[a]
Aluminum	mg/L	0.020	0.020	0.039	0.010	NA
Alkalinity	mg/L $CaCO_3$	53	53	106	53	NA[a]
Arsenic	mg/L	0.0082	0.0086	0.0160	0.0043	0.01
Barium	mg/L	0.018	0.017	0.011	0.028	1
Beryllium	mg/L	0.0016	0.0016	0.0031	0.0008	0.004
Calcium	mg/L	54	54	108	27	NA
Cadmium	mg/L	0.000066	0.000067	0.000130	0.000033	0.005000
Chloride	mg/L	2.6	2.6	5.1	1.3	NA[a]
Chromium	mg/L	0.010	0.01	0.020	0.005	0.1
Copper	mg/L	0.0056	0.0056	0.0111	0.0028	1.3
Fluoride	mg/L	0.27	0.29	0.53	0.14	4
Iron	mg/L	0.012	0.012	0.007	0.021	NA[b]
Mercury	mg/L	0.000111	0.000111	0.000223	0.000056	0.002000
Potassium	mg/L	4.2	4.4	8.30000	2.2	NA
Magnesium	mg/L	0.9	1.3	0.7	7.4	NA
Manganese	mg/L	0.018	0.018	0.03	0.009	NA[b]
Nitrate	mg/L as N	3.4	3.4	3.4	3.4	10

		Model Predictions for CTF at Closure				Groundwater Standards (MT DEQ-7)
		Base Case	Model Sensitivities			
			Waste Rock Surface Area Doubled	Paste Cement Surface Area Doubled	Paste Cement Surface Area Halved	
Sodium	mg/L	4.0	4.1	7.9	2.1	NA
Nickel	mg/L	0.019	0.019	0.037	0.009	0.1
Phosphorus	mg/L	0.021	0.021	0.042	0.010	NA
Lead	mg/L	0.00047	0.00049	0.00092	0.00024	0.015
Sulfate	mg/L	90	93	177	46	NA[b]
Antimony	mg/L	0.0011	0.0011	0.0021	0.0006	0.006
Selenium	mg/L	0.0020	0.0021	0.0040	0.0011	0.050
Silicon	mg/L	0.11	0.12	0.22	0.06	NA
Strontium	mg/L	0.65	0.66	1.29	0.33	4
Thallium	mg/L	0.0022	0.0022	0.0044	0.0011	0.002
Uranium	mg/L	0.0011	0.0018	0.0015	0.0009	0.03
Zinc	mg/L	0.019	0.019	0.039	0.010	2

Source: Enviromin 2017a

$CaCO_3$ = calcium carbonate; CTF = Cemented Tailings Facility; DEQ = Department of Environmental Quality; mg/L = milligrams per liter; MT = Montana; N = nitrogen; NA = not applicable; pH = potential hydrogen; s.u. = standard units
Notes:
[a] narrative standards may exist
[b] secondary standard
Estimate - most nitrate removed by flotation
Supersaturated phases in base case: barite, jarosite
Results include precipitation of supersaturated phases.

At closure, following placement of a 4 percent binder cemented paste lift immediately prior to cover placement, a more neutral solution (pH 4.95 s.u.) is predicted, with no exceedances of groundwater standards for metals predicted for the base case following precipitation of barium arsenate, barite, and jarosite (see **Table 3.5-8**). Limited exceedances of groundwater standards for arsenic and thallium were predicted for the high surface area sensitivity scenario in closure. As noted above, the CTF wet well sump would continue to be pumped in closure until water could no longer be effectively removed from the sump, and minimum volume objectives are met. The planned reclamation procedures (e.g., welded HDPE cover, revegetation) are not accounted for in the model, which predicts water quality prior to use of the cover to eliminate infiltration. The proposed reclamation would minimize the infiltration of water into the CTF after closure.

Process Water Pond Facility

All water from the CTF and some water from the WTP would report to the PWP where it would mix with water from the mill (i.e., thickener overflow), direct precipitation, and run-on. In the PWP model, solutions were mixed and the solution was equilibrated using PHREEQC.

Water quality predictions for the CTF facility and the RO brine from the WTP were used in the PWP model. Process water chemistry and RO brine chemistry were provided in Appendix V (Amec Foster Wheeler 2017) of the MOP Application (Tintina 2017). In addition to these solutions, run-on, and direct precipitation (assumed to be deionized water) would be added and water would be removed as evaporation. A combination of run-on, direct precipitation, and evaporation add up to a net influx of 353,147 cubic feet per year of water, which dilutes the system by only a small amount. The final mixed solution is equilibrated in PHREEQC to predict the PWP chemistry.

The model predicts that the overall chemistry of the PWP is dominated by the thickener overflow from the mill, which provides 93 percent of the flow. The predicted solution has a pH of 5.81, moderate sulfate (903 mg/L), and elevated concentrations of nitrate and metals, including arsenic, copper, nickel, lead, antimony, strontium and thallium (see **Table 3.5-9**). Mixing with process water raises the alkalinity of the solution. PHREEQC modeling predicts that alunite, barium arsenate, barite, and jarosite could form based on mineral solubility limits, with no sorption of metals to ferrihydrite. These minerals would then settle out of the water column, reducing the concentrations of some dissolved solutes. Predicted water quality in the PWP would pose little acute threat to waterfowl that may land on the pond, precluding the need for netting to limit avian access. Water contained within the PWP would not be discharged without prior treatment at the WTP.

Table 3.5-9
Predicted Water Quality in PWP at Year 6

			Aquatic Life Standard	Aquatic Life Standard	Human Health Standard
		Model Prediction of PWP	Acute (MT DEQ-7)	Chronic (MT DEQ-7)	Surface Water (MT DEQ-7)
pH	s.u.	5.81	NA	NA	NA
Aluminum [a]	mg/L	0.016	0.75	0.087	NA
Alkalinity	mg/L $CaCO_3$	205	NA	NA	NA
Arsenic	mg/L	0.0330	0.34	0.15	0.01
Barium	mg/L	0.004	NA	NA	1
Beryllium	mg/L	0.0002	NA	NA	0.004
Calcium	mg/L	509	NA	NA	NA

			Aquatic Life Standard	Aquatic Life Standard	Human Health Standard
		Model Prediction of PWP	**Acute (MT DEQ-7)**	**Chronic (MT DEQ-7)**	**Surface Water (MT DEQ-7)**
Cadmium [b]	mg/L	0.00009	0.0074	0.0024	0.005
Chloride	mg/L	141	NA	NA	4
Chromium	mg/L	0.004	5.61	0.27	0.1
Copper [b]	mg/L	4.0	0.052	0.030	1.3
Fluoride	mg/L	0.55	NA	NA	4
Iron	mg/L	0.004	NA	1	NA
Mercury	mg/L	0.000011	0.0017	0.00091	0.00005
Potassium	mg/L	28	NA	NA	NA
Magnesium	mg/L	1	NA	NA	NA
Manganese	mg/L	0.1	NA	NA	NA
Nitrate	ppm as N	87	NA	NA	10
Sodium	mg/L	44	NA	NA	NA
Nickel[b]	mg/L	0.197	1.52	0.17	0.1
Phosphorus	mg/L	0.10	NA	NA	NA
Lead[b]	mg/L	0.092	0.48	0.019	0.015
Sulfate	mg/L	903	NA	NA	NA
Antimony	mg/L	0.023	NA	NA	0.0056
Selenium	mg/L	0.001	0.02	0.005	0.05
Silicon	mg/L	0.255	NA	NA	NA
Strontium	mg/L	4.22	NA	NA	4
Thallium	mg/L	0.009	NA	NA	0.00024
Uranium	mg/L	0.009	NA	NA	0.03
Zinc[b]	mg/L	0.258	0.39	0.39	7.4

Source: Enviromin 2017a

$CaCO_3$ = calcium carbonate; DEQ = Department of Environmental Quality; mg/L = milligrams per liter; Mn = manganese; MT = Montana; N = nitrogen; NA = not applicable; pH = potential hydrogen; ppm = parts per million; PWP = Process Water Pond; s.u. = standard units
Notes:
Acute standard defined as one-hour average concentration; Chronic standard is 96-hour average concentration
[a] Aluminum standard applicable for dissolved concentrations, with pH from 6.5 to 9.0 only
[b] Aquatic life standards are calculated based on hardness. With predicted solution hardness >400 mg/L, the standards are calculated with hardness = 400 mg/L, per guidance in DEQ-7
Prediction based on assumed 33 ppm from underground and WTP balance.
Supersaturated phases: alunite, $Ba_3(AsO_4)$, barite, jarosite
Results include precipitation of supersaturated phases and sorption.

Treated Water Storage Pond

There is a contingency to the water management plan that includes storage of treated water during the seasonal period when the total nitrogen standard for surface water of 0.3 mg/L is applicable (July 1 to September 30, for Middle Rockies Ecoregion). This proposed contingency includes the addition of a TWSP to the Project. The TWSP would store treated water from the WTP if the effluent from the WTP does not meet the seasonal effluent limits for total nitrogen in the MPDES permit (Zeig et al. 2018).

The proposed TWSP would be located southeast of the WTP and west of Brush Creek. The design of the TWSP was based on an average seasonal flow rate from the WTP of 405 gpm. The average seasonal flow rate is slightly larger than the average annual discharge due to minor differences in seasonal flows from Mill Catchment Runoff associated with the seasonal precipitation and evaporation at the site. The TWSP has been designed to store up to 53.7 million gallons of treated water to provide enough temporary storage of treated water from July 1 to September 30, at an average flow rate of 405 gpm. The pond would be lined with a 60-mil (0.06 inches) HDPE geomembrane liner installed over a 12 ounce per square yard non-woven geotextile cushion (Zeig et al. 2018).

Treated water from the WTP would be pumped through a 6-inch diameter HDPE pipeline to the TWSP for storage. From October 1st to June 30, treated water stored in the TWSP would be pumped back to the WTP via a 6-inch diameter HDPE pipeline, where it would be mixed with other WTP effluent. The blended water would be sampled prior to being discharged per the MPDES permit. The construction of the TWSP requires excavation of weathered bedrock and fractured and moderately weathered limestone and shale (Knight Piésold 2017). Based on geotechnical information (Knight Piésold 2017), excavated materials should be sufficient for use as embankment fill (Zeig et al. 2018).

The TWSP would be operational prior to dewatering the mine workings. This would allow for storage of water (if necessary) during the growing season while there is active dewatering of the underground workings during construction and operations. The pond would remain operational during closure, until the discharge to the UIG is discontinued. Once storage of treated water is not necessary, the TWSP liner would be removed and hauled off-site for disposal or recycling. Embankment material would be used to re-shape and reclaim the TWSP disturbance footprint. The footprint of the TWSP would be ripped to relieve compaction, the site regraded, soil placed, and the site seeded (Zeig et al. 2018).

Underground Infiltration Gallery

Water not used in the milling or mining process would be treated and discharged back to the groundwater system using an alluvial UIG. As specified in the MOP Application (Tintina 2017), all water would be treated by RO to meet applicable nondegradation standards (Amec Foster Wheeler 2017) prior to discharge via the UIG (Hydrometrics 2017b).

It is assumed that all water discharged to the alluvial outfalls would eventually be transported downgradient to discharge to Sheep Creek and Coon Creek. Therefore, based on the operational potentiometric surface there are three different receiving waters that treated water would be discharged to: Sheep Creek alluvial aquifer, Sheep Creek and Coon Creek surface water. Water quality data and statistical analyses for each receiving water through 2016 are included in Appendix G of the integrated discharge permit application narrative (Hydrometrics 2018c). The combined impact of treated discharge mixing with the alluvial UIG, and subsequently with Coon Creek and Sheep Creek would be monitored at SW-1.

The Sheep Creek alluvial UIG (Outfall 001) would discharge directly to the Sheep Creek alluvium. The water quality of the Sheep Creek alluvial system is characterized by results from monitoring conducted at monitoring well MW-4A (Figure 3.2 of the integrated discharge permit application narrative [Hydrometrics 2018c]). Water in the Sheep Creek alluvium has near neutral pH with low to non-detectable concentration of dissolved metals.

It was originally assumed that nearly all water that is discharged to the alluvial UIG would eventually discharge to Sheep Creek near the downgradient end (north end of the Project permit boundary area) of the Sheep Creek Valley where the alluvial system is pinched out at the canyon north of the Project site. However, due to groundwater mounding, there is potential for discharge to Coon Creek as well, which discharges into Sheep Creek. Water quality of Sheep Creek in the vicinity of the Project is best characterized by the ongoing monthly monitoring at site SW-1. Sheep Creek surface water is a calcium/magnesium bicarbonate type water with low to moderate dissolved solids. Chronic aquatic criteria for dissolved aluminum (0.087 mg/L) is often exceeded during periods of high runoff in Sheep Creek. Nutrients are relatively low, with total nitrogen (persulfate method) being below the nutrient criteria during the summer months (<0.04 to 0.15 mg/L).

Much like rainwater, with its low solute content, the buffered RO permeate would equilibrate with sediments, acquiring a small mass of solutes as it transits the disturbed and oxidized infiltration gallery. Given the relatively low reactive mass, and the larger volume of discharged water, the predicted solute concentrations are low. As shown in **Table 3.5-10**, the predicted water quality meets nondegradation criteria for both groundwater and surface water settings. Water discharged to the UIG following RO treatment is thus expected to meet both surface and groundwater nondegradation standards under all cases and in all sensitivity scenarios (Hydrometrics 2017b). However, if the total nitrogen concentration is greater than the effluent limit, the treated water would be discharged to the TWSP from July 1 to September 30. Starting October 1, the stored water would be routed back to the WTP and blended with the WTP effluent prior to discharge. Prior to discharge, the blended water would be sampled/monitored as required in the MPDES permit. The only anticipated impact on groundwater in the vicinity of the UIG is dilution by the discharged water resulting in somewhat improved water quality.

Wet Well Diversion

Tintina submitted a Water Right Application Package to the DNRC on September 7, 2018. This package included applications for a new groundwater beneficial use permit for water put to beneficial use in the mining and milling process, a new high-flow season surface water beneficial use permit and six change applications. The new high-flow season surface water beneficial use permit and six change applications would be used to mitigate potential adverse impacts from the consumptive use of groundwater in the mining and milling process and mitigate potential secondary impacts to wetlands. A portion of the mitigation water would be stored in the NCWR. Water stored in the NCWR would be diverted from Sheep Creek through a wet well adjacent to the creek and transferred to the reservoir through a pipeline up to the NCWR (Zeig et al. 2018).

Table 3.5-10
Results of the Proposed Action Water Quality Predictions

	pH s.u.	Sulfate mg/L	Alkalinity mg/L $CaCO_3$	Parameters > MT Groundwater Standards	Metals >MT Nondegradation Criteria
UG					
Year 6 operations	6.67	304	183	Nitrate, strontium, thallium and uranium	Nitrate
Post-closure	6.79	120	145	Thallium	None
WRS	5.80	2,212	24	Nitrate, strontium and thallium	a
CTF					
Year 6 tailings	4.13	765	97	Nitrate, arsenic, beryllium, copper, nickel, lead, antimony, and thallium	a
Closure	4.95	90	53	Nitrate and thallium	a
PWP	5.81	903	205	Nitrate, arsenic, copper, nickel, lead, antimony, strontium and thallium	a
UIG	8.1	0.16	100.3	None	None

$CaCO_3$ = calcium carbonate; CTF = cemented tailing facility; mg/L = milligrams per liter; MT = Montana; PWP = process water pond; s.u. = standard units; UG = underground workings; UIG = underground infiltration gallery; WRS = waste rock storage
Notes:
a = Collected water treated by RO to meet nondegradation standards

The majority of the water stored in the NCWR would typically be from the new high season flow surface water right. The high season flow diversion would occur when flows are greater than 84 cfs, which is equal to the total flow of the appropriated water rights on Sheep Creek downstream of the diversion. The point of diversion would be located approximately 60 feet west of the private road in the hay meadow adjacent to Sheep Creek. The point of diversion would include a wet well that consists of an 8-foot concrete manhole, which is connected to Sheep Creek through a 22-inch HDPE intake pipe. The intake pipe would be extended approximately 6.5 feet into Sheep Creek and be placed on the streambed. The pipe would be equipped with a fish screen over the intake section. The remainder of the intake pipeline would be solid pipe buried beneath the ground surface at an elevation equal to or slightly below the streambed elevation (Zeig et al. 2018).

When the flow in Sheep Creek exceeds 84 cfs, water would be pumped from the wet well, using a vertical turbine pump, through approximately 7,150 feet of 20-inch HDPE transfer pipeline to the NCWR. The transfer pipeline would be placed on the ground surface along the access road within the hay meadow and would remain on surface except where it crosses the Sheep Creek County Road 119. The pipeline would cross Brush Creek in an area with narrow wetland fringe areas and would be suspended above the wetlands and stream channel (Zeig et al. 2018).

The NCWR would be used for mitigation of residual depletion in surface waters during operations and for approximately 20 years after the cessation of mine dewatering. Once it is not necessary to mitigate flows, the wet well, intake pipeline, and transfer pipeline would be reclaimed. Reclamation would include removal of all non-native materials (pipelines, concrete structure, and fill material). Excavations would be filled with sand and gravel material to within one foot below grade. The disturbed land would be covered with up to 1 foot of topsoil and seeded with a pasture grass seed mix, similar to the current vegetation in the hay meadow, and as approved by the landowner (Zeig et al. 2018).

Impact Assessment

No impacts on the receiving waters (Sheep Creek and Coon Creek) are anticipated since water from all facilities would be collected and treated to meet nondegradation criteria prior to discharge to the alluvial UIG (Hydrometrics 2017b). A 30:1 dilution of the chemicals of concern existing in the original source water is anticipated as a result of mixing with groundwater (Section 3.4). Further dilution occurs when the mixed source water and groundwater reaches Sheep Creek and Coon Creek. Total nitrogen predictions for the receiving environment (75^{th} percentile) are less than 0.12 mg/L for both Sheep Creek and Coon Creek (Hydrometrics 2018c), which is below the total nitrogen seasonal standard of 0.3 mg/L prescribed in the Montana Numeric Water Quality Standards, Circular DEQ-12A (DEQ 2014). However, the MPDES seasonal effluent limit on total nitrogen is based on the non-degradation standard (0.09 mg/L). Hence, there is need for a TWSP as there is no assimilative capacity in the creeks during the July through September period.

Within the estimated 2 to 4 years of closure and reclamation after the end of operations, underground mine openings would be flooded/rinsed with RO permeate (treated water), and the contact water would then be pumped to the WTP. Groundwater nondegradation criteria within the mine openings are expected to be achieved after repeated flooding/rinsing, which may take between six to ten cycles. Until that time (estimated to take 7 to 13 months), water from the UG would continue to be captured and treated. The readily soluble minerals on mine surfaces would be removed by rinsing and when the mechanism for ARD (sulfide oxidation) is shut down by flooding and reducing oxygen exposure, thus minimal loads would be generated. Groundwater from the underground workings would not be treated after the final closure (i.e., once nondegradation criteria are met).

A summary of the Project's impact on surface water quality based on severity and likelihood ratings is presented in **Table 3.5-11**.

Smith River Assessment

Smith River is located approximately 19 river miles downstream of the Project and is the receiving water for Sheep Creek.

As discussed in the previous section, potential Project impacts on Sheep Creek and Coon Creek water quality would be minimal and associated with treated water discharged to the Sheep Creek alluvial UIG. Water released to the UIG is expected to mix with groundwater and discharge to Sheep Creek and potentially Coon Creek, which discharges into Sheep Creek. Therefore Sheep Creek provides the only pathway of interaction for Project-related discharges to the Smith River. Big Butte Creek discharges to Sheep Creek downstream of SW-1 but is not anticipated to receive contact water from the Project. Several other tributaries merge with Sheep Creek downstream from the Project site before its confluence with the Smith River (e.g., Moose Creek, Indian Creek, Cameron Creek, and Calf Creek). As adverse impacts on Sheep Creek water quality due to the Proposed Action are not predicted, no measurable impacts on Smith River are anticipated.

The Smith River is included in DEQ’s 303(d) list of impaired streams for temperature, total phosphorus, *E. coli*, substrate alterations, flow, and stream-side littoral vegetative cover. Agriculture and rangeland grazing are listed as potential sources for those constituents. Nuisance algae growth has been observed in the Smith River, which may be exacerbated by dynamic nutrient concentrations (total nitrogen and phosphorous).

In addition to the aluminum and *E. coli* impairments occurring in Sheep Creek and aluminum impairments in Moose Creek (see Section 3.5.2.2), other tributaries to the Smith River are included in DEQ’s 303(d) list of impaired streams. These include Beaver Creek (chlorophyll-a, total nitrogen, total phosphorous, sedimentation), Benton Gulch (*E. coli)*, Camas Creek (*E. coli*), Elk Creek (total nitrogen), Hound Creek (chlorophyll-a, total nitrogen), Newlan Creek (*E. coli*, sedimentation), and Thompson Gulch (total nitrogen, sedimentation). The agricultural activities, rangeland grazing, grazing in riparian or shoreline zones, and irrigated crop production that impact surface water quality in the Smith River watershed are not associated with the Project and are likely to continue in the future.

Agency Modified Alternative

The intent of the AMA is to backfill all zones of the underground mine workings that contain significant sulfide mineralization. This plan also serves to increase the underground placement of cemented paste tailings. As such, the AMA proposes to backfill more of the USZ underground workings at closure, including 11,352 feet in the primary and secondary access drifts; 361 feet in the main access decline; and 2,526 feet of stopes in the USZ that were previously not planned to be backfilled. In the LSZ, an additional 1,148 feet of previously unfilled stopes and 4,446 feet of main access decline are proposed to be backfilled (Zeig et al. 2018).

Table 3.5-11
Project's Potential Consequences Regarding Surface Water Quality

Project Activities	Project Facilities	Notes
Mine Construction (Phases I and II; Project Years 1-4)	Underground mine facilities (UG)	Collected water treated by RO to meet nondegradation standards
	Waste rock storage (WRS)	Collected water treated by RO to meet nondegradation standards
	Process water pond (PWP)	Collected water treated by RO to meet nondegradation standards
	Cemented Tailings Facility (CTF)	Collected water treated by RO to meet nondegradation standards
	Contact water pond (CWP)	Collected water treated by RO to meet nondegradation standards
	Treated water storage pond (TWSP)	If the total nitrogen concentration is greater than the effluent limit, the treated water will be discharged to the TWSP from July 1st to September 30th
	Underground infiltration gallery (UIG)	Collected water treated by RO to meet nondegradation standards
Mine Production (Phase III; Project Years 5 - 15)	Underground mine facilities (UG)	Collected water treated by RO to meet nondegradation standards
	Waste rock storage (WRS)	Collected water treated by RO to meet nondegradation standards
	Process water pond (PWP)	Collected water treated by RO to meet nondegradation standards
	Cemented tailings facility (CTF)	Collected water treated by RO to meet nondegradation standards
	Contact water pond (CWP)	Collected water treated by RO to meet nondegradation standards
	Treated water storage pond (TWSP)	If the total nitrogen concentration is greater than the effluent limit, the treated water will be discharged to the TWSP from July 1st to September 30th
	Underground infiltration gallery (UIG)	Collected water treated by RO to meet nondegradation standards
Post-Mine Period (Mine Closure; Phase IV)	Underground mine facilities (UG)	Collected water treated by RO to meet nondegradation standards
	Waste rock storage (WRS)	Collected water treated by RO to meet nondegradation standards
	Process water pond (PWP)	Collected water treated by RO to meet nondegradation standards
	Cemented tailings facility (CTF)	Collected water treated by RO to meet nondegradation standards
	Contact water pond (CWP)	Collected water treated by RO to meet nondegradation standards
	Treated water storage pond (TWSP)	If the total nitrogen concentration is greater than the effluent limit, the treated water will be discharged to the TWSP from July 1st to September 30th
	Underground infiltration gallery (UIG)	Collected water treated by RO to meet nondegradation standards

Project Activities	Project Facilities	Notes
Post-Mine Period (Post-Closure; Phase V)	Underground mine facilities (UG)	Flooded underground with section of ramp exposed above water table. Thallium exceeds the Montana Numeric Water Quality Standards.
	Waste rock storage (WRS)	Decommissioned
	Process water pond (PWP)	Decommissioned
	Cemented tailings facility (CTF)	Decommissioned
	Contact water pond (CWP)	Decommissioned
	Underground infiltration gallery (UIG)	No water treatment, no discharge to UIGs

The Proposed Action represents a greater increase in dissolved constituents than the AMA, but still falls within range of results reported for the original sensitivity analyses. The reactive surface area of the UG in the AMA (169,887 square feet) is approximately 30 percent less than the 240,606 square feet of reactive surface area for the Proposed Action, and would have lower potential for solute release. This suggests that the adoption of the AMA would improve water quality as a result of the reduced area of the UG that is in contact with water. Furthermore, backfilling the open mining stopes would potentially improve the geotechnical stability of the walls, which could otherwise crumble over time and expose additional reactive surface area (Zeig et al. 2018).

Smith River Assessment

The impacts of the AMA on water quality in the Smith River would be similar to that described for the Proposed Action Alternative. As described previously based on the Proposed Action description, impacts on surface water quality in Sheep Creek are expected to be negligible to minor, and therefore potential impacts on water quality in the Smith River would be negligible.

3.6. Geology and Geochemistry

Geology is the primary framework for this environmental assessment, influencing the location of mineralization, proposed mining methods, environmental geochemistry, and contributions of constituents to water. Together, hydrology, geology, and mineralogy determine the potential impact of mining on water resources.

3.6.1. Analysis Methods

The geochemical analysis area encompasses the underground zones from which ore and waste rock would be mined and the surface locations on which waste rock or tailings would be placed. Much of the analysis and description of the geology of the proposed mine and tailings impoundment areas presented in this section is based on the 2017 Project MOP Application (Tintina 2017) submitted to DEQ. Elements of the geology that directly affect environmental geochemistry are emphasized within this description.

The following sections summarize the baseline information collected on environmental geochemistry and geology, the approaches used by DEQ in analyzing potential impacts, and the environmental consequences of the proposed Project.

3.6.2. Affected Environment

3.6.2.1. Geology

Resource Modeling, Inc. summarized the geologic setting, deposit types, and mineralization in the Project area (Resource Modeling, Inc. 2010). The following subsections contain a modified summary, with the addition of more recent information. **Figure 3.6-1** shows a geologic map of the Project area, **Figure 3.6-2** includes a stratigraphic section, and **Figure 3.6-3** shows a geologic cross-section through the Project area. Topography in the Project area is from the USGS website: viewer.nationalmap.gov; 2011 Strawberry Butte 7.5 Minute Quadrangle.

Regional Geologic Setting

The copper deposits of the Project area (i.e., MOP Application Boundary) occur in middle Proterozoic (approximately 1.4 billion years old) sedimentary rocks of the Belt Supergroup (Zieg and Leitch 1993). During subsidence and filling of the Belt sedimentary basin, a deep water calcareous shale facies (Newland Formation) was deposited in the Helena embayment, a trough-like seaway that extended eastward into the craton through central Montana (Godlewski and Zieg 1984). The northern depositional boundary of the deeper water sediments of the Helena embayment lay along the present-day southern flank of the Little Belt Mountains, north of White Sulphur Springs, Montana (**Figure 1.3-1**). During the Cretaceous Laramide orogeny (approximately 65 million years ago), renewed thrust faulting along the ancestral northern margin of the Helena embayment formed the VVF (Winston 1986). Tertiary igneous rocks intrude Paleozoic rocks and Belt Supergroup rocks in the region. Tertiary sedimentary rocks have also been identified. The Black Butte copper deposits lay along the northern margin of the Helena embayment, and along the reactivated VVF zone (**Figure 3.6-1**).

Local Geologic Setting

The Newland Formation shale hosts the Black Butte copper deposits (**Figure 3.6-2**). Its evenly laminated shale formed from deposition of microturbidites (small-scale turbidity or density flow deposits) in a subwave base[1] depositional setting. Debris flow conglomerates occur in the sedimentary section (Resource Modeling, Inc. 2010) and record larger mass wasting events from a shallow water shelf in the Newland Formation along the northern margin of the embayment. Alluvial deposits lie beneath the modern stream channels and along the axis of larger drainages. The deposits rest on the thick sequence of dolomitic and silicic shales of the Proterozoic Newland Formation that dip gently to the southeast. The above-described prominent east-west-trending, southerly dipping low-angle VVF forms a northern boundary to Newland Formation exposures within the Project area (**Figure 3.6-1**). Paleozoic (Middle Cambrian) Flathead sandstone (**Figure 3.6-2**) outcrops at the surface on the north side of the VVF. The sandstone lays nonconformably over Proterozoic Newland Formation, Chamberlain Formation shales, Neihart Formation quartzite, and Precambrian crystalline basement rock (**Figure 3.6-3**).

The Newland Formation may be separated into upper (Ynu) and lower (Ynl) subunits (**Figure 3.6-2**) in the immediate deposit areas (north of the BBF). In addition, the lower Newland is further informally separated into Ynl A and Ynl B subunits (**Figure 3.6-2**) relative to their location above and below the USZ, respectively. The Ynl A and Ynl B units are largely used in the MOP Application (Tintina 2017) and its associated baseline studies to define portions of the geologic section based on geochemical subunits (see Section 2.4.2 of the MOP Application, **Table 3.6-1,** and **Figure 3.4-4**) and hydro-stratigraphic subunits (see Section 4.1.2 of the MOP Application, **Figure 3.4-5,** and **Figure 3.6-4**). The use of these units is a matter of convenience for topical studies, designed to be used only in the vicinity of the Johnny Lee Deposit zones, and is not intended to have any larger, regional-scale geologic significance. The Ynl B consists of interbedded dolomitic shale and shale-clast conglomerate and lies beneath the USZ, which consists of stratabound bedded pyrite and contains the UCZ. Undifferentiated dolomitic shale and shaley dolomites of the upper part of the Lower Newland Formation (Ynl A) overlie the USZ.

A separate northeast verging segment of the VVF called the BBF lies south of the Johnny Lee Deposit copper deposit (**Figure 3.6-1**). The area between the BBF and the VVF contains all the known copper resources within the Project area. Tertiary igneous rocks intrude the lower part of the Newland Formation mostly south of the BBF but have not been identified in the deposit areas.

The Buttress Fault likely has a Proterozoic age and carries both the Chamberlain and Newland Formation shales downward against Precambrian crystalline basement rocks (gneiss) on its south side and Neihart Formation quartzite on its north side (**Figure 3.6-3**). The VVF truncates the Buttress Fault, and Cambrian sedimentary rocks (e.g. Flathead sandstone and Wolsey Formation) cover it to the north such that it has no surface expression (**Figure 3.6-1**).

[1] Subwave base refers to below the wave base (i.e., the maximum depth at which a water wave's passage causes significant water motion. For water depths deeper than the wave base, bottom sediments and the seafloor are no longer stirred by the wave motion above).

Mineralization

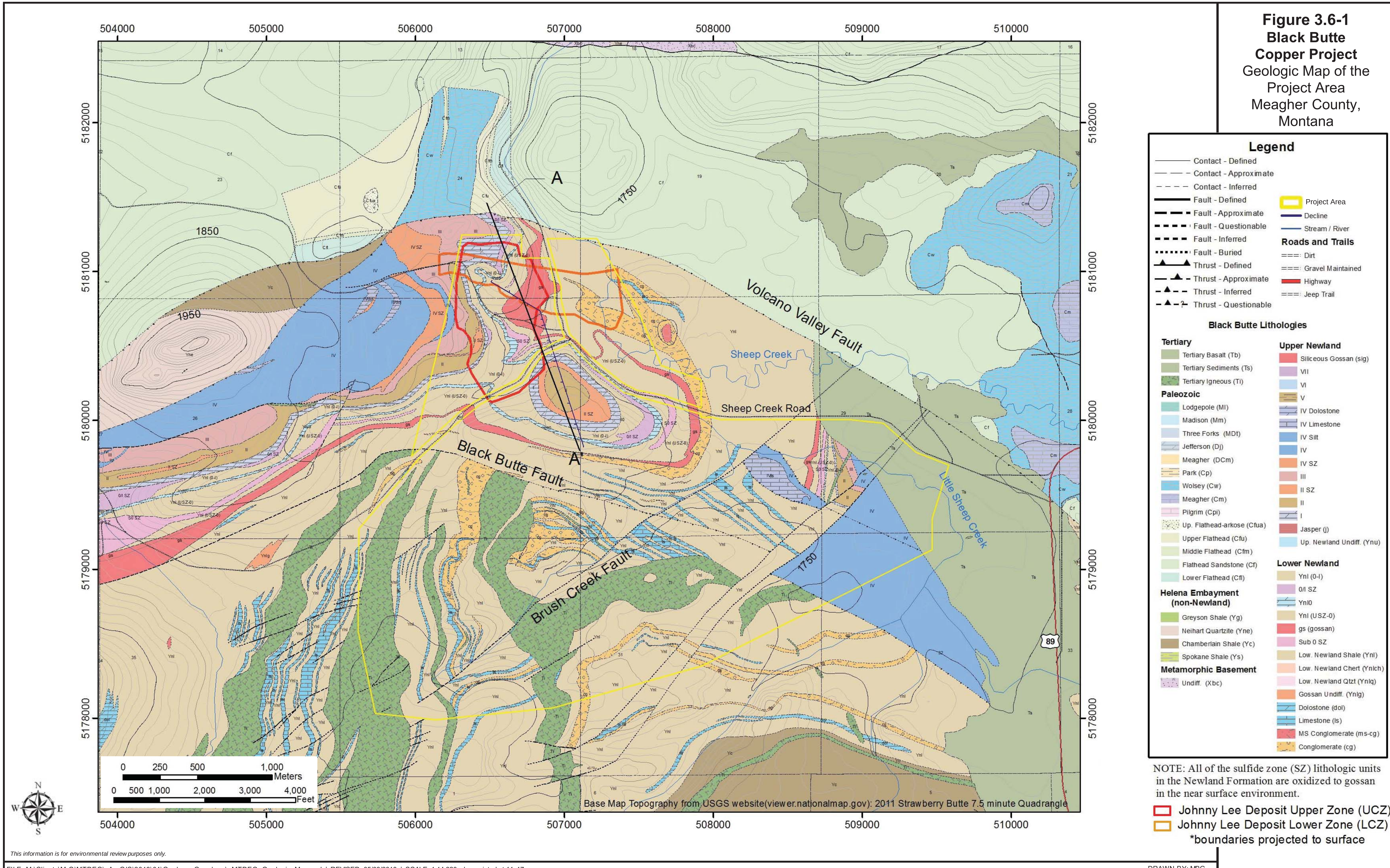
Geologists classify the Johnny Lee Deposit as a sediment-hosted deposit. Bedded pyrite shows higher concentrations in several discrete, semi-continuous, and laterally-extensive stratigraphic horizons or sulfide zones (**Figure 3.6-2**) that locally contain copper enrichments. The sulfide zones exposed in the near-surface environment as shown in **Figure 3.6-1** are typically altered to gossan (due to intense oxidation and leaching of former sulfide minerals) consisting of iron-oxide rich (i.e., goethite) and/or quartz minerals.

The Johnny Lee Deposit consists of two stratabound lenses of mineralization: a UCZ and LCZ, contained respectively within the upper and lower sulfide zones of the lower Newland Formation (**Figure 3.6-2** and **Figure 3.6-3**). The UCZ lies at a depth of approximately 90 to 625 feet bgs and occurs within shale and dolostone of the upper part of the lower Newland. The southward dipping VVF cuts through the entire Newland Formation. A thin slab of the lower Newland Formation lies below the VVF and contains the LCZ, which is at a depth of approximately 985 to 1,640 feet bgs (**Figure 3.6-3**). The LCZ and enclosed lower part of the Newland Formation shale lie on the Chamberlain Formation.

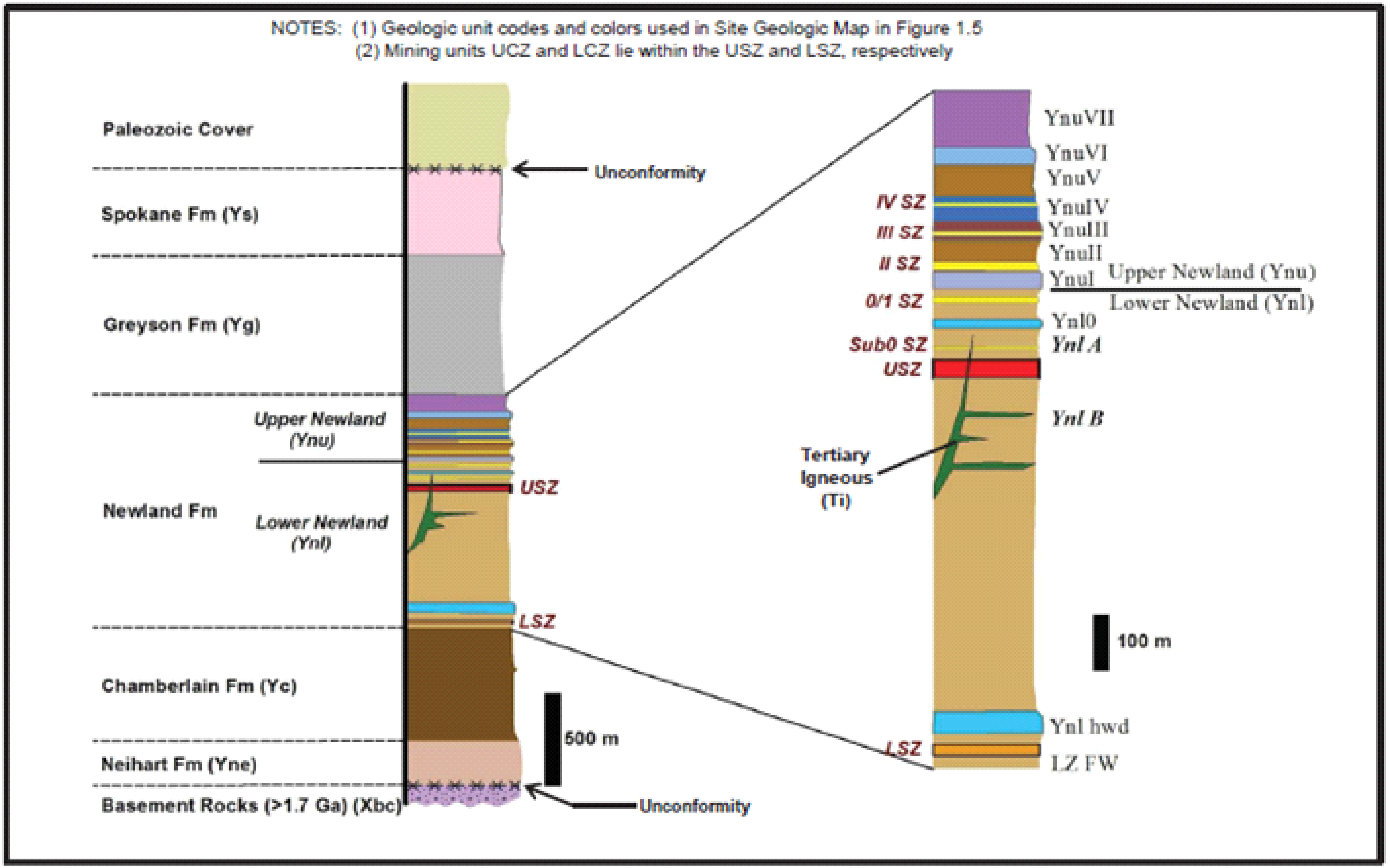
Johnny Lee Deposit Upper Sulfide Zone

The Johnny Lee Deposit USZ consists of a lens of fine-grained bedded pyrite (FeS_2) as thick as 285 feet, and containing two or three chalcopyrite-bearing ($CuFeS_2$) horizons all capped by a barite ($BaSO_4$)-rich pyritic stratigraphy. Himes and Petersen (1990) describe microscopic textures and various sulfide minerals (primarily from copper-enriched horizons) and Graham et al. (2012) and White et al. (2013) have completed more recent work. Pyrite occurs as laminations and beds of very fine-grained pyrite, as micro-crystals, and spheroidal aggregates (1 to 25 microns in diameter). Pyrite and rarely marcasite aggregates contain rims, patches, and sometimes interior cores of chalcopyrite and tennantite ($Cu_{12}As_4S_{13}$), and in many cases amorphous copper (Cu), cobalt (Co), nickel (Ni), and arsenic (As)-rich material. Chalcopyrite occurs as coarser grained veinlets and clots, in parallel bedded layers and bands, in quartz veinlets, and in barite veins and masses.

While local silicification occurs within the USZ, most of the copper mineralization occurs within unsilicified bedded pyrite. The USZ reaches its greatest thicknesses in the south-central portion of the Johnny Lee Deposit. Strontium-rich minerals celestine ($SrSO_4$) and strontianite ($SrCO_3$) occur in some places toward the base of the USZ and below the copper-enriched horizons. Barite concentrations cap the copper zone, and include a sulfide-free shale horizon called the “barite marker horizon.”



Source: Tintina 2017



Abbreviations: Fm = Formation; FW = Footwall; hwd = hanging wall dolomite; SZ = Sulfide Zone; LZFW = Lower Zone Footwall
Other geologic units not listed on this straigraphic section but that are included in Figure 1.5 site geologic map include:
Ts (Tertiary sediments) and Paleozoic cover units (Cw = Wolsey Formation; Cf = Flathead Sandstone;
cg = conglomerate interbeds in Ynu and Ynl; and ls = limestone interbeds in the Ynu and Ynl.
The Ynl unit is divided into tye Ynl A and the Ynl B subunits relative to the location above or below the USZ, respectively.

Figure 3.6-2
Black Butte Copper Project
Stratigraphic Section
Meagher County, Montana

This information is for environmental review purposes only.

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Source: Tintina 2017

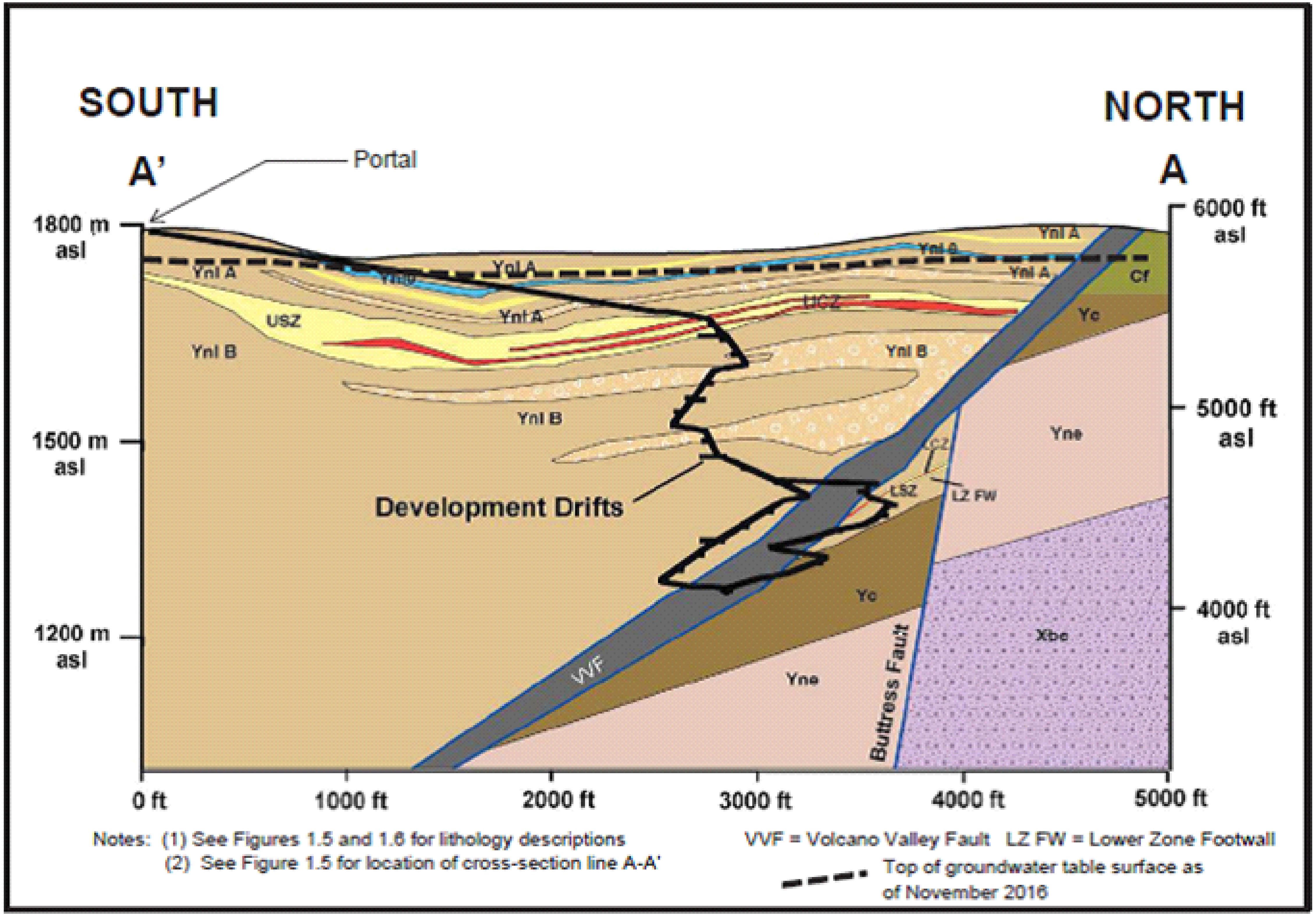

Figure 3.6-3
Black Butte Copper Project
Generalized Geologic Cross-Section A-A' with Ore Deposits and Ramp Access
Meagher County, Montana

This information is for environmental review purposes only.

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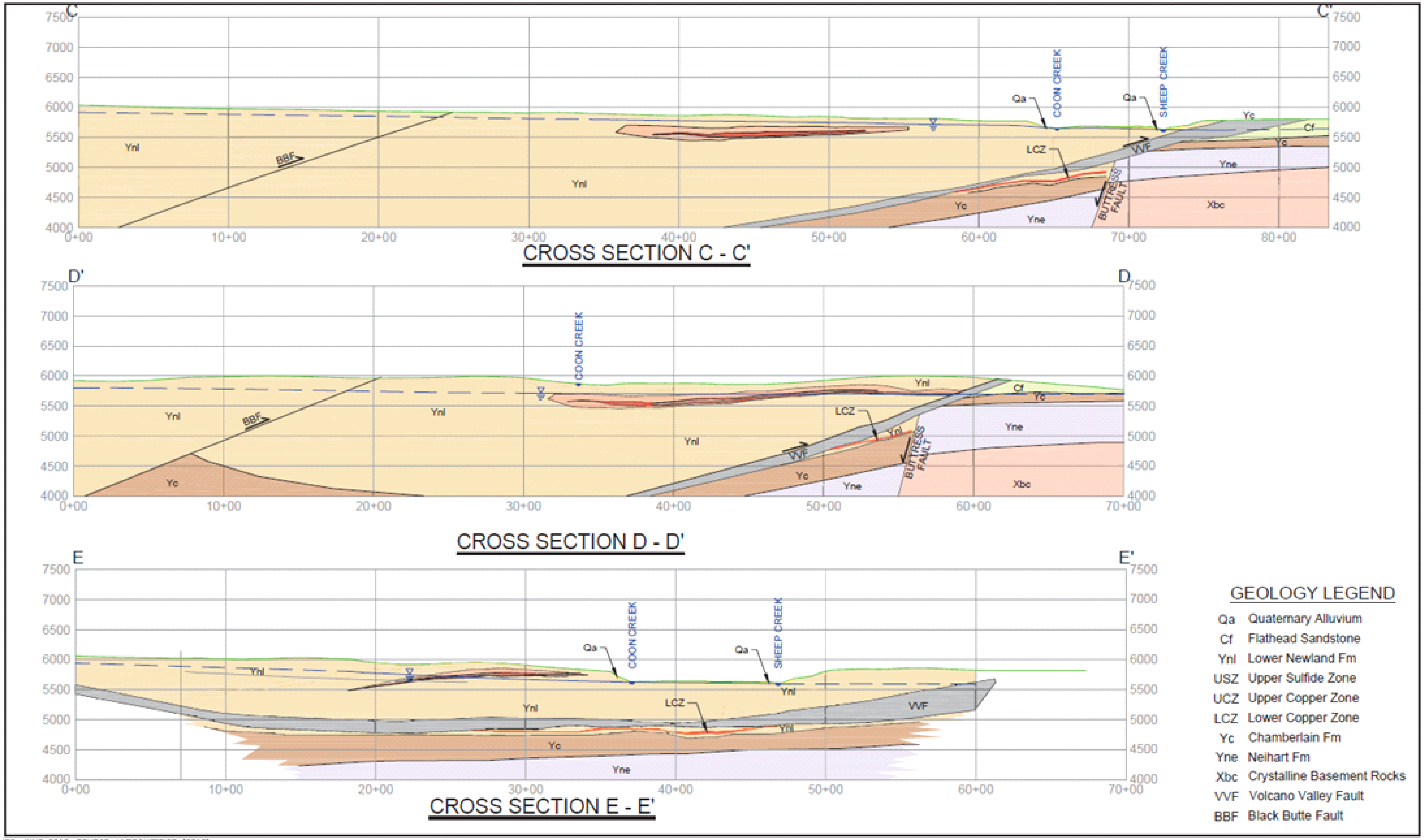
Source: Tintina 2017

Figure 3.6-4
Black Butte Copper Project
Schematic Cross-Sections
Meagher County, Montana



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Source: Tintina 2017

Johnny Lee Deposit Lower Sulfide Zone

The Johnny Lee Deposit LSZ lies in the footwall (below) of the southward-dipping VVF (**Figure 3.6-2**). The LSZ mineralization consists of pyrite and rare marcasite, with high concentrations of chalcopyrite and local occurrences of siegenite ($[Ni,Co]_3S_4$) and cobaltite (CoAsS). The LSZ contains no identifiable barite or strontium-rich minerals. Coarse-grained dolomite alteration is abundant on the margins and above the pyritic zone. Silicification also overprints much of the Cu-mineralized area. A silicified debris flow conglomerate underlies the LSZ with disseminated chalcopyrite, and chalcopyrite also occurs in quartz veinlets. Most sulfide textures show replacement of both preexisting dolomite alteration and of earlier generations of sulfide mineralization. Some pyrite is bedded, even at the base of the LSZ.

The VVF dips more steeply south than the underlying LSZ and truncates the zone (**Figure 3.6-3**) to form its south boundary. The Buttress Fault truncates the LSZ on the north. Because of fault truncations on its north and south, the LSZ retains little evidence of its presumably broader scale mineralogical zoning patterns.

Copper Deposit Geometry

The Johnny Lee Deposit UCZ constitutes 78 percent of the total tonnage of the Johnny Lee Deposit copper resource. The UCZ measures 3,280 feet in a north-south direction and approximately 2,165 feet in an east-west direction (**Figure 3.6-2**), and ranges in depth from 90 to 590 feet from the surface. The UCZ is a flat, tabular deposit that ranges in thickness from 10 to 85 feet. The deposit varies in dip from 0 degrees to 20 degrees to the west. In some areas, the mineralized zone consists of a single lens. In other areas, it consists of two sub-parallel lenses separated by 6 to 53 feet of lower grade material.

The LCZ constitutes 22 percent of the total tonnage of the Johnny Lee Deposit copper resource. It measures approximately 3,300 feet from west to east, and ranges from 160 to 660 feet from north to south (**Figure 3.6-2**). The LCZ dip varies from 20 degrees to 37 degrees to the south and ranges in depth from 985 to 1,640 feet from surface. The mineralized zones range in thickness from 8 to 57 feet.

Mineral Resources

Figure 3.6-2 and cross-section **Figure 3.6-3** illustrate the location of both the UCZ and the LCZ in the Johnny Lee Deposit. Mineral resources were recalculated in 2013 using data collected between 2010 and 2012, including drill hole logs, geologic correlations, and assays to create a block model of the deposit zones (Tetra Tech, 2013). See Table 1-2 of the MOP Application (Tintina 2017) for a summary of the measured and indicated copper resources of the Johnny Lee Deposit.

3.6.2.2. Environmental Geochemistry

Geochemical Assessment Methods and Criteria

The acid generation and metal release potential of waste rock, construction rock, and tailings to be produced by the Project have been characterized using static (acid-base accounting [ABA], multi-element analysis, net acid generation [NAG], and static leach tests) and kinetic methods. Mineralogical analyses of metal residence and asbestiform mineral analyses were also completed. Results of all geochemical tests reported in Appendix D of the MOP Application are summarized below. **Table 3.6-1** summarizes the number of tests completed by method, rock type, and tonnage for waste rock. **Table 3.6-2** provides a summary for tailings testing. These test methods are described and their results are also provided in detail in Appendix D (Enviromin 2017a) of the MOP Application (Tintina 2017) and are summarized below.

Table 3.6-1
Geochemical Testing of Major Waste Rock and Near-surface Materials by Lithotype

Material Type	Lithotypes	Description	Waste Rock % Tonnage	ICP	ABA/ NAG	SPLP	Mineralogy	Asbestos	HCT
Waste Rock Materials	LZ FW	Silicified shale and debris flow	35	550	15	0	0	1	1
	Ynl B	Lower Newland shale and conglomerates	32	1,412	34	2	1	2	2
	USZ	Lower Newland upper sulfide zone	28	2,542	41	2	1	2	2
	Ynl A	Undifferentiated Lower Newland	4	1,138	48	2	1	2	1
	Total Dominant Waste Rock Samples[a]		99	5,642	138	6	3	7	6
	Additional Waste Rock Samples[b]		<1	1,855	37	3	1	4	2
	All Waste Rock Samples[c]		100	7,497	175	9	4	11	8
Near-Surface Materials	Ynl Ex	Near-Surface Lower Newland shale	<1	108	10	—	—	1	1
	Tgd	Tertiary Granodiorite	<1	76	8	—	—	1	1
	Total Excavation Tonnage		NA	184	18	—	—	2	2

Source: Tintina 2017

ABA = acid-base accounting; HCT = Humidity Cell Test; ICP = inductively coupled plasma; LZ FW = lower sulfide zone footwall; NAG = net acid generation; SPLP = synthetic precipitation leachability procedure; Tgd = tertiary sill-form granodiorite intrusive rocks; USZ = upper sulfide zone; Ynl A= Lower Newland Formation subunit above the USZ; Ynl B = Lower Newland Formation subunit below the USZ; Ynl Ex = bedrock zones of the Lower Newland Formation
Notes:

[a] Total waste rock tonnage over the life of the mine equals 706,525 tonnes (778,810 tons). A total of 7,497 ICP analyses of waste rock were evaluated.
[b] Four waste rock types would be mined above 1 percent of total tonnage; 5,642 ICP analyses were evaluated for these units.
[c] Additional waste rock unites were characterized representing less than 1 percent of tonnage; 1,855 samples were evaluated for these units. All geochemical test results are presented in Appendices D and D-1 (Enviromin 2017a and 2017b).

Table 3.6-2
Black Butte Copper Project Tailings Treatments and Related Testing

Tailing Test Table	ABA	NAG	ICP Metals	Saturated HCT	Unsaturated HCT	Diffusion Test
Raw Tailings	X	X	X	X	X	—
Paste Tailings 2%	X	X	X	—	X[a]	—[b]
Paste Tailings 4%	X	X	X	—	X[a]	X
Paste Tailings 4% and Waste Rock	—	—	—	—	X[a]	X

Source: Tintina 2017

ABA = acid-base accounting; HCT = Humidity Cell Test; ICP = inductively coupled plasma; NAG = net acid generation
Notes:
[a] Unsaturated HCTs conducted on intact cement paste cylinders
[b] an attempted test of 2 percent cemented paste tailings could not be completed.

Waste Rock Geochemistry

Static Testing of Waste Rock

The metal contents of whole rock samples were quantified through four-acid digestions followed by inductively coupled plasma (ICP) atomic emission spectroscopy multi-element analyses (method ME- MS61). A total of 5,642 samples of the four dominant waste rock types were statistically analyzed to characterize overall geochemical variability within individual units and to identify representative sample subsets for static testing, as detailed in Appendix D (Enviromin 2017a) of the MOP Application (Tintina 2017).

To evaluate acid generation potential, ABA, and NAG analyses were completed on 138 samples of the four dominant waste rock types and 37 samples of additional waste rock types, for a total of 175 samples. Comparison of neutralization potential (NP) and acid potential (AP) and NAG testing (Figure 2.11 of the MOP Application, Tintina 2017) indicate that the majority of Ynl B and Ynl A samples (90 percent) are unlikely to form acid, while many USZ and LZ FW samples have an uncertain potential or are likely to generate acid. A direct comparison of NP and AP in Figure 2.12 of the MOP Application (Tintina 2017) shows a similar relationship.

Static tests of metal mobility were completed for composites of the 2012 Ynl B, Ynl A, and USZ rock units using EPA Method 1312, the synthetic precipitation leaching procedure. Because these tests show elevated pH values (> pH 9.5, a result of carbonate mineralization reacting with acids used in the test), these results were considered an unrealistic prediction of pH-sensitive metal concentrations. While they are presented and discussed in Appendix A of the revised

Baseline Environmental Geochemistry Evaluation of Waste Rock and Tailings report, which is included as Appendix D (Enviromin 2017a) of the MOP Application (Tintina 2017), they are not discussed further here. All estimates of metal mobility for this project rely on kinetic data from humidity cell tests.

Although asbestiform minerals are highly unlikely to occur in the rock units in the Project area, asbestiform mineral testing was included in the characterization work completed for all waste rock units. No asbestiform minerals were identified in any lithotype, and Appendix D (Enviromin 2017a) of the MOP Application (Tintina 2017) provides detailed methods and results for these tests.

Kinetic Testing of Waste Rock

Kinetic tests of waste rock acid generation and metal release potential were conducted following ASTM International (ASTM) method D5744 for HCTs. This test exposes samples to alternating dry and humidified air, followed by weekly flushing to remove oxidation products. Parameters like pH, alkalinity, acidity, dissolved iron, and sulfate were measured weekly as indications of sulfide oxidation and acid generation potential. All waste rock kinetic tests were conducted on composites of subsamples from the individual lithologies, determined by a statistical analysis of static test results.

Kinetic test results for waste rock are discussed in greater detail in Appendix D (Enviromin 2017a) of the MOP Application (Tintina 2017) and are summarized as follows. Kinetic testing has shown evidence of sulfide oxidation in the four dominant waste rock units. However, consistent with the static test results and the presence of abundant carbonate mineralization, acid generation in waste rock HCTs was limited. Furthermore, metal release from waste rock HCTs was varied. The Ynl A and Ynl B released relatively low concentrations of a few metals (with nickel and thallium exceeding groundwater standards in the initial weeks of testing). In contrast, the USZ released strontium and thallium at concentrations exceeding groundwater standards throughout the test, with additional metals (notably copper, lead, and nickel) exceeding groundwater standards after the pH dropped in week 60. The LZ FW released a different suite of metals, with nickel exceeding groundwater standards in the early weeks of testing, and uranium and arsenic exceeding standards throughout the test.

Total Organic Carbon Analysis

The total organic carbon (TOC) content of several waste rock composites from the Johnny Lee Deposit were analyzed to support observations of organic carbon made in hand specimen, as seen in Appendix N-2 (Enviromin 2017d) of the MOP Application (Tintina 2017). Appendix N (Enviromin 2017c) of the MOP Application (Tintina 2017) identifies organic carbon as one of three possible oxygen sinks from infiltrating groundwater, which is likely consumed via (1) aerobic microbial metabolism, (2) oxidation of sulfide minerals, and (3) reaction with available organic carbon. Further, *in situ* measurements of dissolved oxygen in site groundwater support its depletion with depth. See Appendix B (Hydrometrics, Inc. 2015) of the MOP Application (Tintina 2017).

Results of Laboratory Equipment Corporation (LECO) analyses of TOC in waste rock (Price 2009) are compared with values from published literature (Lyons et al. 2000) in **Table 3.6-3**. The results reported by Lyons et al. (2000) are comparable to the values measured in the Project composites and support the hand specimen observations of organic carbon in these sediments.

Table 3.6-3
Total Organic Carbon Content of Waste Rock Composite Samples

Sample ID	TOC (weight %)
2012 Ynl A	0.81
2015 USZ	0.41
2015 Ynl B	0.50
2015 LZ FW	0.39
2016 Ynl Ex	0.30
Lyons et al. 2000[a]	0.13-3.39

Source: Tintina 2017

LZ FW = lower sulfide zone footwall; TOC = total organic compound; USZ = upper sulfide zone; Ynl A= Lower Newland Formation subunit above the USZ; Ynl B = Lower Newland Formation subunit below the USZ; Ynl Ex = bedrock zones of the Lower Newland Formation.
Notes:
[a] Range of values for samples collected at the Project site, averaging 1.3 percent as reported by Lyons et al. (2000).

Tailings Geochemistry

Static Testing of Tailings

Splits of homogenized tailings reject produced in bench-scale metallurgical testing were used for all tests. While there is some variation in AP and NP between subsamples (Table 2-23 of the MOP Application, Tintina 2017), ABA and NAG tests indicate that the tailings would have a strong potential to generate acid regardless of cement addition (Table 2-23 of the MOP Application, Tintina 2017). The NP resulting from the addition of 2 percent to 4 percent cement is not sufficient to neutralize the sulfide in the tailings; however, this was not the intent of cement addition. The addition of cement is considered to provide structural strength in support of drift and fill mining methods underground, and to change the physical properties of the material to a stable, non-flowable material with low hydraulic conductivities on the order of 10^{-9} meters per second in both surface and underground settings (see Appendix A of this EIS).

Kinetic Testing of Tailings

Kinetic tests of raw, non-amended tailings and cemented paste tailings were completed. **Table 3.6-4** summarizes the tailings characteristics, testing methods and conditions, and the various operational scenarios represented by each kinetic test. Cemented paste tailings cylinders were tested (without crushing) in conventional ASTM method D5744 HCTs to simulate subaerial weathering. They were also tested using ASTM C1308 diffusion tests to simulate diffusion through backfill in saturated underground workings. The ASTM C1308 diffusion test involves the submergence of paste tailings cylinders (height:diameter ratio of 2:1) in 14 sequential deionized water baths over a period of 11 days. The test is designed to predict sulfide reactivity and solute release as a result of diffusion. Raw, non-amended tailings were also tested using ASTM method D5744, both sub-aerially and in a modified, saturated test, to represent dry stack surface placement and subaqueous impoundment deposition scenarios, respectively.

Table 3.6-4
Tailings Characteristics, Kinetic Test Methods, and Facility Scenarios

Action Scenarios	Facility Represented	Tailings Characteristics	Test Method
Proposed	Backfilled Paste in flooded workings	4% binder	ASTM C1308 diffusion test
	Cement paste in CTF, subaerial weathering, routine operations	2% binder	ASTM method D5744 (HCT)
	Cement paste in CTF, subaerial weathering, final closure lift	4% binder	ASTM method D5744 (HCT)
Alternative	Saturated tailing, e.g., subaqueous impoundment	Raw	Modified ASTM method D5744 (saturated HCT)
	Subaerial weathering, e.g., dry stack tailing pile	Raw	ASTM method D5744 (HCT)
Additional[a]	Cement paste in CTF, subaerial weathering	4% co-disposed with waste rock	ASTM method D5744 (HCT)
	Backfilled Paste in flooded workings	4% co-disposed with waste rock	ASTM C1308 diffusion test

Source: Tintina 2017

ASTM = ASTM International; CTF = Cemented Tailings Facility; HCT = Humidity Cell Test
Notes:
[a] Geochemical testing of paste tailings mixed with ROM was conducted to evaluate previously considered scenarios that are no longer pertinent to Tintina's operational plans. See Appendix D (Enviromin 2017a) of the MOP Application (Tintina 2017) for data.

Kinetic test results for the tailings are discussed in greater detail in Appendix D (Enviromin 2017a) of the MOP Application (Tintina 2017) and are summarized as follows. The HCTs indicate that all of the cemented paste tailings samples had potential to oxidize and to release at least some sulfate, acidity, and metals if left exposed to air and water. Importantly, this was not observed immediately in test cells, and the rate of weathering in a humidity cell is recognized to be significantly greater than in the field. Increasing surface area and exposure to air/water drives the sample reactivity. The cement provides structural stability but does not completely neutralize sulfide oxidation.

Near-Surface Materials Geochemistry

Figure 2.17 of the MOP Application (Tintina 2017) shows locations where the Ynl Ex and Tgd near-surface deposits (less than 65 feet depth) have been sampled extensively by geotechnical drilling and soil test pits, providing a population of samples that is representative of the shallow bedrock materials that would be excavated or disturbed by near surface facilities. **Figure 3.6-5** illustrates the proposed construction footprint for the mine facilities of interest along with these same drill holes and test pits. The final selection of samples for composite geochemical testing of Ynl Ex and Tgd is described in Appendix D-1 (Enviromin 2017b) of the MOP Application (Tintina 2017). Geochemical data described below indicate that these highly fractured rocks in the near-surface weathering zone were leached by infiltrating meteoric water, with resulting depletion of sulfide and metals.

A statistical review of select multi-element data as a function of depth was used to determine whether Ynl Ex and Tgd, were comparable to deeper Ynl B and Igneous Dike (IG) test units, respectively. Summary statistics, based on 10 elements from multi-element analyses, were used to test these relationships. Examples of these comparisons are presented in Figure 2.19 of the MOP Application (Tintina 2017). Results and summary statistics are included in Appendix D-1 (Enviromin 2017b) of the MOP Application (Tintina 2017).

Comparisons of the geochemistry as a function of depth demonstrate that weathered surface materials are relatively depleted in metals and sulfur, and are therefore distinct from the deeper materials. This is consistent with observations made while drilling, that the rocks are highly fractured with iron-oxide stained fractures (Knight Piésold Consulting 2017b). The near-surface deposits of Ynl Ex and Tgd are geochemically distinct from the deeper bedrock material; hence, they were tested independently to evaluate acid generation and metal release potential.

The near-surface bedrock excavated materials (Ynl Ex and Tgd) have been characterized using static (ABA, multi-element analysis, and NAG tests) and kinetic methods. Figure 2.20 through Figure 2.22 of the MOP application (Tintina 2017) summarize test results. Like the other rock types, composites of Tgd and Ynl Ex were tested for asbestiform minerals but none were identified. Kinetic tests were conducted as reported in Appendix D-1 (Enviromin 2017b) of the MOP Application (Tintina 2017).

Information provided by static test results and kinetic testing—full details provided in Appendix D (Enviromin 2017a) of the MOP Application (Tintina 2017)—suggests that it is unlikely that either the Ynl Ex or Tgd material would produce acid or release elevated concentrations of metals. Static tests were confirmed by kinetic testing, and metal release was very low. As demonstrated in the MOP Application (Figure 2.23 and Figure 2.24, Tintina 2017), effluent from these HCTs met Montana groundwater quality standards in all weeks. These effluents also met surface water quality standards, except for selenium exceedances in weeks 0 through 4 in Ynl Ex. No metals were detected above surface water quality standards for the Tgd. Mineralogical analyses of asbestiform mineral content were also completed and no asbestiform minerals were identified.

3.6.3. Environmental Consequences

The predicted environmental impacts of rock geochemistry are discussed in water resources sections. The text below describes how mine materials are proposed to be mined, processed, and managed as a consequence of the localized geology and geochemical test results.

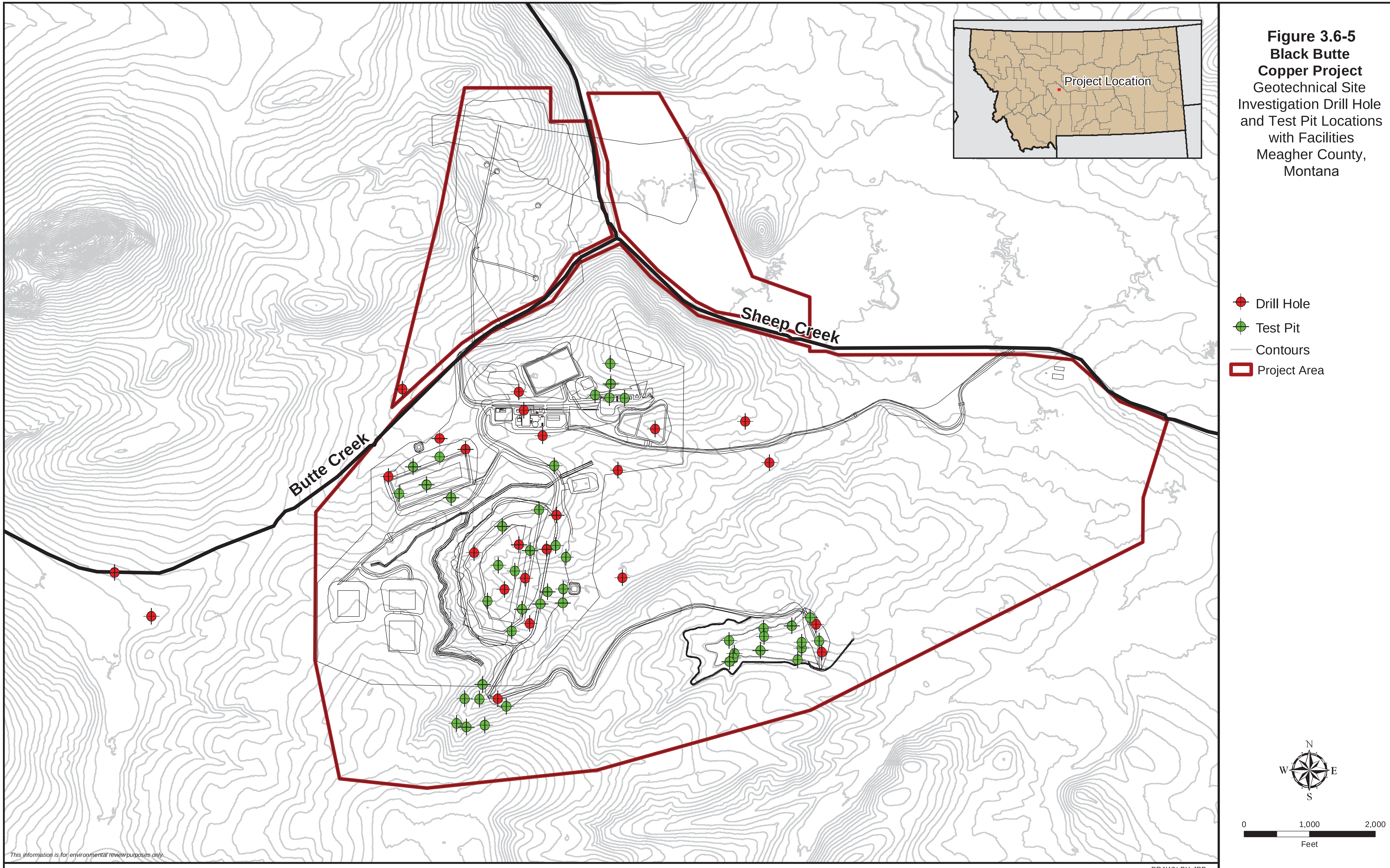


Figure 3.6-5
Black Butte Copper Project
Geotechnical Site Investigation Drill Hole and Test Pit Locations with Facilities
Meagher County, Montana

Source: Tintina 2017

3.6.3.1. *No Action Alternative*

The No Action Alternative would result in no change to geology when compared to baseline conditions. As such, this alternative would not have any impacts on geology resources and would not alter baseline conditions discussed in Section 3.6.2, Affected Environment.

3.6.3.2. *Proposed Action*

The Proponent proposes to mine waste rock from the Lower Newland Formation (Ynl), which contains copper enriched rock in both the USZ and the LSZ. The Proponent's consultant for geochemical services defined operational geochemical units for testing purposes based on mineralization and hydrogeology. The Proponent's proposal includes mining waste rock from the following units:

- Footwall of the LSZ (LZ FW); (35 percent of waste rock tonnage);
- Lower Newland Formation dolomitic shale and turbidite clay-clast conglomerate below the USZ and above the VVF in the Johnny Lee Deposit area (Ynl B, 32 percent);
- Portions of the USZ outside of the copper-enriched UCZ, (USZ, 28 percent); and
- Lower Newland Formation above the USZ (Ynl A, 4 percent).

The LZ FW represents a silicified conglomerate, stratigraphically below the LSZ, that consists of shale clasts from both the lowermost Newland Formation and the Chamberlain Formation.

Specific tonnages for each waste lithotype are listed in **Table 3.6-1**. This rock would be exposed in underground access workings and, temporarily, in active stopes. Some waste rock would also be stockpiled for approximately 2 years on a lined surface pad prior to being co-disposed with cemented tailings early in mine life. Once the temporary WRS pad is reclaimed, all of the waste rock, including the rock to be mined from the LZ FW during development, would report directly to the CTF for use in constructing the foundation drain and ramp. Waste rock produced after the CTF begins full operations would be end dumped from the ramp, where it would be subsequently buried by paste tailings. Additional waste rock units representing tonnages below 1 percent – including Igneous Dykes (IG), Dolomite, Neihart Quartzite, and Chamberlain Shale – have also been characterized in Appendix D (Enviromin 2017a) of the MOP Application (Tintina 2017); those results are not discussed further here.

Operationally, tailings would be produced via flotation and blended with cement/binders to create cemented paste tailings. The Proponent proposes to use a drift and fill mining method, placing 45 percent of produced tailings mixed with 4 percent cement and binder as backfill into mined out underground stopes and access headings during operations. The remaining tailings (approximately 55 percent) would be amended with as much as 2 percent cement and binder, and transferred as paste into a double lined surface tailings impoundment (the CTF). The operational plan for the CTF is to utilize an internal sump to rapidly transfer any water from the CTF to the PWP, providing for little or no water storage on the facility. To provide information for this EIS, raw or non-amended tailings were tested along with cemented paste tailings with 2 percent and 4 percent binders. Both raw or non-amended tailings and cemented paste tailings were tested under subaerial weathering and saturated conditions. To date, the testing regimen supports the selected cement content levels of 2 percent for cemented tailings reporting to the CTF, and does not indicate a need for or benefit from increased cement contents (see Appendix A of this EIS). The one difference between the two paste tailings alternatives is that the 2 percent alternative has a lower operating cost than does the 4 percent alternative, while still providing sufficient structural integrity for the deposited cemented paste (Geomin Resources 2016). Although a 4 percent cement binder mixed with 10 percent (by weight) waste rock (identified as "4%+ROM") was also tested to simulate disposal of blended materials, that option was eliminated. Those data are presented in Appendix D (Enviromin 2017a) of the MOP Application (Tintina 2017) and are not considered further here.

Each of the waste rock units has some potential to generate acid or release concentrations of various metals in excess of groundwater quality standards at different times in the expected weathering process. Hence, all mined waste rock would be encapsulated in cemented paste tailings in the lined CTF impoundment to both minimize the amount of contact water and limit the influx of oxygen. This would delay the potential onset of acid generation in waste rock, as well as reduce the volume of water that might require treatment. Furthermore, the Proponent proposes to collect all seepage from the temporary WRS, the copper-enriched rock stockpile, the CTF, and the UG for treatment to meet non-degradation criteria prior to discharge via underground infiltration galleries. Impacts to surface water and groundwater are therefore not anticipated. Models of water quality for these facilities which incorporate these data are described in Section 4.2 and Appendix N (Enviromin 2017c) of the MOP Application (Tintina 2017).

Shallow, weathered, highly-fractured and oxidized bedrock zones of the Ynl Ex and Tgd would be excavated and used for construction of Project mine facilities, such as embankments, protective layers for liners, and drain-rock.

Of the approximately 3.9 million cubic yards of bulked rock (20 percent after excavation) to be excavated during construction of the facilities listed in **Table 3.6-5a**, approximately half (or 2.0 million cubic yards) would be from each of the Ynl Ex and Tgd units. The Proponent proposes to use an estimated total of 241,343 cubic yards of the excavated Tgd as prepared sub-grade bedding and drainage gravel Project-wide (**Table 3.6-5b**).

Table 3.6-5a
Project Cut and Fill Quantities

Facility	Bulked Volume Available (cubic yards)	Bulked Fill Required after Bulking (cubic yards)	Net (cubic yards)
Mill Pad	64,090	40,546	23,543
Portal Pad	52,318	91,557	-39,239
Contact Water Pond and Brine Pond	110,783	44,496	66,287
Cemented Tailings Facility	2,489,029	2,021,217	467,812

Facility	Bulked Volume Available (cubic yards)	Bulked Fill Required after Bulking (cubic yards)	Net (cubic yards)
Process Water Pond	565,034	623,107	-69,845
Non-Contact Water Reservoir	-31,391	185,075	-216,466
Diversion (Channels and Ditches)	22,235	28,775	-6,540
Temporary Waste Rock Pad	180,497	44,470	136,027
Copper-Enriched Rock Stockpile	34,007	9,156	24,851
Roads and Ditches	419,852	419,852	0
Underground Infiltration Galleries (UIGs)	7,194	7,848	-654
Total	3,901,876	3,516,099	385,777

Source: Adapted from Tintina 2017

Notes:
[a] This table only includes conceptual cut and fill bedrock material volumes (not development waste rock).
[b] All cut and fill volumes listed in this table exclude soils; however estimated topsoil and subsoil thicknesses from 2017 (see Table 7-4 in the MOP Application) have been subtracted from the initial total excavation volume.
[c] The CTF construction bulked rock fill includes 101,135 cubic yards (43 percent) of the excavation rock fill required to construct the CTF haul ramp as shown in Table 3-14b of the MOP Application. Other volume and material type details are also listed in Table 3-14b.
[d] This scenario utilizes 411,537 tonnes (269,134 cubic yards) of development waste rock to construct the following facilities: 31,390 cubic yards for the sub-grade bedding layers above the HDPE liner systems of the WRS pad and the copper-enriched rock stockpile; 104,636 cubic yards for the drainage layer of the CTF basin drain system; and 133,107 cubic yards for the CTF haul ramp. Any additional development waste would be placed on top of the drainage layer of the basin drain system.
[e] Most construction materials <1,000 cubic meters (<1,308 cubic yards) are not included in this table.
[f] Most volumes are rounded to the nearest 1,000 cubic meters (converted to 1,308 cubic yards).
[g] Volumes of cut (after excavation) and fill (after placement and compaction) materials include a 20 percent bulking factor.
[h] The cut and fill volumes from the ventilation raises are included in the waste rock plan presented in Table 3-5 and Table 3-6 of the MOP Application (Tintina 2017). All waste rock ultimate ends up in the CTF above the CTF HDPE liner system.
[i] The net excess 391,009 cubic yards of general rock fill would be placed on the two "reclamation material" stockpiles after construction: 174,307 cubic yards is placed on the northern stockpile whereas 211,469 cubic yards is placed on the southern stockpile located west of the CTF.

Table 3.6-5b
Project Cut and Fill Quantities by Material Type and Source (1)

Development Waste Rock Use (tonnes)****	Assigned Material Designation or Equation	Construction Material Type/Cut or Fill Volume	CTF	PWP	NCWR	Contact Water Pond & Brine Pond	Temporary Waste Rock Storage Pad	Copper-Enriched Rock Stockpile	Mill Pad	Portal Pad	Diversion Channels	UIGs	Roads and Ditches	Total
	A	**Total cut bulked volume available (cubic yards)**	2,489,029	553,263	-31,391	110,783	180,497	34,007	64,090	52,318	22,235	7,194	419,852	**3,901,876**
	1	Embankment fill (cubic yards)	1,748,729	588,578	180,497	34,922	31,391	6,540	40,546	91,557	28,775	1,962	0	**2,753,496**
48,000	2	Sub-grade bedding placed above the HDPE liner system (cubic yards)	57,550	0	0	0	26,159	5,232	0	0	0	0	0	**88,941**
	3	Sub-grade bedding placed below the HDPE liner system (cubic yards)	102,020	31,391	4,578	9,574	13,080	2,616	0	0	0	0	0	**163,258**
	4	***Total subgrade bedding (cubic yards)***	***159,570***	***31,391***	***4,578***	***9,574***	***39,239***	***7,848***	0	0	0	0	0	**252,199**
		Drainage gravel (cubic yards)	11,510	3,139	0	0	0	0	0	0	0	5,886	0	**20,535**
	5	Filter sand (cubic yards)	392	0	0	0	0	0	0	0	0	0	0	**392**
160,000	6	Waste rock forming the drainage layer of the CTF basin drain system (cubic yards)**	104,636	0	0	0	0	0	0	0	0	0	0	**104,636**
	7	CTF haul ramp (HR) (cubic yards)	101,016	0	0	0	0	0	0	0	0	0	0	**101,016**
203,537	8	CTF haul ramp waste rock (cubic yards)	133,107	0	0	0	0	0	0	0	0	0	0	**133,107**
	9	Other (cubic yards)***	0	0	0	0	0	0	0	0	0	0	**419,852**	**419,852**
	B – 1+3+4+5+7+9	Total rock fill construction materials with HR and excluding all waste rock (cubic yards)	2,021,217	623,107	185,075	44,496	44,470	9,156	40,546	91,557	28,775	7,848	419,852	**3,516,099**
	A – B	**Net (cubic yards) only materials sourced from excavation cut (not waste rock)**	**357,668**	**357,668**	**357,668**	**357,668**	**357,668**	**357,668**	**357,668**	**357,668**	**357,668**	**357,668**	**357,668**	**357,668**
411,537	**Total WR tonnes**													

Source: Tintina 2017

CTF = Cemented Tailings Facility; HR = CTF haul ramp; NCWR = Non-Contact Water Reservoir; PWP = Process Water Pond; UIG = Underground Infiltration Gallery; WR = development waste rock

Notes:

[a] The sources of the construction materials are listed below and some are indicated by highlighted cells in the table. The primary source of the construction materials will be from fresh unweathered bedrock from each individual facility excavation footprint. Most of the construction materials will be sourced from the facility that they are excavated from (i.e. most of the mill pad will be constructed with materials sourced from the mill pad excavation). If there is a deficit of material listed in a facility (indicated by a negative volume value in the "Net" cells), then some construction material will be required to be sourced from another facility excavation that has excess fill material. For instance, there is excess material fill from the CTF excavation that will likely be used as construction material to construct the PWP, NCWR, UIG, and diversion channel facilities. The excess fill material from the temporary WRS pad will likely be used for some of the construction materials to construct the portal pad. The same notes included in Table 3-14a are applicable to Table 3-14b.

[b] * Most sub-grade bedding and all drainage gravel materials will be sourced from granodiorite (indicated in the table by volumes highlighted in the magenta color) excavated from the CTF and the PWP excavations. Sub-grade bedding material placed above the HDPE liner system at the WRS pad and the copper-enriched rock stockpile will consist of development waste rock (indicated in the table by volumes and tonnages highlighted in the light blue color) that is temporarily stored on the WRS pad. The sub-grade bedding material and the drainage gravel will require crushing and screening of the excavated bedrock. The crusher and screen plant will need to be located on the temporary WRS pad after the HDPE liner and overlying materials to the liner have been placed. After the development waste rock required for the sub-grade bedding required over the HDPE liner system for the WRS pad and the copper-enriched rock stockpile has been constructed, the crusher and screen plant may be moved to either the temporary construction stockpile or to the CTF excavation basin. The contractor will finalize these details prior to construction. Since excess fill materials from the facility construction will be stored on the northern and southern reclamation material stockpiles, some of the sub-grade bedding and drainage gravel materials could be sourced from these two reclamation material stockpiles too.

[c] ** The minimum volume of development waste rock forming the "drainage layer" in the upper part (minimum 1.0 meter thick) of the CTF basin drain system (see Drawing C2003 in Appendix K; Knight Piésold Consulting 2017a) will be sourced from the remaining unused development waste rock stored on the WRS pad (i.e. after some of the development waste rock has been used to help construct the WRS pad, the copper enriched rock stockpile, and the CTF haul ramp as listed in the table). The maximum volume of development waste rock forming the "drainage layer" is calculated by using the maximum design capacity of the WRS pad (which is 500,000 tonnes) and would be approximately 162,489 cubic yards (248,464 tonnes) making the layer 1.7 yards thick.

[d] *** Other materials refer to road construction materials that will be sourced from the individual road cuts.

[e] **** Development waste rock tonnes are calculated using 1.31 cubic yards = 2 tonnes. All development waste rock utilized for construction of the facilities will be end up at the end of the project (in closure) will be transported and placed in the CTF. The first two years of the mine life will produce 411,537 tonnes as stated in Table 3-6 of the MOP Application which will be stored on the temporary WRS pad.

[f] Filter sand sourced from the CTF excavation cut

[g] All construction materials needed to construct the NCWR will be sourced from the CTF excavation.

[h] Approximately 69,845 cubic yards of the PWP construction materials and 216,466 cubic yards of the NCWR construction materials will be sourced from the CTF excavation.

[i] Construction material volumes <1,000 cubic meters are not included in the table.

[j] All cut and fill volumes listed in the table are conceptual and will be refined after a contractor has been awarded the construction project. However, the development waste rock volumes and tonnages correspond to a preliminary mine plan shown in Tables 3-5 and 3-6 of the MOP Application. All gradation specifications (and placement and compaction requirements) for the embankment fill, sub-grade bedding, and drainage gravel are shown in Drawing C0003 in Appendix K. The specifications for the development waste rock will approximate that for the embankment fill. The development waste rock used to construct the drainage layer of the CTF basin drain system will be required to be a free-draining material.

[k] Total rock fill to be stored in the northern and southern reclamation material stockpiles after the end of construction is 385,777 cubic yards (same as Table 3-14a). The facility names highlighted in the light green colored fill will have their excess general rock fill (totaling approximately 174,308 cubic yards) materials stored in the northern reclamation material stockpile whereas the facility names highlighted in the light orange colored cells will have their excess general rock fill (totaling approximately 211,469 cubic yards) stored on the southern reclamation material stockpile as shown in Figure 1.3 and Map Sheet 1. The excess rock fill volumes stored on the two reclamation material stockpiles in this table are conceptual and will be recalculated by a contractor prior to construction.

[l] Total net rock cut minus rock fill volume excluding materials not sourced from the facility excavation footprints (i.e., development waste rock).

[m] The development underground waste rock schedule for the first two years is 411,537 tonnes; the maximum storage capacity of the temporary WRS pad is 500,000 tonnes which indicates that the WRS pad may be used for more than two years. These tonnages include excavated tonnages from the two development ventilation raises (The waste rock tonnage difference between the first two years and the design capacity is equal to 88,463 tonnes which could be added to the upper part of the drainage layer within the CTF basin drain system during construction).

[n] 241,343 cubic yards (or 369,040 tonnes) of combined sub-grade bedding and drainage gravel is required to construct the mine facilities (not including the sub-grade bedding placed above the HDPE liner system at the WRS pad and the copper-enriched rock stockpile). There is ample granodiorite expected from the CTF and PWP excavations to supply these sub-grade bedding and drainage gravel construction materials.

[o] See Table 3-14c for volume of reclamation materials required to close the following facilities: CTF, NCWR, PWP and NCWR diversion channels, the NCWR spillway, and backfilling of the portal (plug), the drift under the Coon Creek (approximately 200 feet length of workings), and the four ventilation raises.

[p] Diversion channels include: CTF (a permanent facility that will exist during construction, operations, closure, and after closure) and the PWP and NCWR which are not permanent facilities (i.e. will not exist after closure).

[q] This 57,550 cubic yards of material has been identified as Tgd; however, the Proponent may alternatively use Ynl Ex and/or preproduction waste rock for sub-grade bedding material to be placed above the double liner in the CTF. Please see Section 3.6.8.7 of the MOP Application for additional information on these alternative materials.

Given the proposed drift and fill method of mining, distinct surfaces of backfilled material would only be exposed to air for a short period of time, thus reducing the production of sulfate, acidity, and metals. At closure, the backfill material would be submerged by groundwater, reducing oxygen availability (the diffusivity of oxygen in water is 10,000 times less than in air) and reducing sulfide oxidation to negligible levels. Results of the kinetic diffusion tests indicate that the cemented paste tailings (4 percent binders) that are proposed for backfill is unlikely to become acidic and has potential to release only arsenic in concentrations above groundwater standards under saturated conditions at closure. Baseline groundwater monitoring documented that average pre-mining arsenic concentrations in groundwater in the area of the proposed mining stopes are greater than 6 times higher the groundwater standard. Due to the extremely low hydraulic conductivity of this material, interaction with groundwater would be limited. In addition, concrete blocks or plugs would be installed in post-mine tunnels and shafts, which would effectively seal mine workings that are otherwise open. Furthermore, post-closure underground arsenic concentrations were predicted to be non-detectable as a result of the precipitation of $Ba_3(AsO_4)_2$ and sorption to mineral surfaces.

In the CTF, each new lift of cemented paste tailings would behave as a massive block of material with low transmissivity, with a thin upper surface that would be exposed to some degree of oxidation before being covered by fresh cemented paste tailings within 30 days of placement. This is the longest duration of exposure that is anticipated; average exposure times are expected to be shorter, on the order of 7 to 15 days. The unsaturated kinetic tests of cemented paste tailings reflect the type of oxidation to be expected along this surface, while the diffusion tests better represent the majority of tailings placed in each lift. However, it is highly unlikely that the rate of disaggregation observed in the field would approach that observed in the laboratory test, which optimized sulfide oxidation and disaggregation of the small (and unconfined) test cylinders. Waste rock would be placed in lenses adjacent to the ramp in the CTF where it would be encapsulated by cemented paste tailings. The cemented paste tailings placed within the CTF are best represented by the 2 percent binder HCT data, while the final lift of paste tailings in the CTF is best represented by the 4 percent binder HCT data. If material is covered in a timely manner (on the scale of weeks and less than 30 days, average range expected to be 7 to 15 days), relatively less oxidation, acidity, and leaching of metals is expected to occur and it would be limited to the exposed surface of the cemented paste tailings. If operations were to be interrupted, as in the case of a temporary suspension in tailing production, or during early closure, the Proponent would increase the cement binder content to reduce weathering during the period of extended exposure. In addition, any water interacting with oxidized tailings would subsequently flow through and react with waste rock before being collected in a sump within a lined facility for treatment.

Although the CTF would store little to no water during operations, any water remaining in the CTF at closure (e.g., precipitation, runoff, tailings consolidation) would be removed from the facility via the seepage collection sump. At closure, the CTF would be covered with a geotextile membrane over a period of months, which would be welded to the lower liner, eliminating long-term exposure of the final lifts to oxygen and water. The double lined CTF with drainage collection is designed to prevent discharge to surface water and groundwater. Thus, any solutes resulting from oxidation and release of metals by cemented paste tailings within the CTF are unlikely to reach or affect surface water or groundwater.

The acid generation and metal release potential of near-surface rock to be excavated near the Project facilities was characterized. Results of static ABA indicate Tgd is net neutralizing, which was confirmed by kinetic testing – full details provided in Appendix D (Enviromin 2017a) of the MOP Application (Tintina 2017). No metals were detected above any relevant groundwater or surface water standard. Due to this material's lack of chemical reactivity and metals release, the Proponent plans to use it as protective sub-grade bedding below lined facilities, and as drainage rock in its facility foundation drains and underground infiltration galleries. The Ynl Ex also appears unlikely to produce acid, despite a temporary spike in sulfate concentrations. These rocks released low concentrations of selenium that exceeded surface water standards (but not groundwater) in early weeks of testing.

Smith River Assessment

The Project area is limited to the location described in Section 1.3, Project Location and History; therefore, the Proposed Action would have no direct impacts on the geologic resources along any reach of the Smith River. As discussed in previous sections, it is highly unlikely that chemical source water generated at the site (mine contact water and surface facility seepage) would lead to the concentration of any constituent exceeding its estimated groundwater non-degradation standards in shallow groundwater or surface water. The water collection systems within mine workings or surface facilities would convey water to the WTP, and the water released to the alluvial aquifer via the UIG would be treated to assure compliance with groundwater standards and non-degradation criteria per the MPDES permit (Hydrometrics Inc. 2018; Tintina 2018).

There is no direct hydrogeologic connection between groundwater in the Project area and the Smith River or its alluvium. The only geochemical pathway from the site to the Smith River is via Sheep Creek surface water, a river distance of 19 miles from the mine site. Because the proposed Project would not cause Sheep Creek surface water to exceed water quality standards, the mine would also not cause secondary impacts like exceeding standards in the Smith River (see discussion presented in Section 3.5, Subsection 3.5.3.2, Smith River Assessment).

3.6.3.3. Agency Modified Alternative

Under the AMA, the Project would include all the same components as the Proposed Action with one exception: backfilling additional mine workings, access ramps, and ventilation shafts. The additional backfill component would use low hydraulic conductivity material (i.e., cemented tailings generated from mill processing of the stockpiled ore and/or waste rock at the end of operations) as the backfill material. Approximately 106,971 cubic yards of cemented tailings would be needed to backfill portions of the mine workings, access tunnels, and ventilation shafts.

Cemented paste tailings would only be used to backfill certain mineralized mine voids to avoid the potential of degrading groundwater quality in non-mineralized geologic units (DEQ 2018). The upper section of the access decline (within the Ynl A geologic unit) and a lower section of the access tunnel (within the Ynl B geologic unit) would not be backfilled because these units are non-mineralized, and they have better baseline groundwater quality than the Upper Sulfide Zone (USZ) and the Lower Sulfide Zone (LSZ). All mine voids located within the USZ and the LSZ would be backfilled with cemented paste tailings. Hydraulic plugs would be used to separate the backfilled and open areas of the access decline. This proposed configuration of backfilling is aimed at more effectively separating rock zones that are: (1) mineralized vs. non-mineralized, and (2) more permeable vs. less permeable.

Compared to the Proposed Action, the actions taken under the AMA would decrease the load coming from the underground workings during closure, as mineralized zones with a higher potential for acid generation are backfilled with cemented tailings and plugged, while the non-mineralized zones are allowed to refill with groundwater.

Smith River Assessment

Similar to the Proposed Action, the location of the Project area under the AMA would have no direct impacts on the geologic resources along any reach of the Smith River. It is highly unlikely that chemical source water generated at the site (mine contact water and surface facility seepage) would lead to the concentration of any constituent exceeding its estimated groundwater non-degradation standards in shallow groundwater or surface water. The water collection, treatment, and discharge systems in the AMA would be the same as under the Proposed Action. The only geochemical pathway from the site to the Smith River is via Sheep Creek surface water, and because the proposed Project would not cause Sheep Creek surface water to exceed water quality standards, secondary impacts like exceeding standards in the Smith River would also not occur (see discussion presented in Section 3.5, Subsection 3.5.3.2, Smith River Assessment).

3.7. LAND USE AND RECREATION

This section describes the affected environment and addresses potential impacts of the No Action Alternative, the proposed Project, and the AMA on land use and recreation.

3.7.1. Analysis Methods

3.7.1.1. Land Use

The analysis area for land use encompasses the Project area for the mining facilities and adjacent lands. The impacts analysis determined how the Project may alter existing land uses on private land. Changes in land use were calculated based on the acreage of the Project area. The Meagher County City of White Sulphur Springs Comprehensive Plan (Meagher County Planning Board 1981) was reviewed to determine if there were any conflicts with the general plan, zoning regulations, or growth policies. Additionally, the Meagher County Draft Growth Policy (Meagher County 2015) and the City of White Sulphur Springs Growth Policy (City of White Sulphur Springs 2017) completed in February of 2017 were also reviewed.

3.7.1.2. Recreation

The analysis area for recreation impacts encompasses the Project area and an approximately 15-mile radius surrounding the Project area. Due to the large amount of public comments that were received during the Project scoping period, the analysis area also includes the Smith River. Publically available information on campgrounds, trails, angler data, and Smith River floating data within the analysis area was reviewed.

3.7.2. Affected Environment

3.7.2.1. Land Use

Northeastern Meagher County is a rural area with the nearest major population area being the City of White Sulphur Springs, approximately 15 miles to the south of the Project area. Large-lot residential properties, ranches, and cabins are present along U.S. Route 89 between the City of White Sulphur Springs and the Project area. All of the land located within the Project area is privately-owned. Of the approximate 1,888 acres within the proposed Project area, the majority consist of livestock grazing and ranching lands. A portion of Bar Z Ranch (approximately 3.7 acres) is located within the Project area. **Table 3.7-1** shows the existing land uses within the Project area. All water features, which are excluded from **Table 3.7-1**, fall within the existing land use category of fishing.

Table 3.7-1
Existing Land Use within Black Butte Copper Project Area

Land Use Type	Acres	Percent with the Project Area[a]
Livestock Grazing and Ranching	1,769.0	94%
Hay Production	118.7	6%

Notes:
[a] Percent totals are greater or less than 100% due to rounding.

Both the 1981 Meagher County City of White Sulphur Springs Comprehensive Plan and the 2017 City of White Sulphur Springs Growth Policy focus on land use within the City of White Sulphur Springs and do not provide any zoning restrictions or a land use plan for areas outside of the city. According to Montana Cadastral data, the land surrounding the Project area is primarily privately owned and consists of agricultural rural and farmstead rural lands with land uses including grazing and timber. Additionally, there are a few parcels owned by the U.S. Department of Agriculture located to the south and west of the Project area (Montana State Library 2018).

3.7.2.2. Recreation

There are no public recreation opportunities located within the Project area. Bar Z Ranch, located within the Project area, offers lodging and private fly-fishing expeditions along multiple waterbodies including Sheep Creek and the Smith River (Fly Fishing Montana 2017). Public recreational opportunities in the surrounding area include hiking, camping, fishing, hunting, boating, and river floating. **Table 3.7-2** lists the campgrounds located within 15 miles of the Project area (specifically the intersection of Sheep Creek and Butte Creek County Road).

Table 3.7-3 lists the hiking trails located within 15 miles of the Project area (specifically the intersection of Sheep Creek and Butte Creek County Road). In addition to hiking and camping, there are boating and fishing opportunities on Sheep Creek, Smith River, Newland Reservoir, Lake Sutherlin, and Bair Reservoir. While no statistical data is available, non-fishing recreational boating, kayaking, canoeing, and other boating also occur on these waterbodies. Montana Fish, Wildlife & Parks (FWP) collects angler use data every 2 years for Sheep Creek and Smith River. **Table 3.7-4** provides this data for the years of 1995 through 2015. For the Smith River, this data represents Section 2 of the river from Camp Baker to Hound Creek. With the exception of 2003 and 2009 for Sheep Creek and 2003, 2007, and 2011 for Smith River, the majority of angler use days were by residents versus nonresidents.

Table 3.7-2
Public Campgrounds within 15 miles of the Black Butte Copper Project Area

Name	Location	Distance and Direction from Intersection of Sheep Creek and Butte Creek County Road
Miller Gulch "Jeep" Trail – Coxcomb Butte – Butte Creek County Road - Sheep Ck. County Road – U.S. Route 89 Loop	NW ¼ Sec 16 T11N R7E	3.9 miles SE
Sheep Creek Campground	SW ¼ Sec 12 T12N R6E	2.0 miles N-NW
Moose Creek Campground	N ½ Sec 5 T12N R7E	3.4 miles N-NE
Jumping Creek Campground	NE ¼ Sec 36 T12N R7E	4.5 miles E
Newland Creek (Reservoir) Campground	W ½ Sec 12 T10N R6E	7.2 miles S-SW
Many Pines Campground	S ½ Sec 10 T13N R8E	9.5 miles NE
Camp Baker Campground	SW ¼ Sec 13 T12N R4E	10.4 miles W
Smith River Campground	NW ¼ Sec 13 T11N R6E	10.4 miles W-SW
Lake Sutherlin Campground	N ½ Sec 20 T10N R8E	10.1 miles SE
Grasshopper Creek Campground	N ½ Sec 17 T9N R8E	13.8 miles SE
Richardson Creek Campground	SW ¼ Sec 16 T9N R8E	14.3 miles SE
Showdown Winter Sports Area	S ½ Sec 33 T13N R8E	7.9 miles NE
Former Fort Logan Military Reservation	SW ¼ Sec 25 T11N R4E	11.4 miles SW
Montana Sunrise Lodge	E ½ Sec 32 T12N R8E	6.1 miles E

Source: Central Montana 2017a

Table 3.7-3
Public Hiking Trails within 15 miles of the Black Butte Copper Project Area

Name	Location	Distance and Direction from Intersection of Sheep Creek and Butte Creek County Road
Allan Trail	Sec 19 T13N R7E	6.0 miles N
Miller Gulch "Jeep" Trail Loop [a]	Sec 16 T11N R7E	3.9 miles SE
Island Park Trail	Sec 17 T13N R7E	8.0 miles NE
Tenderfoot Trail [a]	Sec 4 T13N R7E	9.6 miles NE
Williams Mountain Trail [b]	Sec 4 T13N R6E	9.8 miles NW
Memorial Falls Trail	Sec 4 T13N R8E	13.8 miles NE
Balsinger Trail	Sec 10 T14N R6E	14.7 miles NW
Lost Stove Trail [a]	Sec 27 T14N R6E	11.7 miles NW

Source: Central Montana 2017b

Notes:
[a] Notes trails that are completely open to motorized vehicles.
[b] Notes trails that are partially open to motorized vehicles.

Table 3.7-4
Angler Use Days for Sheep Creek and Smith River between 2001 and 2015

Year	Sheep Creek			Smith River		
	Total Angler Days	Resident Angler Days	Nonresident Angler Days	Total Angler Days	Resident Angler Days	Nonresident Angler Days
2015	679	454	225	18,997	11,517	7,480
2013	1,139	793	346	14,654	8,674	5,971
2011	347	300	47	11,480	5,402	6,078
2009	1,762	803	959	18,100	11,680	6,420
2007	1,383	1,002	381	8,375	3,751	4,624
2005	770	602	168	14,188	8,371	5,817
2003	849	276	573	6,854	2,742	4,112
2001	1,074	925	149	9,088	6,362	2,726
1999	1,173	1,097	149	7,645	6,422	1,223
1997	808	673	76	13,391	8,302	5,089
1995	514	312	135	11,272	6,425	4,847

Sources: FWP 2017a; McFarland and Hughes 1997; McFarland and Meredith 1998, 2000, 2002, 2005; McFarland and Dykstra 2007, 2008; Selby et al. 2015; and Selby et al. In prep.)

Hunting near the Project area includes elk, deer, black bear, mountain lion, and bobcat. FWP has collected hunting data for various species in the Project vicinity. The two nearest hunting districts are districts 416 and 446, which both have hunter day data for elk and deer going back to 2004. **Table 3.7-5** presents total hunter days and total number of hunters reported by year, district, and species. The data indicates that there has been an increase in reported hunter days for elk since 2014. No data was collected for deer in 2014, 2015, or 2016; however, trends also indicate an increase in reported deer hunter days.

Table 3.7-5
Montana Fish, Wildlife & Parks Hunter Days Data for Deer and Elk

Year	District	Species	Hunter Days [a]	No. Hunters
2016	416	Deer	N/A	N/A
		Elk	13,209	2,055
	446	Deer	N/A	N/A
		Elk	12,752	2,183
2015	416	Deer	N/A	N/A
		Elk	10,411	1,667
	446	Deer	N/A	N/A
		Elk	15,412	2,689
2014	416	Deer	N/A	N/A
		Elk	10,662	1,790
	446	Deer	N/A	N/A

Year	District	Species	Hunter Days [a]	No. Hunters
		Elk	7,391	1,352
2013	416	Deer	9,037	1,356
		Elk	N/A	N/A
	446	Deer	4,939	885
		Elk	N/A	N/A
2012	416	Deer	N/A	N/A
		Elk	12,368	1,986
	446	Deer	N/A	N/A
		Elk	6,607	1,237
2011	416	Deer	6,022	1,155
		Elk	9,572	1,742
	446	Deer	5,369	764
		Elk	7,196	1,199
2010	416	Deer	6,942	1,190
		Elk	9,559	1,618
	446	Deer	4,040	706
		Elk	6,177	1,044
2009	416	Deer	5,481	1,003
		Elk	8,513	1,565
	446	Deer	3,314	640
		Elk	5,208	909
2008	416	Deer	6,144	1,082
		Elk	8,921	1,663
	446	Deer	4,466	752
		Elk	5,960	979
2007	416	Deer	5,506	952
		Elk	8,974	1,608
	446	Deer	4,711	750
		Elk	5,358	1,039
2006	416	Deer	5,248	977
		Elk	6,863	1,302
	446	Deer	4,451	854
		Elk	6,142	1,135
2005	416	Deer	4,783	960
		Elk	7,787	1,360
	446	Deer	3,191	577
		Elk	5,541	982
2004	416	Deer	4,827	992
		Elk	7,182	1,400

Year	District	Species	Hunter Days [a]	No. Hunters
	446	Deer	3,628	699
		Elk	5,509	1,044

Source: FWP 2016

Notes:
[a] Hunter days reported for deer and elk may be inclusive or overlap could occur.

3.7.3. Environmental Consequences

3.7.3.1. No Action Alternative

Under the No Action Alternative, the Project would not be constructed and no direct or secondary impacts on existing land uses or recreation areas would occur. Recreational opportunities and use levels, patterns, and growth trends would be expected to continue at current rates.

3.7.3.2. Proposed Action

Land Use

Under the Proposed Action, impacts on land use would include the direct long-term loss of approximately 311 acres of ranching/livestock grazing and hay production lands from construction and operations of the Project. These direct impacts would last about 19 years through mine construction, operations, closure, and reclamation. No direct impacts on land use for lands adjacent to the Project area would occur as a result of the Project. No conflicts with adjacent land uses are anticipated given that there are no zoning restrictions in this area.

The Proponent would install a fence around the surface facilities, which would allow existing grazing land uses to continue within the Project area outside of the fence line during operations of the mine.

Long-term impacts on land use would occur to the area proposed for disturbance during mine construction, operations, and reclamation due to the loss of livestock, ranching, and grazing lands from ground disturbing activities, construction, and operations of mine facilities, as well as revegetation efforts. After mine closure, the disturbed land would be reclaimed back to pre-mine land uses, including the removal or closure of Project facilities. Given the proposed reclamation plan and the Proponent’s commitment to work with private land-owners, no residual impacts on current existing livestock, ranching, and hay production land uses are anticipated.

Recreation

Under the Proposed Action, no direct impacts on recreation would occur in the proposed disturbance footprint (i.e., approximately 311 acres) as this area is private ranch lands. The only recreation area located within the Project area is Bar Z Ranch, which is not located within the disturbance footprint and would not be directly impacted by the construction or operations of the mine. Potential secondary impacts on recreation opportunities would be related to visual and noise impacts, as discussed in Sections 3.8.3 and 3.11.3, respectively. Hunting does not occur in the disturbance footprint for the proposed mine; therefore, no direct impacts on hunting opportunities would occur as a result of the Project. Potential secondary impacts on hunting opportunities would be directly related to wildlife impacts. As discussed in Section 3.15.3.2, Wildlife and T&E Species Proposed Action, there is abundant adjacent habitat for big games species.

As discussed in Section 3.5.3.1, Surface Water Hydrology Quantity, Section 3.5.3.2, Surface Water Hydrology Quality, impacts on base flow of Sheep Creek as a result of mine dewatering and disposal of treated water to the UIG are expected to be nominal and to partially offset one another. Therefore, no secondary impacts on recreation from surface water would occur. As discussed in section 3.16.3.2, Aquatic Biology Proposed Action, impacts associated with both water quantity and water quality in Sheep Creek would have minor impacts on fisheries and aquatic life in Sheep Creek. Therefore, secondary impacts on recreation associated with fishing within Sheep Creek would also be minor.

As discussed in Section 3.12.3.2, Transportation Proposed Action, during construction approximately 160 daily employee vehicle trips and 8 truck supply trips would be made each day. During operations these numbers would increase to a maximum of 400 daily employee vehicle trips and 48 truck trips. While traffic volumes would increase during Project construction and operation, the major roads in the Project area have additional available capacity to reduce these impacts, as discussed in Section 3.12, Transportation. Therefore, secondary impacts on accessing regional recreation areas by increased traffic along U.S. Route 89 during construction or operations of the Project are not expected.

During construction and operations of the mine, the population increase from mine employees and contractors may increase the number of people using recreation areas in the Project area (see the Socioeconomics Section 3.9.3.2, Proposed Action). Additionally, some of the mine employees could stay in the area after the life of the mine and may continue to engage in recreational activities in the area. Recreational resource demands may be higher during construction and operations given the increase in local population from construction workers and mine operators.

Smith River Assessment

Land Use

No direct or secondary impacts on existing land uses along the Smith River would occur as a result of the Proposed Action.

Recreation

The Smith River is the only river in Montana that requires a permit for both public and commercial floating. Sheep Creek's confluence with the Smith River is located approximately 19 river miles downstream from where Sheep Creek intersects with the northern edge of the Project area. River use data available from FWP was reviewed. In 2017, interest in private float permits increased for the seventh consecutive year and total river use was at an all-time high. **Table 3.7-6** shows the number of private float permit applications received and number of actual floaters by year since 2008. As indicated in the data below, interest in floating the Smith River has nearly doubled in the past 10 years with 5,823 permit applications received in 2008 and 10,007 received in 2017. If the number of persons applying for a float permit increases significantly, it could lead to increased demand for the float permits, resulting in a smaller percentage of applicants receiving permits.

Table 3.7-6
Smith River Private Float Permit Applications by Year

Year	Number of Permit Applications	Number of Floaters	Number of Craft [a]
2017	10,007	5,599	2,591
2016	9,365	5,193	2,459
2015	8,096	4,355	2,113
2014	7,377	5,375	2,506
2013	6,662	4,588	2,232
2012	6,156	4,714	2,135
2011	5,633	3,999	1,967
2010	5,346	4,699	2,153
2009	5,704	5,078	2,323
2008	5,823	4,836	2,225

Source: FWP 2017b

Notes:
[a] Includes rafts, canoes, drift boats, kayaks, and other.

Smith River is the receiving waters for Sheep Creek. Secondary impacts on base flow of Sheep Creek as a result of mine dewatering and disposal of treated water to the UIG are expected to be insignificant and to partially offset one another. Therefore, no direct impacts on recreational opportunities in the Smith River from surface water would occur as a result of the Proposed Action. As discussed in Sections 3.5.3.1, Surface Water Hydrology Quantity, and Section 3.5.3.2, Surface Water Hydrology Quality, impacts on the Smith River associated with water quantity and water quality would both be insignificant. Therefore, potential secondary impacts on recreational opportunities of the Smith River due to changes in water quality or water quantity would also be insignificant.

3.7.3.3. Agency Modified Alternative

The potential direct impacts of the AMA on land use and recreation would be the same as described for the Proposed Action. The disturbance footprint would also be the same for the AMA; therefore, no additional direct impacts on land use or recreation would occur. Secondary impacts on recreation are anticipated to be similar to those described above for the Proposed Action. Secondary impacts on hunting would remain the same considering the amount of adjacent habitat would not change for the AMA. Secondary impacts on fishing would remain the same considering no changes in surface water impacts would occur as part of the AMA. Secondary impacts to traffic would change slightly with the AMA as added truck trips would be required for the material needed for the additional cemented tailings. These additional trips would not meaningfully change the traffic impacts described for the Proposed Action.

Smith River Assessment

The potential direct impacts of the AMA on land use and recreation for the Smith River would be the same as described for the Proposed Action. The disturbance footprint would also be the same for the AMA; therefore, no additional direct impacts on land use or recreation along the Smith River would occur. Secondary impacts on recreation are anticipated to be similar to those described above for the Proposed Action.

3.8. VISUALS AND AESTHETICS

Visual resources and aesthetics are the visible physical features (landforms, water, vegetation, and structures) within the assessment area. The proposed Project would have an underground mine with support facilities and equipment located within the MOP Application Boundary encompassing approximately 1,888 acres (Project area). The total surface disturbance required for construction and operations of the mine-related facilities and access road comprises approximately 311 acres. These facilities would be visible to the public from certain viewpoints. This section describes the potential impacts on visual resources by describing the baseline conditions for visual resources and potential receptors, and providing a qualitative assessment of the severity and likelihood of the impacts of the Proposed Action and AMA.

3.8.1. Analysis Methods

The location of the visible components of the Project facilities, topography and vegetation in the area, and the location of public access roadways and recreation areas are the basis for determining the assessment area of direct and secondary and impacts on visual resources.

Analysis methods involved utilization of desktop research including topographic maps, satellite imagery, and data collected from websites including:

- FWP 2016;
- Montana Office of Tourism 2018;
- MDT 2016a;
- MDT 2016b;
- Woods et al. 2002;
- USGS 2011;
- USGS 2014; and
- USDA 1997.

The assessment of impacts on visual resources also included analysis of viewpoint simulations prepared for the MOP Application (Tintina 2017). Descriptions of views and view-sheds used in this assessment use the following terms to describe viewing distances:

- "Foreground" refers to views from zero to approximately 500 feet;
- "Middle-ground" refers to views from approximately 500 to 1,500 feet; and
- "Background" refers to views beyond 1,500 feet to the horizon.

The assessment area of impacts on visual resources included the area within an approximately 10-mile radius from the center of the Project area. However, because the existing topography and vegetation impose considerable restrictions to sight lines, particular emphasis is given to areas within a 2.5-mile radius (**Figure 3.8-1**).

3.8.2. Affected Environment

The affected environment assessment involved developing baseline descriptions of visual resources and receptors.

3.8.2.1 Visual Resources

Visual resources include the natural and built physical features visible in the existing landscape including buildings, fences, roads, vegetation, land forms, buildings bridges, streams, and water features, vistas of mountain peaks or other unique natural features.

According to U.S. Environmental Protection Agency mapping of ecoregions, the assessment area is located in Level IV Ecoregion 17q – Big Snowy-Little Belt-Carbonate Mountains, which is characterized as having logging, mining, and recreation as the principal land uses (USEPA 2002). The assessment area is in a broad rolling landscape between the Big Belt and Little Belt Mountains. Non-forested areas appear to be grasslands used predominantly for livestock grazing and related activities and drained by creeks. Distant mountain systems and isolated peaks and buttes frame vistas.

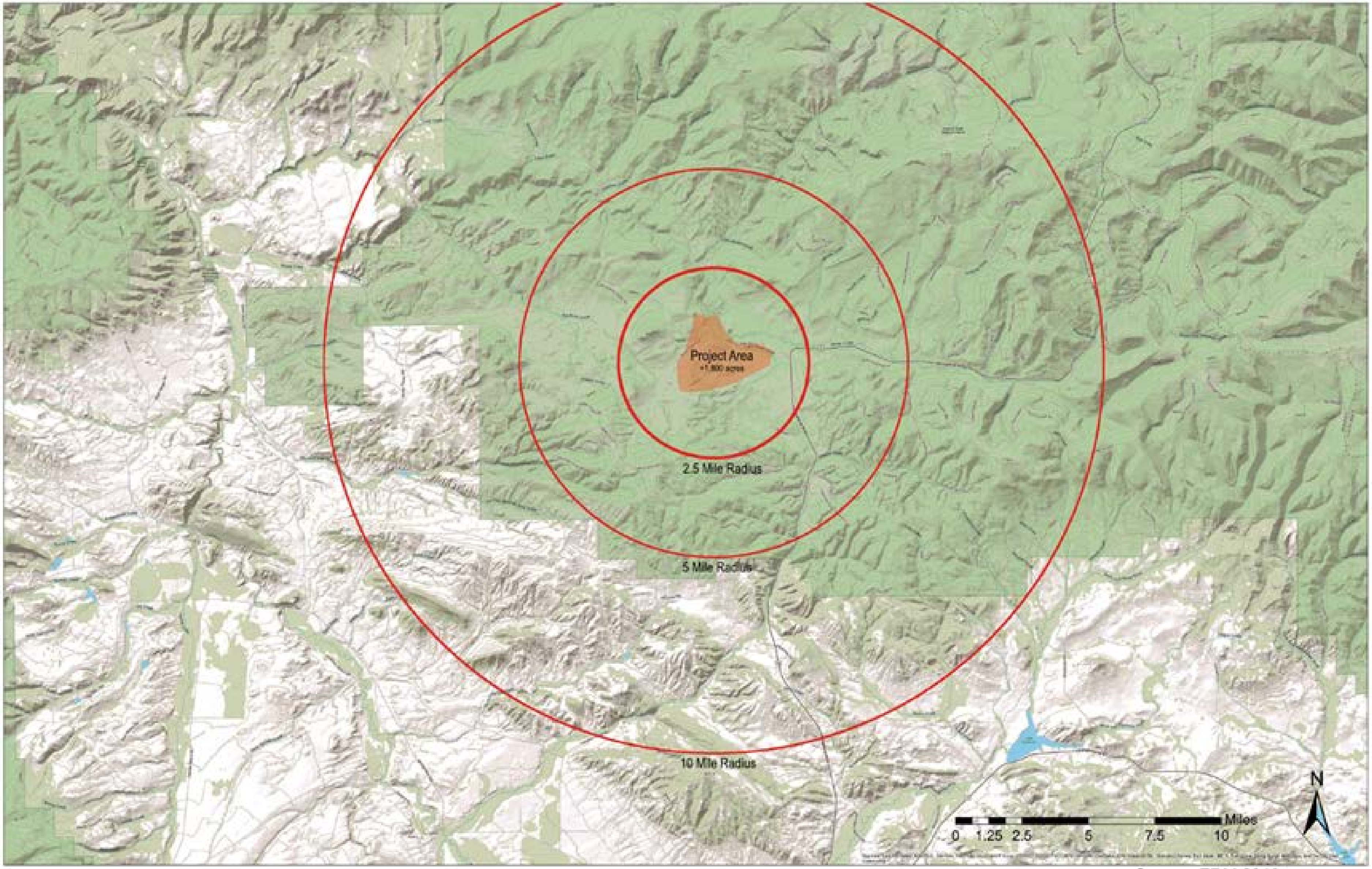
Historical development and land use has impacted the native landscape in the assessment area. There are seven existing or former mines and gravel pits within the assessment area (**Figure 3.8-2**) as well as scattered ranches and home sites.

U.S. Route 89 is the only highway in the assessment area and is the principal viewing corridor near the Project area. Other public roads with views to the Project area include Sheep Creek Road and Butte Creek Road. The foreground and middle-ground views from these roadways is of gentle to moderately sloping grasslands, fenced grazing lands, and occasional residential and quarry/mine development. Background views are generally of forested mountain ridges and occasional buttes.

3.8.2.2 Visual Receptors

Visual receptors include the residents and non-resident visitors that may be affected by changes to the visual resource.

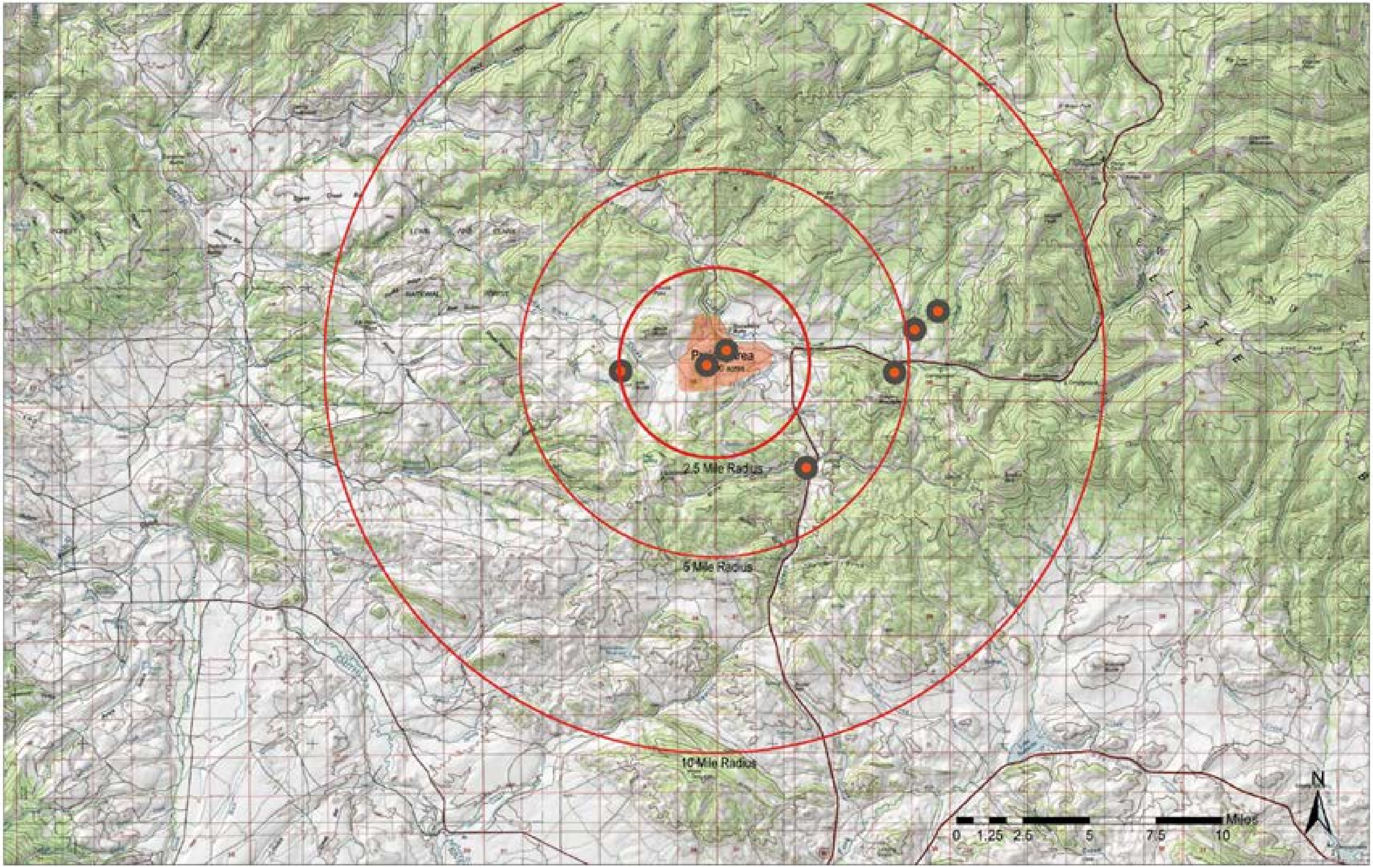
The nearest resident receptors include a single residence/ranch located approximately 2.15 miles east of the Project Area, and a small residential development consisting of approximately 12 homes approximately 3 miles southeast of the Project area. Existing vegetation and topography block some views of the Project area from the single residence and all views of the Project area from the other residential development.



This information is for environmental review purposes only.

Source: ERM 2018

Figure 3.8-1
Black Butte Copper Project
Assessment Area
Meagher County, Montana



This information is for environmental review purposes only.

Source: ERM 2018

Figure 3.8-2
Black Butte Copper Project
Existing Mines and Quarries
Meagher County, Montana

Non-resident visitors include travelers using U.S. Route 89. Some of these are the local population travelling between White Sulphur Springs and Neihart as well as users of the two recreational facilities located within a 10-mile radius of the assessment area that are accessed from the highway (**Figure 3.8-3**). Average annual daily traffic data from the MDT indicates that the number of vehicles using U.S. Route 89 varies from between 469 vehicles north of White Sulphur Springs to 442 vehicles south of Neihart (**Figure 3.8-4**). The short term traffic count station closest to the Project area, Site 30-2-001, is located within a 2.5-mile radius of the Project area and shows an average annual daily traffic of 364 vehicles in 2016. The MDT designates U.S. Route 89 as the King's Hill Scenic Byway. Views to the Project area from U.S. Route 89 are limited to a stretch of that roadway between the intersection of U.S. Route 89 and Sheep Creek Road south for approximately one-half mile.

3.8.3. Environmental Consequences

Viewers along highways and other access roads already view an altered state of the landscape. These existing alterations of the landscape include existing mines, quarries, fencing, and other associated human development.

Users of Sheep Creek Road and Butte Creek Road have prominent views of the Project area. No traffic-count information is available for Sheep Creek Road and it is assumed that it includes a subset of the travelers previously cited, including visitors from other areas using the two recreational facilities located within a 10-mile radius of the assessment area (**Figure 3.8-3**).

Views of the Project area would be limited by the relative elevation of the Project area and by its context within the existing vegetation and topographic variations.

3.8.3.1. No Action Alternative

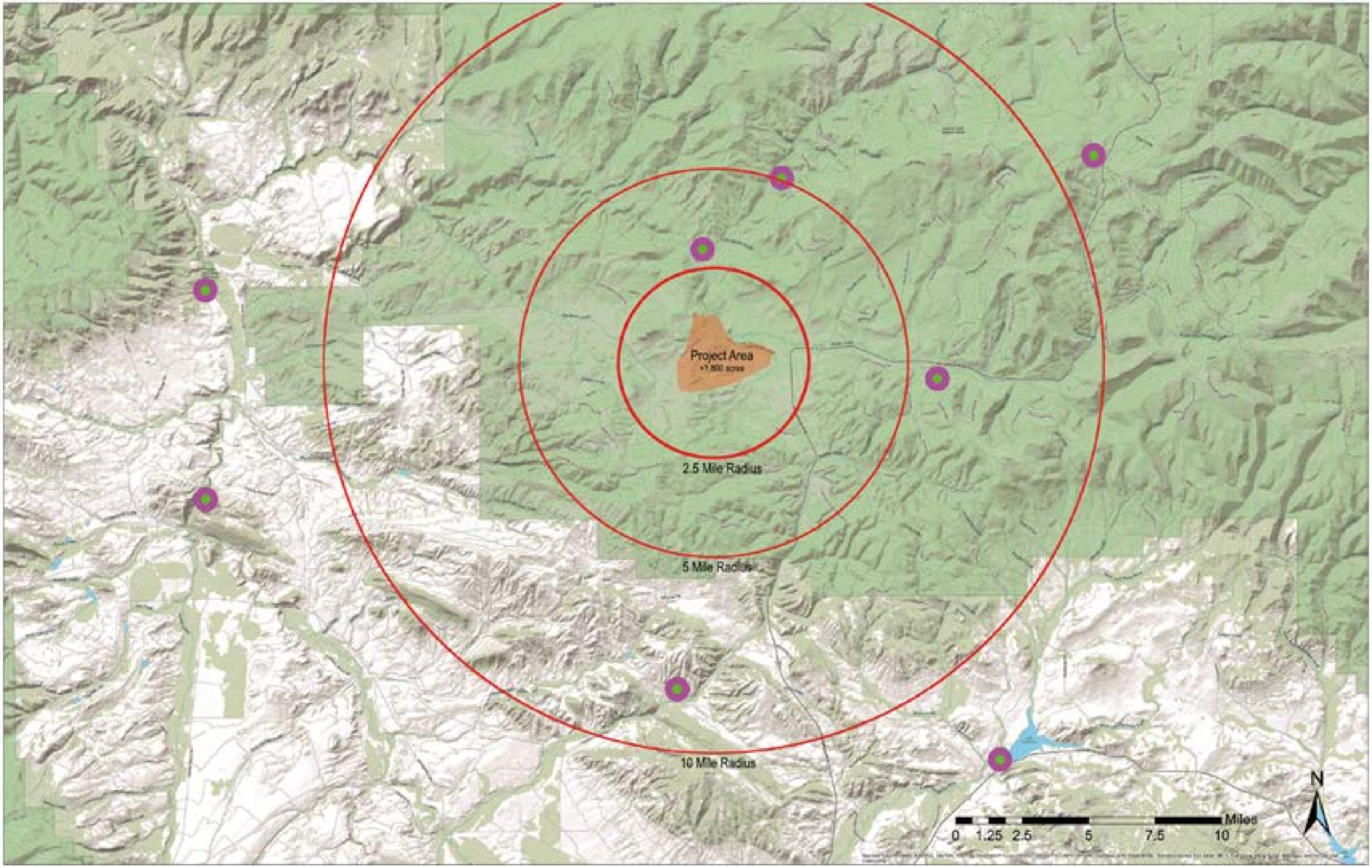
Under the No Action Alternative, the current condition of the visual resources in the assessment area would remain as they are, including the operations of existing mines, quarries, and residential, ranching, and recreational facility activities.

3.8.3.2. Proposed Action

The impact assessment used three key viewpoints from which the public could likely view the Project area:

- Viewpoint 2 located on U.S. Route 89 approximately 0.5 mile south of the intersection with Sheep Creek Road;
- Viewpoint 6 located on Sheep Creek Road approximately 1.3 miles west of the intersection with U.S. Route 89; and
- Viewpoint 7 located on Butte Creek Road approximately 0.75 mile southwest of the intersection with Sheep Creek Road.

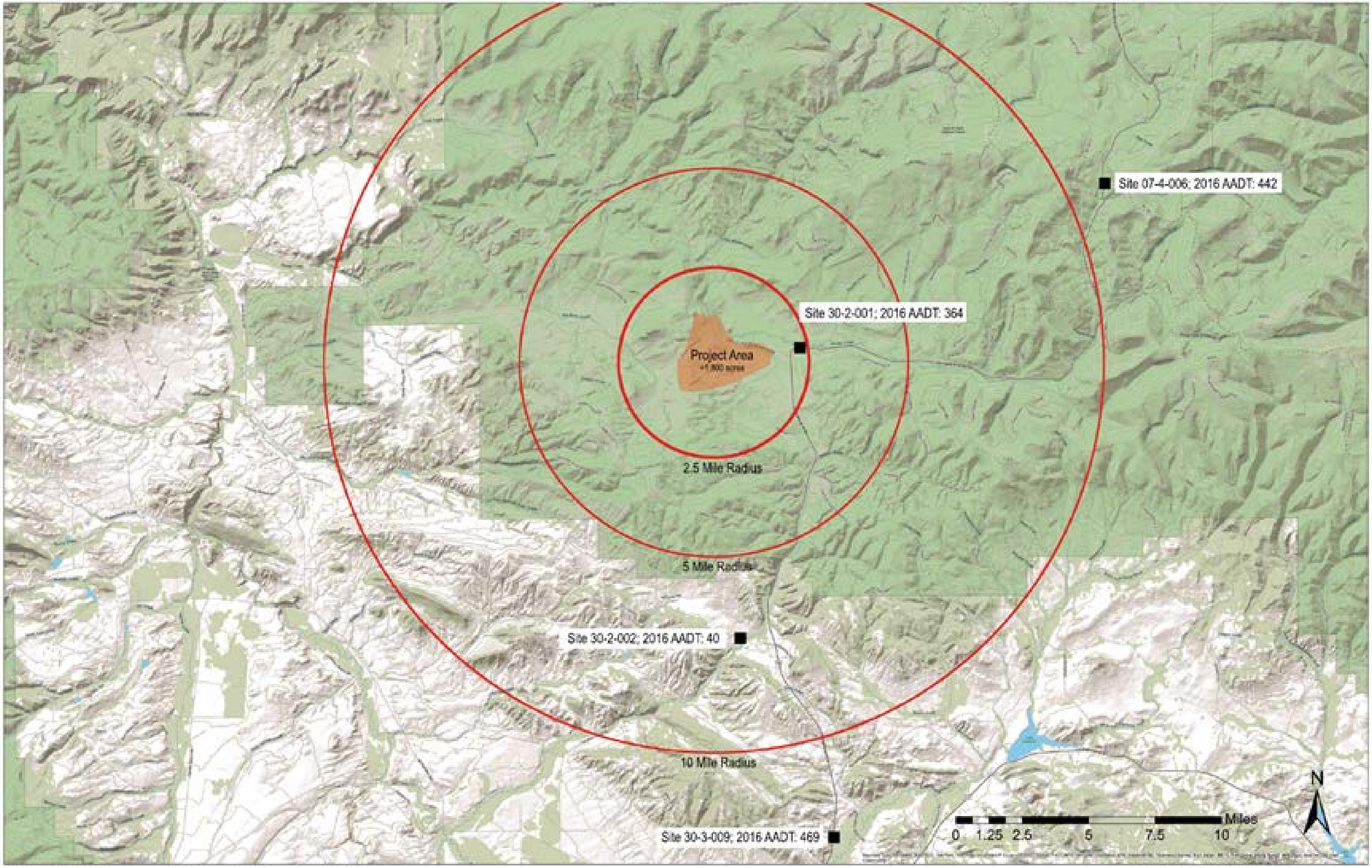
These viewpoints and direction of view-shed are illustrated in **Figure 3.8-5**.



This information is for environmental review purposes only.

Source: ERM 2018

Figure 3.8-3
Black Butte Copper Project
Campgrounds, Parks, and Recreation Areas
Meagher County, Montana



This information is for environmental review purposes only.

Source: ERM 2018

Figure 3.8-4
Black Butte Copper Project
Average Annual Daily Traffic
Meagher County, Montana

As part of the MOP Application, the applicant prepared a before and after simulation for each of these views (**Figure 3.8-6** through **Figure 3.8-11**) as well as an oblique aerial view of the Project (**Figure 3.8-12**). The oblique aerial simulation shows the overall Project development within the context of the landscape and visual resources of the area.

Figure 3.8-6 shows existing views from Viewpoint 2 from U.S. Route 89 and **Figure 3.8-7** simulates the impacts of the Project. The simulation demonstrates that there are no impacts to the foreground and middle-ground views of grassland and fences, and minimal impacts to the background view of Black Butte and the horizon. People travelling along U.S. Route 89 at typical speeds could catch fleeting glimpses of mine operations structures that, within the context of the overall landscape, would have minimal impact on views.

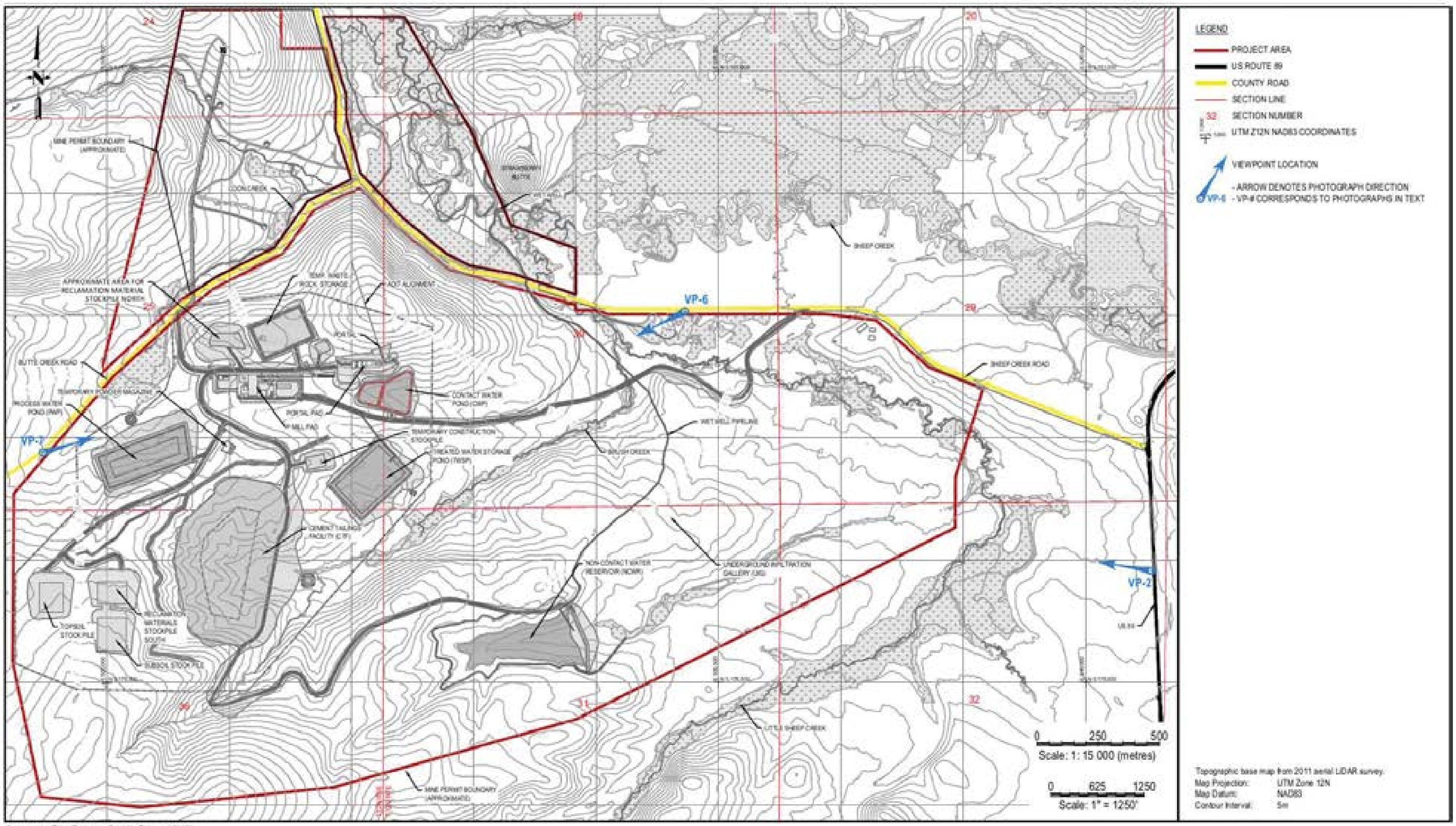
Figure 3.8-8 shows existing views from Viewpoint 6 from Sheep Creek Road and **Figure 3.8-9** simulates the impacts of the Project. The simulation shows the impacts of the construction of the Project access road and associated clearing and grading. Foreground views of grassland and fences and background views of forested areas are unaffected whereas roadwork and removal of vegetation from the cut bank would affect visual resources. People travelling along Sheep Creek Road at typical speeds would likely notice the loss of vegetation and changes to topography required for construction of the mine access road.

Figure 3.8-10 shows existing views from Viewpoint 7 from Butte Creek Road and **Figure 3.8-11** simulates the impacts of the Project. The simulation shows the impacts of the construction of the Project access road, ponds, mine operations structures, and associated clearing and grading. Foreground views of grassland and fences and background views of the forested mountain range are unaffected whereas imposition of mine facilities, ponds, and construction activity would affect the middle-ground views of grasslands and Black Butte. People travelling along Butte Creek Road at typical speeds would notice changes to vegetation and topography, as well as, the imposition of mine structures, roads, and waste rock piles.

In summary, the impacts on views from the three key viewpoints include the following:

- The addition of the Proposed Action to the landscape would not adversely impact views for people using U.S. Route 89.
- Those using Sheep Creek Road to access the two recreational facilities for camping and hiking in natural areas would experience localized impacts as a result of changes to the visible landscape that could have a detrimental impact on their experience.
- Those using Butte Creek Road would experience significant localized changes to views that could have a detrimental impact on their experience.

Impacts to visual resources during construction caused by removal of existing vegetation, temporary fencing, grading, construction of roads and mine structures, and increased construction vehicle traffic would be short term, local in scope, partially reversible, and experienced by a low number of users.



Prepared by Tetra Tech Inc. (Revised February 2019)

This information is for environmental review purposes only.

Source: Tintina 2017

Figure 3.8-5
Black Butte Copper Project
Viewpoints
Meagher County, Montana

This information is for environmental review purposes only.

Figure 3.8-6
Black Butte Copper Project
Viewpoint 2 Existing
Meagher County, Montana

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Figure 3.8-7
Black Butte Copper Project
Viewpoint 2 Proposed
Meagher County, Montana

This information is for environmental review purposes only.

Figure 3.8-8
Black Butte Copper Project
Viewpoint 6 Existing
Meagher County, Montana

This information is for environmental review purposes only.

Figure 3.8-9
Black Butte Copper Project
Viewpoint 6 Proposed
Meagher County, Montana

This information is for environmental review purposes only.

Figure 3.8-10
Black Butte Copper Project
Viewpoint 7 Existing
Meagher County, Montana

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Figure 3.8-11
Black Butte Copper Project
Viewpoint 7 Proposed
Meagher County, Montana

This information is for environmental review purposes only.

Source: Tetra Tech 2017

Figure 3.8-12
Black Butte Copper Project
Oblique Aerial
Meagher County, Montana

Impacts to visual resources during operation would be long term, local in scope, and partially reversible. The Project would use shielded lighting to minimize impacts to visual resources in the Sheep Creek valley during nighttime construction and operations activities. The proposed closure/reclamation process includes redistribution of topsoil and revegetation through planting of trees and seed mixes to re-establish pre-mining vegetative communities. Impacts to visual resources during closure would be from removal of equipment and structures, and from previously described construction and operational impacts. These impacts would be short term, local in scope, and experienced by a moderate number of users. During reclamation, grasses and shrub communities should be established within three to five growing seasons while forested communities would likely require several decades. The visual impacts would gradually diminish, and views would improve over time. Impacts to visual resources after reclamation would be long term (several years), local in scope, and experienced by a moderate number of viewers.

Smith River Assessment

The Project would have no direct or secondary impacts on visual and aesthetics resources in the Smith River area. The closest distance between the Project site and the Smith River is approximately 12 miles. The existing topography and vegetation block views of the Project from the river as well as from Smith River Road.

3.8.3.3. Agency Modified Alternative

The impacts of the AMA on visuals and aesthetics would be the same as described for the Proposed Action during the operational stage of the Project. Some additional waste rock could remain exposed after reclamation due to the "Additional Backfill of Mine Workings" alternative. Impacts would vary depending on the quantity and location of the remaining waste rock and on revegetation efforts.

Smith River Assessment

The AMA would have no direct or secondary impacts on visual and aesthetics resources in the Smith River area. The closest distance between the Project site and the Smith River is approximately 12 miles. The existing topography and vegetation block views of the Project from the river as well as from Smith River Road.

3.9. SOCIOECONOMICS

This chapter presents the socioeconomic resources within the proposed Project area and evaluates potential impacts to these resources. Socioeconomic resources include population and demographics, employment and income, economic activities, housing, public services and infrastructure, and health and quality of life.

3.9.1. Analysis Methods

Baseline information used in the following sections to document and describe the socioeconomic resources of the analysis area was obtained from federal and state government sources available online and the Project "Draft Hard Rock Mining Impact Plan" (Sandfire 2018). Other sources include the U.S. Census Bureau; U.S. Bureau of Labor Statistics; U.S. Bureau of Economic Analysis; Montana Census and Economic Information Center; Montana Department of Labor & Industry; County Health Rankings, and Meagher County. A spreadsheet analysis was used to determine percentages and produce summary tables. In all cases, the most recent, consistent, and reliable data were used in the analysis.

3.9.1.1. Analysis Area

The socioeconomic analysis area (see **Figure 3.9-1)** was based on various factors that may influence the location and magnitude of potential socioeconomic impacts. Some factors include Project location, employment and purchasing, fiscal impacts to local governments, workforce influx, and accommodation. In addition, the analysis area was influenced by comments received during the public scoping process.

The Project is located entirely within Meagher County approximately 15 miles north of White Sulphur Springs and within 110 miles of other population centers including Belgrade, Bozeman, Great Falls, Harlowton, Helena, Livingston, Stanford, and Townsend. As such, the socioeconomic analysis area for the Project includes Meagher County, City of White Sulphur Springs, and School District #8 White Sulphur Springs K-12. It includes a broader region of influence, including Broadwater, Cascade, Gallatin, Judith Basin, Lewis and Clark, Park, and Wheatland counties where job opportunities and economic benefits may extend, and may extend even farther depending on where Project goods and services are purchased.

3.9.2. Affected Environment

3.9.2.1. Population and Demographics

Meagher County's primary population center and only incorporated community is the City of White Sulphur Springs. Three unincorporated communities are located in Meagher County: Lennep, Martinsdale, and Ringling.

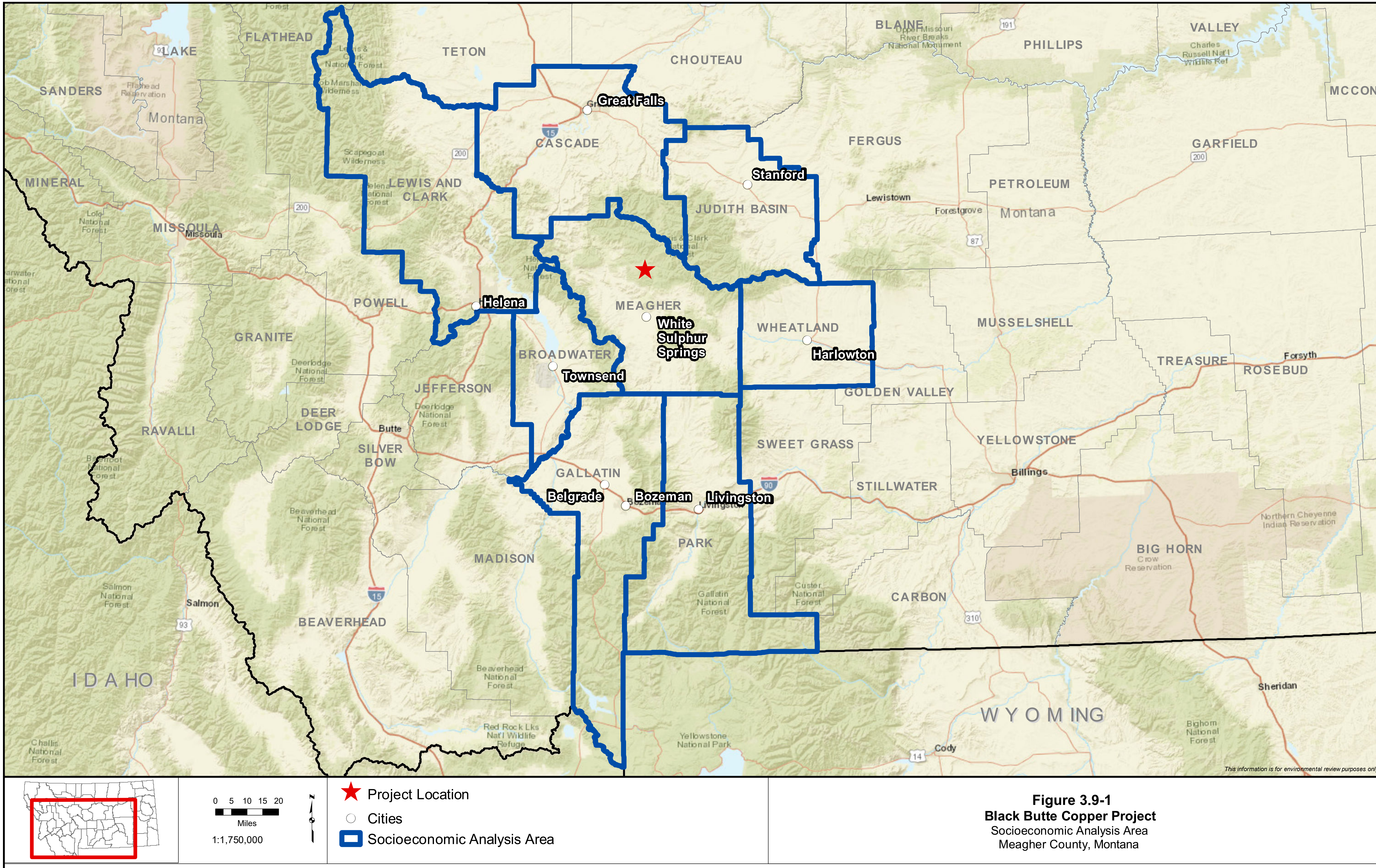


Figure 3.9-1
Black Butte Copper Project
Socioeconomic Analysis Area
Meagher County, Montana

Table 3.9-1 provides a summary of population and demographic measures for Meagher County and surrounding counties in the socioeconomic analysis area, with data for the state of Montana shown for comparative purposes. Meagher County population has increased by nearly 4 percent over the last decade, which is similar to population growth over that same period for Montana (U.S. Census Bureau 2010; U.S. Census Bureau 2016). Gallatin County population has experienced the highest increase in population (9.4 percent) and Judith Basin County has experienced the greatest decline in population (-4.4 percent) of the socioeconomic analysis area counties. Meagher County has an aging population with a median age of approximately 48.6, compared to Montana's median age of 39.8. The median age in all other socioeconomic analysis area counties is higher than the state except for Cascade County and Gallatin County.

Table 3.9-1
2016 Selected Population and Demographic Measures

County	2016 Population Estimate	2010 Census	Population change (2010 to 2016*)	Median Age	Percent White	Percent Minority
Meagher County	1,960	1,891	3.6	48.6	98%	2%
White Sulphur Springs	999	939	6.4	42.2	99%	1%
Broadwater County	5,692	5,612	1.4	46.7	97%	4%
Townsend	1,941	1,878	3.4	40.8	93%	7%
Cascade County	82,049	81,327	0.9	38.0	92%	8%
Great Falls	59,479	58,505	1.7	38.7	91%	9%
Gallatin County	97,958	89,513	9.4	33.2	97%	3%
Bozeman	41,761	37,280	12.0	27.9	95%	5%
Belgrade	7,874	7,389	6.6	32.6	96%	5%
Judith Basin County	1,981	2,072	-4.4	52.0	99%	1%
Stanford	368	401	-8.2	53.7	98%	2%
Lewis and Clark County	65,989	63,395	4.1	41.2	96%	4%
Helena	30,102	28,190	6.8	41.6	96%	4%
Park County	15,843	15,636	1.3	46.4	99%	1%
Livingston	7,210	7,044	2.4	41.3	99%	1%
Wheatland County	2,109	2,168	-2.7	42.9	98%	2%
Harlowton	932	997	-6.5	48.8	97%	3%
Montana	1,023,391	989,415	3.4	39.8	89%	11%

Source: U.S. Census Bureau 2010; U.S. Census Bureau 2016

[a] Percent totals are greater or less than 100 percent due to rounding.

As **Table 3.9-1** shows, Meagher County population in 2016 was more than 98 percent white and other socioeconomic analysis area counties ranged from 92 to 99 percent white, which is generally less diverse than the state of Montana (89.2 percent white).

3.9.2.2. Employment and Income

Mining activity has historically played a major role in the economy of the socioeconomic analysis area communities since the late 1800s. The past gold mining and silver mining boom and bust cycles throughout the 1900s contributed to periods of significant economic growth and decline. Timber and agriculture sectors have also been key to the socioeconomic analysis area economy (Meagher County 2015). Today, the largest industry in Meagher County is farming and ranching. **Table 3.9-2** provides a summary of employment by industry in Meagher County.

Table 3.9-2
2016 Meagher County Employment by Industry

Employment by Industry in Meagher County	Number of Jobs	Percent of Total Employment
Farm	193	25%
Retail Trade	87	11%
Transportation and warehousing	33	4%
Professional, scientific, and technical services	53	7%
Administrative and waste services	18	2%
Educational services	10	1%
Arts, entertainment, and recreation	71	9%
Accommodation and food services	113	15%
Other services, except public admin.	48	6%
Government	146	19%

Source: USBEA 2016a

U.S. Bureau of Economic Analysis does not show Meagher County employment for some industries (i.e., Mining, Forestry, Construction, Health Care) to avoid disclosure of confidential information. As of 2016, mining employment in Montana accounted for 1.2 percent of total employment, compared to less than 1 percent of the total employment in the United States. The median wage for a mining sector job in Montana was $60,190 in 2016, higher than the overall median wage in Montana of $32,750. One can assume that mining wages in the socioeconomic analysis area are similar, at least to the extent that they are higher than the overall median wage in Montana (Montana DLI 2016).

Montana Department of Labor & Industry estimated the labor force in Meagher County to be 875 with 839 people employed and an estimated 36 people unemployed in 2017, with the unemployment rate at 4.1 percent (Sandfire 2018).

Table 3.9-3 provides a summary of five measures of individual prosperity for the overall socioeconomic analysis area economy, with data for the state of Montana shown for comparative purposes. These five measures include unemployment, average earnings per job, per capita personal income, median household income, and families with income below the poverty level. The total labor force is also given in the first column of the table for reference.

Table 3.9-3
2016 Selected Employment and Income Measures

County	Labor Force	Unemployment Rate	Average Earnings Per Job*	Per Capita Personal Income**	Median Household Income***	All Ages in Poverty ***
Meagher County	888	5%	$30,656	$19,989	$39,284	18.3%
Broadwater County	2,499	5%	$30,378	$29,598	$50,791	10.6%
Cascade County	37,979	4%	$46,667	$26,578	$45,569	14.2%
Gallatin County	64,532	3%	$44,612	$31,909	$60,439	11.4%
Judith Basin County	930	4%	$42,875	$28,741	$44,607	13.4%
Lewis and Clark County	35,388	4%	$47,953	$29,892	$60,370	10.4%
Park County	8,192	5%	$32,108	$27,597	$45,405	11.7%
Wheatland County	776	5%	$37,227	$19,407	$37,306	19%
State of Montana	526,944	4%	$43,654	$27,309	$50,265	13.4%

Source: Montana DLI 2017, *USBEA 2016b, **U.S. Census Bureau 2016, ***SAIPE 2016

Meagher County's current economic indicators are generally on the lower end of the larger analysis area, indicating a less healthy economy. Meagher County had the second highest unemployment rate of socioeconomic analysis area counties at 5 percent compared to the Montana unemployment rate of 4.2 percent (Montana DLI 2017). Meagher County and Broadwater County had the lowest average earnings per job of socioeconomic analysis area counties at $30,656 and $30,378 respectively, compared to Montana at $43,654 (USBEA 2016b).

Per capita personal income (or average personal income) is the total personal income of an area divided by that area's population. Meagher County and Wheatland County had the lowest per capita income among socioeconomic analysis area counties at $19,989 and $19,407 respectively, compared to Montana at $27,309 (U.S. Census Bureau 2016).

Median household income is the income level earned by a given household in a given area where half the households in that area earn more and half earn less; "median" household is used instead of "average" or "mean" household income because it can give a more accurate picture of an area's actual economic status. Median household incomes were the lowest in Meagher County and Wheatland County at $39,284 and $37,306 respectively, compared to Montana at $50,265 (SAIPE 2016).

Wheatland County had the highest percentage of persons in poverty at more than 19 percent, followed by Meagher County at more than 18 percent. Lewis and Clark County had the lowest percentage of persons in poverty at 10.4 percent (SAIPE 2016).

The Mountainview Medical Center is the largest employer in the City of White Sulphur Springs and Meagher County. The center is a critical access hospital that employs between 50 and 99 people. Critical access hospitals are limited service hospitals designed to provide essential services to rural communities. Other large employers include Showdown Ski Area and The Equestrian Center at Horse Creek. **Table 3.9-4** summarizes top employers in Meagher County.

Table 3.9-4
2016 Top Employers in Meagher County

Business Name	Number of Employees
All Seasons Inn & Suites	10-19
Bank of the Rockies	10-19
Bar 47	20-49
Castle Mountain Grocery	10-19
Mathis Food Farm	10-19
Mountainview Medical Center	50-99
Seventy-One Ranch LP	10-19
Showdown Ski Area	20-49
The Equestrian Center at Horse Creek	20-49

Source: Montana DLI 2016

3.9.2.3. Housing

Meagher County had a 2010 Census count of 1,432 housing units. The City of White Sulphur Springs had 986 units. Owner occupied housing was 72.9 percent or 1,044 units. The median housing value was $139,500. An additional 388 housing units were either vacant or rented. The median rent was $625 per month. Four motels are in White Sulphur Springs with 87 rooms (Sandfire 2018).

According to the “Meagher County Growth Plan” and White Sulphur Springs Growth Policy, significant numbers of housing units in White Sulphur Springs are deteriorated and there is a need for programs to rehabilitate or replace housing in poor condition (CTA 2017; Meagher County 2015). Almost every residential structure in Meagher County is a single family home or mobile home. A few multiple family structures, mostly apartments, exist in White Sulphur Springs. Over 100 motel rooms and recreational vehicle (RV) sites are available in White Sulphur Springs (Sandfire 2018). Outside of Meagher County, areas with the largest population and housing availability include Bozeman, Great Falls, and Helena. **Table 3.9-5** provides a summary of housing for each county in the socioeconomic analysis area (Sandfire 2018).

Table 3.9-5
2016 Selected Housing Measures

County	Housing Units	Median Value	Vacant/ Rented	Median Rent	Motel/Hotel Rooms
Meagher County	1,432	$139,500	388	$625	-
White Sulphur Springs	986	NA	NA	NA	87
Broadwater County	2,695	$184,600	596	$655	NA
Townsend (40 miles from White Sulphur Springs)	888	NA	NA	NA	36
Cascade County	37,276	$216,900	13,606	$655	NA

County	Housing Units	Median Value	Vacant/ Rented	Median Rent	Motel/Hotel Rooms
Great Falls (100 miles from White Sulphur Springs)	26,854	NA	NA	NA	>2,100
Gallatin County	42,289	$271,500	16,281	$876	NA
Bozeman (80 miles from White Sulphur Springs)	17,463	NA	NA	NA	>2,000
Belgrade (80 miles from White Sulphur Springs)	3,174	NA	NA	NA	>200
Judith Basin County	1,336	$117,000	396	$485	11
Stanford (90 miles from White Sulphur Springs)	247	NA	NA	NA	NA
Lewis and Clark County	30,180	$206,600	9,235	$876	NA
Helena (70 miles from White Sulphur Springs)	13,457	NA	NA	NA	>1,500
Park County	9,375	$216,900	9,235	$783	NA
Livingston (70 miles from White Sulphur Springs)	3,779	NA	NA	NA	>380
Wheatland County	1,197	$83,300	395	$551	NA
Harlowton (50 miles from White Sulphur Springs)	585	NA	NA	NA	37

Source: Sandfire 2018

NA = not applicable

3.9.2.4. Public Infrastructure and Services

Meagher County is governed by a three-member Board of County Commissioners. Other administrative officers include the Clerk and Recorder, Treasurer, County Attorney, Superintendent of Schools, law enforcement, Justice of the Peace, disaster and emergency services, and Clerk of District Court (Sandfire 2018); all of which are located in White Sulphur Springs.

Meagher County has several law enforcement agencies that serve the county, including the Helena-Lewis and Clark National Forest law enforcement officers, Montana Highway Patrol, and the Sheriff's Department. The Sheriff's Department is located in White Sulphur Springs and employs a sheriff, two full-time deputies, and five dispatchers.

The County Road Department maintains approximately 200 miles of roads, most of which are gravel. The department is also responsible for maintaining ten bridges on those roads. The department includes a road supervisor and three full-time employees (Sandfire 2018).

Fire protection is provided in Meagher County by several fire departments: City of White Sulphur Springs, Meagher County Fire District, Martinsdale Fire Service Area, and Grassy Mountain Rural Fire District. In total Meagher County has 12 structure trucks, 7 tenders, and

1 bucket truck. Volunteer fire fighters, with a ½ full-time equivalent fire chief, operate the agencies (Sandfire 2018).

Ambulance and emergency medical service is provided by 18 certified emergency medical technicians and three ambulances (Sandfire 2018). A ½ full-time equivalent paramedic is employed by Meagher County (Sandfire 2018).

The White Sulphur Springs sewage treatment plant is currently being upgraded to comply with the state sewage treatment permit (Sandfire 2018). The upgraded wastewater system will be able to serve a population of 1,800 (Sandfire 2018).

White Sulphur Springs obtains its public water supply from two wells in the northeast part of the city and from South Willow Creek about 2 miles east of the city. The city's water system has gone through several upgrades.

White Sulphur Springs' streets are in poor condition in some locations throughout the city and the situation is exacerbated where underlying water or sewer lines are deteriorated (CTA 2017). The city plans to undertake combined street and water/sewer repaving–line replacement projects to upgrade and repair old, deteriorated, or inadequate water/sewer lines that underlie streets (CTA 2017).

The Meagher County City Library is located in White Sulphur Springs and provides library services across Meagher County. The Library Foundation has secured sufficient funding to construct a new library on a site adjacent to U.S. Route 12/89. Construction began in summer 2018. Library staff includes one full-time librarian and one part-time employee.

One school district in Meagher County serves grades K-12. Enrollment in the 2016 to 2017 school year was 129 students for K-8 and 61 students in grades 9 to 12. K-8 enrollment is down 30 students and high school enrollment is down 19 students, compared to the 2010 to 2011 school year (Sandfire 2018). **Table 3.9-6** provides a summary of student enrollment for each county in the socioeconomic analysis area.

Table 3.9-6
2016-2017 School Enrollment

County	**K-8 Students**	**High School Students**
Meagher County	129	61
Broadwater County	462	208
Cascade County	8,400	3,313
Gallatin County	9,580	3,530
Judith Basin County	180	77
Lewis and Clark County	6,598	2,998
Park County	1,356	611
Wheatland County	236	75

Source: Sandfire 2018

Meagher County has lower educational attainment on average than other counties in the analysis area. As shown in **Table 3.9-7**, Meagher County has the second lowest percentage of the population with a postsecondary degree (i.e., associate's degree, bachelor's degree, and graduate or professional degree) at 28.3 percent compared to other socioeconomic analysis area counties. Wheatland County has the lowest percentage of the population with a postsecondary degree at 21.9 percent and Gallatin County has the highest percentage of the population with a postsecondary degree at 54.5 percent (U.S. Census Bureau 2016).

3.9.2.5. Health and Quality of Life

Health and quality of life are dependent on a number of factors, particularly access to education, public services, healthcare, recreation, and social services. According to the White Sulphur Springs Growth Policy, residents are increasingly interested in ensuring new growth and development be located in suitable locations, and that it be designed and constructed to ensure the health, safety, and livability for residents (CTA 2017). Both the Meagher County and White Sulphur Springs growth plans indicate the aging of the population is likely to continue and could have impacts upon the area's ability to provide services such as healthcare (CTA 2017; Meagher County 2015). This is because aging populations tend to require additional healthcare treatment for more than one chronic condition; therefore, the cost of health care increases.

The Meagher County Draft Growth Policy indicates there has been a departure of businesses important to the health and well-being of the community, such as the loss of a dentist office and a chiropractor (Meagher County 2015). The growth policy recommends an assessment of services to understand the community's service needs, develop strategies to help retain existing services/businesses and identify opportunities to attract new or replacement businesses (Meagher County 2015).

Table 3.9-8 presents selected health measures of county residents from the socioeconomic analysis area, and with data for the state of Montana shown for comparative purposes. County Health Rankings has developed a model for ranking counties relative to the health of other counties in the same state according to summaries of a variety of health measures. Health outcome rankings are calculated based on length of life (mortality) and how healthy people feel while alive (quality of life). Health factor rankings are calculated based on health behaviors, clinical care, social and economic factors, and the physical environment. Rankings are out of 47 because 47 of the 56 counties in Montana were ranked while 9 counties were not ranked due to unreliable or missing data (County Health Rankings 2017).

Table 3.9-7
2016 Educational Attainment

County	Less Than 9th Grade	9th to 12th Grade, No Diploma	High School Graduate (Includes Equivalency)	Some College, No Degree	Associate's Degree	Bachelor's Degree	Graduate or Professional Degree
Meagher County	2%	6%	42%	22%	7%	17%	5%
White Sulphur Springs	3%	6%	52%	16%	11%	9%	2%
Broadwater County	2%	5%	38%	23%	6%	19%	8%
Townsend	4%	8%	39%	19%	8%	14%	9%
Cascade County	2%	6%	31%	25%	9%	18%	8%
Great Falls	2%	7%	31%	26%	9%	18%	8%
Gallatin County	1%	2%	20%	23%	6%	32%	17%
Bozeman	<1%	1%	13%	24%	6%	35%	21%
Belgrade	2%	5%	34%	24%	6%	20%	9%
Judith Basin County	1%	4%	35%	22%	7%	27%	4%
Stanford	<1%	3%	36%	31%	5%	19%	6%
Lewis and Clark County	2%	4%	25%	25%	8%	24%	13%
Helena	2%	3%	21%	22%	8%	27%	17%
Park County	1%	4%	33%	22%	5%	23%	12%
Livingston	<1%	5%	35%	22%	4%	24%	10%
Wheatland County	18%	6%	33%	21%	3%	15%	4%
Harlowton	9%	7%	41%	24%	2%	15%	3%

Source: U.S. Census Bureau 2016

[a] Percent totals are greater or less than 100% due to rounding

Table 3.9-8
2017 Selected Health Measures

County	Health Outcomes Ranking (out of 47)	Select Health Outcome Measures		Health Factors Ranking (out of 47)	Select Health Factor Measures	
		Premature Death (in years of potential life lost)	Poor or Fair Health		Ratio of Population to Primary Care Physicians	Obesity Rate (population 20 years +)
Meagher County	41	NA	16%	34	1,850:1	24%
Broadwater County	23	10,500	13%	23	2,830:1	30%
Cascade County	20	7,200	15%	24	1,310:1	28%
Gallatin County	2	4,200	12%	1	1,330:1	16%
Judith Basin County	30	NA	12%	12	1,990:0	29%
Lewis and Clark County	9	5,900	11%	3	1,140:1	24%
Park County	11	7,600	13%	7	880:1	23%
Wheatland County	26	NA	15%	33	NA	25%
Montana	NA	7,100	NA	NA	1,310:1	25%

Source: County Health Rankings 2017

The data show that Meagher County has the lowest health outcomes ranking and the lowest health factors ranking among socioeconomic analysis area communities. The table includes select health measures as an example of what contributes to the rankings. Premature death is one type of health outcome measure that is factored into the health outcomes ranking, and it is defined as the years of potential life lost before age 75; many premature deaths are considered preventable. Quality of life is the second type of health outcome measure that incorporates four measures (poor or fair health, poor physical health days, poor mental health days, and low birthweight). The data show that premature death is higher in three of the socioeconomic analysis area counties than in Montana on average, and that accessibility to primary care physicians also tends to be lower in these counties. The lack of healthcare professionals is common in rural areas, as are higher rates of obesity, as shown in **Table 3.9-8**.

3.9.3. Environmental Consequences

Potential socioeconomic impacts relate to the expected changes a community experiences as a result of the Project alternatives under consideration in this EIS. These can relate to changes in population, demographics, income, taxes, and demands on community and government services.

3.9.3.1. No Action Alternative

Under the No Action Alternative, there would be minimal impacts to socioeconomics as population, employment, and economic activity levels would be expected to follow current trends.

3.9.3.2. Proposed Action

Under the Proposed Action, potential impacts on socioeconomic resources were assessed based on assumptions using the best available information. This includes the Proponent’s estimates of the number of workers needed for construction, operations, and associated mine support services; findings from other large-scale developments such as the Rosebud Mine near Colstrip, Montana; and monitoring results presented in the most recent “East Boulder Mine Hard Rock Mining Impact Plan,” which indicates that workers will travel up to 2 hours for higher paying natural resource jobs (Sandfire 2018).

Projected Employment

The workforce estimates summarized in **Table 3.9-9** were obtained from the “Draft Hard Rock Mining Impact Plan” and used to project potential workforce and associated population influx over the life of the mine.

Table 3.9-9
Project Workforce Estimates

Worker Type	Construction			Operations	Reclamation/Closure			
	Year 1	Year 2	Year 3	Years 4-14	Year 15	Year 16	Year 17	Year 18
Proponent Employees	14	37	165	235	203	90	60	40
Proponent Contractors	70	115	108	24	24	24	24	24
Associated Support Workers [a]	8	20	89	127	110	49	32	22
Total	92	362	293	386	337	163	116	86

Source: Sandfire 2018

[a] Associated support workers are considered workers that would provide secondary support services to the mine, but would not be employed or contracted directly by the Project.

The Proponent expects to hire up to 200 contractors during the construction phase in Year 1 and into Year 3; not all contractors would be at the Project site at the same time. As shown in **Table 3.9-9**, contractors are expected to peak at 115 during construction in Year 2, and up to 24 contractors are projected to be at the mine site from time to time during the operations and reclamation phases of the project. The number of Proponent employees is projected to gradually ramp up through the first 3 years up to an operating workforce of 235 employees. Associated support workers are considered workers that would provide secondary support services to the mine, but would not be employed or contracted directly by the Project. The Proponent estimates that the number of associated support workers would be at a ratio of 0.54 for every Project employee and contractor.

Projected Workforce Influx

Workforce influx projections were obtained from the "Draft Hard Rock Mining Impact Plan," which includes assumptions about the extent to which workers can be hired locally (defined as within 110 miles of the mining operations or within an approximate 1.5-hour commuting distance) and the extent to which workers may move in from outside the 110-mile area (referred to as in-migrating workers):

- An estimated 30 percent of Proponent employees can be hired locally from the area (within 110 miles of the mining operations) and 70 percent are projected to move in from outside of the 110-mile area.
- An estimated 30 percent of Proponent contractors can be hired locally from the area (within 110 miles of the mining operations) and 70 percent are projected to move in from outside of the 110-mile area.
- An estimated 70 percent of associated support workers can be hired locally from the area (within 110 miles of the mining operations) and 30 percent are projected to move in from outside of the 110-mile area.

Table 3.9-10 provides a summary of workers that are projected to move into the area for the mine by applying the influx assumptions listed above to **Table 3.9-9**.

Table 3.9-10
Projected Workforce Influx

Worker Type	Construction			Operations	Reclamation/Closure			
	Year 1	Year 2	Year 3	Years 4-14	Year 15	Year 16	Year 17	Year 18
In-migrating Proponent Employees (70% of total employees)	10	26	116	165	142	163	42	28
In-migrating Proponent Contractors (70% of total contractors)	49	81	76	17	17	17	17	17
In-migrating Associated Support Workers (30% of total associated support workers) [a]	2	6	27	38	33	15	10	7
Total	61	113	219	220	192	95	69	52

Source: Sandfire 2018

[a] Associated support workers are considered workers that would provide secondary support services to the mine, but would not be employed or contracted directly by the Project.

Projected Population Influx and Distribution

Population influx and distribution projections were obtained from the “Draft Hard Rock Mining Impact Plan.” To estimate potential population influx associated with the Proposed Action and distribution, the Proponent made the following assumptions about whether in-migrating workers may bring their families and where they may decide to reside as a result of the Proposed Action:

- 50 percent of in-migrating workers (i.e., Proponent employees, contractors, and associated support workers) are projected to move into Meagher County; the remainder would reside outside of Meagher County but within 110 miles of the Project.
- In-migrating Proponent employees and associated support workers are projected with dependents, assuming an average of 2.46 people per household based on the state average.
- In-migrating Contractors are projected without dependents given the temporary construction period.
- Among in-migrating workers moving to Meagher County, 90 percent are estimated to stay in White Sulphur Springs.

Table 3.9-11 provides a summary of projected population influx and distribution by applying the assumptions listed above to **Table 3.9-10**. In-migrating workers and associated population influx numbers are presented across three geographic areas in **Table 3.9-11** to show the potential distribution of influx to Meagher County, and outside Meagher County but within 110 miles of the Project and White Sulphur Springs.

Table 3.9-11
Projected Population Influx Relocating to Meagher County and Areas within 110 miles of the Project

Population Influx Type	Construction			Operations	Reclamation/Closure			
	Year 1	Year 2	Year 3	Years 4 -14	Year 15	Year 16	Year 17	Year 18
Meagher County Influx (50% of influx)								
In-migrating workers (including Employees, Contractors and Associated Support Workers)	31	57	110	110	96	48	35	26
Associated population influx	40	80	214	258	224	105	73	52
Influx Outside Meagher County But Within 110 Miles Of The Project (50% of influx)								
In-migrating workers	31	57	110	110	96	48	35	26
Associated population influx	40	80	214	258	224	105	73	52
White Sulphur Springs Influx (90% of Meagher County Influx)								
In-migrating workers	28	51	99	99	86	43	32	23
Associated population influx	36	72	193	232	202	95	66	47

Source: Sandfire 2018

As shown in **Table 3.9-11**, Meagher County is projected to have 214 people move in during peak construction (Year 3), with 193 of them residing in White Sulphur Springs. During operations, Meagher County is projected to have 258 people move in, with 232 of them residing in White Sulphur Springs.

Population and Demographic Change

Under the Proposed Action, Meagher County and the city of White Sulphur Springs are expected to be most impacted by population influx. The population of Meagher County (estimated at 1,960 as of 2016) is projected to increase by 13 percent, assuming 258 people move into Meagher County as a result of the Project. This represents a significant increase, given the population in Meagher County has only increased by 3.6 percent over a 6-year period (since 2010). The City of White Sulphur Springs population (estimated at 999 as of 2016) is projected to increase by 23 percent, assuming 232 of the 258 people in-migrating to Meagher County move into White Sulphur Springs. This would also represent a significant increase, given that the population in White Sulphur Springs has only increased by 6.4 percent over a 6-year period (since 2010). All other socioeconomic analysis area county populations are projected to increase by 1 to 10 percent assuming remaining population influx outside Meagher County but within a 110 mile area of the Project is evenly distributed across cities and towns in the seven counties surrounding Meagher County. It is important to note that both Meagher County and the City of White Sulphur Spring have had larger populations at 2,154 and 1,302 respectively in 1980 (U.S. Census Bureau 1995). This suggests that the projected population increase would bring the population totals roughly back in line with 1980 numbers. In other words, this area has seen and handled the projected higher population numbers before.

Project-related employment would be based on candidate skill set and qualification. While the demographic make-up of individuals that would move to the area as a result of the Project is unknown, based on U.S. labor force statistics, the total employed in mining, quarrying, and oil and gas extraction sector jobs represent a workforce population that is 88 percent white and 13 percent women (USBLS 2018). If Project-related employment is similar to U.S. employment demographics in mining, quarrying, and oil and gas extraction sector jobs, workforce influx would represent a male-dominated, slightly more racially diverse in-migrating population compared to existing analysis area populations (as mentioned in Section 3.9.2, socioeconomic analysis area counties ranged from 92 to 99 percent white).

Employment, Income and Tax Revenues

Under the Proposed Action, the Proponent expects to hire up to 200 contractors during the construction phase and employ an operating workforce of 235 employees. These jobs would be expected to pay more than the average wage of people employed in the socioeconomic analysis area counties. In addition to job creation, the Proposed Action would deliver further benefits to the local economy from Project investment, purchasing, and tax payments.

The Hard Rock Mining Impact Act, Tax Base Sharing Act, and metal mines license tax allocation are intended to mitigate fiscal impacts of a hard rock mineral development and assist affected local governments in preparing for, and mitigating, area fiscal and economic impacts.

The Hard Rock Mining Impact Act requires the mineral developer to prepare an impact plan that describes the financial impacts the Proposed Action would have on affected units of local government, which include Meagher County, the City of White Sulphur Springs, and the White Sulphur Springs Public School District #8. Under the Impact Act, the mineral developer commits to pay all increased local government costs resulting from the construction and operation of the Proposed Action.

Under the Montana Tax Base Sharing Act, the increase in taxable valuation of the mineral development that occurs after the operating permit is issued must be allocated among the affected local government units within each of three categories: counties and incorporated cities or towns, high school districts, or elementary school districts [§ 90-6-403 and § 90-6-404, MCA]. White Sulphur Springs would receive 20 percent of the Project's taxable valuation to assess its mill levies against, and Meagher County would be able to levy 100 percent of its mills for all funds except those that are not levied within the city limits of White Sulphur Springs. The White Sulphur Springs Public School District #8 would receive 100 percent of the Project's taxable valuation since it is the only school district in Meagher County. The increase in taxable valuation is projected to be $8.2 million at peak copper production (Sandfire 2018).

The metal mines license tax is collected by Montana Department of Revenue and is based on the mineral and the extent of processing that occurs before the mineral is transported. Annually, the Department of Revenue transfers 35 percent of metal mines license tax collections to the affected government units as identified in the "Hard Rock Mining Impact Plan." According to the plan, over $4 million per year would be paid in the metal mines license tax to the State of Montana as a result of production from the Proposed Action; over $1.4 million per year is estimated to be distributed to Meagher County during the projected 11 years of production (Sandfire 2018).

Housing

Based on the population influx projections summarized in **Table 3.9-11**, Meagher County is projected to have 214 people move in during peak construction (Year 3), with 193 of them residing in White Sulphur Springs. During operations, Meagher County is projected to have 258 people move in, with 232 of them residing in White Sulphur Springs.

The Proponent does not intend to provide a construction camp or housing for employees. In-migrating workers are expected to seek housing options in populated areas within 110 miles (or approximately within a 1.5-hour commute) to the Project. In-migrating workers are expected to reside in hotels/motels, rental units, recreational vehicles (RVs) or affordable single family homes. The Proponent assumes that private housing developers would provide additional housing after the permitting process is completed and construction begins. The Montana Business Assistance Connection estimates that an additional 112 housing units may be needed as a result of the Project (Sandfire 2018).

Housing impacts could come in the form of increased demand and costs for housing due to population influx. Potential impacts include increased rental and housing values as a result of demand that exceeds the available housing supply, contributing to significant housing constraints and affordability challenges particularly during the construction phase. In the longer term, benefits may include increased housing stock, improved housing units (repaired and/or remodeled existing units), and increased availability of newer units. But if overbuilding during Project construction occurs, this could result in a housing glut during operations due to excess supply of housing stock.

According to the White Sulphur Springs Growth Policy (adopted May 2017), a significant number of housing units are deteriorated and programs are needed to rehabilitate or replace housing in poor condition (CTA 2017). Within 3 years (by May 2020) the City of White Sulphur plans to assess the needs for additional housing and rehabilitation of existing housing units and implement a housing plan to meet the identified housing needs with appropriate housing programs (CTA 2017). According to the "Hard Rock Mining Impact Plan," the Proponent intends to collaborate with Meagher County and the City of White Sulphur Springs and assist with funding community planning and economic development efforts.

Public Infrastructure and Services

Impacts on public infrastructure and services could come in the form of increased demand for services or degradation of public infrastructure due to additional use. Adverse impacts would include demand for services that exceeds the available capacity or degradation that exceeds the county or city's ability to perform repairs. According to White Sulphur Springs and Meagher County Growth Plans, streets are in poor condition in some locations and underlying water and/or sewer lines are also deteriorated and need replacement. The City plans to implement a 5- to 6-year capital improvement plan to address public infrastructure issues, including a combined street repair/water-sewer line replacement plan. Water and sewer upgrades are also underway in White Sulphur Springs.

Although infrastructure improvement planning is in progress, the Project is likely to significantly affect public infrastructure if the City of White Sulphur Springs' plans are not implemented in time for Project construction. Any fiscal impacts on local government service providers would be mitigated through payments as established in the "Hard Rock Mining Impact Plan" (Sandfire 2018). Public service providers would benefit from the additional tax revenues generated by the mine and should be able to adapt to the long-term changes in demand associated with mine operations.

Health and Quality of Life

Potential impacts to health and quality of life depend on the current health status of communities, the capacity of public health services and the ability of area communities to adjust to (and accept) changes in life style as a result of the Proposed Action. As discussed in Section 3.9.2, Meagher County ranks lowest among socioeconomic analysis area counties in health (based on County Health Rankings analysis of a variety of health indicators) and there has been a departure of business important to community health and well-being (e.g., loss of dentist office and chiropractor). The aging of the population, combined with rapid population influx, particularly during Project Construction, has the potential to put significant strain on local healthcare services. Mountainview Medical Center is Meagher County's only hospital and provides inpatient, outpatient, long-term care, diagnostics, and emergency services. However, the facility has the potential to become overloaded with increased demand for services associated with a larger population. Nurse and staff recruitment could be challenging if high housing prices make it difficult to draw needed healthcare professionals to the area.

The Project has the potential to impact local healthcare capacity as a result of associated population influx. As a result, impacts to health and quality of life is a high-likelihood event particular during Project construction as local populations adjust to rapid change in their community from population influx. A younger demographic than what currently exists would likely make up the 20 percent of new population coming to White Sulphur Springs and Meagher County. Also, the boom and bust cycle that sometimes occurs during and after a large project presents a risk. According to the Meagher County Growth Policy, residents of the county welcome new economic opportunities and growth for our communities, but they want to ensure that it occurs in a manner that maintains their identity and quality of life. Effective implementation of Meagher County and White Sulphur Springs Growth Plans would be critical to minimizing impacts on health and quality of life if the Project is approved.

Smith River Assessment

During the public scoping period, numerous comments were received regarding potential impacts to Smith River users (see Section 1.6.1, Public Participation). Based on impact analysis of Project activities on various area resources, the Project could secondarily affect Smith River users as a result of Project traffic impacts (including brief periods of congestion and traffic safety risks) on U.S. Route 89 and U.S. Route 89/12, which provide regional access to and from the Smith River (see Section 3.12.3 for a discussion of potential impacts of Project traffic.) The Smith River is mainly a regional recreation destination in the general Project vicinity. Recreational users on the Smith River are not expected to be affected by the Project in terms of potential socioeconomic impacts. While Project traffic may result in brief periods of congestion at the intersection of Sheep Creek Road and U.S. Route 89 (particularly during employee shift changes), this is not expected to affect Smith River users. Considering that demand to float the river is currently regulated and limited by a permit system, demand to use the Smith River recreationally would likely continue at its current levels into the future. The Project would not likely have direct or secondary impacts on any other resources as summarized below.

As discussed in Section 3.2.3, the impacts of airborne dust and fine particulates are of potential concern for the basin, due to fugitive mining sources and venting of underground emissions. However, modeled concentrations were predicted to be less than the regulatory SIL at all locations within the basin. As such, a negligible level of PM and other pollutants would be conveyed to the Smith River basin from point source and fugitive dust emission sources. Given modeled concentrations are less than SIL, and because the SIL concentrations are well below ambient air standards, which are themselves accepted as protective of sensitive populations, Project emissions would not impact Smith River users, including sensitive populations such as people with asthma, children, and the elderly.

As discussed in Section 3.5.3, Smith River is the receiving waters to Sheep Creek. Secondary impacts on base flow of Sheep Creek as a result of mine dewatering and disposal of treated water to the UIG are expected to partially offset one another. Therefore, the Project is expected to have an insignificant impact on recreational opportunities of the Smith River due to changes in water quality or water quantity (also see Section 3.7.3). It should be noted, however, that the Smith River is included in DEQ’s 303(d) list of impaired streams for flow regime modification due to agricultural irrigation, from the North and South Forks to the mouth at the Missouri River. Those activities which impact surface water quantity are not associated with the Project and are likely to continue in the future.

As discussed in Section 3.8, the Project would not likely have any direct or secondary impacts on visual and aesthetics resources in the Smith River area. The closest distance between the Project site and the Smith River is approximately 12 miles. The existing topography and vegetation block views of the Project from the river as well as from Smith River Road. Therefore, the Project would not impact Smith River users since there would be no changes to the visual and aesthetic resources in the Smith River area.

As discussed in Section 3.11.3, blasting during the construction phase of the Project would be audible for several miles around the Project site. However, any noise associated with blasting activities at the Smith River State Park, if audible, would be significantly below DEQ’s noise threshold for noise sensitive areas. Therefore, Project generated noise is not expected to impact Smith River users.

3.9.3.3. Agency Modified Alternative

The AMA would not change the Project’s construction or operations-phase workforce, purchasing, or procurement activities. Therefore, the potential impacts of the AMA on socioeconomic resources would be the same as described for the Proposed Action.

Smith River Assessment

The impacts of the AMA on the Smith River would be the same as described for the Proposed Action.

3.10. SOILS

3.10.1. Analysis Methods

3.10.1.1. Analysis Area

Soil investigations for the analysis area were conducted by WESTECH Environmental Services, Inc. (WESTECH), which are included as Appendix E (WESTECH 2017) of the MOP Application (Tintina 2017). The soil analysis area included the MOP Application Boundary (i.e., Project area), encompassing approximately 1,888 acres, and the surrounding area for a total of 3,368 acres. This area includes, but is not limited to, all land to be disturbed by mining including the reclamation material stockpile areas, access roads, portal pad, cement tailings area, subsoil stockpile, spillway, and ponds.

3.10.1.2. Information Sources

WESTECH conducted the soil investigations for the analysis area in July and October of 2015 to identify and describe soil profiles, sample representative soil horizons, and determine suitability for reclamation. WESTECH based their study on the soil survey procedures developed by the Natural Resource Conservation Service (NRCS) as part of the Soil Survey Manual (USDA 1993). The baseline soils survey contains descriptions of field, laboratory, and interpretation methods (WESTECH 2017). Meagher County soils have been mapped and data are available online as part of the U.S. Department of Agriculture's Web Soil Survey.

3.10.1.3. Methods of Analysis

The baseline soil survey included 30 soil survey sites that were selected after traversing the landscape and observing variable soil conditions in the field. Of these 30 sites, samples were collected from major soil horizons at 25 locations. Each soil survey site was manually excavated with a shovel or hand auger to either a depth of 40 inches, auger refusal, or upon hitting bedrock. For each sample location, the following characteristics were recorded in the field: drainage class, slope range, parent material, vegetation and land use, topography and position, aspect, surface runoff, erosion, permeability, horizon types, depths and thickness, color and texture, coarse fragment content, carbonates, clay films, effervescence, roots, and structure.

Laboratory analyses were performed on selected physical and chemical characteristics of the soils. Particle size analysis, percent rock fragments, organic matter percent, salinity/conductivity, and chemical properties including soil pH, arsenic, cadmium, copper, lead, and zinc were determined as part of the study. Baseline soils survey interpretations were used to access the likely impacts of each alternative. Laboratory analyses were completed in August and November of 2015.

Initial map unit boundaries were drawn based on field results and then refined based on literature review and laboratory analysis results.

3.10.2. Affected Environment

3.10.2.1. Soil Types

Based on the results of the baseline soil survey, 18 NRCS-established soil series were identified as components of identified soil map units in the analysis area (see **Figure 3.10-1**). The following sections summarize relevant physical and chemical properties of each series. **Table 3.10-1** provides a breakdown of map units by acres present within the analysis area.

Table 3.10-1
Summary of Soil Map Units in the Analysis Area

Map Unit Name	Acres in the Analysis Area	Percent of the Analysis Area
Adel loams	26.9	<1
Caseypeak, skeletal loams	222.4	7
Caseypeak, skeletal loams steep	79.3	2
Cheadle, channery loams	798.5	24
Clunton, clay loams	26.5	<1
Duckcreek, clay loams	138.0	4
Farlin, clay loams	46.5	1
Houlihan, sandy loams	50.2	2
Kimpton, skeletal loams	345.8	10
Kimpton, skeletal loams steep	127.7	4
Libeg, clay loams	197.8	6
Medicinelodge frequently flooded	256.4	8
Medicinelodge occasionally flooded	71.7	2
Poin, skeletal sandy loams	188.3	6
Raynesford, silty clay loams	67.5	2
Redchief, silty loams	86.5	3
Redfish, occasionally flooded	31.5	<1
Sebud, gravelly loams	35.7	1
Wineglass, channery clay loams	166.4	5
Woodhall, skeletal loams	328.1	10
Woodhurst, skeletal loams	27.9	<1
Disturbed Land	36.9	1
Rock Outcrop	11.3	<1
Total	3,367.8	100[a]

Source: WESTECH 2017
Notes:
[a] Percent totals are greater or less than 100 percent due to rounding.

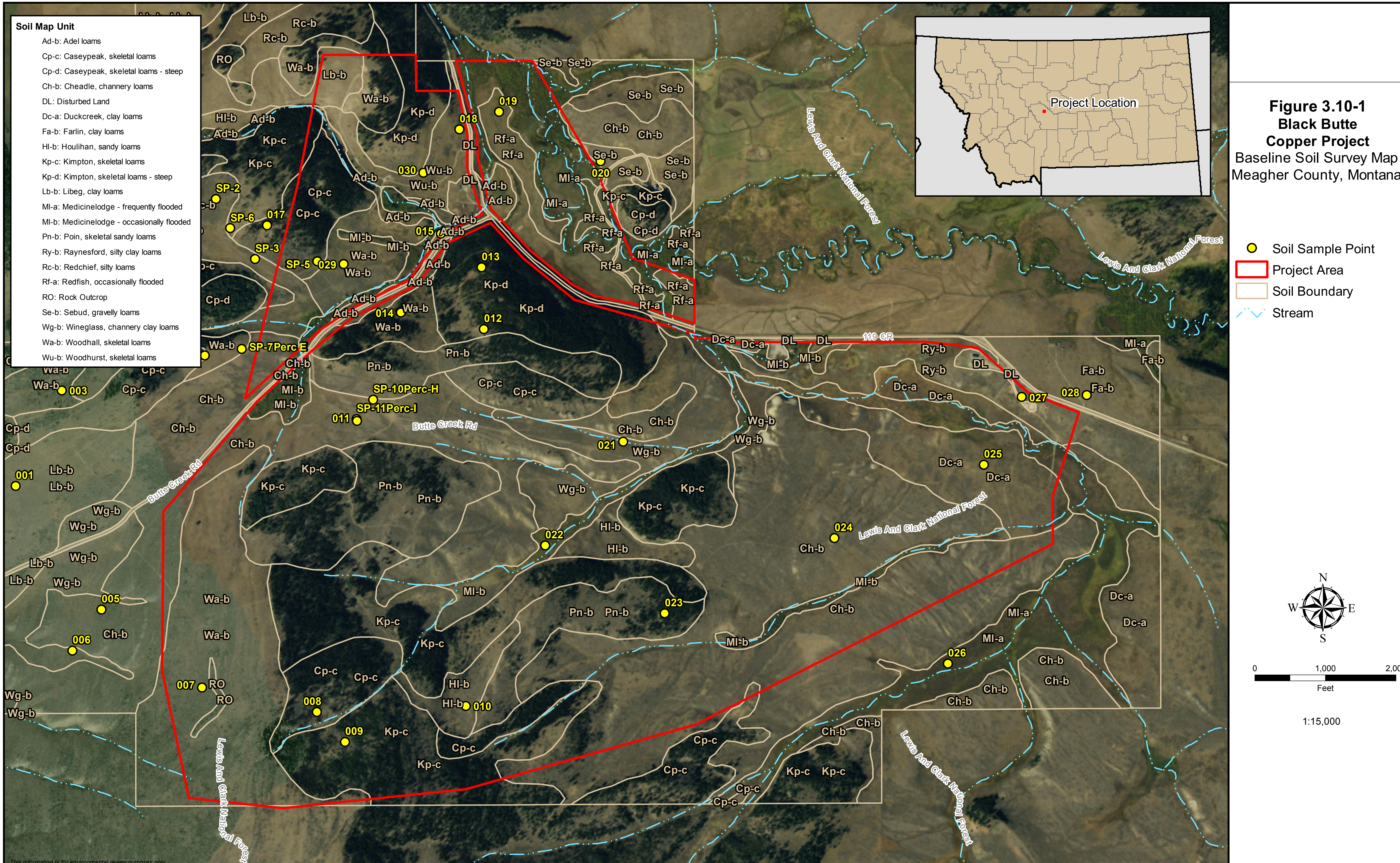


Figure 3.10-1
Black Butte Copper Project
Baseline Soil Survey Map
Meagher County, Montana

FILE: M:\Clients\M-O\MTDEQ\BlackBute_Copper_ArcGIS\2017\12\Soils_MTDEQ_Black_Butte_Soils.mxd | REVISED: 02/01/2019 | SCALE: 1:15,000 when printed at 11x17 DRAWN BY: JPB

Ad-b: Adel loam (5 to 15 percent slopes)

Soils within the Adel series consist of very deep and well-drained soils that typically form in alluvium, colluvium, or slide deposits. Permeability is moderate, and soils are found on a variety of landforms including alluvial fans, mountain slopes, hills, stream terraces, and drainage ways. High volumes of coarse fragments were found in the Adel loam sample survey Site BB15 with 50 percent coarse fragments identified at a depth of 15 to 32 inches and 60 percent at a depth of 32 to 40 inches. The Adel series has a wind erodibility group (WEG) rating of 5 and a soil erodibility factor rating of 0.2 to 0.3, both exhibiting low to moderate susceptibility to erosion. Chemical property test results indicated levels exceeding the Montana DEQ threshold levels for arsenic, lead, zinc, and cadmium (WESTECH 2017; NRCS 2017; Hydrometrics, Inc. 2013). Adel loams represent less than 1 percent of the soils proposed to be disturbed as part of the Project.

Cp-c: Caseypeak, skeletal loams (15 to 40 percent slopes) and Cp-d: Caseypeak, skeletal loams steep (40 to 70 percent slopes)

Soils within the Caseypeak series consist of shallow and well-drained soils that typically form in residuum derived from coarse-grained, igneous rocks such as granite. Permeability is moderately rapid and soils are found on mountains and hills. High volumes of coarse fragments were found in the Caseypeak sample survey Sites BB02 and BB17. Site BB02 showed 75 percent coarse fragments at a depth of 0 to 3 inches. Site BB17 showed 50 percent coarse fragments identified at a depth of 0 to 4 inches and 75 percent coarse fragments at a depth of 4 to 12 inches. Shallow bedrock was also identified at sample Sites BB02, BB08, and BB17 at depths of 20, 3, and 12 inches, respectively. Soil series Cp-d was identified as having a slope limit that could inhibit soil salvage. The Caseypeak series has a WEG rating of 5 and a soil erodibility factor rating of 0.2 to 0.3, both exhibiting low to moderate susceptibility to erosion. Chemical property test results indicated levels exceeding the DEQ threshold levels for arsenic, lead, and zinc (WESTECH 2017; NRCS 2017; Hydrometrics, Inc. 2013). Caseypeak, skeletal loams represent 8 percent of the soils proposed to be disturbed as part of the Project.

Ch-b: Cheadle, channery loams (5 to 15 percent slopes)

Soils within the Cheadle series consist of shallow and well-drained soils that typically form in colluvium and residuum derived primarily from hard sandstone. Permeability is moderate and soils are found on plains, hills, mountains, ridges, and escarpments. High volumes of coarse fragments were found in the Cheadle sample survey Sites BB05, BB11, and BB24. Site BB05 showed 50 percent coarse fragments identified at a depth of 4 to 9 inches and 80 percent coarse fragments at a depth of 9 inches and deeper. Site BB11 showed 50 percent coarse fragments at a depth of 19 to 30 inches, while Site BB24 exhibited 90 percent coarse fragments at a depth of 6 to 10 inches. Shallow bedrock was also identified at sample Sites BB05, BB11, and BB24 at depths of 9, 30, and 10 inches, respectively. The Cheadle series has a WEG rating of 6 and a soil erodibility factor rating of 0.3 to 0.4, both exhibiting low to moderate susceptibility to erosion. Chemical property test results indicated levels exceeding the DEQ threshold level for lead

(WESTECH 2017; NRCS 2017; Hydrometrics, Inc. 2013). Cheadle, channery loams represent 27 percent of the soils proposed to be disturbed as part of the Project.

Cl-a: Clunton, clay loams frequently flooded (0 to 5 percent slopes)

Soils within the Clunton series consist of very deep and very poorly drained soils that typically form in alluvium. Permeability is moderate and soils are found on floodplains, floodplain steps, and drainage ways. Depth to groundwater for the Clunton series is ten inches, which may restrict soil salvage operations. The Clunton series has a WEG rating of 5 and a soil erodibility factor rating of 0.2 to 0.4, both exhibiting low to moderate susceptibility to erosion. Chemical property test results indicated levels exceeding the DEQ threshold level for lead (WESTECH 2017; NRCS 2017; Hydrometrics, Inc. 2013).

Dc-a: Duckcreek, clay loams (0 to 5 percent slopes)

Soils within the Duckcreek series consist of moderately deep and well-drained soils that typically form in interbedded sandstone and shale residuum as well as clayey sedimentary beds. Permeability is slow and soils are found on hills, mountains, and escarpments. Soil texture at Site BB25 exceeded clay content levels identified by DEQ for reclamation potential. The Duckcreek series has a WEG rating of 6 and a soil erodibility factor rating of 0.2 to 0.3, both exhibiting low to moderate susceptibility to erosion. Chemical property test results indicated levels exceeding the DEQ threshold level for lead (WESTECH 2017; NRCS 2017; Hydrometrics, Inc. 2013). Duckcreek, clay loams represent 1 percent of the soils proposed to be disturbed as part of the Project.

Fa-a: Farlin, clay loams (0 to 5 percent slopes)

Soils within the Farlin series consist of very deep and well-drained soils that typically form in alluvium, colluvium, and limestone slide deposits. Permeability is moderate and soils are found on hills, mountain slopes, ridges, landslides, fan remnants, and escarpments. The Farlin series has a WEG rating of 6 and a soil erodibility factor rating of 0.2 to 0.3, both exhibiting low to moderate susceptibility to erosion (WESTECH 2017 and NRCS 2017).

Hl-b: Houlihan, sandy loams (5 to 15 percent slopes)

Soils within the Houlihan series consist of very deep and well-drained soils that typically form in alluvium and colluvium. Permeability is moderate and soils are found on hills, mountain slopes, swales, and fan remnants. High volumes of coarse fragments were found in the Houlihan sample survey Site BB11, showing 50 percent coarse fragments at a depth of 19 to 30 inches. The Houlihan series has a WEG rating of 6 and a soil erodibility factor rating of 0.2 to 0.4, both exhibiting low to moderate susceptibility to erosion (WESTECH 2017 and NRCS 2017). Houlihan, sandy loams represent 1 percent of the soils proposed to be disturbed as part of the Project.

Kp-c: Kimpton, skeletal loams (15 to 40 percent slopes) and Kp-d: Kimpton, skeletal loams steep (40 to 70 percent slopes)

Soils within the Kimpton series consist of moderately deep and well-drained soils that typically form in colluvium and slope alluvium. Permeability is moderate and soils are found on bedrock-floored plains, mountain slopes, hills, and ridges. Soil texture at Site BB12 exceeded clay content levels identified by DEQ for reclamation potential. High volumes of coarse fragments were found in the Kimpton sample survey Sites BB09, BB12, and BB13. Site BB09 showed 60 percent coarse fragments identified at a depth of 12 to 30 inches. Site BB12 showed 60 percent coarse fragments at a depth of 36 to 42 inches and deeper. Site BB13 exhibited 55 percent coarse fragments at a depth of 5 to 14 inches and 70 percent coarse fragments at a depth of 14 to 24 inches and deeper. Shallow bedrock was also identified at sample Sites BB09 and BB12 at depths of 30 and 24 inches, respectively. Soil series Kp-d was identified as having a slope limit that could inhibit soil salvage. The Kimpton series has a WEG rating of 6 and a soil erodibility factor rating of 0.3 to 0.4, both exhibiting low to moderate susceptibility to erosion. The pH value identified at Site BB09 fell within the acidic range, which could impede revegetation. Chemical property test results indicated levels exceeding the DEQ threshold levels for arsenic, lead, zinc, and cadmium (WESTECH 2017; NRCS 2017; Hydrometrics, Inc. 2013). Kimpton, skeletal loams represent 26 percent of the soils proposed to be disturbed as part of the Project.

Lb-b: Libeg, clay loams (5 to 15 percent slopes)

Soils within the Libeg series consist of very deep and well-drained soils that typically form in alluvium, colluvium, outwash, till, or slide deposits. Permeability is moderate and soils are found on a variety of landforms including alpine moraines, mountain slopes, avalanche chutes, stream terraces, and hills. The Libeg series has a WEG rating of 7 and a soil erodibility factor rating of 0.2 to 0.4, both exhibiting low to moderate susceptibility to erosion. The pH value identified at Site BB01 fell within the acidic range, which could impede revegetation. Chemical property test results indicated levels exceeding the DEQ threshold levels for arsenic, lead, zinc, and cadmium (WESTECH 2017; NRCS 2017; Hydrometrics, Inc. 2013).

Ml-a: Medicinelodge frequently flooded (0 to 5 percent slopes) and Mb-b: Medicinelodge occasionally flooded (5 to 15 percent)

Soils within the Medicinelodge series consist of very deep and poorly drained soils that typically form in clayey alluvium. Permeability is slow and soils are found on stream terraces, drainage ways, floodplain steps, depressions, and landslides. High volumes of coarse fragments were found in the Medicinelodge sample survey Site BB26 with 50 percent coarse fragments identified at a depth of 24 to 36 inches and 60 percent at a depth of 36 to 42 inches. Depth to groundwater for the Medicinelodge series is 24 to 36 inches, which may restrict soil salvage operations. The Medicinelodge series has a WEG rating of 7 and a soil erodibility factor rating of 0.2 to 0.3, both exhibiting low to moderate susceptibility to erosion. The pH value identified at Site BB022 fell within the acidic range, which could impede revegetation (WESTECH 2017 and

NRCS 2017). Medicinelodge soils represent less than 1 percent of the soils proposed to disturbed as part of the Project.

Pn-b: Poin, skeletal sandy loams (5 to 10 percent)

Soils within the Poin series consist of shallow and well-drained soils that typically form in colluvium and residuum derived from various rocks including granite, sandstone, and quartzite. Permeability is moderately rapid and soils are found on bedrock-floored plains, mountains, ridges, and hills. High volumes of coarse fragments were found in the Poin sample survey Site BB23 with 50 percent coarse fragments identified at a depth of 4 to 9 inches and 55 percent at a depth of 9 to 12 inches. Shallow bedrock was also identified at sample Site BB23 at a depth of 16 inches. The Poin series has a WEG rating of 6 and a soil erodibility factor rating of 0.3 to 0.4, both exhibiting low to moderate susceptibility to erosion. The pH value identified at Site BB23 fell within the acidic range, which could impede revegetation (WESTECH 2017 and NRCS 2017). Poin, skeletal sandy loams represent about 25 percent of the soils proposed to be disturbed as part of the Project.

Ry-b: Raynesford, silty clay loams (5 to 15 percent)

Soils within the Raynesford series consist of very deep and well-drained soils that typically form in alluvium and slope alluvium, or colluvium derived from limestone and shale. Permeability is moderate and soils are found on a variety of landforms including swales, stream terraces, mountain slopes, and alluvial fans. Soil texture at Site BB27 exceeded clay content levels identified by DEQ for reclamation potential. The Raynesford series has a WEG rating of 6 and a soil erodibility factor rating of 0.3 to 0.4, both exhibiting low to moderate susceptibility to erosion (WESTECH 2017 and NRCS 2017).

Rc-b: Redchief, silty loams (5 to 15 percent)

Soils within the Redchief series consist of very deep and well-drained soils that typically form in slope alluvium, colluvium, till, or glaciofluvial deposits. Permeability is slow and soils are found on a variety of landforms including alluvial fans, stream terraces, hills, and mountain slopes. High volumes of coarse fragments were found in the Redchief sample survey Site BB16 with 60 percent coarse fragments identified at a depth of 22 to 30 inches. Shallow bedrock was also identified at sample Site BB16 at a depth of 30 inches. The Redchief series has a WEG rating of 7 and a soil erodibility factor rating of 0.2 to 0.3, both exhibiting low to moderate susceptibility to erosion. The pH value identified at Site BB16 fell within the acidic range, which could impede revegetation (WESTECH 2017 and NRCS 2017).

Rf-a: Redfish occasionally flooded (0 to 5 percent slopes)

Soils within the Redfish series consist of very deep and poorly to very poorly drained soils which typically form in alluvium. Soils are found on floodplains, fan remnants, and valley floors. High volumes of coarse fragments were found in the Redfish sample survey Site BB19 with 70 percent coarse fragments identified at a depth of 17 to 28 inches and deeper. Depth to groundwater for the Redfish series is 20 inches, which may restrict soil salvage operations. The

Redfish series has a WEG rating of 7 and a soil erodibility factor rating of 0.2, both exhibiting low to moderate susceptibility to erosion (WESTECH 2017 and NRCS 2017). Redfish occasionally flooded soils represent 1 percent of the soils proposed to be disturbed as part of the Project.

Sb-b: Sebud, gravelly loams (5 to 15 percent slopes)

Soils within the Sebud series consist of very deep and well-drained soils that typically form in till, outwash, alluvium, slope alluvium, and colluvium. Permeability is moderate and soils are found on till plains, alluvial fans, moraines, alluvial fans, hills, and mountains. High volumes of coarse fragments were found in the Sebud sample survey Site BB20 with 60 percent coarse fragments identified at a depth of 32 to 48 inches and 85 percent coarse fragments identified at a depth of 48 inches and deeper. The Sebud series has a WEG rating of 6 and a soil erodibility factor rating of 0.2 to 0.3, both exhibiting low to moderate susceptibility to erosion (WESTECH 2017 and NRCS 2017).

Wg-b: Wineglass, channery clay loams (5 to 15 percent slopes)

Soils within the Wineglass series consist of very deep and well-drained soils that typically form in colluvium, alluvium, and residuum derived from various rock types. Permeability is moderately slow and soils are found on mountain side slopes. High volumes of coarse fragments were found in the Wineglass sample survey Site BB06 with 65 percent coarse fragments identified at a depth of 34 to 50 inches. The Wineglass series has a WEG rating of 6 and a soil erodibility factor rating of 0.3 to 0.4, both exhibiting low to moderate susceptibility to erosion. Chemical property test results indicated levels exceeding the DEQ threshold level for lead, zinc, and cadmium (WESTECH 2017; NRCS 2017; Hydrometrics, Inc. 2013). Wineglass, channery clay loams represent about 4 percent of soils proposed to be disturbed as part of the Project.

Wa-b: Woodhall, skeletal loams (5 to 15 percent slopes)

Soils within the Woodhall series consist of moderately deep and well-drained soils that typically form in non-calcareous gravelly colluvium or slope alluvium derived from either igneous or sedimentary rock. Permeability is moderate and soils are found on a variety of landforms including structural benches, ridges, upland hills, and U-shaped valleys. High volumes of coarse fragments were found in the Woodhall sample survey Sites BB03, BB07, and BB14. Site BB03 showed 60 percent coarse fragments identified at a depth of 13 to 22 inches and 70 percent coarse fragments at a depth of 22 to 36 inches. Site BB07 showed 50 percent coarse fragments at a depth of 9 to 14 inches, while Site BB14 exhibited 75 percent coarse fragments at a depth of 11 to 24 inches. Shallow bedrock was also identified at sample Site BB07 at a depth of 14 inches. The Woodhall series has a WEG rating of 6 and a soil erodibility factor rating of 0.2 to 0.4, both exhibiting low to moderate susceptibility to erosion. The pH value identified at Site BB16 fell within the acidic range, which could impede revegetation. Chemical property test results indicated levels exceeding the DEQ threshold level for lead, zinc, and cadmium (WESTECH 2017; NRCS 2017; Hydrometrics, Inc. 2013). Woodhall skeletal loams represent about 5 percent of the soils proposed to be disturbed as part of the Project.

Wu-b: Woodhurst, skeletal loams (5 to 15 percent slopes)

Soils within the Woodhurst series consist of moderately deep and well-drained soils that typically form in colluvium over residuum derived from igneous rocks (nonacid). Permeability is moderate and soils are found on hills and mountains. High volumes of coarse fragments were found in the Woodhurst sample survey Site BB18 with 70 percent coarse fragments identified at a depth of 24 to 35 inches and 75 percent coarse fragments identified at a depth of 35 to 45 inches. The Woodhurst series has a WEG rating of 5 and a soil erodibility factor rating of 0.2 to 0.4, both exhibiting low to moderate susceptibility to erosion. Chemical property test results indicated levels exceeding the DEQ threshold level for arsenic, copper, lead, zinc, and cadmium (Hydrometrics, Inc. 2013). The Woodhurst series was the only sample to also exceed the U.S. Environmental Protection Agency regional screening level threshold for lead (WESTECH 2017 and NRCS 2017). Woodhurst, skeletal loams represent less than 1 percent of the soils proposed to be disturbed as part of the Project.

3.10.3. Environmental Consequences

This section addresses soil impacts resulting from the Proposed Action and other alternatives identified as described in Chapter 2, Description of Alternatives. Soil impacts resulting from the Project, typical of any operations where soil is removed, stored, and replaced, would include:

- Loss of soil and soil profile development;
- Soil erosion from disturbed areas and loss of suitable salvage materials through handling and erosion;
- Reduction of favorable physical soil properties;
- Reduction in biological activity; and
- Changes in soil nutrient levels.

These impacts, in combination with the proposed reclamation plan, aid in determining the success of restoring land to existing land use and vegetation types after mine operations have ceased. Where reclamation success is limited, secondary impacts on soils including soil erosion and sedimentation into waterbodies, reduced soil productivity, and seasonal increases in air pollution due to wind erosion may occur.

3.10.3.1. No Action Alternative

Under the No Action Alternative, the Project would not be developed and impacts on soil resources would be limited compared with other alternatives. Erosion and sedimentation would occur at current rates along the existing roads. Natural erosional processes due to rainfall and wind would continue to occur throughout the analysis area. Loss of soil development characteristics would be minimized and limited to new disturbances planned in the Project area in the future.

3.10.3.2. Proposed Action

Soil Loss

The majority of the soils proposed for disturbance and salvage under the Proposed Action are skeletal loams and channery loams with a high percentage of rock fragments. Many of the soils identified in the analysis area and discussed in Section 3.10.2.1, Soil Types, are not proposed for disturbance or reclamation. While not identified in **Table 3.10-2,** these "undisturbed" soils could be disturbed as part of 10 percent construction buffer, which includes a 25-foot perimeter around all Project facilities and was added to the total soil volume calculations.

Under the Proposed Action, a total of 283.7 acres of soils would be disturbed as part of the Project in areas of stockpiled and non-stockpiled soils (as depicted in **Table 3.10-2**). Soils would be stripped from the majority of these areas. Total soil volumes of about 563,692 cubic yards would be salvaged and stockpiled long-term for reclamation activities associated with mine closure, and approximately 304,773 cubic yards of soils would be temporarily stored and replaced on site for reclamation of construction activities, including grading, slope stabilization, drainage control, topsoil and subsoil placement, and seeding. An additional approximately 29.6 acres of disturbance would occur in areas where no soil salvage would occur.

Table 3.10-2
Acres of Disturbance and Estimated Salvage Volumes for Soil Series Associated with the Project

Map Unit Name	Soils to be Stockpiled		Soils to be Stored and Replaced on Site (No Stockpiling)	
	Total Acres of Disturbance	Total Soil Volume (Topsoil and Subsoil) (yd^3)	Total Acres of Disturbance	Total Soil Volume (Topsoil and Subsoil) (yd^3)
Adel loams	0.0	0.0	0.1	542.0
Caseypeak, skeletal loams	15.1	27,285.0	4.7	8,493.0
Caseypeak, skeletal loams steep	0.0	0.0	0.0	0.0
Cheadle, channery loams	41.9	75,711.0	28.6	51,678.0
Clunton, clay loams	0.0	0.0	0.0	0.0
Duckcreek, clay loams	0.0	0.0	2.9	15,720.0
Farlin, clay loams	0.0	0.0	0.0	0.0
Houlihan, sandy loams	0.0	0.0	2.9	15,720.0
Kimpton, skeletal loams	52.5	284,592.0	9.3	50,413.0
Kimpton, skeletal loams steep	0.0	0.0	0.4	0.0
Libeg, clay loams	0.0	0.0	0.0	0.0
Medicinelodge frequently flooded	0.0	0.0	1.2	6,505.0
Medicinelodge occasionally flooded	0.0	0.0	0.7	3,795.0
Poin, skeletal sandy loams	36.6	66,134.0	25.6	46,258.0
Raynesford, silty clay loams	0.0	0.0	0.0	0.0

Map Unit Name	Soils to be Stockpiled		Soils to be Stored and Replaced on Site (No Stockpiling)	
	Total Acres of Disturbance	Total Soil Volume (Topsoil and Subsoil) (yd^3)	Total Acres of Disturbance	Total Soil Volume (Topsoil and Subsoil) (yd^3)
Redchief, silty loams	0.0	0.0	2.0	10,842.0
Redfish, occasionally flooded	0.0	0.0	1.8	9,757.0
Sebud, gravelly loams	0.0	0.0	0.0	0.0
Wineglass, channery clay loams	7.5	40,656.0	5.7	30,899.0
Woodhall, skeletal loams	5.0	18,069.0	6.7	24,213.0
Woodhurst, skeletal loams	0.0	0.0	0.6	2,168.0
Disturbed land	1.8	0.0	0.5	0.0
10% construction buffer	--	51,245.0	--	27,770.0
Total	**160.4**	**563,692.0**	**93.7**	**304,773.0**

Source: Tintina 2017
yd^3 = cubic yards

The potential for soil loss would occur during Project construction and operations phases. Vegetation removal during clearing and grading exposes soil and makes it more susceptible to erosive forces. Loss of soil would also occur from the removal and storage of soils during mine construction and operations, and during reclamation where redistributed soils would once again be subject to erosive forces.

All stockpiled soil would be susceptible to erosion. Topsoil and subsoil would be stored in two separate stockpiles and would be constructed with horizontal to vertical ratios of 2.5H:1V side slopes and 3H:1V for access ramps. Stockpiles would be in place for the life of the mine until reclamation occurs. The Proponent has proposed implementation of interim seeding to minimize water and wind erosion until the soil is needed during reclamation. Broadcast seeding would occur during the first seeding season following stockpiling. If needed, the stockpile surface would be scarified to provide a better seeding surface.

Erosion would occur during reclamation activities when salvaged soil is redistributed on recontoured surfaces. Salvaged soils would be redistributed evenly over disturbed areas with an average depth of approximately 14.6 inches of topsoil and 12.4 inches of subsoil. Areas reclaimed without storage (direct-hauled soil), would have less potential for erosion than areas reclaimed with stored stockpiled soil. Vegetation would establish more rapidly on direct-hauled soil as the soil would still be biologically active and would retain a higher level of favorable physical and chemical soil characteristics. Areas where soil would be immediately replaced include pipeline trenches, roadside disturbances, diversion ditch perimeters, and buried power lines.

Soil losses would be long-term and have a high likelihood to occur within all disturbed Project areas given that erosion rates would remain elevated after reclamation until vegetated ground cover reaches predisturbance levels. After vegetation is well established, soil losses would be similar to preconstruction rates. The Proponent would implement sediment control BMPs and install berms around topsoil and subsoil stockpiles to minimize impacts on soil loss during construction, operations, and closure phases of the Project. These BMPs would include:

- Vegetation management and revegetation;
- Mulching;
- Rolled erosion control products;
- Slope roughening;
- Recontouring;
- Use of silt fences, temporary sediment traps, and sediment basins;
- Use of filter bags and flocculants; and
- Use of collection ditches, diversion ditches, culverts, and water bars.

Additionally, soil erosion and construction monitoring would occur during active construction and maintenance monitoring during mine closure. Monitoring would occur at all Project ground disturbances to identify where slumps, rills, gullies, and sheet wash may occur. All identified erosion control issues would be immediately corrected. Monitoring and the implementation of BMPs would minimize soil losses; however, soil loss would still occur under the Proposed Action.

Although implementation of BMPs and monitoring would reduce the overall impact of soil loss, residual impacts remain likely and long-term.

Physical, Biological, and Chemical Characteristics

The Proposed Action would alter the physical, biological, and chemical characteristics of soil. Soil structure and nutrient levels would be altered by handling, salvage, and storage activities. Potential impacts to chemical properties include changes in heavy metal concentrations and pH.

Changes in soil structure, compaction (destruction of pore space continuity and soil structure), and loss of organic matter due to mixing and storage would occur. In areas where the soil profile would be altered, it would take years for soil productivity to return to predisturbance conditions after reclamation. The establishment of vegetation, root systems, and physical processes (e.g., freezing and thawing, wetting and drying) would restart the soil building processes and help rebuild the natural soil profile.

Soil compaction modifies the structure and reduces the porosity and moisture-holding capacity of soils. Construction equipment traveling over wet soils could disrupt the soil structure, reduce pore space, increase runoff potential, or cause rutting. The degree of compaction depends on moisture content and soil texture. Fine-textured soils with poor internal drainage that are moist or saturated during construction are most susceptible to compaction and rutting. Soils with a high potential for compaction and structural damage in the Project area are typically very poorly drained soils with an organic soil component. Coarse-textured and well-drained soils are typically not considered compaction-prone. To minimize these impacts and reduce compaction, where practicable, the Proponent would time salvage activities to avoid periods of wet or saturated soil. Prior to soil redistribution, compacted areas would be ripped to relieve compaction and eliminate the potential for slippage along soil layer contacts, and promote root growth. Following reclamation, compaction in re-spread soils would be similar to pre-mine conditions. Soil compaction would be short-term and have a high likelihood to occur.

Biological impacts would occur in salvaged soils. The majority of disturbed soils would not be reclaimed until the end of mine operations and would be stockpiled for 19 years or longer. Storing topsoil and subsoil for prolonged periods of time reduces the number of vital soil microorganisms (i.e., fungi, bacteria, and algae) that are key to soil nutrient cycling. Additional components typically found in native soils that are lost during soil storage include native plant seeds and stems, which are both capable of producing new plants (Birnbaum et al. 2017). While the surface layer of each stockpile would be revegetated, this would only replenish organisms to the first 6 or 8 inches of the stockpile, leaving the majority of the soil with reduced biological activity.

Mycorrhizae are important soil structures that develop when certain plant roots and fungi form a symbiotic relationship and serve as an extension of a plant's root system. These structures are primarily present in forested areas or where lower woody species are present. Many species rely on mycorrhizae for their survival, especially in soils lacking needed nutrients. These systems are eliminated in soils stored for extended periods of time (Malloch et al. 1980). As discussed in Section 3.13.2.1, Vegetation and Plant Communities, the majority of the analysis area consists of upland grassland and shrubland habitat; however some forested land is present. Biological impacts would be long-term and have a high likelihood to occur. The Proponent would minimize these impacts by removing vegetation during initial Project construction with small shrubs and herbaceous vegetation being salvaged with topsoil. Non-commercial trees, slash, tall shrubs, and small stumps would be chipped and salvaged with topsoil. Over time after reclamation, mycorrhizae would spread from adjacent undisturbed land, thereby increasing species diversity.

Aluminum, iron, and manganese are common metals released by the weathering of soil parent materials, even in non-mineralized areas. They can become concentrated in a particular soil horizon by various soil-formation processes. While these metals are usually not available to plants with soils of neutral pH values, if soil surveys indicate soil pH is around 5.0, additional soil metal testing may be required to identify possible naturally occurring concentrations of these and other metals.

Soil samples tested had pH values from 5.0 to 8.0, with values between 5.7 and 7.5 being the most common. Only six sample locations had pH values lower than 5.5 with none being lower than 5.0. Samples with low pH were all observed within the rooting zone of existing native vegetation. Given the minimal presence of low pH soils, no impacts on vegetation growth are expected from salvaged soil due to the prevalence of soil materials with neutral pH values. No changes to soil pH values are expected from Project construction or operations.

Soil samples in the analysis area were tested for a number of heavy metals that often are associated with mineralized zones and could hinder plant growth. These included lead, zinc, copper, arsenic, and cadmium. As discussed in Section 3.10.2.1, Soil Types, multiple soils in the analysis area exhibited levels that exceed DEQ baseline background values for these inorganic elements (Hydrometrics, Inc. 2013). Given that these exceedances were found in vegetated native soils, they are not anticipated to reduce soil suitability for reclamation. Exceptions to this include the high levels of inorganic elements found in the deep horizons of the Woodhurst soils, which were taken into consideration in the development of proposed soil salvage depths.

Impacts to biological and chemical compositions of the soil would have a high likelihood and moderate severity; therefore, impacts would be moderate in all disturbed areas.

Reclamation Impacts

DEQ’s guidelines for soil salvage consider soils on slopes greater than 50 percent to be unsalvageable due to equipment limitations and safety requirements. In addition to the slope criteria, soil depth, percent rock fragments, pH, and soils texture are also used to determine if the soil can be used in reclamation. While DEQ’s guidelines advise soil salvage suitability, individual site conditions may necessitate the salvage of less suitable soils to achieve reclamation goals. The soils in the analysis area are generally suitable for salvage and reclamation. Salvageable soils, including surface soil and subsoil layers, occur in depths ranging from 12 to 36 inches. Organic matter levels in surface soils were on average high, and pH values ranged from 5.0 to 8.0, but were typically between 5.5 and 7.0.

Topsoil and subsoil would be salvaged and stockpiled for the majority of facility construction areas including the CTF, mill pad, portal pad, copper-enriched stockpile pad, temporary WRS pad, CWP, PWP, and NCWR embankment footprint. Soils would be salvaged, but not stored in the main stockpiles for facilities such as new roads, diversion ditches, infiltration galleries, vent raises, and buried pipelines. When possible, soil removed from a specific construction area would be hauled directly to, and used to reclaim, another previously disturbed area, thereby eliminating the need for prolonged storage. Additionally, soils removed during road and diversion ditch construction would be concurrently used to revegetated adjacent cut and fill slopes.

The volume of soil suitable for salvage and reclamation would be limited by slope, shallow depth to bedrock, coarse fragment quantity, and exposed bedrock. The principal limitation of soil suitability for reclamation identified during the baseline soil survey was rock fragment content. Thirteen of the 18 soil series had 50 percent or greater rock fragments identified in at least one survey location. High levels of rock fragment content ranged from 50 to 90 percent. The Proponent’s proposed salvage recommendations are presented in **Table 3.10-3;** however, a soils scientist would be present on site during initial soil salvage activities to establish salvage guidelines for specific soil types and landscape features. If there is a shortage of cover soils, soils containing more than 50 percent coarse rock fragments would be screened and salvaged for use during reclamation to avoid the need for offsite topsoil. The remaining coarse material would be used as fill during mine closure.

Table 3.10-3
Salvage Recommendations for Soil Series Associated with Project Disturbance

Soil Series	Soil Limitations	Recommendations
Adel (Ad-b)	Coarse fragment content of 50% and arsenic and cadmium levels exceeding DEQ levels	1st lift salvage depth of 12 inches and a 2nd lift depth of 24 inches to a total of 36 inches
Caseypeak (Cp-c and Cd-d)	Poor salvage potential due to very high coarse fragment content, shallow bedrock, steep slopes, and exceeding DEQ levels for lead and zinc	Single lift depth of 12 inches for Cp-c and no salvage for Cp-d
Cheadle (Ch-b)	Coarse fragment content of 50% and arsenic and cadmium levels exceeding DEQ levels	Single lift depth of 12 inches
Duckcreek (Dc-a)	Exceeding DEQ levels for lead	1st lift salvage depth of 12 inches and a 2nd lift depth of 24 inches to a total of 36 inches
Houlihan (Hl-b)	None	1st lift salvage depth of 12 inches and a 2nd lift depth of 24 inches to a total of 36 inches
Kimpton (Kp-s and Kp-d)	High coarse fragment content, pH levels below 5.5, occurring on slopes steeper than 50%, and exceeding DEQ levels for arsenic, cadmium, lead, and zinc	1st lift salvage depth of 12 inches and a 2nd lift depth of 24 inches to a total of 36 inches for Kp-c. No salvage recommended for Kp-d.
Medicinelodge (Ml-a and Ml-b)	Associated with wetlands and shallow groundwater and high coarse fragment content	1st lift salvage depth of 12 inches and a 2nd lift depth of 24 inches to a total of 36 inches
Poin (Pn-b)	High coarse fragment content, pH levels below 5.5, and shallow depth to bedrock	Single lift depth of 12 inches
Redfish (Rf-a)	High coarse fragment content and shallow depth to groundwater	1st lift salvage depth of 12 inches and a 2nd lift depth of 24 inches to a total of 36 inches
Wineglass (Wg-b)	High coarse fragment content and exceeding DEQ levels for lead and zinc	1st lift salvage depth of 12 inches and a 2nd lift depth of 24 inches to a total of 36 inches
Woodhall (Wa-b)	High coarse fragment content, pH levels below 5.5, and exceeding DEQ levels for cadmium, arsenic, lead, and zinc	1st lift salvage depth of 12 inches and a 2nd lift depth of 12 inches to a total of 24 inches
Woodhurst (Wu-b)	High coarse fragment content and exceeding DEQ levels of arsenic, cadmium, copper, lead, and zinc	1st lift salvage depth of 12 inches and a 2nd lift depth of 12 inches to a total of 24 inches

Source: WESTECH 2017

The recognition of inherent soil properties and design of salvage programs to retain these favorable properties can increase reclamation success. The potential for reclamation success of disturbed lands is improved when soil is salvaged and later replaced in two or more lifts to provide an adequate growth medium for plants. As shown in **Table 3.10-3**, the majority of soils associated with the Proposed Action would be salvaged using a two-lift method. This method would limit impacts from mixing soil horizons; however, time would be needed to re-establish a new soil profile. Over time, natural processes would rebuild a new soil profile that may be similar or different from preexisting conditions. The loss of soil development and the time required to rebuild a new soil profile would be unavoidable long-term Project impacts.

Reclamation success may be enhanced by the use of soil amendments. Use of mulches and/or tackifiers could reduce the amount of soil loss until seedlings can establish. The Proponent has proposed the use of mulch (e.g., straw, wood fiber, wood chips) for erosion control and protection of seed beds during revegetation. Wood-based organic amendments could be added to the soil to reduce compaction, crusting, and bulk density; increase soil fertility and organic matter content; and potentially improve establishment of mycorrhizae communities and increase the growth of woody plant species. The Proponent would mow or chip small shrubs, herbaceous vegetation, noncommercial trees, slash, tall shrubs, and small stumps. This woody debris would then be salvaged with topsoil.

The primary factors that would determine the success of revegetation include scheduling of final revegetation, plant species selection, planting plans, establishment success, and growth rates to achieve cover and density objectives. Revegetation success would be monitored each year during the growing season until all reclaimed areas have achieved a vegetative cover of at least 70 percent of the comparable vegetative cover on a nearby undisturbed site. Revegetation is discussed in more detail in Section 3.13, Vegetation.

If there is a temporary period of inactivity at the mine, where the continuation of mining is still under consideration, temporary closure of the site (to last no longer than 1 year) would occur. Temporary short-term closure of the mine would include stabilization and revegetation of existing disturbances. The Proponent would implement final reclamation activities within 1 year of deciding to permanently discontinue mining in the Project area. Before initiating final closure procedures, the Proponent would meet with DEQ to review their final long-term closure plan and revise as needed. The Proponent would comply with all applicable requirements outlined in § 82-4-366, MCA, for permanent reclamation.

Over time, natural processes would rebuild a new soil profile that may be similar or different from preexisting conditions. The loss of soil development and the time required to rebuild a new soil profile would be unavoidable long-term Project impacts. Overall, the impacts on soils from the reclamation process are expected to be major.

Smith River Assessment

The Project would not have any direct impacts on soil resources in the Smith River area. Potential secondary impacts include increased or decreased erosion rates due to changes in water quantity. As discussed in Section 3.5.3.1, Surface Water Quantity, based on the Proposed Action description, impacts on surface water quantity in Sheep Creek are expected to be minor; therefore, potential impacts on water quantity in the Smith River would be insignificant. Any secondary impacts associated with soil resources along the Smith River would also be insignificant.

3.10.3.3. Agency Modified Alternative

The potential impacts of the AMA on soils would be the same as described for the Proposed Action. The disturbance footprint would also be the same for the AMA; therefore, the same amount and types of soils would be impacted by the alternative. Additionally, the AMA does not propose any changes to soil reclamation. Any potential secondary impacts would be similar to those described for the Proposed Action Alternative as surface water impacts would be similar to those for the Proposed Action Alternative.

Smith River Assessment

The potential impacts of the AMA on soils would be the same as described for the Proposed Action. The disturbance footprint would also be the same for the AMA; therefore, no direct impacts on soil resources in the Smith River area would occur.

3.11. NOISE

Noise is generally defined as unwanted sound, and can be intermittent or continuous, stationary or transient. Noise levels heard by humans and animals depend on several variables, including distance and ground cover between the source and receiver and atmospheric conditions. Noise can influence humans or wildlife by interfering with normal activities or diminishing the quality of the environment. Noise levels are quantified using units of decibels (dB). To account for the human ear's sensitivity to low-level noises, decibel levels are corrected using the A-weighted scale (dBA). The dBA scale begins at zero—the sound intensity at which sound becomes audible to a young person with normal hearing. Each 10 dBA increase in sound approximates a doubling in loudness, so that 60 dBA is twice as loud as 50 dBA. People generally have difficulty detecting sound level differences of 3 dBA or less. C-weighted decibels (dBC) are used to describe lower frequency noises, such as the rumble of large fans or the boom of blasting.

Two measurements used to relate the time-varying quality of environmental noise to its known impacts on people are the equivalent sound level (L_{eq}) and the day-night sound level (L_{dn}). L_{eq} is defined as the sound pressure level of a noise fluctuating over a period of time, expressed as the amount of average energy. L_{dn} is defined as the 24-hour average of the equivalent average of the sound levels during the daytime (from 7:00 a.m. to 10:00 p.m.) and the equivalent average of the sound levels during the nighttime (from 10:00 p.m. to 7:00 a.m.). Specifically, in the calculation of the L_{dn}, late night and early morning (10:00 p.m. to 7:00 a.m.) noise exposures are increased by 10 dB to account for people's greater sensitivity to sound during nighttime hours. To measure sounds of short duration but higher intensity, such as blasting, the unweighted instantaneous peak noise level (L_{peak}) is used.

No federal regulations govern noise levels in the proposed Project area; however, the USEPA identifies outdoor noise levels less than or equal to 55 dBA L_{dn} as sufficient to protect public health and welfare in residential areas and other places where quiet is a basis for use (USEPA 1978). DEQ has established general regulations applicable to blasting operations (DEQ 1999), as well as noise regulations applicable to surface blasting activities. The surface blasting noise regulations limit peak sound levels from blasting activities at any dwelling or public, commercial, community, or institutional building, unless the structure is owned by the operator and is not leased to any other person (DEQ 2004). MDT determines that traffic noise impacts occur if predicted 1-hour traffic noise levels are 66 dBA or greater at a residential property during the peak traffic hour, or if the projected traffic noise levels exceed the existing peak hour [L_{eq}(h)] by 13 dBA or more (MDT 2016).

In addition, the Federal Transit Administration has established guidelines for assessing short duration (1 hour) and long duration (8 hours) impacts associated with construction noise based on adjacent land uses as shown in **Table 3.11-1** (FTA 2006).

Table 3.11-1
Construction Noise Guidelines

Adjacent Land Use	Daytime L_{eq}	Nighttime L_{eq}
Short Duration Noise Guidelines (1 hour)		
Residential	90 dBA	80 dBA
Commercial	100 dBA	100 dBA
Industrial	100 dBA	100 dBA
Long Duration Noise Guidelines (8 hours)		
Residential	80 dBA	70 dBA
Commercial	85 dBA	85 dBA
Industrial	90 dBA	90 dBA

Source: FTA 2006
dBA = decibels on A-weighted scale; L_{eq} = equivalent sound level

Changes in noise levels are also used to determine audibility and potential impacts associated with noise sources. Comparing the L_{eq} noise levels of a noise source to ambient noise levels exceeded 90 percent of the time (L_{90}) at a location can be used to approximate whether a noise source would be audible, and how significantly the ambient environment would change due to a new noise source (**Table 3.11-2**).

Table 3.11-2
Anticipated Community Noise Reaction

Noise Condition	Description	Anticipated Community Reaction
$L_{eq} \leq L_{90}$	Rarely heard	Minimal
$L_{90} < L_{eq} \leq L_{90} + 10$	Sometimes audible	Moderate
$L_{eq} > L_{90} + 10$	Clearly audible	High

Sources: Menge 2005 and Cavanaugh 2002, as cited in Big Sky Acoustics 2017
L_{90} = ambient noise level; L_{eq} = equivalent noise level

3.11.1. Analysis Methods

The analysis encompasses an area potentially affected by Project facilities along Sheep Creek Road and Butte Creek Road, which includes the Project's mine facilities, aboveground equipment, and access roads.

Big Sky Acoustics, LLC (Big Sky Acoustics), on behalf of the Proponent, collected ambient noise levels at four locations in proximity to the Project area on September 10 and 11, 2013. Big Sky Acoustics completed one, 24-hour noise level measurement at Location 1, and 1-hour daytime (7 a.m. to 7 p.m.) and 15-minute nighttime (7 p.m. to 7 a.m.) noise level measurements at Locations 2 through 4. The noise level measurement locations relative to the Project area are presented on **Figure 3.11-1** (Big Sky Acoustics 2017). Big Sky Acoustics developed predicted noise level contours for the construction and operations phases of the Project using Cadna-A noise prediction software assuming, conservatively, that all equipment applicable to the construction or operations phase is operated simultaneously.

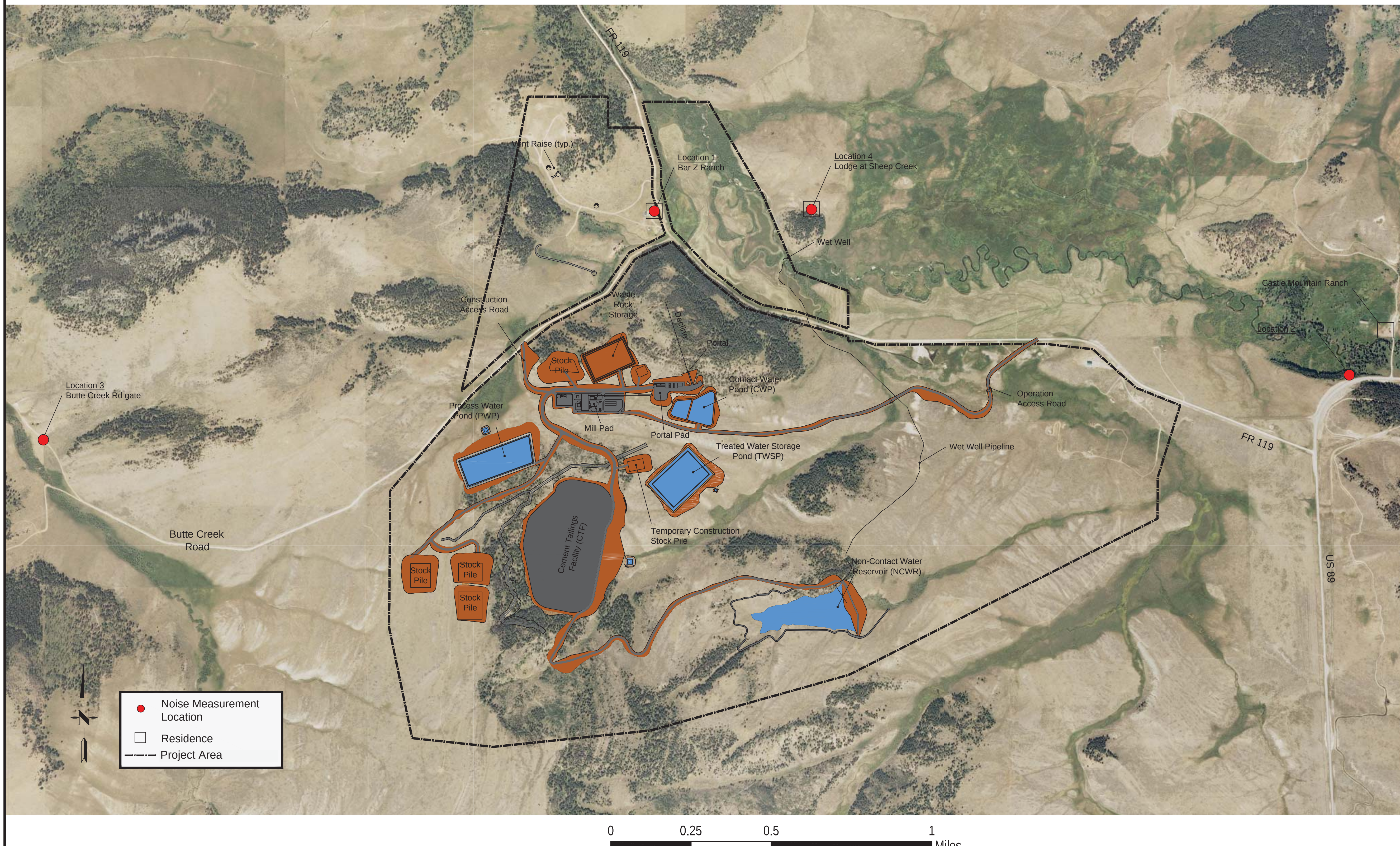


Figure 3.11-1
Black Butte Copper Project
Project Facilities and Noise Measurement Locations
Meagher County, Montana

This information is for environmental review purposes only.

3.11.2. Affected Environment

Existing sound levels in the analysis area are low and characteristic of rural or quiet suburban areas. Nighttime sound levels are 3 to 9 dB lower than daytime levels due to cessation of many human-related activities. Natural sound sources include wind, wildlife, water flow, and wind-induced noise such as the rustling of foliage. Other sound sources include vehicles, such as trucks or airplanes, and human activities.

Two residences or cabins are within 1 mile of the Project area. **Table 3.11-3** summarizes the results of the ambient noise monitoring, including the approximate distance and direction of each noise measurement location from the Project site.

Table 3.11-3
Ambient Noise Levels

Noise Measurement Location	Distance/Direction from Mill Pad	Daytime L_{eq}	Nighttime L_{eq}	Measured L_{dn}
Location 1 Bar Z Ranch [a]	2,950 feet/north-northeast	35-45	22-48	42
Location 2 Castle Mountain Ranch/ U.S. 89	12,360 feet/east	44	41	48
Location 3 Butte Creek Road Gate	9,400 feet/west	33	24	33
Location 4 Lodge at Sheep Creek	4,370 feet/northeast	28	24	31

Source: Big Sky Acoustics 2017
L_{dn} = day-night sound level; L_{eq} = equivalent noise level
[a] Measured range based on 24-hour noise monitoring at Location 1.

3.11.3. Environmental Consequences

3.11.3.1. No Action Alternative

Under the No Action Alternative, the analysis area would continue to have quiet sound levels characteristic of rural areas as described above. Existing noise levels would not change.

3.11.3.2. Proposed Action

Construction Phase

The construction phase of the Project would include building the mill, portal pad, ponds, tailings facilities, wet well, and wet well pipline and is estimated to last 2 to 3 years. During the construction phase, noise would be produced by earth-moving equipment, a rock crusher and screen plant, haul or water trucks, air compressors, and diesel generators. The noise analysis is based on the assumption that most equipment would be operated 20 hours per day, with the exception of air compressors and diesel generators, which would be operated 24 hours per day.

Table 3.11-4 summarizes the predicted construction phase noise levels assuming that all equipment is operating simultaneously.

Table 3.11-4
Predicted Construction Phase Noise Levels (dBA)

Noise Measurement Location	L_{dn} Noise Level		Audibility			
	Calculated Baseline Noise Level (L_{dn})	Predicted Construction Noise Level (L_{dn})	Average Measured Baseline Noise Level (L_{90})	Predicted Construction Noise Level (L_{eq})	Difference $L_{eq} – L_{90}$	Perception of Construction Noise at Locations
Location 1	42	41	24	38	+14	Clearly audible
Location 2	48	32	25	30	+5	Occasionally audible
Location 3	33	33	21	29	+8	Occasionally audible
Location 4	31	31	22	28	+6	Occasionally audible

Source: Big Sky Acoustics 2017
dBA = decibels on the A-weighted scale; L_{90} = ambient noise levels; L_{dn} = day-night sound level; L_{eq} = equivalent sound level

As presented in **Table 3.11-4**, the predicted noise attributable to construction activities would be less than 70 dBA L_{eq} at each of the four noise measurement locations, which is the level recommended in the Federal Transit Administration construction noise guidelines for residential areas. The audibility analysis shows that noise attributable to construction activities would be clearly audible at Location 1, which is in close proximity to the nearest residence to the Project location. Therefore, construction activities would have a moderate impact at the nearest residence; however, construction activities would only be occasionally audible at additional noise sensitive areas farther from the construction site. To further minimize equipment noise, the Proponent would implement the following noise mitigation measures:

- On all diesel-powered construction equipment, replace standard back-up alarms with approved broadband alarms that limit the alarm noise to 5 to 10 dBA above the background noise.
- Install high-grade mufflers on all diesel-powered equipment.
- Restrict the surface and outdoor construction activities to daytime hours (7:00 a.m. to 7:00 p.m.).
- Combine noisy operations to occur for short durations during the same time periods. Turn idling equipment off.

Implementation of these mitigation measures is expected to reduce overall impacts; however, the residual impacts from construction activities are expected to remain moderate at the nearest residence.

During the scoping phase of the Project, DEQ received a comment requesting analysis of the potential impacts associated with the Project on the Little Moose Subdivision located approximately 3 miles from the mill pad. The noise evaluations completed for the Project included noise sensitive areas approximately 2 miles from the mill pad. As noted in **Table 3.11-4**, noise associated with the construction phase of the Project would be equivalent to background sound levels and only occasionally audible within 1 to 2 miles of the Project area. Because sound levels attenuate with distance, noise associated with the construction phase of the Project would likely be less than the noise level presented in **Table 3.11-4** for Location 2, which is approximately 2 miles from the mill pad. Therefore, noise levels associated with the construction phase of the Project would likely be either not perceptible or only occasionally audible at the Little Moose Subdivision.

Construction phase activities would also involve periodic blasting at or near the ground surface. As the Project progresses to the operations phase, blasting would proceed further underground, and blasting noise at the ground surface would decrease. As previously noted, DEQ regulates noise levels associated with blasting at nearby noise sensitive areas. **Table 3.11-5** presents the estimated noise levels associated with blasting for comparison to the DEQ's noise regulation.

Table 3.11-5
Predicted Noise Levels for Blasting at or near the Ground Surface

Noise Measurement Location	Predicted Blast Noise Level (L_{peak} dBC)	DEQ Noise Threshold (dBC)
Location 1	87	105
Location 2	87	105
Location 3	75	105
Location 4	85	105

Source: Big Sky Acoustics 2017
dBC = decibels on the C-weighted scale; L_{peak}= peak noise level

Blasting would be a short-term, temporary impact during the construction phase of the Project. While blasting would be audible for several miles around the Project site, the noise levels associated with blasting at or near the ground surface would be less than the DEQ's noise threshold for noise sensitive areas, as shown in **Table 3.11-5**.

As noted above, blasting during the construction phase of the Project would be audible for several miles around the Project area. Therefore, the potential exists that blasting activities associated with the construction phase may be audible at the Little Moose Subdivision. Blasting would be a short-term, temporary impact during the Project construction phase. As presented above, the noise levels associated with blasting at or near the ground surface would be less than the DEQ's noise threshold at nearby noise sensitive areas, which are located between 0.5 mile and 2 miles from the Project area. As such, any noise associated with blasting activities at the Little Moose Subdivision, if audible, would be below the DEQ's noise threshold for noise sensitive areas.

Operations Phase

The operations phase of the Project would include operation of the indoor mill, operation of the crusher on the portal pad, haul trucks transporting material from the underground mine portal to the crusher, a front-end loader operating at the crusher, and a ventilation fan. The noise analysis is based on the assumption that the indoor mill, haul trucks, and ventilation fan would operate 24 hours per day, and the outdoor crusher and front-end loader would operate 20 hours per day. **Table 3.11-6** summarizes the predicted operations phase noise levels assuming that all equipment is operating simultaneously.

Table 3.11-6
Predicted Operations Phase Noise Levels (dBA)

Noise Measurement Location	L_{dn} Noise Level		Audibility			
	Calculated Baseline Noise Level (L_{dn})	Predicted Operational Noise Level (L_{dn})	Average Measured Baseline Noise Level (L_{90})	Predicted Operational Noise Level (L_{eq})	Difference $L_{eq} – L_{90}$	Perception of Operational Noise at Locations
Location 1	42	40	24	35	+11	Clearly audible
Location 2	48	34	25	30	+5	Occasionally audible
Location 3	33	36	21	31	+10	Clearly audible
Location 4	31	32	22	27	+5	Occasionally audible

Source: Big Sky Acoustics 2017
L_{90} = ambient noise level; L_{dn} = day-night sound level; L_{eq} = equivalent sound level

As presented in **Table 3.11-6**, the predicted noise attributable to mine operations would be less than 55 dBA L_{dn} at each of the four noise measurement locations, which is the level recommended by the USEPA for outdoor noise levels in noise-sensitive areas. The audibility analysis shows that noise attributable to mine operations would be clearly audible at Locations 1 and 3, which are in close proximity to the nearest residences. Therefore, mine operations would have a moderate impact at the nearest residences; however, mine operations would only be occasionally audible at additional noise-sensitive areas farther from the construction site. To minimize equipment noise, the Proponent would implement the following noise mitigation measures:

- Install a ventilation fan designed to meet 85 dBA at 3 feet.
- Install high-grade mufflers on all diesel-powered equipment.
- Restrict the surface operation activities to daytime hours (7:00 a.m. to 7:00 p.m.).
- Reduce the noise of underground haul trucks by enclosing the engine.

Implementation of these mitigation measures is expected to reduce overall impacts; however, the residual operations phase impacts are expected to remain moderate at the nearest residence.

Traffic Noise

Additional noise would be generated by traffic associated with both the construction and operations phases of the Project. Project-related traffic would travel along U.S. 89 and Forest Road (FR) 119 to and from the Project site, both of which are shown on **Figure 3.11-1**. Speed limits are 70 miles per hour (mph) for cars and 65 mph for trucks on U.S. 89, and 35 mph on FR 119.

Big Sky Acoustics estimated traffic for both the construction and operations phases of the Project using the Federal Highway Administration's Traffic Noise Model. Because traffic noise is intermittent, it is evaluated using 1-hour L_{eq}(h) and is evaluated separately from continuous noise sources.

During the construction phase, approximately six trucks per day would be used to transport material, supplies, and water to and from the site, and approximately 75 employee vehicles per day would be expected to travel roundtrip. Construction phase traffic would access the site using U.S. 89, FR 119, Butte Creek Road, and the construction access road on the west side of the site, as shown on **Figure 3.11-1**. To estimate 1-hour traffic volume, Big Sky Acoustic assumed that all 70 employee vehicles would travel the roads in the same hour near a shift change, but that truck traffic would be distributed evenly throughout an 8-hour shift, resulting in approximately 1 truck per hour.

During the operations phase, approximately 40 trucks (i.e., delivery, fuel, and haul trucks) and 280 employee vehicles per day are predicted to travel roundtrip. Operations phase traffic would access the site using U.S. 89, FR 119, and the operation access road east of the site, as shown on **Figure 3.11-1**. Big Sky Acoustics assumed all 1/3 of the employee vehicles (approximately 93 vehicles) would travel the road in the same 1-hour period during a shift change, and the trucks would be distributed evenly throughout a 24-hour period, resulting in approximately 2 trucks per hour.

The predicted traffic noise levels at noise level measurement Locations 1, 3, and 4 are presented in **Table 3.11-7**. The traffic noise levels shown in the table consider the impact of the natural topography in the area. Since Location 2 is adjacent to U.S. 89, it was evaluated along with other predicted noise levels in proximity to U.S. 89 (see **Table 3.11-8**).

Table 3.11-7
Predicted Construction and Operations Phase Traffic Noise Levels Near the Mine Site

Noise Measurement Location	Measured Daytime L_{eq} (dBA)	Construction Phase		Operations Phase	
		Predicted Construction Traffic Noise L_{eq}(h) (dBA)	Difference versus Measured L_{eq}	Predicted Operations Traffic Noise L_{eq}(h) (dBA)	Difference versus Measured L_{eq}
Location 1	38 [a]	43	+5	38	0

Noise Measurement Location	Measured Daytime L_{eq} (dBA)	Construction Phase		Operations Phase	
		Predicted Construction Traffic Noise L_{eq}(h) (dBA)	Difference versus Measured L_{eq}	Predicted Operations Traffic Noise L_{eq}(h) (dBA)	Difference versus Measured L_{eq}
Location 3	33	33	0	33	0
Location 4	28	30	+2	30	+2

Source: Big Sky Acoustics 2018
dBA = decibels on the A-weighted scale; h = hour; L_{eq} = equivalent sound level; L_{eq}(h) = existing peak hour
[a] Represents the average measured daytime L_{eq}(h) obtained during the 24-hour measurement.

As shown in **Table 3.11-7**, the predicted traffic noise levels with the addition of the mine-related traffic are less than the MDT's L_{eq}(h) 66 dBA criterion, and do not exceed the MDT's +13 dBA significant increase criterion at the nearby receptors.

Big Sky Acoustics also estimated traffic noise levels at various distances from U.S. 89. Traffic data for U.S. 89 were obtained from a traffic study completed by Abelin Traffic Services. The traffic data is provided in terms of average annual daily traffic (AADT). Based on the Abelin Traffic Study, the AADT in the year 2016 was 568, which includes approximately 3 percent commercial (heavy) trucks. The predicted traffic noise levels shown assume a direct line of sight exists between the road and a listener. The results of the U.S. 89 traffic noise analysis for the Project's construction and operations phases are presented in **Table 3.11-8**.

Table 3.11-8
Predicted U.S. 89 Traffic Noise Levels

Distance from Centerline of U.S. 89	Existing U.S. 89 Traffic Noise Level L_{eq}(h) (dBA)	Construction Phase		Operations Phase	
		Existing U.S. 89 + Construction Traffic Noise Level L_{eq}(h) (dBA)	Difference vs. Existing U.S. 89 Traffic Noise	Existing U.S. 89 + Operations Traffic Noise Level L_{eq}(h) (dBA)	Difference vs. Existing U.S. 89 Traffic Noise
100 feet	58	61	+3	61	+3
200 feet	51	54	+3	54	+3
300 feet	46	49	+3	49	+3
400 feet	43	45	+2	45	+2
500 feet	41	43	+2	43	+2
750 feet (Location 2)	36	38	+2	38	+2
1,000 feet	34	36	+2	36	+2
5,000 feet	24	26	+2	26	+2
10,000 feet	20	22	+2	22	+2

Source: Big Sky Acoustics 2018
dBA = decibels on the A-weighted scale; L_{eq}(h) = existing peak hour; U.S. = United States highway

As shown **Table 3.11-8**, the traffic noise levels due to the addition of mine-related traffic to the U.S. 89 traffic volume is not predicted to exceed MDT's criterion of L_{eq}(h) 66 dBA, and do not exceed MDT's +13 dBA significant increase criterion.

As previously noted, DEQ received a scoping comment requesting analysis of the potential impacts associated with the Project on the Little Moose Subdivision located approximately 3 miles from the mill pad. The noise evaluations completed for the Project included noise sensitive areas approximately 2 miles from the mill pad. As noted in **Table 3.11-6**, noise associated with the operations phase of the Project would be equivalent to background sound levels and only occasionally audible within 1 to 2 miles of the Project area. Because sound levels attenuate with distance, noise associated with the operations phase of the Project would likely be less than the noise level presented in **Table 3.11-6** for Location 2, which is approximately 2 miles from the mill pad. Therefore, noise levels associated with the operations phase of the Project would likely be either not perceptible or only occasionally audible at the Little Moose Subdivision.

Closure Phase

The noise associated with the closure phase of the Project would be similar in nature to the construction phase of the Project as presented in **Table 3.11-4**; however, blasting activities would not be required. The Proponent has estimated that mine closure activities would last up to 4 years.

Smith River Assessment

Noise associated with the Project would not likely have any direct or secondary impacts on recreational resources in the Smith River area. Based on the analysis provided by Big Sky Acoustics, noise associated with the construction and operations phases of the Project would be equivalent to background sound levels and only occasionally audible within 1 to 2 miles of the Project area. The Smith River is located approximately 12 miles west of the Project area at its closest point; therefore, it is unlikely that noise associated with the construction and operations phases of the Project would be perceived by recreational users of the Smith River.

As noted above, blasting during the construction phase of the Project would be audible for several miles around the Project site. Therefore, the potential exists that blasting activities associated with the construction phase of the Project may be audible to recreational users of the Smith River. Blasting would have a short-term, temporary impact during the construction phase of the Project. As presented in Section 3.11.3.2, the noise levels associated with blasting at or near the ground surface would be less than the DEQ's noise threshold at nearby noise-sensitive areas, which are located between 0.5 and 2 miles from the Project area. As such, any noise associated with blasting activities, if audible to recreational users at the Smith River State Park, would be below the DEQ's noise threshold for noise sensitive areas.

3.11.3.3. Agency Modified Alternative

The impacts of the Agency Modified Alternative on noise levels in the Project area would be similar to those described for the Proposed Action because the modifications would not modify the noise generating activities associated with mine construction, operation, and closure.

Smith River Assessment

The impacts of the Agency Modified Alternative on noise levels in the Smith River area would be similar to those described for the Proposed Action.

3.12. TRANSPORTATION

This section describes the affected environment and potential impacts of the proposed Project on roads. The local road network is evaluated using a level of service analysis, review of accident rates, and review of the physical road characteristics. The evaluation identifies potential road improvements to increase road safety and address impacts.

3.12.1. Analysis Methods

3.12.1.1. Analysis Area

Analysis of transportation impacts includes both traffic function (traffic volumes, congestion, and delay) and transportation safety. The analysis area for transportation encompasses the road system that would be used to transport mine concentrates between the Project area and the Livingston and/or Townsend rail yards, including portions of Sheep Creek Road, U.S. Route 89, U.S. Route 12, Interstate 90 (I-90), and local roads in Livingston and Townsend.

3.12.1.2. Data Sources

Current and projected future (non-Project) traffic volumes, traffic classifications (i.e., by vehicle type), and safety data were obtained online from publicly available information provided by the MDT. The Proponent provided estimates of Project traffic volumes and vehicle classifications during construction and operations.

3.12.1.3. Transportation Analysis

Road transportation conditions are described not only according to traffic volumes and classifications, but also using Level of Service (LOS), a mathematical measure of the amount of traffic congestion or delay experienced on roadways and at intersections. LOS is typically evaluated for a road or intersection’s peak hour (i.e., rush hour), and is expressed as a letter grade between A and F. LOS A indicates roads with minimal congestion and intersections with little to no delay, while LOS F indicates heavily congested roads (to the point of gridlock) and intersections with long delays (Transportation Research Board 2010). In rural areas, roads and intersections functioning at LOS C or better are typically considered to be operating acceptably, while LOS D or worse typically reflects conditions perceived as unacceptable for drivers.

Construction- and operations-phase road conditions are established by adding Project-related traffic to projected non-Project traffic volumes (i.e., the amount of traffic that would use the road system in future years if the Project were never to be constructed or operated).

Highway safety is commonly evaluated in terms of incident rates, such as the number of crashes, injuries, or fatalities per million vehicle miles traveled. All other factors being equal, the number of incidents increases in proportion with increases in traffic volumes. Other factors that can increase traffic incidents include increased congestion, poor road conditions, and increased truck volumes. The Project would result in increased total traffic and increased truck traffic on public roadways, which could increase the number of incidents. Analysis of traffic safety impacts reflects the change in the total number and rate of incidents due to the addition of Project traffic.

The Proponent prepared a traffic study to evaluate baseline and future peak hour LOS for key intersections impacted by Project traffic. As stated in the traffic study, "due to the relatively low traffic volumes along the study roadways compared to the roadways capacity, no specific LOS calculations were performed for the study roadways" (Abelin Traffic Services 2018).

The Proponent's traffic study also analyzes historic vehicle crash information, intersection sight distance, and turning lane requirements at the following locations:

- U.S. Route 89 at Sheep Creek Road;
- The U.S. Route 89/U.S. Route 12 split northeast of White Sulphur Springs;
- Main Street at 3rd Avenue (both signed as U.S. Route 89/U.S. Route 12) in White Sulphur Springs;
- The U.S. Route 89/U.S. Route 12 split south of White Sulphur Springs;
- U.S. Route 12 at U.S. Route 287 in Townsend (entrance to the Townsend rail yard); and
- U.S. Route 12 through Deep Creek Canyon in the Helena National Forest.

This section assumes that employee commuter trips, and delivery of construction and operations-phase components, materials, consumable supplies, and hazardous materials (e.g., diesel fuel) would access the Project area through the roads listed in Section 3.12.1.1, Analysis Area. Specific origin points and delivery and commuter routes have not been defined. Accordingly, this section includes a generalized evaluation of traffic impacts on the roads in the analysis area.

3.12.2. Affected Environment

3.12.2.1. Existing Road Network

As described in Section 3.12.1.1, Analysis Area, major roads in the analysis area include U.S. Route 89, U.S. Route 12, Sheep Creek Road, and a small segment of I-90. Other roads impacted by the Project include Butte Creek Road and local roads in Livingston and Townsend.

Access to the Project area would be via Sheep Creek Road and Butte Creek Road during construction and via Sheep Creek Road during mine operations. During mine operations, the haul route for mine concentrates would include the following road segments listed here and described in detail below. **Table 3.12-1** provides the AADT on these roads, while **Figure 3.12-1** shows AADT locations.

- U.S. Route 89 from Sheep Creek Road to the point where U.S. Route 89 and U.S. Route 12 join, just north of White Sulphur Springs; and
- U.S. Route 89/U.S. Route 12 from their merger north of White Sulphur Springs, through the town, to their split, approximately 9 miles south of White Sulphur Springs.

Deliveries destined for Livingston would proceed along the following road segments:

- U.S. Route 89 south to I-90;
- I-90 from exit 340 to I-90 Business/U.S. Route 89 (Exit 337);
- I-90 Business/U.S. Route 89 (East Park Street) to Old Clyde Park Road; and
- Bennett Street/East Gallatin Road to the Livingston rail yard. The specific entry point for the rail yard has not been determined by the Proponent and Montana Rail Link (MRL).

Deliveries destined for Townsend would proceed west along U.S. Route 12 to Townsend, through Townsend on U.S. Route 12/Broadway Street and directly across U.S. Route 287/Front Street into the Townsend rail yard.

The Proponent's traffic study anticipates that about 80 percent of employee traffic to the Mine would travel on U.S Route 89 from the White Sulphur Springs area, while the remaining 20 percent would come from the north using U.S. Route 89 and from the south and east using U.S. Route 12 and U.S. Route 89.

Table 3.12-2 shows historic AADT. Traffic volumes on most major analysis area roads increased from 2005 to 2011, but have since declined to near 2005 levels. The exceptions are U.S. Route 287 in Townsend and U.S. Route 89 south of the Yellowstone River Bridge (just north of I-90), which have seen steady increases. No seasonal traffic data are available for analysis area roads; however, statewide trends show peak volume in July and August, approximately twice as high volumes in January and February (MDT 2017).

Table 3.12-1
2016 Average Annual Daily Traffic on Analysis Area Roads

Road	Location Milepost (MP)	2016 AADT		Truck Percent
		Total	**Commercial**	
North of Project area				
U.S. Route 89	North of Meagher County line MP 28.95	442	49	11.1%
U.S. Route 89	0.5 mile east of Sheep Creek Road MP 15.65	364	49	13.5%
South of Project area				
U.S. Route 89	0.5 mile north of U.S. Route 12 MP 0.51	469	49	10.4%
U.S. Route 12/ U.S. Route 89	East of 3rd Avenue, White Sulphur Springs MP 42.19	2,286	106	4.6%
U.S. Route 12/ U.S. Route 89	South of Main Street, White Sulphur Springs MP 42.10	1,777	106	6.0%
U.S. Route 12/ U.S. Route 89	0.5 mile north of U.S. Route 89/U.S. Route 12 split MP 34.10	844	106	12.6%
South of Project area, route to Townsend				
U.S. Route 12	0.5 mile west of U.S. Route 89/U.S. Route 12 split MP 32.94	677	112	16.5%
U.S. Route 12	Deep Creek Canyon (Helena National Forest)	700	112	16.0%

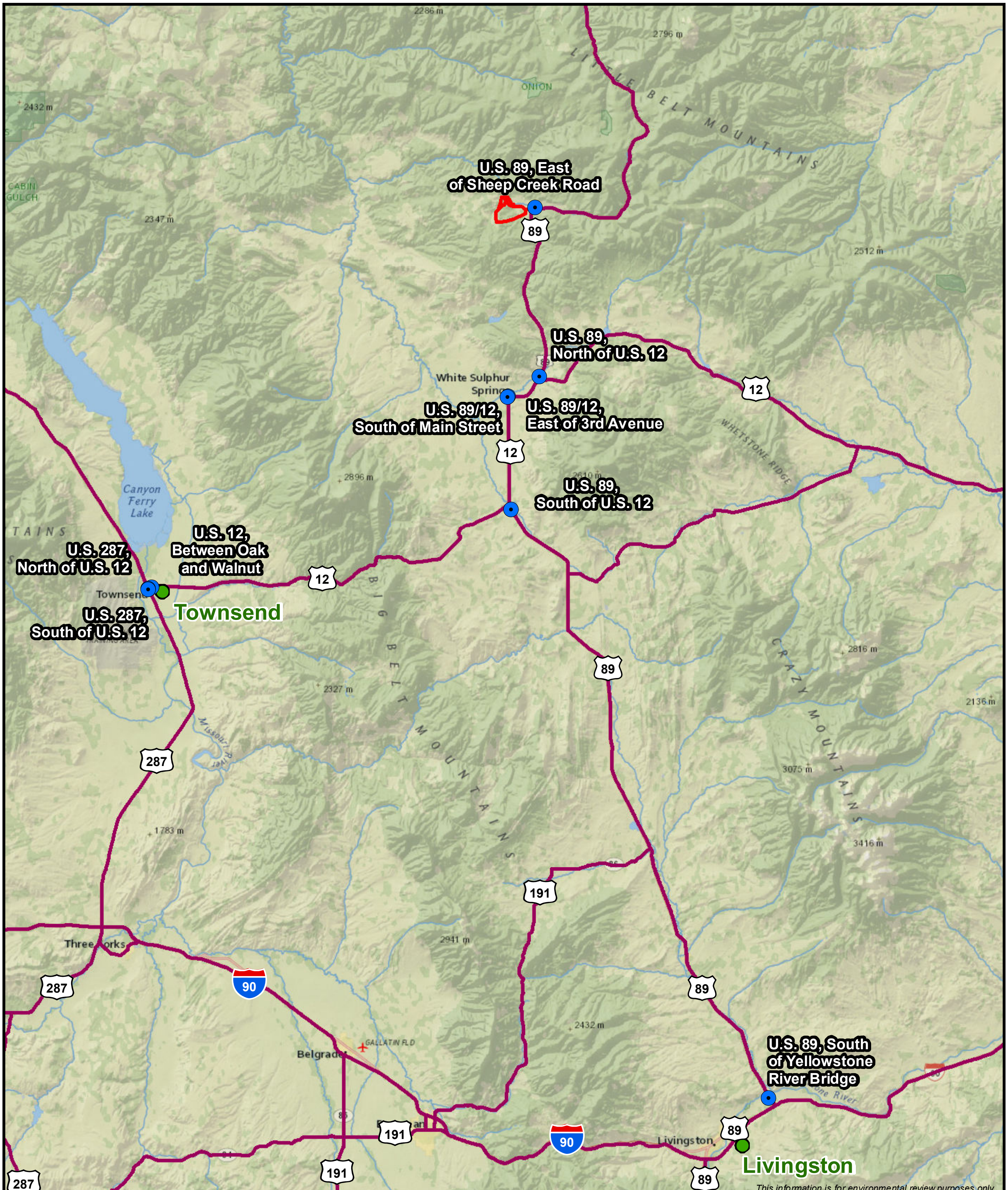
Road	Location Milepost (MP)	2016 AADT		Truck Percent
		Total	Commercial	
U.S. Route 12	East of U.S. Route 287, Townsend MP 0.04	3,052	112	3.7%
U.S. Route 287	North of U.S. Route 12, Townsend MP 77.52	6,909	679	9.8%
U.S. Route 287	South of U.S. Route 12, Townsend MP 77.60	6,291	482	7.8%
South of Project area, route to Livingston				
U.S. Route 89	0.5 mile south of U.S. Route 89/U.S. Route 12 split MP 56.94	564	46	8.2%
U.S. Route 89	1 mile north of I-90 MP 1.43	2,190	72	3.4%
I-90	West of U.S. Route 89 MP 338.46	13,133	1,892	14.4%
I-90B (U.S. Route 89)	West of Yellowstone River Bridge MP 55.77	3,946	287	7.3%
Bennett Street	North of I-90B/U.S. Route 89, Livingston MP 0.12	2,382	126	5.3%

Source: MDT 2017

Table 3.12-2
Historic Average Annual Daily Traffic on Analysis Area Roads

Road	Location	Historic Traffic Data (AADT)				
		2005	2008	2011	2014	2016
North of Project area						
U.S. Route 89	0.5 mile east of Sheep Creek Road	330	390	460	390	364
South of Project area						
U.S. Route 89	0.5 mile north of U.S. Route 12	410	320	360	510	469
U.S. Route 12/ U.S. Route 89	East of 3rd Avenue, White Sulphur Springs	2,540	2,130	3,120	2,120	2,286
U.S. Route 12/ U.S. Route 89	0.5 mile north of U.S. Route 89/U.S. Route 12 split	860	870	930	870	844
South of Project area, route to Townsend						
U.S. Route 12	Between Oak and Walnut, Townsend	4,080	3,570	3,660	3,330	3,064
U.S. Route 287	North of U.S. Route 12, Townsend				5,370	6,107
U.S. Route 287	South of U.S. Route 12, Townsend				3,590	4,196
South of Project area, route to Livingston						
U.S. Route 89	0.5 mile south of U.S. Route 12	550	560	610	630	564
U.S. Route 89	South of Yellowstone River Bridge	1,840	1,840	1,830	1,900	2,109

Source: MDT 2017



AADT Points
Towns
Highways
Project Area

1:700,000
0 5 10 Miles

Figure 3.12-1
Black Butte Copper Project
AADT Count Locations
Meagher County, Montana

ERM

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Sheep Creek Road (County Route 119) and Butte Creek Road

The primary access to the Project area is via Sheep Creek Road (County Road 119). Sheep Creek Road intersects U.S. Route 89 approximately 0.5 mile east of the MOP Application Boundary, and intersects Butte Creek Road within the Project area about 2.2 miles west of U.S. Route 89. No AADT or traffic safety data are available for Sheep Creek Road.

Sheep Creek Road is a two-lane roadway with a gravel surface and total width ranging from 24 to 28 feet. The road crosses gently rolling terrain from U.S. Route 89 through the Project area, and enters mountainous terrain north and west of the Project area. An unpaved acceleration area is present at the U.S. Route 89 intersection.

U.S. Route 89 and U.S. Route 12

U.S. Route 89 is the primary regional access route for the Project area. It runs north-south from Yellowstone National Park in Wyoming to the Canadian border near Glacier National Park, via Livingston, White Sulphur Springs, and Great Falls. U.S. Route 89 has an almost 90-degree curve, beginning about 500 feet north of the Sheep Creek Road intersection.

U.S. Route 89 is a paved, two-lane road, with two 12-foot travel lanes and 0- to 2-foot shoulders outside of the communities.

U.S. Route 12 runs east-west through Montana, from North Dakota to Idaho, via White Sulphur Springs and Townsend. In the analysis area (from the northern U.S. Route 89 intersection to Townsend), U.S. Route 12 is a paved, two-lane road, with two 12-foot travel lanes and shoulders widths varying from 0 to 2 feet outside of the communities.

As shown in **Table 3.12-1**, AADT on U.S. Route 89 are low near the Project area, and increase toward White Sulphur Springs, particularly in the segment that overlaps with U.S. Route 12. AADT on U.S. Route 12 is low outside of Townsend.

There are no curbs outside of towns, while guardrail and turn lanes are provided in some locations. U.S. Route 89 and U.S. Route 12 are generally flat to gently rolling, except the segment of U.S. Route 12 east of Townsend, in the Helena National Forest. This segment has dramatic elevation changes, climbing (westbound) 800 feet and then descending 2,000 feet to Townsend.

Posted speed limits outside of towns are 70 miles per hour (mph) (65 mph at night) for passenger vehicles, and 60 mph (50 mph at night) for trucks. Within White Sulphur Springs, Wilsall, and Clyde Park, speed limits decrease to 45 mph and then 25 to 35 mph within town centers. Within White Sulphur Springs and Townsend, U.S. Route 89/12 and U.S. Route 12 typically have on-street parking adjacent to travel lanes, with curb/gutter and sidewalks in some locations.

I-90

I-90 is a limited-access freeway that runs east-west through the entire width of Montana, and links the Atlantic and Pacific coasts, from Boston to Seattle. Mine concentrate shipments would use the segment of I-90 between I-90 Business (exit 337) and U.S. Route 89 (exit 340). Each of the separate eastbound and westbound lanes of the Interstate consists of two 12-foot travel lanes, 8-foot wide outside shoulders, and 4-foot inside shoulders. Acceleration and deceleration lanes are provided for both exits. AADT on this segment of I-90 exceeds 13,000 vehicles per day, of which more than 14 percent are heavy trucks.

Other Roads

U.S. Route 287 runs north-south through Townsend, linking West Yellowstone to Helena. Mine concentrate shipments would not travel on U.S. Route 287, but would cross it on U.S. Route 12, at the Broadway Street/Front Street intersection in Townsend. Roads along the mine concentrate haul route in Livingston would include I-90 Business (which is also signed as U.S. Route 89, and becomes Park Street) and Bennett Street, both of which are two-lane paved roads with a typical width of 24 feet and paved shoulders in most locations. Bennett Street becomes Gallatin Street in the vicinity of the Livingston rail yard.

3.12.2.2. Traffic Safety Data

The Proponent’s traffic study evaluated general vehicle crash trends, as well as historic crash rates at the intersections listed in Section 3.12.1.3. “In general, a vehicle crash rate of less than one crash per million vehicles entering (MVE) [i.e., vehicles entering the intersection] is typical for rural highway intersections. The road segment crash rate for rural highways is generally between 0.5 to 1.0 crashes per million vehicle miles traveled” (Abelin Traffic Services 2018). Vehicle crashes in the past 10 years, as well as existing safety measures (aside from stop signs or standard traffic signals) for Project-area intersections are summarized below:

- Intersection of U.S. Route 89 at Sheep Creek Road: no crashes in past 10 years.
- Intersection of U.S. Route 12/U.S. Route 89 east of White Sulphur Springs: one crash, a single-vehicle rollover. The intersection has approaching warning rumble strips on U.S. Route 89 and overhead warning flashers at the intersection. U.S. Route 12 has a left-turn lane to facilitate vehicles turning onto U.S. Route 89 from the south.
- Intersection of U.S. Route 12/89 (Main Street at 3rd Avenue) in White Sulphur Springs: no crashes.
- Intersection of U.S. Route 12/U.S. Route 89 south of White Sulphur Springs: Three crashes, including a collision with a wild animal, a single-vehicle rollover, and a multi-vehicle sideswipe. The crash rate for this intersection is 0.68 crashes per MVE.
- Intersection of U.S. Route 12 and U.S. Route 287 in Townsend: ten vehicle crashes, nine of which were multi-vehicle collisions. The crash rate for this intersection is 0.34 crashes per MVE. The intersection has four-way stop signs with overhead warning flashers.

- Road Segment of U.S. Route 12 through Deep Creek Canyon (Helena National Forest): 60 crashes, of which 53 were single-vehicle crashes. Wet, icy, or snow covered roads or dark conditions contributed to 41 of these crashes. The overall vehicle crash rate through Deep Creek Canyon is 2.13 per million vehicle miles traveled, which is higher than the average rate of crashes on most rural highways. The roadway was improved in 2016 with new bridges, signage, and guardrails. As a result, it is not yet known whether these upgrades have improved safety conditions on this road segment.

3.12.3. Environmental Consequences

MDT generally assumes annual traffic growth rates of one percent for U.S Route 12 and U.S. Route 89. These roads typically operate at 5 to 10 percent of their carrying capacity. Based on MDT assumptions, baseline traffic not associated with the Project would increase about 20 percent (above the traffic volumes shown in **Table 3.12-2**) by the end of the Project's operational life, and total traffic on Project-area roads would still be less than 20 percent of total capacity. This assumption provides the basis for the discussion of the Project's traffic impacts.

3.12.3.1. No Action Alternative

Without the Project, there would be no Project-related increases in traffic, traffic congestion, or highway safety incidents.

3.12.3.2. Proposed Action

Project Traffic

Project construction and operations would generate the following vehicle traffic (Abelin Traffic Services 2018):

- During the 2-year construction period, approximately 160 daily vehicle trips generated by approximately 75 employees, in addition to eight truck round trips per day carrying supplies and construction materials.
- During operations:
  - 18 truck round trips per day transporting mine concentrate in sealed containers to MRL rail yards in Livingston and/or Townsend;
  - An average of six truck round trips for supplies and other deliveries; and
  - 477 employee vehicle trips (see below).

As stated in Section 3.9.3.2, Project operations would employ a total of 394 workers (Proponent employees, Proponent contractors, and associated support workers) at the mine site. This includes the 240 Proponent workers listed in the Proponents' Mine Operating Permit application, as well as 24 contractors and 130 support workers. The Mine Operating Permit application states that 104 of the 240 Proponent employees (43 percent) would be on site during the day shift (the largest employee shift) and 41 (17 percent) would be onsite during the night shift. The remaining employees would be on leave or not on shift.

Applying these ratios to the full operational employment of 394, a maximum of 171 total workers would be on site during the day shift and 67 would be on site during the night shift. These workers would generate a maximum of 477 total vehicle movements (trips to and from the Project site): 342 for the day shift and 135 for the night shift.

The Proponent would encourage carpooling, and would provide shuttle service from White Sulphur Springs to the mine using at least one 40-person shuttle vehicle for each shift change. Actual shuttle bus and carpool use would depend on employee preferences.

Based on this information, the Proponent's traffic study estimates a maximum of 400 employee vehicle movements, 36 concentrate haul truck movements, and 12 other truck movements per day during operations.

Road Congestion

Table 3.12-3 shows Project-related increases, as cited in the Proponent's traffic study, in total and truck traffic on major roads in the Project area during construction, while **Table 3.12-4** shows traffic increases during operations. The largest Project-related traffic volumes would occur on the segment of U.S. Route 89 between White Sulphur Springs and the Project site.

No traffic counts are available for Sheep Creek Road or Butte Creek Road; however, given the rural nature of these roads, and the absence of commercial or residential destinations, existing traffic is likely to be minimal. Project traffic would thus represent an increase in existing traffic. Project traffic may result in brief periods of congestion at the intersection of Sheep Creek Road and U.S. Route 89, particularly during employee shift changes.

Table 3.12-3
Increase in AADT during Project Construction

		Number		Percent Increase	
Road	**Location**	**Total**	**Truck**	**Total**	**Truck**
U.S. Route 89	South of the Project area	178	16	38%	33%
U.S. Route 12/U.S. Route 89	East of 3rd Avenue, White Sulphur Springs	178	16	8%	15%
U.S. Route 12/U.S. Route 89	South of Main Street, White Sulphur Springs	178	16	10%	15%
U.S. Route 12/U.S. Route 89	0.5 mile north of U.S. Route 12	178	16	21%	15%

Table 3.12-4
Increase in AADT during Project Operations (Compared to 2016 AADT)

Road	Location	Number [a]		Percent Increase	
		Total	Truck	Total	Truck
U.S. Route 89	North of the Project area	20	0	4%	0%
U.S. Route 89	South of the Project area	280	54	60%	110%
U.S. Route 12/U.S. Route 89	East of 3rd Avenue, White Sulphur Springs	280	54	12%	51%
U.S. Route 12/U.S. Route 89	South of Main Street, White Sulphur Springs	280	54	16%	51%
U.S. Route 12/U.S. Route 89	0.5 mile north of U.S. Route 12	20	54	2%	51%
U.S. Route 12	South of White Sulphur Springs	40	54	6%	48%
U.S. Route 12	Deep Creek Canyon (Helena National Forest)	20	54	3%	48%
U.S. Route 89	South of U.S. Route 12	20	54	4%	117%
U.S. Route 89	North of I-90	20	54	1%	75%

Source: Abelin Traffic Services 2018

Notes:
[a] Because the Proponent has not determined how many concentrate trucks would travel to either the Townsend and/or Livingston, the Truck Volumes column indicates the maximum possible increase in truck traffic on any of the major Project-area roads.

South of White Sulphur Springs, mine-related traffic is anticipated to disperse over several routes, including the major roads listed in Section 3.12.2.1, Existing Road Network, as well as other roads leading to and from the Project area. Mine concentrate trucks would travel primarily to Townsend and/or Livingston; these are also likely destinations for employee and supplier traffic.

Although **Tables 3.12-3** and **3.12-4** show substantial percent increases in total and truck traffic, actual Project-related traffic volume increases would be small, compared to the capacity of U.S. Route 89 and other major roads. For example, the capacity of two-lane rural arterial highways, such as U.S. Route 89 and U.S. Route 12, exceeds 3,000 vehicles per hour under extreme congestion conditions (Transportation Research Board 2014).

Road Safety

As discussed in Section 3.12.1.3, Transportation Analysis, the number of highway safety incidents could increase in proportion to Project-related changes in Traffic volumes. The Project could generate an increase in traffic incidents (crashes) during construction and operations. Increased traffic safety risk would be greatest on U.S. Route 89 at Sheep Creek Road.

To address traffic safety concerns, potential safety improvements cited in the Proponent's traffic study are listed below:

- U.S. Route 89 at Sheep Creek Road: The limited sight distance to the north along U.S. Route 89 (750 feet) does not meet MDT design standards for truck traffic. The Proponent's traffic study recommends realignment of Sheep Creek Road at least 500 feet to the south. If this is not feasible, the traffic study recommends improvements such as grading and installation of actuated warning flashers. In addition, the traffic study found that although a northbound left-turn lane on U.S. Route 89 would not be required by the MDT Road Design Manual, it would enhance intersection safety.
- U.S. Route 12 west of U.S. Route 89 (Milepost 28.0 to 29.9): Ensure the pullouts and vehicle chain-up areas on U.S. Route 12 near Deep Creek Canyon meet MDT length, width, and surface condition standards. Conduct a special speed zone investigation to consider lowering the posted speed limit.
- Review school bus schedules and consider scheduling Project truck traffic to limit the risk of interactions with school bus traffic.
- Use on-board systems to monitor truck speed, limit mine concentrate truck speeds along certain portions of the route, especially on U.S. Route 12 near the Deep Creek Divide.

Spills

The Proponent proposes to transport mine concentrate in sealed shipping containers from the Project area to the MRL rail facilities. Assuming the shipping containers are transferred directly onto rail cars, transportation of mine concentrate would not result in spills or leakage except, in the case of an accident severe enough to compromise the integrity of the container.

Reclamation

During reclamation, impacts of the Proposed Action on transportation would be similar to those anticipated for construction.

Summary of Impact

Using the assessment rating explained in Section 3.1.2.1, Impact Assessment Methodology, the transportation impacts are summarized below.

Road Congestion

Although project traffic volumes would result in substantial percentage increases in traffic volumes during Project construction and operations, Project area major roads have substantial available capacity. The Proponent's traffic study states that Project operations would not meaningfully impact road traffic capacity. As a result, traffic congestion is a low-likelihood event during both construction and operations.

Road Safety

During Project construction and operations, Project traffic could increase the chance of traffic incidents, degradation of roadways, and other risks to road safety. This increased risk would not necessarily occur at every intersection or on every road segment. The Proponent’s traffic study recommends improvements to the intersection of Sheep Creek Road at U.S. Route 89 to improve sight distance.

Based on existing traffic conditions and behaviors described in Section 3.12.2.1, non-Project drivers are likely to be accustomed to varying road and weather conditions, as well as the presence of heavy truck traffic on analysis area roads.

Smith River Assessment

Transportation activity associated with construction and operations of the Project could potentially increase traffic congestion and safety risks for non-Project traffic traveling to and from the Smith River.

None of the analysis area roads cross the Smith River, although U.S. Route 89 would follow Sheep Creek for approximately 12 miles north of Sheep Creek Road, and would cross other tributaries to the Smith River. As discussed in Section 3.7.2.2, Recreation, private fishing access to Sheep Creek and the Smith River is available at various points along the Smith River. As shown in **Table 3.7-4**, recreational river use has increased over the past decade. Public boating on the Smith River is regulated by permit, with no more than nine boating groups of up to 15 people, each permitted to use a 59-mile stretch of the river, between one designated put-in (at Camp Baker, at the mouth of Sheep Creek) to one designated take-out (at Eden Bridge where Boston Coulee Road crosses the river). Road access to boating put-in and take-out locations includes (see **Figure 3.12-2**):

- To Camp Baker from the south: State Route 360, which forms the eastern leg of the Main Street/3rd Avenue intersection in White Sulphur Springs (where U.S. Route 89/12 turns south), to Smith River Road;
- To Camp Baker from the north: via Belt Park Road, which intersects U.S. Route 89 approximately 30 miles north of Sheep Creek Road;
- To Eden Bridge from the south: State Route 360 from White Sulphur Springs to Millegan Road (U.S. Route 330); and
- To Eden Bridge from the north: I-15 to State Route 330/Millegan Road (exit 270).

Figure 3.12-2
Black Butte Copper Project
Smith River Float Route and Major Roads
Meagher County, Montana

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From the south, and from areas east of Great Falls, road access to other segments of Sheep Creek, the Smith River, and its tributaries generally relies on U.S. Route 89 and U.S. Route 89/12 in White Sulphur Springs. Traffic to the Smith River occurs primarily from April through July, when weather and water levels allow boating.

Impacts to traffic using U.S. Route 89 and U.S. Route 89/12 are described in Section 3.12.3.2, Proposed Action. Once off U.S. Route 89 and U.S. Route 89/12, travelers visiting the river are unlikely to encounter Project traffic, with the possible exception of mine employees who live locally. Therefore, the Project would have no impact on transportation associated with the Smith River outside of U.S. Route 89 and U.S. Route 89/12.

3.12.3.3. Agency Modified Alternative

The modifications identified would result in impacts similar to those described for the Proposed Action, with the following exception. Additional backfilling associated with the AMA would require another 106,971 cubic yards of cemented paste tailings. The additional shipments of flotation chemicals and dry cement would occur during Project operations and closure. It is assumed that truck traffic associated with the AMA would follow the same routes as trucks associated with the Proposed Action.

Transportation of flotation chemicals and dry cement would marginally increase truck traffic compared to the number of truck trips shown in **Table 3.12-4.** These additional trips would not meaningfully change the traffic impacts described for the Proposed Action.

Smith River Assessment

The impacts of AMA traffic on the Smith River would be the same as described for the Proposed Action. Smith River travelers on U.S. Route 89 and U.S. Route 89/12 would encounter Project-related traffic. Once exiting U.S. Route 89 and U.S. Route 89/12, travelers visiting the river are unlikely to encounter Project traffic, with the possible exception of mine employees who live locally. Therefore, the Project would have no impact on transportation associated with the Smith River outside of U.S. Route 89 and U.S. Route 89/12.

3.13. VEGETATION

This section describes the affected environment and addresses potential impacts of the proposed Project and the AMA on vegetation and federally listed threatened and endangered (T&E) plant species as well as Montana Species of Concern (SOC).

3.13.1. Analysis Methods

3.13.1.1. Analysis Area

The vegetation analysis area for the vegetation baseline data surveys encompasses 3,317 acres within Sections 24 through 26, 35 and 36 in T12N, R6E, and Sections 19 and 29 through 32 in T12N, R7E (WESTECH 2015). The vegetation analysis area is included on **Figure 3.13-1**.

3.13.1.2. Information Sources for Vegetation and Ecological Communities

The baseline vegetation surveys were conducted by WESTECH in May, June, and July 2015.Vegetation data from the 2014 baseline wetlands inventory was also used, in part, for the "2015 Baseline Vegetation Inventory" (WESTECH 2015), which is included as Appendix H of the MOP Application (Tintina 2017). These data were used for evaluating the potential impacts on vegetation.

3.13.1.3. Information Sources for T&E and Species of Concern

T&E and SOC information is provided in the "2015 Baseline Vegetation Inventory" report (WESTECH 2015) as well as the updated lists of SOC plant species provided by the Montana Natural Heritage Program (MTNHP) (MTNHP 2016).

3.13.1.4. Methods of Analysis

The vegetation resources impact analysis was conducted by reviewing the MOP Application, which includes the "2015 Baseline Vegetation Inventory" report (WESTECH 2015). WESTECH preliminarily mapped the vegetation resources using desktop methods and color ortho-photos. Field surveys (i.e., pedestrian and vehicular surveys) then verified the mapping and identified T&E, SOC, and noxious weeds present within the vegetation analysis area.

3.13.2. Affected Environment

This section describes the existing habitat and plant communities; rangeland and cropland classifications; T&E and SOC; and noxious weeds in the vegetation analysis area.

3.13.2.1. Vegetation and Plant Communities

The "2015 Baseline Vegetation Inventory" report summarizes the results of vegetation sampling for a total of 185 sample plots surveyed throughout the vegetation analysis area. The results of the surveys indicated there are five habitat and community types within the vegetation analysis area:

- Upland grassland;
- Upland shrubland;
- Conifer forest and woodland;
- Lowland altered grassland; and
- Riparian and wetland (RW).

These habitat and community types are divided into sub-categories defined by the dominant vegetation noted within each habitat and community type, as summarized in **Table 3.13-1**. The vegetation community types are mapped on **Figure 3.13-1**.

Table 3.13-1
Habitat and Sub-Community Type Noted in the Analysis Area

Habitat Type	Sub-Community Type	Area within Analysis Area (acres)	Percent of Analysis Area (%)
Upland Grassland	Upland native grassland	607	18
	Upland altered grassland	172	5
Upland Shrubland	*Artemisia tridentata/Poa pratensis*	1,372	41
	Artemisia tridentata/Festuca idahoensis		
	Artemisia tridentata/Festuca campestris		
	Artemisia tridentata-Dasiphora fruticosa/ Poa pratensis		
	Dasiphora fruticosa-Artemisia tridentata/ Festuca campestris		
	Mixed Shrub-Shale Outcrop		
Conifer Forest and Woodland	Mature conifer stands	502	15
	Immature conifer stands	235	7
Lowland Altered Grassland	Noxious weed tailings	7	0
	Lowland altered grassland – hay meadow	118	4
Riparian and Wetland (RW)	Herbaceous RW	75	2
	Shrub-dominated RW	216	7
	Deciduous forest RW	13	0
Total		**3,317**	**99**

Note: Total percentage does not add to 100% due to rounding.

3.13.2.2. Rangeland

Rangeland is included in the upland altered grassland sub-community type. Rangeland or animal grazing capacity is based on the ecological site and soil mapping unit classifications (**Figure 3.13-1** and **Figure 3.13-2**). The information presented in the "2015 Baseline Vegetation Inventory," which was derived from Natural Resources Conservation Service data, indicates that the rangeland productivity varies considerably by soil type. The actual animal grazing capacity is likely much less than the literature values, which were based on the historic climax plant community values. Due to the current and historic land use as cattle pasture for the majority of the vegetation analysis area, the actual animal grazing capacity is likely considerably less than literature values (WESTECH 2015).

3.13.2.3. Cropland

In addition to cattle rangeland, the vegetation analysis area is utilized for cropland, which is included in the upland altered grassland sub-community type. Hay is grown in the meadow areas located within the Sheep Creek floodplain, accounting for approximately 2 percent of the vegetation analysis area.

3.13.2.4. T&E and Species of Concern

There are no federally listed T&E plant species in Montana; however, Montana does maintain a list of SOC, which are species that are rare, threatened, and/or have declining populations and as a result are at risk or potentially at risk of extirpation in Montana (MTNHP 2016). Designation as an SOC is not a statutory or regulatory classification in Montana (FWP 2015).

The "2015 Baseline Vegetation Inventory" reported eight SOC species within the Meagher County element data. Of these eight species, one was identified within the analysis area: long-styled thistle *(Cirsium longistylum)*. No federal species were reported within the vegetation analysis area.

Since the results of "2015 Baseline Vegetation Inventory" were made available, a subsequent list of the Meagher County MTNHP data was updated to include 16 additional SOC plant species. None of the additional SOC species were documented within the vegetation analysis area during the field surveys. The Meagher County MTNHP SOC plant list is summarized in **Table 3.13-2**.

3.13.2.5. Noxious Weeds

Twelve state, county, and problematic listed noxious weed species were noted within the vegetation analysis area during the 2014 to 2015 baseline vegetation surveys. Of these 12 species, the 3 most common noxious weeds were Canada thistle (*Cirsium arvense*), common houndstongue (*Cynoglossum officinale*), and musk thistle (*Carduus nutans*). The Canada thistle and houndstongue were primarily encountered in the lowland areas, while musk thistle was common in nearly all community types present in the vegetation analysis area.

A list of all noxious and problematic weeds encountered during the baseline vegetation inventories is provided in **Table 3.13-3**.

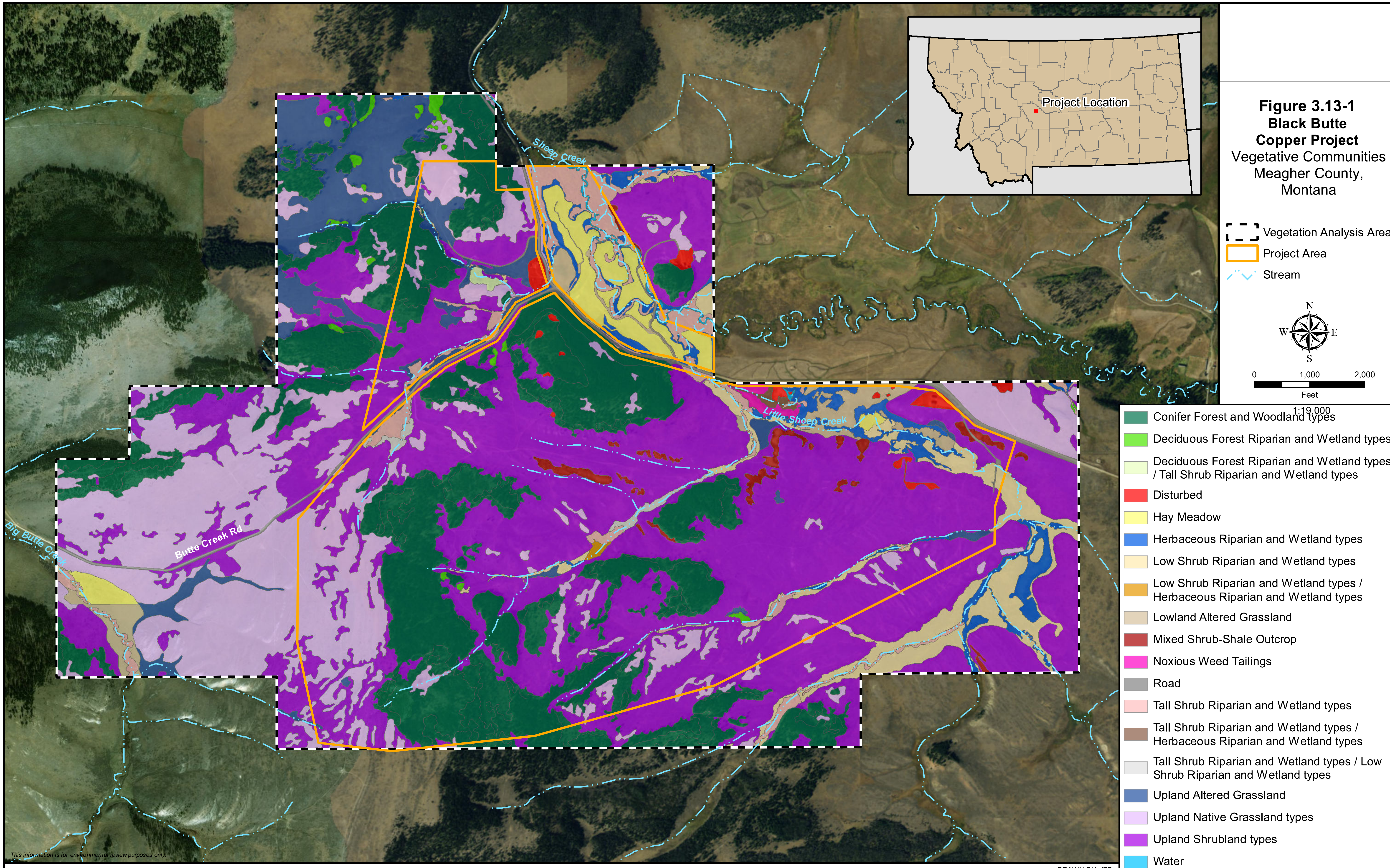

Figure 3.13-1
Black Butte Copper Project
Vegetative Communities
Meagher County, Montana

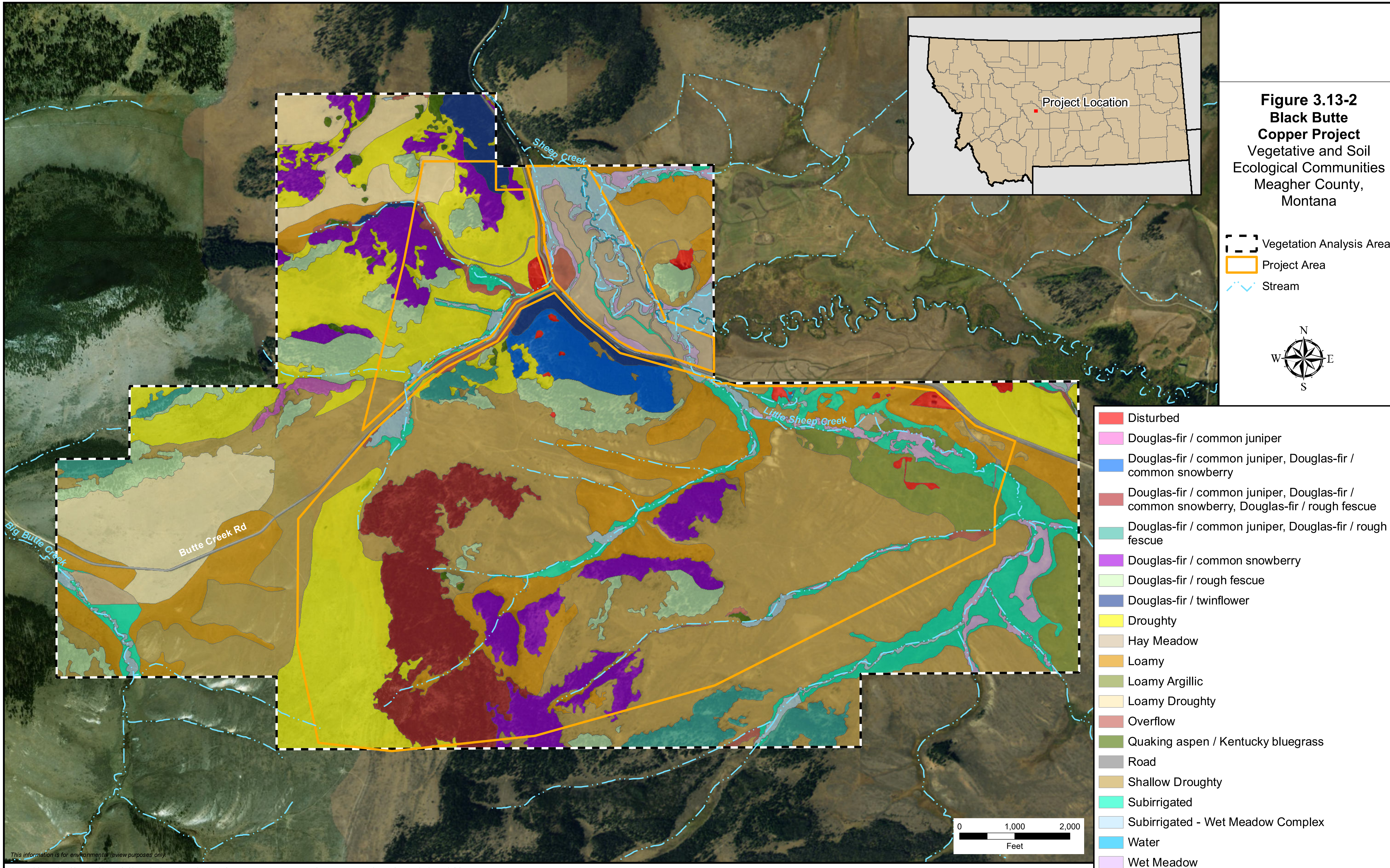

Figure 3.13-2
Black Butte
Copper Project
Vegetative and Soil
Ecological Communities
Meagher County,
Montana
Project Location
Vegetation Analysis Area
Project Area
Stream
N
S
E
W
Disturbed
Douglas-fir / common juniper
Douglas-fir / common juniper, Douglas-fir / common snowberry
Douglas-fir / common juniper, Douglas-fir / common snowberry, Douglas-fir / rough fescue
Douglas-fir / common juniper, Douglas-fir / rough fescue
Douglas-fir / common snowberry
Douglas-fir / rough fescue
Douglas-fir / twinflower
Droughty
Hay Meadow
Loamy
Loamy Argillic
Loamy Droughty
Overflow
Quaking aspen / Kentucky bluegrass
Road
Shallow Droughty
Subirrigated
Subirrigated - Wet Meadow Complex
Water
Wet Meadow
Sheep Creek
Little Sheep Creek
Butte Creek Rd
Big Butte Creek
0
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Table 3.13-2
Plant Species of Concern Known to Occur in Meagher County, Montana

Scientific Name	Common Name	Habitat	Occurs within Analysis Area
Adoxa moschatellina	Musk-root	Rock/talus	
Allium geyeri var. *geyeri*	Geyer's onion	Moist, open slopes, meadows, or stream banks in mountains	
Asplenium trichomanesramosum	Limestone maidenhair spleenwort	Montane to alpine shaded rocks	
Bolboschoenus fluviatilis	River bulrush	Freshwater shores, marshes and riparian communities; tolerates alkaline conditions	
Castilleja gracillima	Slender Indian paintbrush	Riparian wetlands	
Cirsium longistylum	Long-styled thistle	Montane-subalpine meadows	X
Delphinium glaucum	Pale larkspur	Upper montane and lower subalpine to alpine; open evergreen woods and wet tall-herb meadows and thickets	
Delphinium depauperatum	Slim larkspur	Moist sagebrush basins to subalpine meadows; moist meadows, often along streams; montane	
Descurainia torulosa	Wyoming tansymustard	Subalpine talus slopes	
Downingia laeta	Great Basin downingia	Shallow water ponds and lakes	
Eleocharis rostellata	Beaked spikerush	Alkaline wetlands	
Equisetum palustre	Marsh horsetail	Valleys to montane shallow water wetlands, often in forests	
Equisetum pratense	Horsetails	Riparian wetlands	
Goodyera repens	Northern rattlesnake plantain	Mesic forests	
Noccaea parviflora	Small-flowered pennycress	Montane to alpine moist meadows	
Phlox kelseyi var. *missoulensis*	Missoula phlox	Open foothills to subalpine slopes and ridges	
Physaria klausii	Divide bladderpod	Open, montane to subalpine slopes	
Piperia elegans	Hillside rein orchid	Dry, coniferous forests; valleys, montane, dry or briefly moist meadows and ditches in lowlands	

Scientific Name	Common Name	Habitat	Occurs within Analysis Area
Piperia elongata	Dense-flower rein orchid	Moist to wet meadows; valleys; dry, exposed habitats, forest chaparral, shrubby areas, woods and woods edges, from lowland to montane elevations	
Primula incana	Mealy primrose	Riparian wetlands	
Salix serissima	Autumn willow	Riparian wetlands	
Pinus albicaulis	Whitebark pine	Timberline of subalpine forests	
Trifolium cyathiferum	Cup clover	Valleys to montane wet meadows, sandy streambanks, and roadsides	
Trifolium microcephalum	Woolly clover	Moist meadows and sandy banks along rivers to dry hillsides	

Source: MTNHP 2016 and 2017; WESTECH 2015

Table 3.13-3
Noxious and Problematic Weeds within the Analysis Area

Weed List	Common Name	Scientific Name
State of Montana	Spotted knapweed	*Centaurea maculosa*
	Canada thistle	*Cirsium arvense*
	Common houndstongue	*Cynoglossum officinale*
	Leafy spurge	*Euphorbia esula*
	Oxeye daisy	*Leucanthemum vulgare*
Meagher County	Common wormwood	*Artemisia absinthium*
	Musk thistle	*Carduus nutans*
	Bull thistle	*Cirsium vulgare*
	Field scabious	*Knautia arvensis*
	Field sow-thistle	*Sonchus arvensis*
Problematic[a]	Caraway	*Carum carvi*
	Yellow rattle	*Rhinanthus crista-galli*

Notes:
[a] Categorized as problematic weeds by WESTECH, meaning that these weeds are not listed as noxious weeds by state of Montana or Meagher County, but are generally accepted as noxious or problematic by other counties (WESTECH 2015).

3.13.3. Environmental Consequences

3.13.3.1. No Action Alternative

The No Action Alternative would not change the existing landscape and, therefore, would not disturb or affect vegetation.

3.13.3.2. Proposed Action

This section describes the potential environmental consequences of the Proposed Action to vegetation resources, including impacts to state, federal, and SOC listed species and introduction of noxious weeds. The potential environmental consequences are described in terms of direct, secondary, and residual impacts. Actions taken to avoid or mitigate for vegetation impacts are considered in the discussions below. These actions would be implemented during the pre-construction, operations, and closure phases of the Project.

Direct Impacts

Direct impacts to vegetation communities, listed species, and ecological communities occur through clearing, filling, and other construction activities. A direct impact to a listed threatened species, endangered species, or SOC occurs when the action results in the removal or loss of an individual plant or entire plant population.

Surface Grading and Construction

The Proposed Action would disturb approximately a total of 311 acres within the Project area (i.e., the MOP Application Boundary encompassing approximately 1,888 acres), which is within the vegetation analysis area, as a result of the above ground infrastructure. This disturbance from Project infrastructure includes new access roads, stockpiles, the mill and plant site, and other associated mine facilities occurring during the mining operations, as well as a 10 percent construction buffer. These disturbances would directly affect the existing vegetation by surface grading and development of the above ground infrastructure in the Project area during the operations phase of the mine. **Table 3.13-4** below lists the vegetation community types affected by the Proposed Action.

Among the earliest Project activities would be the clearing of vegetation to allow for the construction of Project surface facilities and infrastructure. Pre-construction treatments may include mechanical means (e.g., mowing, brush clearing, tree harvesting) and are proposed for Years 0 through 2. The vegetation would be displaced within the majority of the approximately 311-acre disturbed area during the operations phase in Years 3 through 15 as the Project infrastructure would replace the vegetation. During the closure phase (Years 16 through 19) all previously vegetated areas would be reclaimed as described in Section 7.3.5 of the MOP Application. The exception to this would be the main Project access road, where the proposed plan would be to downsize but not totally reclaim this access road during closure (Tintina 2017).

To keep the integrity of the topsoil organic content and natural seedbank until the closure phase, the topsoil stockpile would be revegetated using an appropriate seed mix (native grass seed mixture of Western wheatgrass, bluebunch wheatgrass, and slender wheatgrass) and surrounded by silt fence to minimize erosion and retain soil moisture and stripping of organic matter until the topsoil would be needed for the reclamation phase (Tintina 2017).

The resulting impacts to vegetation communities would be expected to have low severity in the long-term, as they would only be realized during the pre-construction and operations phase. The closure phase would include various stages of revegetation to ultimately bring the vegetated communities back to the comparable pre-existing conditions. The reclamation and closure plan would be implemented during the closure phase, and all affected areas except the Project access road noted above would be regraded and revegetated to a vegetation community with comparable stability and utility as the original conditions. Though it is likely that short-term impacts would occur from the Project infrastructure disturbances, long-term impacts would be minimal due to revegetation efforts, since the site would be revegetated using native seed and tublings and noxious weeds would be controlled. The revegetation measures would include soil replacement using the stockpiled topsoil and subsoil, seedbed preparation, and seeding with the Project approved seed mixes detailed in the MOP Application; the reclamation and closure plan is structured to meet the requirements of the § 82-4-301, MCA (Tintina 2017). Based upon these factors, the impacts on vegetation communities from surface grading and construction would be minimized with the use of appropriate revegetation measures.

A summary of the revegetation plan, as detailed in the MOP Application includes:

- Protect and stored topsoil and subsoil during stockpiling by revegetation and soil erosion controls;
- Decompact soils prior to revegetation and properly prepare seed bed;
- Revegetate with appropriate native seed mixes for grasses and shrubs and tublings for trees;
- Initiate revegetation within one year of reaching a decision to permanently discontinue mining in Project area, unless otherwise permitted by DEQ;
- Monitor revegetated areas for noxious weeds and control if noted;
- Long-term closure of site is expected to take two to three years.

Table 3.13-4
Mine Site Vegetation Community Impacts

Vegetative Community	Acres of Disturbance
Upland Grassland	85.0
Upland Shrubland	110.7
Conifer Forest and Woodland	84.4
Lowland Altered Grassland	0.1
Riparian and Wetland	1.5
Previously Disturbed	0.4
Existing Roads	0.5
Sub-total	**282.6**
Construction Buffer (10%)	28.3
TOTAL	**310.9**

Direct impacts to the ecological community would affect the suitability of the Project area for use as wildlife habitat, rangeland, or cropland during the life of the mine during the operations phase. **Table 3.13-5** below lists the ecological community types affected by the Proposed Action. Like the vegetation impacts, the ecological community impacts would occur during the pre-construction and operations phase during Years 0 through 15, since the pre-construction ecological communities could not be used for wildlife habitat, rangeland, or cropland. During the reclamation phase (Years 16 through 19), there would be little availability of these ecological communities until the site is fully reclaimed and the pre-existing conditions are reclaimed to comparable stability and utility.

Also like the vegetation community impacts, the ecological community impacts would be considered short term, which would occur from the Project infrastructure disturbances; long-term impacts would be minimal due to revegetation efforts. The impact on vegetation in the long term would be realized during the operations phase, as the reclamation and closure plan would be implemented during the closure phase and all affected areas would be regraded and revegetated to a vegetation community, and therefore ecological community, with comparable stability and utility as the original conditions. As described above, the revegetation measures generally would include soil replacement using the stockpiled topsoil and subsoil, seedbed preparation, and seeding with the Project approved seed mixes detailed in the MOP Application and noxious weed control detailed in the "MOP Noxious Weed Management Plan" (Tintina 2017).

These measures would return the areas affected from the operations phase of the mine to the hay meadows and rangeland that currently occur in the Project area. Based upon these factors, the impacts to ecological communities from surface grading and construction would be negligible with the use of appropriate proposed revegetation measures, as described above in the vegetation community impacts discussion.

Table 3.13-5
Mine Site Ecological Community Impacts

Ecological Community	Acres of Disturbance
Disturbed	0.4
Douglas-fir/common juniper, Douglas-fir/common snowberry, Douglas-fir/rough fescue	60.7
Douglas-fir/common juniper, Douglas-fir/rough fescue	1.6
Douglas-fir/common snowberry	6.8
Douglas-fir/rough fescue	12.5
Droughty	32.9
Hay Meadow	0.1
Loamy	25.6
Loamy Argillic	2.5
Overflow	0.6
Quaking aspen/Kentucky bluegrass	0.7
Road	0.6
Shallow Droughty	135.2
Subirrigated	1.7

Ecological Community	Acres of Disturbance
Subirrigated - Wet Meadow Complex	0.6
Wet Meadow	0.2
Sub-total	**282.7**[a]
Construction Buffer (10%)	28.3
TOTAL	**311** [a]

[a] Acreage total is less than reported due to rounding.

No impacts to state or federally listed plant species would occur due to the Proposed Action since none were noted during the field surveys. One SOC species, long-styled thistle, was noted primarily within upland altered grassland communities; however, a review of the planned mining above ground facilities indicates this species would not be impacted within its known locations as determined by the vegetative field surveys.

Secondary Impacts

A secondary impact occurs when a cover type, plant community, or ecological habitat type experiences a change in vegetative composition, occurs over time, or after the action is complete, and can occur on or off site. Secondary impacts to vegetation may include changes in hydrology, deposition of particulate matter (dust), changes in successional stage, a decline in species structure, and/or invasion of non-native species.

The MOP Application indicates plans would be in place to control changes from hydrology and deposition of particulate matter. Specifically, the mine closure and reclamation plans would assure surface and groundwater hydrology would be brought back to comparable conditions as the pre-Project conditions. During operations, some springs and seeps located within the mine drawdown cone might experience decreased flow, and some might dry up. Many of the springs and seeps appear to be connected to perched groundwater bodies and may only flow seasonally; these would not likely be directly affected by mine dewatering. Vegetation may be affected at the springs or seeps depleted by dewatering, which might include stress to existing species and increased growth of successional species. Spring flow would be anticipated to reestablish when shallow groundwater recovers to baseline conditions, within two years after the cessation of dewatering. See further discussion in Section 3.5, Surface Water.

Likewise, deposition of particulate matter would be controlled through the fugitive dust collection system (Tintina 2017). As a result, the severity and likelihood of the secondary impacts described above to vegetation, ecological communities, and listed species would be low. In addition, the likelihood and severity of succession of noxious weeds would be low because noxious weeds would be monitored and controlled during all phases of the Project, as summarized in the MOP Application “Noxious Weed Management Plan” (Tintina 2017). This plan states that preventative measures would be used during the pre-construction phase to treat for known populations of noxious weeds prior to soil stripping, and would then monitor vegetation during the operations and closure phase, and would reactively treat mechanically or with herbicide if new populations are noted.

Based upon these factors, the secondary impacts to vegetation, ecological communities, and T&E species from changes in hydrology, deposition of particulate matter (dust), changes in successional stage, and/or invasion of non-native species would not be adverse.

Residual Impacts

Residual impacts are those direct or secondary impacts to vegetation, ecological communities, or listed species that are not eliminated by mitigation procedures. The severity and likelihood of having residual impacts from the direct or secondary impacts would be low since reclamation and closure plan would be implemented during the closure phase and all affected areas would be regraded and revegetated to vegetated communities with comparable stability and utility as the original conditions. Specific measures would be implemented to monitor the effectiveness of the revegetation effort and introduction of new populations of noxious weeds, as described in the MOP Application Section 7.3.5, Revegetation, and the MOP Application Appendix K, Noxious Weed Management Plan. The effectiveness of the revegetation effort would be insured in the form of a performance bond, where the monetary amount would be determined by DEQ. Per the MOP Application, if revegetation does not respond appropriately due to overlying factors, appropriate remedial actions would be taken to correct any significant problem identified by DEQ (Tintina 2017). Likewise, if new or reoccurring populations of noxious weeds are noted during monitoring efforts, appropriate and agency-approved methods would be utilized to control these populations of noxious weeds. Monitoring and management would continue until revegetation success criteria have been met and the performance bond is released.

Smith River Assessment

The Smith River is located approximately 12 miles directly west of the Project area, and approximately 19 river miles (along Sheep Creek) from the Project area. The potential impacts from the Proposed Action are expected to be localized to the immediate Project area and would not affect the riparian vegetation along the Smith River.

The goal of the monitoring program described in the MOP Application Weed Management Program is to protect weed-free vegetation communities by monitoring and treating new or expanding weed populations in the Project area. As a result of weed management within the Project area, the severity and likelihood of spreading invasive species or noxious weeds to the Smith River banks via Sheep Creek, wind transport, or bird transport is expected to be low. Based upon this, the impacts to vegetation communities on the Smith River from the Proposed Action would be negligible with the use of weed management within the Project area.

3.13.3.3. Agency Modified Alternative

The impacts of the AMA on vegetation, ecological communities, or listed species would be the same as described for the Proposed Action. The additional backfill component of the AMA would not affect any additional vegetation because the surface disturbance footprint would not change. As a result, the impacts to vegetation or listed species would be the same as the Proposed Action.

Smith River Assessment

The impacts of the AMA modifications on vegetation would be the same as described for the Proposed Action because there would be no additional surface disturbances that could affect vegetation. The Weed Management Program in the Proposed Action would still be implemented to protect weed-free vegetation communities by monitoring and treating any new or expanding weed populations in the Project area. As a result of weed management within the Project area, the severity and likelihood of spreading invasive species or noxious weeds to the Smith River banks via the Smith River tributary routes, wind transport, or bird transport is expected to be low.

3.14. WETLANDS

This section addresses the affected environment and potential impacts to wetland resources within the Project area, which includes the proposed MOP Application Boundary.

3.14.1. Analysis Methods

3.14.1.1. Analysis Area

The outermost perimeters of the lands that are leased for the Project are known collectively as the "Project leased area" and encompass 7,684 acres (Tintina 2017). The analysis area for the wetland and waterbody baseline surveys (i.e., wetland analysis area) includes the resources located within the Project leased area (**Figure 3.14-1**).

3.14.1.2. Information Sources for Wetlands

The baseline wetland and waterbody surveys were conducted by WESTECH in August and September 2014, and were summarized in the "Baseline Wetland Delineation and Waterbody Survey" report (WESTECH 2015a) as included as Appendix C-1 of the MOP Application (Tintina 2017). The wetlands within the wetland analysis area were delineated using the methods described in the 1987 USACE Wetland Delineation Manual.

The baseline survey report summarized the existing wetland and waterbody resources located within the wetland analysis area and informed the MOP Application (Tintina 2017), the USACE Section 404 Permit Application, and the associated Jurisdictional Determination (JD) Report (USACE 2017).

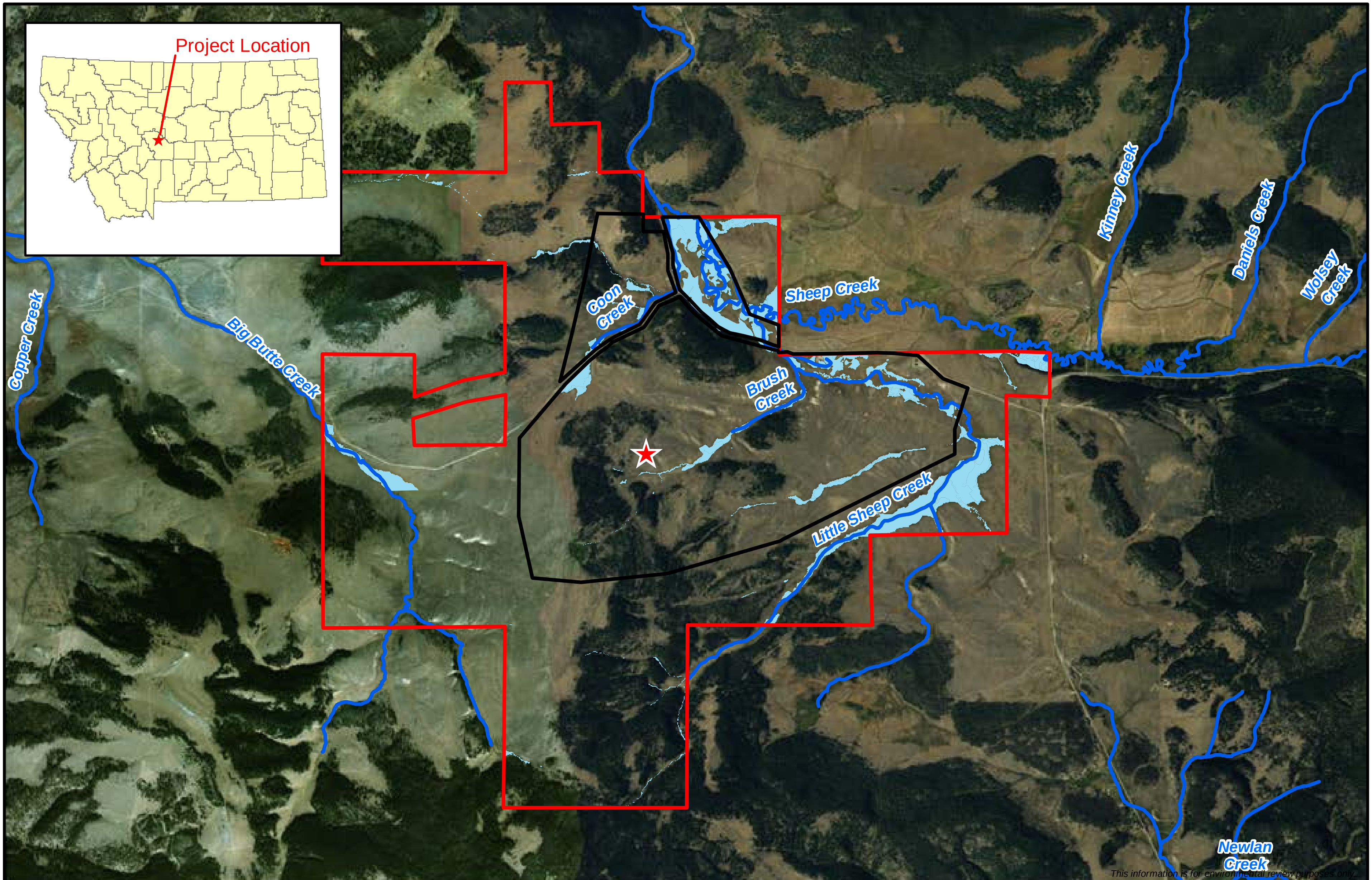
The Project wetlands that were surveyed and delineated by WESTECH in 2014 were evaluated for wetland function and values pursuant with methods developed by Montana DOT and DEQ (MDT 2008). The Project wetland functions assessment was summarized in 2015 by WESTECH in the "Functional Assessment Report" (WESTECH 2015b) and included as Appendix C-2 of the MOP Application (Tintina 2017).

The following sections analyze the wetland resources within the wetland analysis area; however, the associated surface water features, also summarized in the above-referenced documents, are discussed in Section 3.5, Surface Water Hydrology.

3.14.2. Affected Environment

3.14.2.1. Wetlands

The 2014 wetland and waterbody baseline survey identified 328.8 acres of wetlands within the wetland analysis area (**Figure 3.14-1**). The largest wetlands and wetland complexes were associated with the herbaceous meadows and shrub wetlands within the riparian areas surrounding Sheep Creek and Little Sheep Creek (WESTECH 2015a). Smaller, and sometimes isolated wetlands, were associated with the headwaters of the wetland analysis area wetlands and waterbodies.



★ Project Location
Wetland Analysis Area
Project Area
Perennial NHD Stream
Surveyed Wetlands

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Figure 3.14-1
Black Butte Copper Project
Surveyed Wetlands
Meagher County, Montana

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The hydrology for most of the Project wetlands is groundwater-driven. Drainage features and/or streams within the vicinity of most wetlands are present, but their water sources appear to be springs and likely are not primarily dependent on precipitation or snow melt (WESTECH 2015a).

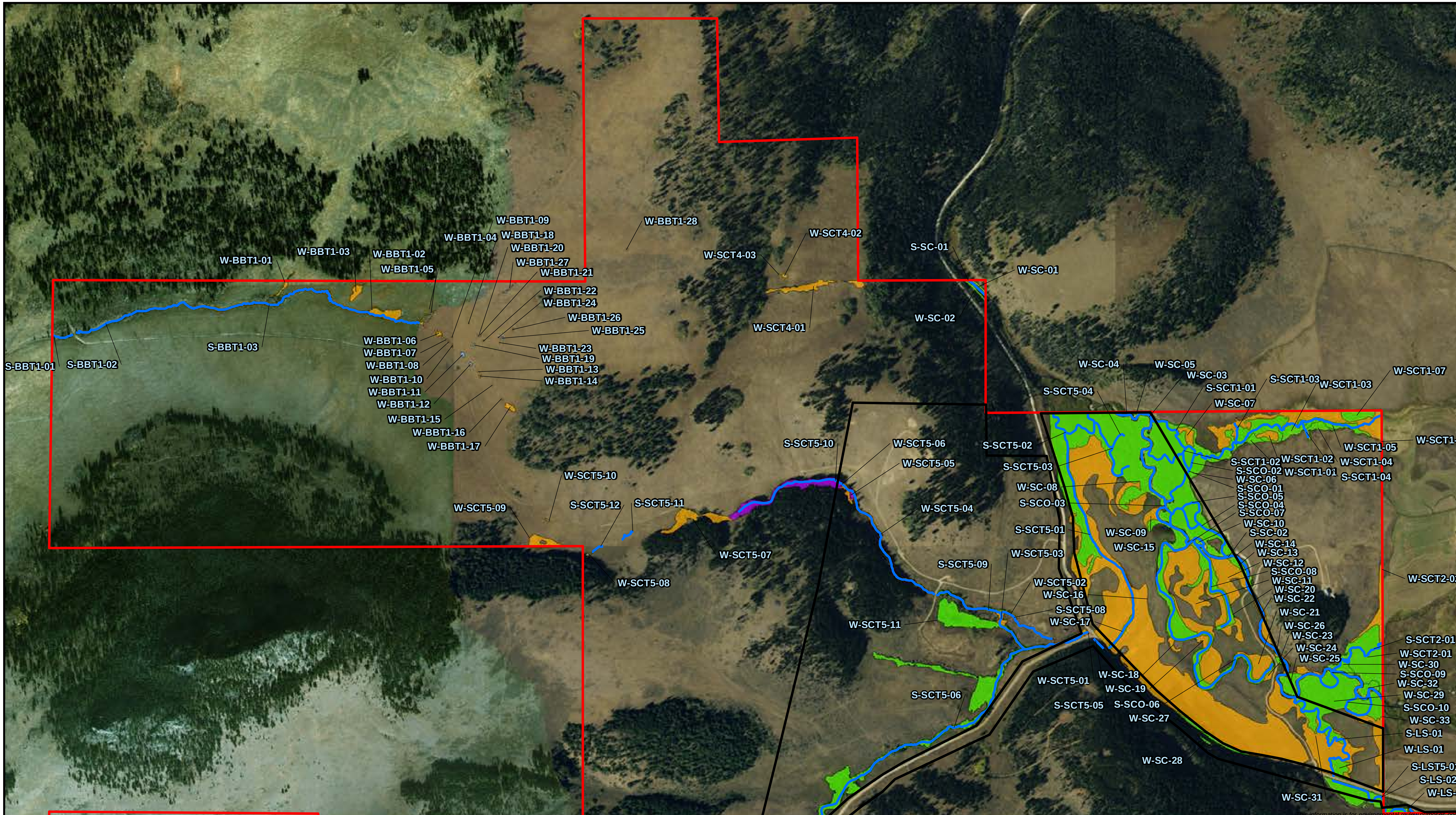
The wetland acreage and classifications for wetlands within the wetland analysis area are summarized in **Table 3.14-1**. The wetlands observed during the surveys are shown on **Figures 3.14-2** through **3.14-5**.

Approximately half of the Project wetlands exhibit scrub-shrub characteristics, with various willow species or shrubby cinquefoil as the dominant vegetation. Most other Project wetlands exhibit emergent wetland features with sedges or grasses dominating the herbaceous vegetative stratum. One small palustrine forested wetland is dominated by Engelmann spruce. Three of the wetlands contain fen-like characteristics and are of high quality compared to the other Project wetlands (WESTECH 2015a). Fens are uncommon, but widely distributed in western Montana, and are generally described as exhibiting alkaline, waterlogged substrates that promote the accumulation of peat (DEQ 2017).

Table 3.14-1
Wetland Acreage by Cowardin Classification and Watershed

Project Watershed	Cowardin Classification[a]					Total Area by Watershed (acres)
	Palustrine Emergent	Palustrine Scrub-Shrub (willow dominant)	Palustrine Scrub-Shrub (shrubby cinquefoil dominant)	Palustrine Forested	Palustrine Unconsolidated Bottom	
Black Butte Creek	10.7	7.9	1.6	0.0	0.0	20.2
Black Butte Creek Tributaries	2.8	0.2	0.0	0.0	0.1	3.1
Little Sheep Creek	51.0	5.2	63.0	0.0	0.1	119.2
Little Sheep Creek Tributaries	24.6	7.4	8.9	0.0	0.4	41.2
Sheep Creek	52.8	53.9	0.0	0.0	0.0	106.6
Sheep Creek Tributaries	10.7	16.4	9.5	1.9	0.0	38.5
Total	**152.6**	**90.8[b]**	**82.8[b]**	**1.9**	**0.6**	**328.8**

Notes:
[a] See Cowardin 1979 for classification descriptions. Palustrine forested have a dominant tree stratum, palustrine scrub-shrub have a dominant shrub stratum, palustrine emergent have a dominant herbaceous vegetative stratum, and palustrine unconsolidated bottom have limited vegetation and substrate is dominated by mud and/or silt.
[b] Acreage total is more than reported due to rounding.



Stream
Wetland Analysis Area
Project Area
Palustrine Emergent
Palustrine Forested
Palustrine Scrub-Shrub
Palustrine Unconsolidated Bottom

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Feet
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Figure 3.14-2
Black Butte Copper Project
Surveyed Wetland Classifications
Meagher County, Montana

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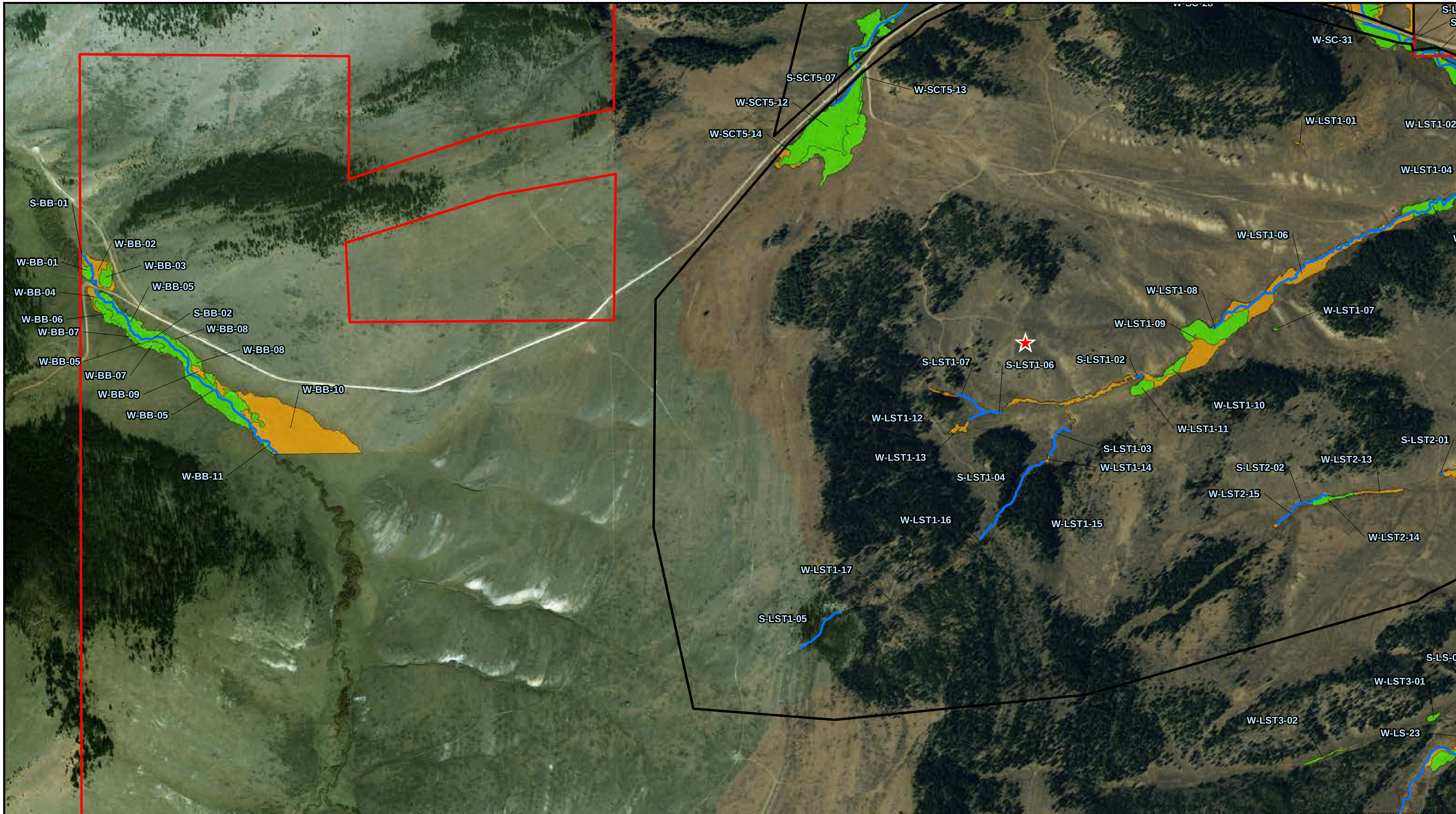

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Stream

Wetland Analysis Area

Project Area

Palustrine Emergent

Palustrine Scrub-Shrub

Figure 3.14-3

Black Butte Copper Project

Surveyed Wetland Classifications

Meagher County, Montana

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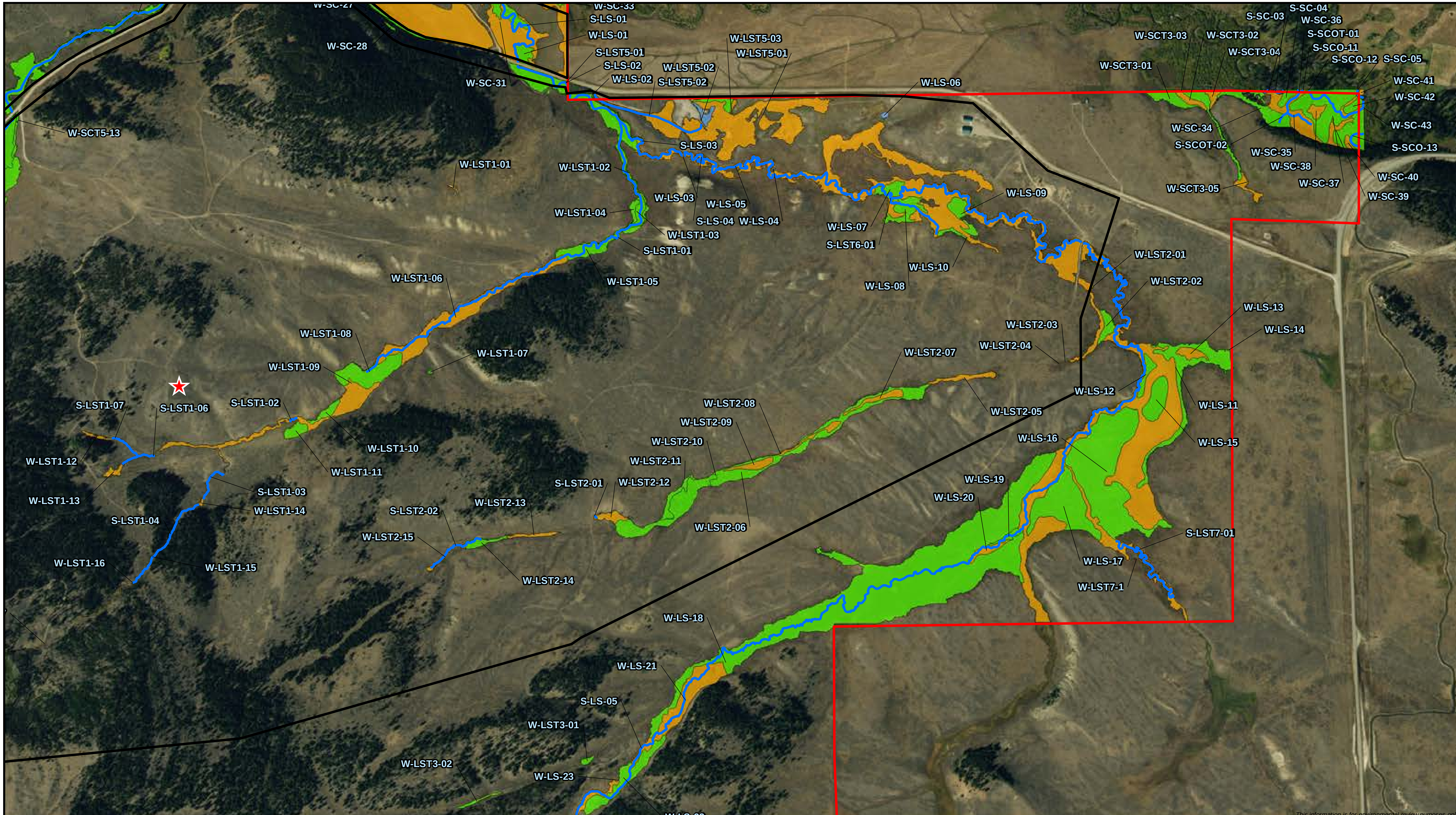

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Stream
Wetland Analysis Area
Project Area
Palustrine Emergent
Palustrine Scrub-Shrub
Palustrine Unconsolidated Bottom

Figure 3.14-4
Black Butte Copper Project
Surveyed Wetland Classifications
Meagher County, Montana

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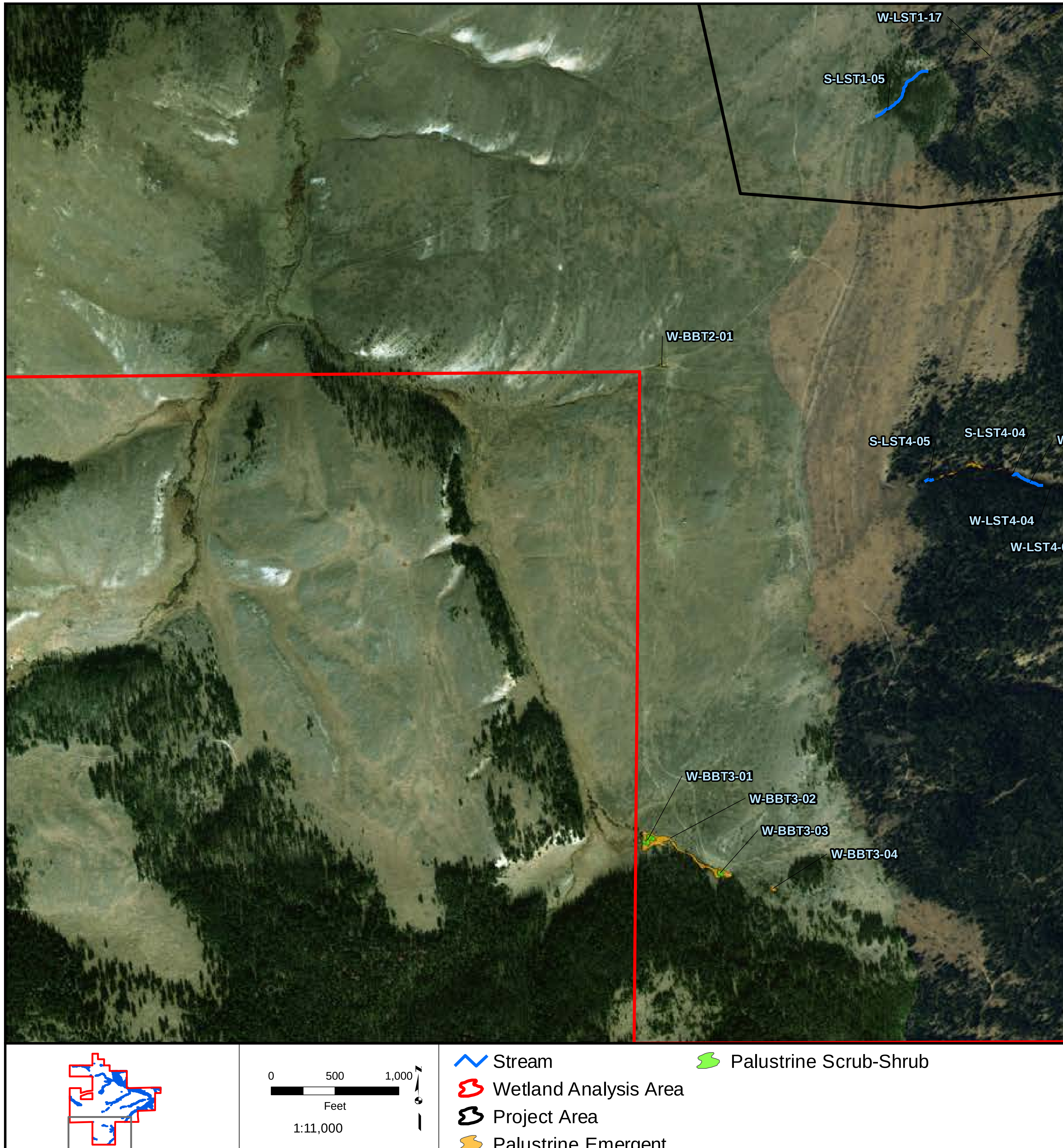

Figure 3.14-5
Black Butte Copper Project
Surveyed Wetland Classifications
Meagher County, Montana

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3.14.2.2. Wetland Functional Assessment

Wetlands can serve many functions, including groundwater recharge/discharge, flood storage and alteration/attenuation, nutrient and sediment removal/transformation, toxicant retention, fish and wildlife habitat, wildlife diversity/abundance for breeding migration and wintering, shoreline stabilization, production export, aquatic diversity/abundance, vegetative diversity/integrity, and support of recreational activities. Montana uses the Montana DOT Montana Wetland Assessment Method (MDT 2008) to evaluate wetland function. The U.S. Environmental Protection Agency determined it to be one of the seven best rating systems in the country to use as a model for development of functional assessment methods (WESTECH 2015b). The functional assessment categories include Category I, II, III, and IV:

- Category I wetlands are high quality wetlands and are generally uncommon and provide potential habitat for listed species.
- Category II wetlands are more common than Category I, provide potential habitat for listed species or high quality fish or wildlife habitat, and have high values for wetland functions.
- Category III wetlands are more common than Category I and II and are less diverse than Category II wetlands.
- Category IV wetlands are generally small or isolated wetlands that lack diversity and provide little wildlife habitat (WESTECH 2015b).

During the 2014 surveys conducted for the wetland analysis area by WESTECH, the primary wetland functions were rated using the Montana Wetland Assessment Method rating system and the wetland function was evaluated based on a review of the following:

- Habitat for federally listed or proposed threatened or endangered species;
- Habitat for Montana Natural Heritage Program S1, S2, or S3 SOC;
- General wildlife habitat;
- General fish habitat;
- Flood attenuation;
- Surface water storage;
- Sediment/nutrient/toxicant retention/removal;
- Sediment/shoreline stabilization;
- Production export/terrestrial and aquatic food chain support;
- Groundwater discharge/recharge;
- Uniqueness; and
- Recreation/education potential.

WESTECH divided the wetland analysis area into multiple assessment areas, delineated by drainage basins, hydrologic connectivity, proximity to other wetlands, and type of wetland to evaluate each of the above functional characteristics.

The results of the functional assessment are summarized in **Table 3.14-2** and indicate that 14 assessment areas are rated as Category I, II, or III. The associated area locations are shown on **Figure 3.14-6**. The Little Sheep Creek Wet Meadow and the Sheep Creek Spring Tributary assessment areas are rated as Category I, primarily because of the fen features located within these assessment areas. The six Category II assessment areas are rated as Category II rather than Category I because of the lack of fen features within these wetlands. The six Category III assessment areas are rated in this category primarily due to their decreased function compared to the other categories, which lowered their rating.

Table 3.14-2
Black Butte Project Wetland Rating by Assessment Areas

Assessment Area	Category Rating
Black Butte Creek Wetlands	II
Little Sheep Creek Wet Meadow	I
Little Sheep Creek Upper Wet Meadow	II
Little Sheep Creek Wetland/Upland Mosaic	II
Little Sheep Creek Tributary 1	II
Little Sheep Creek Tributary 1 Minor Drainages	III
Little Sheep Creek Tributary 2	III
Sheep Creek Wet Meadow	II
Sheep Creek Tributary 1	III
Sheep Creek Tributary 2	III
Sheep Creek Spring Tributary	I
Upper Sheep Creek Shrub Wetlands	II
Northwest Springs and Depressions	III
Southwest Minor Drainages	III

3.14.2.3. Jurisdictional Determination

The Proponent requested an Approved JD from the USACE as part of the Section 404 permitting process. The October 3, 2017 Approved JD determined that most of the wetlands delineated within the analysis area were jurisdictional (a total of 327.4 acres) and, therefore, would require authorization via Section 404 of the Clean Water Act for any proposed dredge or fill impacts to these wetlands. The Approved JD also determined that the small, isolated wetlands W-LST3-02, W-LST3-01, W-BBT2-01, W-SCT4-01, W-BBT1-28, and W-LST-01, which totaled approximately 1.3 acres, were not jurisdictional and, therefore, would not require Section 404 permit authorization to impact these wetland features (USACE 2017).

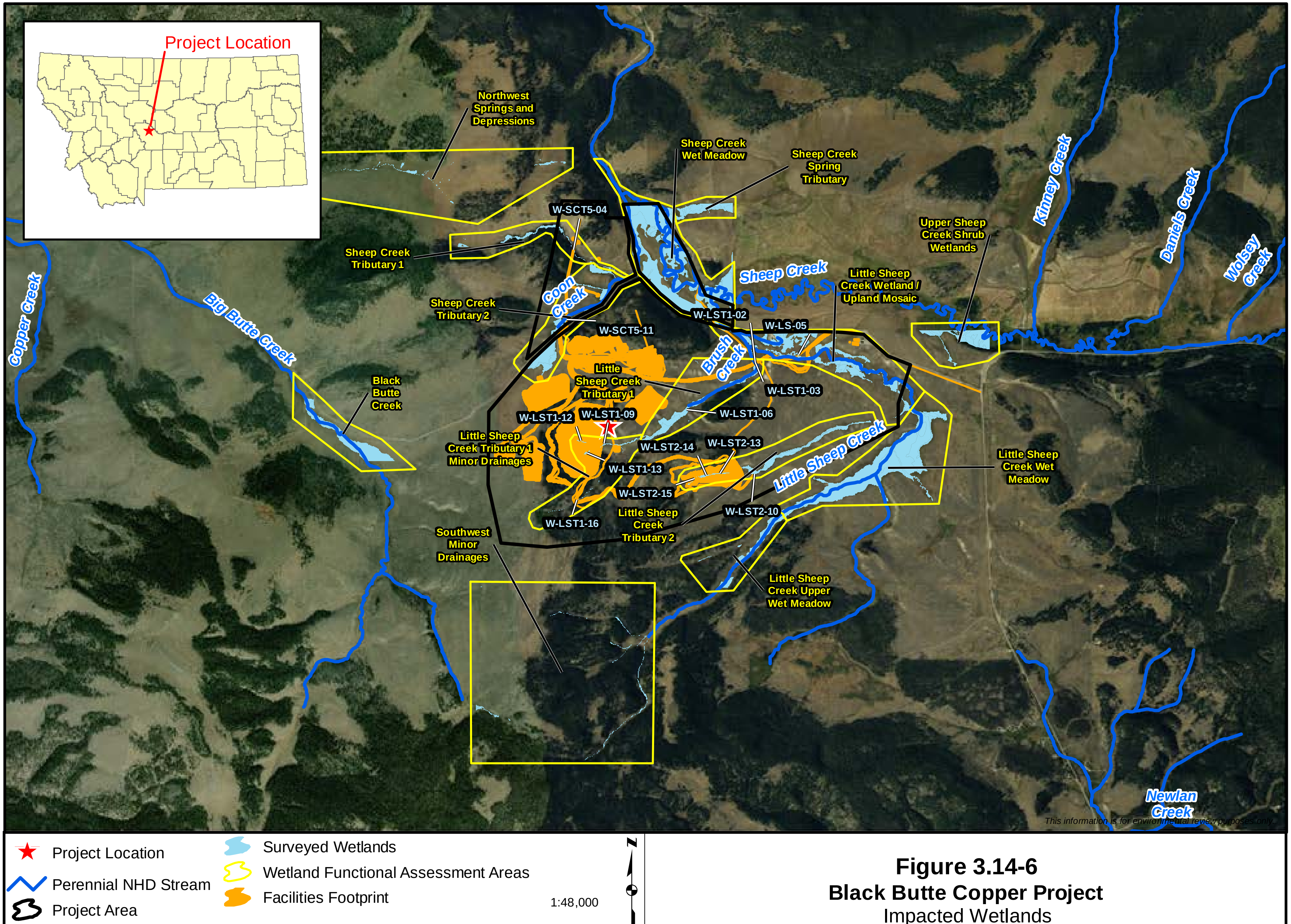

Figure 3.14-6
Black Butte Copper Project
Impacted Wetlands
Meagher County, Montana

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3.14.2.4. Wetland Hydrology

The wetlands delineated within the analysis area exhibit hydrology that is primarily groundwater-dependent. Few, if any, of these wetlands are dependent on precipitation or stream flow. The wetland areas within the Little Sheep Creek, Black Butte Creek, and Sheep Creek riparian areas encompass too large of a surface area to exhibit wetland hydrology that is dependent on stream flow (WESTECH 2015a).

Hydrologic modeling was completed for the analysis area. The modeling utilized available regional data, groundwater monitoring wells, and piezometers to surmise that groundwater generally flows in an eastward direction, across the analysis area, toward the Little Sheep Creek and Sheep Creek surface waterbodies and that groundwater generally discharges from the riparian wetland features, from the alluvial groundwater system, and to the surrounding Project site tributaries (Tintina 2017).

3.14.3. Environmental Consequences

3.14.3.1. No Action Alternative

The No Action Alternative would not change the existing landscape or groundwater flow and therefore, would not disturb or affect the wetlands.

3.14.3.2. Proposed Action

This section describes the potential environmental consequences of the Project to wetland resources, including the potential direct and secondary impacts. This section also describes actions that would be taken to avoid or mitigate wetland impacts, proposed wetland mitigation options, and wetland monitoring plans. The potential environmental consequences for the Project-associated streams and drainage features are included in Section 3.5.3.

Direct Impacts

Surface Fill and Dredge

The area of analysis for the direct impacts includes the area where the mining infrastructure would be installed, which is within the Project area (i.e., the MOP Application Boundary of approximately 1,888 acres). A geographic information system analysis of the areas that would be directly disturbed by mining infrastructure and operations identified potential direct wetland impacts from the Project Proposed Action. Potential impacts include construction of the access and/or service roads, the cement tailings facility, and the wet well proposed to be constructed for diverting and piping Sheep Creek spring runoff water.

Filling or excavation of wetlands would result in permanent direct impacts to wetlands. The wetland impact analysis identifies wetland type (according to the Cowardin Classification system), total acres of direct impact, percent of analysis area, and the wetland name to be impacted by the Project.

Installation of the cement tailings facility, the wet well for the Sheep Creek water diversion, and associated mine facility access and service roads would result in approximately 0.85 acre of permanently impacted wetlands from fill and dredging activities. **Table 3.14-3** summarizes, by wetland community type, the directly impacted wetlands. **Figures 3.14-7** through **3.14-10** provide the locations of the wetland impacts.

Table 3.14-3
Total Projected Wetland Impacts at the Black Butte Copper Mine Site

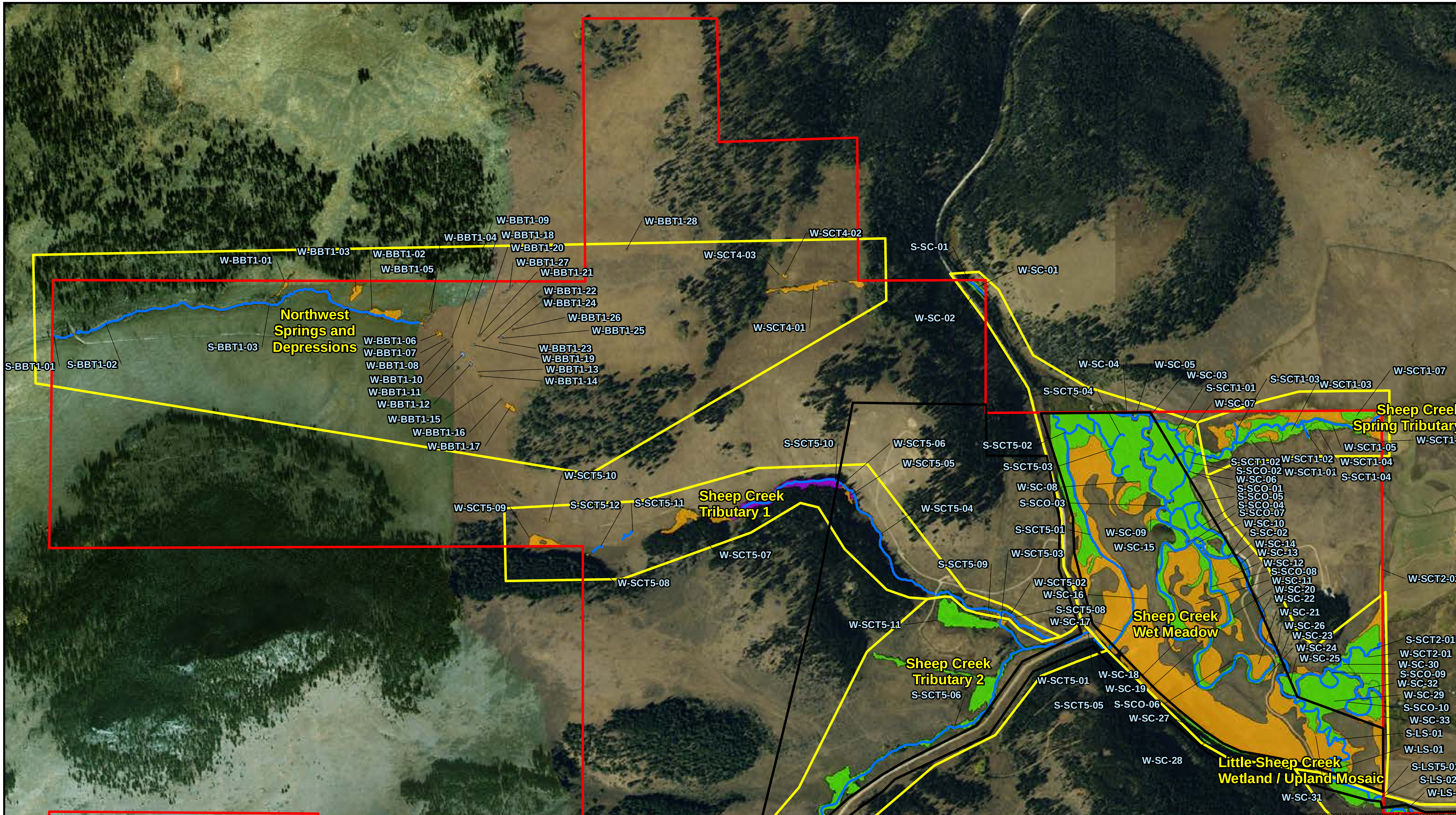
		Directly Impacted Wetlands		
Wetland Community Type[a,c]	**Project Facility**	**Acres**	**Percent of Analysis Area[b]**	**Wetland ID**
PSS6B	Access road	0.03	<1	W-LST1-02
PSS1B	Access road	0.03	<1	W-LST1-03
PEM1E	Access road	0.06	<1	W-LS-05
PEM1B	Cement Tailings Facility	0.27	<1	W-LST1-13
PEM1B	Cement Tailings Facility	0.16	<1	W-LST1-12
PEM1B	Cement Tailings Facility	0.29	<1	W-LST1-09
PEM1A	Service road	0.01	<1	W-LST1-16
PSS1E	Wet well	<0.001	<1	W-SC-31
Total		**0.85**	**<1**	

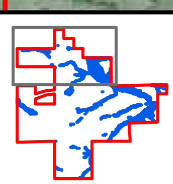
Notes:
[a] Cowardin 1979
[b] Wetland analysis area wetlands totaled 327.4 acres (Tintina 2017).
[c] PSS wetlands are palustrine scrub-shrub wetlands, PEM wetlands are palustrine emergent, herbaceous wetlands.

In addition to the direct permanent impacts to the specific wetlands listed in **Table 3.14-3**, permanent impacts to functional assessment areas would occur. The majority of direct impacts to wetland functional assessment areas, totaling 0.7 acre of PEM wetlands, would occur within the Little Sheep Tributary Minor Drainages Class II AA. The remaining 0.2 acre of direct wetland impacts occur in Little Sheep Creek Tributary 1 Brush Creek, Little Sheep Creek Wetland/Upland Mosaic, and Sheep Creek Wet Meadow. Each are classified as Category II assessment areas.

<u>Regulatory Setting</u>

Discharges of dredged or fill material into water of the United States or jurisdictional wetlands are regulated by statute under both the USACE 404 and DEQ 401 Water Quality Certification permitting processes. Impacts to jurisdictional wetlands would require both a USACE 404 and DEQ 401 Water Quality Certification permit prior to Project initiation. The Proponent submitted permit applications for both and received authorization in January 2017 through the federal and state regulatory process via the USACE 404 Permit NOW-2013-01385-MTH and DEQ 401 Permit MT4011018, respectively.





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- Stream
- Wetland Analysis Area
- Project Area
- Wetland Functional Assessment Area
- Palustrine Emergent
- Palustrine Forested
- Palustrine Scrub-Shrub
- Palustrine Unconsolidated Bottom

Figure 3.14-7
Black Butte Copper Project
Wetlands Functional Assessment
Meagher County, Montana

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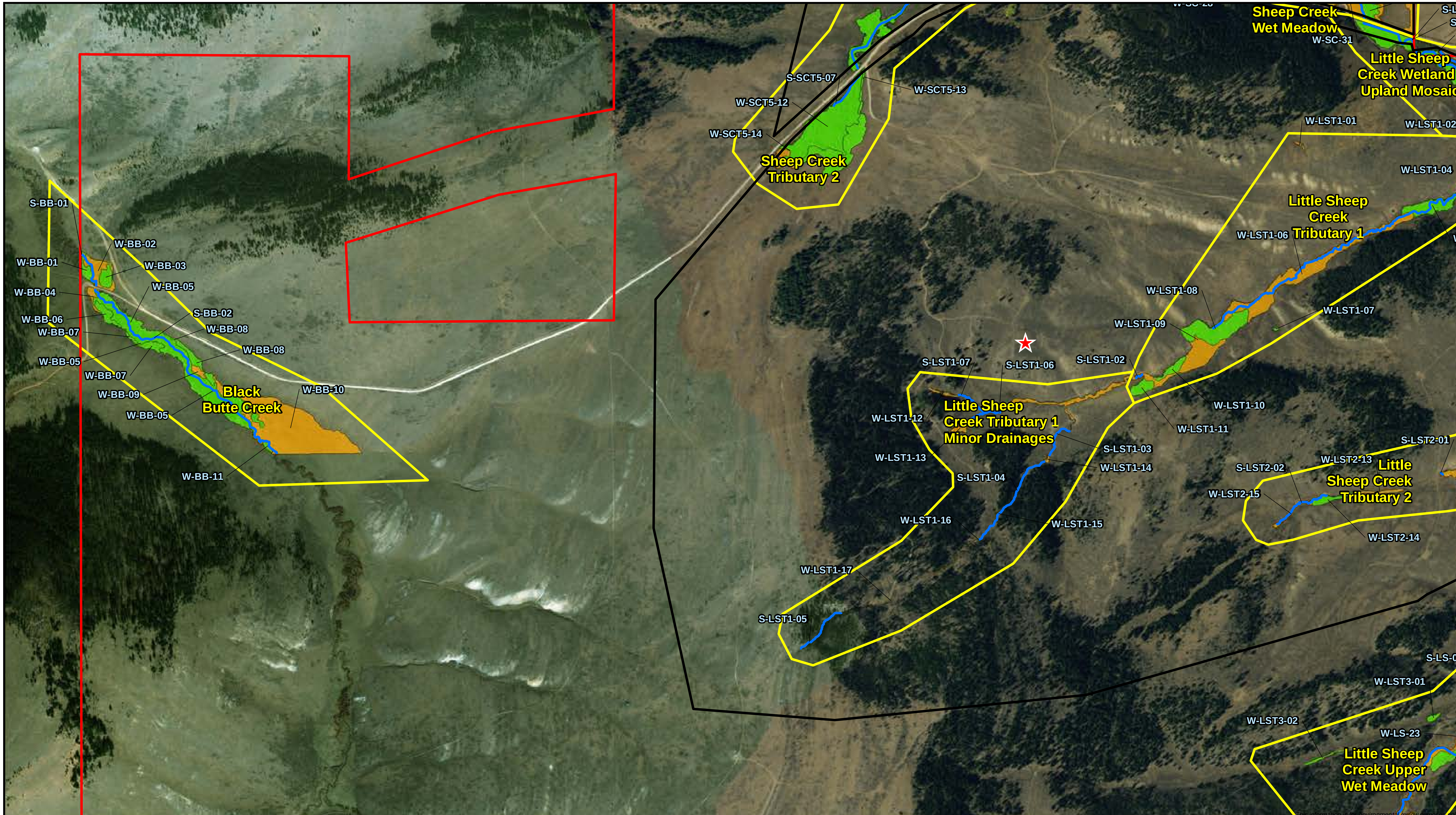

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Stream

Wetland Analysis Area

Project Area

Wetland Functional Assessment Area

Palustrine Emergent

Palustrine Scrub-Shrub

Figure 3.14-8

Black Butte Copper Project

Wetlands Functional Assessment

Meagher County, Montana

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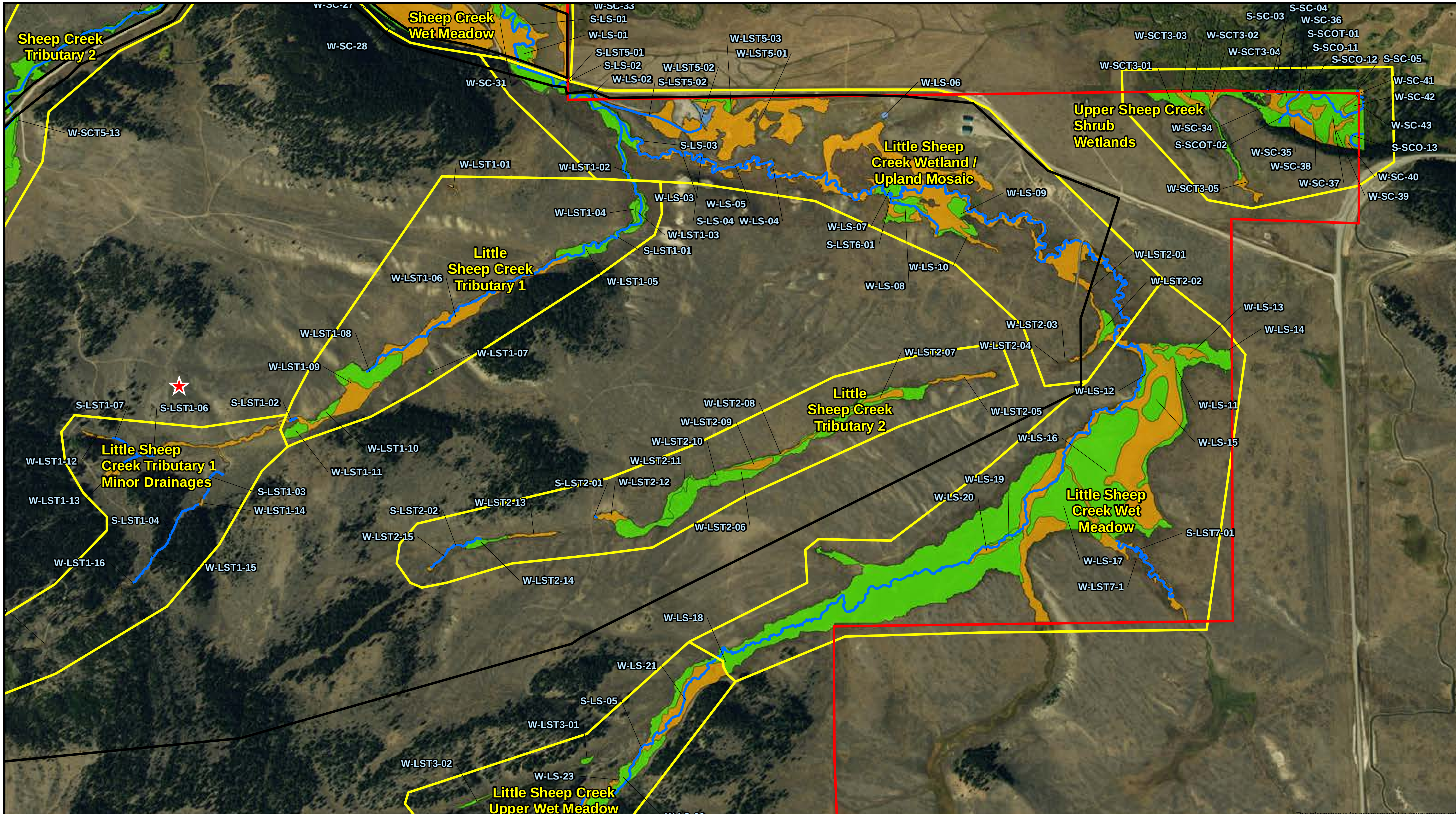

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- Stream
- Wetland Analysis Area
- Project Area
- Wetland Functional Assessment Area
- Palustrine Emergent
- Palustrine Scrub-Shrub
- Palustrine Unconsolidated Bottom

Figure 3.14-9
Black Butte Copper Project
Wetlands Functional Assessment
Meagher County, Montana

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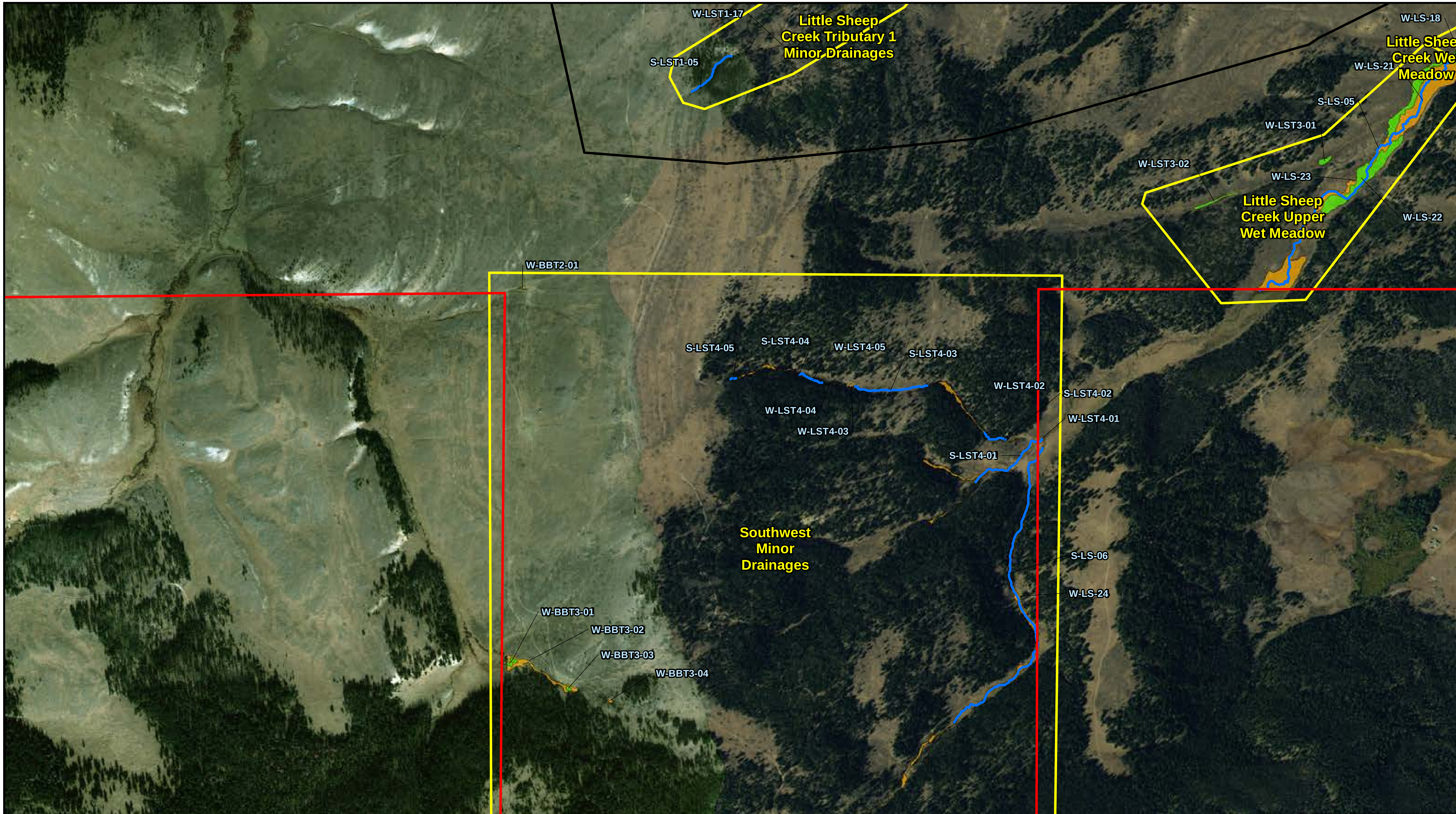

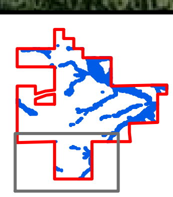

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Stream
Wetland Analysis Area
Project Area
Wetland Functional Assessment Area
Palustrine Emergent
Palustrine Scrub-Shrub

Figure 3.14-10
Black Butte Copper Project
Wetlands Functional Assessment
Meagher County, Montana

Mitigation

To compensate for the 0.9 acre of direct wetland impacts and functional assessment areas, the Proponent would be required to purchase 1.3 acres of wetland mitigation credits from an approved wetland mitigation bank or In-Lieu Fee program (ILF). Specifically, the conditions of the USACE 404 Permit NOW-2013-01385-MTH state that:

> In order to provide compensatory stream and wetland mitigation for the unavoidable impacts to 0.85 acre of wetland and 696 linear feet of stream channel, Tintina is required to purchase 1.275 acre of advanced or pre-certified wetland credit and 4,750 advanced or pre-certified stream credits from the MARS In-lieu Fee Program. If certified credits are available at the time of credit purchase, 0.85 acre of certified wetland credits and 3,167 certified stream credits from the MARS In-lieu Fee Program must be purchased. Proof of credit purchase must be provided to the Corps prior to placing any fill material into waters of the U.S. (USACE 2017b).

Montana Aquatic Resources Services (MARS) is the certified sponsor of the Montana Statewide ILF. MARS works closely with the USACE Omaha District to screen, review and monitor ILF projects (MARS 2017).

Further avoidance of direct impacts to wetlands would be minimized by assuring that all Project wetlands are marked prior to construction proximal to all proposed construction areas (Tintina 2017). Based upon these factors, the direct impacts to wetlands from the Proposed Action would be reduced with the use of appropriate mitigation measures.

Secondary Impacts

Multiple factors could affect whether a wetland would experience secondary impacts from the Proposed Action. This section assesses the potential secondary wetland impacts from the Proposed Action that may result from one of the following six factors: (1) wetland fragmentation; (2) changes to watershed and surface flow; (3) changes in groundwater hydrology from mine operations; and (4) changes in wetland water quality related to atmospheric deposition of dust or changes in groundwater associated with the Project operations. The potential secondary impacts are discussed, below.

Wetland Fragmentation

A wetland may be fragmented as the result of direct impacts that split a wetland resource area into multiple parts. These fragmented parts could be isolated from other wetlands and therefore would no longer have the same adjacent upland watershed area. This would result in the loss of wetland function. While a wetland may be fragmented by direct impacts, this does not necessarily mean the remaining fragmented part of the wetland resource area would be affected. Criteria used to evaluate secondary impacts caused by fragmentation include primarily the size of the direct impacts. Due to the small size of the Project direct impacts, measurable secondary impacts from wetland fragmentation associated with the Project mining operations would be negligible.

Furthermore, there would likely be no measurable secondary impacts to wetland functions associated with the functional assessment areas described above due to the small size of wetland surface area fragmentations resulting from Project. Based upon these factors, the secondary impacts to wetlands due to fragmentation would be diminutive.

Changes to Watershed and Surface Flow

Surface water flow is not a factor for evaluating wetland impacts in the wetland analysis area because the wetlands' primary source of hydrology is groundwater. Therefore, secondary impacts to wetlands from watershed or surface water changes are not likely. However, if secondary impacts from changes in surface water flow are present, these would be negligible due to the designed surface water and groundwater mitigation proposed in the MOP Application. The Project design plans during post-closure would return any surface water flow changes back to the pre-Project conditions.

Changes in Groundwater Hydrology

The majority of the analysis area wetlands are groundwater-dependent (WESTECH 2015a). If left unmitigated, lowering groundwater elevations for Project operations could result in a reduction of the primary water source for these wetlands. Section 3.4, Groundwater Hydrology, indicates that groundwater is generally in direct contact with the alluvial system under the wetlands and that there is a general upward movement of groundwater to the alluvial system, to the seeps within the wetland analysis area, and to the riparian wetlands adjacent to the wetland analysis area surface water features. Section 3.4 also describes that the Sheep Creek system acts as a groundwater sink with the exception of periods of peak surface water flow during the spring, where the surface water recharges the groundwater through the alluvial system under the wetlands.

Although mine operations could result in lowering of groundwater, modeling indicates that water inputs back to the groundwater and surface water from underground injection and the non-contact water reservoir would mitigate these potential impacts (Tintina 2017).
Section 3.4.3, Environmental Consequences, describes this in detail. Therefore, if Project operations are functioning as designed, measureable impacts to wetlands from lowering groundwater elevations would not be likely. Based upon the above, the secondary impacts to wetlands due to changes in groundwater hydrology would be diminutive.

Water Quality

Mine operations are not expected to impact wetland water quality within the analysis area. The potential impacts from fugitive dust, groundwater inputs, or surface water inputs would be controlled, as described in the MOP Application and below.

In general, the fine milling and separation steps are wet processes that generate little, if any, dust to be controlled. The dust generated from the crushing and grinding operations would be captured by the fugitive dust collection system from various areas inside the process plant. Air quality monitoring would be conducted to help assess impacts to flora or fauna during operations. In addition, air quality rules require reasonable precautions to be taken to prevent emission of airborne particulate matter. The Proponent would be required to obtain a Montana Air Quality Permit under the Montana Clean Air Act that specifies requirements for applicable State and Federal air quality standards (Tintina 2017).

Important components of the dust control plan that would offer protection from fugitive dust include:

- Minimizing exposed soil areas to the extent possible by prompt revegetation of un-reclaimed areas;
- Establishing temporary vegetation on inactive soil and sub-soil stockpiles that would be in place for 1 year or more;
- Utilizing chemical dust control products on access and trucking road surfaces;
- Applying water to access roads and active haul roads during dry periods;
- Enclosing screens, crushers, and copper-enriched rock and waste transfer points;
- Covering conveyor belts; and
- Utilizing fabric filter dust collectors at crushing, screening, transfer, and loading points.

Degradation to water quality in the alluvial system from the discharge of RO treated water through the alluvial UIG would be negligible. The models produced for comparing WTP discharge in this alluvial system to the nondegradation standards indicated that, after its initial mixing with groundwater, the discharge water total nitrogen could reach values above the nondegradation criteria for surface water in Sheep Creek, with an estimated average concentration of 0.32 mg/L (standard limit = 0.12 mg/L). Therefore, the Proponent proposes to store this water in the TWSP between July 1 and September 30 (when the seasonal effluent limit for nitrogen applies). From October 1 to June 30, treated water stored in the TWSP would be pumped back to the WTP, where it would be mixed with other WTP effluent. The blended water would be sampled prior to being discharged to the alluvial UIG per the MPDES permit.

Potential sources of contamination from surface water flows into the existing wetlands would be controlled by the dust collection system and the storm water management plan detailed in the MOP Application. Water discharged from the WTP to the alluvial UIG would meet water quality standards. Based upon the above, there would be no secondary impacts to wetlands due to changes in water quality from surface water discharges.

Wetland Monitoring

The MOP Application describes plans to monitor for secondary impacts in accordance with the USACE 404 permit and DEQ 401 certification conditions. The MOP Application summarizes the plan to monitor wetlands during construction, operations, and closure. The Proponent plans to compare existing baseline data with data from four reference site wetlands as well as from four Project area wetlands to determine whether or not secondary impacts to Project area wetlands are occurring. The Proponent identified four reference site wetlands and four Project area wetlands for this study and began collecting baseline data for all eight wetlands in 2016. Data would be collected by vegetative monitoring plots, piezometers, and transducer data loggers to show the status and trends at each wetland which would aid in identifying any secondary impacts, should they occur (Tintina 2017). The Proponent proposes to grout the bedrock fractures where the development decline ramp passes, approximately 90 feet under Coon Creek and its associated wetlands and/or the Proponent would augment flows to the wetlands from water stored in the NCWR (Tintina 2019).

In addition, wetland monitoring would continue after closure to identify potential impacts and continue until such time that DEQ determines that the frequency and number of sampling sites for each resource can be reduced or that closure objectives have been met and monitoring can stop (Tintina 2017).

Smith River Assessment

The Smith River is located approximately 12 miles (19 river miles) west of the Project area. The potential wetland and wetland functions impacts from the Proposed Action are expected to be localized to the immediate Project area and would be relatively small in size. Therefore, the Proposed Action would not likely affect the wetlands or water quality of the Smith River riparian wetland complexes. Based upon this, the impacts to wetlands near the Smith River from the Proposed Action Alternative would be immeasurable.

3.14.3.3. Agency Modified Alternative

The AMA modifications identified would result in impacts similar to those described for the Proposed Action. The additional backfill component of the AMA would not affect any additional wetlands because the surface disturbance footprint would not change. As a result, any potential impacts to wetlands would be similar to the Proposed Action.

Smith River Assessment

The AMA modifications would result in impacts to wetlands near the Smith River similar to those described for the Proposed Action. Therefore, impacts to wetlands or water quality of the Smith River riparian wetland complexes from the AMA would be negligible.

3.15. WILDLIFE

3.15.1. Analysis Methods

The wildlife analysis for the proposed Project was conducted by reviewing current listed or special concern terrestrial species for Meagher County, Montana. Both a county list and a generated Information for Planning and Consultation (IPaC) resource list were referenced for this exercise. Wildlife studies conducted by WESTECH (2015) in the wildlife analysis area (approximately 5,290 acres) were also referenced. WESTECH conducted the baseline fieldwork irregularly from August 2014 to August 2015, though most fieldwork occurred from April to July of 2015. A list of species that could potentially occur in the wildlife analysis area was compared against occurrence records and whether preferred habitats were available. Species with a potential to occur in the wildlife analysis area and with suitable habitat were evaluated for potential impacts.

3.15.2. Affected Environment

The wildlife analysis area (see **Figure 3.15-1**) includes the Project area (i.e., the MOP Application Boundary of approximately 1,888 acres) and an additional 3,402 acres surrounding the MOP Application Boundary. The wildlife analysis area takes into account the broader ranging habits of many of the wildlife species present or assumed to occur in the vicinity of the Project. Several wildlife species have large home ranges that could extend beyond the Project area.

Topography within the wildlife analysis area is level to steeply rolling and ranges from 5,400 to 6,200 feet above mean sea level (WESTECH 2015). Sheep Creek flows through the analysis area. Little Sheep Creek (tributary to Sheep Creek) flows through and drains the eastern portion of the analysis area, while Big Butte Creek (tributary to Sheep Creek) drains the western portion of the analysis area. The land cover near Sheep Creek is mostly pasture and hayfield, while riparian areas associated with the stream and drainages include grasses and mesic (i.e., require a moderate amount of water to grow) shrubs as well. Higher elevation upland areas are predominantly sagebrush and grassland habitats mixed with coniferous forest. Habitat types are further discussed in Section 3.15.2.1 below. There are existing roads and some buildings in portions of the wildlife analysis area, mostly along the northern edge.

3.15.2.1. Habitat

Wildlife habitat consists of both biotic features (e.g., vegetation, animal species) and abiotic features (e.g., topography, climate). However, this analysis defines habitat as the types of vegetation or vegetative communities preferred by a particular species. Habitat components (e.g., water, food, cover, and space) and how they are spatially arranged can be used to estimate the presence of wildlife species potentially occurring in a given area.

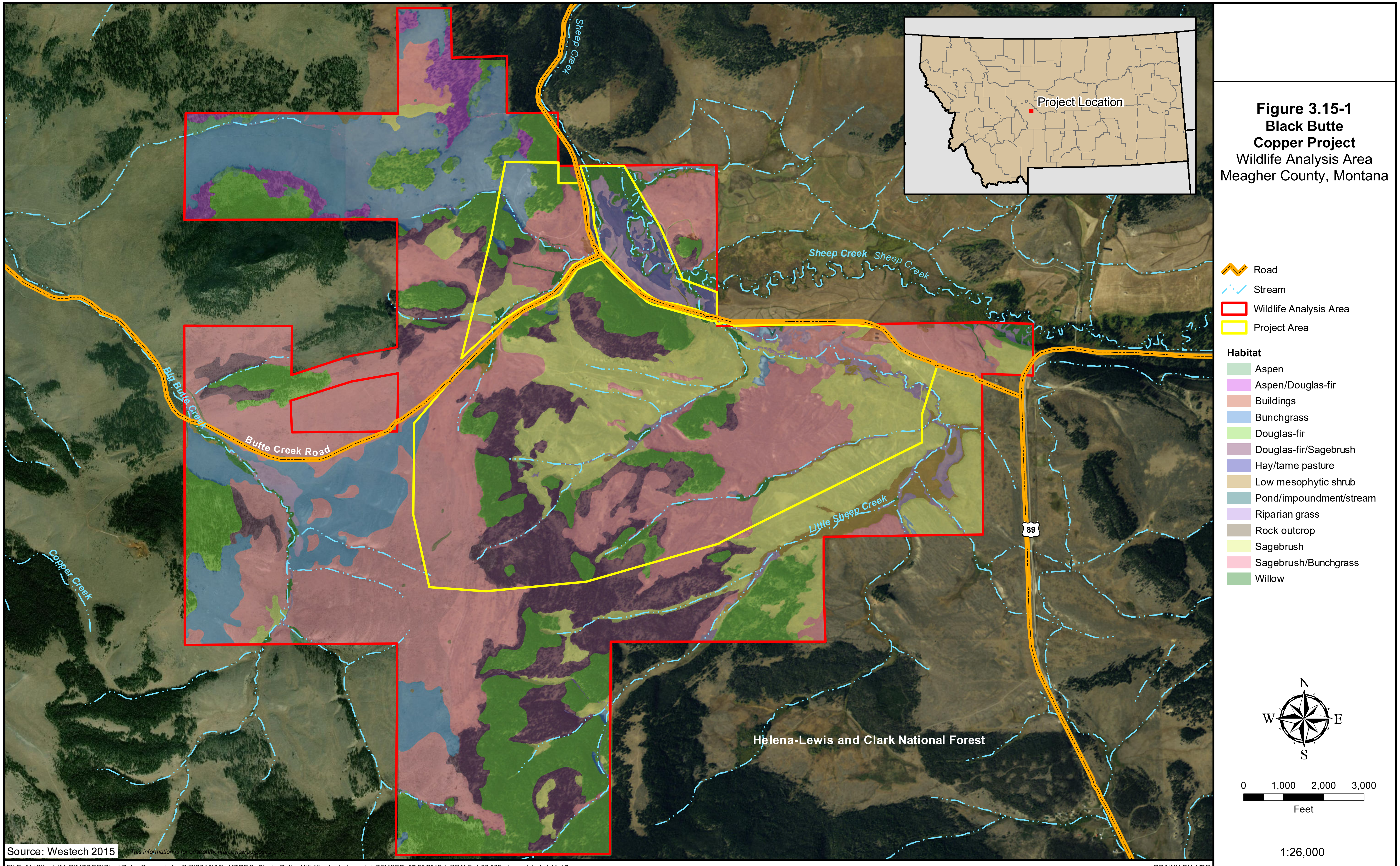

Figure 3.15-1
Black Butte
Copper Project
Wildlife Analysis Area
Meagher County, Montana
Project Location
Road
Stream
Wildlife Analysis Area
Project Area
Habitat
Aspen
Aspen/Douglas-fir
Buildings
Bunchgrass
Douglas-fir
Douglas-fir/Sagebrush
Hay/tame pasture
Low mesophytic shrub
Pond/impoundment/stream
Riparian grass
Rock outcrop
Sagebrush
Sagebrush/Bunchgrass
Willow
N
S
E
W
0
1,000
2,000
3,000
Feet
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Sheep Creek
Sheep Creek
Sheep Creek
Big Butte Creek
Butte Creek Road
Copper Creek
Little Sheep Creek
89
Helena-Lewis and Clark National Forest
Source: Westech 2015
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Additionally, terrestrial wildlife species require different habitats throughout the year or throughout their lifetime. For example, big game species may use a certain habitat type for calving/fawning during the spring and summer, but then migrate to winter habitat in the autumn. Additionally, migratory bird species spend the breeding season in northern areas and then migrate south for the winter.

Wildlife habitat within the wildlife analysis area was mapped according to dominant existing vegetation types and physical features (WESTECH 2015). From this mapping, six major habitat types were identified, each with various subtypes for a total of 15 subtypes (see **Table 3.15-1**).

Table 3.15-1
Habitat Types in Wildlife Analysis Area

Habitat Type	Subtype	Acres	Percent
Xeric Shrub			
	Sagebrush	822	16
	Sagebrush/bunchgrass mosaic	1,669	32
	Sub- total	**2,491**	**48**
Woodland			
	Aspen	29	1
	Aspen/Douglas- fir	88	2
	Willow	97	2
	Douglas- fir	929	18
	Douglas- fir/sagebrush	662	13
	Sub- total	**1,805**	**36**
Grassland			
	Bunchgrass	661	13
	Riparian Grass	165	3
	Sub- total	**826**	**16**
Mesophytic Shrub			
	Low Mesophytic shrub	83	2
	Sub- total	**83**	**2**
Agriculture			
	Hay/Tame Pasture	38	1
	Sub- total	**38**	**1**

Habitat Type	Subtype	Acres	Percent
Miscellaneous			
	Rock Outcrop	4	<1
	Pond/Impoundment/Stream	5	<1
	Road	28	1
	Buildings	10	<1
	Sub- total	**47**	**1**
	TOTAL	**5,290**	**104[a]**

Source: WESTECH 2015

Notes:
[a] Percent total is greater than 100% due to rounding.

The following are descriptions of the habitat types and subtypes listed in **Table 3.15-1**:

- Xeric Shrub includes dry sagebrush and sagebrush/bunchgrass mosaic subtypes. Combined, this habitat type comprised 48 percent of the wildlife analysis area and a large amount of the "…wildlife species observed during the study were recorded at least once in this habitat" (WESTECH 2015).
- Woodland includes aspen, aspen/Douglas-fir mix, willow, Douglas-fir, and Douglas-fir/sagebrush mix subtypes. The Douglas-fir and Douglas-fir/sagebrush habitats combined comprised about 31 percent of the wildlife analysis area, with the other subtypes comprising about 5 percent. The variety of structure in these woodland habitats provided a high species richness.
- Grassland includes bunchgrass and riparian grass subtypes, and comprised about 16 percent of the wildlife analysis area combined. Species recorded in the bunchgrass subtype were also recorded in the sagebrush subtype. Species recorded in the riparian grass subtype were also recorded in the water, willow, or sagebrush subtypes.
- Mesophytic Shrub includes low-growing moderately water-requiring shrubs and only occupied less than 2 percent of the wildlife analysis area. It contained a relatively small number of wildlife species.
- Agriculture includes hayfields or pasture and comprised less than 1 percent of the wildlife analysis area. This habitat type was found along Sheep Creek.
- Miscellaneous Features includes roads, buildings, water sources, and rock outcrops. Although this type comprised about 1 percent of the wildlife analysis area, the species richness was comparatively high (WESTECH 2015).

3.15.2.2. Endangered, Threatened, or Proposed Species

According to the U.S. Fish and Wildlife Service county list (USFWS 2017) and IPaC resource list (IPaC 2018), there are three listed, proposed, or candidate species under the Endangered Species Act of 1973 for Meagher County: Canada lynx (*Lynx canadensis*; listed threatened), grizzly bear (*Ursus arctos horribilis*; listed threatened), and wolverine (*Gulo luscus*; proposed threatened).

According to WESTECH (2015), "the dominant vegetation that constitutes lynx habitat in the Northern Rocky Mountains is subalpine fir (*Abies lasiocarpa*), Engelmann spruce (*Picea engelmannii*) and lodgepole pine (*Pinus contorta*)." The forested portions of the wildlife analysis area consist mostly of ponderosa pine (*Pinus ponderosa*) and dry Douglas-fir (*Pseudotsuga menziesii*). Therefore, preferred habitat for the Canada lynx is not available in the wildlife analysis area. Additionally, there is no listed Designated Critical Habitat for Canada lynx in the wildlife analysis area (WESTECH 2015; IPaC 2018). Any occurrences would likely include transient individuals, although no Canada lynx have been recorded within 10 miles of the Project area (WESTECH 2015). Typical home range sizes for Canada lynx are 6.2 to 7.7 square miles (MTNHP 2018). As such, the likelihood of Canada lynx occurrence within the wildlife analysis area is very low.

The grizzly bear primarily uses meadows, riparian zones, mixed shrub fields, and closed and open timber habitats (MTNHP 2018). There is potential preferred habitat in the wildlife analysis area for the grizzly bear. There have also been occurrences of the grizzly bear in the region. According to FWP (FWP, Pers. Comm., November 30, 2017), "a sub-adult grizzly was detected on both 5/28/17 and 7/2/17 at the same location in the Big Belt mountains, approximately 35 air miles west of the [Project] location." Additionally, two sub-adult male grizzly bears were lethally removed following a livestock depredation event north of the Little Belt Mountains (approximately 35 miles northeast of the Project location) on June 25, 2017 (FWP, Pers. Comm., November 30, 2017). The Project area is located between the Yellowstone and the Northern Continental Divide grizzly bear recovery zones (IGBC 2018). Although the wildlife analysis area is not located in either designated grizzly bear recovery zone, there is a potential for grizzly bears to occur in the wildlife analysis area. Typical home range sizes for grizzly bears are 48 to 297 square miles (MTNHP 2018).

The wolverine occupies primarily roadless wilderness areas in alpine tundra, boreal and mountain forests (primarily pine, fir, and larch), and riparian areas in the western mountains (MTNHP 2018). There is no preferred habitat in the wildlife analysis area for wolverines and there is a very low likelihood of occurrence (WESTECH 2015). Typical home range sizes for wolverines are 150 to 163 square miles (MTNHP 2018).

3.15.2.3. Species of Concern

FWP defines Montana SOC as "native animals breeding in the state that are considered to be 'at risk' due to declining population trends, threats to their habitats, and/or restricted distribution" (FWP 2018e). Montana maintains a list of vertebrate wildlife species that are of special concern. The wildlife analysis area includes potential habitat for 47 SOC, potential SOC, or special status species, although only 13 species (1 mammal and 12 birds) were recorded in the wildlife analysis area (see **Table 3.15-2**). For any wildlife SOC that were observed by WESTECH (2015), information about the species was recorded including habitat and location of the observation. Surveys for the species below occurred between August 2014 and August 2015, with most of the survey efforts occurring between April and August 2015.

Table 3.15-2
Potential Occurrence of Listed Terrestrial Species or Species of Concern

Species	Preferred and/or Breeding Habitat in the Wildlife Analysis Area	Recorded in or near the Wildlife Analysis Area	Recorded within 12 miles of Wildlife Analysis Area	Potential Occurrence in or near Wildlife Analysis Area
Amphibians				
Western toad	Yes		X	High
Reptiles				
Western milksnake	Yes			Low – on range periphery
Mammals				
Hayden's shrew	Yes			Low – on range periphery
Merriam's shrew	Yes			Low – on range periphery
Dwarf shrew	Yes			Moderate
Preble's shrew	Yes			Moderate
Townsend's big- eared bat	Yes			Moderate
Spotted bat	No			Low – no preferred roosting habitat and near elevation limit
Silver- haired bat	Yes			Moderate
Hoary bat	Yes			Moderate
Little brown myotis	Yes			Moderate
Fringed myotis	Yes			Moderate
Porcupine	Yes	X		Very high
Water vole	Yes			Low – on range periphery
White- footed mouse	Yes			Moderate
Swift fox	Yes			Low – on range periphery
Canada lynx	No			Low – limited habitat
Grizzly bear	Yes			Low
Birds				
Greater sage- grouse	Yes		X	Moderate

Species	Preferred and/or Breeding Habitat in the Wildlife Analysis Area	Recorded in or near the Wildlife Analysis Area	Recorded within 12 miles of Wildlife Analysis Area	Potential Occurrence in or near Wildlife Analysis Area
Great blue heron	Yes	X	X	Very high – no nesting habitat
Bald eagle	Yes	X	X	Very high – no nesting habitat
Northern goshawk	Yes	X	X	Very high
Ferruginous hawk	Yes	X		Very high
Golden eagle	Yes	X	X	Very high
Long- billed curlew	Yes		X	Moderate
Western screech- owl	Yes			Low – on range periphery
Northern hawk owl	Yes			Moderate
Great gray owl	Yes	X		Very high
Short- eared owl	Yes			Moderate
Common poorwill	Yes			Moderate
Rufous hummingbird	Yes	X		Very high
Pileated woodpecker	Yes			Low – limited habitat
Loggerhead shrike	Yes			Moderate
Plumbeous vireo	Yes			Low – on range periphery
Clark’s nutcracker	Yes	X	X	Very high
Brown creeper	Yes		X	Moderate – limited habitat
Varied thrush	Yes			Low – limited habitat
Sage thrasher	Yes			Moderate
Green- tailed towhee	Yes			Low – very limited habitat
Brewer’s sparrow	Yes	X	X	Very high
Sagebrush sparrow	Yes			Low – on range periphery
Baird’s sparrow	Yes	X		Very high – on range periphery
Bobolink	Yes	X	X	Very high – very limited habitat and near elevation limit

Species	Preferred and/or Breeding Habitat in the Wildlife Analysis Area	Recorded in or near the Wildlife Analysis Area	Recorded within 12 miles of Wildlife Analysis Area	Potential Occurrence in or near Wildlife Analysis Area
Gray-crowned rosy-finch	Yes			Moderate – no nesting habitat
Black rosy-finch	Yes			Moderate – no nesting habitat
Cassin’s finch	Yes	X	X	Very high
Evening grosbeak	Yes		X	Moderate

Source: WESTECH 2015

The following are descriptions of the species occurrences in the wildlife analysis area listed in **Table 3.15-2**:

- Sign of porcupine (*Erethizon dorsatum*) (i.e., chews) was occasionally observed within Douglas-fir forest types (WESTECH 2015). There is suitable habitat within the wildlife analysis area for porcupines.
- Both bald eagles (*Haliaeetus leucocephalus)* and golden eagles (*Aquila chrysaetos*) are often seen in the wildlife analysis area, particularly during migration periods, and there is suitable habitat within the area. A juvenile bald eagle was observed over a hay field in August 2015. Three separate golden eagles were observed along Sheep Creek in September 2014, near Little Sheep Creek feeding on a Richardson's ground squirrel (*Urocitellus richardsonii*) in June 2015, and over Douglas-fir forest in August 2015. The nearest bald and golden eagle nest observations are along the Smith River, about 11 to 12 miles from the Project area (WESTECH 2015). Although individuals were observed in the Project vicinity, potentially suitable nesting habitat within the wildlife analysis area was surveyed and no nests were found.
- There was one observation of a northern goshawk (*Accipiter gentilis*) in April 2015 between Douglas-fir and sagebrush habitats. Although several nests have been recorded within 10 miles of the Project area and WESTECH (2015) surveyed suitable nesting habitat, no nests were found.
- Ferruginous hawks (*Buteo regalis*) were sighted on two occasions over sagebrush habitats in September 2014 and 2015, which suggests they were transients/migrants. Although there is suitable nesting habitat present, no nests are recorded within 10 miles of the Project area (WESTECH 2015).
- Great gray owl (*Strix nebulosa*) was observed by WESTECH (2015) in September 2014. Although there are several occurrence records within 25 miles of the Project area, there are no nest records within 10 miles and no nests were observed by WESTECH (2015). However, suitable nesting habitat is present within the wildlife analysis area.
- Great blue herons (*Ardea herodias*) have been observed along Sheep Creek, although nesting was not documented by WESTECH (2015). The wildlife analysis area elevation may be too high to support great blue heron nesting, as most Montana records occur below 5,000 feet (WESTECH 2015).
- Rufous hummingbird (*Selasphorus rufus*) is a potential SOC, meaning more information is needed about the species to determine its status. It was observed in July 2015 in aspen and willow habitats and there is suitable habitat in the wildlife analysis area (WESTECH 2015).
- Clark's nutcracker (*Nucifraga columbiana*) was observed multiple times within Douglas-fir habitats of the wildlife analysis area. This nutcracker depends on conifer (especially pine) seeds. Loss of pine forests to fires, disease, and bark beetles could affect populations of the nutcracker (WESTECH 2015).

- Brewer's sparrow (*Spizella breweri*) was not observed by WESTECH (2015) during the 2014 to 2015 surveys, but they have been recorded in the wildlife analysis area before by the University of Montana's Avian Science Center monitoring (WESTECH 2015). They primarily occupy sagebrush habitat, and so loss of this habitat could affect the species.
- Baird's sparrow (*Ammodramus bairdii*) was observed in May 2015 by WESTECH (2015) in sagebrush habitat. Since the wildlife analysis area is located on the edge of the species' range, so it is possible the observed birds were migrating through wildlife analysis area and may not have been local residents.
- Bobolinks (*Dolichonyx oryzivorus*) were recorded in the wildlife analysis area near Sheep Creek in July 2015 in a hayfield/pasture habitat (WESTECH 2015). Its preferred habitat of old fields is limited in the wildlife analysis area.
- Cassin's finch (*Haemorhous cassinii*) was not observed by WESTECH (2015) during the 2014 to 2015 surveys, but they have been recorded in the wildlife analysis area before by the University of Montana's Avian Science Center monitoring (WESTECH 2015).

3.15.2.4. Big Game Species

Big game species include any large mammals defined as "game animals" by FWP (§ 87-2-101(4), MCA) that could potentially occur in the wildlife analysis area, including: pronghorn antelope (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), white-tailed deer (*Odocoileus virginianus*), elk (*Cervus elaphus*), moose (*Alces americanus*), mountain lion (*Puma concolor*), and black bear (*Ursus americanus*) (WESTECH 2015). The gray wolf (*Canis lupus*) is also included in this category since it is a large mammal that can be hunted or trapped in Montana (WESTECH 2015). Observed species were recorded by species, date, time, habitat, age, sex, and Global Positioning System location, if possible. All of these species except moose and mountain lion were recorded in 2014 and 2015 by WESTECH (2015). However, Proponent personnel have observed moose in the surrounding area (WESTECH 2015). Additionally, mountain lions have been harvested within a few miles of the Project area, and it is possible that they occasionally utilize the wildlife analysis area. FWP has a Crucial Areas Planning System (CAPS) that assesses the importance of land for wildlife. This system was used to assess winter habitat for several of the big game species, with the results further discussed below (WESTECH 2015).

Pronghorn Antelope

Pronghorn antelope were observed multiple times (12 sightings totaling 85 individuals) by WESTECH (2015) during the 2014 to 2015 surveys. Almost all of the sightings occurred in open habitats (sagebrush and bunchgrass) in the spring and summer seasons. Antelope were observed starting in April and steadily increased in number until June. It is possible that fawning occurred in the wildlife analysis area. The maximum number of antelope observed at one time was 23 individuals in July 2015.

There is no pronghorn antelope winter range within the wildlife analysis area, as the sagebrush habitat elevation is too high and results in prolonged snow depths. WESTECH (2015) observed antelope numbers declining by October and there were no winter sightings. FWP's CAPS mapping identified winter range 7 to 8 miles southwest of the Project area, which is likely where the summer resident antelope moved to in the winter.

Mule Deer

Mule deer are commonly observed within the wildlife analysis area year-round. WESTECH (2015) recorded nine different sightings, totaling 24 individuals. There was a single sighting in autumn 2014, and two sightings that winter. Three sightings were recorded in spring 2015 followed by three sightings in summer 2015. Mule deer were observed in sagebrush, riparian grass, Douglas-fir, bunchgrass, aspen, and low mesic shrub habitats. According to WESTECH (2015), CAPS mapping identified the wildlife analysis area as Class 3 mule deer winter range (Class 1 is highest and Class 4 is lowest for winter range quality).

The wildlife analysis area lies within FWP's Prairie/Mountain Foothills population management unit and Hunting District 416. The 2017 hunting regulations (FWP 2018a) would be considered restrictive (antlered buck only), indicating that mule deer numbers are less than desired.

White-tailed Deer

White-tailed deer were observed eight different times (totaling nine individuals) by WESTECH (2015). Evidence of white-tailed deer (e.g., tracks, scat) was observed in stream bottom habitats along Sheep Creek and Little Sheep Creek. The sightings occurred in hayfields/pastures, along riparian areas, and in willows and riparian grass habitats. It is possible that fawning occurred within the wildlife analysis area as a fawn was observed with a doe in July 2015. Generally, white-tailed deer use the stream drainage areas within the wildlife analysis area, although they may also utilize the upland areas as well.

The high elevation, deep snow, and lack of suitable thermal cover and/or food sources in the wildlife analysis area likely prevent its use by white-tailed deer in winter (WESTECH 2015). Additionally, FWP's CAPS mapping did not identify the wildlife analysis area as white-tailed deer winter range. However, the Smith River to the west of the wildlife analysis area may contain enough habitat to support white-tailed deer in winter.

The wildlife analysis area lies within FWP's Prairie/Mountain Foothills population management unit and Hunting District 416. The 2017 hunting regulations (FWP 2018a) would be considered standard (either sex), indicating that white-tailed deer numbers are stable.

Elk

WESTECH (2015) observed elk on five different occasions (totaling 23 individuals). One sighting occurred in October 2014, and the other four occurred in April and May 2015. The autumn sighting occurred in Douglas-fir habitat, while the spring sightings occurred in Douglas-fir, sagebrush, bunchgrass, and riparian grass habitats. Elk tracks were also observed at water features (e.g., seasonal or permanent ponds). It is possible that calving takes places in the wildlife analysis area, as calves were observed with cows in May.

FWP's CAPS mapping did not identify the wildlife analysis area as elk winter range. However, elk winter range is mapped within 2 to 3 miles west of the Project area. Since the sightings occurred in spring and autumn, it is likely that the wildlife analysis area is located in a transitional area between summer and winter elk ranges (WESTECH 2015).

The wildlife analysis area lies within FWP's elk Hunting District 416. According to WESTECH (2015), "FWP flies a winter aerial survey of approximately the western two-thirds of the district" including the wildlife analysis area. In 2017, FWP observed 913 elk in Hunting District 416, but the population objective for the district is 475 observed wintering elk (FWP 2018d). Therefore, the population is significantly over objective in this district.

Moose

As mentioned above, no moose or their sign were observed by WESTECH (2015) during the 2014 to 2015 surveys. However, the Proponent personnel have reported that moose are occasionally observed in the wildlife analysis area (WESTECH 2015). Moose primarily occupy river valleys, mountain meadows, clear-cuts, willow flats, and swampy areas during the summer, but transition to closed canopy coniferous forests adjacent to willow flats during the winter (MTNHP 2018). It is likely that the closed canopy provides thermal protection from the wind and reduced snow depths. The riparian areas of Sheep Creek and Little Sheep Creek, along with the Douglas-fir stands, may offer potential habitat for moose.

The wildlife analysis area occurs within moose Hunting District 494. There were only four licenses available in this district in 2017, eligible for an either sex moose. Moose harvest in this district since 2010 has averaged about three to four moose per season (FWP 2018b).

Mountain Lion

Though no sightings or sign were observed by WESTECH (2015) during the 2014 to 2015 surveys, a few mountain lions have been harvested within a few miles of the Project area between 2008 and 2017, and several have been taken within 6 miles of the wildlife analysis area. There is potential habitat (e.g., foothills, forests, shrublands) and prey species (e.g., deer, elk, porcupine) present. The wildlife analysis area is located in mountain lion Management Unit 416 (FWP 2018c). In 2015, there were five mountain lions harvested in this unit (FWP 2018b). As such, it is likely that some individuals occasionally occur in the wildlife analysis area.

Black Bear

Black bears were observed four different times (totaling four individuals) within the wildlife analysis area by WESTECH (2015). The sightings occurred near a building site in autumn 2014, in Douglas-fir habitat in spring 2015, and in aspen and Douglas-fir habitats in summer 2015. Black bear tracks and scat were also observed near water features, and in aspen, Douglas-fir, and riparian grass habitats. No evidence of denning was observed on the wildlife analysis area.

FWP records black bear harvest locations in the area. For the period of 2008-2017, there were more than 30 harvests within 6 miles of the Project area, including a few within the wildlife analysis area. These harvest data appear to indicate that black bears are relatively common in the wildlife analysis area.

Gray Wolf

The gray wolf has potential habitat (e.g., forests, shrublands, riparian areas) within the wildlife analysis area. Additionally, the year-round presence of ungulates (e.g., deer, elk) is one of the primary requirements for population occurrence (MTNHP 2018). However, no individuals or their sign were observed by WESTECH (2015) during the 2014 to 2015 surveys. Wolf packs occur primarily in western Montana, and the nearest known pack in 2015 was located more than 50 miles west of the Project area (FWP 2018g).

The wildlife analysis area is located within wolf Management Unit 390, and up to five wolves can be harvested per person per season (FWP 2018f). However, only one wolf was harvested via hunting within approximately 30 miles of the wildlife analysis area in 2016 (FWP 2018f). The majority of wolf harvests occurred further west and south of the wildlife analysis area, and more wolves were taken via hunting than trapping.

3.15.2.5. Migratory Birds

Migratory birds; parts, nests, or eggs of any such bird; or any products made from these are protected under the Migratory Bird Treaty Act. Bald and golden eagles are also protected under the Bald and Golden Eagle Protection Act. Neotropical migratory birds are species that spend their spring and summer breeding season in northerly latitudes until their chicks are fledged, but migrate south in the autumn to spend the winter months in warmer environments. FWP and § 87-2-101(7), MCA define migratory game birds as “waterfowl, including wild ducks, wild geese, brant, and swans; cranes, including little brown and sandhill; rails, including coots; Wilson's snipes or jacksnipes; and mourning doves.” Additionally, many nongame land birds are migratory species. According to WESTECH (2015), “the University of Montana’s Avian Science Center conducted long-term land bird monitoring throughout western Montana,” including land near the western edge of the wildlife analysis area, with the resulting observations included in the species list of WESTECH’s report (WESTECH 2015).

According to Appendix A of WESTECH (2015) and other wildlife surveys in the vicinity, there have been 76 bird species recorded in the wildlife analysis area. These include land birds, migratory game birds, upland game birds, and raptors. The majority of these species are protected under the Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act (in the case of bald and golden eagles).

3.15.2.6. General Wildlife

In addition to the species discussed above, several other reptiles/amphibians, bats, and furbearers were observed by WESTECH (2015), as described below.

Reptiles and Amphibians

No amphibians were recorded by WESTECH (2015) during the 2014 to 2015 study. However, the Columbia spotted frog (*Rana luteiventris*) was incidentally observed along Sheep Creek and Little Sheep Creek by Stagliano (2018) during an aquatic survey. A juvenile western toad (*Anaxyrus boreas*), a Montana SOC, was incidentally recorded during 2016 summer surveys along Sheep Creek (Stagliano 2018). This species had been previously recorded by Stagliano (2018) within 1 mile of Sheep Creek sampling site SH22.7 (located approximately 0.5 mile east of the intersection of U.S. Route 89 and County Road 119), but had not been observed during the 2014 or 2015 surveys until summer 2016, and was not observed again in 2017.

The common garter snake (*Thamnophis sirtalis*) was the only reptile observed by WESTECH (2015) during the 2014 to 2015 study. This species was sighted several times in stream bottom habitats. Stagliano (2018) also observed common garter snakes during summer surveys in 2016 and 2017 along Tenderfoot Creek and Moose Creek.

Upland Game Birds

Upland game birds, as defined under § 87-2-101(13), MCA, could also occur in the wildlife analysis area, including: gray partridge (*Perdix perdix*), ring-necked pheasant (*Phasianus colchicus*), ruffed grouse (*Bonasa umbellus*), greater sage-grouse (*Controcercus urophasianus*), dusky grouse (*Dendragapus obscurus*), sharp-tailed grouse (*Tympanuchus phasianellus*), and wild turkey (*Meleagris gallopavo*).

WESTECH (2015) observed a dusky grouse during the 2014 to 2015 study, and ruffed grouse have also been observed in the area. Although there is suitable habitat for both species, displaying males were not heard in spring 2015, and so it is assumed that both species are uncommon in the wildlife analysis area (WESTECH 2015).

Raptors

WESTECH (2015) recorded 11 raptor species in the wildlife analysis area: bald eagle, golden eagle, red-tailed hawk (*Buteo jamaicensis*), ferruginous hawk, rough-legged hawk (*Buteo lagopus*), northern harrier (*Circus cyaneus*), sharp-shinned hawk (*Accipiter striatus*), northern goshawk, American kestrel (*Falco sparverius*), great horned owl (*Bubo virginianus*), and great gray owl. A Swainson's hawk (*Buteo swainsoni*) was also separately observed in the wildlife analysis area in late August 2011 (WESTECH 2015). Five of these species are discussed above in Section 3.15.2.3, Species of Concern, while the rest are discussed below:

- Red-tailed hawks were the most observed buteo (broad-winged) raptor in the wildlife analysis area (WESTECH 2015). One individual was observed in autumn 2014, four were observed in spring 2015, and one was recorded in summer 2015, all in Douglas-fir habitat. Although there is suitable nesting habitat in the wildlife analysis area and the wildlife analysis area is at the right elevation for nesting in Montana, no active or inactive nests were found during the survey (WESTECH 2015).

- A single rough-legged hawk was observed in mid-October 2014, perched on a rock outcrop in grassland habitat. They are considered a migrant species/winter resident in Montana, but the deep snow in open habitats of the wildlife analysis area may limit prey availability.
- WESTECH (2015) observed two adult male northern harriers, one in spring 2015 and one in summer 2015. The hawks were recorded flying over sagebrush and riparian grass habitats. Although the wildlife analysis area contains suitable nesting habitat, most Montana records of the species are from below 5,500 feet in elevation and it is assumed northern harriers do not nest in the area.
- One sharp-shinned hawk was recorded in September 2014 in Douglas-fir habitat (WESTECH 2015). Although suitable nesting habitat is available in the wildlife analysis area, it is likely that the observed individual was a migrant since there were no observations during the 2015 nesting season.
- WESTECH (2015) observed one female American kestrel flying over grassland habitat in late June 2015. Although the wildlife analysis area contains suitable nesting habitat, most Montana records of the species are from below 5,500 feet in elevation and it is assumed American kestrels do not nest in the area.
- One great horned owl was observed by WESTECH (2015) flushing from willow habitat in mid-July 2015. However, no other individuals were observed during surveys in late April, mid-May, and mid-June. As such, it is likely that the great horned owl is a transient or uncommon species in the wildlife analysis area.
- Although not observed by WESTECH during the 2014 to 2015 survey, a Swainson's hawk was recorded in the wildlife analysis area in August 2011 (WESTECH 2015). There is potential foraging habitat, but no nesting habitat, available in the wildlife analysis area for this species.

Furbearers and Other Mammals

Fur bearing mammals, as defined under § 87-2-101(3), MCA, include beaver (*Castor canadensis*), muskrat (*Ondatra zibethicus*), bobcat (*Lynx rufus*), northern river otter (*Lontra canadensis*), marten (*Martes americana*), and American mink (*Mustela vison*). Fur bearing mammals also include "predatory animals" (§ 87-2-101(11), MCA), such as coyote (*Canis latrans*), weasels (*Mustela* spp.), and striped skunk (*Mephitis mephitis*). Other medium and small-sized mammals are considered "nongame wildlife" by FWP (§ 87-2-101(8), MCA).

Medium-sized mammals observed in the wildlife analysis area included white-tailed jackrabbit (*Lepus townsendii*), mountain cottontail (*Sylvilagus nuttallii*), beaver, porcupine, yellow-bellied marmot (*Marmota flaviventris*), Richardson's ground squirrel, coyote, bobcat, and badger (*Taxidea taxus*). Evidence of beavers (i.e., chewed tree trunks) was observed along Big Sheep Creek, but beavers were considered uncommon in the wildlife analysis area (WESTECH 2015). Similarly, porcupine chews were occasionally observed in Douglas-fir habitats. Yellow-bellied marmots were commonly observed in rock outcrops and nearby grasslands. Richardson's ground squirrels were common in several open habitats throughout the wildlife analysis area.

White-tailed jackrabbits were recorded in sagebrush and between sagebrush and Douglas-fir habitats (WESTECH 2015), although they were considered uncommon in the wildlife analysis area. The mountain cottontail or its sign (e.g., pellets, hair) was recorded in several habitats and it was considered common. One badger was observed digging in the U.S. Route 89 barrow pit on the east side of the wildlife analysis area (WESTECH 2015). Badger sign (i.e., diggings) was commonly observed in sagebrush and bunchgrass habitats, especially near Richardson's ground squirrel locations.

Coyotes were observed three separate times in sagebrush and bunchgrass habitat subtypes. Coyote sign (e.g., tracks, scat, hair) was commonly recorded in several habitats throughout the wildlife analysis area.

WESTECH (2015) observed one bobcat in Douglas-fir habitat on the southern edge of the wildlife analysis area. For the period of 2008-2017, FWP reported more than 10 bobcat harvests within 6 miles of the Project area, including a few within the wildlife analysis area. Female bobcats in western Montana frequently have average home ranges of 23 square miles, while males occupy home ranges closer to 31 square miles (WESTECH 2015). While bobcats appear somewhat common in this region, the wildlife analysis area would represent about 25 to 35 percent of the home range of a single bobcat.

Small mammals were not quantitatively sampled by WESTECH (2015), but readily observed species were recorded. Small mammals commonly observed in the wildlife analysis area included northern pocket gopher (*Thomomys talpoides*), red squirrel (*Tamiasciurus hudsonicus*), and chipmunks (*Tamias* spp.). A bushy-tailed woodrat (*Neotoma cinerea*) midden (i.e., collection of branches, twigs, grasses, or leaves surrounding a nest) was observed in a rock outcrop subtype habitat. Additionally, weasels have been observed near building sites by Proponent personnel (WESTECH 2015).

Bats

Though no acoustic surveys were conducted as part of the 2014 to 2015 surveys, bat species occurrences were recorded when observed (WESTECH 2015). There are 11 bat species that could potentially occur in the wildlife analysis area (WESTECH 2015). WESTECH (2015) recorded unidentified bat species in several different habitats at dusk in June 2015.

3.15.3. Environmental Consequences

3.15.3.1. No Action Alternative

Under the No Action Alternative, the Project as described above would not occur. No underground mine or associated infrastructure would be built. The Project area consists of privately owned surface rights, so the existing land uses of cattle ranching, hay production, and recreational use (i.e., hunting and fishing) would continue to occur. There would be an ongoing risk of wildlife-vehicle collisions from traffic along County Road 119 and U.S. Route 89 due to residential use and exploration activities. The Proponent may continue other exploration activities in the Project area under their updated and approved exploration license, which could displace wildlife near the portal entrance during construction and exploration activities. The habitat in the wildlife analysis area would likely continue to be used as it is currently used by the various species discussed in Section 3.15.2 until exploration activities cease.

3.15.3.2. Proposed Action

Under the Proposed Action, the Project area would be developed during construction and operated throughout the life of the mine. Primary (direct) impacts to wildlife species would occur in the same area and at the same time as the disturbance, while secondary impacts are further impacts to the human environment that may be stimulated or induced by or otherwise result from a direct impact of the action.

The Project is modeled to comply with primary and health-based air quality standards, and so it would be protective of wildlife and vegetation. Though dust would be likely during dry conditions over the course of the Project, the dust would comply with standards. Additionally, dust control measures (i.e., spraying roads) would be implemented in the Project area to reduce the impacts of fugitive dust. As such, any fugitive dust impacts on wildlife or habitat within the Project area would be negligible.

Mine-related water discharged to the Sheep Creek alluvial infiltration gallery would be treated and required to meet nondegradation criteria throughout operations. Impacts on base flow of Sheep Creek as a result of mine dewatering and disposal of treated water to the alluvial UIG are expected to be negligible and to partially offset one another. As such, surface water quantity would not adversely change during the life of the mine as a result of the Proposed Action. It is unlikely that the Project would affect habitat for aquatic wildlife or species that drink from the creek. Therefore, secondary impacts on animals or habitat in the Project area (due to a change in surface water quality or quantity) would be negligible.

Baseline investigations identified 9 seeps and 13 springs in the Project area, and some of the sites are located within the area that could be affected by the mine drawdown cone, including springs developed for stock use (**Figure 3.5-3**). Many of the springs and seeps appear to be connected to perched groundwater bodies and may only flow seasonally; these would not likely be directly affected by creation of the deeper groundwater drawdown cone. Wetland vegetation and wildlife utilizing these areas as habitat may be affected, if springs or seeps are depleted by dewatering. Spring flow would be anticipated to reestablish when shallow groundwater recovers to baseline conditions, within two years after the cessation of dewatering.

The PWP would have a footprint of 23.9 acres, and would contain slightly acidic process water (pH of approximately 5.8)1. The PWP would primarily store thickener overflow from the mill, as well as contact water from precipitation and run-on, and collected water from the foundation drain collection ponds (Tintina 2017). The overall chemistry of the PWP is dominated by the thickener overflow, which provides 93 percent of the flow (Tintina 2017). The predicted solution

[1] The pH scale is a logarithmic scale used to measure the acidity or alkalinity of a system. Distilled or pure water has a neutral pH of 7. Liquids with a pH less than 7 are acidic (gastric acid, pH=1; orange juice, pH=3), while liquids with a pH greater than 7 are alkaline, or basic (ammonia, pH=11; bleach, pH=13). Rainfall, not affected by air pollutant emissions, typically has a pH of 5.3-5.6 in the western United States.

has a pH of 5.81, moderate sulfate (903 mg/L), and elevated concentrations of nitrates and metals, including copper, nickel, lead, antimony, and thallium (Table 7-1, Appendix N of the MOP Application [Tintina 2017]). It is possible that bird species may drink from the PWP and ingest the slightly acidic water with elevated concentrations of salts and metals.

The CWP would have a footprint of approximately 8.9 acres, and would contain surface run-off from the mill area, portal pad, WRS pad, copper-enriched rock storage pad, CTF road north of the mill, and from the CWP itself, as well as water from underground mine dewatering. This water could come into contact with potentially contaminated source material from the facilities. Additionally, brine generated as a byproduct from the water treatment plant will be stored in a sub-cell brine pond (approximately 3 acres in size) in the western portion of the CWP. The brine cell may contain elevated metals and would have a high salinity (approximately like seawater). It is possible that bird species may drink from the CWP and ingest the water with elevated concentrations of salts and metals.

Noise levels from the Project during construction and operations would be equivalent to background sound levels and are modeled to attenuate to ambient levels within 1 to 2 miles of the disturbance. Wildlife species within the Project area would occasionally be disturbed by construction, blasting, or other Project noise. There would be a negligible effect to individuals further than 2 miles away from the disturbances because the noise would be similar to ambient levels past this distance.

A potential secondary impact of the Proposed Action would include the introduction of invasive plant species to the site during construction or operations. This could affect habitat and foraging for small mammals and grazing species in the future. However, the Proponent would utilize a weed management plan to reduce any of these impacts.

During construction and operations, approximately 311 acres of wildlife habitats would be altered or removed due to surface disturbances (see **Table 3.15-3**), which would make them unsuitable for wildlife use during the life of mine. However, reclamation efforts would take place to stabilize disturbed areas on a simultaneous schedule. At the end of mine life, permanent reclamation and closure would occur. Disturbed areas within the Project area would be recontoured to topography similar to the pre-mine conditions and revegetated in accordance with § 82-4-336, MCA. Stockpiled subsoil and topsoil from onsite would be used to prepare the seedbed. Three native revegetation seed mixes would be used to reclaim the disturbed areas to either upland shrub, conifer forest, or upland grass communities depending on the pre-mining vegetative communities present. Grassland and shrubland communities reclaimed on various Project feature areas would be available for wildlife use within three to five growing seasons, offering a similar level of habitat as currently exists. However, forested communities could take decades to provide a similar habitat structure to pre-mining conditions. Individual animals would likely be displaced into surrounding habitats during this time.

Habitat

The Proposed Action, including a 10 percent construction buffer area, would disturb approximately 311 acres within the Project area. This disturbance includes new access roads, stockpiles, ponds, the mill and plant site, tailings facilities, and other associated mine facilities. Disturbance associated with construction and operations of these facilities would primarily affect wildlife habitat in the immediate vicinity, and the largest habitat losses would include sagebrush, sagebrush/bunchgrass, and Douglas-fir/sagebrush habitats. However, road construction, maintenance, and use would also result in the loss of wildlife habitat and additional activity within the wildlife analysis area. **Table 3.15-3** below lists the habitat types affected by the Proposed Action.

Table 3.15-3
Proposed Action Habitat Impacts in Wildlife Analysis Area

Habitat Type	Disturbed Acres
Aspen	0.5
Buildings	0.4
Bunchgrass	1.9
Douglas-fir	23.9
Douglas-fir/Sagebrush	59.3
Hay/Pasture	0.1
Low mesophytic shrub	0.0
Riparian grass	1.4
Road	0.5
Sagebrush	110.7
Sagebrush/Bunchgrass	83.2
Willow	0.6
Sub-total	**282.5**[a]
Construction Buffer (10%)	28.3
TOTAL	**310.8**[a]

Source: WESTECH 2015

[a] Acreage total is less than reported **Table 2.2-1** due to rounding.

Endangered, Threatened, or Proposed Species

As discussed in Section 3.15.2.2, there is no identified preferred habitat for Canada lynx or wolverine in the wildlife analysis area, but both species could potentially occur as transients in the area. The approximately 311 acres of surface disturbances from the Project would represent 6 to 8 percent of a single home range for Canada lynx and approximately 0.3 percent of a single home range for wolverines. An increase in traffic due to employees, support vehicles, or concentrate trucks along haul roads, access roads, and main roads would likely represent the largest potential impact to transient individuals due to potential wildlife-vehicle collisions or avoidance behavior. However, given the lack of occurrences and large home ranges of both species, it is unlikely that the Proposed Action would affect the Canada lynx or wolverine.

The grizzly bear has potential preferred habitat in the wildlife analysis area. Given the large home ranges of the grizzly bear, the surface disturbances from the Project would represent about 0.2 to 1.0 percent of an individual's home range. Although no individuals have been observed in the wildlife analysis area, three sub-adult individuals were observed within 35 miles of the Project area in 2017. Transient grizzly bears may use the wildlife analysis area's grassland, sagebrush, and riparian areas along Sheep Creek and Little Sheep Creek. There would be a minor reduction of bunchgrass or riparian grass habitats, while 1.5 percent of sagebrush/bunchgrass habitats and 2 percent of sagebrush habitats would be impacted within the wildlife analysis area (see **Table 3.15-3**). This would be a relatively small and temporary loss of habitat since the area would be reclaimed at closure. Post-closure, the reclaimed Project area would not offer similar habitat structure as pre-mining conditions for several years or decades, but the removal of structures and human activity would likely eliminate the displacement effect on grizzly bears.

There would be an increase of approximately 160 daily vehicle trips by employees and 8 truck round trips per day during construction. During operations, there would be an increase of 18 concentrate truck round trips per day, 6 supply truck round trips per day, and 477 employee vehicle trips per day. Linear features and roads, along with associated traffic, have historically had a displacement effect on grizzly bears (McLellan and Shackleton 1988; Lamb et al. 2018). As such, it is expected that grizzly bears using the wildlife analysis area in the future would avoid haul roads, access roads, and main roads during construction, operations, and reclamation and closure, and there would be a low likelihood of vehicle collisions. Given the low likelihood but severity of a collision (for human safety and taking a listed species), there could be a potential effect on the grizzly bear.

Additionally, noise impacts throughout construction, operations, and reclamation could disturb individual bears and result in changes in animal movement through the area. However, Project-related noise during construction and operations is modeled to attenuate to ambient noise levels within 1 to 2 miles of the Project features. Since there is suitable habitat surrounding the Project area, individual bears could likely avoid Project activities that generate noise during the life of the mine (2 years of construction and development mining, 13 years of active production mining, and 4 years of reclamation and closure).

All water-bearing lined ponds would be surrounded with eight-foot-tall chain-link fencing within the Project area, which would exclude grizzly bears from accessing the PWP, CWP, or TWSP.

Species of Concern

The Montana SOC that were observed in the wildlife analysis area (see **Table 3.15-2**) would likely be affected by habitat loss and noise during construction and operations (approximately 15 years). During reclamation activities (approximately four years), Project features would be reclaimed and revegetated, but the displacement would likely be similar to construction and operations. Ground-nesting birds and small mammals may face individual mortalities due to construction, operations, and reclamation activities, but it is unlikely there would be population level effects. They would likely also be displaced from the disturbance areas and may avoid habitats within 1 mile of the Project features due to noise. However, the wildlife analysis area is part of a contiguous, montane, sagebrush steppe habitat where wildlife densities are generally low, especially in the fall and winter. There is likely sufficient habitat adjacent to the disturbance areas to supply most of the habitat needs for the wildlife species observed by WESTECH (2015).

All water-bearing lined ponds would be surrounded with eight-foot-tall chain-link fencing within the Project area, which would exclude medium and large mammals from using the PWP, CWP, or TWSP. However, avian, small mammal, or amphibian SOCs may drink water from these ponds. These wildlife species could potentially be exposed to water with elevated concentrations of metals, sulfate, and salts in the PWP or CWP. An increase in the surface water area of almost 24 acres for the PWP, almost 9 acres for the CWP, and approximately 20 acres for the TWSP would likely attract waterfowl, water birds, and songbirds in an area lacking large surface water features. Avian species not adapted to encountering saline fluids can suffer from sodium toxicity at very high doses, although it is unlikely that the PWP or CWP would reach salinity levels that high. Predicted water quality in the PWP would pose little acute threat to waterfowl that may land on the pond, precluding the need for netting to limit avian access. The TWSP would store treated water, and it is not expected to be an issue for SOC. As a mitigation measure, the Proponent proposes to place bird netting over the CWP brine pond, which would deter bird species from landing on the brine pond or consuming water from it.

Big Game Species

Big game species are somewhat common, but not abundant in the wildlife analysis area. Approximately 311 acres of habitat would be directly disturbed by the Project, which would remove potential habitat for several big game species. The Project area may be located in a transitional zone for migrating ungulate species (e.g., deer, elk). According to WESTECH (2015), the area is mapped as mule deer winter range, though mule deer were only observed twice in winter. Brown et al. (2012) observed that ungulates (e.g., elk and pronghorn) in northwest Wyoming quickly became accustomed to human disturbance and were less responsive to increasing levels of vehicle traffic and noise. There could also be an increased possibility of wildlife-vehicle collisions due to the increased traffic associated with the Project. As mentioned above, all water-bearing lined ponds would be surrounded with eight-foot-tall chain-link fencing within the Project area, which would exclude big game mammals from using the PWP, CWP, or TWSP.

The predatory big game species (e.g., mountain lions, black bears, and gray wolves) tend to be more reclusive and may be displaced by habitat disturbance and increased human activity in the Project area. This avoidance effect may also reduce the likelihood of wildlife-vehicle collisions. There is abundant adjacent habitat for big game predators.

Migratory Birds

The Proposed Action would disturb potentially suitable foraging or nesting habitat for several migratory bird species. Noise and light disturbance would likely disturb songbirds and raptors within 1 mile of the Project features, as noise pollution can stress birds and interfere with mating calls and light pollution can interrupt activity cycles. However, there is adjacent suitable habitat within the wildlife analysis area such that the Project features could be avoided.

Avian species may drink water from the PWP, CWP, or TWSP. These wildlife species could potentially be exposed to water with elevated concentrations of metals, sulfate, and salts in the PWP or CWP. An increase in the surface water area of almost 24 acres for the PWP, almost 9 acres for the CWP, and approximately 20 acres for the TWSP would likely attract migratory waterfowl species in an area lacking large surface water features. Avian species not adapted to encountering saline fluids can suffer from sodium toxicity at very high doses, although it is unlikely that the PWP or CWP would reach salinity levels that high. Predicted water quality in the PWP would pose little acute threat to waterfowl that may land on the pond, precluding the need for netting to limit avian access. The TWSP would store treated water, and it is not expected to be a concern to migratory bird species. As a mitigation measure, the Proponent proposes to place bird netting over the CWP brine pond, which would deter bird species from landing on the brine pond or consuming water from it.

Other Animals

Direct impacts on other animals in the Project area would be similar to those discussed above for listed species or SOC. Approximately 311 acres would be disturbed, which would displace noise-sensitive species and reduce the available nesting, roosting, and foraging habitat for several wildlife species. However, there is adjacent suitable habitat within the wildlife analysis area such that the Project features could likely be avoided.

Reptiles, amphibians, game birds, raptors, bats, and small mammals could potentially be impacted from consuming water from the PWP or CWP. As a mitigation measure, the Proponent proposes to place bird netting over the brine pond portion of the CWP, which would deter most species from accessing the brine pond or consuming water from it.

Mine-related discharge water would eventually flow to surface waters, but it would not negatively affect amphibian populations, such as the Columbia spotted frog or western toad. Discharge water would be treated to meet nondegradation criteria and surface water standards that are protective of amphibians. Surface water quantity would not adversely change during the life of the mine as a result of the Proposed Action, and it is unlikely to affect habitat for aquatic wildlife. Amphibians and small animals that utilize seeps and springs affected by the Project may experience a loss of water until shallow groundwater recovers to baseline conditions.

Smith River Assessment

The Smith River is located approximately 12 miles west of the Project area. Wildlife species with large home ranges or highly mobile species may travel between the two areas seasonally, and they are discussed below. Small mammals, reptiles, and amphibians are unlikely to migrate between the two areas and are not discussed further.

All water discharges from the Project would be required to meet water quality standards and nondegradation criteria. As such, it would not negatively affect wildlife species along Sheep Creek or downstream to the Smith River. Surface water quantity would vary seasonally but would not adversely change during the life of the mine as a result of the Proposed Action. Consequently, there would likely be no effect to wildlife and riparian habitat along the Smith River.

Noise levels from the Project during construction and operations are modeled to attenuate to ambient levels within 1 to 2 miles of the disturbance. As such, wildlife species near the Smith River would not be affected by noise from the Project.

The Project is modeled to comply with primary and health-based MAAQS and NAAQS, and so they are expected to also be protective of wildlife and vegetation. Dust control measures (e.g., spraying roads) would be implemented in the Project area to reduce the impacts of fugitive dust. As such, any fugitive dust effects on wildlife near the Smith River would be negligible.

Potential Secondary Impacts to Wildlife Species

Grizzly bears typically have large home ranges that could potentially include the wildlife analysis area and the Smith River. There is a potential for grizzly bears to occur in the wildlife analysis area. However, if individual grizzly bears were displaced from the Project area due to disturbances and human activity, there is adequate adjacent habitat for them to avoid the area. There would be a negligible effect on grizzly bears that occur near the Smith River due to the Project.

Both the bald eagle and golden eagle have mapped nest sites along the Smith River, approximately 11 to 12 miles from the wildlife analysis area. Since habitat along Sheep Creek would not be directly disturbed and there is adjacent habitat for migrating individuals, there would likely be negligible impacts to the bald or golden eagles that nest along the Smith River. There would also be negligible impacts to other raptors and migratory bird species that travel between the wildlife analysis area and the Smith River seasonally.

Big game species may seasonally travel between the wildlife analysis area and the Smith River. While not formally mapped as white-tailed deer winter range, it is likely that white-tailed deer observed near the wildlife analysis area winter in bottomlands near the Smith River (WESTECH 2015). Because the Proposed Action is unlikely to affect big game species, impacts to the white-tailed deer or other big game species near the Smith River would be negligible.

Other wildlife species that could potentially travel between the two areas would face the same conditions, and it is unlikely they would be affected.

3.15.3.3. Agency Modified Alternative

Under the AMA, the Project would include all the same components as the Proposed Action with one exception: backfilling additional mine workings, access ramps, and ventilation shafts. The additional backfill component of the AMA would not impact any additional habitat because the surface disturbance footprint would not change. However, it would likely result in longer periods of time where mining and milling equipment would operate to accomplish backfilling. This operational noise could affect terrestrial wildlife within 1 to 2 miles of the Project, as with the Proposed Action. It is possible, although unlikely, that this increase in operational machinery within the Project footprint could result in additional wildlife-vehicle collisions, as well. Fencing around the facilities would exclude large mammals from this impact, but birds and small mammals may still be impacted.

Smith River Assessment

The AMA modifications would result in impacts similar to those described for the Proposed Action. Noise levels from the Project during operations under the AMA are expected to attenuate to ambient levels within 1 to 2 miles of the disturbance. As such, wildlife species near the Smith River would not be affected by noise from the Project.

3.16. AQUATIC BIOLOGY

The proposed Project area (the MOP Application Boundary of approximately 1,888 acres) encompasses part of the Sheep Creek drainage. Waterbodies in the proposed aquatic assessment area include Sheep Creek and its tributaries, Little Sheep Creek, Brush Creek, and Coon Creek, which provide a variety of habitats for fish and aquatic macroinvertebrates. This section describes the existing conditions of the fish, aquatic macroinvertebrate, and periphyton communities associated with waterbodies found in the Sheep Creek watershed, and the potential environmental consequences of the Proposed Action.

Sheep Creek is a high-quality fifth order stream and a tributary to the Smith River (Tintina 2017). Sheep Creek is approximately 36 miles long and has a total watershed area of roughly 194 square miles. The aquatic baseline assessment area near the Project is within the Sheep Creek drainage basin and approximately 19 river miles above the confluence with the Smith River, which is a popular destination for recreational anglers, rafters, and boaters. The Sheep Creek watershed upstream from the Project area drains approximately 78 square miles and is located approximately 15 miles north of White Sulphur Springs, Montana.

3.16.1. Analysis Methods

Baseline sampling reaches were established in the Sheep Creek and Little Sheep Creek basins upstream and downstream of the proposed mine activity drainage corridor (Project area) from 2014 to 2017 (see **Figure 3.16-1**) (Stagliano 2018a). The survey locations are arranged in consideration of a Before, After, Control (upstream and offsite reference), and Impact (within and downstream) (BACI) sampling design (see **Table 3.16-1**) in relation to proposed mine activity. This could allow the data to be analyzed using both univariate and multivariate statistical methods between years, streams, treatments, and stations. Tenderfoot Creek, located north of the Project area and Sheep Creek watershed, was chosen as the offsite control reach; the creek is a 40-mile-long tributary to the Smith River that has a total watershed area of 108 square miles.

The watershed areas upstream of the Sheep Creek assessment area and Tenderfoot Creek reference reaches are nearly identical in size, approximately 78 square miles each (see **Figure 3.16-1**). Eight mainstem reaches in Sheep and Tenderfoot creeks, and three tributary reaches in Little Sheep Creek (two reaches) and Coon Creek (one reach) were visited seasonally (see **Figure 3.16-1** and **Table 3.16-1**). Moose Creek, an 11-mile-long tributary to Sheep Creek, was added to the monitoring plan in 2017, and fish population estimates and redd counts were performed in fall 2017. In spring and summer of 2017, Brush Creek, a tributary to Little Sheep Creek, was sampled approximately 40 meters upstream and downstream of the proposed mine access road in the spring and summer.

Seasonal baseline surveys of fish, macroinvertebrates, periphyton, and stream habitat were conducted on similar dates along the same designated reaches of Sheep, Little Sheep, and Tenderfoot creeks from 2014 to 2017, and are summarized below as referenced from Stagliano

(2015, 2017a, 2018a). No fish were captured at Coon Creek in 2014 or 2015, so this tributary was only sampled for macroinvertebrates in 2016 and 2017.

Seventy-three seasonal fish survey events, 96 macroinvertebrate survey events, and 30 periphyton survey events occurred from 12 established monitoring stream reaches from 2014 to 2017.

Prior to the baseline surveys, no standardized biological sampling or monitoring had been conducted within the assessment area of Sheep Creek (Stagliano 2018a). These baseline aquatic surveys (Stagliano 2015, 2017a, 2018a), which are summarized below, were the primary sources used to determine the fish, macroinvertebrate, and periphyton distribution in the assessment area; however, literature and database searches were also conducted (see Section 3.16.1.1, Literature and Database Surveys).

Methods for the habitat assessments and aquatic community surveys used in the baseline surveys are summarized below. Refer to Stagliano (2015, 2017a, 2018a) for more specific methodology.

3.16.1.1. Literature and Database Surveys

The FWP Fisheries Information System Database (FWP 2014), the MTNHP database (MTNHP and FWP 2017), and the Montana DEQ's ecological database application (DEQ 2017a) were the primary sources used to determine the potential presence and distribution of aquatic species in the analysis area. Additionally, information pertaining to federally listed threatened and endangered aquatic species was obtained from the U.S. Fish and Wildlife Service county list (USFWS 2017).

3.16.1.2. Habitat Data

Baseline sampling reaches were established in the Sheep Creek and Little Sheep Creek basins upstream and downstream of the proposed mine activity drainage corridor (Project area) in 2014, 2015, 2016, and 2017. During the 2014 to 2017 baseline surveys, biological community integrity was calculated using impairment metrics known to be affected by water and habitat quality. Physical habitat was evaluated by dividing the stream biological assessment reach into ten equally spaced transects according to Environmental Monitoring and Assessment Protocols followed by DEQ (Lazorchak et al. 1998; DEQ 2012). Stream gradients were estimated using the difference in the upper and lower Global Positioning System elevations of individual reaches and dividing by the reach length. Onsite habitat assessments were conducted using the rapid assessment protocol developed for the Bureau of Land Management by the National Aquatic Assessment Team (scores 0 to 24) (BLM 2008). The process for determining Proper Functioning Condition (PFC) followed Pritchard et al. (1993). Basic water quality parameters (temperature, total dissolved solids, pH, and conductivity) were recorded prior to biological sampling. Water quality of the streams and creeks in the Project area are discussed in Section 3.5, Surface Water Hydrology). Sites ranking higher using these protocols were determined to have higher quality habitat at the local reach scale.

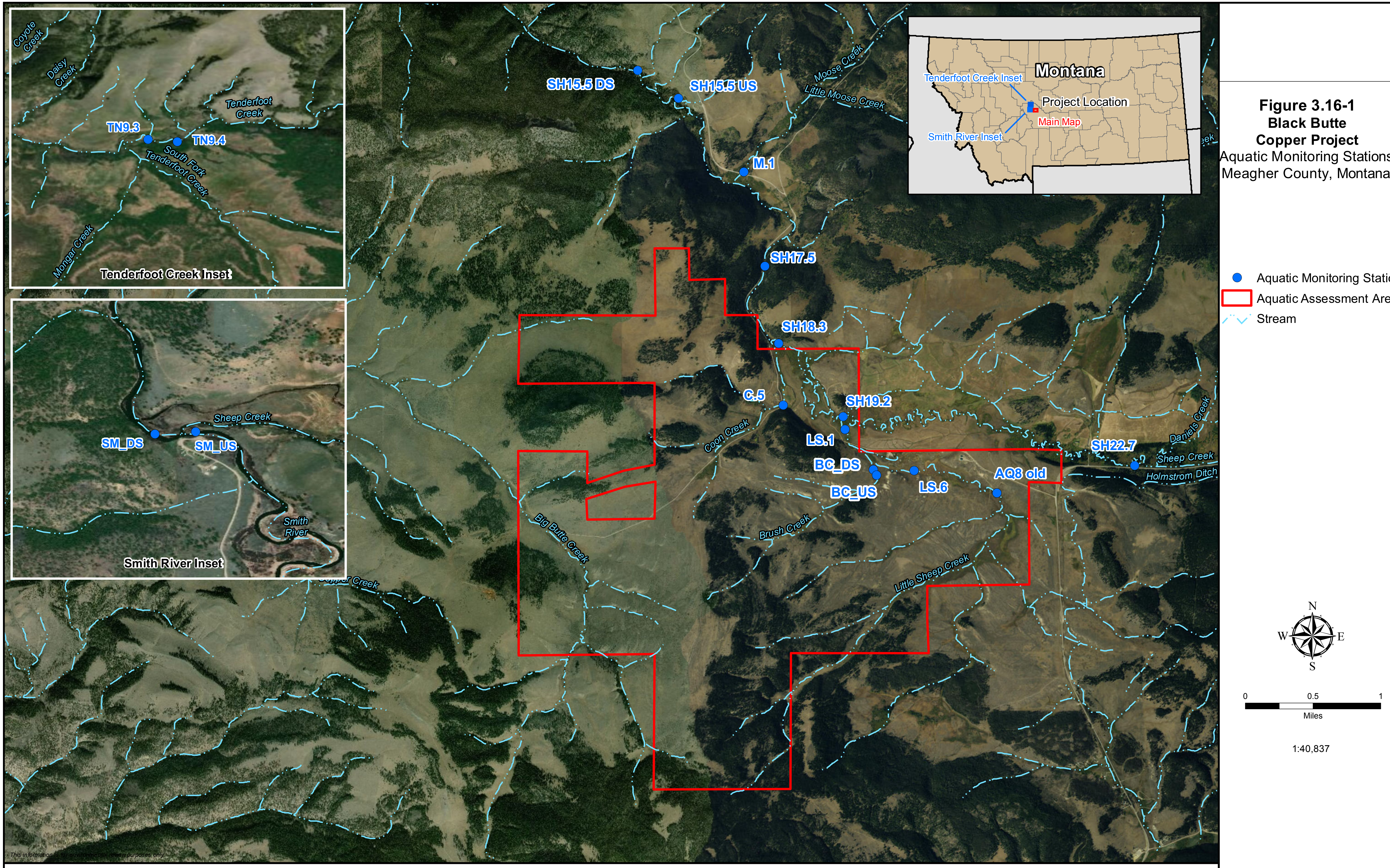

Figure 3.16-1
Black Butte Copper Project
Aquatic Monitoring Stations
Meagher County, Montana
Aquatic Monitoring Station
Aquatic Assessment Area
Stream
N
S
E
W
0
0.5
1
Miles
1:40,837
Montana
Tenderfoot Creek Inset
Project Location
Main Map
Smith River Inset
Coyote Creek
Daisy Creek
Tenderfoot Creek
TN9.3
TN9.4
South Fork Tenderfoot Creek
Mongar Creek
Tenderfoot Creek Inset
Sheep Creek
SM_DS
SM_US
Smith River
Smith River Inset
SH15.5 DS
SH15.5 US
Moose Creek
Little Moose Creek
M.1
SH17.5
SH18.3
C.5
SH19.2
LS.1
Coon Creek
BC_DS
BC_US
LS.6
AQ8 old
SH22.7
Daniels Creek
Sheep Creek
Holmstrom Ditch
Brush Creek
Big Butte Creek
Little Sheep Creek
Copper Creek
FILE: M:\Clients\M-O\MTDEQ\BlackBute_Copper_ArcGIS\2017\12\Aquatics_MTDEQ_Black_Butte_Aquatics_Sampling.mxd | REVISED: 02/13/2019 | SCALE: 1:40,837 when printed at 11x17
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Table 3.16-1
Aquatic Monitoring Station Locations at the Downstream and Upstream Ends of the Assessment Reach

Site RM Code [a]	Old Site Code [a]	Station Name [b]	BACI Type	Avg WW (m) [c]	Reach Length (m)	Latitude	Longitude	Elev. (m)	Location Comment
SH22.7	SHEEP AQ2	Sheep Cr. @ SW2 (D/S) Sheep Cr. @ SW2 (U/S)	Control	8.2	320	46.771973 46.771977	-110.853445 -110.851741	1,743	Upstream of Castle Mtn Ranch off U.S. 89
SH19.2	SHEEP AQ3	Sheep Cr. (D/S) Sheep Cr. (U/S)	Control	9.0	360	46.777247 46.777667	-110.898818 -110.898003	1,716	Hansen Meadow Reach U/S of L. Sheep Cr.
SH18.3	SHEEP AQ4	Sheep Cr. (D/S) Sheep Cr. (U/S)	Impact	8.0	320	46.785116 46.784465	-110.908826 -110.906504	1,706	Lower Meadow Reach on the Forest Service boundary
SH17.5	SHEEP AQ1	Sheep Cr. @ SW1 (D/S) Sheep Cr. @ SW1 (U/S)	Impact	15.0	600	46.795122 46.793008	-110.910367 -110.911062	1,697	Downstream Canyon Reach on Forest Service land
SH15.5 DS SH15.5 US	SHEEP AQ10, 11	Sheep Cr. (D/S) Sheep Cr. (U/S)	Impact	15.7	~1,000	46.81598 46.81112	-110.94058 -110.92398	1,652	Fishing access site (2 miles D/S of AQ1) D/S to the Davis Ranch
SH.1	NA	Sheep Cr. (D/S) Sheep Cr. (U/S)	Impact	16.0	150	46.804281 46.804404	-111.182992 -111.180809	1,320	New monitoring reach 0.1 mile U/S confluence
MO.1	NA	Moose Creek (D/S) Moose Creek (U/S)	Control/ Reference	5.2	210	46.803451 46.804935	-110.914155 -110.91313	1,661	New monitoring reach 0.1 mile U/S confluence
TN9.3	TEND AQ5	Tenderfoot Cr. (D/S) Tenderfoot Cr. (U/S)	Control/ Reference	10.0	400	46.95049 46.95077	-111.14739 -111.14447	1,435	Lower reach at South Fork Tenderfoot confluence
TN9.4	TEND AQ6	Tenderfoot Cr. (D/S) Tenderfoot Cr. (U/S)	Control/ Reference	10.2	410	46.95018 46.95032	-111.14362 -111.14365	1,438	Upper reach U/S of Forest Service boundary
LS.1	LSHEEP AQ7	Little Sheep Cr. (D/S) Little Sheep Cr. (U/S)	Impact	2.1	150	46.775038 46.775897	-110.89779 -110.89849	1,718	500 meters D/S of County Road culvert and proposed mine access road

Site RM Code [a]	Old Site Code [a]	Station Name [b]	BACI Type	Avg WW (m) [c]	Reach Length (m)	Latitude	Longitude	Elev. (m)	Location Comment
LS.6	LSHEEP AQ8	L. Sheep Cr. D/S SW8 (D/S) L. Sheep Cr. D/S SW8 (U/S)	Control	1.5	150	46.77145 46.77147	-110.88644 -110.8878	1,728	100 meters U/S of the future proposed mine access road culvert
C.5	COON AQ9	Coon Cr. @ SW3 (D/S)	Impact	0.5	150	46.77871	-110.90834	1,708	Upstream of County Road culvert at SW3 site
SM_DS SM_US	SMITH	Smith River D/S Sheep Cr. Smith River U/S Sheep Cr.	Impact Control	20.0	150	46.804 46.8041	-111.1841 -111.1824	1,316	D/S and U/S of the Sheep Cr. confluence
BC_DS BC_US	NA	Brush Creek	Impact	NR	80	46.77159 46.770987	-110.894071 -110.893572	NR	Spot-sampling upstream and downstream of the proposed haul road culvert

Source: Stagliano 2018a

Avg = average; BACI = Before, After, Control (upstream and offsite reference), and Impact (within and downstream); Cr. = Creek; D/S = downstream; L = Little; m = meters; Mtn = mountain; NA = not applicable; NR = not reported; RM = river mile; U/S = upstream; WW = wetted width

Notes:

[a] Site codes are based on river miles. Old Site Codes are used in Stagliano (2015, 2017a) and are included for reference.

[b] Station names denoted with SW are associated with Hydrometrics surface water monitoring sites.

[c] Average channel wetted width (WW) was measured at four reaches during summer base flows.

3.16.1.3. Fish Population Data

Only two previous trout population estimates from 1973 and 1992 are available for the assessment area at the upstream Sheep Creek control site (SH22.7; FWP 2014). During the 2014 to 2017 baseline surveys, six reaches of Sheep Creek, two reaches on Little Sheep Creek, and two reaches of Tenderfoot Creek were sampled using backpack electrofishing equipment. In fall 2017, Moose Creek was also sampled using this method. In 2014 and 2015, each reach was divided into two 60- or 90-meter sections separated by shallow riffles and block seines. In 2016 and 2017, these reach lengths were extended to at least 150 meters (Little Sheep) and 300 to 400 meters (Sheep and Tenderfoot creeks).

Each fish collected was identified to species, weighed (grams), and measured (total length in millimeters), and random trout in the study were fin-clipped on the upper caudal fin to establish a section recapture percentage for reach fidelity. Young-of-the-year fish less than 30 millimeters were noted on the field sheet if species could be determined, and then immediately released to prevent mortality. All salmonids captured during the 2016 and 2017 surveys were scanned for passive integrated transponders (PIT tags) that are part of a Montana State University and Montana FWP fish movement study, and tag numbers were recorded with the other biometric data of the fish. Fish population estimates for 2016 and 2017 were calculated using an iterative process (Two Pass depletion estimates) to incorporate a maximum likelihood population estimate (Stagliano 2018a).

3.16.1.4. Metals in Fish Tissue

Metals analyses of Rocky Mountain sculpin and juvenile salmonid tissue collected from two sites downstream and two sites upstream of the assessment area were conducted in 2016 and 2017. The homogenized whole-fish tissue samples were analyzed to determine cadmium, copper, iron, lead, manganese, mercury, selenium, and zinc concentrations (reported as milligrams per kilogram) (Stagliano 2018a).

3.16.1.5. Redd Counts

During the 2014 to 2017 aquatic baseline surveys, redd count surveys were completed in the fall for brown trout for all Sheep Creek and Little Sheep Creek reaches during the last week of October using methods outlined in Thurow et al. (2012). In 2017, a redd count survey was also conducted at the Moose Creek station (MO.1). Within the assessment area, approximately 4,500 meters of stream channel in 2016 and 4,900 meters in 2017 were evaluated for the presence of trout spawning redds during the last week in October. Different salmonid species' redds were identified based on size, visibly identifying fish on redds, or habitat selection preferences between brown and brook trout. Brook trout prefer redd sites in areas of groundwater seepage typically where mean stream velocities are approximately 18 cm/second. Average geometric mean sediment size of brook trout redds is significantly smaller than that of brown trout redds (5.7 mm versus 6.9 mm; $P < 0.02$), but less well sorted. Brown trout favor faster water velocities (mean 46.7 cm/second) and coarser substrates (Witzel and Maccrimmon 1983).

3.16.1.6. Freshwater Mussel Data

In 2014, surveys were conducted at all eight original monitoring sites for the western pearlshell mussel (*Margaritifera falcata*), a Montana SOC and Forest Service sensitive species. No evidence of current or historical presence was observed (Stagliano 2015). In the summer of 2016, the two newly added Sheep Creek reaches (SH15.5U and SH15.5D) were surveyed using the same longitudinal transect survey techniques as in 2014. No evidence of current or historical presence was observed (Stagliano 2018a).

3.16.1.7. Macroinvertebrate Population Data

In 2016, quantitative macroinvertebrate Hess sampling was conducted within the DEQ-recommended range for the DEQ sampling time frame (June 21 to September 30) at one riffle reach from all monitoring sites and processed according to DEQ protocols (DEQ 2012; see **Figure 3.16-1**). Three Hess samples were taken at each reach. Macroinvertebrate communities were also sampled with a dip net from each of the ten equally spaced transects within the assessment reach using the Environmental Monitoring and Assessment Protocol's, Reach-Wide protocol (BLM 2008; Lazorchak et al. 1998). Sorting, identification, and data analysis of the samples was conducted at the Montana Biological Survey laboratory in Helena, Montana.

Macroinvertebrates were identified to the lowest taxonomic level (DEQ 2012), counted, and imported into the Ecological Data Application System, which provides metric values that are used to infer the health of the macroinvertebrate community. The biological metrics were calculated from the Ecological Data Application System data using DEQ's multi-metric indices (MMI) protocols (Feldman 2006; DEQ 2012). Metric results were scored using the DEQ bioassessment criteria and each sample categorized as nonimpaired or impaired according to threshold values. The impairment threshold set by the DEQ's MMI protocols is 63 on a 100-point scale for the Mountain Stream Index; thus, any scores above this threshold are considered unimpaired (DEQ 2012; Feldman 2006).

The Hilsenhoff Biotic Index (HBI), which measures the pollution tolerance for various benthic macroinvertebrate families, was also analyzed. HBI tolerance values are based on a 0 to 10 scale, where 0-ranked taxa are most sensitive and 10-ranked taxa are most tolerant to pollutants. For Montana surface waters, an HBI score of 4.0 should be used as the threshold (i.e., maximum allowable value) to prevent impacts on fish and associated aquatic life uses (DEQ 2016; DEQ 2012). HBI values of 0 to 3.0 in mountain streams indicate no organic pollution (excellent conditions), and values of 3.0 to 4.0 indicate slight organic pollution (very good) (Stagliano 2018a). Increased sedimentation also results in higher HBI values (DEQ 2012).

In 2016, the Upper Missouri Watershed Alliance (UMOWA) began the Smith River Baseline Macroinvertebrate Monitoring program. This study established eight monitoring sites along the Smith River, two of which (SM_DS and SM_US) are proposed aquatic monitoring locations for the Project (Stagliano 2017c) for sampling benthic macroinvertebrates between Fort Logan and Eden Bridge. The sampling methods were consistent with those outlined above and relevant monitoring data from 2016 and 2017 (Stagliano 2017d, Stagliano 2018b) was included in Section 3.16.2.5, Macroinvertebrate Communities.

3.16.1.8. Periphyton Population Data

During the 2014 to 2017 aquatic baseline surveys, periphyton communities were sampled semi-quantitatively from each of the ten transects within the assessment reach using the Sample Collection and Laboratory Analysis of Chlorophyll-*a* Standard Operation Procedure (DEQ 2011a) and using the Periphyton Standard Operating Procedure (DEQ 2011b). Summer periphyton samples were collected within the DEQ-recommended range for the DEQ sampling time frame (June 21 to September 30) (DEQ 2012). The periphyton samples were processed by Rhithron Associates, Inc. in Missoula, Montana. Periphyton biointegrity metrics were generated and interpreted according to Teply and Bahls (2006).

3.16.2. Affected Environment

Twelve stream reaches in the assessment area were evaluated between 2014 and 2017. Aquatic Ecological Systems (AESs) are stream systems within a drainage area that have similar geomorphology and environmental processes (e.g., hydrologic, geologic, nutrient, and temperature regimes) (Groves et al. 2002). Standard attributes used to classify AESs are defined in Higgins et al. (2005) and include stream size, gradient, connectivity to other waterbodies and underlying lithology. Using this system, eight mainstem stream reaches on Sheep Creek (six sites) and Tenderfoot Creek (two sites) were classified as Mountain Streams (C003), Moose Creek was classified as a Small Forested Mountain Stream (D003), and two tributary reaches on Little Sheep and the reach on Coon Creek were classified as Headwater Stream (D001) systems (see **Table 3.16-1**) (Stagliano 2018a). Upstream of the Coon Creek sampling location (C.5), Coon Creek is currently diverted into a ditch from its original stream channel as it enters the Sheep Creek alluvial valley. Coon Creek flows through the ditch for approximately 2,586 feet before returning to its natural channel approximately 650 feet upstream of its confluence with Sheep Creek (Hydrometrics 2018b; see Sheet 1 in Hydrometrics).

Stream flows at most Sheep Creek sites during the spring sampling periods of 2015, 2016, and 2017 have been above optimal levels for efficient electrofishing, so population estimates during these periods are considered qualitative estimates of salmonid abundance. There are no USGS streamflow gages on any streams in or near the Project area to consult; however, stream flow data was collected by Hydrometrics, Inc. (Hydrometrics 2017; see **Table 3.16-2**). The study is included as Appendix V-1 of the MOP Application (Tintina 2017). According to the study, from 2015 to 2017, spring runoff began10 to 14 days earlier than the 30-year historical flow average, and the runoff conditions persist until mid-June. Flows recorded at Sheep, Little Sheep, and Coon creeks during the dates closest to the seasonal sampling events are presented in **Table 3.16-2**. Annual average stream flows for Sheep Creek have declined since the high flows of 2014 (Stagliano 2018a). For additional information on stream hydrology, see Section 3.5, Surface Water Hydrology.

Table 3.16-2
Stream Discharge Reported at Four Surface Water Quality Stations and Associated Aquatic Monitoring Reaches in the Project Area, 2014–2017

		2014 (cfs)		2015 (cfs)		2016 (cfs)				2017 (cfs)			
		Summer	Fall	Spring	Summer	Spring	Summer	Fall	Fall	Spring	Summer	Fall	Fall
Site	Stream	8/21/14	9/3/14	4/29/15	6/25/15	4/29/16	7/14/16	9/20/16	10/22/16	4/23/17	7/17/17	9/11/17	10/17/17
SH17.5/SW1	Sheep Creek	25	22	103	47	84.2	17.2	19.7	22.2	40.6	18.9	10.7	17.5
SH22.7/SW2	Sheep Creek	19.3	17	82.2	36	68	9.2	16.7	18.5	31.3	14.6	6.8	13.7
LS.6/SW8	Little Sheep	0.5	0.6	1	0.7	0.7	0.5	0.2	0.2	0.8	0.5	0.1	0.1
C.5/SW3	Coon Creek	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	<0.1	0.2	0.2

Source: Stagliano 2018a

C = Coon Creek; cfs = cubic feet per second; LS = Little Sheep Creek; SH = Sheep Creek

3.16.2.1. Aquatic Special Status Species

No federally or state-listed threatened or endangered aquatic special status species were found in the Project area during surveys. According to available data, two state-listed SOC are known to occur in the general vicinity of the assessment area. The western pearlshell mussel (*Margaritifera falcate*), which is also a Forest Service sensitive species, was not observed during the 2014 or 2016 surveys performed in the assessment area. The last documented live mussel of this species in the Smith River basin was reported at Fort Logan bridge (Highway 360) in 2011 (Stagliano 2018a).

The westslope cutthroat trout (*Oncorhynchus clarkii lewisi*) is reported to occur in the Project area in Sheep Creek (MTNHP and FWP 2017), but there are no documented occurrences. Pure westslope cutthroat trout have been documented in Daniels Creek and Jumping Creek, upstream tributaries to Sheep Creek (FWP 2014), so pure westslope cutthroat trout could potentially be in the Project area at low densities. While no westslope cutthroat trout were documented during any of the Sheep Creek surveys between 2014 and 2017, a fish was collected from Tenderfoot Creek in 2017 that had characteristics/genetics indicating it was greater than 90 percent pure westslope cutthroat trout. Westslope cutthroat trout (>90 percent pure) are documented to occur about 6.8 miles upstream of the Tenderfoot Creek reference reach, TN9.4, and in the South Fork Tenderfoot Creek, which enters the Tenderfoot near reach TN9.3 (FWP 2014). Only rainbow/cutthroat hybrids were collected at the Sheep Creek sites during the 2014 to 2017 baseline surveys. Genetic testing to determine if any of the rainbow/cutthroat hybrids in Sheep Creek are at least 90 percent pure was not conducted (Stagliano 2018a).

3.16.2.2. Habitat Evaluations

During the 2014 to 2017 baseline surveys, six of the 12 sampling reaches evaluated in the assessment area were found to be in PFC with a stable trend and 6 were Functional at Risk. The sites ranked Functional at Risk had riparian habitat altered recently or historically by cattle (LS.1, LS.6, SH22.7, SH15.5U, MO.1, and TN9.3), or by human stream encroachment or manipulation (SH17.5 and SH22.7). The highest site integrity scores using both the Bureau of Land Management Habitat and PFC assessment methods were recorded at the Sheep Creek meadow reaches (SH19.2 and SH18.3), SH15.5DS, and the Tenderfoot Creek site (TN9.4). Lower habitat scores were reported for sites that were structurally degraded by cattle and had high associated livestock use indices (LS.6, SH22.7, and TN9.3) (Stagliano 2018a).

The stream reach habitat features mapping performed in 2014 found that Sheep Creek and Tenderfoot Creek can be classified broadly as Rosgen Type C, based on reach gradient, stream geomorphology, and bottom substrate characteristics. Little Sheep Creek has characteristics of Type E and F classes, being moderately entrenched at LS.6 and some sections of LS.1. Coon Creek has morphologic characteristics of a Type F channel (Rosgen 1996).

Type C channels are characterized as moderately sinuous (meandering), having a mild slope and a well-developed floodplain, and being fairly shallow relative to their width. Type E channels are similar to Type C, except they tend to be more sinuous and deeper relative to their width. Type F channels are also similar to Type C, except they are more entrenched with very high channel width to depth ratios at the bankfull stage. Type F channels can have high bank erosion rates and are often a failed or failing Type C channel. Stream habitat morphology is dominated by riffles and runs at all sites and Tenderfoot Creek sites had slightly more pool area than the Sheep Creek sites overall.

3.16.2.3. Fish Communities

Nine fish species and one hybrid were identified from more than 14,000 fish collected and handled during the 73 seasonal stream reach surveys conducted between 2014 and 2017. In 2016 and 2017, 5,031 and 6,177 individuals were collected, respectively. The higher number in 2017 (over 1,100 more individuals than in 2016) was attributed to the addition of the new Moose Creek site and lengthened fish sampling reaches. In 2014 and 2015, each reach was divided into two 60- or 90-meter sections separated by shallow riffles and block seines. In 2016 and 2017, the reach lengths were extended to at least 150 meters (Little Sheep) and 300 to 400 meters (Sheep and Tenderfoot Creeks). The Moose Creek reach length was 210 meters (Stagliano 2018a). Abundance and diversity of taxa among the 2014 to 2017 aquatic monitoring sampling locations were indicative of mountain streams populated by typical species, including mountain whitefish, Rocky Mountain sculpin, and longnose dace, in addition to gamefish such as brook trout, brown trout, and rainbow trout (see **Table 3.16-3**). The presence of two or more sensitive or intermediate species in each of these monitoring locations is one indication that quality habitat is present at these sites (see **Table 3.16-3**).

Rocky Mountain sculpin were present at all sites (100 percent site occupancy), comprised the highest proportion of total individuals collected (74 percent), and usually were the most abundant fish species captured (see **Figure 3.16-2**, **Figure 3.16-3**, and **Figure 3.16-4**). Tenderfoot Creek had the highest percentage of Rocky Mountain sculpin comprising the catch (80 percent) due to their high abundance. The other native species, mountain whitefish, longnose dace, white sucker, and mountain sucker had site occupancy rates of 52, 12, 12, and 1 percent, respectively (Stagliano 2018a). Rainbow trout was usually the most abundant salmonid present (see **Figure 3.16-5**) and the average densities in the Sheep Creek downstream impact sites (n=4) was higher (168 per mile ± 60 standard error) than the control sites (n=2) (85 per mile ± 35 standard error). In 2017, Sheep Creek monitoring locations SH19.2 and SH15.5DS had the highest species diversity with eight species recorded at each location (see **Table 3.16-3**).

Approximately 10 percent of the brook trout and rainbow trout documented in Little Sheep Creek in 2016 were affected by opercula erosion, a condition that can be caused by bacterial gill disease and results in swollen gills and the gill cover eroding away. While a definitive cause of opercula erosion has not been determined, when found in wild fish it is often an indication of organic loading into streams (Stagliano 2018a). The number of brook trout affected at LS.1 increased to approximately 17 percent in 2017. Based on macroinvertebrate and periphyton metrics (see Section 3.16.2.5, Macroinvertebrate Communities, and Section 3.16.2.6, Periphyton Communities), nutrient loading is still occurring in Little Sheep Creek although conditions may be improving (Stagliano 2018a).

During spot sampling of Brush Creek in spring 2017, three brook trout were collected within approximately 131 feet (40 meters) upstream of the proposed mine access road culvert. No fish were collected from this reach in the summer although water was present (Stagliano 2018a). During sampling of Little Sheep Creek (LS.6) in spring 2017, 6 brook trout and 30 sculpin were collected. No brook trout and 67 sculpin were collected in this reach in the summer. Because this reach had extremely low flows, warm water temperatures (21.5°C), and aquatic vegetation filling the channel, it is likely that the brook trout migrated out of the reach to more suitable habitat.

In fall 2017, the Moose Creek station (MO.1) was sampled for the first time and five fish species were captured (see **Table 3.16-3**). Salmonid population estimates for Moose Creek were 1,004 trout per mile, which is approximately three times more abundant than adjacent Sheep Creek estimates (Stagliano 2018a). As described above, in 2017 the reach lengths in Sheep Creek were between 300 to 400 meters and the reach length of Moose Creek was 210 meters. Fish population estimates were reported as numbers per unit distance (per section or per stream mile) based on Two Pass depletion estimates averaged between the two sampled section units per reach (Stagliano 2018a).

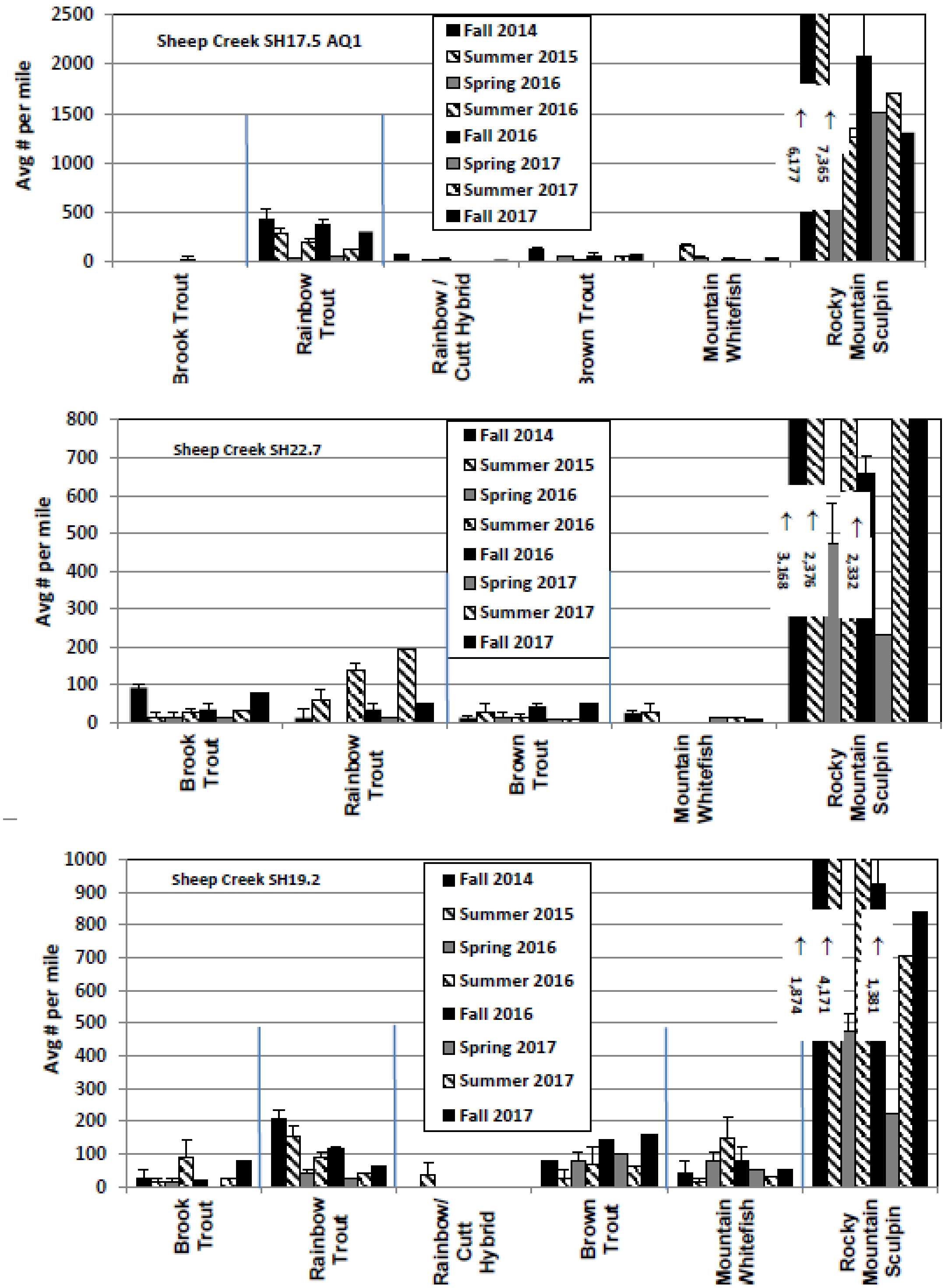
Trout and mountain whitefish were also tagged in the area of the Sheep Creek and Moose Creek confluence. These fish have been detected throughout the Smith River drainage, including in Benton Creek, Birch Creek, Camas Creek, Newlan Creek, Rock Creek, Tenderfoot Creek, and the Smith River from as far upstream as Canyon Ranch (RM 108.7) and as far downstream as Truly Bridge (RM 9.1). These points are the most upstream and most downstream points within the Smith River drainage where attempts have been made to detect fish movements. These data illustrate trout and mountain whitefish throughout the Smith River drainage use Sheep Creek in the vicinity of Moose Creek, and that fish from this area disperse throughout the entire Smith River drainage (DEQ, Pers. Comm., June 21, 2018).

Table 3.16-3
Fish Species Documented in the Black Butte Copper Project Area, 2014–2017

Species	Scientific Name	Trophic	General Tolerance	Origin	Total Length 3 years (mm)	LS.1	LS.6	SH22.7	SH19.2	SH18.3	SH17.5	SH15.5 U/S	SH15.5 D/S	MO.1	TN 9.3/ TN9.4
White sucker	*Catostomus commersonii*	OM	TOL	N	229	X	X	NR	X	X	NR	NR	NR	NR	NR
Mountain sucker	*Catostomus platyrhynchus*	INV	INT	N	102	NR	NR	NR	NR	NR	NR	NR	X	NR	NR
Rocky Mountain sculpin	*Cottus bondii*	INV	INT	N	86	X	X	X	X	X	X	X	X	X	X
Longnose dace	*Rhinichthys cataractae*	INV	INT	N	71	NR	NR	NR	X	X	NR	NR	X	NR	NR
Brook trout	*Salvelinus fontinalis*	INV	S	I	240	X	X	X	X	X	X	X	X	X	X
Brown trout	*Salmo trutta*	INV/C	TOL	I	269	X	NR	X	X	X	X	X	X	X	NR
Rainbow trout	*Oncorhynchus mykiss*	INV	S	I	260	X	NR	X	X	X	X	X	X	X	X
Rainbow trout x westslope cutthroat hybrid	*Oncorhynchus mykiss x clarkii lewisi*	INV	S	I	266	NR	NR	NR	X	NR	X	NR	X	X	X
Westslope cutthroat trout	*Oncorhynchus clarkii lewisi*	INV	S	N	266	NR	NR	NR	NR	NR	NR	NR	NR	NR	X
Mountain whitefish	*Prosopium williamsoni*	INV	INT	N	190	X	NR	X	X	X	X	X	X	NR	NR
Study year						2015-2017	2014-2017	2014-2017	2014, 2016, 2017	2014-2017	2014-2017	2016, 2017	2016, 2017	2017	2014-2017
Number of species observed						6	3	5	8	7	6	5	8	5	5

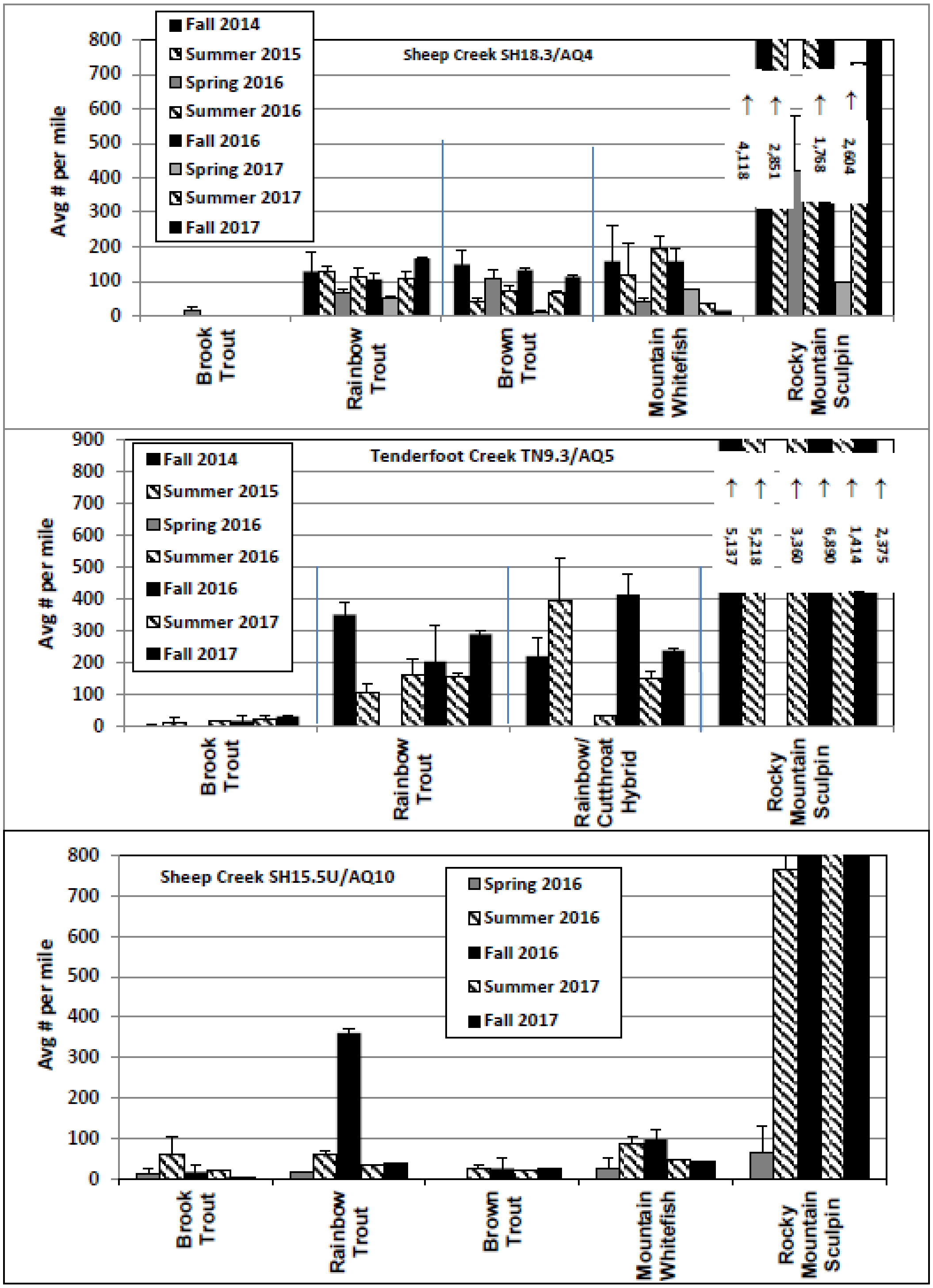
Source: Stagliano 2015, 2017a, 2018a

C = carnivore; D/S = downstream; I=introduced; INT = intermediate; INV = invertivore; LS = Little Sheep Creek; mm = millimeters; N = native; NR = not recorded; OM = omnivore; S = sensitive; SH = Sheep Creek; TOL = tolerant; TN = Tenderfoot Creek; U/S = upstream; X = documented in reach during 2014 to 2017 baseline surveys



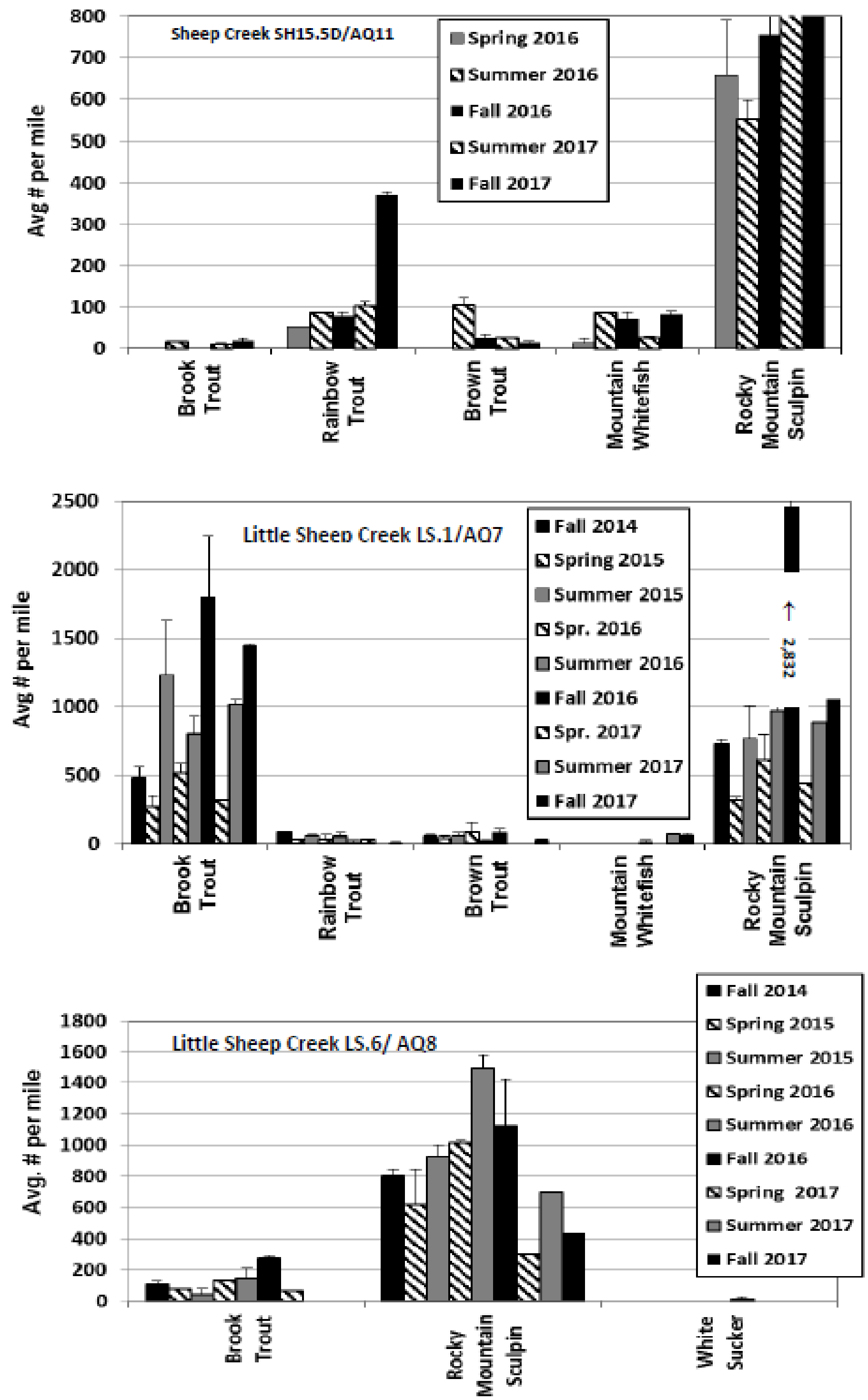
Source: Stagliano 2018a

Figure 3.16-2
Seasonal Average Fish Abundance per Mile with Standard Deviation Error Bars for Project Aquatic Sampling Locations on Sheep Creek SH17.5 (top), SH22.7 (middle), and SH19.2 (bottom)



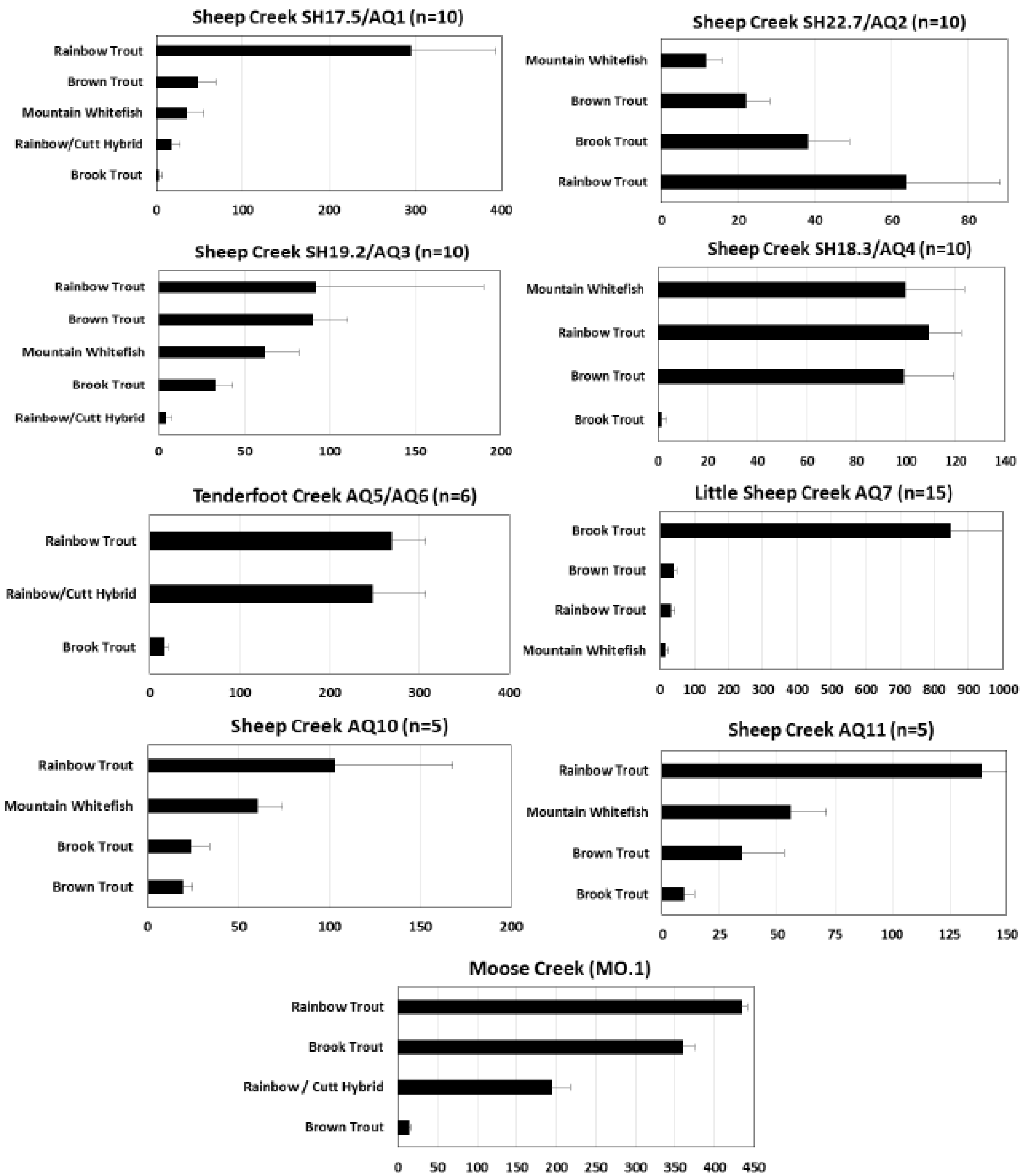
Source: Stagliano 2018a

Figure 3.16-3
Seasonal Average Fish Abundance per Mile with Standard Deviation Error Bars for Project Aquatic Sampling Locations on Sheep Creek SH18.3 (top), Tenderfoot Creek TN9.3 (middle), and Sheep Creek SH15.5US (bottom)



Source: Stagliano 2018a

Figure 3.16-4
Seasonal Average Fish Abundance per Mile with Standard Deviation Error Bars for Project Aquatic Sampling Locations on Sheep Creek SH18.3 (top), Tenderfoot Creek TN9.3 (middle), and Sheep Creek SH15.5US (bottom)



Source: Stagliano 2018a

Figure 3.16-5
Overall Average Salmonid Abundance per Mile with Standard Deviation Error Bars for Sheep, Little Sheep, and Tenderfoot Creek Sampling Locations

During the 2016 aquatic baseline studies, eleven PIT-tagged fish (two recaptures) from the Montana State University/FWP study were captured and released. These were found in Sheep Creek (SH17.5, SH18.3, SH19.2, and SH15.5US) and included five rainbow trout, six mountain whitefish, and one brown trout. The furthest upstream detection of any tagged fish into the Project area was a mountain whitefish captured at Sheep Creek SH19.2 in the summer of 2016. Tagged fish captured at Sheep Creek SH17.5 during the summer 2016 sampling were recently tagged at that location and showed signs of handling stress (i.e., missing scales, poor condition). No PIT-tagged fish were identified at any site during any season in 2017. No PIT-tagged rainbow trout were detected near the Project area during any season; however, given the densities of young year-class rainbow trout and cut-bow hybrids collected in the fall of 2017 (approximately 80 percent were less than 200 mm in length), they are likely using Moose Creek for the majority of spring spawning (Stagliano 2018a).

Trout that enter tributaries in the Project vicinity to spawn usually arrive in April and leave in May (Grisak 2013, FWP 2001).

Metals in Fish

Currently there are no state-wide fish consumption advisories for Montana. However, the FWP, DEQ, and Montana Department of Health and Human Services (2014) have published sport fish consumption guidelines with specific guidelines for some waterbodies. No waterbodies in the Project vicinity, or the Smith River, currently have consumption advisories or specific guidelines. Results of the baseline whole body metal analysis performed on Rocky Mountain sculpin and juvenile salmonids in 2016 and 2017 are presented in **Table 3.16-4**. The reported values for all metals in the fish tissue are below the impairment threshold for Aquatic Life Standards (DEQ 2017b). Mercury was not reported at any site at detectable levels in 2016 or 2017.

Fall Redd Counts

During the last week in October of 2016 and 2017, approximately 2.8 miles and 3.0 miles of stream channel encompassing the Sheep Creek and Little Sheep Creek monitoring sections were surveyed for brook and brown trout redds (see **Figure 3.16-6**). **Figure 3.16-7** shows the average number of redds per 100 meters at sites within the assessment area. The highest number of brown trout redds were reported in 2016 at Sheep Creek sites SH19.2 and SH18.3 and averaged 3.3 and 2.8 per 100 meters, respectively.

Table 3.16-4
Baseline Whole Body Metal Values Downstream and Upstream of the Project Area

Stream Site	Cd (mg/kg)		Cu (mg/kg)		Fe (mg/kg)		Pb (g/kg)		Mn (mg/kg)		Ni (mg/kg)		Se (mg/kg)		Zn (mg/kg)	
	2016	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Sheep SH17.5 (D/S)	N/D	N/D	2	1	204	53	N/D	N/D	8	9	N/D	N/D	1	N/D	25	20
Sheep SH18.3 (D/S)	N/D	N/D	1	1	177	43	N/D	N/D	4	11	N/D	N/D	3	N/D	18	27
Average	NR	NR	**1.5**	**1.0**	**190.5**	**48.0**	NR	NR	**6.0**	**10.0**	NR	NR	**2.0**	**N/D**	**21.5**	**23.5**
Sheep SH22.7 (U/S)	N/D	N/D	1	1	171	24	N/D	N/D	7	6	N/D	N/D	2	N/D	22	20
L. Sheep LS.1 (U/S)	N/D	N/D	1	N/D	275	155	N/D	N/D	8	5	N/D	N/D	2	1	24	23
L. Sheep LS.1 (EBT)	NR	N/D	NR	1	NR	23	NR	N/D	NR	3	NR	N/D	NR	N/D	NR	22
Average	NR	NR	**1.0**	**0.7**	**223.0**	**67.3**	NR	NR	**7.5**	**4.7**	NR	NR	**2.0**	**0.5**	**23.0**	**21.7**
F-test, p-value (C x I)	NR	NR	**0.2**	**0.3**	**0.3**	**0.4**	NR	NR	**0.3**	**<0.1**	NR	NR	**0.5**	**0.3**	**0.4**	**0.3**
F-test, p-value (year)	NR	NR	**0.1**	NR	**<0.1**	NR	NR	NR	**0.5**	NR	NR	NR	**0.1**	NR	**0.5**	NR

Source: Stagliano 2018a

C = control; Cd = cadmium; Cu = copper; D/S = downstream; EBT = juvenile brook trout; Fe = iron; I = impact; L. = Little; mg/kg = milligrams per kilogram; Mn = manganese; N/D = nondetectable at reporting limits; Ni = nickel; NR = not reported; Pb = lead; Se = selenium; U/S = upstream; Zn = zinc

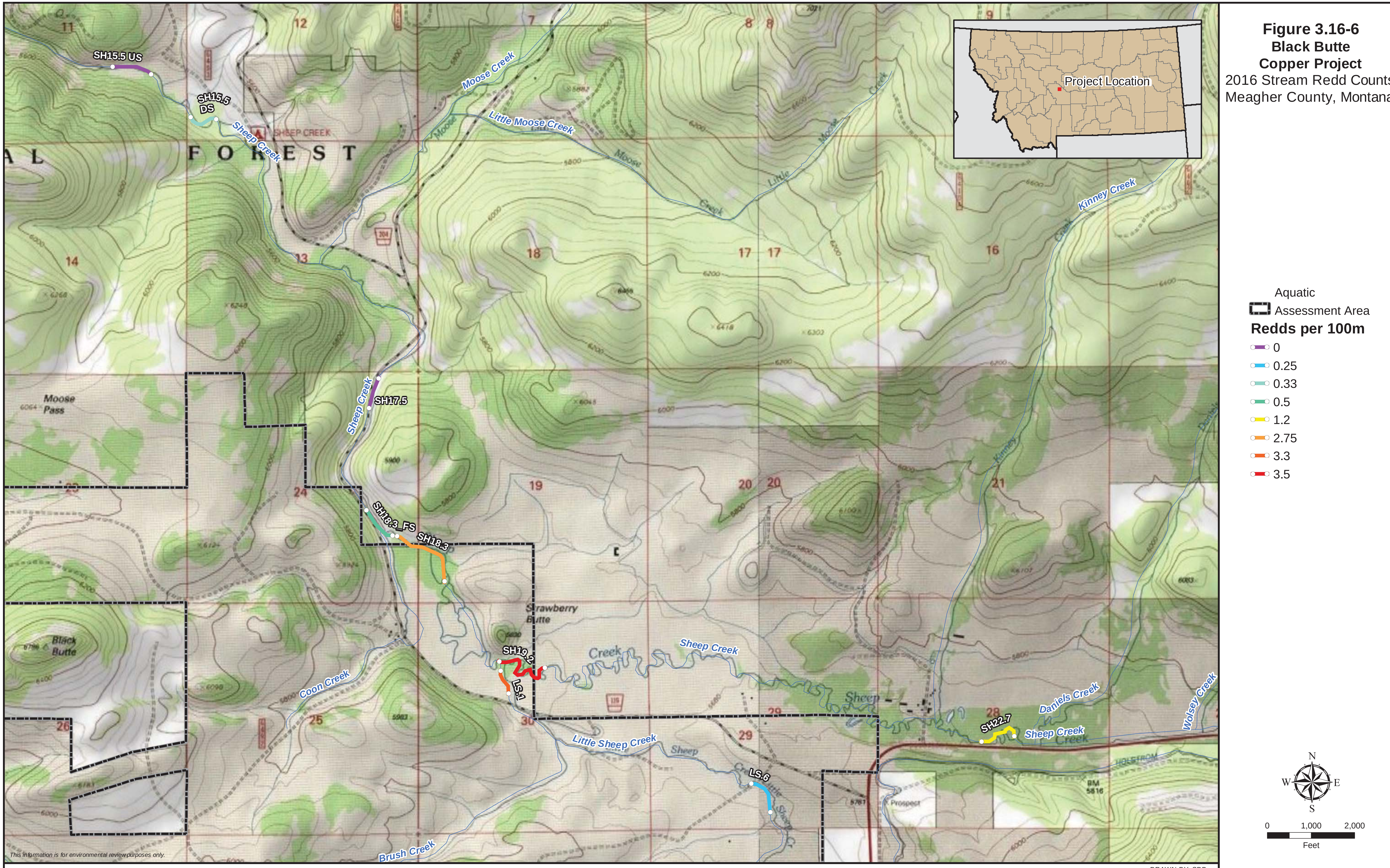


Figure 3.16-6
Black Butte
Copper Project
2016 Stream Redd Counts
Meagher County, Montana
Project Location
Aquatic
Assessment Area
Redds per 100m
0
0.25
0.33
0.5
1.2
2.75
3.3
3.5
SH15.5 US
SH15.5 DS
SH17.5
SH18.3_FS
SH18.3
SH19.2
LS.1
LS.6
SH22.7
Sheep Creek
Moose Creek
Little Moose Creek
Kinney Creek
Daniels Creek
Wolsey Creek
Coon Creek
Little Sheep Creek
Brush Creek
Strawberry Butte
Black Butte
Moose Pass
0 1,000 2,000
Feet
This information is for environmental review purposes only.
FILE: M:\Clients\M-O\MTDEQ\BlackBute_Copper_ArcGIS\2018\06\BBC_Aquatics_Figure_BBC_Aquatics.mxd | REVISED: 09/11/2018 | SCALE: 1:24,000 when printed at 11x17
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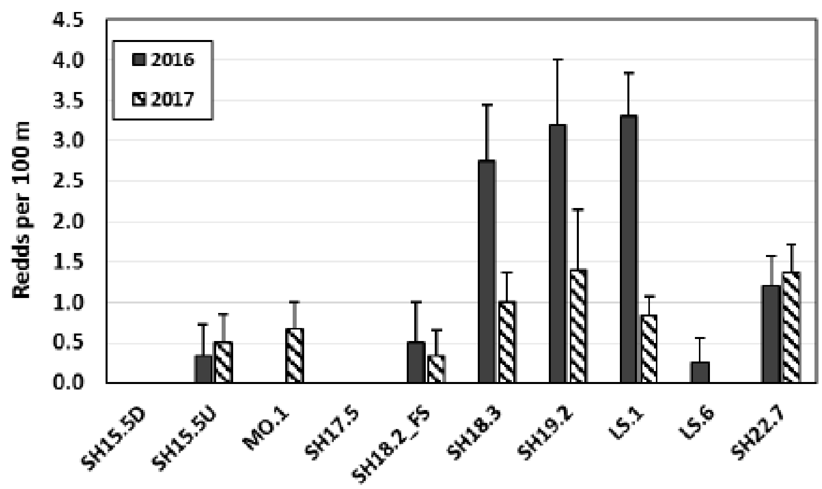
Brook trout redds were identified in areas with lower stream velocity and smaller substrate sizes and averaged 3.3 and 0.25 per 100 meters in 2016 at Little Sheep Creek LS.1 and LS.6, respectively (see **Figure 3.16-7**). In 2017, brook trout redds at LS.1 were less than 1/3 those densities and no redds were observed in LS.6 (see **Figure 3.16-7**). Redd counts of Moose Creek were added in 2017 and contained brook trout redds at densities of 0.67 per 100 meters (see **Figure 3.16-6**).



Source: Stagliano 2018a

Note that sites are arranged from further downstream to upstream of the Project area.

Figure 3.16-7
Average Number of Redds per 100 meters within the Project Area

3.16.2.4. Freshwater Mussel Surveys

During the 2014 and 2016 surveys of Sheep Creek, Little Sheep Creek, and Tenderfoot Creek reaches, no evidence of the western pearlshell mussel was reported. As stated in Section 3.16.2.1, Aquatic Special Status Species, this species is considered extirpated in the Smith River basin (Stagliano 2018a). No further analysis will be done for this species in this EIS.

3.16.2.5. Macroinvertebrate Communities

The 2014 to 2016 aquatic baseline surveys reported 146 macroinvertebrate taxa in the assessment area. No Montana invertebrate SOC was collected. Average macroinvertebrate richness across all sites was 45 taxa, while Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) (EPT) taxa averaged 15 per site. The highest taxa richness (60 species) was reported at SH18.3, while SH22.7 had the highest number of combined EPT (21 species). The results of the baseline analysis indicate that habitats for macroinvertebrate assemblages at the SH22.7 Sheep Creek study sites are comparable to the reference condition mountain stream (Tenderfoot Creek) as the percent of EPT taxa (%EPT) at SH22.7 was similar to the Tenderfoot Creek sites. However, the SH19.2 Sheep Creek control site reported much lower macroinvertebrate MMI scores than the Tenderfoot Creek reference sites (see **Table 3.16-5**).

Streamflow inputs from Sheep Creek and other tributaries in the use-permit canyon affect the Smith River water quantity, quality, and temperatures. Increased densities and diversity of insect communities, especially EPT taxa, have been documented in the Smith River below the tributaries. The Smith River downstream of the Sheep Creek confluence maintains a more cool-water macroinvertebrate community because of the colder water influx. Smith River sites upstream of the Sheep Creek confluence reported lower diversity, biological integrity, and sensitivity of macroinvertebrates than downstream of the confluence (Stagliano 2018b).

In 2016, Smith River locations SM_US and SM_DS reported 20 and 23 EPT, respectively. The 2016 to 2017 cumulative EPT richness for SM_DS was 32 species, which was the second highest reported of all sites in the UMOWA study. The highest average densities were documented in the Smith River downstream of the confluence with Sheep Creek (15,260 individuals per square meter at SM_DS). These are high densities of macroinvertebrates, rivaling nutrient-rich aquatic environments, such as spring creeks or the Missouri River below Holter Dam (Stagliano 2017d). In 2016, the macroinvertebrate densities averaged 3,425 individuals per square meter in Sheep Creek approximately 16 miles upstream from the Smith River (see **Table 3.16-5** and **Figure 3.16-1**).

Tenderfoot Creek reported the highest integrity scores ranked by the DEQ MMI (average 70), while the Sheep Creek sites averaged 61.6, which is ranked slightly impaired by DEQ thresholds (Stagliano 2018a).

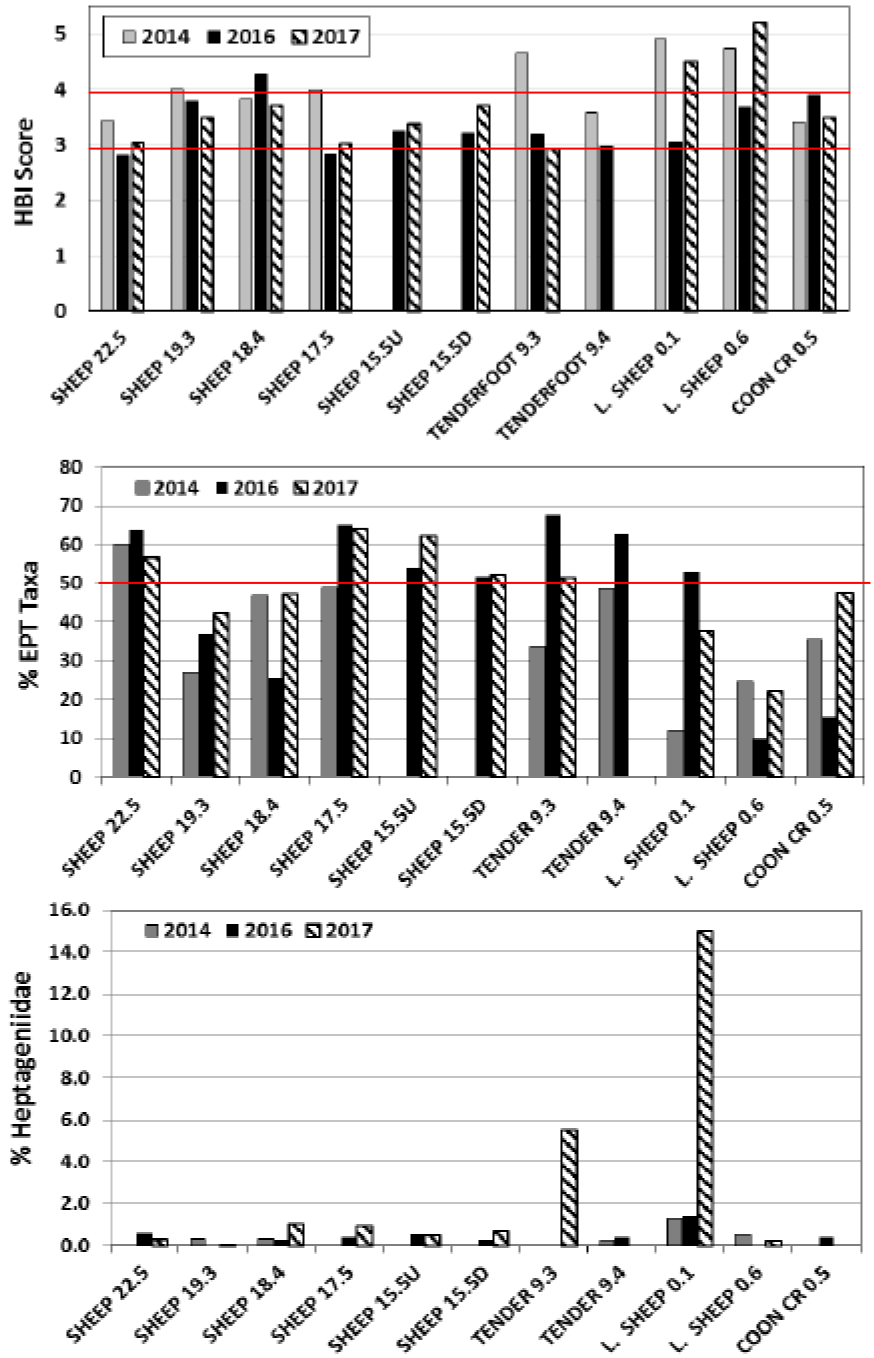
The HBI scores averaged across all sites were 4.1, 3.4, and 3.65 in 2014, 2016, and 2017, respectively. These scores are slightly impaired for mountain streams (>3 to 4), indicating probable nutrient, sedimentation, or other organic impairment to all sites (Stagliano 2018a; DEQ 2016; DEQ 2012). However, from 2014 to 2017, the HBI scores have decreased at four sites, including SH17.5, SH22.7, TN9.3, TN9.4, and a steady improvement at site SH19.2 (see **Figure 3.16-8**). Little Sheep Creek sites LS.1 and LS.6 were the only sites in 2017 reporting moderate organic pollution with HBI scores of greater than 4 (see **Figure 3.16-8**). Annual average stream flows for Sheep Creek have been declining since the high flows of 2014 (**see Table 3.16-2**) (Stagliano 2018a), and this could be contributing to organic impairments.

Low numbers of the mayfly family, Heptageniidae, were present across the Sheep Creek sites between 2014 and 2017. Tenderfoot Creek TN9.3 and Little Sheep LS.1 reported the highest percentages of Heptageniidae in 2017 (see **Figure 3.16-8**). One of the factors that influence the absence or decreased abundance of Heptageniidae has been shown to be a measure of a community’s sensitivity to heavy metal impacts (Winner et al. 1980; Clements 1991; Nelson and Roline 1993), since these taxa are considered the most sensitive to metals.

Table 3.16-5
Macroinvertebrate Sample Characteristics and Metrics

Site RM Code	Date Collected	Ind/m²	Mtn MMI Index [a]	Total Taxa	EPT Taxa	% EPT [b]	% CrusMol	% NonIns	HBI [c]
SH17.5	7/14/2016	4,335	65.5	58	20.7	65.2	1.8	2.3	2.8
SH22.7	7/12/2016	5,632	70.1	59	21.1	63.6	0.3	0.6	2.8
SH19.2	7/12/2016	3,940	**53.7**	35	14.4	36.8	0.0	1.3	3.8
SH18.3	7/11/2016	1,840	**60.8**	64	17.5	25.5	0.8	4.1	4.3
SH15.5DS	7/12/2016	2,044	65.8	55	19.5	53.9	0.6	0.9	3.2
SH15.5US	7/12/2016	2,760	**60.1**	45	14.2	51.6	2.9	4.8	3.2
	avg.	**3,425.2**	**62.6**	**52.7**	**17.9**	**49.5**	**1.1**	**2.3**	**3.4**
TN9.3	7/12/2016	2,224	68.1	47	18.3	67.7	0.0	0.2	3.2
TN9.4	7/12/2016	2,515	72.8	42	19.9	62.6	0.0	0.0	3.0
	avg.	**2,369.5**	**70.4**	**44.5**	**19.1**	**65.2**	**0.0**	**0.1**	**3.1**
LS.1	7/11/2016	2,612	**61.1**	45	20.0	52.7	3.5	5.2	3.1
LS.6	7/12/2016	1,136	**39.7**	29	8.0	9.9	7.8	9.9	3.7
	avg.	1,874	**50.4**	37.0	14.0	31.3	5.6	7.5	3.4
C.5	7/12/2016	2,520	**47.5**	35.0	11.0	15.5	1.8	3.8	3.9
SH17.5	8/16/2014	2,952	63.7	44	18.0	48.8	1.1	1.9	4.0
SH22.7	8/15/2014	3,260	63.3	47	13.6	60.0	2.6	3.4	3.4
SH19.2	8/16/2014	3,158	**55.8**	39	16.2	26.9	0.0	0.5	4.0
SH18.3	8/16/2014	5,872	**62.7**	60	18.8	47.0	0.1	3.1	3.8
	avg.	**3,810.5**	**61.4**	**47.5**	**16.7**	**45.7**	**1.0**	**2.2**	**3.8**
TN9.3	8/16/2014	6,080	68.6	53	18.3	33.8	0.0	1.1	4.7
TN9.4	8/16/2014	7,424	71.4	43	18.4	48.4	0.0	0.0	3.6
	avg.	**6,752.0**	**70.0**	**48.0**	**18.4**	**41.1**	**0.0**	**0.5**	**4.1**
LS.1	8/16/2014	3,040	**39.7**	35	8.8	12.1	4.5	4.7	4.9
LS.6	8/15/2014	1,132	**46.9**	37	10.4	24.7	8.5	14.8	4.7
	avg.	**2,086.0**	**43.3**	**36.0**	**9.6**	**18.4**	**6.5**	**9.8**	**4.8**
C.5	7/8/2015	2,520	**48.5**	36.0	14.0	35.4	2.4	19.4	3.4

Source: Stagliano 2015, 2017b
avg. = average; CrusMol = crustaceans/mollusks; EPT = Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies), see note b; HBI = Hilsenhoff Biotic Index, see note c; Ind/m² = individuals per square meter; MMI = multi-metric indices; Mtn = mountain; NonIns = non-insects; RM = river mile
Notes:
[a] The impairment threshold set by DEQ is 63 for the Mountain Stream Index, thus any scores above this threshold are considered unimpaired (DEQ 2017b). Values below this threshold are underlined.
[b] %EPT indicates the percent of mayflies, stoneflies, and caddisflies within the macroinvertebrate sample. High EPT percentages of the population typically indicate degraded habitat conditions are not present.
[c] HBI is the measure of macroinvertebrate assemblage's tolerance toward organic (nutrient) enrichment. HBI tolerance values are based on a 0 to 10 scale, where 0-ranked taxa are most sensitive and 10-ranked taxa are most tolerant to pollutants. HBI values of 0 to 3.0 in mountain streams indicate no organic pollution (excellent conditions), and values of 3.0 to 4.0 indicate slight organic pollution (very good).



Source: Stagliano 2018a

Notes:
[a] Red lines bracket the slight organic impairment range (3.0 to 4.0); below 3.0 indicates minimal impairment.
[b] Monitoring location SH19.2 is mislabeled as SH19.3 on the figure above from Stagliano 2018a.

Figure 3.16-8
Macroinvertebrate Metrics in the Project Area Arranged Upstream to Downstream

Chlorophyll-*a* levels from Sheep and Moose Creek sites sampled by DEQ in 2015 were well below the nuisance levels of 150 milligram per square meter (mg/m^2) with the highest value in the assessment area recorded at SH17.5 (65.2 mg/m^2). In 2017, underwater photographs of the substrate were taken instead of collecting Chlorophyll-*a* samples since benthic algal levels reported during the previous years were low (<50 mg/m^2, one-third the nuisance level of 150 mg/m^2) at all transects of the stream reaches (Stagliano 2018a).

3.16.2.6. Periphyton Communities

The 2016 to 2017 aquatic baseline surveys reported 167 unique diatom and algae taxa from the 10 periphyton assessment samples collected in the assessment area. The average periphyton richness per site in both 2016 and 2017 was 68.6 taxa, which is approximately10 taxa higher than in 2014 (57 taxa). Sheep Creek survey location SH19.2 reported the highest periphyton taxa richness (86 species in 2016), while Little Sheep Creek LS.1 reported the lowest (43 species in 2017) (see **Table 3.16-6**). Abundant filamentous algae outbreaks were visually observed at the lower Sheep Creek sites (SH15.5U and SH15.5D) in 2015 and 2016, but not in 2017. The outbreaks were confirmed with *Cladophora* being the dominant periphyton taxa at both sites in 2016 (Stagliano 2018a).

While the CWA and subsequent regulations set forth national goals and minimum standards for ambient water quality, individual states have the responsibility to monitor water quality and to set and enforce standards. Biocriteria are particularly useful for assessing impairment from sediment and nutrients. Teply and Bahls (2006) developed biocriteria for using the composition and structure of periphyton communities to assess biological integrity and impairment of aquatic life in Montana streams specific to USEPA Ecoregion 17 (Middle Rockies). The study classified impaired streams as those where aquatic life use support was listed as partial or none and where the cause of impairment was sediment, nutrients, or metals. Nonimpaired streams were classified as those where support for aquatic life use was full or where the cause of impairment was other than sediment, nutrients, or metals (Teply and Bahls 2006). The 50 percent probability of impairment occurs at about 17.9 percent relative abundance of an increaser taxa; this is the threshold for sediment impairment reported by Teply (2010).

Based on Teply's Diatom Index, Sheep Creek site SH17.5 had the highest probability (61 percent) of sediment impairment in 2014; however, in 2017 this probability was reduced to 28 percent. The 2016 and 2017 analyses reported that Sheep Creek site SH18.3 had the highest probability of impairment (82 percent) followed by the Sheep Creek site SH19.2 at 60 percent (see **Table 3.16-6**). Based on the Index, other Sheep Creek and Little Sheep Creek sites had a 40 percent or less chance of being impaired. During all 3 years, the Tenderfoot Creek sites were the least likely to be impaired; however, the dominance of *Nostoc* indicates there is likely some nutrient loading from cattle use in the watershed.

Table 3.16-6
Periphyton Sample Metrics

Site RM Code (BACI Type)	2014			2016			2017			2014		2016		2017	
	Total Taxa	**% RA**	**% PI [a]**	**Total Taxa**	**% RA**	**% PI [a]**	**Total Taxa**	**% RA**	**% PI [a]**	**Dominant Taxa 1**	**Dominant Taxa 2**	**Dominant Taxa 1**	**Dominant Taxa 2**	**Dominant Taxa 1**	**Dominant Taxa 2**
SH22.7 (C)	68	9.8	33	44	8.4	29	59	5.6	22	Diatoms	*Draparnaldia*	*Tolypothrix*	Diatoms	*Calothrix*	Diatoms
SH19.2 (C)	71	6.9	25	86	19.6	<u>62</u>	54	6.5	24	*Cladophora*	*Tolypothrix*	Diatoms	*Phormidium*	*Phormidium*	Diatoms
SH18.3 (I)	57	6.5	24	82	27.5	<u>82</u>	69	16.7	<u>53</u>	Diatoms	*Homeothrix*	Diatoms	*Phormidium*	*Phormidium*	Diatoms
SH17.5 (I)	62	19.3	<u>61</u>	57	12.8	41	53	7.9	28	Diatoms	*Cladophora*	Diatoms	*Phormidium*	*Closteridium*	Diatoms
SH15.5U (I)	NR	NR	NR	82	12.7	41	55	2.4	15	NR	NR	*Cladophora*	Diatoms	Diatoms	*Nostoc*
SH15.5D (I)	NR	NR	NR	84	12.1	40	63	5.7	22	NR	NR	*Cladophora*	Diatoms	Diatoms	*Nostoc*
TN9.3 (R)	44	3.3	18	61	3.4	18	43	2.7	16	Diatoms	*Zygnema*	Diatoms	*Nostoc*	Diatoms	*Nostoc*
TN9.4 (R)	42	2.0	15	60	4.3	20	48	3.5	18	Diatoms	*Zygnema*	Diatoms	*Nostoc*	*Nostoc*	Diatoms
LS.1 (I)	53	9.6	32	56	11.7	38	41	5.4	22	*Spirogyra*	Diatoms	Diatoms	*Phormidium*	*Phormidium*	Diatoms
LS.6 (C)	59	4.8	20	74	5.9	23	NR	NR	NR	Diatoms	*Anabaena*	Diatoms	*Cladophora*	NR	NR

Source: Stagliano 2015, 2018a

% PI = percent probability of impairment; % RA = percent relative abundance of dominant taxa; BACI = Before, After, Control (upstream and offsite reference), and Impact (within and downstream); C = control; I = impact; NR = not reported; R = reference; RM = river mile
Note:
[a] Probable Impairment values are underlined.

3.16.3. Environmental Consequences

This section describes the potential impacts of the Project on aquatic biological resources. Impacts on aquatic resources would be associated with potential impacts on groundwater and surface water as described in Sections 3.4, Groundwater Hydrology, and 3.5, Surface Water Hydrology, respectively. Water quantity, local stream habitat, and water quality have the potential to affect fish, mussels, amphibians, and other aquatic organisms because of their dependence on the aquatic environment. Impacts previously described in those sections are not repeated in detail here except to explain how changes would potentially affect aquatic resources.

3.16.3.1. No Action Alternative

Under the No Action Alternative, the Project as described in Section 2.3, Proposed Action, would not occur. No underground mine or associated infrastructure would be built. The No Action Alternative (or No Mine Alternative) would not change the existing landscape or result in changes to groundwater or surface water hydrology. The No Action Alternative would not alter baseline conditions discussed in Section 3.16.2, Affected Environment, and the existing land uses of cattle ranching, hay production, and recreational use (i.e., hunting and fishing) would continue to occur.

3.16.3.2. Proposed Action

This section describes the potential environmental consequences of the Proposed Action to aquatic resources, including the potential direct and secondary impacts.

Stream Crossings and Sedimentation

The Proposed Action would disturb 0.84 acres of wetlands and 1,551 feet of streams during construction. The only impact on riparian wetland Waters of the United States would be from the mine access road crossings of Brush Creek and Little Sheep Creek. The sites for the two stream crossings were selected specifically to minimize impacts on wetlands, which also minimizes impacts on aquatic life that use that habitat since wetlands provide them with food, shelter, and nursery areas. At each creek crossing, a 9.8-foot-diameter, bottomless pipe arch, and two 5.9-foot-diameter, round culverts would be installed, one on each side of the bottomless pipe arch. In general, stream crossings are designed using structures capable of passing mean annual flood discharge without compromising existing channel width. The use of a bottomless pipe arch would preserve the natural creek substrate as the streambed would not be disturbed. The MOP Application stated that any storm flow not accommodated by the stream crossing would potentially overtop or damage the road requiring occasional repairs.

Along the roadway, drainage control would be established. To control erosion, cut and fill slopes and culverts would be installed as necessary. Revegetation of the cut and fill slopes would occur as soon as practicable (Tintina 2017). The two stream crossings would permanently alter two wetlands, Brush Creek and Little Sheep Creek. The eastern crossing would affect 0.05 acre of riparian wetlands (W-LS-05) and 85 feet of Little Sheep Creek (S-LS-O4). The western crossing would affect 0.05 acre of wetlands (W-LST1-02) and 69 feet of the Brush Creek tributary to

Little Sheep Creek (S-LST-001). Construction of the stream crossings would potentially introduce sediment into the two creeks and could impact fish that are resident or spawn in the area, particularly brook trout, which were identified during fall surveys as having redds in the lower stream velocity area of Little Sheep Creek. If redd quality is reduced due to sedimentation, the mortality rates of the fish eggs may be affected.

Increased sedimentation may also result in changes to the benthic invertebrate community. Suspended sediments affect benthic invertebrates through abrasive action of particles, interference in food gathering, and clogging of respiratory surfaces, all of which may induce organisms to drift downstream. Species type, richness, and diversity may change as excess sediment inputs convert the dominant substrate from larger sizes (pebbles, cobble) to small particles (sand, silt, clay). Aquatic communities that were dominated by EPT taxa may become dominated by burrowing invertebrates such as segmented worms (Oligochaeta) and midges (Chironomidae) as a result of sedimentation (Herbst et al. 2011). These changes would have cascading impacts on the food web, particularly for fish.

Erosion control methods and BMPs, such as silt fencing, sediment traps, vegetation management and revegetation, and rolled erosion control products, would be implemented during the construction, operations, and closure phases. These methods and BMPs would minimize the potential for negative impacts on stream habitat and aquatic life from introduced sediment from increased turbidity and deposition. During construction, silt fencing would be used and maintained to control sediment from disturbed areas and natural drainage patterns would be retained whenever possible. During construction and operations, reclamation efforts would take place to stabilize disturbed areas on a simultaneous schedule. At the end of mine life, permanent reclamation and closure would occur.

The main access road to the mine site (including bridges), construction access roads, and service access roads to various facilities on private property would not be open to the public. They would either be completely reclaimed or left open with a reduced footprint at the landowner's request. Disturbed areas within the Project area would either be reclaimed or recontoured to premining topography and revegetated, in accordance with § 82-4-336, MCA. Impacts on aquatic habitat from soil erosion or sedimentation from culvert installations, any storm events that overtop the road, or culvert removals in closure, would be short term, would be fairly likely to occur, and could be reduced by limiting or avoiding in-stream construction activities during fall spawning when redds are likely to be found nearby. Based on these factors, the impacts on aquatic life from the stream crossings would be minor with the use of BMPs, such as appropriate soil erosion and sediment controls during road construction and maintenance activities.

Changes in Water Quantity (Streamflow)

Section 3.4, Groundwater Hydrology, and Section 3.5, Surface Water Hydrology, describe the impacts the Proposed Action would have on water quantity in the nearby creeks. Model simulations show no measurable change in streamflow to Moose Creek. However, the model predicts that Coon Creek (defined as AES type D001-Headwater Stream system) would be reduced by approximately 70 percent of the steady state base flow observed in the stream (0.2 cfs at the confluence with Sheep Creek) during operations due to mine dewatering (see Section 3.4, Groundwater Hydrology, and Section 3.5, Surface Water Hydrology). To mitigate this predicted impact, water from the NCWR would be pumped into the headwaters of Coon Creek to augment flows within 15 percent of the average monthly flow (Hydrometrics 2018c).

As previously stated, Coon Creek is often fully diverted during the irrigation season and frozen during the winter months; therefore, it does not provide ideal fish habitat. After baseline surveys in 2015, it was determined to be fishless upstream of the county road near SW3; however, near its confluence with Sheep Creek, Coon Creek provides a refuge for young-of-the-year brown trout (Tintina 2017). Other aquatic life was documented in Coon Creek during the baseline surveys. Coon Creek was sampled for macroinvertebrates and determined to have an MMI score below the threshold of 63 set by DEQ, which is indicative of an impaired waterbody (see **Table 3.16-5**) (DEQ 2012). The total reduction in Coon Creek from mine dewatering is estimated at approximately 70 percent of the steady state base flow observed in the stream. This 70 percent reduction is considered a conservative estimate, as there is evidence that the headwaters of that creek are not connected to the deeper bedrock system subject to dewatering (Hydrometrics 2015; Hydrometrics 2018c).

The depletion of base flow from mine dewatering in other creeks near the Project area is estimated to be much smaller or not detectable. Reduction in Black Butte Creek would be approximately 0.1 cfs, or 3 to 4 percent of the steady-state base flow (3.2 cfs) in the stream, while reduction of base flow in the Sheep Creek SW-1 station would be on the order of 2 percent, or approximately 0.35 cfs from the 15.3 cfs steady state base flow at this station. This reduction in Sheep Creek would be comparable in magnitude to the Project's estimated consumptive water use (210 gpm) (Hydrometrics 2015). The water discharged to the environment via the UIG within the alluvial plain of Sheep Creek would offset the surface water flow reduction from mine dewatering above the consumptive use rate. The water infiltration would commence before the cone of depression from mine dewatering and the associated reduction of creek base flow would reach its maximum extent.

The Proponent plans to augment flows to the surface water system with water stored in the NCWR, should impacts on wetlands or streams develop over the relatively short period of mining (13 years). After the mine ceases its production and dewatering, groundwater levels would start recovering, with water levels in wells completed in Ynl A recovering to within 1 to 2 feet of the premining simulation after 3 to 4 years postmining. The analysis showed similar results in wells completed in the USZ and UCZ. The model simulations indicated that the Project would not result in any long-term residual impacts regarding groundwater levels and base flows in creeks (see Section 3.4, Groundwater Hydrology). Based on these factors, the changes in water quantity would have a minor impact on aquatic life in the area with most of the impacts limited to the aquatic life in Coon Creek, including the young-of-the-year brown trout that are known to take refuge near the Coon Creek confluence with Sheep Creek (Tintina 2017). Changes in water quantity may cause some aquatic biota to move to areas with more favorable habitat conditions.

Non-Contact Water Reservoir's Wet Well and Pipeline

The purpose of the design and operation of the NCWR is to address depletion of surface water flow in the affected watersheds associated with consumptive use of groundwater during operations. The conceptual plan (pending review and approval from the DNRC) outlines that water to fill the NCWR could be pumped from a diversion point based on existing leased water rights along Sheep Creek. Existing surface water rights would allow the NCWR to be filled during the 5-month irrigation period of the year. The NCWR would be filled using a wet well with the diversion point approximately 60 feet west of the private road in the hay meadow adjacent to Sheep Creek, depicted in **Figure 2.2-1** (Hydrometrics 2018a).

The diversion point would consist of a wet well with an 8-foot concrete manhole connecting to Sheep Creek through a 22-inch HDPE DR 21 intake pipe. The intake pipe would extend approximately 6.5 feet into Sheep Creek placed on the streambed. The pipe would be equipped with a fish screen over the intake section. The remainder of the intake pipeline would be solid pipe buried beneath the ground surface at an elevation equal to or slightly below the streambed elevation. Water from the wet well would be pumped to the NCWR when flow in Sheep Creek exceeds 84 cfs.

Potential impacts on surface water quantity are not anticipated as the diversion of streamflow is based on existing leased water rights along Sheep Creek (see Section 3.5.31, Surface Water Quantity). Therefore, impacts on aquatic biota due to changes in water quantity from the water diversion are not anticipated. However, aquatic biota would be impacted during the intake pipe installation, which would have short-term impacts likely to affect aquatic biota, including increased turbidity and sedimentation near the installation, degraded water quality, and substrate alteration. Longer-term impacts from the installation could potentially include changes in the substrate and sediments, habitat quality, and hydrology (Johnson et al. 2008).

Even with fish screens, water intake structures could result in adverse impacts on aquatic resources by entrainment and impingement of fishes and invertebrates; alteration of natural flow rates and hydroperiod; degradation of shoreline and riparian habitats; and alteration of aquatic community structure and diversity. Water diversion projects are known to cause injury and mortality when organisms too large to pass through screening devices become stuck or impinged against the screen and as a result, increased predation may occur near intake pipes. Eggs and larval stages of aquatic organisms are more susceptible to injury and mortality from intake pipes (Johnson et al. 2008).

Changes in Water Quality

The Proposed Action would affect surface water quality in the Project area during mine construction and operations either directly through surface water runoff or secondarily through water discharged via the UIG. Based on the small percentage of disturbed area, changes in surface runoff would not be expected to have an adverse impact on surface water quality to Sheep Creek. However, the smaller drainages in the immediate Project vicinity, including Brush Creek, Coon Creek, and Little Sheep Creek, would potentially be affected by surface runoff, but impacts on water quality would not extend outside the immediate area (see Section 3.5, Surface

Water Hydrology). This may cause some aquatic biota, such as fish, to move to areas with more favorable habitat conditions. As stated above, erosion control methods and BMPs would be implemented during the construction, operations, and closure phases, minimizing impacts on aquatic life. Therefore, impacts on aquatic organisms from surface runoff would be minor.

There could potentially be secondary Project impacts on the water quality of Sheep Creek. Water from the facilities would be collected and treated by the reverse osmosis treatment plant prior to discharge via the alluvial UIG in non-wetland areas beneath the floodplain of Sheep Creek southwest of Strawberry Butte. No impacts on Sheep Creek water quality are anticipated during the construction and operations phases since modeling has shown that the solute concentrations of infiltrated water would be low and meet both the surface and groundwater nondegradation standards prior to discharge to the alluvial UIG (see Section 3.4, Groundwater Hydrology, and Section 3.5, Surface Water Hydrology).

The quality of the groundwater reporting to Sheep Creek would be the same if not better than baseline conditions (see Section 3.4, Groundwater Hydrology, and Section 3.5, Surface Water Hydrology). However, groundwater from the underground workings would not be treated after the final closure (i.e., once nondegradation criteria are met). At least 2 to 4 years after the end of operations, up to an estimated ten rinsing cycles of the underground workings are proposed to ensure that water quality meets the groundwater nondegradation criteria. Groundwater quality modeling showed that after the post-closure rinsing, only thallium would be dissolved in contact groundwater at concentrations exceeding DEQ Groundwater Standards by a factor of two. However, thallium would be at concentrations below the estimated groundwater nondegradation criteria (Enviromin 2017, see Table 4-5) (see Section 3.4, Groundwater Hydrology; Section 3.5, Surface Water Hydrology; and the MOP Application Section 4.2.3.1, Underground Mine).

As stated in Section 3.4.3.2, Postclosure Groundwater Quality, the combined flow rate of potential chemical sources from the Proposed Action is expected to be less than about 3 gpm. Referring to **Figure 3.4-8**, the groundwater flow rate in Ynl A within the mine area is estimated to be about 90 gpm. If 3 gpm of chemically affected water were to completely mix with Ynl A groundwater, and the Ynl A water does not have significant concentrations of the chemicals of concern (COCs), one would expect a 30:1 dilution of the COCs existing in the original source water.

Affected water in the Ynl A would eventually flow into the Sheep Creek alluvium, which has an estimated groundwater flow rate of 200 gpm. Complete mixing of the chemical source water with the alluvial groundwater would be expected to dilute the original COCs by a factor of 67.

The alluvial groundwater eventually becomes groundwater discharge to Sheep Creek, which has a minimum flow rate of 6,700 gpm. Complete mixing of the chemical source water with Sheep Creek surface water would dilute the original COC concentrations by a factor of 2,200 or more.

Regardless of the above dilution analysis, all parameters in underground mine water post-closure are predicted to remain within non-degradation limits (i.e., comparable to existing groundwater quality). Therefore, water of similar quality already flows from the aquifer to adjacent streams and no changes to surface water quality are projected.

While the above statements are based on general index values, they provide evidence that chemically affected water from the mine workings or surface facilities (if any) is unlikely to cause significant impacts on ambient groundwater in the Ynl A, Sheep Creek Alluvium, or Sheep Creek surface water. Given the large mixing and retardation factors, concentrations would most likely be decreased to below the standards far before discharging to Sheep Creek.

Any elevation in nitrate in surface waters in the Project area may cause more blooms of nuisance algae, which can reduce water quality for other aquatic organisms, and may adversely affect fish or other aquatic life. These impacts would be limited to the immediate area near the source and most mobile aquatic life would move to areas with more favorable habitat conditions. Less mobile aquatic organisms could experience minor impacts in the short term. As a part of the MPDES permitting process it was identified that during maximum discharge to the UIG the concentration of total nitrogen in the ditched portion of Coon Creek and Sheep Creek may exceed the nondegradation criteria. To avoid such exceedances, a Treated Water Storage Pond (TWSP) would be in place to store Water Treatment Plant (WTP) effluent during periods when total nitrogen exceeds effluent limits, which is applicable from July 1 to September 30. Treated water from the WTP would be pumped through a 6-inch diameter HDPE pipeline to the TWSP. During the rest of the calendar year, water stored in the TWSP would be pumped back to the WTP via a 6-inch diameter HDPE pipeline, where it would be mixed with the WTP effluent and allow for the blended water to be sampled prior to being discharged per the MPDES permit (Zeig 2018). Based on the surface water quality changes that could potentially affect aquatic biota in the Project Area, overall impacts on aquatic organisms from potential pollutants in the discharge water would be minor.

Thermal Impacts

During operations, excess water pumped from the mine would be treated to nondegradation standards and released through the UIG located in the Sheep Creek alluvial aquifer system. Modeling has shown that the solute concentrations of infiltrated water would be low and meet both the surface and groundwater nondegradation standards (see Section 3.4, Groundwater Hydrology, and Section 3.5, Surface Water Hydrology). The WTP discharge point would be sampled for water quality, including temperature. In addition, temperature would be monitored during the spring, summer, and fall at all surface water and aquatic monitoring stations. It is not known what the temperature difference between the UIG and existing groundwater would be, but it is assumed that the temperature of the discharge would equilibrate to the ambient groundwater temperature prior to discharging to any surface water resources (Tintina 2017).

Water stored in the NCWR would be allowed to seep from the reservoir floor to the downstream catchment as required to offset a portion of mine site consumptive use. Analyses indicate an average seepage rate of approximately 50 gpm. The analyses also indicate that the predicted rate of seepage from the NCWR would not be high enough to fully drain the reservoir within a single year. Therefore, both a floating pump system and a system that pumps from the reservoir bottom would be in place to dewater the NCWR. This would allow water to be discharged at a suitable rate to offset mine site consumptive use on a monthly basis to an infiltration basin or underground infiltration gallery east of the spillway, and ensure that it is at a temperature that would not affect aquatic life. If stream flow were to be augmented via direct discharge from the NCWR, the temperature would be monitored, and discharges limited as necessary, in order to prevent impacts to aquatic life.

Studies have shown that heat can be used as a natural tracer of groundwater movement near streams (Constantz 2008), so any change in the groundwater temperature could also result in stream temperature changes near the Project, which would be observed during monitoring. Any change in surface water temperature could result in residual impacts to the resident fish species or other aquatic life, as well as those fish species or other aquatic life that migrate to the Project area or immediately below. As noted above for elevated levels of nitrates, an extended elevation in water temperature may indirectly cause blooms of nuisance algae, which can reduce water quality in the Project area and result in low dissolved oxygen and corresponding impacts on fish. Abundant filamentous algae outbreaks have already been observed at the lower Sheep Creek sites (SH15.5U and SH15.5D) and confirmed with *Cladophora* being the dominant periphyton taxa at both sites in 2016. Temperature is one of the factors that limits *Cladophora* growth. Impacts on aquatic habitat from thermal impacts related to discharge of water to the UIG would be of medium duration and have a low likelihood of occurring. This means the impacts on aquatic life from thermal impacts would be minor.

Required Monitoring

Adequate monitoring is necessary to verify whether the required mitigations are effective or ineffective in reducing environmental impacts to acceptable levels. Aquatic monitoring is outlined in the "Final Aquatic Monitoring Plan for the Black Butte Copper Project in Upper Sheep Creek Basin in Meagher County, Montana" (Stagliano 2017c), which is a finalized version of the Draft Plan of Study included as Appendix G-1 (Stagliano 2017e) of the MOP Application (Tintina 2017). Monitoring would occur annually at 15 established sites, including five stations on Sheep Creek and one each on Little Sheep and Coon creeks that are within or downstream of the Project disturbance boundary lines (see **Figure 3.16-1** and **Table 3.16-1**). Two sites on the Smith River, upstream and downstream of the Sheep Creek confluence (see **Figure 3.16-1**), would be quantitatively sampled for macroinvertebrates to detect any future changes in these communities during Project operations; these sites have previously been sampled in 2016 and 2017 by the UMOWA (Stagliano 2017d).

Two Sheep Creek stations and one Little Sheep Creek station are upstream of potential impacts from the Project and would serve as control stations. Two Tenderfoot Creek stations and a Moose Creek station are outside the Project sub-basin and would serve as reference control streams (see **Figure 3.16-1** and **Table 3.16-1**). Results would be compared to the cumulative monitoring record. Monitoring methods to detect potential impacts are described in Stagliano (2017c).

Assessment of impacts would be based on data collected before, during, and after mine construction and operations by comparison to two reference reaches in Tenderfoot Creek and one reference reach in Moose Creek, and comparison to DEQ biotic indices for similar streams in Montana. The objective of the biological monitoring plan is to confirm that aquatic beneficial uses and fisheries are being protected in the Sheep Creek drainage during construction, operations, and closure. Surface water quality samples, temperature, and discharge data would be collected adjacent to four of the aquatic biological monitoring plan stations during the biological monitoring plan sample periods (within 5 days), to provide information for the interpretation of the biological data. Fisheries population surveys, habitat assessments, macroinvertebrate and periphyton sampling, and redd counts would be conducted to support the biological monitoring plan and provide the field data necessary to assess the influence of the Proposed Action on stream biota. Fish tissue and sediments would be analyzed for metal concentrations (Stagliano 2017c).

Smith River Assessment

The Smith River is located approximately 19 river miles downstream of the Project and is the receiving water for Sheep Creek. As discussed in Section 3.4, Groundwater Hydrology, and Section 3.5, Surface Water Hydrology, significant impacts are not expected on surface water quantity or water quality in Sheep Creek, or the receiving waters of the Smith River, due to the Proposed Action. **Figure 3.4-8** (Section 3.4, Groundwater Hydrology) provides an indication of the magnitude of mixing the contact water with other waters (the rates of groundwater flow within the mine footprint: 0.4 gpm contact water, 90 gpm shallow bedrock groundwater, 200 gpm alluvial aquifer groundwater, and 6,700 gpm Sheep Creek base flow). Given the large mixing and retardation factors, analyte concentrations would most likely be decreased to below the standards before discharging to Sheep Creek and are unlikely to contribute to water quality impairments currently observed in the Smith River. Therefore, the Project would not likely have any direct or secondary impacts on aquatic life in the Smith River. However, as stated above in Section 3.16.2.3, Fish Communities, studies have confirmed that trout from the Smith River basin migrate to Sheep Creek where it is believed they spawn (Grisak 2012 and 2013; Grisak et al. 2012). These studies did not track any fish to the Project area, but did track several trout to the confluence of Sheep Creek and Moose Creek approximately 2 miles downstream from the Project area.

In 2016, four tagged mountain whitefish were documented during the baseline surveys in the Project area at Sheep Creek sites SH19.2 and SH18.3. Any fish or other aquatic species that travel into the Project area from the Smith River would be affected by the Proposed Action as described in Section 3.16.3.2, Proposed Action. Specifically, fish that migrate into the Project area could be affected by changes in water quality or quantity. These impacts may be limited to the immediate area near the source and the fish would move to areas with more favorable habitat conditions. Construction of the stream crossings for the access roads would potentially introduce sediment into Brush Creek and Little Sheep Creek and could affect fish that spawn in the area. If redds fill in due to sedimentation, the mortality rates of the fish eggs would increase.

As stated in Section 3.16.3.2, Proposed Action, impacts on aquatic habitat from the Proposed Action would likely be short term, have a medium likelihood of occurring, and could be reduced by limiting in-stream construction activities during the fall when spawning occurs and redds are likely to be found nearby. Based on these factors, the impacts on Smith River aquatic life that migrates into the Project area would be minor with the use of BMPs and appropriate soil erosion and sediment controls.

As stated in Section 3.16.3.2, in the Required Monitoring section, two sites on the Smith River (one upstream and one downstream of the Sheep Creek confluence) (see **Figure 3.16-1**), would be quantitatively sampled for macroinvertebrates to detect any future changes in these communities during Project operations; these sites were previously sampled in 2016 and 2017 by the UMOWA (Stagliano 2017d). In addition, all salmonids captured during the monitoring surveys in Sheep Creek (SH15.5, SH17.5, SH18.3, SH19.2, SH22.7), Little Sheep Creek (LS.1 and LS.6), Moose Creek (M.1), and Tenderfoot Creek (TN9.3 and TN9.4) would be scanned to document fish that may have been tagged in the Montana State University and Montana FWP fish movement study on the Smith River.

3.16.3.3. Agency Modified Alternative

The modifications identified in the AMA would result in impacts similar to those described for the Proposed Action Alternative. Modifications to the Proposed Action include an additional backfill of mine workings component. This project alternative proposes to backfill additional mine workings with a low hydraulic conductivity material consisting of cemented paste tailings generated from mill processing of the stockpiled ore and/or waste rock at the end of operations. This would help prevent air and groundwater flow within certain mine workings, preventing further surface oxidation and potential groundwater contamination. Impacts of the underground mine facilities on surface water quality during post-closure under the AMA would be less than expected under the Proposed Action. Therefore, impacts on aquatic biota under the AMA due to changes in water quality would be reduced with the use of required BMPs and appropriate soil erosion and sediment controls, such as silt fencing, sediment traps, vegetation management and revegetation, and rolled erosion control products (Tintina 2017).

Smith River Assessment

The AMA modifications would result in impacts on aquatic biota in the Smith River similar to those described for the Proposed Action. Therefore, impacts on Smith River aquatic life that migrate into the Project area from the AMA would be minor with the use of required BMPs and appropriate soil erosion and sediment controls.

4. CUMULATIVE, UNAVOIDABLE, IRREVERSIBLE AND IRRETRIEVABLE, AND SECONDARY IMPACTS AND REGULATORY RESTRICTIONS

4.1. METHODOLOGY

Cumulative impacts described in this section are changes to resources that can occur when incremental impacts from one project combine with impacts from other past, present, and future projects. Montana defines cumulative impacts as "the collective impacts on the human environment within the borders of Montana of the proposed action when considered in conjunction with other past, present, and future actions related to the proposed action by location or generic type," (§ 75-1-220, MCA). Cumulative impacts can result from state or non-state (private) actions that, "have occurred, are occurring, or may occur that have impacted or may impact the same resource as the proposed action," (Montana EQC 2017).

The cumulative impacts analysis for this Project was conducted in accordance with MEPA by completing the following:

1. Identifying the location or geographic extent for each resource potentially impacted by the Project;
2. Determining the timeframe in which the potential impacts of the Project could occur;
3. Identifying past, present, and future actions or projects that overlap the Project's spatial and temporal boundaries and that, in combination with the Project, could impact a particular resource; and
4. Analyzing the potential for cumulative impacts for each resource identified.

The cumulative impacts analysis for each potentially impacted resource is presented in Section 4.2.

4.1.1. Identification of Geographic Extent

The geographic extent of potential cumulative impacts includes the area or location of resources potentially impacted by the Project. For many resources (e.g., soil, vegetation, and geology), the geographic extent used to assess direct and secondary impacts, such as the Project footprint, is the same area used to assess cumulative impacts. However, for other resources (e.g., noise and air quality), the geographic extent is more expansive. MEPA requires the use of reasonable and rational spatial boundaries (e.g., hydrologic unit codes, wildlife management units, sub-basins, areas of unique recreational opportunity, viewshed) that will result in a meaningful and realistic evaluation (Montana EQC 2017). **Table 4.1-1** below describes the geographic extent where cumulative impacts from past, present, and future projects and actions could potentially impact each relevant resource.

Table 4.1-1
Cumulative Impacts Assessment Areas

Resource	Assessment Area
Air Quality	31-mile radius from the Project (modeling domain)
Groundwater Hydrology	Upper 2/3 of the Sheep Creek watershed
Surface Water Hydrology	Sheep Creek watershed, tributaries that feed Sheep Creek, and Black Butte Creek (Upper 2/3 of the Sheep Creek watershed)
Transportation	Meagher, Park, and Broadwater counties
Vegetation	3,317 acres = MOP Application Boundary (1,888 acres) + 1,429 surrounding acres
Wetlands	Project leased area (7,684 acres) = MOP Application Boundary (1,888 acres) + 5,796 surrounding acres
Wildlife	5,290 acres = MOP Application Boundary (1,888 acres) + 3,402 surrounding acres (identified by WESTECH [2015] surveys)
Socioeconomics	Meagher County, City of White Sulphur Springs, and School District #8 White Sulphur Springs K-12. Employment and income analyses extend to Broadwater, Cascade, Gallatin, Judith Basin, Lewis & Clark, Park, and Wheatland counties
Aquatic Biology	Sheep Creek watershed, tributaries that feed Sheep Creek, and Black Butte Creek

4.1.2. Identification of Timeframes

The timeframe in which potential Project impacts could be expected to occur includes the duration of both construction and operations (i.e., the overall Project lifespan). The Project lifespan is estimated as 19 years inclusive of construction, operations, reclamation, and closure (2018 to 2037). An analysis of cumulative impacts must also take into account past actions.

There is no history of industrial development on the proposed site. Mineral exploration started in the Project area in 1894 with small-scale underground copper mineralization development projects (see Section 1.3, Project Location and History). Homestake Mining Company started exploring for non-ferrous metals in the Project area in 1973 and 1974. No mining is known to have occurred within the Project area prior to 1973. Therefore, the timeframe for which potential cumulative impacts from past, present, and future projects and actions are to be assessed is from 1973 to 2037, which is approximately 64 years.

4.1.3. Identification of Past, Present, and Future Projects/Actions

Past, present, and future projects or actions that could impact individual resources when carried out in combination with the Project are included in this analysis. Permanent impacts as a result of past and present projects and actions since mining began in the vicinity of the proposed Project (circa 1894) were considered as part of the existing baseline conditions for each resource addressed in Chapter 3, Affected Environment and Environmental Consequences. As such, potential impacts from past projects and actions are already included in the evaluation of direct and secondary impacts. Related future actions may have an impact on a resource when combined with the Project. However, future actions “may only be considered when these actions are under concurrent consideration by any agency through pre-impact statement studies, separate impact statement evaluations, or permit processing procedures” (§ 75-1-208(11), MCA). This EIS refers to such projects as pending.

The following actions were completed to obtain information regarding present and pending actions and projects in the mine area:

- Contacting government staff at agencies with potential projects or actions in the area;
- Reviewing the EIS scoping comments for this Project; and,
- Independently researching nearby projects and activities.

Future actions are defined as those that are related to the proposed action by location or generic type. Related future actions were considered in the cumulative impact analysis only if they met one of the following criteria in accordance with § 75-1-208(11), MCA:

- The project is currently under consideration by any agency through pre-impact studies;
- The project is currently under consideration by any agency through separate impact statement evaluations; or,
- The project is currently under consideration by any agency through a permit processing procedure.

Present and pending projects or actions that, in combination with the Project, could potentially result in cumulative impacts are described in the section below.

4.2. CUMULATIVE IMPACTS

MEPA requires an analysis of cumulative environmental impacts of the proposed Project. Cumulative impacts are collective impacts of a project or action on the human environment within the borders of Montana when added to other past, present, and future actions. These impacts can result in individually minor but collectively significant impacts.

4.2.1. Present Projects and Actions

Actions identified for evaluation of potential cumulative impacts during the scoping process (see Section 1.6) and during this analysis include water withdrawals, remediation sites, new industrial activity along the Missouri River corridor, existing mines, and reclamation of abandoned mines. Potential cumulative impacts related to the listed projects and actions are discussed in the following sections. As discussed in Section 1.3, the Proponent also conducts surface exploration activities on the Project site under Exploration License No. 00710. These activities are considered under the existing conditions of the site.

4.2.1.1. Water Withdrawals

Resources listed in **Table 4.1-1** were evaluated for cumulative impacts related to water withdrawals. Potential cumulative impacts were identified for groundwater and surface water hydrology resources, and are discussed below. Cumulative impacts were not identified for the remaining resources.

Water withdrawals from the Project in combination with water withdrawals from nearby groundwater supply wells would impact groundwater and potentially nearby perennial streams. Section 3.4, Groundwater Hydrology, provides a discussion about how dewatering of the mine would result in a consumptive use of water by the Project. While developing a regional groundwater model, Hydrometrics (2015) completed a search of Montana's Groundwater Information Center database (maintained by the Montana Bureau of Mines and Geology). Several wells listed in that database were identified to be present within the model's domain (Hydrometrics 2015, Figure 2-5). Only five of those wells are present within the Project Hydrogeology RSA, as defined in Section 3.4.1.2 and shown on **Figure 3.4-2**: 5740, 5780, 5828, 5838, and 5847.

If the five wells are used for production of groundwater, the impacts of the mine dewatering upon groundwater levels in those wells would likely be limited. As **Figure 3.4-9** shows, all five wells are outside of the groundwater model-predicted mine dewatering cone of depression as defined by a drawdown of more than 10 feet. With limited overlap, cumulative impacts would be minimal.

In addition, the Proponent would acquire water rights under lease agreements with landowners, as stated in the MOP Application (Tintina 2017). As part of these water rights, the Proponent's water rights mitigation plan would offset stream depletion in Sheep Creek, Coon Creek, and Black Butte Creek, if necessary, by mitigating flows at a rate equal to the consumptive use of the Project. Flows would be mitigated by pumping water from the NCWR into the headwaters to maintain flows within 15 percent of the average monthly flow.

4.2.1.2. Remediation Sites

There are no known existing remediation sites that overlap with the Project, with the exception of the Livingston rail superfund site. The Livingston rail superfund site (i.e., the Burlington Northern Livingston Shop Complex) in Livingston, Montana, is currently undergoing remediation under a consent decree between Burlington Northern Santa Fe Railway and DEQ (Montana.gov 2018). The Livingston rail superfund site is located at the Montana Rail Link rail yards in Livingston almost 100 miles south of the Project. The only overlapping activities of the proposed Project with the remediation site would be the transport and transfer of shipping containers.

The Project would use sealed shipping containers on trucks to transport the copper concentrate to rail facilities in Livingston and/or Townsend. The truck transport route would include portions of Sheep Creek Road, U.S. Route 89, U.S. Route 12, I-90, and local roads in Livingston and Townsend. The concentrate would be transferred in the sealed containers to rail cars at the Montana Rail Link rail yards in Livingston and/or Townsend and shipped via rail in the same sealed containers to end markets via the Montana Rail Link mainline and Burlington Northern Santa Fe Railway mainline tracks in Montana. The transport and transfer of shipping containers at the rail yard is not expected to result in any cumulative impact on resources listed in **Table 4.1-1**.

4.2.1.3. New Industrial Activity along the Missouri River Corridor

Resources listed in **Table 4.1-1** were evaluated for cumulative impacts related to new industrial activity along the Missouri River Corridor, which extends 725 miles across Montana and passes through 14 counties. The upper reach of the Missouri River Corridor is the stretch nearest to the Project area. Potential cumulative impacts were identified for air quality, transportation, and socioeconomics resources, and are discussed below. Cumulative impacts were not identified for the remaining resources.

The air quality impacts of regional industrial activity were accounted for in a general manner in the air dispersion modeling analysis for the Proposed Action. Following DEQ guidance, monitored ambient air background concentrations are added to the modeled impacts of the Project-related impacts as described in Section 3.2, and these combined impacts are compared to federal and state ambient air standards (DEQ 2007). In this approach, the combined impacts of the surrounding projects and actions are represented in the selected background data and results described in Section 3.2. Appropriate ambient data would be that collected at a monitoring station in an area of similar characteristics of the region being modeled. The Proponent utilized background data from several sources that were approved by DEQ to ensure that the background was representative and conservative (Tintina 2018).

As stated in Section 3.12.3, the transportation analysis in Chapter 3 assumes that traffic on the transportation assessment area roads would increase by about 20 percent over the life of the mine, consistent with typical MDT assumptions. This background traffic increase includes new industrial activity along the Missouri River Corridor. Potential cumulative impacts, therefore, are included in the baseline data and results described in Section 3.12.3.

The upper reach of the Missouri River Corridor encompasses four counties within the socioeconomic assessment area, including Broadwater County, Cascade County, Gallatin County, and Lewis and Clark County. The Helena and Great Falls areas have experienced a boost in industrial activity, which has benefitted the local economy, driven by expansions in 2014 at companies like Lowenbro (an industrial construction and service company) and ADF Group (a fabrication and module assembly company). The Montana Business Assistance Connection (MBAC) developed a 2014 to 2019 Comprehensive Economic Strategy for the Helena Tri-County Region (i.e., Broadwater County, Lewis and Clark County, and Meagher County), which highlights how the regional economy is anchored by state and federal employment in Helena, with diminishing economic activities in peripheral counties (MBAC 2014). In Meagher County, livability issues and the need for quality jobs were identified as important concerns (MBAC 2014). The most significant economic threats to the region are considered to be continued historical trends of an aging population, a shrinking labor pool, and stagnating or decreasing incomes. For this reason, the Project along with growth in aerospace manufacturing are identified as the most significant economic opportunities across the Helena tri-county region (MBAC 2014). The Project combined with the expansion of aerospace manufacturing would significantly contribute to the area’s economic development goals, delivering benefits to Meagher County and the regional economy through job creation, investment, purchasing, and tax payments.

4.2.1.4. Existing Mines

Individual resources listed in **Table 4.1-1** were evaluated for cumulative impacts related to the operation of existing mines. Potential cumulative impacts were identified for air quality, transportation and wildlife, and are discussed below. Cumulative impacts were not identified for the remaining resources.

Mining has been a historical industry in Meagher County and adjacent counties such as Broadwater County and Lewis and Clark County. Graymont Western currently operates a limestone quarry and processing facility in Broadwater County (Operating Permit No. 00105), producing hydrated lime and quick lime. The quarry and processing facility are located approximately 45 miles southwest of the Proposed Action area. The Black Butte Mine (Operating Permit No. 00071) is an open-pit mine that supplies iron ore as an ingredient for cement production, and it is located approximately 2.5 miles southwest of the Proposed Action area.

The air quality impacts of existing mines in the region was accounted for in a general manner in the air dispersion modeling analysis for the Proposed Action. Following DEQ guidance, monitored ambient air background concentrations are added to the modeled impacts of the Project-related impacts as described in Section 3.2, and these combined impacts are compared to federal and state ambient air standards (DEQ 2007). In this approach, the combined impacts of the operation of existing mines are represented in the selected background data and results in Section 3.2.

The Black Butte Mine is the only existing mine located within the wildlife cumulative impacts assessment area; with a surface disturbance area of approximately 6 acres, it does not occupy a large footprint. The wildlife species observed by WESTECH (2015) in the Project wildlife analysis area were present adjacent to the Black Butte Mine; therefore, the combined impacts of the operations of existing mines are represented in the background data and results presented in Section 3.15.

4.2.1.5. Reclamation of Abandoned Mines

Individual resources listed in **Table 4.1-1** were evaluated for cumulative impacts related to reclamation of abandoned mines. Potential cumulative impacts were identified for air quality and transportation, and are discussed below. Cumulative impacts were not identified for the remaining resources.

The air quality impacts of reclamation of abandoned mines in the region were accounted for in a general manner in the air dispersion modeling analysis for the Proposed Action. Following DEQ guidance, monitored ambient air background concentrations are added to the modeled impacts of the Project-related impacts as described in Section 3.2, and these combined impacts are compared to federal and state ambient air standards (DEQ 2007). In this approach, the combined impacts of the reclamation operations are represented in the selected background data and results presented in Section 3.2.

As stated in Section 3.12.3, the transportation analysis in Chapter 3 assumes that traffic on the transportation assessment area roads would increase by about 20 percent over the life of the mine, consistent with typical MDT assumptions. This background traffic increase would incorporate some new traffic associated with reclamation of abandoned mines, but would not include large-scale mine reclamation, such as multiple new reclamation projects or a single very large reclamation project.

4.2.2. Related Future Actions

Future projects and actions identified for evaluation of potential cumulative impacts include:

- Gordon Butte Pumped Storage Project (Federal Energy Regulatory Commission Project No. 13642-003);
- Castle Mountains Restoration Project; and
- Portable aggregate crushing and screening operation in Great Falls, Cascade County (Montana Air Quality Permit #5186-00).

These future projects or actions that, in combination with the Project, were identified as having a potential to result in cumulative impacts are described in the sections below.

Comments during the scoping process also requested that the Project EIS evaluate cumulative impacts from possible future expansion of the proposed mine and expansion of other mines in the area. This EIS does not address the potential for mine expansion or development of a mining district of multiple projects, as neither of these options are currently proposed or under consideration by any agency.

4.2.2.1. Gordon Butte Pumped Storage Project

The Gordon Butte Pumped Storage Project developed by Absaroka Energy, LLC, would be located on private land in Meagher County, Montana, 36 miles southeast of the Proposed Action. This project is proposed to have upper and lower closed-loop reservoirs connected by an underground concrete and steel-lined hydraulic shaft. Gordon Butte construction could begin in 2018, and operations could begin in 2022; this project’s 3-year construction period could overlap with the 3-year construction period of the Proposed Action (GB Energy Park 2018). Potential cumulative impacts for air quality, transportation, and socioeconomic resources were identified for the 3-year period, and are discussed in more detail below.

Air Quality

Impacts on air quality resulting from the Gordon Butte Pumped Storage Project would consist primarily of transient impacts during the construction phase. Earthmoving equipment, material handling, and other construction-related activities would result in emissions of tailpipe emissions (primarily NO_X, CO, VOC, and $PM_{2.5}$), and fugitive dust emissions (primarily PM_{10}). During operations, the additional air quality impacts would be minimal, comprised of emissions from vehicle operation on unpaved roads for employee travel to and around the facility. Due to the distance from the Project and low-level of emissions, cumulative impacts are not expected to occur.

Groundwater Hydrology

The Gordon Butte Pumped Storage Project would be located 36 miles southeast of the Project in the Musselshell River watershed, which drains east past the town of Martinsdale, Montana. The Gordon Butte project is outside of the hydrogeology RSA, as defined in Section 3.4. The RSA is an area where secondary impacts of the Project (i.e., groundwater impacts to surface water) could occur; beyond the RSA boundary, secondary impacts are not expected. Because the proposed Project and the Gordon Butte project are 36 miles apart and in different watersheds, DEQ does not expect any cumulative impacts on groundwater hydrology.

Surface Water Hydrology

The Gordon Butte Pumped Storage Project is located 36 miles southeast of the Project and is outside the surface water assessment area, as defined in Section 3.5. Because the proposed Project and the Gordon Butte project are 36 miles apart and in different watersheds, DEQ does not expect any cumulative impacts to surface water hydrology (quantity or quality).

Transportation

Gordon Butte is 38 road miles east of White Sulphur Springs via U.S. Route 294 and U.S. Route 12. Gordon Butte would likely add construction traffic to U.S. Route 12/89 in White Sulphur Springs during its 3-year construction period. Peak construction traffic for this project would occur during Year 2, when 350 employees would be present on site. Gordon Butte construction traffic would be temporary and would not overlap with the period of greatest traffic volume from the proposed Black Butte Copper Mine. The Proposed Action would generate its highest levels of traffic during mine operations, beginning in or after 2021, whereas Gordon Butte Pumped Storage Project construction could begin in 2018 and operations in 2022 (Borgquist et al. 2017).

The Gordon Butte project developer has proposed to implement a traffic management plan, provide bus service for project personnel, and schedule work shifts and deliveries to limit traffic during school bus traffic times (FERC 2016). As noted in Section 3.12.3.2 and the Proponent's traffic study, current traffic is significantly below the roadway capacity for U.S. Route 12 and U.S. Route 89 south of White Sulphur Springs (Abelin Traffic Services 2018). The highways have sufficient capacity to handle the temporary, cumulative traffic, although the addition of Gordon Butte traffic may further strain the capacity of the Main Street/3rd Avenue intersection in White Sulphur Springs (see Section 3.12.3.2). Overall, the cumulative impact of construction and operation of the Project and the Gordon Butte project on road transportation would be minimal.

Vegetation

The Gordon Butte Pumped Storage Project is located 36 miles southeast of the Project and would be outside of the vegetation and T&E analysis area, as defined in Section 3.13. The vegetation and T&E analysis area is an area where secondary impacts of the Project could occur; beyond this analysis area, secondary impacts are not expected. Because the Project and the Gordon Butte project are 36 miles apart, DEQ does not expect any cumulative impacts on vegetation.

Wetlands

The Gordon Butte Pumped Storage Project is located 36 miles southeast of the Project and would be outside of the wetlands assessment area, as defined in Section 3.14. The Project would permanently impact 0.85 acre of emergent and scrub/shrub wetlands within the MOP Application Boundary in the Sheep Creek watershed. Because the Project and the Gordon Butte project are 36 miles apart and in different watersheds, DEQ does not expect any cumulative impacts on wetlands or associated waterbodies.

Wildlife

The Gordon Butte Pumped Storage Project is located 36 miles southeast of the Project and would be outside of the wildlife analysis area, as defined in Section 3.15. Because of the distance between the two projects, potential impacts within the wildlife analysis area are not expected to overlap with potential impacts from the Gordon Butte project. Cumulative impacts on wildlife species with large home ranges (e.g., grizzly bear, Canada lynx, wolverine, big game species) or highly mobile species that may travel seasonally between the two project areas (e.g., migratory bird species) are possible. Given the distance between the projects and the abundant suitable habitat for wildlife species in the area, cumulative impacts are expected to be minimal on these species. Small mammals, upland game birds, reptiles, and amphibians are unlikely to migrate between the two areas and are not expected to be impacted. An increase in traffic due to a cumulative increase in employees, support vehicles, or trucks along existing main roads between the two project areas would likely represent the largest potential impact to transient wildlife species due to potential wildlife-vehicle collisions or avoidance behavior. However, given that the cumulative impacts on transportation activities described above are expected to be minimal, the cumulative impacts on potential wildlife-vehicle collisions or avoidance behavior are also expected to be minimal.

Aquatic Biology

The Gordon Butte Pumped Storage Project is located 36 miles southeast of the Project in a different drainage basin and would be outside of the aquatic biology assessment area, as defined in Section 3.16. Secondary impacts of the Project (i.e., impacts to fisheries) are not expected. Because the Project and the Gordon Butte project do not share aquatic habitat that could potentially be impacted by both projects, DEQ does not expect any cumulative impacts on fisheries between these two projects.

4.2.2.2. Castle Mountains Restoration Project

The Castle Mountains are about 15 to 20 miles south of the proposed Black Butte Copper Mine, situated east of the city of White Sulphur Springs and south of U.S. Highway 12 in Meagher County. The Castle Mountains Restoration Project would restore many forest and grassland ecosystems to minimize the potential for high intensity fires to occur within the Willow Creek municipal watershed and other valued areas within the Castle Mountains. Prescribed fire treatments are being proposed to meet the goals of this project. This project has the potential to impact wildlife habitat, big-game winter ranges, and migration routes, and there is potential for increased grazing due to the thinning resulting from prescribed burns (USDA 2018).

Air Quality

Impacts on air quality resulting from the Castle Mountains Restoration Project would be limited to transient impacts during the active periods for controlled burns, revegetation, and other habitat treatments. Vehicle travel in any given management area would be limited in duration, and no new permanent unpaved roads are planned. Controlled burns can create significant local air pollution during and immediately after the fire, consisting primarily of NO_X, CO, VOC, and PM. Burn Plans would be in place to mitigate these emissions to the extent practical and reduce impacts by conducting the fires during periods when weather patterns tend to reduce the impact to local residents and resources (USDA 2018). While the short-term, localized air quality impacts of restoration project activities—in particular the controlled burns—can be substantial, these impacts should not result in cumulative air quality impacts with respect to the Project. This is because of the distance to the restoration project area and the temporary nature of the air emissions from restoration activities.

Groundwater Hydrology

The Castle Mountains Restoration Project would be located about 15 to 20 miles south of the Project and outside of the hydrogeology RSA, as defined in Section 3.4. The RSA is an area where secondary impacts of the Project (i.e., groundwater impacts to surface water) could occur; beyond the RSA boundary, secondary impacts are not expected. Because the Project and the Castle Mountain Restoration Project are 15 miles apart and in different watersheds, DEQ does not expect any cumulative impacts on groundwater hydrology.

Surface Water Hydrology

The Castle Mountain Restoration Project would be located about 15 to 20 miles south of the Project and outside the surface water assessment area, as defined in Section 3.5. No impacts to surface water hydrology (quantity or quality) are expected beyond the assessment area. Because the Project and the Castle Mountain Restoration Project are 15 miles apart and in different watersheds, DEQ does not expect any cumulative impacts on surface water hydrology (quantity or quality).

Transportation

Traffic would be generated during implementation of the restoration project, when equipment and personnel would reach the project area by traveling on U.S. 12 or U.S. 89 east and south of White Sulphur Springs. The project-generated traffic would be temporary and would travel on roads that have substantial capacity for additional traffic, according to the Proponent's traffic study (Abelin Traffic Services 2018). As a result, the Castle Mountains Restoration Project, when combined with the Proposed Action, would have a negligible cumulative impact on road transportation.

Vegetation

The Castle Mountains Restoration Project would be located about 15 to 20 miles south of the Project and outside of the vegetation and T&E analysis area, as defined in Section 3.13. The vegetation and T&E analysis area is an area where secondary impacts of the Project could occur; beyond this area, secondary impacts are not expected. Because the Project and the Castle Mountains Restoration Project are 15 miles apart, DEQ does not expect any cumulative impacts on vegetation.

Wetlands

The Castle Mountains Restoration Project would be located about 15 to 20 miles south of the Project and outside of the wetlands assessment area, as defined in Section 3.14. There are no anticipated cumulative impacts due to this related future action. Because the Project and the Castle Mountains Restoration Project are 15 miles apart and in different watersheds, DEQ does not expect any cumulative impacts on wetlands or associated waterbodies.

Wildlife

The Castle Mountains Restoration Project would be located about 15 to 20 miles south of the Project and outside of the wildlife analysis area, as defined in Section 3.15. Because of the distance between the two projects, potential impacts within the wildlife analysis area are not expected to overlap with potential impacts from the restoration project. Cumulative impacts on wildlife species with large home ranges (e.g., grizzly bear, Canada lynx, wolverine, big game species) or highly mobile species that may travel seasonally between the two project areas (e.g., migratory bird species) are possible. The restoration project would restore some habitat types for wildlife, but the impact and benefit would vary by species. Given the distance between the projects and the abundant suitable habitat for wildlife species in the area, cumulative impacts are expected to be minimal on these species. Small mammals, upland game birds, reptiles, and amphibians are unlikely to migrate between the two areas and are not expected to be impacted. In addition, given that the cumulative impacts on transportation activities described above are expected to be minimal at most, the cumulative impacts on potential wildlife-vehicle collisions or avoidance behavior are also expected to be minimal.

Aquatic Biology

The Castle Mountains Restoration Project would be located about 15 to 20 miles south of the Project and would be outside of the aquatic biology assessment area, as defined in Section 3.16. Secondary impacts of this project (i.e., impacts to fisheries) are not expected. Because the Project and the Castle Mountains Restoration Project do not share aquatic habitat that could potentially be impacted by both projects, DEQ does not expect any cumulative impacts on fisheries between these two projects.

4.2.2.3. Portable Aggregate Crushing and Screening Operation in Great Falls, Cascade County

The portable aggregate crushing and screening operation will be located within a gravel pit in Belt, Montana, about 40 miles north of the Proposed Action along U.S. Route 89. This operation will be owned by and operated in Cascade County. The equipment will be used to crush and sort gravel and sand materials used for construction. Material is fed through a primary and secondary crusher; after separations, materials are stored in load out piles (DEQ 2017b).

Air Quality

The Cascade County aggregate crushing, screening, and storage facility is subject to a number of federal and state regulations to curb particulate emissions and reduce the potential for cumulative impacts. As examples, the crusher is not to exhibit an opacity (a measure of the portion of natural light obscured by airborne dust) in excess of 12 percent (40 CFR 60, Subpart OOO), and other equipment sources are to not exhibit opacity of 20 percent or greater (ARM 17.8.304). The facility is prohibited from operating more than two crushers and two screeners at a time. Further, state regulations require the operation of water sprays and implementation of reasonable precautions on unpaved roads and parking lots to control airborne particulate matter (ARM 17.8.308 and ARM 17.8.752). The dust mitigation measures and resulting low rate of daily and annual emissions indicate that there is at most a minor contribution to air quality cumulative impacts. Further, the facility in Great Falls is located about 40 miles from the Project site, so there is no potential for overlapping air quality impacts.

Groundwater Hydrology

Portable Aggregate Crushing and Screening Operation would be located about 40 miles north of the Project and outside of the hydrogeology RSA, as defined in Section 3.4. Because the Project and the aggregate crushing operations are located about 40 miles apart and in different watersheds, DEQ does not expect any cumulative impacts on groundwater hydrology.

Surface Water Hydrology

The Portable Aggregate Crushing and Screening Operation will be located about 40 miles north of the project and outside the surface water assessment area, as defined in Section 3.5. Because the Project and the aggregate crushing operations are located about 40 miles apart and in different watersheds, DEQ does not expect any cumulative impacts on surface water hydrology (quantity or quality).

Transportation

Aggregate equipment would be moved as needed within Cascade County, north of Meagher County, and would initially be operated within the gravel pit. Traffic impacts would be limited to travel by employees who would operate the equipment. Although some aggregate equipment could travel to Meagher County, most activity would be on roads north of the Proposed Action, which are not anticipated to handle substantial traffic volume associated with the Proposed

Action. Accordingly, the Portable Aggregate Crushing and Screening Operation would have no cumulative impacts on road transportation when combined with the Proposed Action.

Vegetation

The portable aggregate crushing and screening operations would be located about 40 miles north of the Project and outside of the vegetation and T&E analysis area, as defined in Section 3.13. Because the Project and the aggregate crushing operations are located about 40 miles apart, DEQ does not expect any cumulative impacts on vegetation.

Wetlands

The portable aggregate crushing and screening operation would be located about 40 miles north of the Project and outside of the wetlands assessment area, as defined in Section 3.14. Because the Project and the aggregate crushing operations are about 40 miles apart and in different watersheds, DEQ does not expect any cumulative impacts on wetlands or associated waterbodies.

Wildlife

The portable aggregate crushing and screening operation would be located about 40 miles north of the Project and outside of the wildlife analysis area, as defined in Section 3.15. Cumulative impacts on wildlife species with large home ranges (e.g., grizzly bear, Canada lynx, wolverine, big game species) or highly mobile species that may travel seasonally between the two project areas (e.g., migratory bird species) are possible. Given the distance between the projects, the limited species traveling between these two project areas, and the abundant suitable habitat for wildlife species in the areas, cumulative impacts are expected to be minimal.

Aquatic Biology

The portable aggregate crushing and screening operation would be located about 40 miles north of the Project and outside of the aquatic biology assessment area, as defined in Section 3.16. Because the Project and the aggregate crushing operations do not share aquatic habitat that could potentially be impacted by both projects, DEQ does not expect any cumulative impact on fisheries between these two projects.

4.3. Unavoidable Adverse Impacts

Unavoidable adverse impacts are discussed below for each resource where they were identified during the impact evaluation described in Chapter 3, Affected Environment and Environmental Consequences. Unavoidable adverse impacts were not identified for the remaining resources evaluated in Chapter 3.

4.3.1. Groundwater Hydrology

Dewatering associated with the proposed underground mine operations would cause lowering of groundwater levels and some loss of base flow in the streams near the mine during mining and for some years after the mine is closed. Disposal of treated water to the alluvial UIG would partially offset the impacts from dewatering. Mine-related water discharged to the alluvial UIG would be treated and required to meet water quality standards and nondegradation criteria prior to discharge. Impacts on base flow in nearby streams, primarily Sheep Creek and Coon Creek, as a result of mine dewatering is expected to be negligible. These impacts are unavoidable, except under the No Action Alternative.

4.3.2. Vegetation

Unavoidable adverse impacts related to vegetation would include disturbance to vegetation communities through clearing, filling, and construction activities. Upon reclamation and closure, all affected areas would be regraded and revegetated to vegetation communities with comparable stability and utility as the original conditions, but the impacts would be unavoidable in the short term.

4.3.3. Wetlands

There would be unavoidable adverse impacts related to wetlands within the Project area through filling or excavation activities. Construction of access roads, service roads, the wet well, and the CTF would result in approximately 0.85 acre of permanently impacted wetlands from fill and dredging activities. The Proponent has obtained approval to impact the above wetlands via both a USACE Section 404 Permit and a DEQ Section 401 Water Quality Certification (Permit # NOW-2013—1385-MTH and MT4011018, respectively). As a condition of the USACE Permit, and before impact to the site wetlands can occur, the Proponent would be required to purchase 1.275 acres of advanced or pre-certified wetland credits or purchase 0.85 acre of certified wetland credits from the MARS In-lieu Fee Program.

4.3.4. Wildlife

Unavoidable adverse impacts related to the wildlife analysis would primarily include habitat removal. Terrestrial wildlife habitat would be removed where it overlaps Project features and would not be reclaimed to a similar functionality and value for several years. Grassland and shrubland communities reclaimed on various Project feature areas would be available for wildlife use within three to five growing seasons, offering a similar level of habitat as currently exists. However, forest communities could take decades to provide a similar habitat structure to pre-mining conditions. Additionally, noise from construction, operations, and reclamation activities would be unavoidable and would likely affect wildlife within 1 to 2 miles of the Project.

4.3.5. Aquatic Biology

Unavoidable adverse impacts related to aquatic biology would include disturbance to aquatic communities due to changes in the hydrology of streams and water quality and loss of aquatic habitat. As stated in Section 4.3.1, Groundwater Hydrology, dewatering associated with the proposed underground mine operations would cause some loss of base flow in the streams near the mine during mining and for some years after the mine is closed. Changes in water quantity would impact aquatic life in the Project area with most of the impacts limited to the aquatic life in Coon Creek (defined as AES type D001 - Headwater Stream System), which is projected to be reduced by approximately 70 percent of the steady state base flow observed in the stream during operations due to mine dewatering. As stated in the environmental consequences subsection of Section 3.16.3, Aquatic Biology, in order to mitigate this predicted impact, water from the NCWR would be pumped into the headwaters of Coon Creek to augment flows within 15 percent of the average monthly flow (Hydrometrics 2018).

Construction of the mine access road crossings of Brush and Little Sheep Creek would permanently impact 0.1 acre of riparian wetlands and 154 feet of streams. These construction activities could directly impact areas that aquatic life use for food, shelter, and nursery areas as well as potentially introduce sediment into the streams, which could affect aquatic life, particularly fish that are resident or spawn in the area. BMPs would be implemented to reduce impacts on these features, including the use of half-culverts spanning the channels of Brush Creek and Little Sheep Creek where the main access road intersects them, and the use of a directional utility installation drill to avoid impacts during the installation of underground pipelines.

Impacts on water quality from surface runoff and construction activities would not extend out of the immediate area (see Section 3.5, Surface Water Hydrology). However, increased sedimentation in the streams due to runoff or construction activities could cause some aquatic life, such as fish, to move to areas of the creeks with more favorable habitat conditions. To reduce the volume of contact storm water runoff in the disturbance area, storm water control and management BMPs would be implemented as required for the Storm Water Pollution Prevention Plan. BMPs are provided in the MOP Application (Tintina 2017) and include the construction of surface water diversion ditches to convey the non-contact water around the Project facilities.

4.4. Irreversible and Irretrievable Commitment of Resources

MEPA requires a detailed statement on any irreversible and irretrievable commitments of resources that would be involved in the proposed action if it is implemented (§ 75-1-201(b)(iv)(F), MCA). Irreversible resource commitments generally refers to impacts on or a permanent loss of a resource, including land, air, water, and energy, that cannot be recovered or reversed. Examples include the loss of cultural resources, or conversion of wetlands to another use. Irreversible commitments are usually permanent, or at least persist for a long time. Irretrievable resource commitments involve a temporary loss of the resource or loss in its value such as a temporary loss of vegetation while the land is being used for another purpose. The loss of habitat during this period is irretrievable, but the loss of the resource is not irreversible.

Irreversible or irretrievable commitments of resources are described below for those resources where they were identified during the impact evaluation described in Chapter 3, Affected Environment and Environmental Consequences. Irreversible or irretrievable commitments of resources were not identified for the remaining resources.

4.4.1. Vegetation

Irretrievable impacts on vegetation could include the temporary loss of vegetation communities during construction and operations. Although this loss of vegetation would be temporary and reversible (upon reclamation and closure), it would take decades to re-establish relatively mature trees.

4.4.2. Wetlands

There would be an irreversible impact related to wetlands within the Project area through filling or excavation activities. Construction of access roads, service roads, and the CTF would result in approximately 1 acre of permanently impacted wetlands from fill and dredging activities, and would convert the wetlands there to a different use.

4.4.3. Wildlife

Irreversible impacts on wildlife could include direct mortality from wildlife-vehicle collisions. The increase in traffic in the Project area could increase the risk of direct mortality for small species to big game animals.

Irretrievable impacts on wildlife could include the temporary loss of habitat during construction and operations. Although this loss of habitat would be reversible and temporary (i.e., it would be revegetated during the reclamation phase), it would take decades to re-establish the habitat created by relatively mature trees.

4.4.4. Aquatic Biology

There would be an irreversible impact related to aquatic habitat within the Project area through construction activities. Construction of the mine access road crossings of Brush and Little Sheep Creek would permanently impact 0.1 acre of riparian wetlands and 154 feet of streams from the construction of culverts.

4.5. REGULATORY RESTRICTIONS

MEPA requires an evaluation of regulatory restrictions imposed on private property rights as a result of major actions of state agencies, including an analysis of alternatives that reduce, minimize, or eliminate the regulation of private property (§ 75-1-201(1)(b)(iv)(D), MCA). This includes alternatives and mitigation measures that are designed to protect environmental, cultural, visual, and social resources, but may also add to the cost of the project. Alternatives and mitigation measures either required by state or federal laws and regulations to meet minimum environmental standards or consented to by the Proponent do not need to be evaluated for private property rights implications.

5. COMPARISON OF ALTERNATIVES

This chapter compares the impacts of each of the alternatives to resources. Impacts to each resource by alternative are detailed in the Environmental Consequences sections of Chapter 3. **Table 5-1** summarizes the potential impacts of each alternative for each resource.

5.1. COMPARISON OF ALTERNATIVES

Chapter 2 provides a detailed description of the No Action Alternative, the Proposed Action, and the Agency Modified Alternative (AMA); a summary is provided here for reference.

5.1.1. No Action Alternative

The No Action Alternative is the baseline upon which potential impacts can be measured due to the Project. Under the No Action Alternative, DEQ would not approve the Proponent's application for an operating permit under the MMRA, an MPDES Permit, or an Air Quality Permit. The Proponent would not be able to construct and operate the proposed mine. Land within the Project site would remain largely as it is today (see Affected Environment sections of Chapter 3), with the exception of potential exploration activities. Impacts of the No Action Alternative would be limited to the current land use activities associated with cattle grazing and hay production, and the potential continuation of exploration activities conducted by the Proponent under its Exploration License No. 00710.

5.1.2. Proposed Action

The Proposed Action is described in detail in Section 2.2 of this EIS, and summarized here with a focus on Project details relevant to proposed changes associated with the AMA.

The Proponent intends to construct, operate, and reclaim a new underground copper mine over 19 years and thereafter monitor and close the site. Project construction would occur in Mine Years 0 through 2; Project operations (active mining) would occur in Mine Years 3 through 15. Tailings would total 12.9 million tons over the life of the Project. The tailings would be thickened and sent to a paste plant where cement, slag, and/or fly ash may be added to the tailings as a binder. These cemented paste tailings would be piped either to the underground mine to backfill workings or to a double-lined tailings basin called the CTF. During operations, all water would be routed to the WTP for treatment. The treated water would then either be routed to the Sheep Creek alluvial UIG or TWSP, or used in the internal mine processes.

Project reclamation and closure would occur in Mine Years 16 through 19. Closure and reclamation would focus on removal of surface infrastructure and exposed liner systems, covering exposed tailings, and revegetation of the site. Mine closure would include the continued backfilling of all underground mined-out stopes and some primary and secondary access drifts with fine-grained, low permeability, cemented paste tailings. The decline, access ramps, and ventilation shafts would not be backfilled. Mine workings would be sequentially flooded at closure with groundwater. Prior to final flooding a particular portion of the mine, the walls of the workings within that zone would be rinsed to remove oxidation products. Rinse water would be collected, pumped, and treated as necessary. The zone would then be flooded with groundwater and a hydraulic barrier would be installed. In all, 14 hydraulic barriers would be installed in the underground workings. The primary purpose of the hydraulic barriers is to segment the mine workings based upon sulfide content to facilitate rinsing and improve water management. The Proponent would continue to treat water until groundwater nondegradation criteria are attained.

Impacts of the Proposed Action on each resource are presented in **Table 5-1**.

5.1.3. Agency Modified Alternative: Additional Backfill of Mine Workings

The AMA is described in detail in Section 2.3 of the EIS, and is summarized here. The AMA includes all elements from the Proposed Action with one replacement component: backfilling additional mine voids as part of mine closure, as compared to the Proposed Action. The AMA was proposed by DEQ to reduce the potential for groundwater mixing between upper and lower aquifers, and reduce potential groundwater contamination from exposed underground mine surfaces at closure compared to the Proposed Action.

The AMA proposes to backfill the decline, access ramps, ventilation shafts, and all mine voids in the USZ and LSZ with a low hydraulic conductivity material consisting of cemented paste tailings generated from mill processing of the stockpiled ore and/or waste rock at the end of operations. Hydraulic barriers would be used to separate the backfilled and open areas of the access decline. The AMA would result in extended production of cemented tailings, as well as a small increase in truck traffic.

The potential environmental and social impacts of the AMA are evaluated for each resource in Chapter 3, and are summarized in **Table 5-1**. The AMA is expected to have the same impacts to each resource as the Proposed Action, with the following exceptions:

- Air Quality: Emissions from extended production of cemented tailings to backfill more of the mined areas are a small fraction of emissions from the Proposed Action, and are likely to have little impact on the air quality resource.
- Surface Water and Aquatic Biology: Additional backfill of the mine workings would potentially reduce impacts to base flow in Coon Creek.
- Transportation: Additional backfilling associated with the AMA would marginally increase truck traffic compared to the Proposed Action over a 4-year period. These additional trips would not meaningfully change the traffic impacts described for the Proposed Action.
- Wildlife: There would potentially be a slight increase in mortalities due to more vehicle traffic onsite associated with additional backfilling. Fencing around the facilities would exclude large mammals from this impact, but birds and small mammals could still be impacted (low likelihood).

Table 5.1-1
Comparison of Project Impacts by Alternative

Resource Area / Impact [a]	No Action Alternative	Proposed Action	Agency Modified Alternative
Air Quality			
Ambient Air Quality Standards	No change from current condition.	Predicted impacts for criteria pollutants at all offsite locations comply with health-based Montana and federal primary standards, which are protective of ambient air quality.	Same as Proposed Action. Emissions from extended production of cemented tailings to backfill more of the mined areas are a small fraction of emissions from the Proposed Action, and likely to have little impact on the air quality resource.
Regional Haze/Visibility	No change from current condition.	Project emissions of haze precursor pollutants are sufficiently below regulatory thresholds to not warrant evaluation of haze/visibility impacts.	Same as Proposed Action.
Chemical Deposition	No change from current condition.	Predicted impacts from Project emissions comply with Montana and federal secondary air standards, which are protective with respect to chemical deposition impacts.	Same as Proposed Action.
Cultural/Tribal/Historic Resources			
Historic Properties	No change from current condition.	Historic properties would be avoided or would be mitigated with a SHPO-approved treatment plan.	Same as Proposed Action.
Groundwater Hydrology			
Groundwater Quantity	No change from current condition.	Mine dewatering would extensively lower groundwater levels around the mine, somewhat reducing base flow in nearby creeks; potentially impacting springs and seeps within the cone of depression. Operation of UIG would increase groundwater discharge, partially compensating mine-dewatering caused by decreased base flow. Operation of a NCWR would potentially increase groundwater discharge, partially compensating the mine-dewatering caused decrease in base flow.	Same as Proposed Action.
Groundwater Quality	No change from current condition.	The contact groundwater from post-mine voids [b] would migrate via shallow bedrock toward discharge zones mixing with non-contact groundwater; transport chemicals dissolved in contact groundwater would be retarded by process of adsorption; groundwater discharging to Sheep Creek would not affect its water quality.	Same as Proposed Action.
Surface Water Hydrology			
Runoff Surface Disturbance	No change from current condition.	Surface disturbance is less than 1% of local watershed area. Best management practices and the relatively small percentage of the total area (<1%) of stream and wetland features would be impacted through surface disturbance during construction.	Same as Proposed Action.
Stream Flows	No change from current condition.	Diversion of water to the NCWR falls within existing leased water rights along Sheep Creek (pending review and approval by the DNRC).	Same as Proposed Action.
		Secondary impacts on base flow of Sheep Creek as a result of mine dewatering and disposal of treated water to the UIG are expected to be insignificant and to partially offset one another. A more significant impact upon base flow would be possible for Coon Creek (70% reduction) during mine dewatering and recovery and pending approval by the DNRC it would require an agreement with the water rights holder. No other creeks are present within the area of a 10-foot drawdown of the water table, as computed by the groundwater model.	Same as Proposed Action.

Resource Area / Impact [a]	No Action Alternative	Proposed Action	Agency Modified Alternative
Water Quality	No change from current condition.	Process water discharged to surface waters via UIG would be treated and therefore not impact water quality in Sheep Creek. Post-closure exceedances of Montana Numeric Water Quality Standards (DEQ-7 Circular, May 2017) in underground water are expected to be attenuated and diluted by the time underground water migrates to Sheep Creek where more dilution occurs.	Same as Proposed Action.
Land Use and Recreation			
Existing Land Use	No change from current condition.	A total of 311 acres of existing land use would be impacted, which would be reclaimed back to existing uses after mine closure (i.e., 19 years).	Same as Proposed Action.
Hunting, Fishing, and Boating	No change from current condition. Recreational opportunities and use levels, patterns, and growth trends would be expected to continue at current rates.	No direct impacts on hunting opportunities would occur. There is abundant adjacent habitat for big game species surrounding the Project area. No secondary impacts on fishing or boating would occur from surface water.	Same as Proposed Action.
Population Increase	No change from current condition.	Recreational resource demands may be higher during construction and operations given the increase in local population from construction workers and mine operators; however, given the number and abundance of regional recreational opportunities, it is not expected that mine employee recreational resources use would significantly deprive other regional recreationists from enjoying the same resources.	Same as Proposed Action.
Visual and Aesthetics			
Visual Resources	No change from current condition.	Impacts to visual resources during construction caused by removal of existing vegetation, temporary fencing, grading, construction of roads and mine structures, and increased construction vehicle traffic would be short term, medium frequency, local in scope, and partially reversible. Impacts to visual resources after reclamation would be long term, medium frequency, and local in scope.	Same as Proposed Action.
Socioeconomics			
Population Increase	No change from current condition. Current population and use trends would continue.	The Proponent expects to hire up to 200 contractors during construction and employ an operating workforce of 235 employees. The associated population influx (i.e., the number of in-migrating workers and their family members) would be distributed across area county and town populations. Growth in population due to Project workforce would mean increased demand for and use of socioeconomic resources, such as housing, public infrastructure, and services. The nature and extent of these impacts would depend on where in-migrating populations choose to reside, the ability of public service providers to serve fluctuating populations, and the ability of area residents to adjust to (and accept) changes in life style.	Same as Proposed Action.
Employment, Income, and Tax Revenues	No change from current condition. Current employment, income and tax revenues trends would continue.	In addition to employment and income impacts, affected government units would benefit from the additional tax revenues generated by the mine.	Same as Proposed Action.
Soils			
Soil Loss	No change from current condition. Erosion and sedimentation would occur at current rates along the existing roads. Loss of soil development characteristics would be limited to new disturbances planned in the Project area in the reasonably foreseeable future.	Potential adverse impact expected. A total of 283.7 acres of soils would be disturbed as part of the Project in areas of stockpiled and non-stockpiled soils. Total soil volumes of about 563,692 cubic yards would be salvaged and stockpiled long-term, and approximately 304,773 cubic yards of soils would be temporarily stored and replaced on site.	Same as Proposed Action.
Physical, Biological, and Chemical Characteristics	No change from current condition. Physical, biological, and chemical changes to soils would be minimized and limited to new disturbances planned in the Project area in the reasonably foreseeable future.	Short-term soil compaction impacts would occur as part of the Proposed Action. Biological impacts would occur in salvaged soils. No changes to soil pH values are expected from Project construction or operations.	Same as Proposed Action.

Resource Area / Impact [a]	No Action Alternative	Proposed Action	Agency Modified Alternative
Reclamation Impacts	No change from current condition.	The soils in the analysis area are generally suitable for salvage and reclamation. The majority of soils would be salvaged using a two-lift method, which improves reclamation success. The loss of soil development and the time required to rebuild a new soil profile would be unavoidable long-term Project impacts given the long-term storage of soil.	Same as Proposed Action.
Noise			
Sound Levels at Residential Receptors	No change from current condition.	Construction, operation, and mine closure could result in some audible noise at nearby residential receptors.	Same as Proposed Action.
Sound Levels at Recreational Receptors	No change from current condition.	Temporary blasting associated with mine construction could result in some audible noise at nearby recreational receptors in the Smith River area.	Same as Proposed Action.
Transportation			
Traffic Congestion	No change from current condition.	Project construction would generate an average of 160 employee daily vehicle movements (i.e., one trip to or from the Project site), along with 8 supply truck round trips per day. Project operations would generate up to 477 employee vehicle movements per day, 36 concentrate haul truck movements per day, and 12 other truck movements per day. Traffic generated by Project construction and operations would not meaningfully impact traffic capacity on analysis area roads. As a result, traffic congestion is a low-likelihood event during both construction and operations.	Same as Proposed Action. Additional backfilling would marginally increase truck traffic over a 4-year period. These additional trips would not meaningfully change the traffic impacts described for the Proposed Action.
Road Safety	No change from current condition.	During Project construction and operations, Project traffic could increase the chance of traffic incidents, degradation of roadways, and other risks to road safety. Non-Project drivers are likely to be already accustomed to varying road and weather conditions, as well as the presence of heavy truck traffic on analysis area roads. Proponent-recommended road and intersection improvements would further minimize impacts on road safety.	Same as Proposed Action. Additional traffic would not meaningfully change the traffic impacts described for the Proposed Action.
Vegetation			
Vegetation	Ongoing exploration and ranching activities may disturb vegetation within the Project area.	A total of 311 acres of vegetation would be disturbed, which would be reclaimed after mine closure (i.e., 19 years). No impacts to T&E species.	Same as Proposed Action.
Wetlands			
Wetland Fill, Hydrology, and Quality	Ongoing ranching activities may slightly disturb wetlands within the Project area.	A total of 0.85 acre of permanent direct impacts to wetlands would occur due to access/service roads, CTF, and the wet well for the Sheep Creek water diversion. No secondary impacts expected due to fragmentation, hydrology changes, or water quality.	Same as Proposed Action.
Wildlife			
Habitat	Continued exploration activities and agricultural use of Project site could affect habitat.	A total of 311 acres of habitat removal, to be reclaimed after mine closure (i.e., 19 years).	Same as Proposed Action.
Direct Mortalities	Ongoing potential for wildlife-vehicle collisions due to private recreational and agricultural use of the land.	Low likelihood of wildlife-vehicle collision for T&E species. Medium likelihood for big game species and other species of concern. No population-level impacts anticipated.	Potential increased adverse impact compared to Proposed Action. Potentially a slight increase in mortalities as more vehicle traffic onsite associated with additional backfilling. Fencing would limit potential impacts to birds and small mammals.
Displacement	Wildlife occasionally disrupted by exploration activities or recreational use.	Wildlife likely disrupted within 1 to 2 miles of the Project throughout the life of the mine.	Same as Proposed Action.
Water Quality and Quantity	No change from current condition.	Process water discharged to surface waters via the UIG would be treated to avoid impacts to wildlife. Potential contamination for avian species ingesting water from CWP brine pond. There would be no adverse impacts related to water quantity.	Same as Proposed Action.

Resource Area / Impact [a]	No Action Alternative	Proposed Action	Agency Modified Alternative
Aquatic Biology			
Stream Crossings and Sedimentation	Ongoing potential for increased sedimentation from continued exploration activities, ranching, and fishing activities.	The two crossings combined would affect 0.1 acre of riparian wetlands, 85 feet of Little Sheep Creek, and 69 feet of the Brush Creek tributary to Little Sheep Creek, disturbing aquatic habitat and potentially introducing sediment into the aquatic system and affecting spawning fish.	Same as Proposed Action.
Changes in Water Quantity	Aquatic biota may be impacted by exploration and ranching activities when water is withdrawn for use. Otherwise, no change from current condition.	Aquatic biota, particularly in Coon Creek, could be impacted by changes in hydrology due to mine dewatering during operations. The Proponent proposes to augment flows with water from the NCWR.	Same as Proposed Action.
NCWR Wet Well and Pipe	No change from current condition.	Aquatic biota could be impacted by the installation of the intake pipe. Further impacts likely due to the presence of the intake pipeline include entrainment and impingement of fishes and invertebrates; alteration of natural flow rates when water is pumped (when the flow in Sheep Creek exceeds 84 cfs); degradation of shoreline and riparian habitats; and alteration of aquatic community structure and diversity.	Same as Proposed Action.
Changes in Water Quality	No change from current condition.	Process water discharged to surface waters would be treated to avoid impacts to wildlife.	Same as Proposed Action.
Thermal Impacts	No change from current condition.	The assumption is that the temperature of the UIG discharge would equilibrate to the ambient groundwater temperature prior to discharging to any surface water resources. If stream flow were to be augmented via direct discharge from the NCWR, the temperature would be monitored, and discharges limited as necessary, in order to prevent impacts to aquatic life.	Same as Proposed Action.

CTF = Cemented Tailings Facility; CWP = Contact Water Pond; MPDES = Montana Pollutant Discharge Elimination System; NCWR Non-Contact Water Reservoir; PWP = Process Water Pond; SHPO = State Historic Preservation Office; T&E = threatened and endangered; UIG = Underground Infiltration Gallery

Notes:

a Impacts include direct and secondary impacts, as well as severity, probability, and duration of impact.

b A “void” is the space from which the ore was removed.

Impacts to groundwater quality were expected to be the same as with the Proposed Action. As described in Section 3.4.3.3 of this EIS (Groundwater Environmental Consequences), it is unlikely that the mine would affect shallow groundwater quality or Sheep Creek surface water quality regardless of whether the access tunnels/shafts were backfilled, plugged, or left completely open.

In summary, the AMA would be expected to have only a negligible (if any) impact compared to the Proposed Action, or to have the same impact as the Proposed Action (**Table 5-1**).

6. CONSULTATION AND COORDINATION

MEPA requires DEQ to consult with and obtain comments from (1) any state agency that has jurisdiction by law or special expertise with respect to environmental or human resources that could be directly impacted by the Project and (2) any Montana local government that could be directly impacted by the Project (§ 7-12-1103, MCA). The responsible state official shall also consult with and obtain comments from Montana state agencies with respect to regulation of private property involved.

Consultation and coordination took place prior to and during the formal scoping period, as well as during EIS preparation. Consultation occurred in person as well as through email and phone communication. DEQ consulted the following federal, state, and local agencies during the development of this EIS (see **Table 6-1**).

The names of individuals and organizations contacted during the development of the MEPA document are available upon request from DEQ.

Table 6-1
Agencies Consulted

State of Montana and Federal Agencies	Tribal Governments	Counties	Cities
• Montana Department of Commerce • Montana Department of Natural Resources and Conservation • Montana Department of Transportation • Montana Fish, Wildlife & Parks • Montana State Historic Preservation Office • U.S. Forest Service • U.S. Army Corps of Engineers	• Blackfeet Nation • Chippewa Cree Tribe • Confederated Salish & Kootenai Tribes • Crow Nation • Fort Belknap Assiniboine & Gros Ventre Tribes • Little Shell Chippewa Tribe • Northern Cheyenne Tribe	• Meagher County	• City of White Sulphur Springs

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