Black Butte Copper Project Final Environmental Impact Statement

Prepared for:

DEQ Montana Department of Environmental Quality

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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.

de-pyritization: The process of removing pyrite from the tailings, resulting in a tailings stream and concentrated pyrite stream.

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 Plant.

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.

pyrite: A yellow iron mineral.

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 waterbody floor 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
$\mu g/m^3$	microgram(s) per cubic meter
a.m.	ante meridian (morning and before noon)
AADT	average annual daily traffic
ABA	acid-based accounting
ACHP	Advisory Council on Historic Preservation
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
ELG	Effluent Limit Guidelines
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	gallon per minute
H_2SO_4	sulfuric acid
HAP	hazardous air pollutants
HBI	Hilsenhoff Biotic Index
HCT	humidity cell test
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
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
NHPA	National Historic Preservation Act
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
nPAG	non-Potentially Acid Generating
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)
PAG	Potentially Acid Generating
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	Tintina Resources Inc.
PSD	Prevention of Significant Deterioration
PWP	Process Water Pond
Qal	Quaternary Alluvial Deposits
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
SO_2	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
SWPPP	Storm Water Pollution Prevention Plan
T&E	threatened and endangered
TBELs	Technology-based Effluent Limitations
TDI	trophic diatom index
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

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
VMT	vehicle miles traveled
VOC	volatile organic compound
VVF	Volcano Valley Fault
WEG	wind erodibility group
WESTECH	WESTECH Environmental Services, Inc.
WET	whole effluent toxicity
WQBELs	Water Quality-based Effluent Limitations
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 EIS prior to taking state action on applications for permits or other state authorizations submitted by Tintina Montana, Inc. (the Proponent). The 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 EIS. Please refer to the EIS, its appendices, or referenced reports for more information. The 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); a list of the consultation and coordination efforts undertaken as part of the EIS development (Chapter 6); and responses to substantive comments received during the Draft EIS public comment period (Chapter 8).

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. Additional Project updates were submitted to DEQ on January 30, 2018, and November 21, 2018. The Draft EIS for the Project was issued on March 11, 2019.

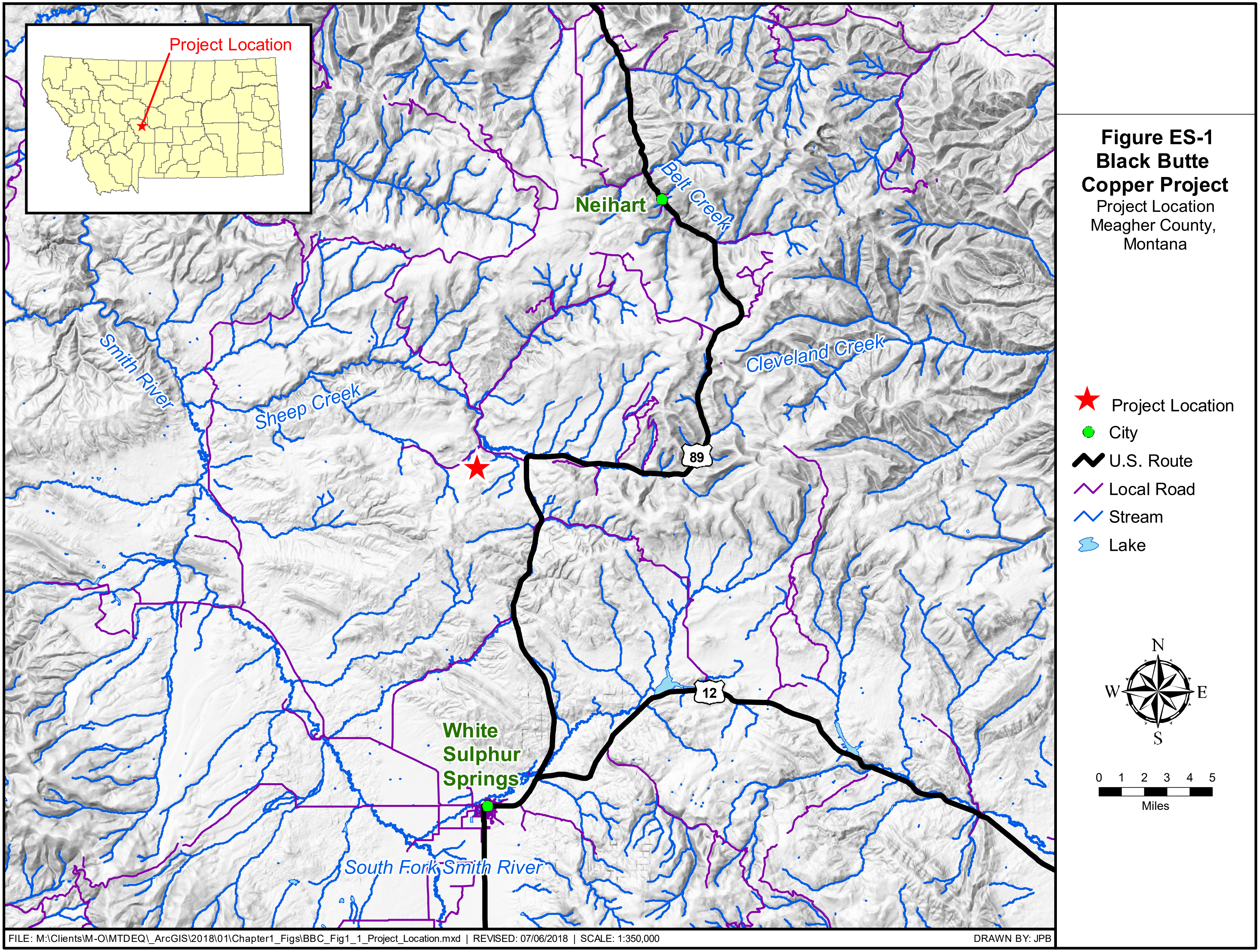

Figure ES-1
Black Butte Copper Project
Project Location
Meagher County, Montana

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.

DEQ established a public comment period on the Draft EIS from March 11, 2019, to May 10, 2019 (i.e., 60 calendar days). On April 24, 2019, a public meeting was held at the Great Falls High School fieldhouse in Great Falls, Montana. On April 29, 2019, a second meeting was held at the Park County High School Gymnasium in Livingston, Montana. The third public meeting was held at the White Sulphur Springs High School gymnasium in White Sulphur Springs, Montana, on April 30, 2019. Two online webinar public meetings were also held on May 1 and May 2, 2019. During this public comment period, DEQ received oral and written comments at the public meetings, by regular mail, and by electronic mail. Chapter 8, Response to Comments, presents the substantive public comments received and responses to those comments.

5. ALTERNATIVES

Alternatives fully evaluated in the 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 2.3 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

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

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. Montana Rail Link mainline tracks serving these railheads, as well as Burlington Northern Santa Fe Railroad mainline tracks in Montana, would be utilized.

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 235 workers, with an additional 24 contract miners and 127 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. Prior to the final flooding in 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, and the rinsing process would be performed repeatedly for a particular segment of the mine. 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 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, yet the AMA would have potential benefits over the Proposed Action. 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. As such, backfilling would further reduce the potential for groundwater mixing between upper and lower aquifers, and further reduce potential groundwater contamination from exposed underground mine surfaces at closure compared to the Proposed Action.

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 472 employee vehicle movements per day, 36 concentrate haul truck movements per day, and 12 to 18 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 0.85 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. It is acknowledged that lowering the water table for the duration of mining may impact some ecosystems, even if drawdown is less than 2 feet. In instances where small, isolated wetlands exist outside of the area affected by the underground injection of groundwater, and no perched water table is available, reduction in available groundwater could cause these wetlands to temporarily dry up and revert back once hydrology is restored. Thus, secondary impacts to wetlands due to changes in groundwater hydrology would be negligible. No secondary impacts are expected due to wetland fragmentation 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; however, mitigation measures would be implemented to reduce these impacts. 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, 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. The Proponent has clarified their plan to use an UIG in order to augment stream flow into Coon Creek. Aquatic biota (i.e., macroinvertebrates) in the natural channel of Coon Creek may be impacted by sedimentation from temporary construction activities and by changes in hydrology during operations due to mine dewatering. Aquatic biota could be temporarily impacted by the installation and reclamation 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	Historic properties have been impacted by subsurface archaeological testing and Project-related, ground-disturbing activities. Additional mitigation would not occur under the No Action Alternative.	Historic properties have been impacted by subsurface archaeological testing and Project-related, ground-disturbing activities. 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.	Backfilling would further reduce the potential for groundwater mixing between upper and lower aquifers, and further reduce potential groundwater contamination from exposed underground mine surfaces at closure compared to the 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 of 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. Pending approval by the DNRC, this 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. The contact groundwater from 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 process of adsorption; groundwater discharging to Sheep Creek would not affect its water quality.	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.

Resource Area / Impact [a]	No Action Alternative	Proposed Action	Agency Modified Alternative
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.
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.	Noise from construction and operations would not likely be audible at the Smith River. However, temporary blasting associated with mine construction could result in some audible noise at nearby recreational receptors in the Smith River area. If audible, it would be below DEQ's noise threshold for noise sensitive areas.	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. Negligible and temporary secondary impacts to small, isolated, non-jurisdictional wetlands due to hydrology changes. No secondary impacts expected due to fragmentation 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.

Resource Area / Impact [a]	No Action Alternative	Proposed Action	Agency Modified Alternative
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.
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.
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.
Water Quality	No change from current condition.	Process water discharged to surface waters via the UIG would be treated to avoid impacts to wildlife.	Same as Proposed Action.
Thermal Impacts	No change from current condition.	As part of mine operations, the Proponent anticipates discharging water seasonally from the WTP and/or TWSP via the UIG, which would discharge to a segment of Sheep Creek after mixing with an alluvial groundwater system. The discharge would be governed by an MPDES permit. Montana administrative rules applicable to B1 classified streams such as Sheep Creek restrict temperature changes to a 1 °F maximum increase above naturally occurring water temperatures, and a 2 °F decrease below naturally occurring water temperatures. Under these requirements, impacts to aquatic life are not anticipated.	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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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 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 (MMRA) (§ 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 is applying for and the governing state laws include: (1) an operating permit in compliance with the 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). This joint venture 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 regarding 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 submitted an application for a Mine Operating Permit (MOP) to DEQ on December 15, 2015, and submitted revisions May 8 and July 14, 2017. The Proponent submitted the following additional requests for updates:

- DEQ letter dated January 30, 2018 (DEQ 2018a), "Update to Proposed Treated Water Disposition for the Black Butte Project," which includes Underground Infiltration Galleries (UIGs) to Sheep Creek alluvium (Proponent request letter dated January 11, 2018 [Tintina 2018a]);
- DEQ letter dated January 30, 2018 (DEQ 2018b), "Update to Proposed Rail Load Out Facilities for Shipment of Containerized Copper Concentrates" (Proponent request letter dated January 11, 2018 [Tintina 2018b]); and
- DEQ letter dated November 21, 2018 (DEQ 2018c), "Update to Mine Operating Permit Application for the Black Butte Copper Project, Proposed Holding Pond Facility for Treated Water, Revision to Annual Water Balance, and Addition of a Wet Well" (Proponent request letter dated October 26, 2018 [Tintina 2018c]).

DEQ reviewed all updates and determined that the proposed Project changes were not considered substantial changes to the MOP Application; as such, the modifications did not change DEQ's completeness and compliance determination.

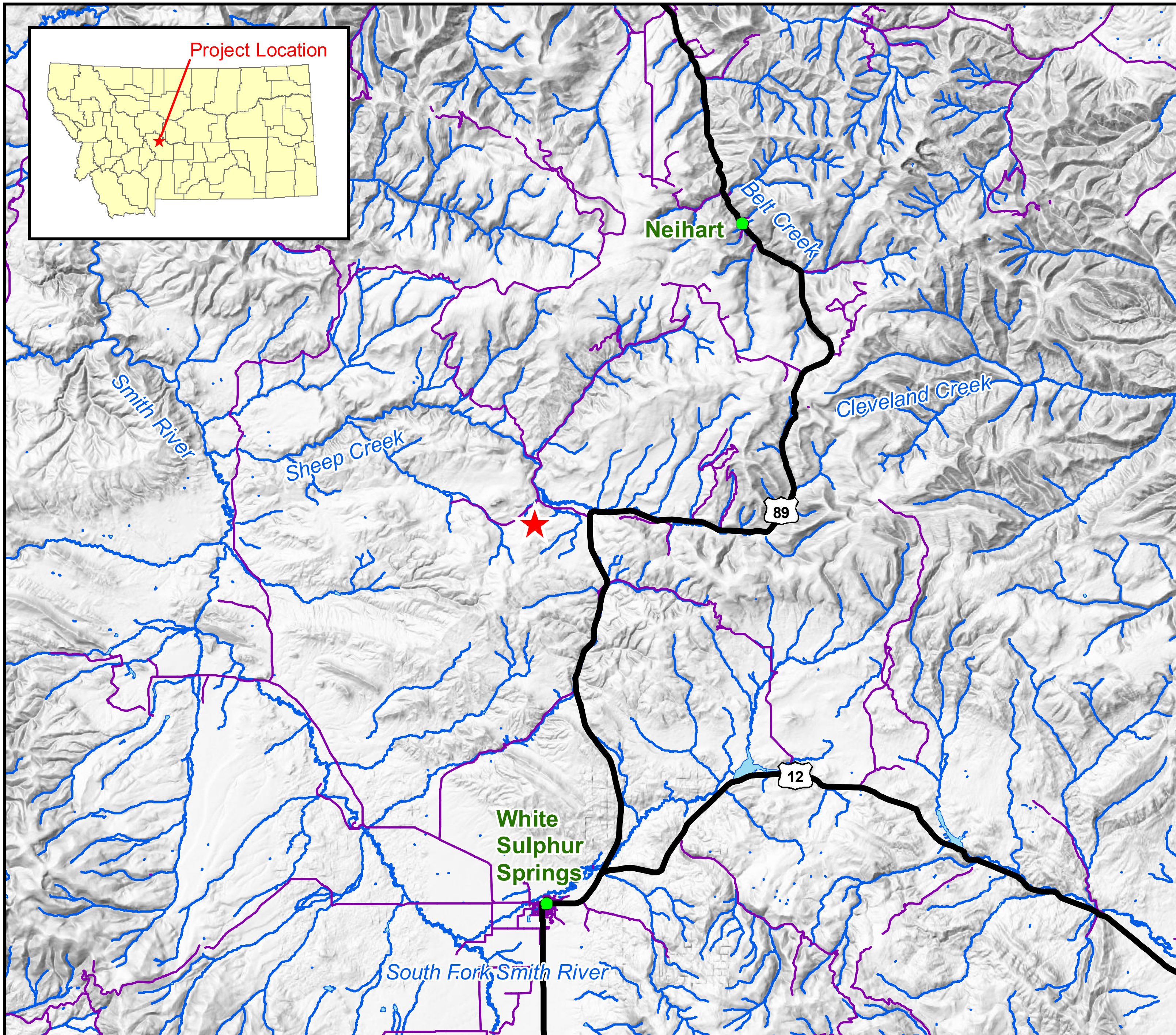

Figure 1.3-1
Black Butte Copper Project
Project Location
Meagher County, Montana

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 EIS in compliance with MEPA. This 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 ten 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 EIS.
- Chapter 8. Response to Public Comments: Chapter 8 provides the substantive public comments received during the Draft EIS public comment period, and responses to them.
- Chapter 9. References: Chapter 9 provides a list of the source materials that were used in preparation of the EIS.
- Chapter 10. Index: Chapter 10 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 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. Preliminary Determination on Air Quality Permit Application
- Appendix K. Seasonal Fish Size-Frequency Data

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 and county agencies listed in **Table 1.5-1** have relevant permits or reviews that would potentially be required for the Project.

Table 1.5-1
State and County Agencies–Potential Requirements

Potential Permits or Reviews Required (Statutory Reference)	Purpose of Permit or Review
Meagher County Conservation District	
Montana Streambed Preservation Act - 310 Permit (work in streams)	Required by any private or non-governmental entity to work in or near a stream on public or private land.
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.

Potential Permits or Reviews Required (Statutory Reference)	Purpose of Permit or Review
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.
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 non-degradation 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. On July 3, 2019, DEQ certified that the Project amendment 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 Streambed Preservation Act - 318 Permit (short-term turbidity)	Required by any entity initiating a construction activity that may cause short or temporary violations of state surface water quality standards for turbidity.
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,

Potential Permits or Reviews Required (Statutory Reference)	Purpose of Permit or Review
	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.
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 U.S. 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, Permit to Appropriate Water (§ 85-2-311, MCA) and Change Authorization	The Montana Department of Natural Resources and Conservation (DNRC) is responsible for administration of various components of the Water Use Act, and determines whether or not to issue permits and changes to existing appropriation rights. Permits to Appropriate Water and Change Authorizations would be required before appropriating water for beneficial use or commencing construction of diversion, impoundment, withdrawal, or related distribution works.
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, which is also discussed in Section 2.3. 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, DEQ's third-party contractor 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.

DEQ established a public comment period for the Draft EIS from March 11 to May 10, 2019 (i.e., 60 calendar days). During that time, DEQ received oral and written comments at the public meetings, by regular mail, and by electronic mail. On April 24, 2019, a public meeting was held at the Great Falls High School fieldhouse in Great Falls, Montana. On April 29, 2019, a second meeting was held at the Park County High School Gymnasium in Livingston, Montana. On April 30, 2019, a third public meeting was held at the White Sulphur Springs High School gymnasium in White Sulphur Springs. Two online webinar public meetings were also held on May 1 and May 2, 2019.

1.6.2. Issues of Concern

Based on comments received during the public scoping process, DEQ prepared a Scoping Report 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 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 impact 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

Under Section 82-4-338(1), MCA, an operating permit applicant is required to file a reclamation bond with DEQ payable to the state of Montana in a sum determined by and conditioned upon the performance of MMRA requirements, rules adopted under the MMRA, and the operating permit. This 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. If the Proponent is issued a permit, the Proponent would have to submit an application to amend the operating permit to conduct any expanded mining. Any further exploration would also require the Proponent to submit an application to amend its exploration license.

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.

1.6.3.10. Wild and Scenic Rivers

No Wild and Scenic Rivers would be affected by any of the alternatives. Two river systems 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.

Portions of the Smith River are listed as eligible for Wild and Scenic River designation. Chapter 3 discusses potential impacts to the Smith River; however, there would be no effects to outstandingly remarkable values.[2] Portions of Tenderfoot Creek are also listed as eligible for Wild and Scenic River designation, but this river would not be impacted by the Project as it is located about 15 miles north of the Project area and is not connected to Sheep Creek. As such, no eligible Wild and Scenic Rivers would be impacted.

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

[2] The Wild and Scenic Rivers Act of 1968 describes select rivers that "possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural or other similar values, shall be preserved…" as Wild and Scenic Rivers.

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.

1.6.3.14. Climate Change

Public comments suggested that the EIS consider impacts to and from the Project due to climate change and changing weather conditions. Under Section 75-1-201 (2), MCA, an environmental review conducted under MEPA is not required to include a review of actual or potential impacts that are regional, national, or global in nature. Because effects of climate change are regional, national, or global in nature, MEPA does not allow consideration of climate change as direct, secondary, or cumulative impacts.

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 Updates:
  - DEQ letter dated January 30, 2018 (DEQ 2018d), "Update to Proposed Treated Water Disposition for the Black Butte Project," which includes UIGs to Sheep Creek alluvium (Proponent request letter dated January 11, 2018 [Tintina 2018c]);
  - DEQ letter dated January 30, 2018 (DEQ 2018b), "Update to Proposed Rail Load Out Facilities for Shipment of Containerized Copper Concentrates" (Proponent request letter dated January 11, 2018 [Tintina 2018d]); and
  - DEQ letter dated November 21, 2018 (DEQ 2018e), "Updates to Mine Operating Permit Application for the Black Butte Copper Project, Proposed Holding Pond Facility for Treated Water, Revision to Annual Water Balance, and Addition of a Wet Well" (Proponent request letter dated October 26, 2018 [Tintina 2018b]).
- 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.

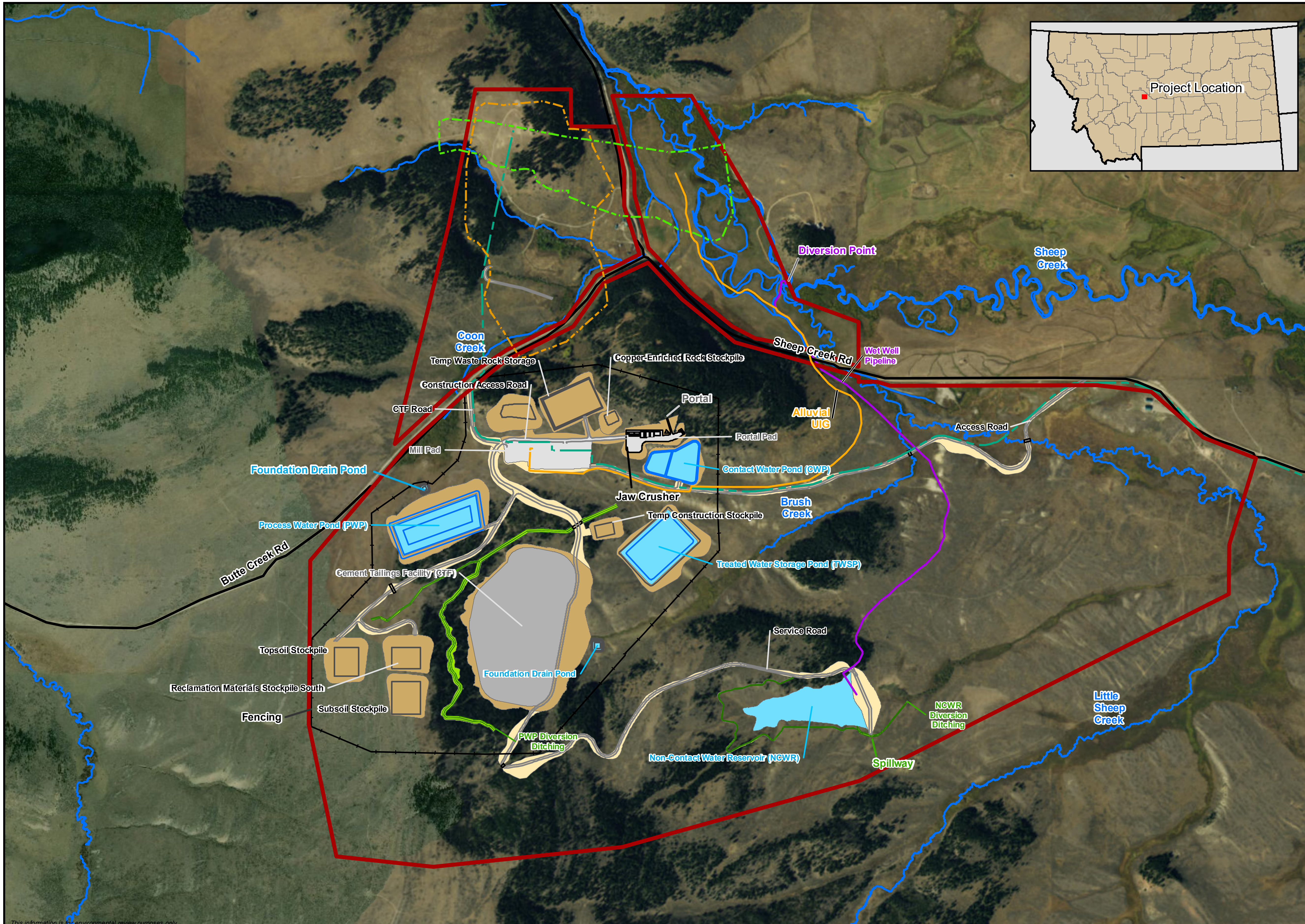
The Proponent intends to construct, operate, and reclaim a new underground copper mine over 19 years, followed by monitoring and closure of the site. There is no history of industrial development on the site. The site is located about 15 miles north of White Sulphur Springs in Meagher County, Montana. 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 235 workers, with an additional 24 contract miners and 127 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



- LCZ_Footprint
- UCZ_Footprint
- MOP Application Boundary
- Fencing
- County Road
- Alluvial UIG
- Power Line
- Access Road
- Culvert Crossing
- Pipeline
- Mill Area
- Cement Tailings Facility
- Water
- Access Road
- Topsoil Stockpile
- Diversion Ditching
- Stream

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DRAWN BY: JPB

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 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. Before water is pumped to the PWP, it would be pumped to the crest of the CTF and returned to the CTF first where it would ultimately flow into the CTF basin drain and into the

CTF reclaim system. The MOP Application states that service life of the CTF liner is estimated as 400 years or more (Tintina 2017).

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 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. The primary purpose of the NCWR is water storage for stream flow augmentation that the Montana Department of Natural Resources and Conservation (DNRC) may require for water rights mitigations. Surface water would be 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). Water stored in the NCWR could be used to augment flows at several locations, as required, including Sheep Creek (via discharge back through the wet well), Coon Creek, Black Butte Creek, Little Sheep Creek (via seepage through the bottom of the reservoir), and Brush Creek (if indirect impacts to wetlands are observed due to interception of groundwater beneath the CTF). Discharges to Coon Creek, Black Butte Creek, and the Brush Creek wetland would likely occur via small UIGs constructed adjacent to the streams so that the transferred water may equilibrate with ground

[1] 1-mil = 1/1,000 of an inch

temperatures before entering the streams. NCWR water could also offset consumptive use of groundwater by the milling and mining operation (about 220 gallons per minute), as per DNRC requirements (DNRC 2012). As the NCWR would be used for transfer of water between Sheep Creek and other streams, discharges from the NCWR would not require coverage under an MPDES permit (see ARM 17.30.1310(1)(g) and 40 CFR 122.3(i)).

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 2 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, Interstate 90 (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. 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).

The MOP Application (Tintina 2017) describes that all pipelines carrying potentially contaminated water (e.g., WRS and copper-enriched stockpile to CWP, CTF to PWP, PWP to WTP, CWP/brine pond to WTP, and CTF foundation pond to WTP or PWP) would have secondary containment measures. Further, the MOP Application states:

> "The [CTF] pipeline will be constructed with secondary containment to capture and contain tailings in the event of a main pipeline leak, (one alternative includes a double-walled pipeline between the mill site and the CTF and between the mill and the portal, another such as a lined trench with a cover may be more appropriate for the project). Secondary containment will not be required on the CTF crest as tailings will flow onto the liner and into the CTF in the event of a leak. The pipeline will have an internal HDPE liner to prevent corrosion." (Tintina 2017)

The MOP Application also states:

> "The Project will be operating in freezing temperatures for a significant portion of each year. The pipeline will be insulated or heat traced to protect against freezing. Additionally, the pipeline will be flushed with about 5,000 gallons of water per pumping cycle (every 6-7 days) and drained when not in use so that no standing water or tailings are left in the pipeline to freeze or set up." (Tintina 2017)

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. Prior to the final flooding in 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, and the rinsing process would be performed repeatedly for a particular segment of the mine. 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 non-degradation 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 non-degradation criteria are attained.

The NCWR would be used for mitigation of depletion in surface waters during operations and for approximately 20 years after the end of mine dewatering (Hydrometrics, Inc. 2018a). Once the flow mitigation system is 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.

2.2.9. Design and Safety Considerations

Reasonably foreseeable and/or potential environmental consequences and effects due to the Project have been analyzed in Chapter 3 of this EIS. The failure analysis of Project facilities and processes is described in more detail in the “Failure Modes Effects Analysis” (Geomin Resources, Inc. 2015), which is included as Appendix R of the MOP Application (Tintina 2017).

2.2.9.1. Cemented Tailings Facility

Section 82-4-376, MCA, requires a permit applicant proposing to construct a new tailings storage facility to submit a design document to DEQ that contains certification by an engineer of record. The design document must demonstrate compliance with design requirements in § 82-4-376, MCA, for tailings impoundment safety and stability, including a dam breach analysis, a failure modes and effects analysis or other appropriate detailed risk assessment, and an observational method plan addressing residual risk. The impoundment design must also demonstrate that the seismic response of the tailings storage facility would not result in the uncontrolled release of impounded materials when subject to the ground motion associated with the 1-in-10,000-year event or the maximum credible earthquake, whichever is greater.

Under § 82-4-377, MCA, an independent review panel consisting of three independent review engineers is required to review the design document. The panel is required to submit its review and recommended modifications to the permit applicant. The panel's determination is conclusive, and the engineer of record is required to modify the design document to address the recommendations of the independent review panel.

The Project’s CTF would not meet the definition of "Tailings Storage Facility" as described in § 82-4-303 (34), MCA, because it would store less than 50 acre-feet of water within it. Despite this, the Proponent opted to conduct a safety and stability review of the proposed CTF under §§ 82-4-376 and 377, MCA. Knight Piésold Consulting prepared a “Tailings Storage Facility Design” review in September 2017 (Knight Piésold Consulting 2017), which served as the tailings storage facility design document pursuant to § 82-4-376, MCA. An independent review panel of three scientists or engineers reviewed the design document, pursuant to § 82-4-376, MCA. The design document was modified to incorporate recommendations of the independent review panel. The “Tailings Storage Facility Design” document (Knight Piésold Consulting 2017) concludes that the likelihood of embankment failure due to foundation and slope instability is ‘Very Low’. It states:

> “An earthquake could potentially induce deformations and settlement of the embankment crest, which could theoretically lead to a potential loss of freeboard and overtopping. However, this has a very low probability of occurrence as the CTF is designed to withstand the 1 in 10,000 year earthquake event, and would have to be simultaneously flooded by a storm event at the time of failure. The risk of earthquake-induced deformation leading to overtopping is very low.” (Knight Piésold Consulting 2017)

Because the CTF is designed to retain the Probable Maximum Precipitation event of 22 inches, which is estimated to be a 1-in-10,000-year event as well, the odds of a major earthquake and a Probable Maximum Precipitation storm event occurring within 1 month of each other is extremely low.

Additionally, Knight Piésold Consulting prepared a "Tailings Operations, Maintenance and Surveillance (TOMS) Manual" in July 2017, which is included as Appendix I of the Tailings Storage Facility Design document (Knight Piésold Consulting 2017), pursuant to § 82-4-379, MCA. Appendix G ("CTF Dam Breach Risk Assessment") of the "Tailings Storage Facility Design" document analyzes the risk of seismic activity on the CTF. Appendix G states that tailings deposited in the CTF would be mixed with binding agents (e.g., cement, fly-ash) before deposition. Once it sets, it would be a non-flowable mass. Although it is very unlikely the CTF embankment would breach and the liner system would tear, the tailings would likely slump in place in such a situation, but would not flow out to the downstream receiving environment. Although the probability of failure is very low, the consequence of failure under normal operating conditions or an earthquake event is considered to be Moderate, which means there could be serious deformation but no uncontrolled release of containment (Appendix G of Knight Piésold Consulting 2017). The "Tailings Storage Facility Design" document concludes:

> "The probability of failure for the various hazards (foundation and slope instability, overtopping, internal erosion and piping) is either not credible or 'Very Low'. The CTF is designed for the storage of non-flowable cemented tailings, and is not a water retaining impoundment. Therefore, the resulting consequences of failure for the credible but 'Very Low' probability items are 'Moderate'. This indicates an overall 'Very Low' risk related to a breach of the CTF." (Knight Piésold Consulting 2017)

2.2.9.2. Liner Performance

The CTF impoundment would be double-lined, and each of the two liner layers would be constructed of 0.1-inch 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. The MOP Application (Tintina 2017) describes that the estimated potential seepage from a fully saturated CTF to the geonet layer would be approximately 4.2 gallons per day; however, the CTF would be operated with a small volume of stored water, and so seepage rates are expected to be less. Seepage through the lower liner of the CTF would be limited by the upper liner at the rate of 4.2 gallons per day (assuming inundated conditions). Seepage through the lower liner would be collected in the CTF foundation drain system.

The life expectancy of HDPE geomembrane liners was evaluated and reported in the MOP Application (Tintina 2017). HDPE geomembranes used in landfills should last for about 400 years (Peggs 2003). Tintina (2017) estimates the service life of the CTF lining system to be about 400 years as well, given the specific design details, ambient temperature range, and recommended construction methods.

2.3. ALTERNATIVES TO THE NO ACTION AND PROPOSED ACTION ALTERNATIVES

MEPA states, “A reasonable alternative is one that is practical, technically possible, and economically feasible. A reasonable alternative should fulfill the purpose and need of the proposed action and will address significant and relevant issues” (Montana EQC 2017).

For the purpose of this screening process, individual alternative ideas were identified and evaluated for potential integration into one or more alternatives to be analyzed as part of the EIS. Therefore, this EIS refers to the term “alternative idea” as the concept that was screened, rather than “alternative.” The term “alternative idea” includes any aspect of Project construction, operation, closure, or reclamation, as related to timing, geography, design, or process. For example, alternative ideas could include different locations for treatment ponds or facilities, alternate methods of tailings management, or alternate timing of reclamation.

The alternative idea screening process involved a multi-step approach of developing a list of alternative ideas to be screened based on a review of all available information and input compiled to date; developing screening criteria and the screening table to be used for identifying “reasonable” alternative ideas; and evaluating each alternative idea against the screening criteria using the screening table.

The following sources were reviewed:

- Scoping Report (Appendix J of this EIS); original comments were reviewed where additional detail was required beyond that provided in the Scoping Report;
- MOP Application (Tintina 2017) and DEQ-approved updates (Section 2.2, Proposed Updates, of this EIS);
- Technical Memoranda (Appendices A through H of this EIS);
- DEQ’s third-party contractor Subject Matter Expert input; and
- DEQ input.

Three screening criteria were used to assess the alternative ideas. The first three criteria were whether the alternative idea is practical:

- Does it meet the Project purpose and need (see definition in Chapter 1 of this EIS)?
- Is it technically feasible (achievable by current technology)?
- Is it economically feasible? Economic feasibility is determined solely by the economic viability for similar projects having similar conditions and physical locations and determined without regard to the economic strength of the specific project sponsor.

An additional consideration was whether the alternative idea provides an environmental benefit to any aspect of the human environment compared to the Proposed Action. For purposes of determining whether to carry forward an alternative for detailed analysis, DEQ may consider the environmental benefit relative to the Proposed Action. The “environment” includes all aspects of the human environment (e.g., physical, biological, chemical, social, and cultural).

The review process identified 13 alternative ideas that merited the initial screening. Of these, 12 were found to not meet at least one of the screening criteria and were therefore eliminated from further analysis. These 12 alternative ideas are described below in Section 2.3.2, Alternatives Considered but Dismissed from Detailed Analysis.

One alternative idea was found to warrant further analysis in the EIS. This alternative idea was carried forward and developed as the AMA, and proposes to backfill certain voids with cemented paste tailings generated from mill processing of the stockpiled ore and/or waste rock at the end of operations. The alternative idea is described in detail in Section 2.3.1.

2.3.1. Agency Modified Alternative: Additional Backfill of Mine Workings

This section describes the Project modifications to be incorporated into the AMA. This alternative idea appears to be a reasonable alternative that is both practicable and likely to result in environmental benefits over the Proposed Action. Environmental benefits of the AMA could include (1) reducing the potential for groundwater mixing between upper and lower aquifers, and (2) reducing the risk of groundwater contamination from exposed underground mine surfaces at closure compared to the Proposed Action. The potential environmental impacts of the AMA are evaluated further 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.

2.3.2. 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.

2.3.2.1. 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) presented and analyzed four potential locations for the CTF. The West Impoundment location would be a short valley to the west of the other Project facilities, and it would be in a different drainage basin than other facilities. Within that drainage, the location of Black Butte Creek would limit the extent of the West Impoundment footprint, so the facility would only provide a fraction of the tailings storage capacity necessary for the Project. This site would have limited expansion capacity, requiring additional extensive excavation. As such, it would not achieve the purpose and need of the Project and was dismissed by DEQ. The Central Impoundment location would provide adequate storage capacity for the Project, and it would require a disturbance footprint of 97.7 acres, the relocation of a county road, a tailings discharge pipeline length of 0.93 mile, and approximately 6.56 acres of disturbance to wetlands. The East Impoundment location would provide similar storage capacity as the Central Impoundment site, but it would require a larger disturbance footprint of 128.9 acres, a tailings discharge pipeline length of 1.43 miles, and approximately 11.05 acres of disturbance to wetlands. The fourth potential CTF location would provide adequate storage capacity for the Project, but it would require a smaller disturbance footprint of 87.7 acres, a tailings discharge pipeline length of 0.87 mile, and approximately 0.71 acre of disturbance to wetlands.

Based on the analysis of these alternative designs, the Central and East Impoundments were considered to have greater environmental impacts. DEQ concluded that the fourth CTF location, which was selected for the Proposed Action, would result in the least environmental impacts, particularly to wetlands. Therefore, the alternative impoundment locations were dismissed and not carried forward for further detailed analysis.

2.3.2.2. 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.

2.3.2.3. 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.

2.3.2.4. 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 U.S. Route 89, over King’s Hill, then west on U.S. Route 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

U.S. Route 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 U.S. Route 12 to Harlowton, south on U.S. Route 191, cross the Yellowstone River at Big Timber, then west on I-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: U.S. Route 89 to east of Livingston and U.S. Route 89/U.S. Route 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, as a disclosure of the potential impacts to the human environment as required by MEPA. 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.

2.3.2.5. 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 and Temperature, in this EIS).

2.3.2.6. Increase Cement Content in Tailings

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

Both Appendix Q of the 2017 MOP Application (Geomin Resources, Inc. 2016) and Technical Memorandum 1 (see Appendix A of this EIS) show that the cement and binder contents proposed for both the surface CTF (0.5 to 2 percent) and the cemented tailings backfill (4 percent) of the underground mine are sufficient to achieve necessary strength and comply with water quality protection requirements. Increasing the cement and binder content in the paste tailings in either location would not provide additional environmental benefits, and if too much cement and binder were added, it would not be possible to pump the tailings through a pipeline. Technical Memorandum 1 recommended operational flexibility in cement content to allow optimizing performance in pumping and final behavior.

The quantity of cement and binder proposed to be added to the paste tailings is not intended to delay or prevent ARD formation. Rather, it is meant to provide structural strength and to change the physical properties of the solidified tailings to a stable, non-flowable material with low hydraulic conductivity. Elevated sulfide content in the tailings does not necessarily equate to acid production. In order for the internal sulfides to oxidize and produce sulfate, the right physical and chemical conditions for oxidation are required. This is precluded if the material has low hydraulic conductivity and it sufficiently limits ingress of water and/or oxygen.

The tested quantities of cement and binder (2 percent and 4 percent) were determined to be sufficient to limit blowing dust (i.e., in the CTF) and reduce the formation of acidity on the tailings surface, although the test cylinders were unsupported and eventually disaggregated and further oxidized. In the underground mine, the cemented paste tailings backfill would solidify in approximately 1 month, but the potential for expansion, disaggregation, and exposure of the backfill would be limited due to placement methods. The cemented paste tailings backfill would be confined by a shotcrete bulkhead. The backfill would solidify in the stope within low conductivity bedrock, further reducing the potential for physical degradation and oxidation of the tailings surfaces and the resulting impacts to water quality.

The tailings surface in the CTF would be covered by successive layers of paste tailings within 7 to 30 days, before extensive oxidation and degradation could occur. Near closure, whether permanent or temporary, the upper lift of cemented paste tailings would contain additional cement and binder (4 percent) (Tintina 2017). This would decrease the potential for dust, increase the surface strength, and create a more durable surface for equipment to perform reclamation activities. No tailings would be left exposed near the surface in closure. Sections 2.2.2 and 2.2.8 of this EIS describe that the CTF foundation would be double lined with HDPE liners, and the top would be capped with a HDPE geomembrane liner covered by a minimum of 5 feet of non-reactive fill material and soil, which would then be revegetated. Any seepage or contact water within the liner, during the reclamation steps or following closure, would be captured by the internal sump and pumped to the WTP. As with the underground backfill, when the CTF has been encapsulated, there is very limited potential for breakdown or disaggregation of the cemented tailings. The vegetated reclamation cover and upper liner placement would also restrict water and oxygen from entering the CTF, precluding sulfide oxidation on exposed surfaces and impacts to water quality.

2.3.2.7. 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. As designed, the CTF underdrain would lower the water table such that there would be no groundwater pressure against the CTF liner. Therefore, potential impacts to groundwater would not necessarily be reduced by raising the elevation of the CTF. 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 U.S. Route 89.

2.3.2.8. 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. The tailings de-pyritization[2] process would generate a larger volume of non-Potentially Acid Generating tailings and a smaller fraction of Potentially Acid Generating concentrated sulfides, the latter corresponding to a potentially more hazardous pyritic sulfide-rich waste stream in comparison to either the remaining tailings or the Proposed Action. With other minerals or buffering constituents removed from the sulfide-rich waste stream, the fine-grained material would have greater potential for oxidation (i.e., acid production) and/or spontaneous combustion.

Production of the concentrated pyritic sulfide-rich waste stream would also require the use of considerably more chemicals (e.g., acids, bases, and organic flotation chemicals). Handling of these materials would require an additional and larger pyrite flotation circuit in the mill, a separate tailings pumping system, and a separate PWP in addition to the proposed PWP. If surface storage were the preferred method for long-term disposal, a new and separate storage

[2] The process of removing pyrite from the tailings, resulting in a tailings stream and concentrated pyrite stream

facility (tailings impoundment) would be needed for handling and disposal of the sulfide concentrate (i.e., two impoundments would be required). A surface impoundment may also be needed under the scenario where only a portion of the total volume of sulfide-rich tailings would fit in the underground workings, and/or the sulfide-rich tailings would not provide sufficient strength characteristics to allow using it completely for underground backfill.

If underground storage were the preferred method for long-term disposal, only about 45 percent of the total tailings volume could be physically placed underground as backfill. If the volume of high-sulfide waste from full pyrite separation exceeds that amount, it would require additional storage space beyond the proposed mine plan for complete underground disposal. This would require mining un-mineralized rock in order to provide room for sulfide concentrate storage underground, thereby generating additional amounts of waste rock to be disposed on the surface. It may not be feasible to convert the pyrite concentrate into a cemented paste that would cure properly and provide the necessary strength for ground support in the underground backfill. This would limit the ability to fully utilize the sulfide concentrate as backfill adjacent to mining areas, meaning that additional storage space would need to be mined or a surface disposal facility would also be necessary.

The separation of a concentrated (i.e., 95 percent) pyrite tailing stream and the suitability of placing that material underground as either unconsolidated tailings or cemented tailings backfill was not specifically tested because the environmental risks and potential water quality impacts produced by creating and disposing a separate pyrite concentrate stream were deemed too significant. Whether the sulfide-rich waste would be stored in a surface impoundment, as underground backfill, or both, additional management strategies would have to be developed for long-term storage to mitigate oxidation (i.e., acid 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 Project 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. Due to all these factors, an alternative requiring full pyrite separation was considered but dismissed from detailed analysis.

2.3.2.9. 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 the potential to contaminate groundwater. 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 applying surface treatments to limit oxidation during operations. Technical Memorandum 6 concluded that most of the commonly used methods in the mining industry to control inflow are already proposed for the Project, and other water source control options would be no more effective than the proposed best practice methods. The modeling of post-closure conditions demonstrates compliance with non-degradation groundwater criteria, so additional methods of inflow control are not deemed necessary.

While the application of asphalt, synthetic spray-on covers, or wax barriers could be used to limit oxidation on tunnel surfaces, they would be subject to degradation and would not be practical for underground mining. Polypropylene fiber reinforced shotcrete is proposed to be used to aid in ground support for underground stability, as well as a cementitious surface cover over the bulkheads used for sealing backfilled mine surfaces. The use of potassium permanganate was not reviewed in detail for its potential to prevent oxidation because the stopes that could primarily contribute to acid generation would be backfilled within a short timeframe of exposure (1 to 2 months). As demonstrated by kinetic testing of the mineralized bedrock (Enviromin 2017), the surfaces that would be exposed by mining would have considerable buffering capacity to delay the generation of acidity, even though there are elevated sulfide concentrations in the rock. These surfaces would be backfilled before oxidation results in net acid generation. The application of a reagent like potassium permanganate utilizes the oxidizing ability of the permanganate ion to create a manganese-iron oxide coating on sulfidic rock. All treated surfaces would still have potentially reactive rock below the coating, and oxidation could return if the outer manganese-iron oxide coating is removed, whether by physical or chemical means. The stope backfill approach is considered to be more permanent and effective at limiting the exposure and oxidation of reactive surfaces than the application of a surface treatment.

2.3.2.10. 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.

2.3.2.11. 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.

2.3.2.12. 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. Although kinetic testing of tailings indicated that maintaining saturated or sub-aqueous tailings in the proposed CTF would limit tailings oxidation within the facility, 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 safely contain both tailings and water, which would result in increased embankment material sourcing impacts, increased embankment disturbance footprint, and increased visual impacts. This alternative would require other methods of operational water balance management, resulting in additional water collection and treatment and potential mitigations to prevent wildlife (e.g., waterfowl, shorebirds, etc.) from interacting with a large pond.

Maintaining permanently saturated or sub-aqueous conditions in the post-closure facility would require a long-term source and water right for the water needed to maintain a pond; water collection; and water treatment facilities may still be needed, which would extend the duration of potential impacts to wildlife and geotechnical stability. Unless the tailings are permanently stored under saturated or sub-aqueous conditions, they would need to be eventually capped and revegetated in order to reduce exposure and geochemical reactivity. This would require the tailings to adequately dry and consolidate before being trafficable.

In order to effectively cover the tailings and limit the potential for oxidation, water from the operational pond would need to be removed and potentially treated. This would extend the timeline for draining the pond and the tailings pore water, as well as the time period for potential tailings oxidation, 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.

2.4. 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 AMA as the agency's preferred alternative.

The AMA 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. Backfilling would further reduce the potential for groundwater mixing between upper and lower aquifers, and further reduce potential groundwater contamination from exposed underground mine surfaces at closure compared to the Proposed Action.

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, and 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

Environmental Impact Criteria		
Severity	**Duration/Frequency**	**Description**
Low	Short term (up to 1 year) Low frequency	Affects environmental conditions, water, resources, air quality, species, and habitats over a short period. The impact is localized and reversible. Environmental standards would not be exceeded.
Medium	Medium term (1 to 7 years) Medium or intermittent frequency	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.
High	Long term (more than 7 years)/Irreversible Constant frequency	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.

Social Impact Criteria				
Severity	**Duration/Frequency**	**Extent**	**Ability to Adapt**	**Social Outcome**
Low	Short term (up to 1 year) Low frequency	Individual/ Household	Those affected would be able to adapt to the changes with relative ease and maintain pre-impact livelihoods, culture, and quality of life.	Inconvenience but with no consequence on long-term livelihoods, culture, quality of life, resources, infrastructure, and services.
Medium	Medium term (1 to 7 years) Medium or intermittent frequency	Small number of households	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.	Direct and secondary impacts on livelihoods, culture, quality of life, resources, infrastructure, and services.
High	Long term (more than 7 years)/Irreversible Constant frequency	Large part or entirely	Those affected would not be able to adapt to changes and continue to maintain pre-impact livelihood.	Widespread and diverse direct and secondary impacts would likely be impossible to reverse or compensate for.

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 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 and outside of 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-month	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 dioxide; 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 J). 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. 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. 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, even though 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.

Mobile Source Regulations

The USEPA regulates mobile sources of air pollution in Montana through federal mobile source standards. Vehicles used in 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 require 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 J). 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 4.2.1, as well as a future related action in the analysis area, described in detail in Section 4.2.2, 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 consisted of 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 Appendix W of 40 CFR 51 (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 3.2-5** for 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 3.2-5** for 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 reacts 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 when deposited to the surface 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 to 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 to 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 to DEQ 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
- GHG[3] 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 would 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 years 1 to 2	X	N/A	56.42	14.38	1.44
F3	Road dust, operating years 2 to 15, annual average	N/A	X	17.79	4.53	0.45
F4	Road dust, operating years 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 years 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 years 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 years 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 years 16 to 18	N/A	X	4.17	1.21	0.39
F20	Copper-enriched rock drop to stockpile, operating years 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 years 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 years 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, years 0-2 average	X	N/A	0.90	0.23	0.02
F30	Road dust, main access road, years 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**, point sources (i.e., those that exhaust through a stack or vent) 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 transfer and storage 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 Emissions 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 tpy. 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 raises.

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. The underground emissions due to blasting are tabulated in **Table 3.2-6** as ANFO underground explosive. It is generally found that larger particulates generated by the blasts are able to settle within the underground workings; however, that is not necessarily the case for fine particulates and gaseous emissions. The emissions due to blasting were included in the modeled air quality impacts as part of the mine vent point sources, and were found to not be a significant contributor to air quality effects. The amount of explosive used is limited on an annual basis as a condition of the air quality permit, which also regulates the exhaust ports as point sources of opacity restrictions. In addition, control of dust from blasting must be included in the Site Fugitive Dust Control Plan.

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; and
- 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.

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[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

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 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. A paste plant in the mill complex would mix fine-grained tailings from the milling process with a binder—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 (Tintina 2017). The use of cemented tailings inhibits dust formation from the tailings impoundment, and provides added surface crust strength. The cemented crust of the completed tailings surfaces would resemble cured concrete, and would not contribute significant quantities of dust. On-going facility inspections required by the Site Fugitive Dust Control Plan within the air quality permit would further validate that the CTF is not a source of windblown dust.

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 of 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).

The impacts of existing projects and activities in the region are assumed to be included in the monitored air pollutant background concentrations used in the air modeling to assess conformance with NAAQS and MAAQS. Combining the highest modeled Project impacts with the monitored background conditions serves as a measure of air quality characteristics after implementation of the Project. As a result, cumulative effects of the existing projects plus the Project sources are reflected in the NAAQS analysis results provided in the following section.

Fires, including controlled burns, can have adverse impacts that may temporarily exceed NAAQS, usually for PM_{10}. Project impacts would increase the likelihood that added emissions from a controlled burn could result in cumulative local and temporary NAAQS exceedances, depending on size of the burned area and distance from the Project site. However, controlled burns or uncontrolled wildfire may cause these temporary exceedances, with or without the Project.

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 and PM_{10}. 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.

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 3.2-8
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.

The total impacts for 24-hour average PM_{10} and 1-hour average NO_2 are predicted 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.

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

Pollutant	Avg. Period	Modeled Conc. (μg/m³)	Background Conc. (μg/m³)	Total Pollutant Impact Conc. (μg/m³)	NAAQS (μg/m³)	% of NAAQS	MAAQS (μg/m³)	% 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/m³ = 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/m³ and was not included in the table. With the addition of the 20.7 μg/m³ 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.

Emergency generators would only be required in situations when normal mine operations could not continue. For routine operations, the generators would undergo intermittent and brief periods of testing and maintenance to ensure reliability; emissions for the emergency generators and other emergency engines on this basis are tabulated in **Table 3.2-6** as sources P7, P8, and P9 for each criteria pollutant. These units were modeled separately in the assessment of significance and NAAQS conformance because their non-emergency schedule is limited by regulation to 500 hours per year rather than the 8,760 hours per year assumed for other Project sources. To account for unpredictable emergency operations, the potential impacts for these generators were modeled to simulate operation for 2 consecutive but arbitrary hours per day. This scenario provides an overestimation of routine operations at 730 hours of operation per year.

As a first step, the modeled impacts due to a new source alone are compared to Significant Impact Levels (SILs), which are threshold concentrations established by regulation for Class II areas. The SILs are a small fraction of the NAAQS, and serve as an indicator of a new source's potential for significant air quality effects. The results of the SIL analysis for the group of four emergency engines are shown in **Table 3.2-10.** Only the predicted 1-hour NO_2 maximum concentration was higher than the SIL.

Based on these results, the NO_2 impact analysis was extended to a comparison of modeled results for the group of four emergency engines with the 1-hour average NO_2 NAAQS as shown in **Table 3.2-11.** Results show that the maximum receptor impact is 85 percent of the NO_2 standard; however, this would be at a location that would not overlap with the highest impacts from other Project sources.

Table 3.2-10
Impacts Comparison of Four Emergency Generators/Engines to Significant Impact Levels

Pollutant	Averaging Period	Max. Modeled Concentration [a] (μg/m³)	Class II SIL (μg/m³)	Significant Impact
PM_{10}	24-hour	1.4	53	No
$PM_{2.5}$	24-hour	0.97	1.2	No
$PM_{2.5}$	Annual	0.03	0.3	No
NO_2	1-hour	240	7.52	Yes
NO_2	Annual	0.79	1	No
SO_2	1-hour	5.6	7.8	No
SO_2	3-hour	3.8	25	No
SO_2	24-hour	0.48	5	No
SO_2	Annual	0.013	1	No
CO	1-hour	398	2,000	No
CO	8-hour	70	500	No

Source: Tintina 2018

SIL = Significant Impact Level; μg/m³ = microgram per cubic meter; Avg. = averaging; CO = carbon monoxide; 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
Note:
[a] Modeled concentration is the highest value predicted for the stated pollutant and averaging time at any receptor.

Table 3.2-11
Comparison of Nitrogen Dioxide Impacts from Four Emergency Generators/Engines

Pollutant	Averaging Period	Max. Modeled Concentration [a] (μg/m³)	Background Concentration (μg/m³)	Total Pollutant Impact Concentration (μg/m³)	NAAQS (μg/m³)	% of NAAQS
NO_2	1-hour	139.26	20.7	159.96	188	85

Source: Tintina 2018

μg/m³ = microgram per cubic meter; NAAQS = National Ambient Air Quality Standards; NO_2 = nitrogen dioxide
Note:
[a] Modeled concentration is predicted at the receptor with the highest concentration consistent with the criteria for the 1-hour NO_2 NAAQS (i.e., the 8th highest value modeled over a 5-year meteorological data 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 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.

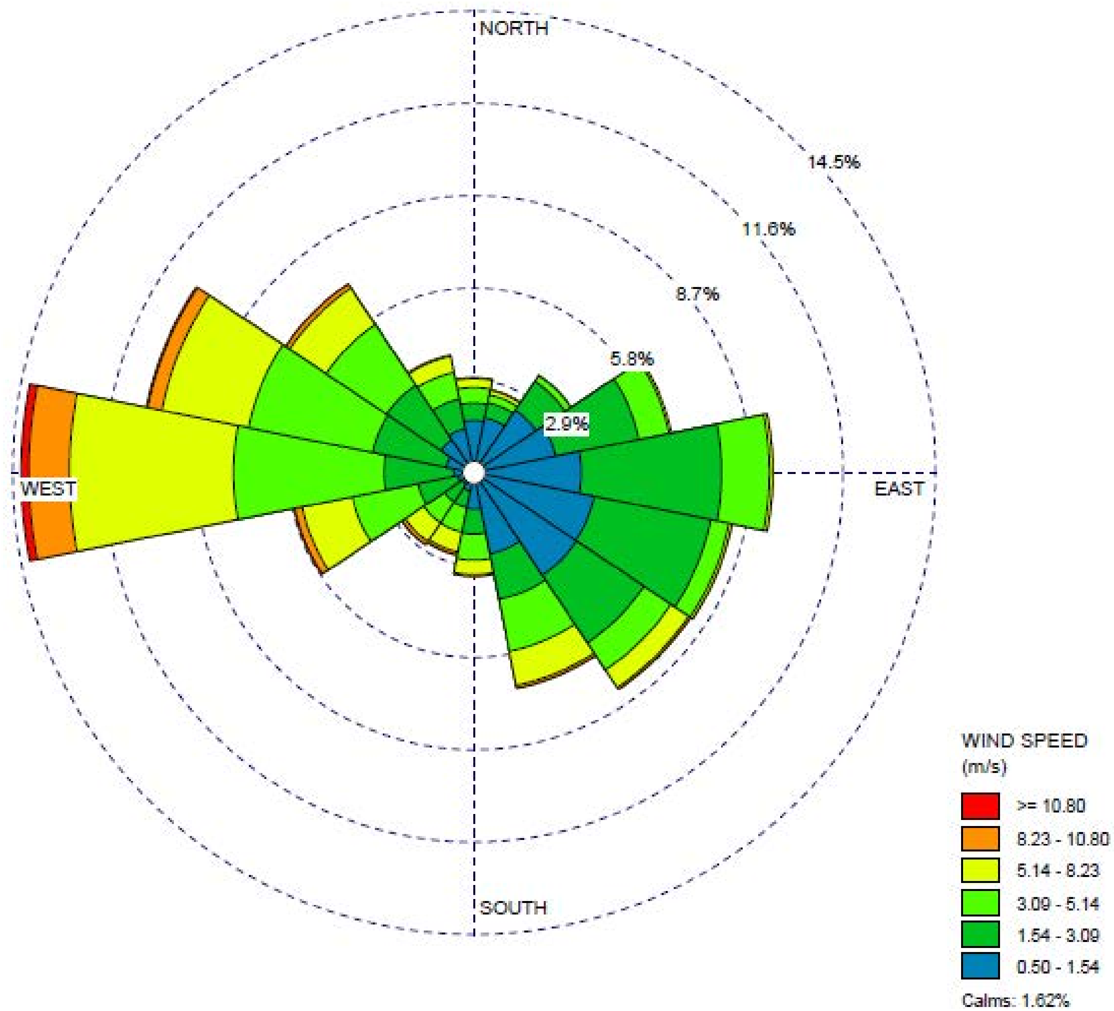
Smith River Assessment

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 $\mu g/m^3$ for the 24-hour average, and 1 $\mu g/m^3$ 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.

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 $\mu g/m^3$ for the 24-hour average, and 0.3 $\mu g/m^3$ 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 1.6 miles (2.5 kilometers) 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.



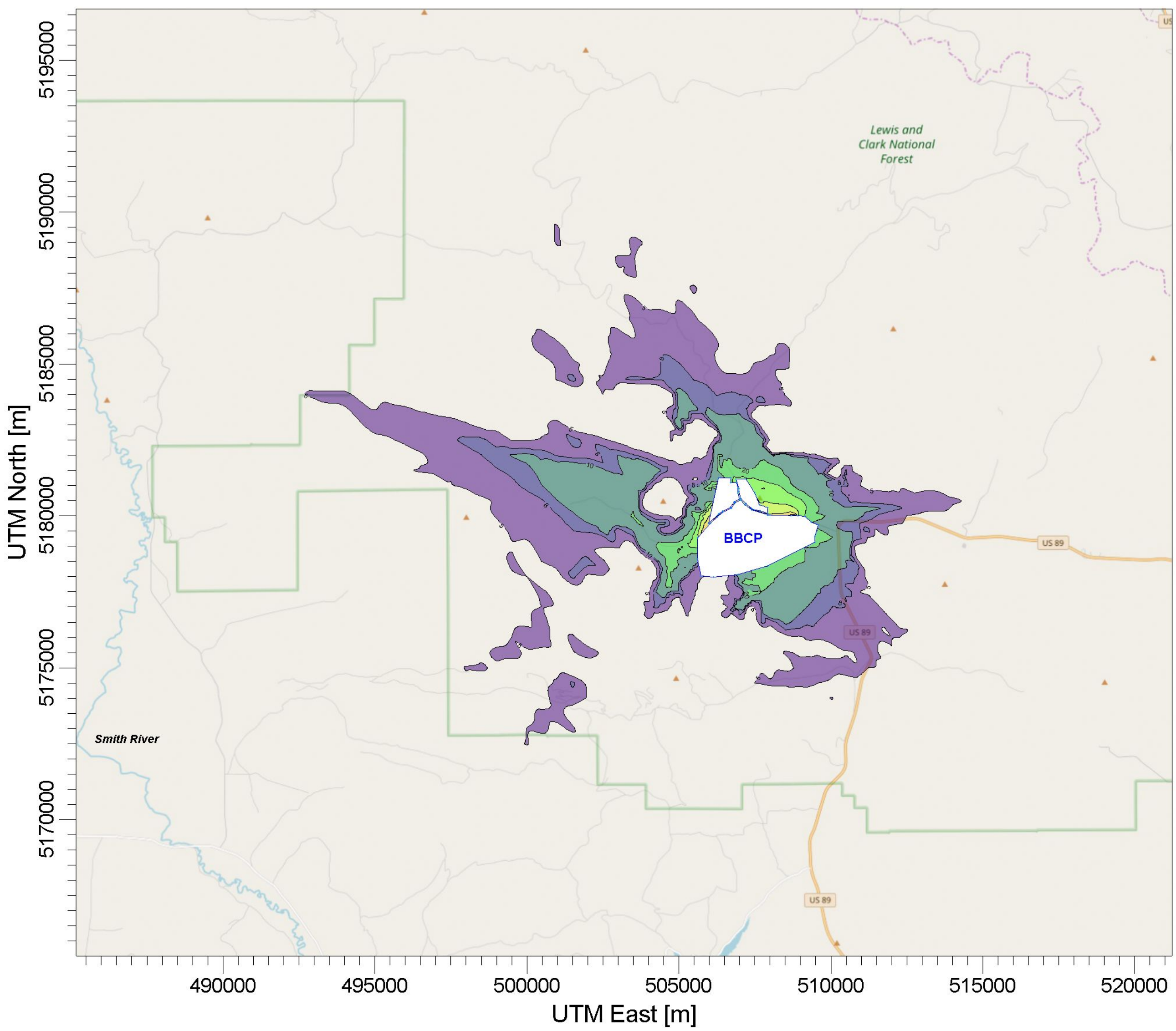
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
Indicates wind direction (blowing from) and wind speed (m/s) from the BBCP on-site meteorological station.	**Start Date: 5/1/2012 - 00:00** **End Date: 5/1/2017 - 23:59**	**Bison Engineering, Inc.**	
		MODELER: **Brian Murphy**	
	CALM WINDS: **1.62%**	TOTAL COUNT: **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:

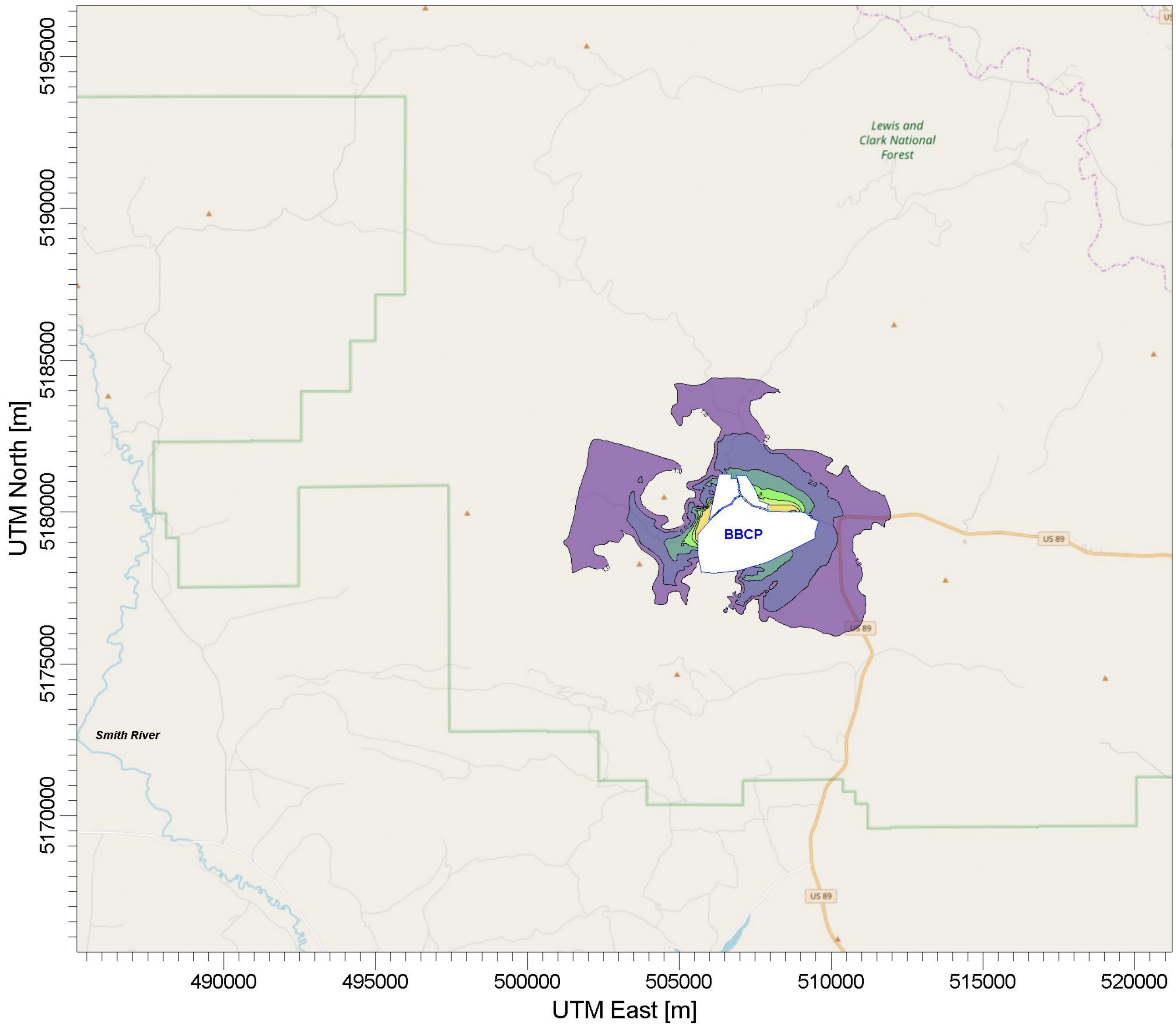
Illustrates modeled concentrations exceeding the Significant Impact Level (SIL) in relation to the Smith River.
PM10 24-Hour SIL = 5 ug/m3 Concentrations do not include ambient background.

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)

1.0	2.0	4.0	6.0	8.0	10.0	20.0	40.0

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.

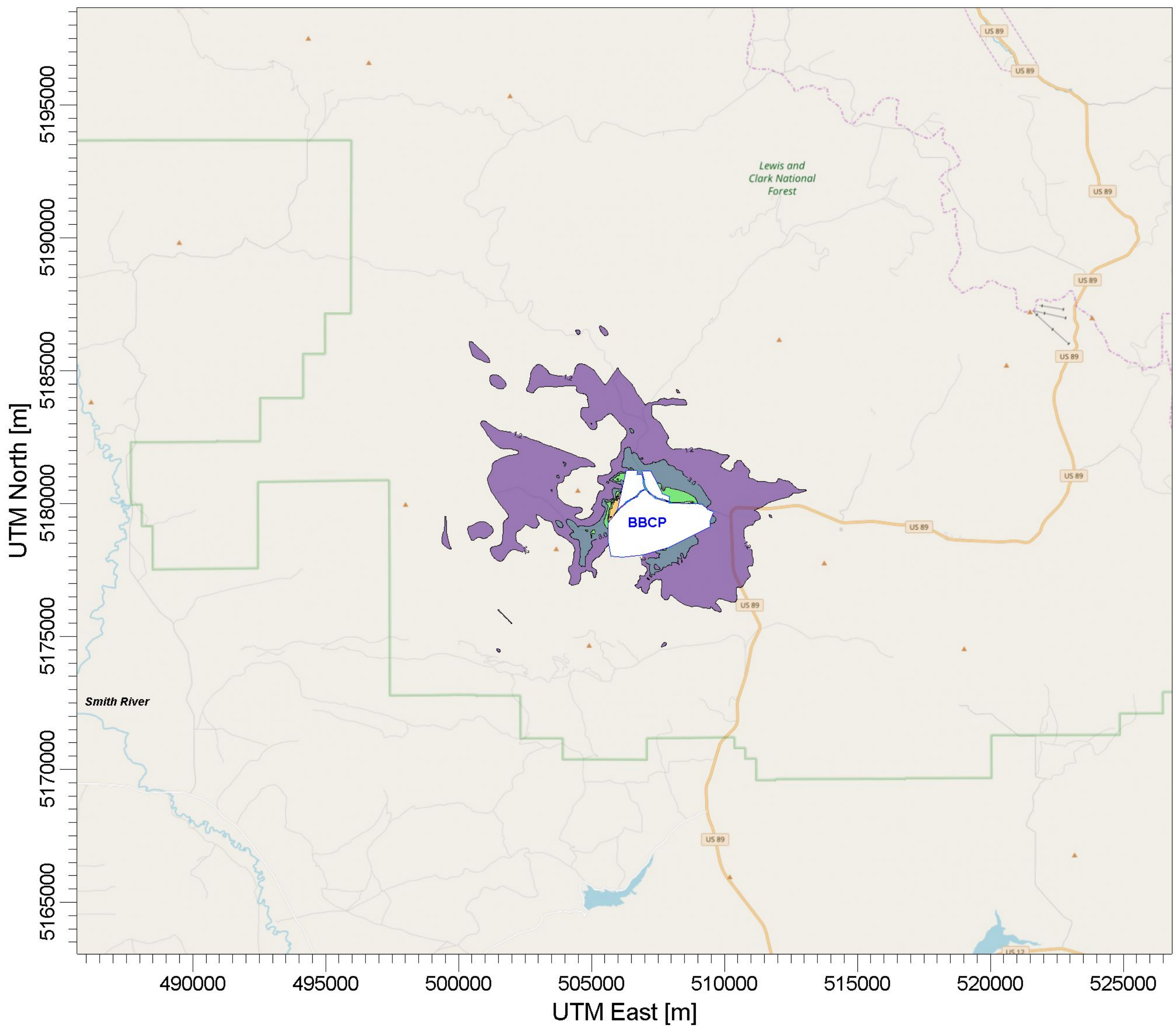
PM10 Annual SIL = 1 ug/m3 Concentrations do not include ambient background.

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)

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

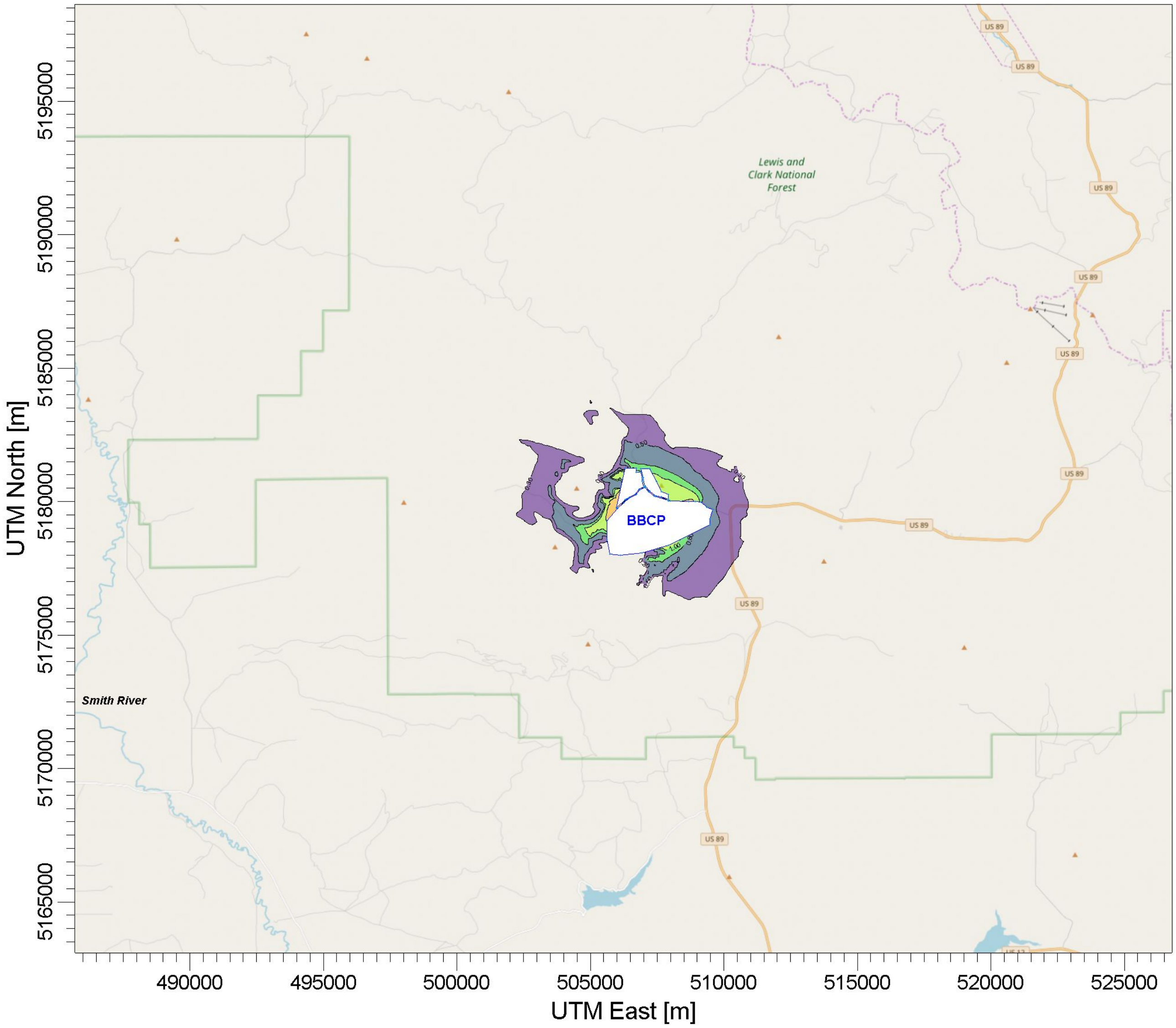
Black Butte Copper Project

$PM_{2.5}$ 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

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 6 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.

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 3.2-12** for the modification to backfill remaining underground mine workings after the end of operations.

Table 3.2-12
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 to Mill	5.84	1.49	0.15
Fugitive windblown dust from Ore Rock Stockpile and Waste 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 3.2-12**, 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 [NHPA]) 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. Additional evaluative testing was conducted in 2019.
- 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 in the NRHP.
- Site 24ME1111 (the Sheep Creek Quarry District) has been determined eligible for listing in the NRHP. Mitigations to address impacts to the district have been determined but not implemented.
- Evaluative testing on one archaeological site (24ME163) in 2012 to determine its eligibility for listing in the NRHP. Based on evaluative testing, the site was recommended as eligible for listing in the NRHP. A mitigation plan was submitted to DEQ and SHPO in 2019. SHPO did not concur with the proposed mitigation plan. Mitigation was performed in June 2019 without SHPO approval. The Montana Antiquities Act and federal laws relating to the

protection of cultural resources on private land as described above do not apply to this site as it is located on private land and there is no federal regulatory involvement.

- Evaluative testing was conducted on four archaeological sites (24ME0166, 24ME1105, 24ME1109, and 24ME1110) in 2019. Based on the evaluative testing, two sites (24ME0166 and 24ME1110) are recommended as not eligible for listing in the NRHP and two sites (24ME1105 and 24ME1109) are recommended as eligible for listing in the NRHP. No mitigation measures for the two eligible sites have been proposed at this time. Any construction at these two locations could result in resource impacts.

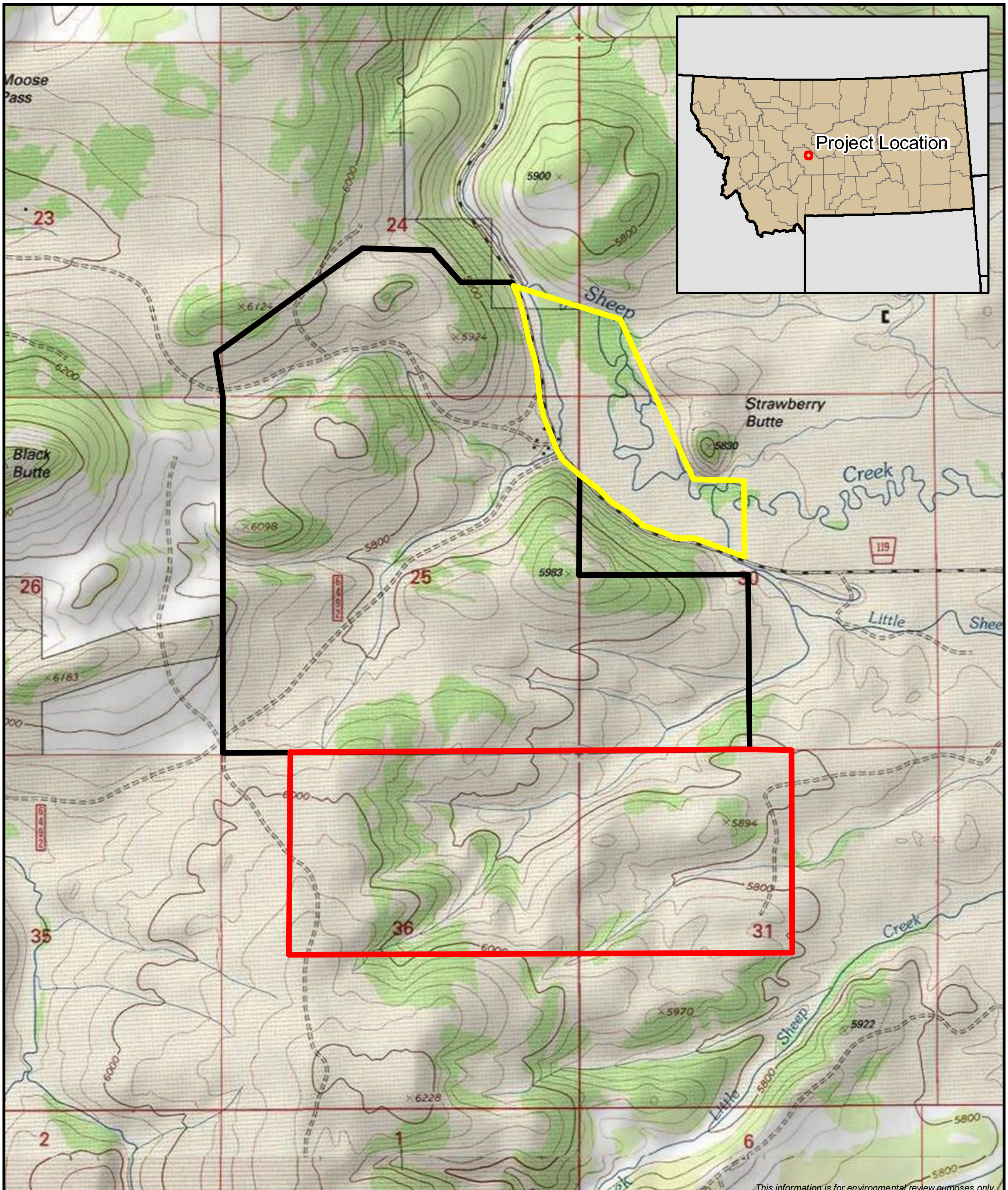
3.3.2. Affected Environment

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 (amsl). 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**). 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 remained unevaluated for listing in the NRHP. SHPO concurred with all eligibility recommendations of sites identified in the survey reports. Evaluative testing was conducted on four of the unevaluated sites; two of these sites are recommended as not eligible for listing in the NRHP and two are recommended as eligible for listing in the NRHP (see Section 3.3.1).



2011-2012 Inventory Area
2015 Inventory Area
2018 Inventory Area

N

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

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
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	No Impact	Tested, not eligible	Tetra Tech 2013a, 2019
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	Impacted	Tested, eligible under Criterion D	Tetra Tech 2015, 2019
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	Tested, eligible under Criterion D	Tetra Tech 2015, 2019

Site Number	Site Type	Potential Impacts	NRHP Recommendation	Report Source
24ME1110	Lithic Scatter	No Impact	Tested, not eligible	Tetra Tech 2015, 2019
24ME1111	Sheep Creek Surface Stone Quarry District	Impacted	Eligible under Criterion D	Tetra Tech 2015
24ME1135	Coon Creek Irrigation Ditch	No Impact	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. However, limited mitigation conducted at Site 24ME163, evaluative testing that has occurred to 24ME1105 and 24ME1109, and all ground-disturbing activities that have occurred to date in regard to the Sheep Creek Surface Stone Quarry District (24ME1111) represent an adverse effect to Historic Properties due to a reduction of integrity to those sites. Data collection tied to these efforts may assist in reducing the adverse effects.

3.3.3.2. Proposed Action

One historic site (24ME1104) was recommended as eligible under Criterion C; three prehistoric sites (24ME0163, 24ME1105 and 24ME1109) were recommended as eligible under Criterion D; and seven historic sites (24ME0158, 24ME0159, 24ME925, 24ME0936, 24ME940, 24ME1135, 24ME1136), two prehistoric sites (24ME0166 and 24ME1110), and two isolated finds were recommended as not eligible for listing in the NRHP. The Sheep Creek Surface Stone Quarry 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 further contribute to the eligibility recommendation of this district.

Avoidance was recommended for the eight unevaluated sites; if avoidance is not possible, additional testing to determine eligibility was recommended. As currently designed, the Project would avoid six of the unevaluated sites (24ME0160, 24ME0161, 24ME0162, 24ME1106, 24ME1107, and 24ME1108); no further work is recommended at these sites. If there are design changes that would impact these sites, then additional testing is recommended.

Project activities would avoid eligible site 24ME1104. Project activities could impact eligible sites 24ME1105 and 24ME1109; no mitigation measures have been proposed at this time. A mitigation plan for eligible site 24ME0163 was proposed and discussed among SHPO, the Proponent, and DEQ in October 2018. At that time, a concept for an acceptable approach was developed with a written mitigation plan to be forthcoming. In May 2019, the Proponent submitted a mitigation plan to DEQ that was different from the concept previously discussed and agreed upon. DEQ submitted the plan to SHPO, and SHPO did not concur with the proposed mitigation. The Proponent proceeded with the proposed mitigation in June 2019.

A mitigation plan for the Sheep Creek Quarry District (24ME1111) was developed (Tetra Tech 2016). Mitigation of 24ME111 is proposed to 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.

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.

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

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 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 substantive 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.

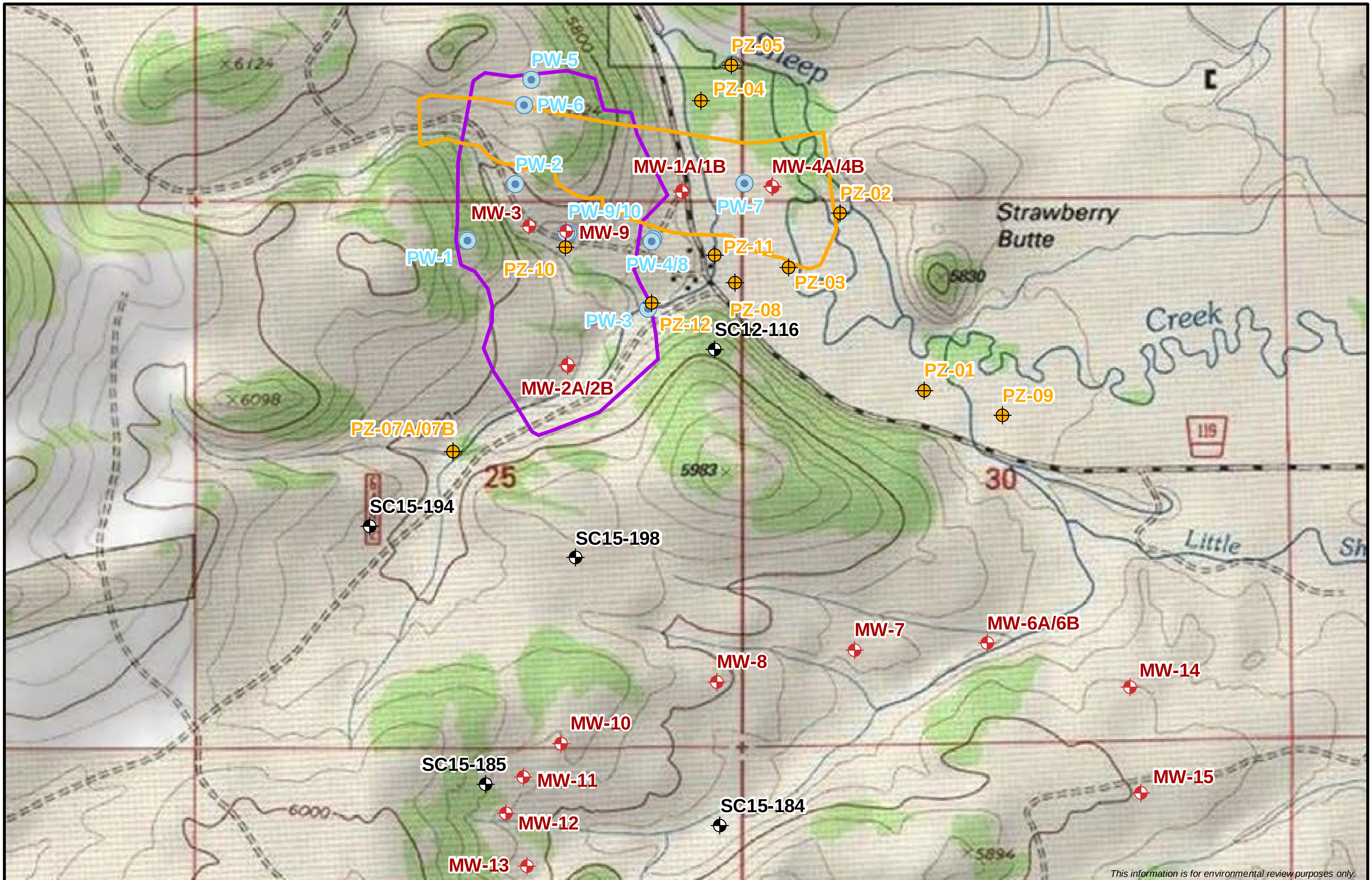
Below is a summary of methods used to complete the groundwater-focused tests, studies, and analyses.

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, Inc. 2016b), which is included as Appendix U of the MOP Application (Tintina 2017).



Piezometer

Monitoring Well

SC Well

Test Well

Lower Johnny Lee Deposit

Upper Johnny Lee Deposit

0 1,000 2,000 Feet

N

Figure 3.4-1

Black Butte Copper Project

Groundwater Hydrology Baseline Monitoring Sites/Local Study Area

Meagher County, Montana

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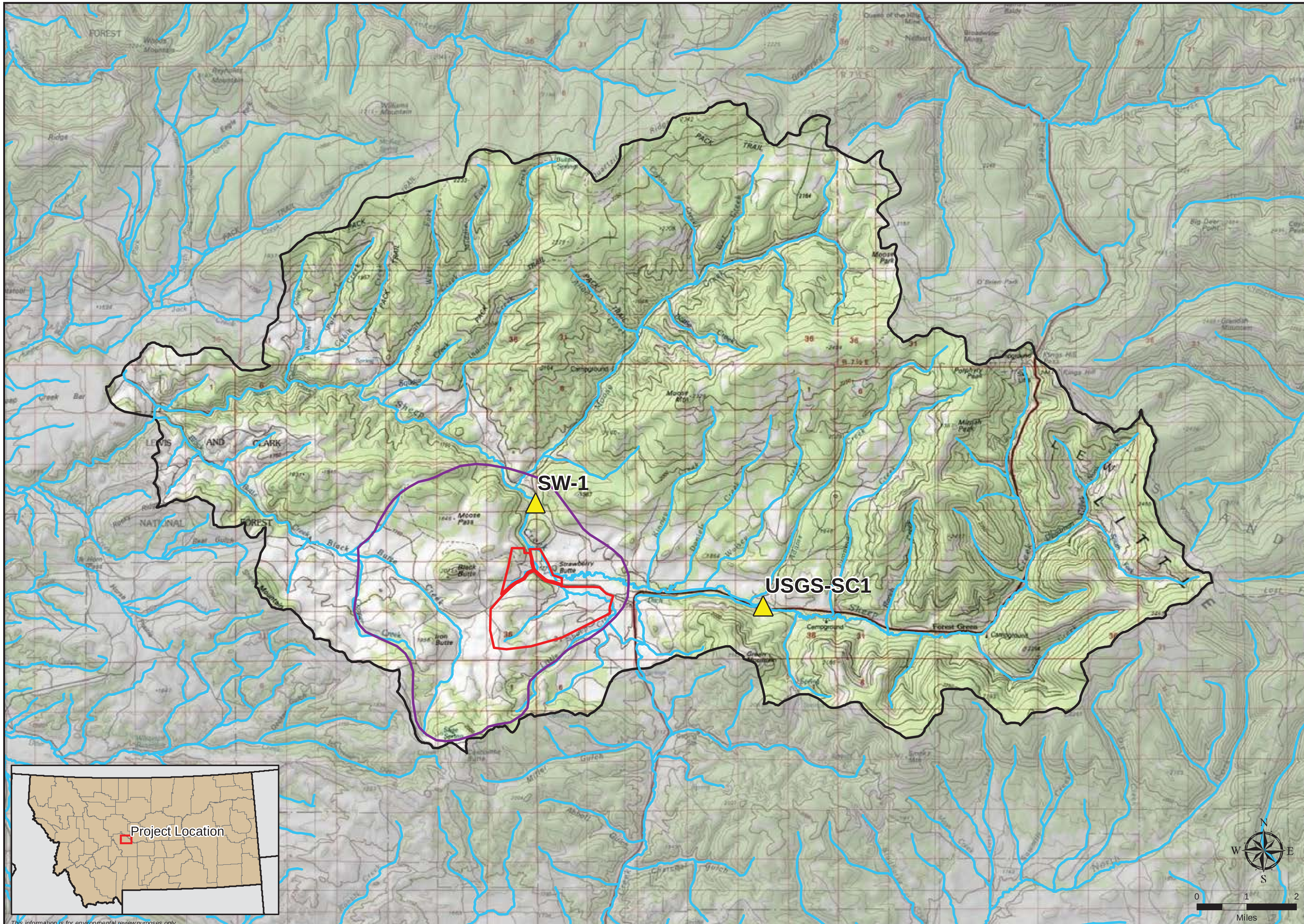

Figure 3.4-2
Black Butte Copper Project
Groundwater Hydrology Conceptual Model Area & Regional Study Area
Meagher County, Montana

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

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Source: Hydrometrics, Inc. 2016f

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. 2017c (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. 2017c).

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. 2017c).

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. 2016f). 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. 2016f).

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 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. 2017b).

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. 2018c).

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 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. 2017b).

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. 2017a) 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 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. 2016f). 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.

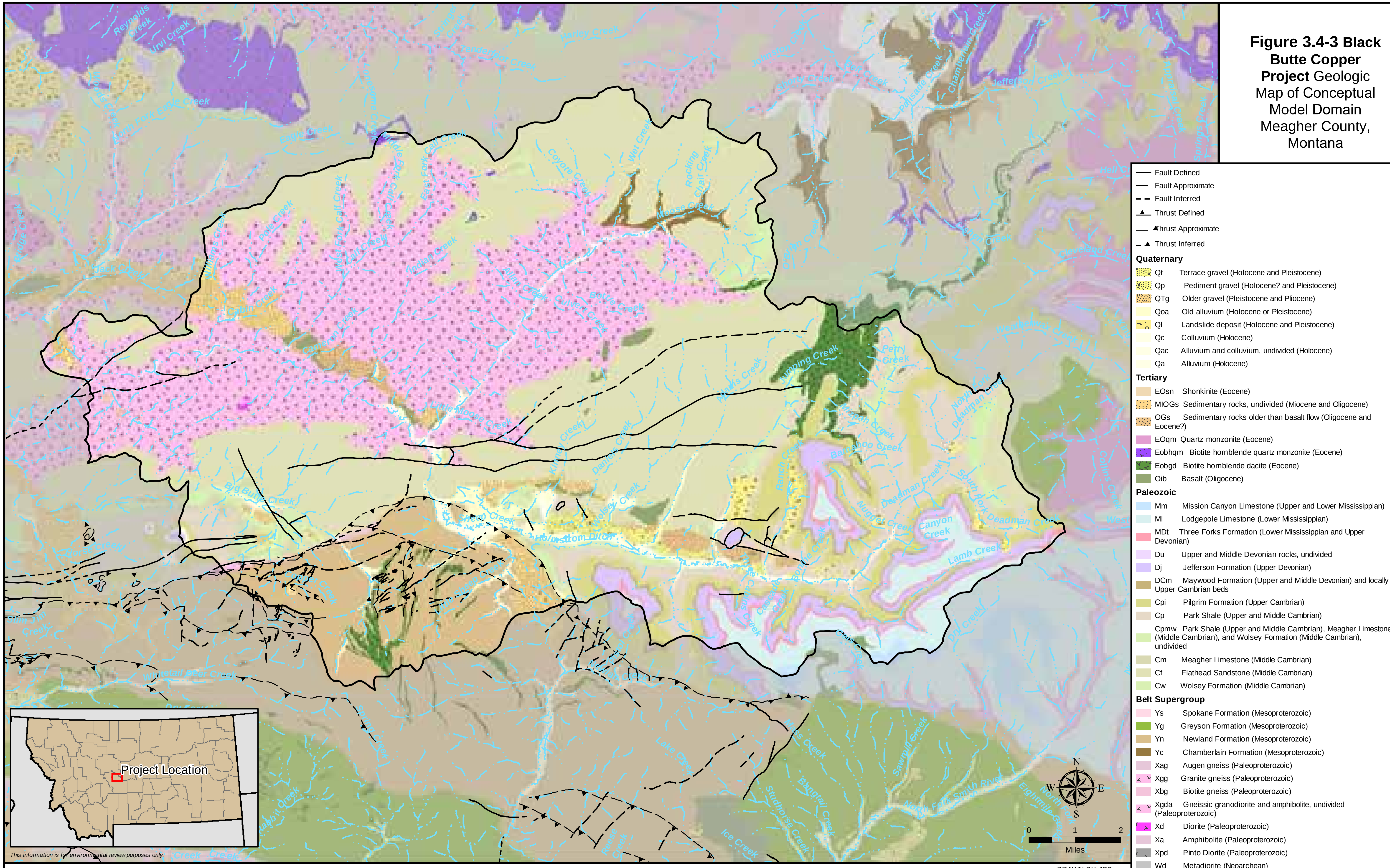
The prominent east-west trending fault (VVF) runs through the southern part of the Sheep Creek drainage. The geology to the south of the VVF consists largely of Precambrian Lower Newland Formation shales (see **Figure 3.4-3**), which extend to the southernmost boundary of the Sheep Creek drainage. The 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.

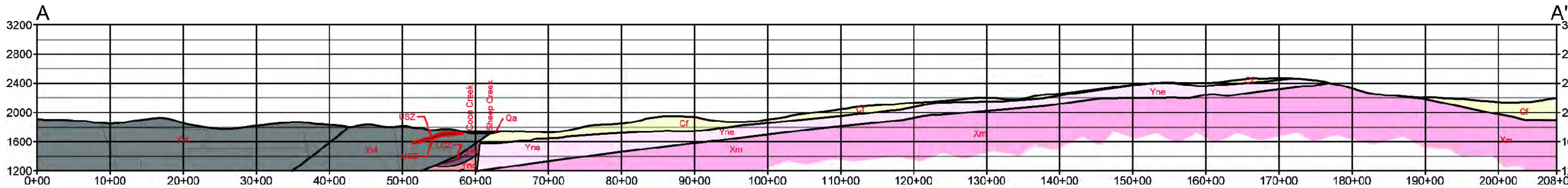
Unconsolidated surficial deposits within the Conceptual Model Domain include alluvial deposits present along the axis of the major drainages and older (Quaternary/Tertiary) basin-fill sediments that form terraces flanking these drainages in a few areas (see **Figure 3.4-3**). The most prominent alluvial 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. 2016f).

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.

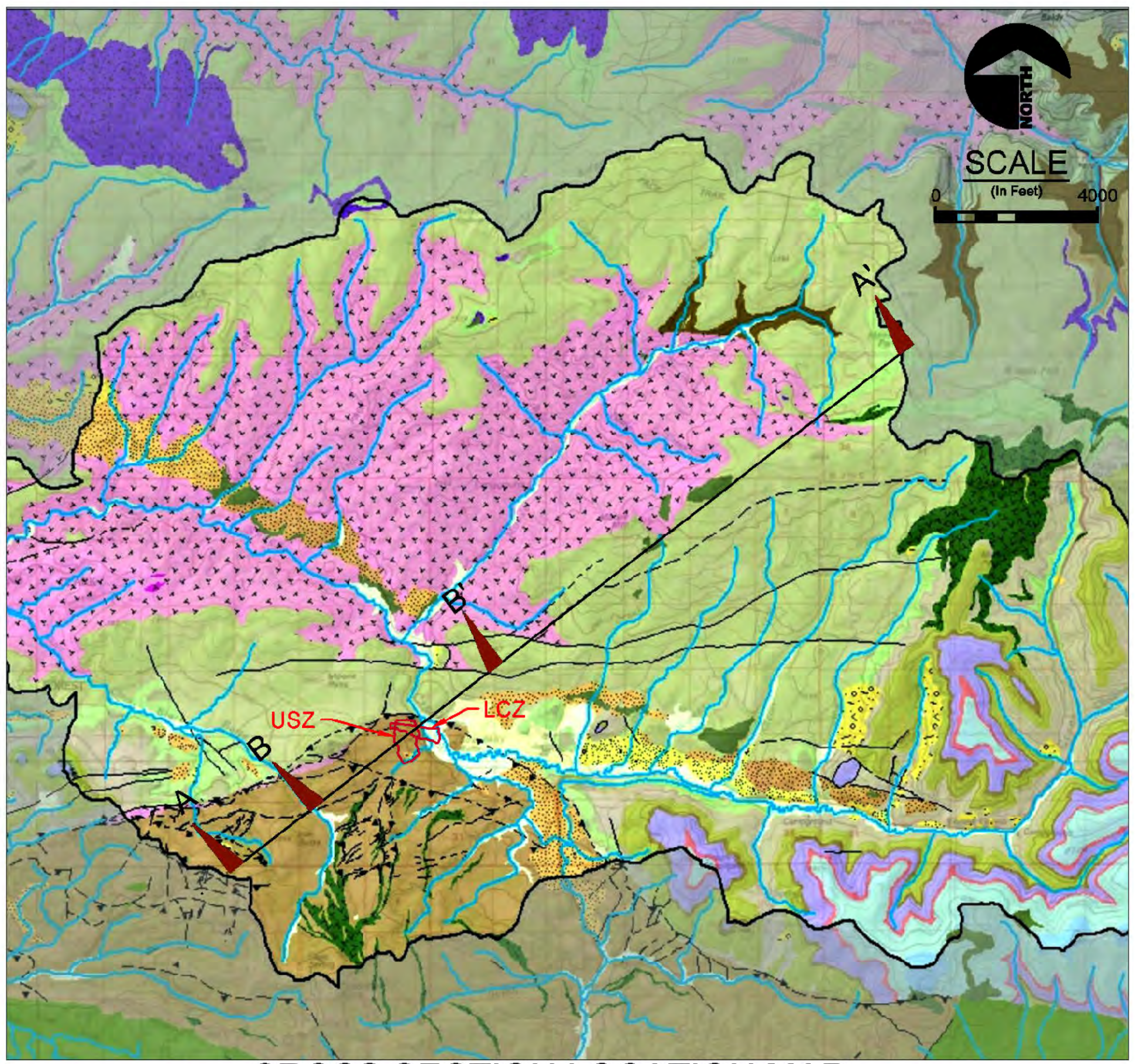


Source: Hydrometrics, Inc. 2016f

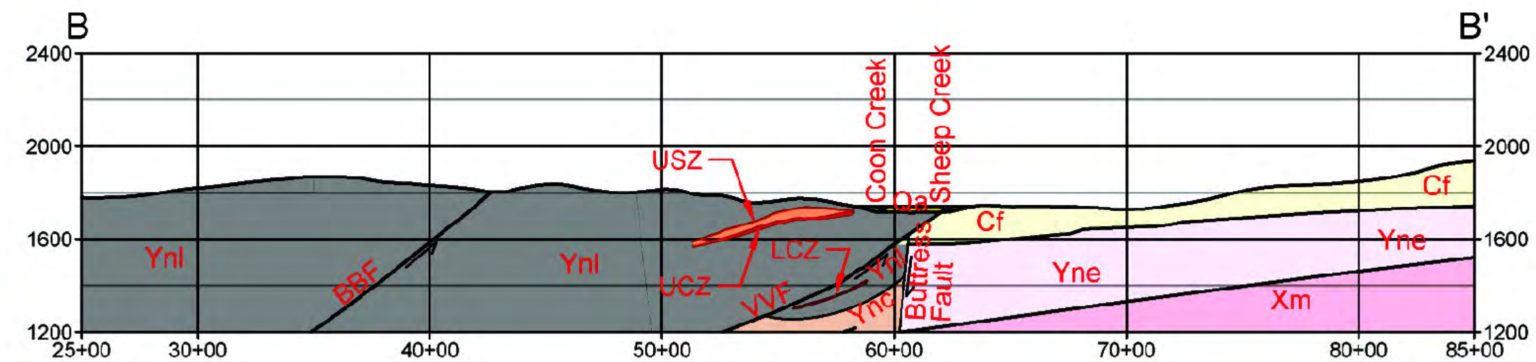


CROSS SECTION A - A'

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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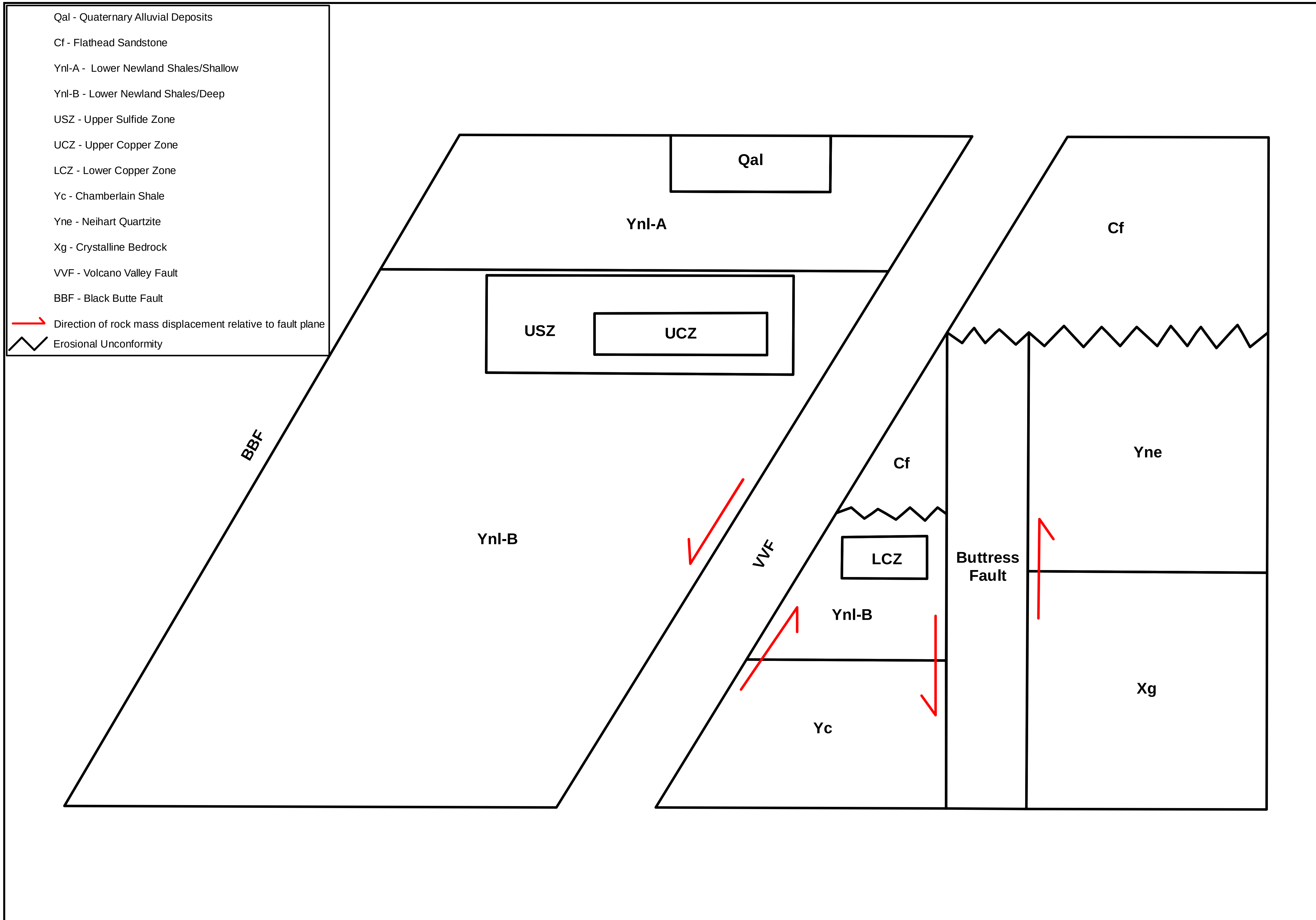
Source: Hydrometrics, Inc. 2016f

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



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Source: Hydrometrics, Inc. 2016f

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. 2016f). 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. 2016f). **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. 2016f).

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. 2016f).

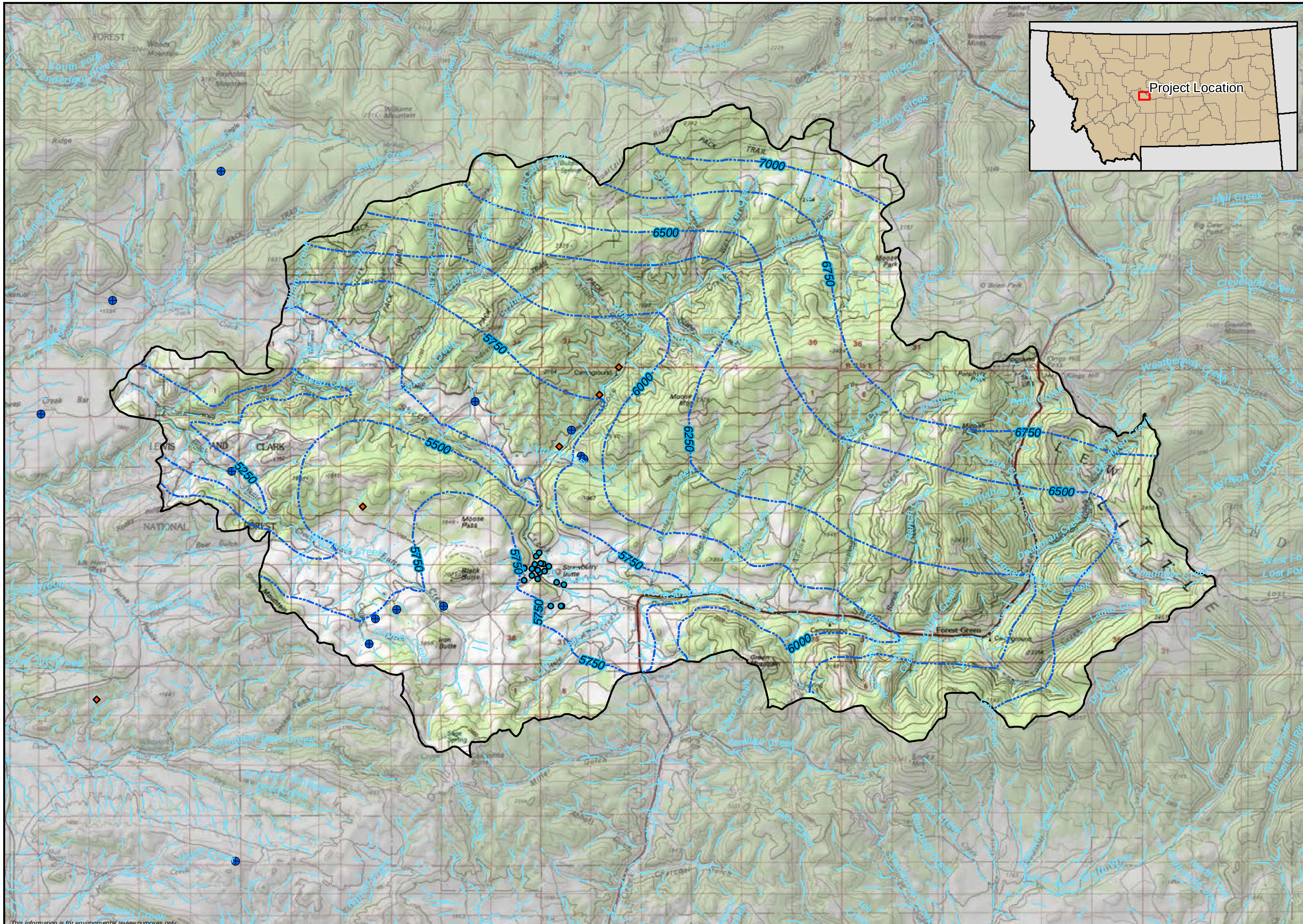

Figure 3.4-6
Black Butte Copper Project
Groundwater Potentiometric Map for Conceptual Model Domain
Meagher County, Montana

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

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Source: Hydrometrics, Inc. 2016f

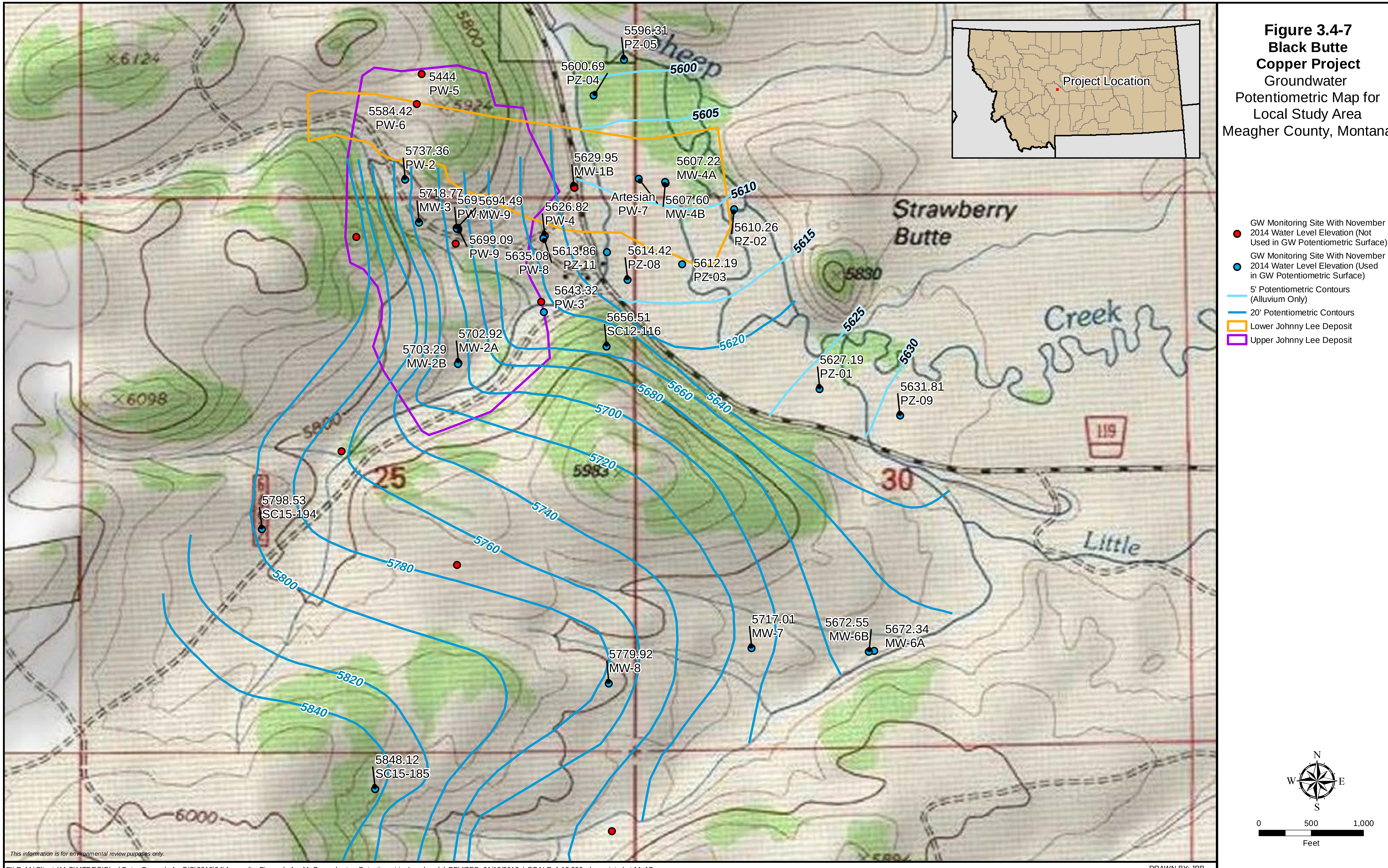

Figure 3.4-7
Black Butte Copper Project
Groundwater Potentiometric Map for Local Study Area
Meagher County, Montana

Source: Hydrometrics, Inc. 2016f

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. 2016f).

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. 2016f).

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 0.2 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. 2016f), 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).

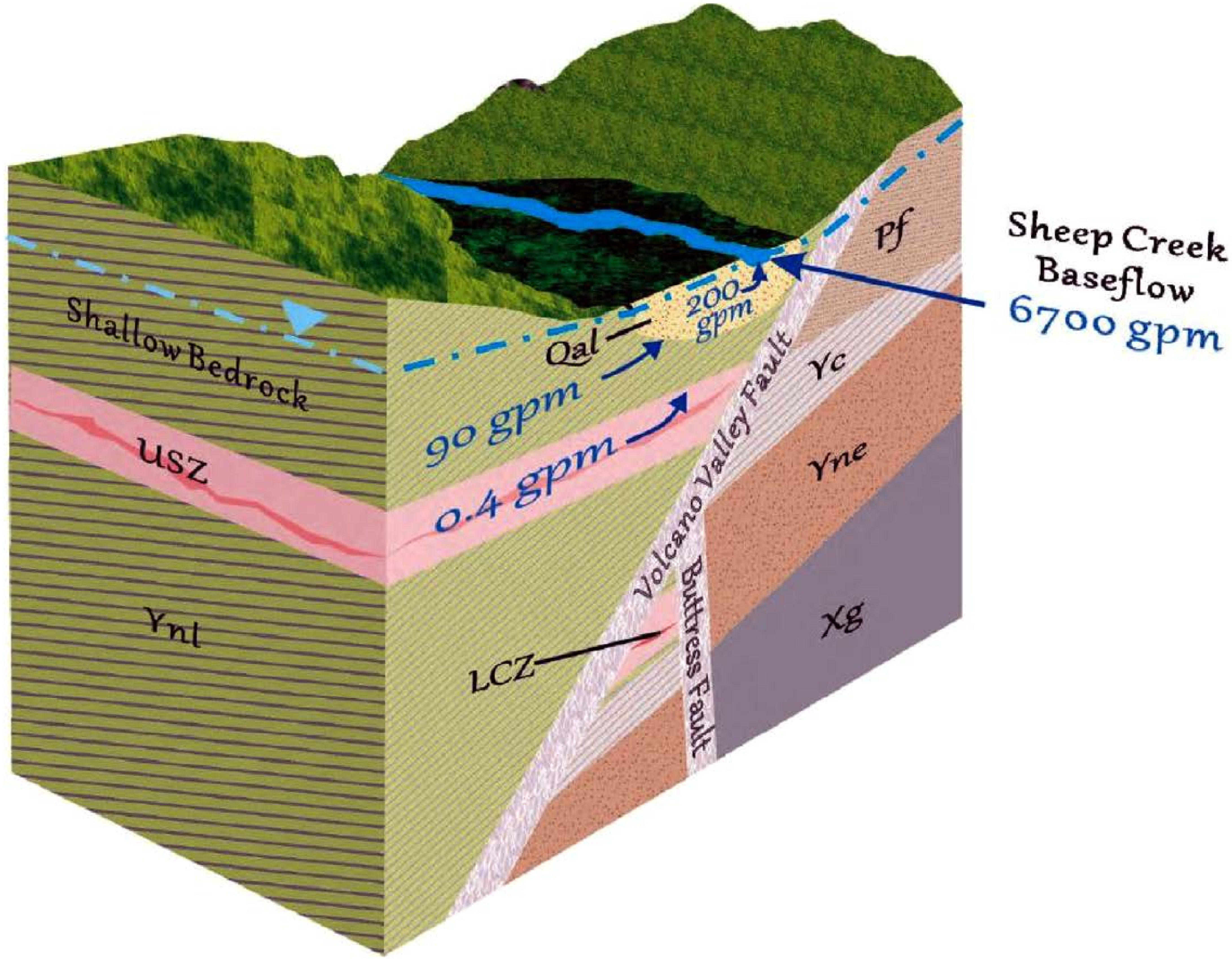

Figure 3.4-8
Black Butte Copper Project
Block Groundwater Flow Diagram
Meagher County, Montana

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DRAWN BY: JPB

Source: Hydrometrics, Inc. 2016f

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. 2016f). 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. 2016f).

3.4.2.6. Groundwater Quality

Groundwater chemistry data for the LSA is compiled in Hydrometrics (2017d) 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. 2017c).

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. 2017c).

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. 2017c). 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. 2017c). 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. 2017c).

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, Inc. 2017c). 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)

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

MW-4A (Well Completed in Alluvium)										
Parameters	**Units**	**No. of Measurements**	**No. of Detects**	**Min.**	**Max.**	**Mean**	**25% PCLT**	**50% PCLT**	**75% PCLT**	**SD.**
Total Persulfate Nitrogen	mg/L	1	0	<0.04	<0.04	NA	NA	NA	NA	NA
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)

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

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.**
Total Persulfate Nitrogen	mg/L	1	1	0.05	0.05	NA	NA	NA	NA	NA
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)

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										
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

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.**
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
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 Lower Copper Zone)

PW-7 (Well Completed 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
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

PW-7 (Well Completed in Lower Copper Zone)										
Parameters	**Units**	**No. of Measurements**	**No. of Detects**	**Min.**	**Max.**	**Mean**	**25% PCLT**	**50% PCLT**	**75% PCLT**	**SD.**
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
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. 2016f). 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**).

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
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
Note:
[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).

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 (less than 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. 2016f). 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 3.4-5
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
Notes:
[a] Elevation dependent
[b] Calculated as 10 percent 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 would 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. 2016f). 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. 2016f). 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.

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. 2016f (Table 5-1)

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.

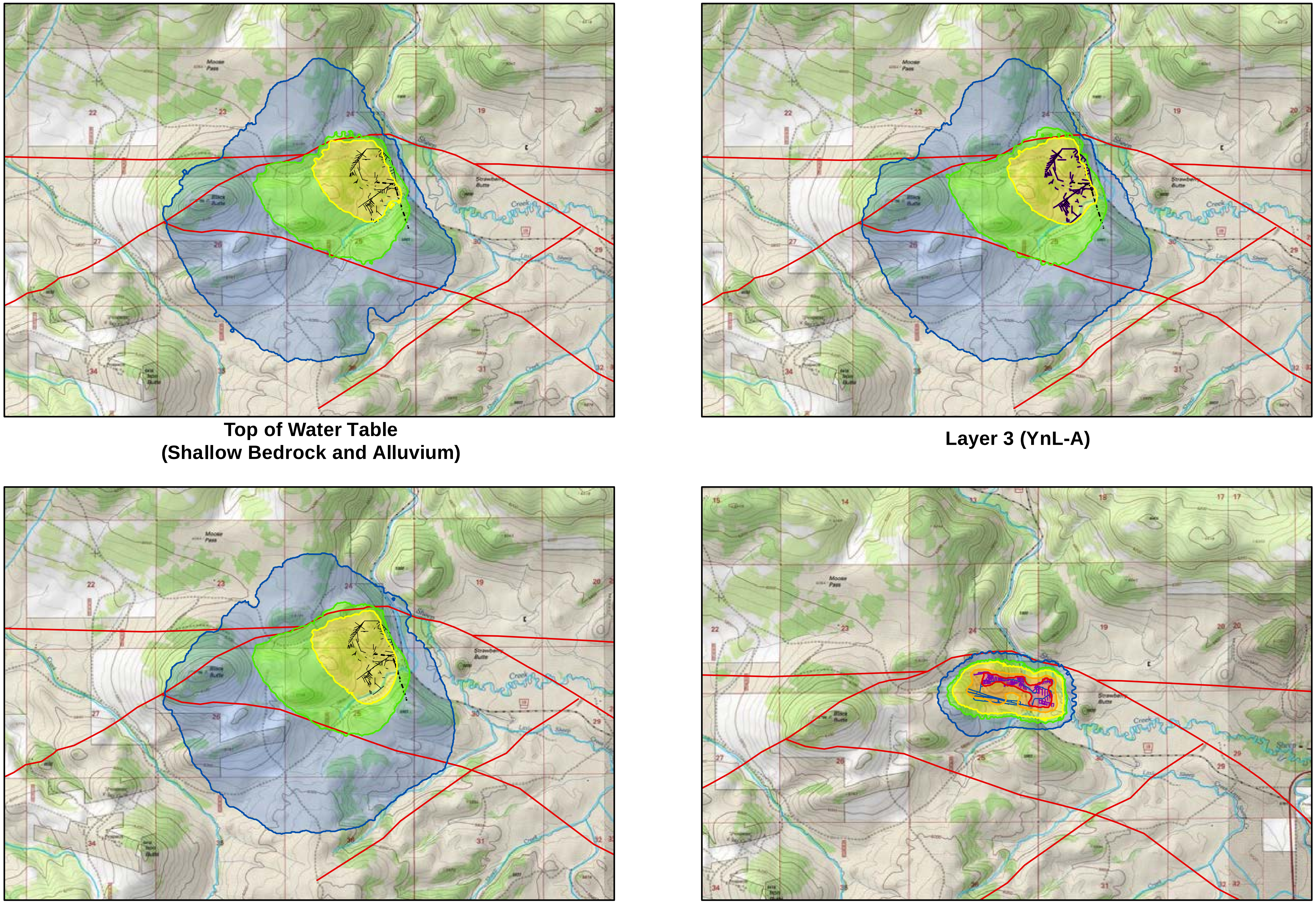
For shallow HSUs (Alluvium, Ynl A, and UCZ), simulations predict that the greatest drawdowns occur in Year 4 corresponding to the initial mining stage when the model predicts the highest inflows to the upper mine workings. At Year 15, the drawdowns are comparable, but somewhat less because the dewatering 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. 2016f). 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 recharge boundary to the Alluvium, Ynl A, and UCZ, and would provide some recharge to these units during the mining period. However, because of a large contrast between hydraulic conductivity of the alluvium (within which Sheep Creek flows near the proposed mine) and shallow bedrock, loss of water by Sheep Creek caused by the mine-dewatering-formed cone of depression would be limited. Groundwater model simulations show the decrease of groundwater discharge to Sheep Creek would be 157 gpm by the end of the mining period (Hydrometrics, Inc. 2016f); this represents about 37 percent of the rate of pumping from the mine at that time. As such, the model indicates that the remaining 63 percent of water entering the mine workings would be contributed by bedrock formations, not the creek or its alluvium.

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).

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.

Figure 3.4-9
Black Butte
Copper Project
Model-Simulated
Groundwater Drawdowns
- Year 4
Meagher County, Montana



Upper Decline
UpperAccess
Faults (surface expression)
Rivers and Streams

Drawdown Interval (feet)

- 10
- 50
- 100
- 500
- 1000

N
W E
S

0 0.25 0.5 1
Miles

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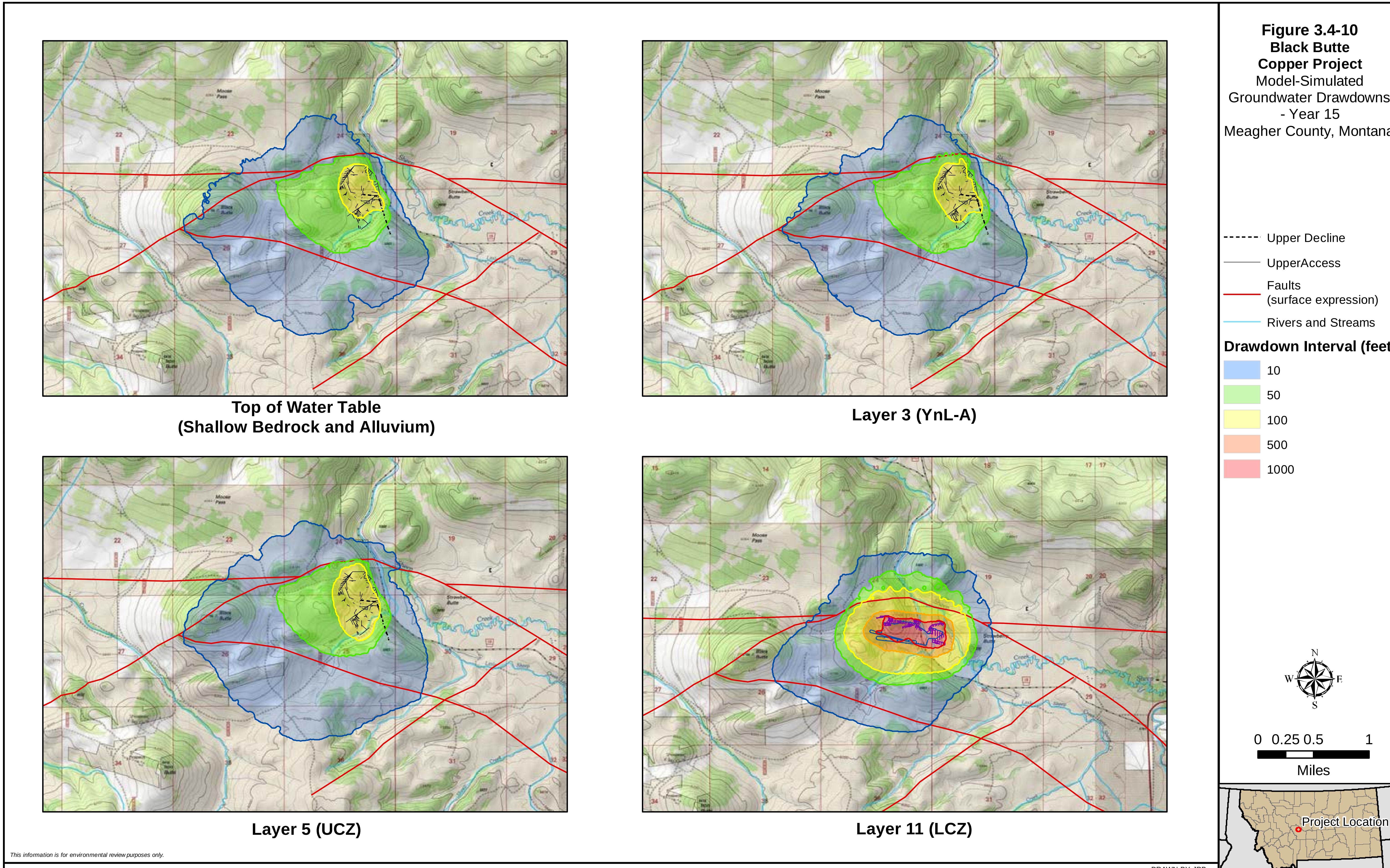
Source: Hydrometrics, Inc. 2016f



Source: Hydrometrics, Inc. 2016f

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.

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.

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, Inc. 2016f). After 1 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.

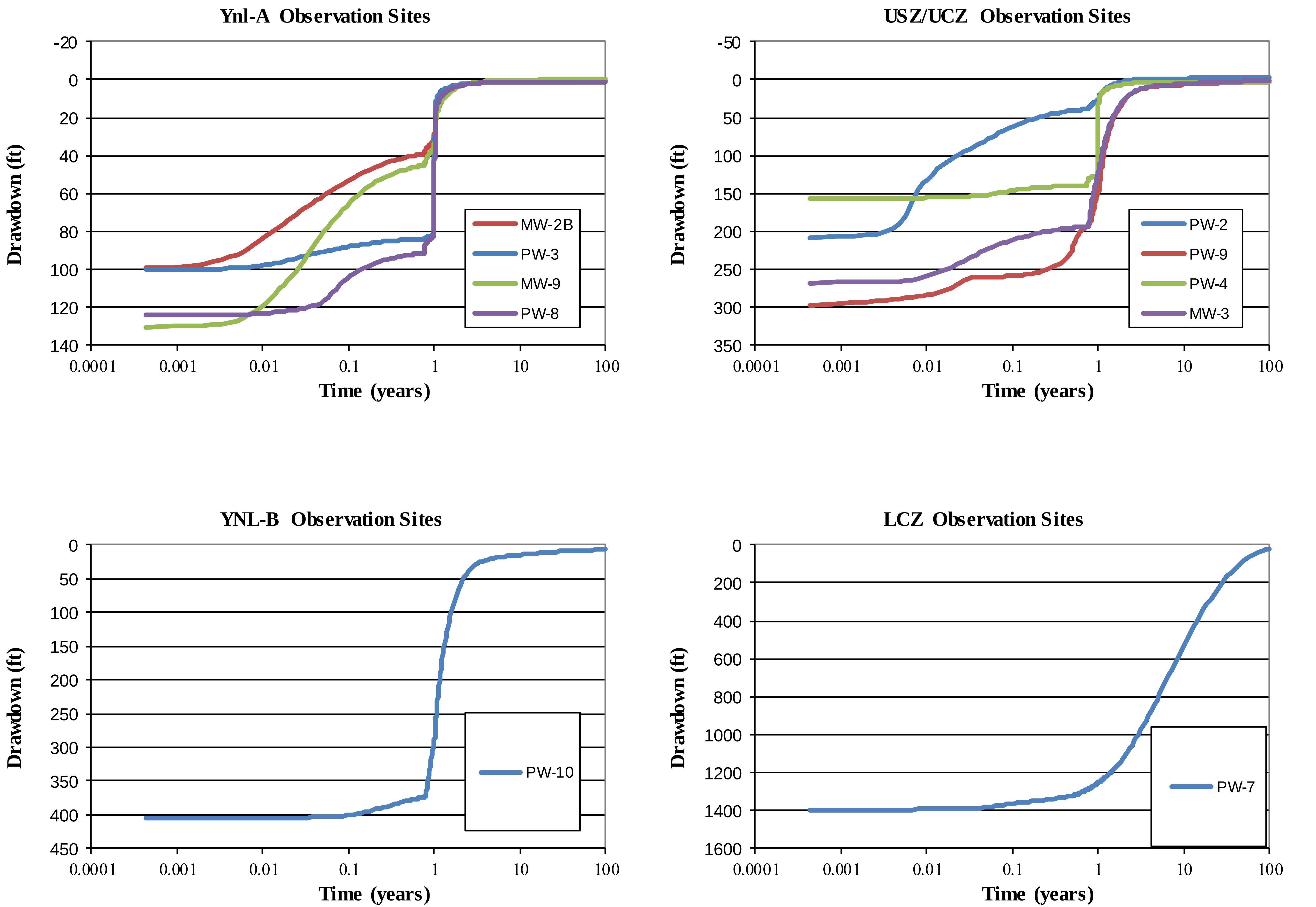
Table 3.4-7
Model-Simulated Groundwater Discharge to Surface Waters

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. 2016f (Table 5-3)

cfs = cubic foot per second

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. 2016f

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. 2017a). 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 (**Figure 3.4-12a**). 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, Inc. 2018a, Response to Comment 3, Form 2D, Part III.A). The alluvial UIG is designed for maximum total discharge of 575 gpm (Hydrometrics, Inc. 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. 2017b).

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, Inc. 2017b). 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, Inc. 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. 2017b). 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, Inc. 2016f).

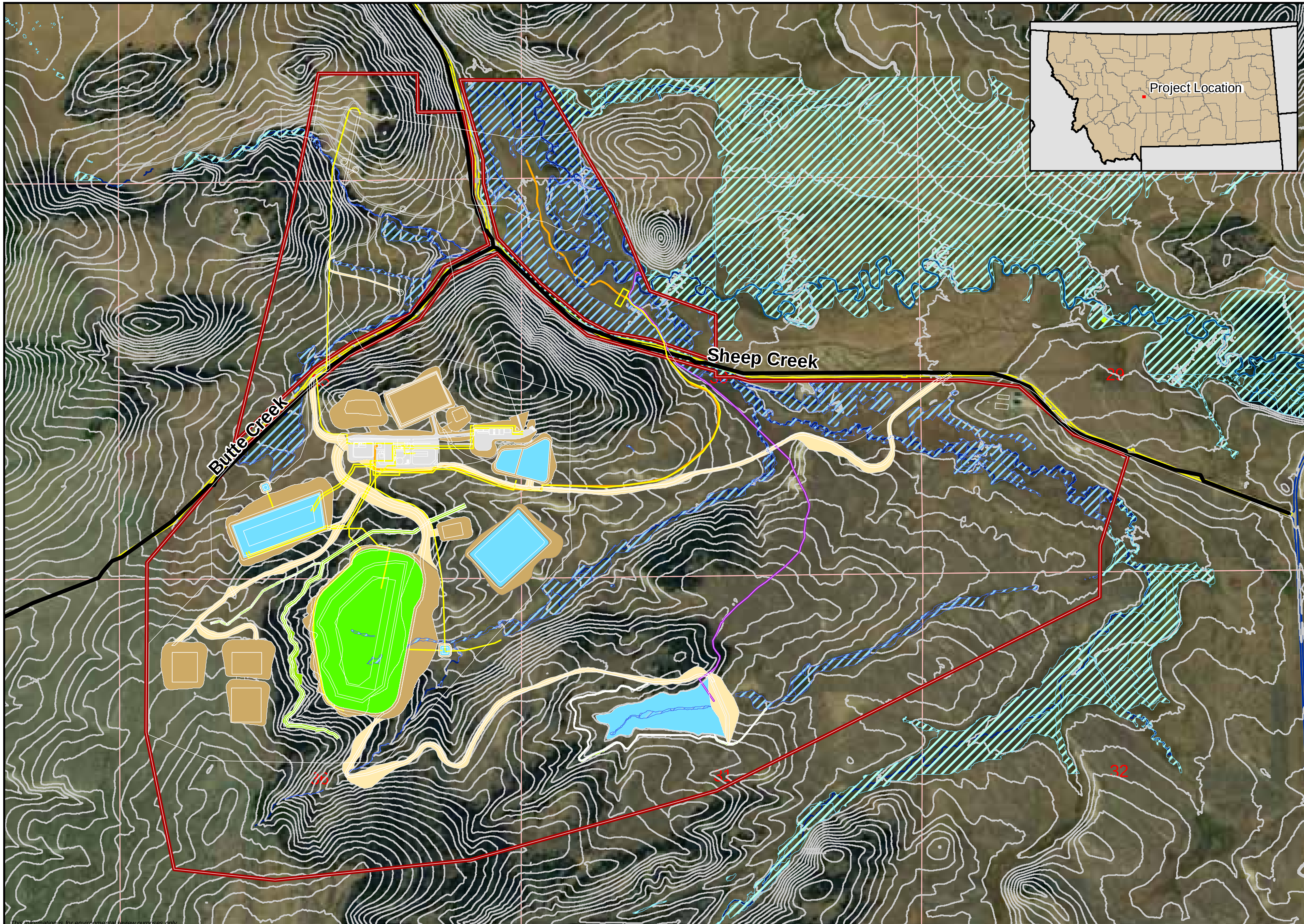

Figure 3.4-12a
Black Butte
Copper Project
Project Facilities Site Plan
Meagher County, Montana

Project Area
Wetland
Wetland (Outside Project Boundary)
Wet Well Pipeline
Alluvial UIG
Mill Area
Cement Tailings Facility
Water
Access Road
Topsoil Stockpile
Diversion Ditching
Contours

N
W E
S

0 500 1,000
Feet

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Source: Tintina 2017

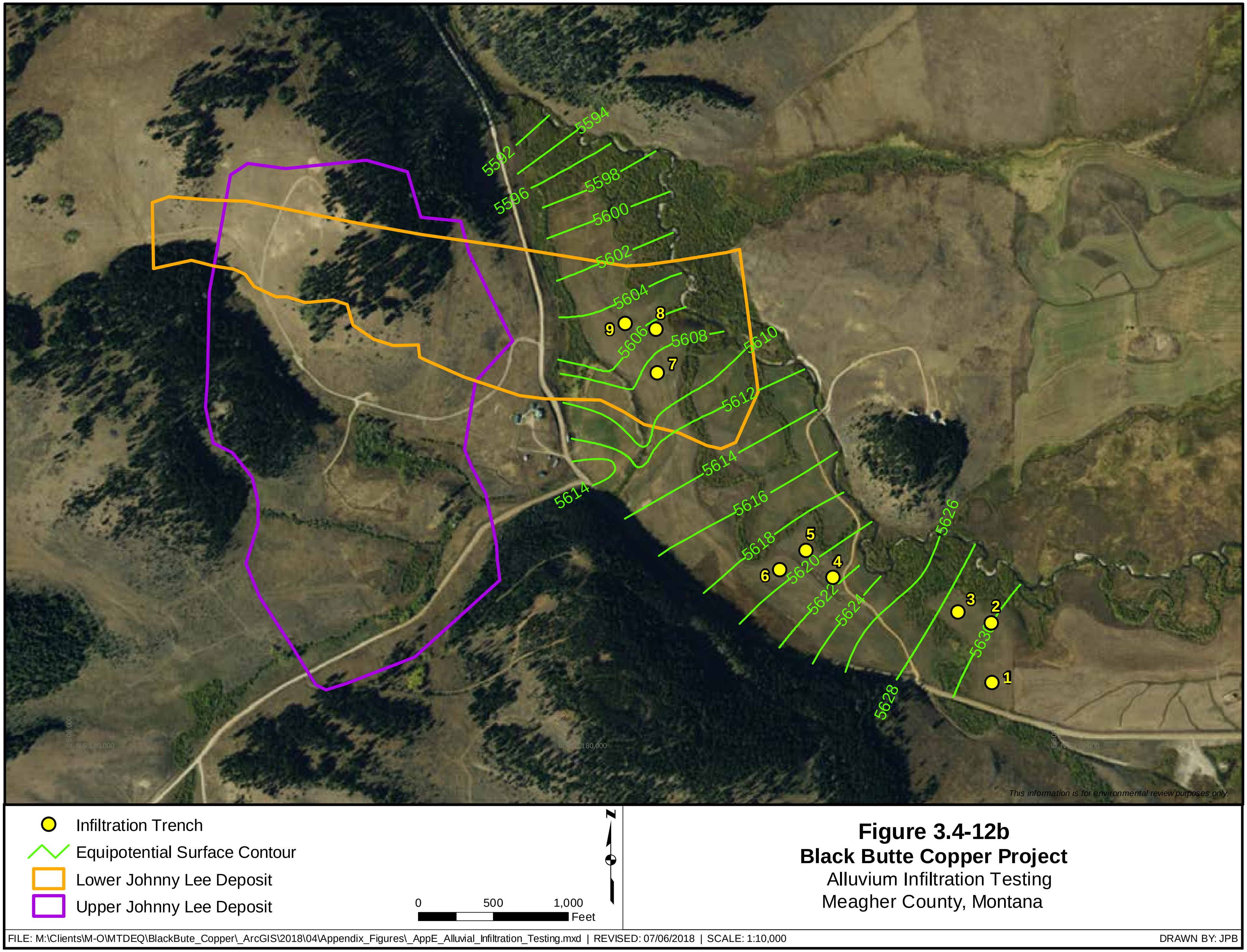

Figure 3.4-12b
Black Butte Copper Project
Alluvium Infiltration Testing
Meagher County, Montana

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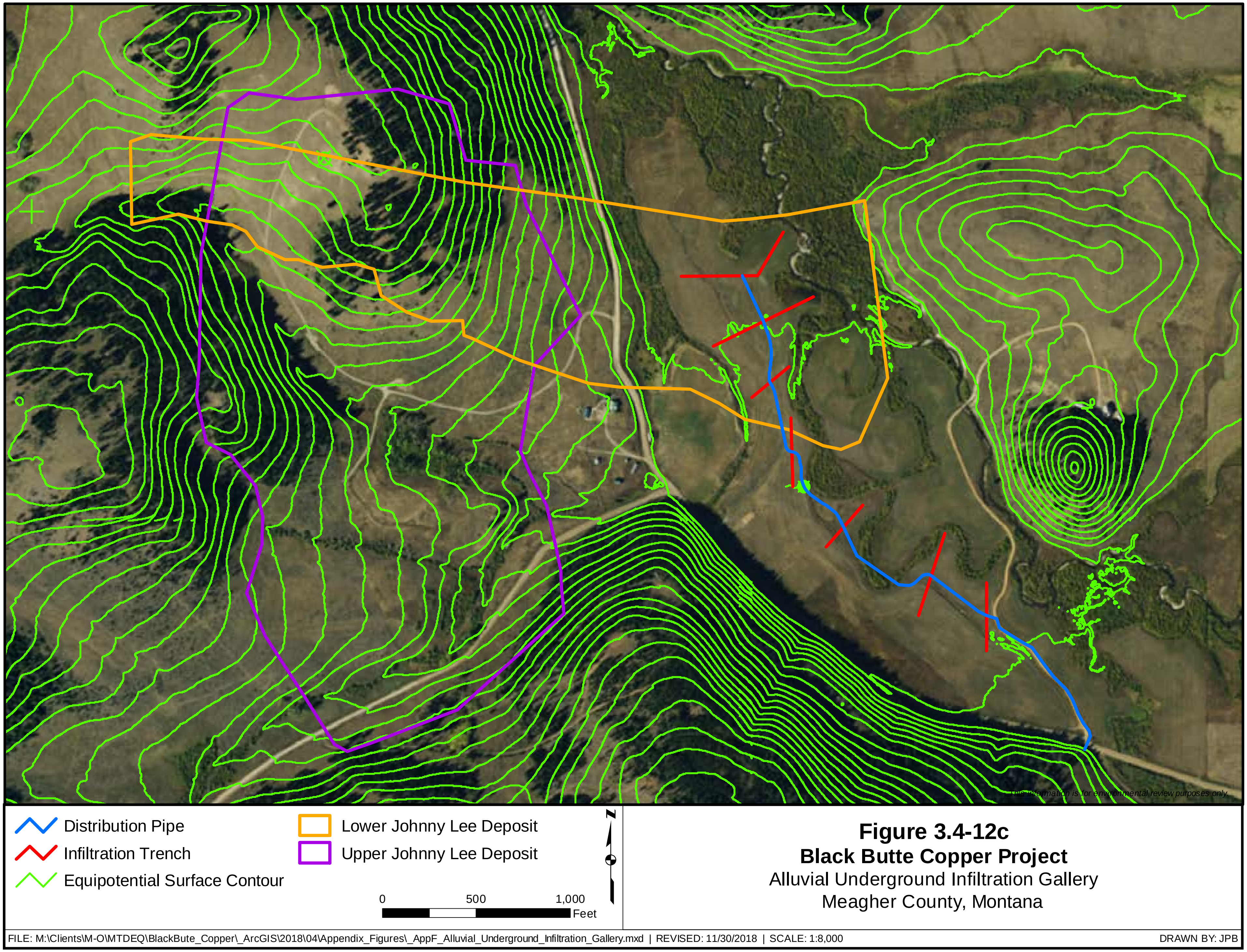
Source: Hydrometrics, Inc. 2017b



Source: Hydrometrics, Inc. 2018c

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 potential contaminants of concern (COCs) would be dissolved in post-mine contact groundwater at concentrations below the Estimated Groundwater Non-degradation Criteria (Hydrometrics, Inc. 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 of potential chemical sources (i.e., contact groundwater) from the surface mine facilities during both mine operations and post-closure periods are expected to be less than about 3 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 contact groundwater with Sheep Creek surface water would dilute the original solutes by a factor of 1,000 or more.

Surface water quality is expected to be the same or similar to surface water quality under current (baseline), pre-mining conditions. This conclusion is based on consideration of the substantial mixing of waters, as explained above, and a projection that groundwater flow paths during post-closure period would be similar to flow paths present under current conditions.

The groundwater potentially affected by surface mine facilities that discharges to Coon Creek might undergo less mixing compared to Sheep Creek. However, the combined groundwater flow rate from the surface mine facilities during both mine operations and post-closure periods are expected to be on the order of a few gallons per minute. The potential of groundwater impacts from the surface facilities would further decrease during a post-mine period due to attenuating mechanisms.

In summary, the completed analyses indicate 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 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 at any given location within the mine would mostly depend on groundwater inflows and rock stability observed during the initial excavation of the mine openings. The proponent intends to grout to the extent needed for safe and efficient execution of mine operations and to avoid the need to manage excessive volumes of water. 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. 2016f). 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. 2016f).

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. 2016f).

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. 2016f).

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, 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 AMA would require the Proponent 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). While the AMA would result in impacts similar to those described for the Proposed Action, it would provide additional benefits as discussed below.

The regional groundwater model constructed to evaluate the proposed mine (Hydrometrics, Inc. 2016f) 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 Zieg et al. (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 (Zieg et al. 2018).

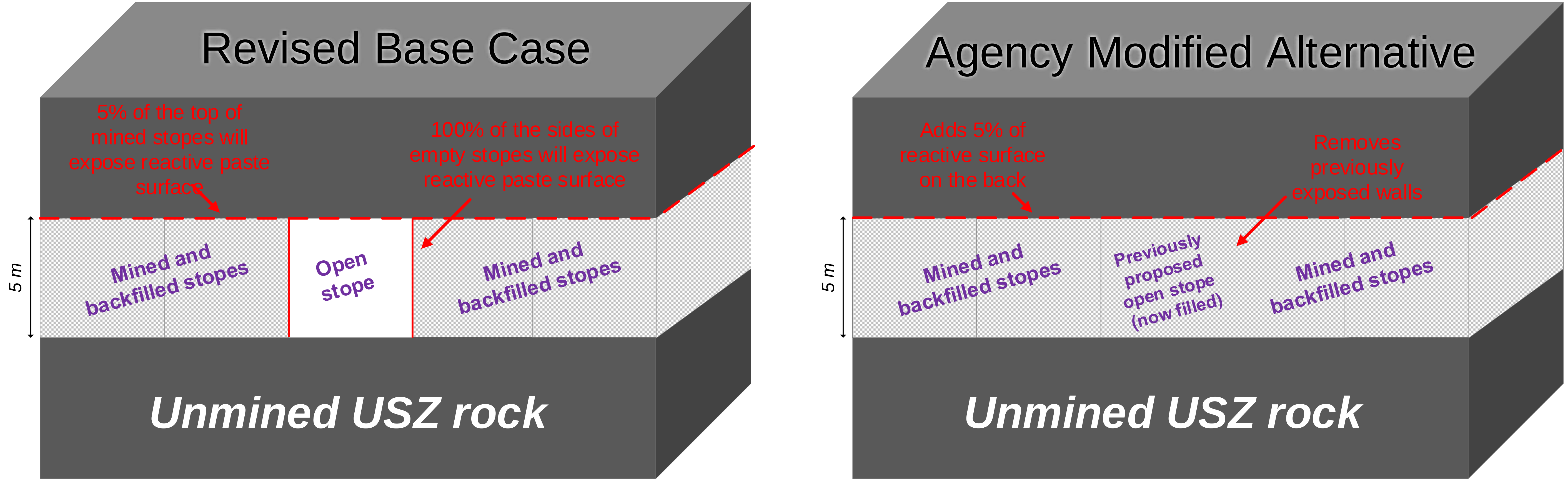


Figure 3.4-13
Black Butte Copper Project
Schematic Comparison of Revised Base Case (Proposed Action) and Agency Modified Alternative
Meagher County, Montana

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Drawn By: CJL

Source: Zieg et al. 2018

Calculations performed in the MOP Application by Tintina (2017) and Zieg et al. (2018) predict that the Proposed Action is unlikely to 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 benefits of the AMA include (1) additional assurance that water quality would not be degraded, (2) greater consistency with how the Proponent's model simulated the post-closure period, and (3) a slower rate of post-mine migration of the deep groundwater to the 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 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 for both the Proposed Action and AMA. 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)	Potential Impacts: 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)	Potential Impacts: 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 would be required 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 would be required 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 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, Inc. 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, Inc. 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, Inc. 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, Inc. 2018b).

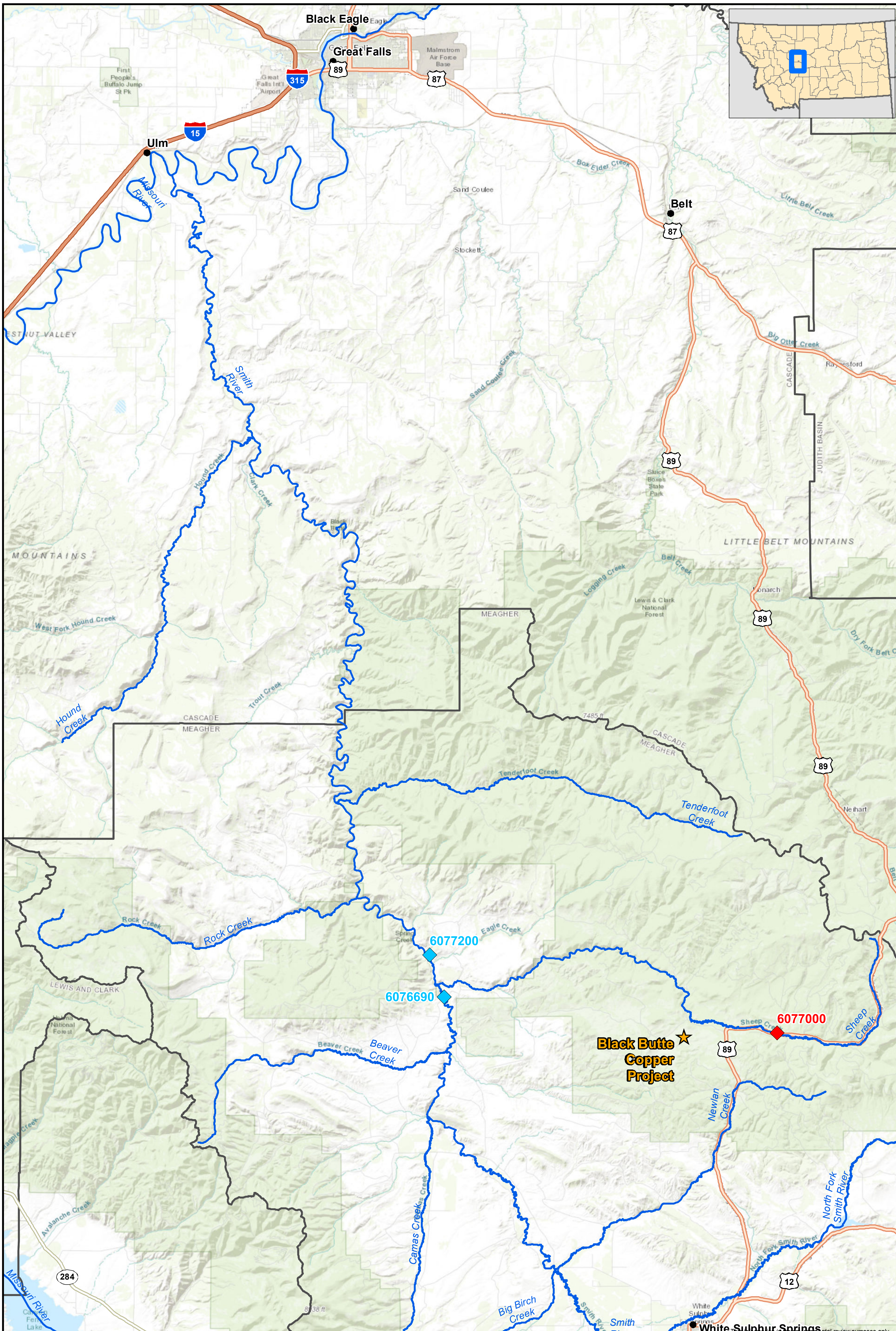
Surface water monitoring was established at 11 sites to characterize the stream flow for the Project area (see **Figure 3.5-2**). Quarterly flow and stage monitoring have been conducted at these sites since 2011. Since 2014, additional monthly flow measurements have been collected at the two surface 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, Inc. 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
Miles

Figure 3.5-1
Black Butte Copper
Project Location
Meagher County, Montana

ERM

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Source: Tintina 2017

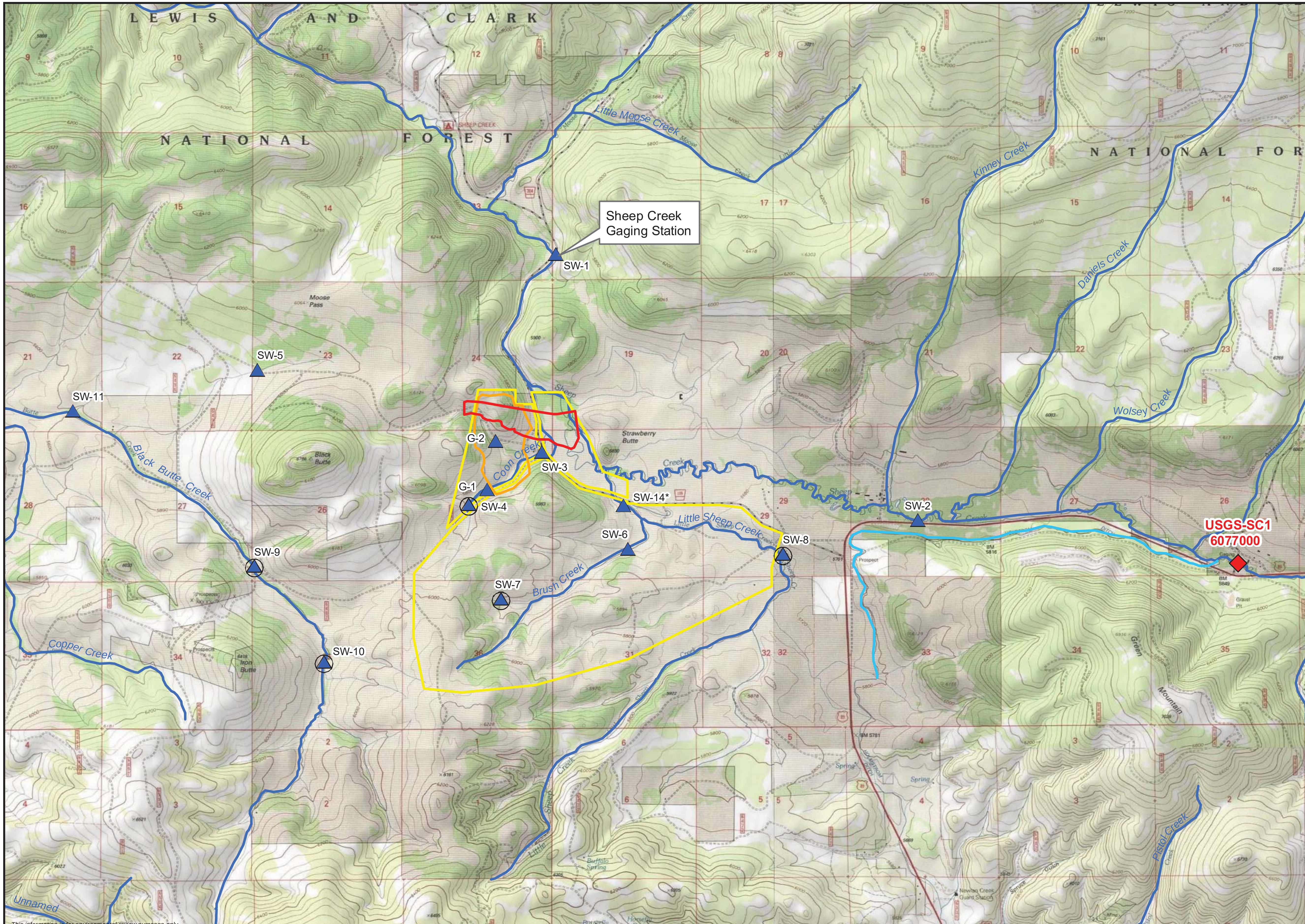

Figure 3.5-2
Black Butte Copper Project
Surface Water Resource Monitoring Sites, Major Creeks, and Tributaries
Meagher County, Montana

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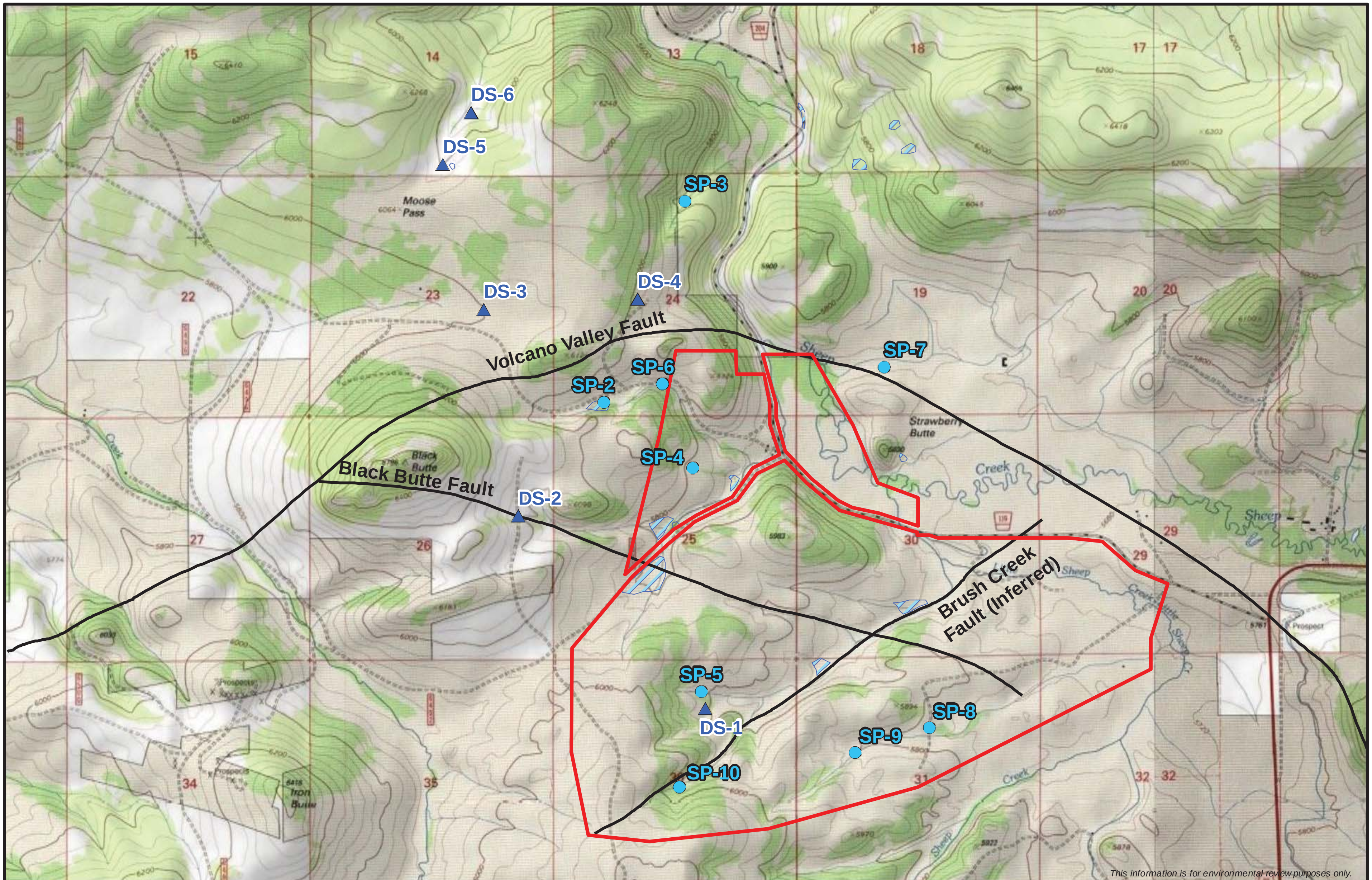
Source: Tintina 2017



Spring
Developed Spring/Seep
Major Fault
Project Area
Seep Area

0 2,000 4,000 Feet

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, Inc. 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, Inc. 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 cubic feet per second (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, Inc. 2018b

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

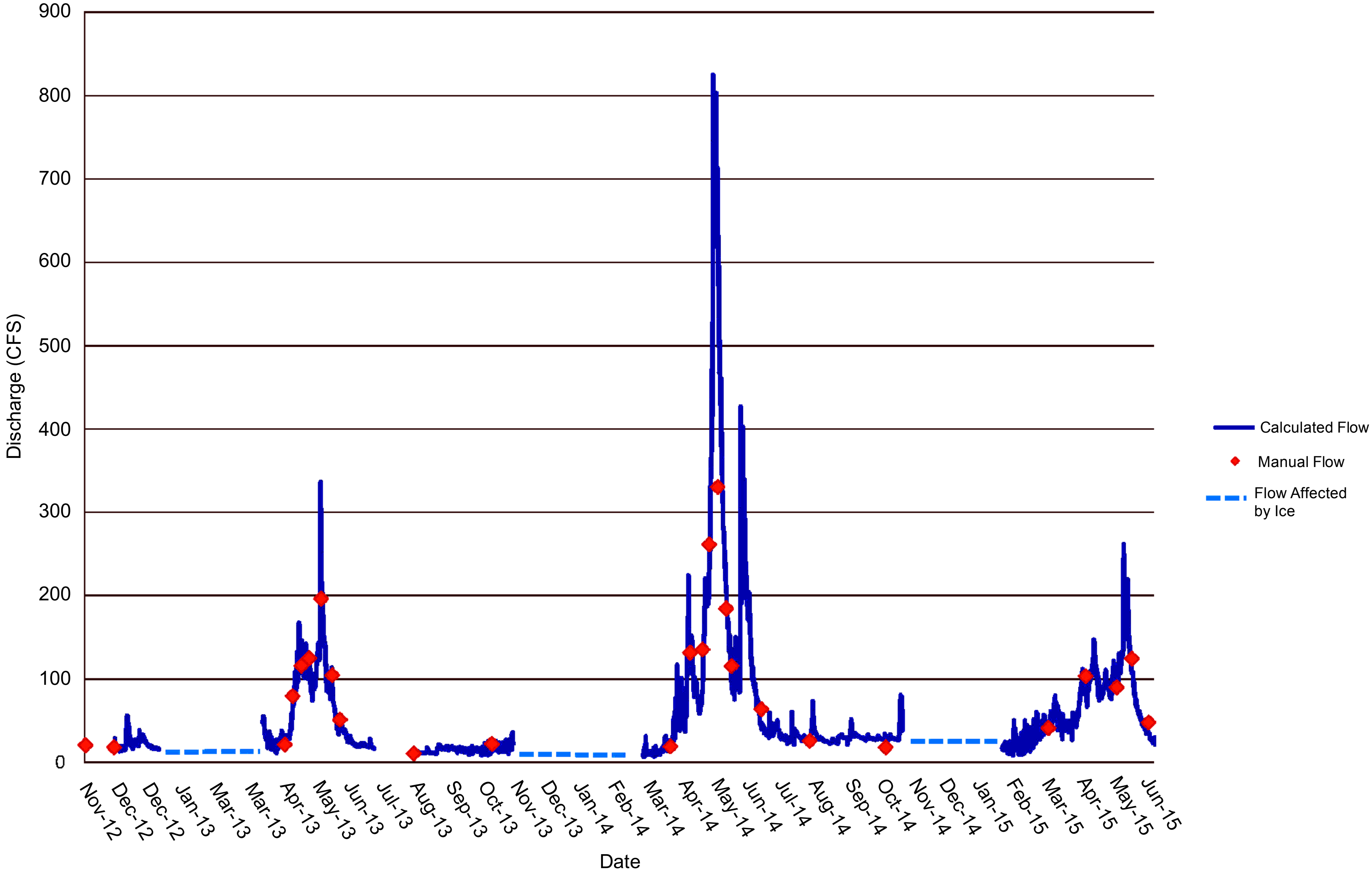
The discharge hydrograph generated for monitoring site SW-1 on Sheep Creek, presented on **Figure 3.5-4,** illustrates the seasonal stream flow pattern across the monitoring period. The highest stream flows at SW-1 occur from mid-May through mid-June, when flows exceeded 100 cfs. Annual peak flows captured 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, Inc. 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.



This information is for environmental review purposes only.

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, Inc. 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, including temperature. 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 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) as well as Section 4.5 of the Integrated Discharge Permit Application Narrative (Hydrometrics, Inc. 2018c). BMPs would be used to minimize erosion and sedimentation, and to control surface and storm water runoff at the Project site. BMPs include but are not limited to:

- Suspend construction dirt work during periods of heaviest precipitation and runoff to minimize soil disturbance and erosion.
- Hydroseed or revegetate cut and fill slopes and disturbed natural slopes as early as possible.
- Use mulches and other organic stabilizers to minimize erosion until vegetation is established on sensitive areas.
- Isolate cleared areas and building sites with diversion channels, ditches, and swales to redirect runoff.
- Retain natural drainage patterns wherever possible.
- Install runoff diversion ditches that are primarily located at surface facilities and separate contact storm water and non-contact storm water.
- Line unavoidably steep interceptor or conveyance ditches with filter fabric, rock, polyethylene lining, or armoring to prevent channel erosion.
- Construct stable, non-erodible ditches, and inlet and outlet structures.
- Construct, operate, and maintain sediment control ponds.

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 0.85 acre 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 water storage for stream flow augmentation to address depletion of surface water flow in the affected watersheds associated with consumptive use of groundwater during operations (mine dewatering). 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 end of mine dewatering (Tintina Montana, Inc. 2018b). A high-flow water rights application package was submitted to the DNRC on September 7, 2018. The Proponent 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 conditions from May through July, and only when flow in Sheep Creek exceeds 84 cfs, which is equal to the total flow of the appropriated water rights (including instream flow reservations) on Sheep Creek downstream of the diversion (where the wet well would operate). Water would be diverted at a maximum 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. As the NCWR would be used for transfer of water between Sheep Creek and other streams, discharges from the NCWR would not require coverage under an MPDES permit (ARM 17.30.1310(1)(g) and 40 CFR 122.3(i)).The measures spelled out in 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 to mitigate potential indirect impacts to wetlands.

Potential impacts due to the diversion of stream flow to fill the NCWR would be nominal, as the majority of the diversion would occur under a new water right limited to May through July and only when stream flow is in excess of all existing water rights and instream flow requirements (84 cfs). Any diversions during other months would be based on using existing leased water rights along Sheep Creek that are currently being put to beneficial use (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 rate of mine dewatering drawing from the shallow groundwater hydrostratigraphic units (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, Inc. 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 stream flow 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, Inc. 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 groundwater flow to Sheep Creek from the model domain of 0.35 cfs (157 gpm). 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 non-degradation rules. Under the rare 7Q10 low flow conditions, Sheep Creek flow is calculated to be 5.67 cfs (2,545 gpm). In those conditions, non-degradation 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. If necessary to maintain flow in Sheep Creek, the Proponent may also discharge water diverted to the NCWR from Sheep Creek during high flow conditions back to Sheep Creek via the wet well during other months.

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 this reduction in Coon Creek flow, 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, other than during peak spring runoff (Sheep Creek flow in excess of 84 cfs), 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, Inc. 2018c). Nominal impacts are expected for Black Butte Creek, with a predicted reduction of 3 to 4 percent of steady state base flow. The Proponent has proposed to DRNC that some water from the NCWR also be routed to Black Butte Creek to offset the predicted stream flow depletion. 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. BMPs 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 streams except Coon Creek is less than 10% and therefore is expected to be nominal. 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 is less than 10% and therefore is expected to be nominal.
	Underground infiltration gallery	Partially compensates for the potential loss of base flow in 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	Based on existing leased water rights along Sheep Creek and a new water right limited to high flow conditions. The NCWR would be used for mitigation of residual depletion in surface waters for approximately 20 years after the end of mine dewatering.
	Mine dewatering	Base flow depletion is expected to cease within 2 years after dewatering stops. Where required, base flow reduction would be offset with water from the NCWR. The NCWR would be used for mitigation of residual depletion in surface waters for approximately 20 years after the end of mine dewatering.
	Underground infiltration gallery	No discharge to UIG after underground mine is closed and water treatment no longer necessary.

BMP = best management practice; DNRC = Montana Department of Natural Resources and Conservation; NCWR = Non-Contact Water Reservoir; UIG = Underground Infiltration Gallery

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, Inc. 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 and Temperature

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, temporary WRS pad, CTF, PWP, CWP, WTP, and TWSP to minimize potential impacts on water quality. Apart from groundwater in the underground workings at the end of the closure phase, water from all facilities would be collected and treated to meet non-degradation criteria prior to discharge (Hydrometrics, Inc. 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.

- Underground workings: 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.

As part of mine operations, the Proponent anticipates discharging water seasonally from the WTP and/or TWSP via the UIG, which would flow into a segment of Sheep Creek after being discharged to the adjacent alluvial groundwater system. The discharge would be governed by an MPDES permit. Therefore, the Proponent has developed predictions regarding potential thermal effects resulting from the UIG discharge on Sheep Creek. Montana administrative rules applicable to B1 classified streams such as Sheep Creek restrict temperature changes to a 1 °F maximum increase above naturally occurring water temperatures, and a 2 °F decrease below naturally occurring water temperatures.

Water Quality 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, Inc. 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, Inc. 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, Inc. 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 underground workings 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 non-degradation criteria (Hydrometrics, Inc. 2016c).

[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.

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 non-degradation 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 non-degradation 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 6-inch (150 mm) 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 (Zieg et al. 2018).

At mine closure, much of the underground workings 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. Non-degradation criteria within the underground workings 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 underground workings 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 non-degradation 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, Inc. 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 non-degradation criteria (Hydrometrics, Inc. 2016c).

The post-closure contact groundwater would be unlikely to affect surface water quality. Such contact groundwater would be subject to mixing and retardation, while migrating via shallow groundwater system toward surficial environments (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 with other waters that the contact water would undergo (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 combined flow rate of potential contact water from the Proposed Action is expected to be less than about 3 gpm. If 3 gpm of the contact water were to completely mix with Ynl A groundwater, the likely result would be a 30:1 dilution of the COCs present in the Project contact water. Furthermore, complete mixing of the contact water with Sheep Creek surface water would dilute the original COC concentrations by a factor of 2,200 or more (also see Section 3.4.3.2).

The limited variation between the base case and sensitivity scenarios reflects the robust design and plan for management of the underground workings, 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		Groundwater Standards (MT DEQ-7)	Estimated Groundwater Non-degradation Criteria
		Proposed Action	Agency Modified Alternative		
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

		Underground model predictions at closure, after PHREEQC		Groundwater Standards (MT DEQ-7)	Estimated Groundwater Non-degradation Criteria
		Proposed Action	Agency Modified Alternative		
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
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.

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]
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]

		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)	Model Sensitivities: Reactive Mass Halved (e.g., 3-month infiltration OR half surface area OR 80% porosity)	
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.

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.

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 x 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.

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
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

		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	
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.

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.

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 plans to seal 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. Covering the CTF with subsoil and topsoil to support vegetation and contouring the CTF to preclude standing water would minimize the amount of precipitation that infiltrates into the reclaimed CTF. Eliminating 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)
			Model Sensitivities			
		Base Case	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]

		Model Predictions for CTF at Closure				Groundwater Standards (MT DEQ-7)
			Model Sensitivities			
		Base Case	Waste Rock Surface Area Doubled	Paste Cement Surface Area Doubled	Paste Cement Surface Area Halved	
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
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.

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
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

			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)
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 (Zieg 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 (Zieg 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 (Zieg 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 (Zieg et al. 2018).

Water Temperature Thermal Analysis Methods and Results

As part of the Proposed Action, the Proponent would discharge water from the NCWR and TWSP to creeks via UIG systems and direct discharge via the wet well. This section addresses concerns related to the thermal impact associated with the release of these waters. A summary of conservative thermal analyses conducted by the Proponent indicating the absence of significant temperature effects on creeks is outlined below.

The Proposed Action and AMA require the Proponent to conduct water temperature monitoring related to TWSP discharge. Thermal analyses conducted by the Proponent (Zieg 2019a, 2019b) and outlined below supports the determination of no significant temperature effects on streams.

<u>Non-Contact Water Reservoir</u>

Water output volume from the NCWR as allocated by Zieg (2019a) consists of the following pathways.

- Direct discharge to Sheep Creek (October through April) via the wet well. This represents the most significant NCWR output volume, ranging between 114 gpm in November to 136 gpm in April.
- Seepage to Little Sheep Creek (year-round). Discharge from the NCWR as seepage to groundwater would occur beneath the reservoir. This seepage would migrate as groundwater approximately 1 mile prior to entering Little Sheep Creek more than a mile before its confluence with Sheep Creek, and would represent a limited contribution to the total flow in Sheep Creek (seepage output volume is estimated to range between 5 gpm in April to 24 gpm in July). This contribution is not expected to have a detectable influence on Sheep Creek’s water temperature.
- Discharge to Coon Creek (year-round). This represents the second most significant NCWR output volume, and remains steady year-round at approximately 70 gpm. The water transfer from the NCWR is proposed via buried pipeline to a UIG adjacent to Coon Creek, which would allow for temperature equilibration in the subsurface prior to the water entering Coon Creek. Any temperature increase in Coon Creek would not significantly affect Sheep Creek’s water temperature because Coon Creek base flow amounts to only 1 percent of base flow in Sheep Creek.

- Discharge to Black Butte Creek (May through September), also via a UIG. Although the need to augment losses in Black Butte Creek base flow as a result of mine-dewatering is unlikely, NCWR water (45 gpm) has been allocated in Zieg (2019a). The groundwater model simulations estimate a loss of base flow between 3 and 4 percent of Black Butte Creek steady-state base flow, which is less than the ±15 percent change in base flow allowed per non-degradation threshold criterion (ARM 17.30.715).
- NCWR evaporation (April through October). This output volume ranges between 9 gpm in April to 43 gpm in July.

Future monthly NCWR water temperatures were estimated using Newton's Law of cooling and mass flow equations to calculate (1) the total heat transferred into the reservoir in May and June using an overall heat transfer coefficient, (2) the average area of the reservoir (average of previous and current months), (3) the average temperature of the creek water coming into the reservoir (at station SW-1), and (4) the average site ambient air temperature. The heat transfer coefficient accounts for heat lost by long-wave radiation, convection, and evaporation less the heat gained by short-wave radiation (Williams 1963). The NCWR temperature was estimated July through April using similar methods; however, since the discharge to the reservoir would be small (estimated as 106 gpm during July through September [Zieg 2019a]) compared to the total volume, discharge to the reservoir was not considered during these months. Known factors, inputs, and assumptions are outlined in a July 25, 2019, technical memorandum (Zieg 2019a).

Results indicate that water temperature in the NCWR would be greater than in Sheep Creek during the following 5 months: May (Mean Creek temperature 41.6 °F vs. NCWR water temperature 41.8 °F), June (Mean Creek temperature 49.6 °F vs. NCWR water temperature 49.7 °F), August (Mean Creek temperature 53.2 °F vs. NCWR water temperature 54.7 °F), September (Mean Creek temperature 46.9 °F vs. NCWR water temperature 51.9 °F) and October (Mean Creek temperature 39.7 °F vs. NCWR water temperature 51 °F). Of these 5 months during which NCWR water temperature exceeds Sheep Creek water temperature, the Proponent only proposes to transfer water from the NCWR to Sheep Creek via the wet well during the month of October (Zieg 2019a). Mixing analysis shows that the NCWR discharge to Sheep Creek would only increase the temperature in Sheep Creek during the month of October, and the increase would be about 0.5 °F (Hydrometrics, Inc. 2019), which is less than the 1 degree change allowed for per ARM 17.30.623(2)(e).

Direct discharges via the wet well from the NCWR to Sheep Creek during May to September are not proposed. Seepage from the reservoir (estimated to range from 22 to 26 gpm during summer months) would migrate to Little Sheep Creek via subsurface (groundwater) flow and is expected to equilibrate with ground temperatures prior to entering surface water; therefore, this seepage is not expected to have a detectable influence on the creek's water temperature. Water transfers from the NCWR to Coon Creek and Black Butte Creek are expected to equilibrate with groundwater temperatures as a result of (1) flow through buried pipelines and (2) equilibration with subsurface temperatures following discharge to UIGs.

The Proponent would be required to monitor water temperature in the NCWR and in the water leaving the facility. In the unlikely scenario that transfers of water from the NCWR would cause water temperatures to fall outside regulatory criteria, the Proponent would be required to implement engineering controls such as changing the depth the water is pulled from the NCWR. Changing the depth that NCWR water is pulled from represents a highly effective engineering control allowing for access to deeper, colder water. As long as depletion of water in the NCWR is insignificant, discharge of NCWR water would not result in rising creek temperature.

Treated Water Storage Pond

The rate at which the Project would discharge water to the alluvial aquifer represents a small percentage of Sheep Creek's total discharge. In addition, water discharged via the UIG would migrate through the alluvial aquifer for some distance before discharging to the creek. During that migration, the UIG injected water would equilibrate with ambient groundwater and be influenced by the temperature of the sediments, which generally retain or approach the mean annual surface air temperature year-round. As a result, the difference in temperature between the discharge water and groundwater would decrease.

Regardless, future monthly TWSP water temperatures were estimated by calculating the total heat transferred into the pond for July, August, and September using (1) an overall heat transfer coefficient, (2) the average area of the pond, (3) the average temperature of groundwater being pumped into the reservoir following treatment, and (4) the average site ambient air temperature. The heat transfer coefficient accounts for heat lost by long-wave radiation, convection, and evaporation less the heat gained by short-wave radiation (Williams 1963). The end of the month temperature difference was calculated by dividing the total heat energy in the reservoir. The estimated temperature was calculated by subtracting the temperature difference by the temperature of the incoming water. For all other months (October through June), the TWSP temperature was calculated using the previous month's calculated TWSP water temperature. Known factors, inputs, and assumptions are outlined in an August 1, 2019, technical memorandum (Zieg 2019b).

Results indicate that water temperatures in the TWSP would be lower than the projected maximum allowable temperature for water being discharged to the UIG for all months except October and November. The thermal analysis does not account for equilibration with ambient subsurface temperature during seepage through the alluvial sediments after discharge. Water discharged via the UIG would migrate through the alluvial aquifer for some distance before discharging to the creek. The discharge would be governed by an MPDES permit. The rate at which the Project would discharge water to the alluvial aquifer represents a small percentage of Sheep Creek's total discharge. Thermal analyses conducted by the Proponent (Zieg 2019b) and outlined below supports the determination of no significant temperature effects on streams.

The higher water temperatures introduced by discharge from the TWSP in October and November are expected to be rapidly attenuated. For example, temperature differences between TWSP discharge and the projected maximum allowable temperature in the UIG is 1.5 °F in October and 3.6 °F in November (Zieg 2019b). With consideration for the analyses, it is unlikely there would be thermal impacts as a result of discharging the TWSP water.

The Proponent would be required to monitor water temperature in the TWSP discharge and at the stream monitoring sites. If water temperatures fall outside regulatory criteria, the Proponent would be required to implement engineering controls, including but not limited to (1) changing the depth the water is pulled from the TWSP; (2) managing the combined flows from the TWSP and treated groundwater; and/or (3) installing heat exchange unit(s). These engineering controls would be sufficient to avoid any temperature-related adverse effects.

Engineering Control 1: Changing the depth that water is pulled from the TWSP

The Proponent plans to pull deeper water from the TWSP. As a result, water leaving the TWSP would consist of deeper, colder water. As long as depletion of water in the TWSP is insignificant, discharge of TWSP water would not result in rising creek temperature.

Engineering Control 2: Managing the combined flows from the TWSP and treated groundwater

Mixing TWSP water with water from the WTP represents another engineering control.

The WTP would receive water from the following main sources (Tintina 2018b Figure 3.44):

- Mill catchment runoff (at a rate of 13.1 gpm);
- Water from the foundation drain of the CTF (at a rate of 20 gpm); and
- Water pumped from the mine (at a rate of 499.7 gpm).

Most of the water received by the WTP would be groundwater pumped from the mine and delivered to the WTP via underground pipes. Temperature of that groundwater would be close to average annual air temperature, thereby regulating any seasonal temperature variation. Subsequently, water temperature leaving the WTP is not expected to be significantly higher than the water pumped from the mine. Mixing TWSP water with WTP water at the appropriate proportion may allow for controlling the temperature of the water discharged to the Sheep Creek UIG, such that instream temperatures are not altered. Prior to discharge, the blended water would be sampled/monitored as required in the MPDES permit.

Engineering Control 3: Installing heat exchange units

If engineering controls 1 and 2 outlined above are insufficient to prevent thermal impacts to Sheep Creek, heat exchange units may be installed. Heat exchange units are used to move heat from one medium where it is readily available to another medium that can accept it. Here, routing TWSP water through a refrigeration circuit is proposed. During this process, energy is absorbed from the refrigerant (i.e., TWSP water), thereby lowering the water temperature as needed to comply with set average monthly and maximum daily temperature changes as outlined in the MPDES permit.

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 non-degradation standards (Amec Foster Wheeler 2017) prior to discharge via the UIG (Hydrometrics, Inc. 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, Inc. 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, Inc. 2018c]). Water in the Sheep Creek alluvium has near neutral pH with low to non-detectable concentration of dissolved metals. Regarding aluminum, DEQ has ensured that non-degradation limits are in the MPDES permit. As a result, there would be no decline in water quality for aluminum caused by the discharge. Regardless, as noted in Appendix V-1 of the MOP Application (Hydrometrics, Inc. 2017b) and Table 3-3 of the Integrated Discharge Permit Narrative, aluminum concentrations in the discharge water are projected to be less than 0.001 mg/L.

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. Additional monitoring would be implemented on Upper Coon Creek as described in Section 6 of the MOP Application (Tintina 2017). 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 (less than 0.04 to 0.15 mg/L).

Water treated with RO would contain very low levels of dissolved solids, giving the water a potential to dissolve elements from sediment similar to that of rainwater. To reduce the potential for RO permeate to leach, the water would be buffered by routing it through a calcium carbonate filter, which would give the effluent an alkalinity similar to that of the receiving groundwater. 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 non-degradation 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 non-degradation standards under all cases and in all sensitivity scenarios (Hydrometrics, Inc. 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 (Zieg 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 Non-degradation Criteria
Underground Workings					
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 Tailings Facility; mg/L = milligrams per liter; MT = Montana; PWP = Process Water Pond; s.u. = standard units; UIG = Underground Infiltration Gallery; WRS = Waste Rock Storage
Notes:
a = Collected water treated by RO to meet non-degradation 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 in the months of May through July 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 (Zieg 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 (Zieg et al. 2018).

The NCWR would be used for mitigation of depletion in surface waters during operations and for approximately 20 years after the end of mine dewatering (Hydrometrics, Inc. 2018e). Once the flow mitigation system is unnecessary, the wet well, intake pipeline, and transfer pipeline to the NCWR would be removed and 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 (Zieg 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 non-degradation criteria prior to discharge to the alluvial UIG (Hydrometrics, Inc. 2017b). A 30:1 dilution of the solute concentrations 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, Inc. 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 non-degradation 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 underground workings 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 non-degradation 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.

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	Collected water treated by RO to meet non-degradation standards
	Waste rock Storage (WRS)	Collected water treated by RO to meet non-degradation standards
	Process Water Pond (PWP)	Collected water treated by RO to meet non-degradation standards
	Cemented Tailings Facility (CTF)	Collected water treated by RO to meet non-degradation standards
	Contact Water Pond (CWP)	Collected water treated by RO to meet non-degradation standards
	Treated Water Storage Pond (TWSP)	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
	Underground Infiltration Gallery (UIG)	Collected water treated by RO to meet non-degradation standards
Mine Production (Phase III; Project Years 5 - 15)	Underground mine facilities	Collected water treated by RO to meet non-degradation standards
	Waste Rock Storage (WRS)	Collected water treated by RO to meet non-degradation standards
	Process Water Pond (PWP)	Collected water treated by RO to meet non-degradation standards
	Cemented Tailings Facility (CTF)	Collected water treated by RO to meet non-degradation standards
	Contact Water Pond (CWP)	Collected water treated by RO to meet non-degradation standards
	Treated Water Storage Pond (TWSP)	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
	Underground Infiltration Gallery (UIG)	Collected water treated by RO to meet non-degradation standards
Post-Mine Period (Mine Closure; Phase IV)	Underground mine facilities	Collected water treated by RO to meet non-degradation standards
	Waste Rock Storage (WRS)	Collected water treated by RO to meet non-degradation standards
	Process Water Pond (PWP)	Collected water treated by RO to meet non-degradation standards
	Cemented Tailings Facility (CTF)	Collected water treated by RO to meet non-degradation standards
	Contact Water Pond (CWP)	Collected water treated by RO to meet non-degradation standards
	Treated Water Storage Pond (TWSP)	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
	Underground Infiltration Gallery (UIG)	Collected water treated by RO to meet non-degradation standards

Project Activities	Project Facilities	Notes
Post-Mine Period (Post-Closure; Phase V)	Underground mine facilities	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

RO = reverse osmosis

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 (Zieg et al. 2018).

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 underground workings 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 underground workings 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 (Zieg 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.”

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

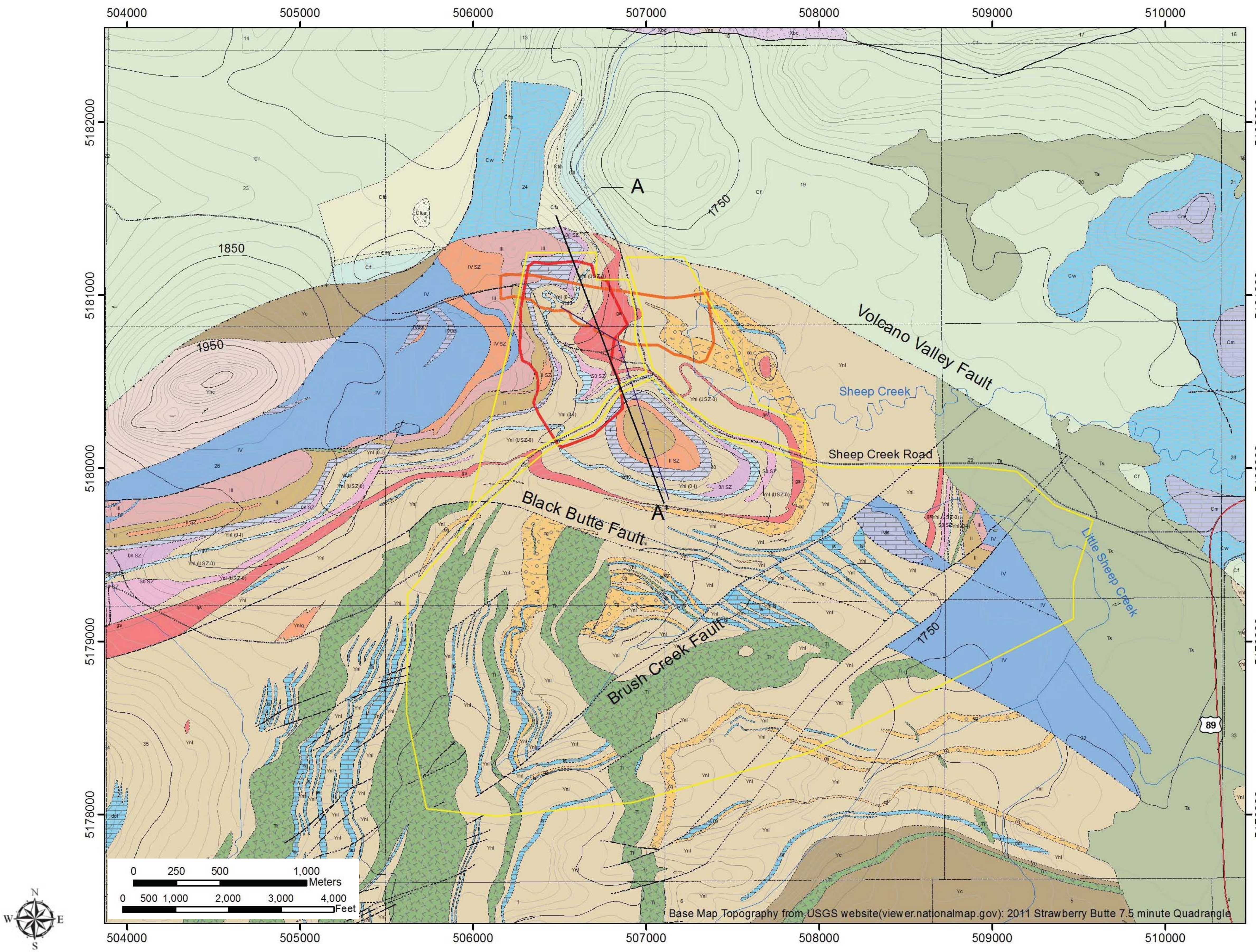
Figure 3.6-2 and cross-section **Figure 3.6-3** illustrate the location of both the UCZ and the LCZ in the Johnny Lee Deposit. Mineral resources were recalculated in 2013 using data collected between 2010 and 2012, including drill hole logs, geologic correlations, and assays to create a block model of the deposit zones (Tetra Tech, 2013). See Table 1-2 of the MOP Application (Tintina 2017) for a summary of 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.

Figure 3.6-1
Black Butte Copper Project
Geologic Map of the Project Area
Meagher County, Montana



NOTE: All of the sulfide zone (SZ) lithologic units in the Newland Formation are oxidized to gossan in the near surface environment.

Johnny Lee Deposit Upper Zone (UCZ)
Johnny Lee Deposit Lower Zone (LCZ)
*boundaries projected to surface

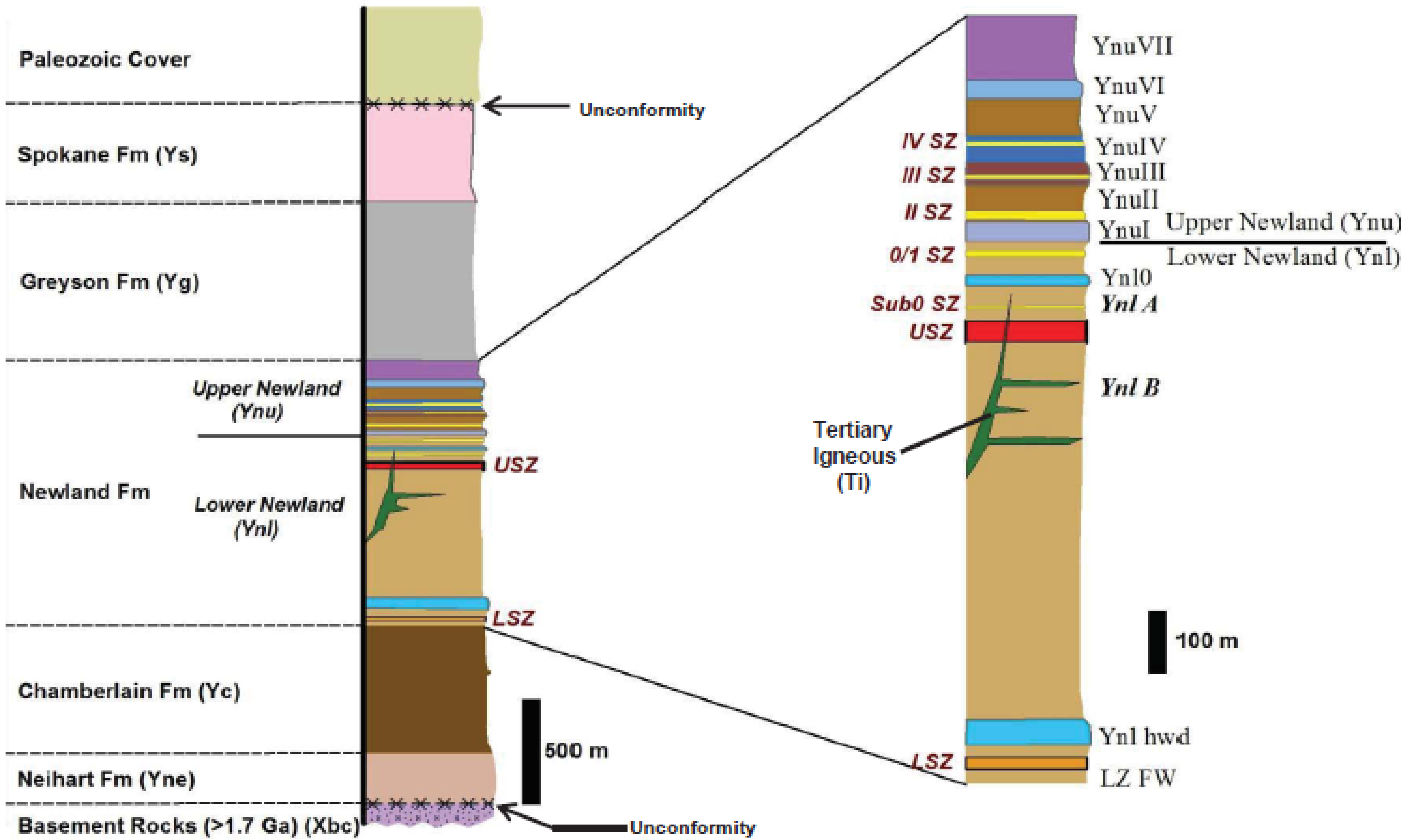
This information is for environmental review purposes only.

FILE: M:\Clients\M-O\MTDEQ_ArcGIS\2018\04\Geology_Geochem_MTDEQ_Geologic_Map.mxd | REVISED: 05/08/2018 | SCALE: 1:14,320 when printed at 11x17

DRAWN BY: MBG

Source: Tintina 2017

NOTES: (1) Geologic unit codes and colors used in Site Geologic Map in Figure 1.5
(2) Mining units UCZ and LCZ lie within the USZ and LSZ, respectively



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

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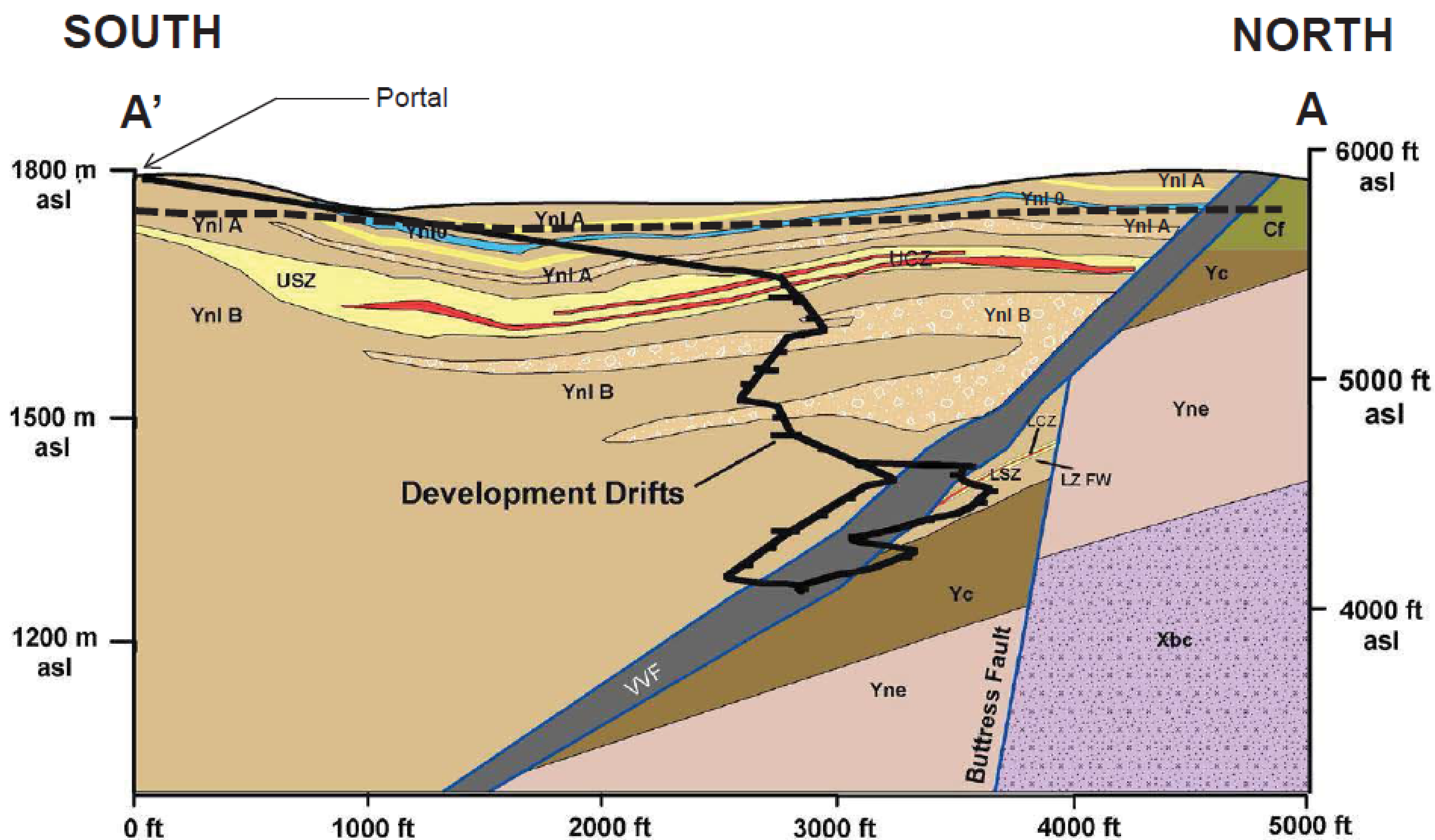
DRAWN BY: JPB

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



Notes: (1) See Figures 1.5 and 1.6 for lithology descriptions
(2) See Figure 1.5 for location of cross-section line A-A'

VVF = Volcano Valley Fault LZ FW = Lower Zone Footwall

Top of groundwater table surface as of November 2016

This information is for environmental review purposes only.

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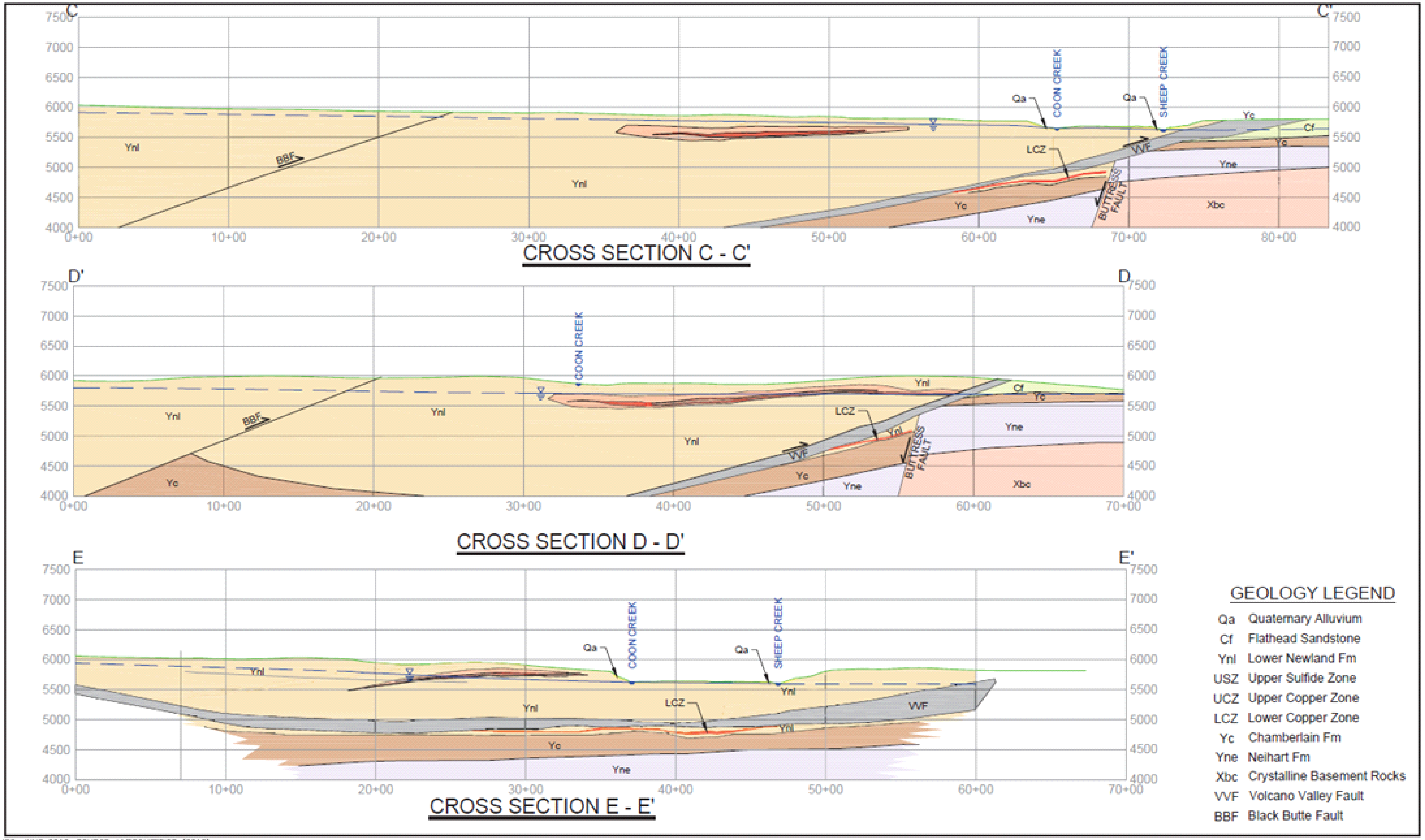
Source: Tintina 2017

Figure 3.6-4
Black Butte Copper Project
Schematic Cross-Sections
Meagher County, Montana



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Source: Tintina 2017

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. 2017) 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).

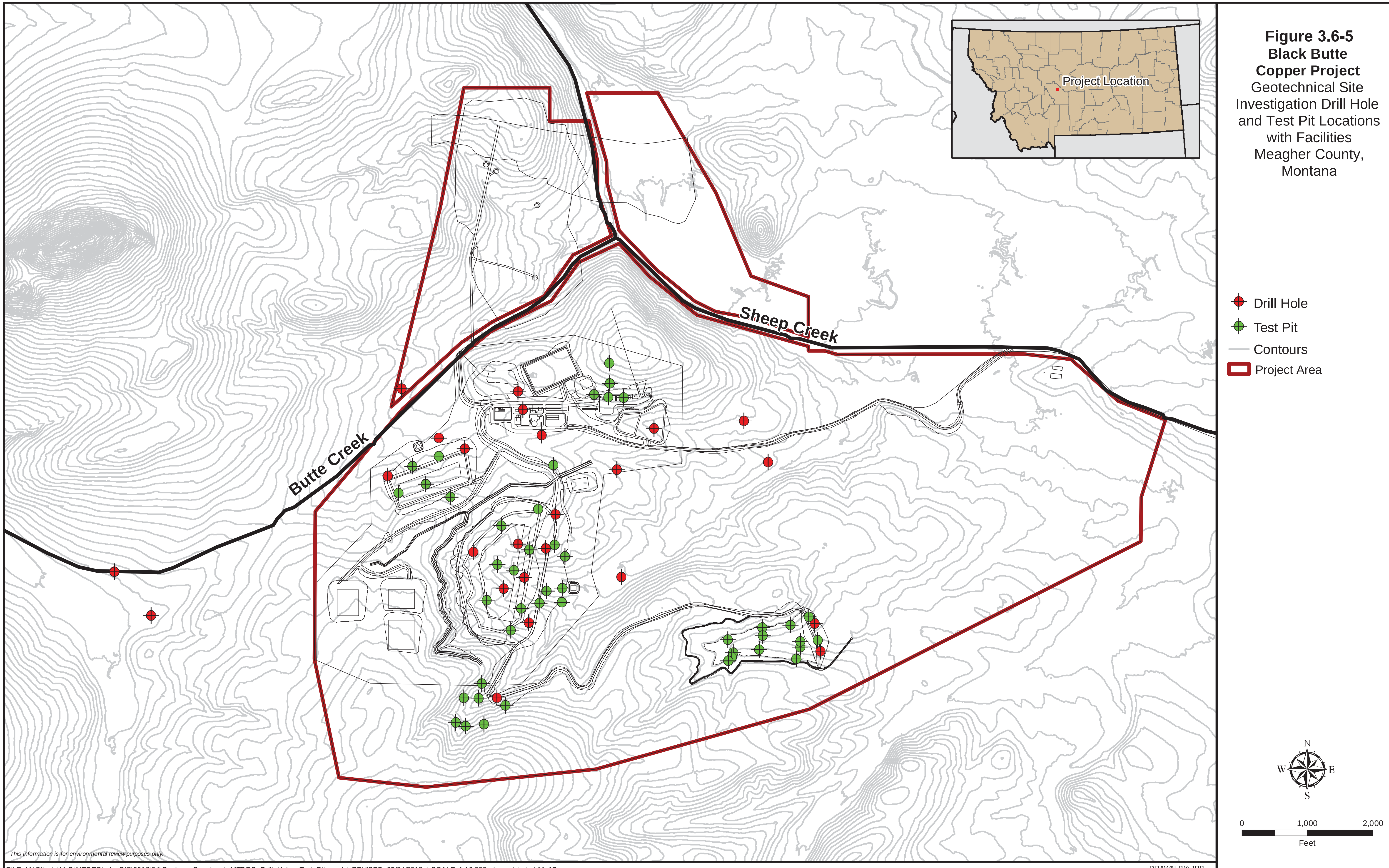
Comparisons of the geochemistry as a function of depth demonstrate that weathered surface materials are relatively depleted in metals and sulfur, and are therefore distinct from the deeper materials. This is consistent with observations made while drilling, that the rocks are highly fractured with iron-oxide 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.



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, Inc. 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 that 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
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 [a]

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 would be from fresh unweathered bedrock from each individual facility excavation footprint. Most of the construction materials would be sourced from the facility that they are excavated from (i.e., most of the mill pad would 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 would 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 would 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 would 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 would 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 would 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 would require crushing and screening of the excavated bedrock. The crusher and screen plant would 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 would finalize these details prior to construction. Since excess fill materials from the facility construction would 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 J; Knight Piésold Consulting 2017a) would 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 would 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 would be end up at the end of the project (in closure) would be transported and placed in the CTF. The first 2 years of the mine life would produce 411,537 tonnes as stated in Table 3-6 of the MOP Application, which would 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 would 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 would 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 would 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 J. The specifications for the development waste rock would approximate that for the embankment fill. The development waste rock used to construct the drainage layer of the CTF basin drain system would 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 would 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 would 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 would 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 would exist during construction, operations, closure, and after closure) and the PWP and NCWR which are not permanent facilities (i.e., would not exist after closure).

[q] These 57,550 cubic yards of material have 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 hydrogeological 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, Surface Water Quality and Temperature).

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, Surface Water Quality and Temperature).

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 impact analysis determined how the Project could 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. The land 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 Within 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 percent 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 that include 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 from 1995 to 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

Year	**District**	**Species**	**Hunter Days [a]**	**No. Hunters**
2014	416	Deer	N/A	N/A
		Elk	10,662	1,790
	446	Deer	N/A	N/A
		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

Year	District	Species	Hunter Days [a]	No. Hunters
		Elk	5,541	982
2004	416	Deer	4,827	992
		Elk	7,182	1,400
	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 landowners, 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 within the Project area is Bar Z Ranch, which is not located within the disturbance footprint and would not be directly affected 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 game species.

As discussed in Section 3.5.3.1, Surface Water Quantity, Section 3.5.3.2, Surface Water 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 300 daily employee vehicle trips and 48 to 54 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 Section 3.9.3.2, Socioeconomics 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 Quantity, and Section 3.5.3.2, Surface Water 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 1967
- USGS 1995
- 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, landforms, buildings bridges, streams, and water features, vistas of mountain peaks or other unique natural features.

According to USEPA 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.

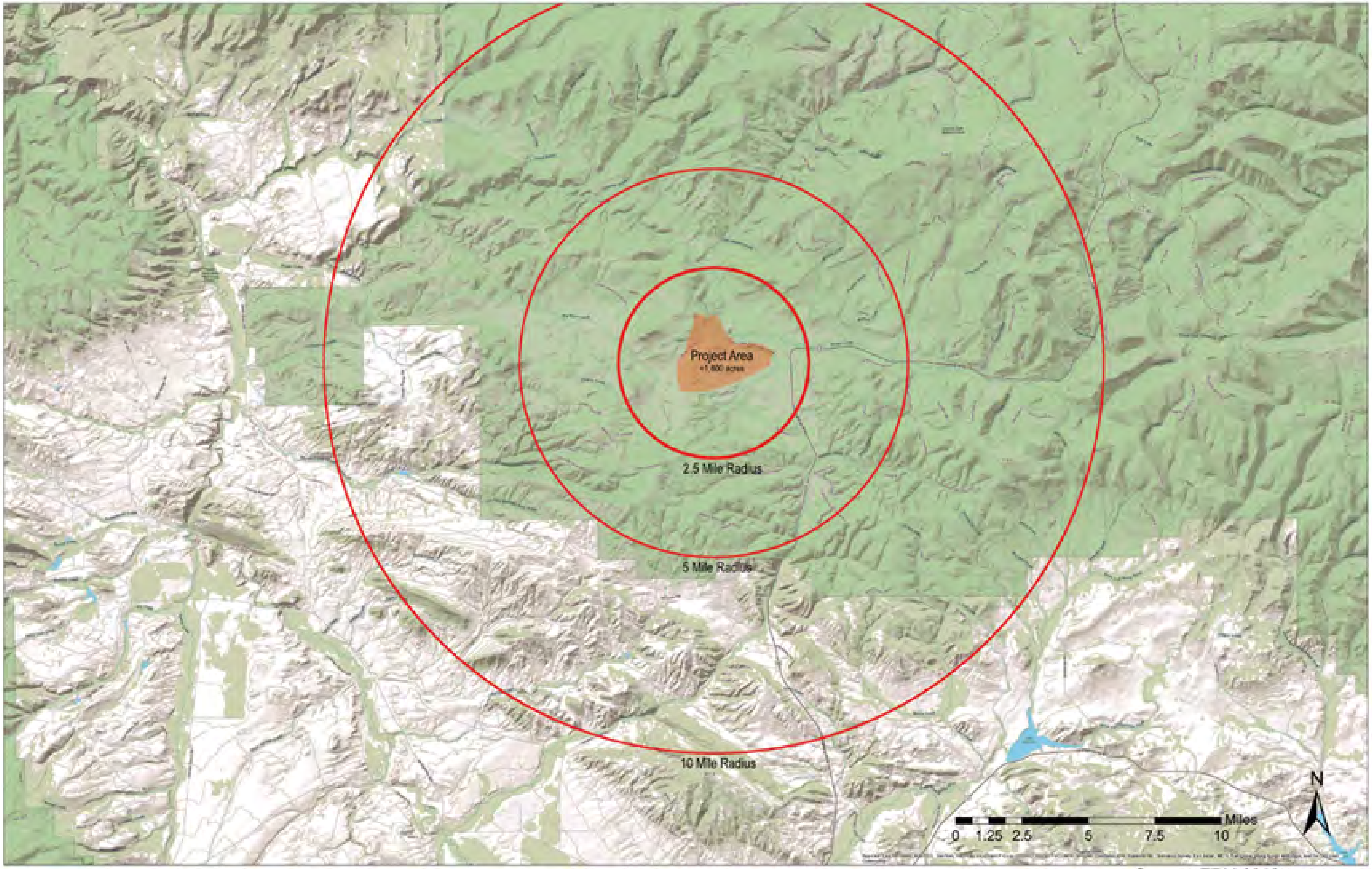
Historical development and land use has impacted the native landscape in the assessment area. Seven existing or former mines and gravel pits are within the assessment area (**Figure 3.8-2**) as well as scattered ranches and home sites.

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.

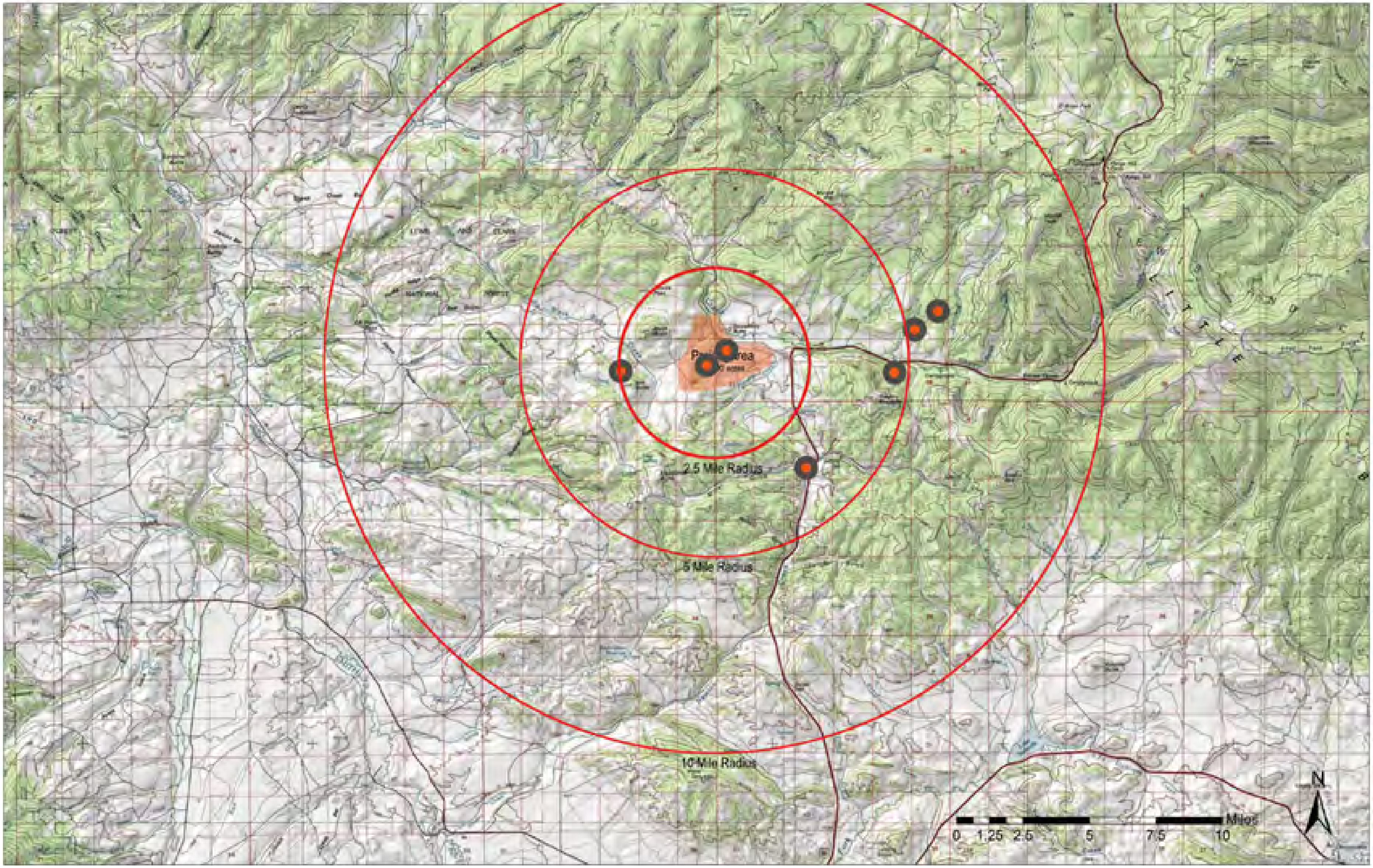
The nearest resident receptors include a single residence/ranch located approximately 2.15 miles east of the Project Area, and a small residential development consisting of approximately 12 homes approximately 3 miles southeast of the Project area. Existing vegetation and topography block some views 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 (AADT) 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 AADT 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

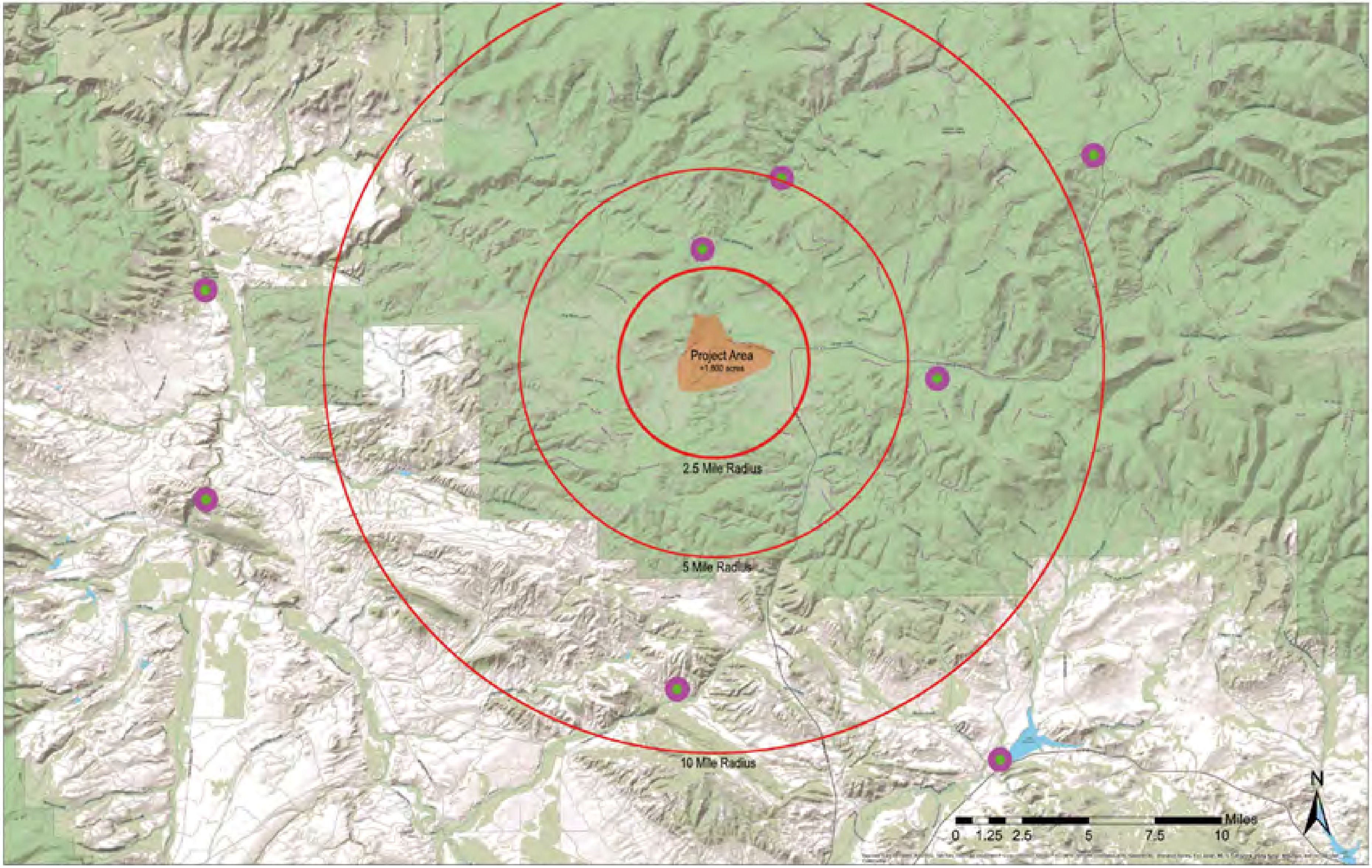
Under the No Action Alternative, the current condition of the visual resources in the assessment area would remain as they are, including the operations of existing mines, quarries, and residential, ranching, and recreational facility activities.

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**.



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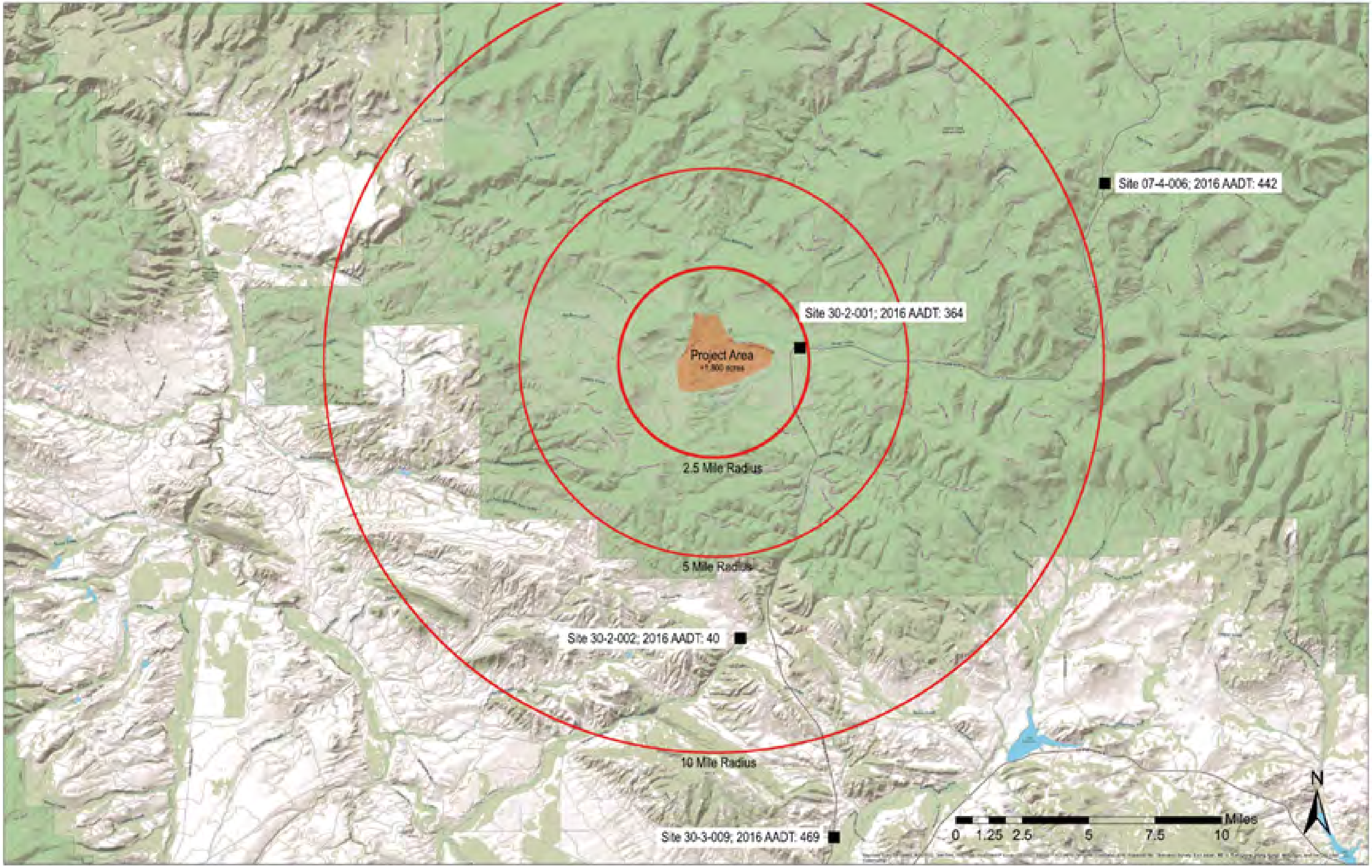
Source: ERM 2018

Figure 3.8-3
Black Butte Copper Project
Campgrounds, Parks, and Recreation Areas
Meagher County, Montana



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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.

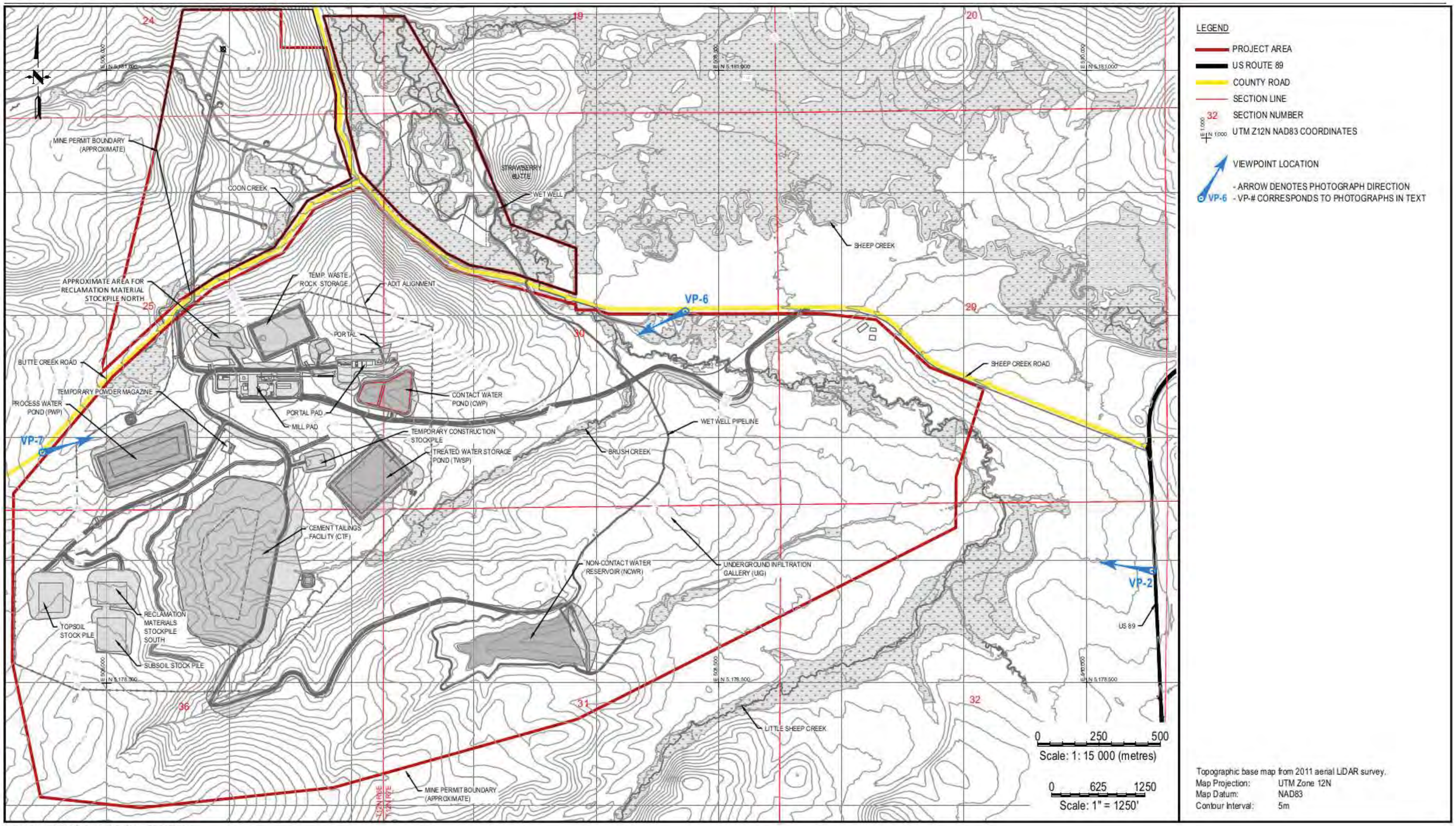
Figure 3.8-8 shows existing views from Viewpoint 6 from Sheep Creek Road and **Figure 3.8-9** simulates the impacts of the Project. The simulation shows the impacts of the construction of the Project access road and associated clearing and grading. Foreground views of grassland and fences and background 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

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Figure 3.8-6
Black Butte Copper Project
Viewpoint 2 Existing
Meagher County, Montana

This information is for environmental review purposes only.

Figure 3.8-7
Black Butte Copper Project
Viewpoint 2 Proposed
Meagher County, Montana

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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

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Figure 3.8-10
Black Butte Copper Project
Viewpoint 7 Existing
Meagher County, Montana

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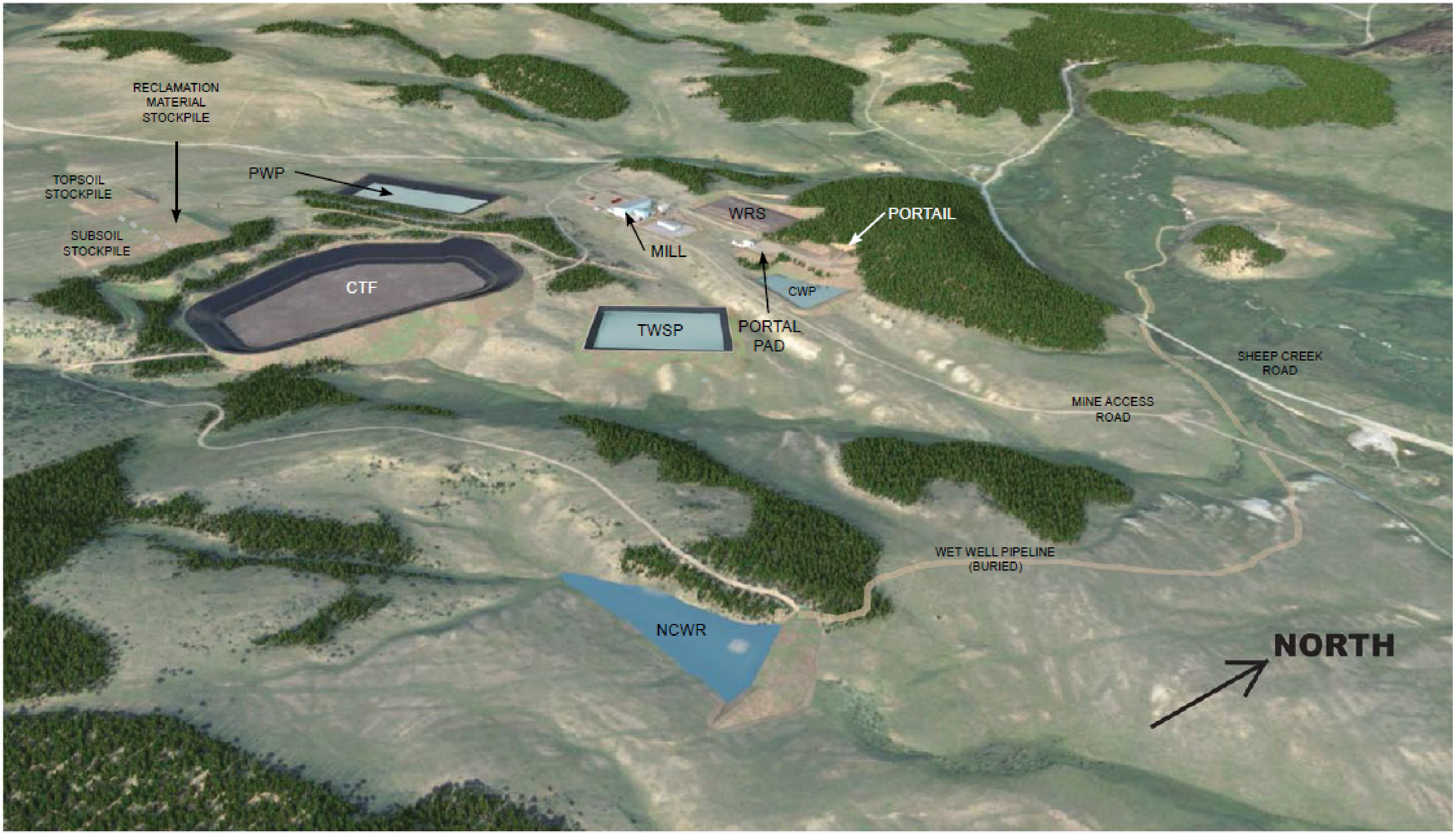
Figure 3.8-11
Black Butte Copper Project
Viewpoint 7 Proposed
Meagher County, Montana



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. 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.

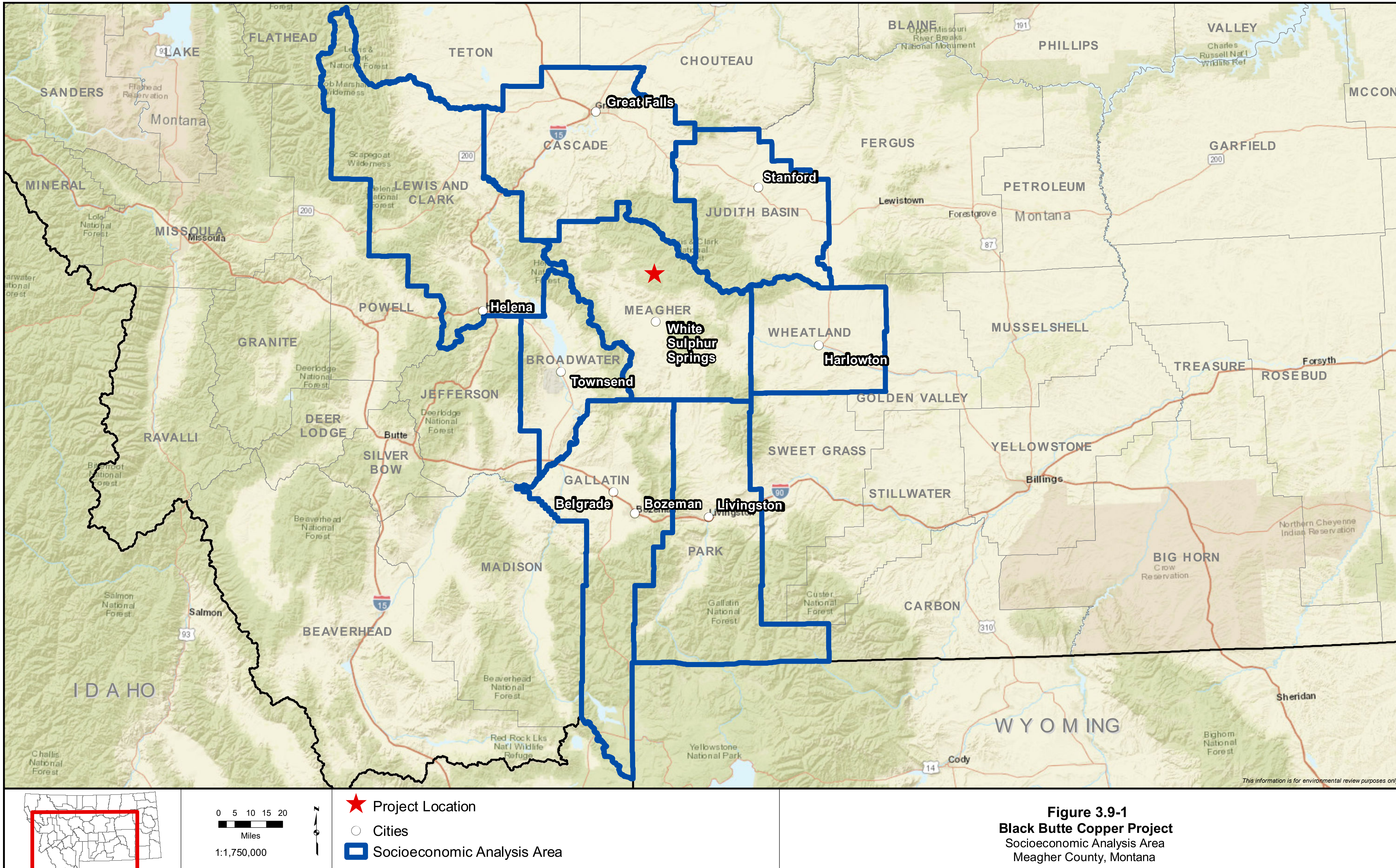


Figure 3.9-1
Black Butte Copper Project
Socioeconomic Analysis Area
Meagher County, Montana

MPLS M:\Clients\M-O\MTDEQ_ArcGIS\2018\03\Socioeconomic_Areas_Socioeconomic_Areas.mxd | REVISED: 03/26/2018 | SCALE: 1:1,750,000 when printed at 11x17 DRAWN BY: MBG

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 930 with 890 people employed and an estimated 40 people unemployed in 2017, with the unemployment rate at 4.3 percent (Montana DLI 2017).

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	930	4.3%	$30,656	$19,989	$39,284	18.3%
Broadwater County	2,584	4.6%	$30,378	$29,598	$50,791	10.6%
Cascade County	37,753	3.7%	$46,667	$26,578	$45,569	14.2%
Gallatin County	64,527	2.7%	$44,612	$31,909	$60,439	11.4%
Judith Basin County	923	3.6%	$42,875	$28,741	$44,607	13.4%
Lewis and Clark County	35,249	3.4%	$47,953	$29,892	$60,370	10.4%
Park County	8,621	3.8%	$32,108	$27,597	$45,405	11.7%
Wheatland County	784	4.3%	$37,227	$19,407	$37,306	19%
State of Montana	526,914	3.9%	$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 (along with Wheatland County) at 4.3 percent compared to the Montana unemployment rate of 3.9 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

Montana's outdoor recreation industry plays an important role in the economy of the socioeconomic analysis area communities. While there are no public recreation opportunities located within or adjacent to the MOP Application Boundary, recreation within 15 miles of the Project area includes hiking, camping, fishing, hunting, boating, and river floating (see Section 3.7, Land Uses and Recreation).

FWP provides statewide estimates of hunter and angler trip-related expenditures, which can be found on their website. FWP estimated $760.4 million in total expenditures from river/stream angler use in 2018 in Montana (Lewis 2018). According to FWP in a comment on the Draft EIS during the public comment period, they estimated angler expenditures associated with the Smith River at $9.1 million annually based on the number of angler days and average per day expenditures for the river and its North and South Fork tributaries (see Submittal ID HC-001, comment number 6 in **Table 8.2-2** in Chapter 8, Response to Public Comments, of this EIS).

3.9.2.3. Housing

Meagher County had an estimated count of 1,432 housing units, of which the City of White Sulphur Springs had an estimated 600 units. Vacant housing units made up 43 percent of housing units in Meagher County. Median housing values were lowest in Meagher County and Wheatland County, at $122,200 and $89,700 respectively (U.S. Census Bureau 2016). The median rent in Meagher County was $625 per month (U.S. Census Bureau 2016). Four motels are in White Sulphur Springs with 87 rooms (Sandfire 2018).

According to the Meagher County Growth Policy 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. 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	Percentage of Vacant Housing Units	Median Rent	Motel/Hotel Rooms*
Meagher County	1,378	$122,200	43%	$625	-
White Sulphur Springs	600	NA	NA	NA	87
Broadwater County	2,691	$192,400	10.2%	$626	NA
Townsend (40 miles from White Sulphur Springs)	900	NA	NA	NA	36
Cascade County	37,714	$165,800	9.5%	$671	NA
Great Falls (100 miles from White Sulphur Springs)	27,405	NA	NA	NA	>2,100
Gallatin County	44,932	$285,200	13.7%	$895	NA
Bozeman (80 miles from White Sulphur Springs)	19,070	NA	NA	NA	>2,000
Belgrade (80 miles from White Sulphur Springs)	3,200	NA	NA	NA	>200
Judith Basin County	1,338	$136,500	31.6%	$507	11
Stanford (90 miles from White Sulphur Springs)	248	NA	NA	NA	NA
Lewis and Clark County	30,646	$212,600	12.7%	$802	NA
Helena (70 miles from White Sulphur Springs)	14.169	NA	NA	NA	>1,500
Park County	9,369	$222,500	23.9%	$704	NA
Livingston (70 miles from White Sulphur Springs)	3,750	NA	NA	NA	>380
Wheatland County	1,297	$89,700	33%	$525	NA
Harlowton (50 miles from White Sulphur Springs)	725	NA	NA	NA	37

Source: U.S. Census Bureau 2016; *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).

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**.

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

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 would 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 as a result of 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**.

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 3.9-10
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.

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

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
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, Affected Environment, 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. According to the Meagher County Growth Policy, implementation of Growth Policy goals includes an action plan to utilize the Hard Rock Mining Act process to address mining impacts on community services (Meagher County 2015).

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. This could lead in some cases to higher property taxes if property values rise. 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 Meagher County Growth Policy, the county may consider developing and implementing temporary workforce regulations to ensure that housing selected by construction workers is designed to protect public health and safety and to ensure that necessary services and infrastructure is provided (Meagher County 2015). 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, Affected Environment, 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 or low salaries 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, Environmental Consequences, 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 3.2.4, 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.

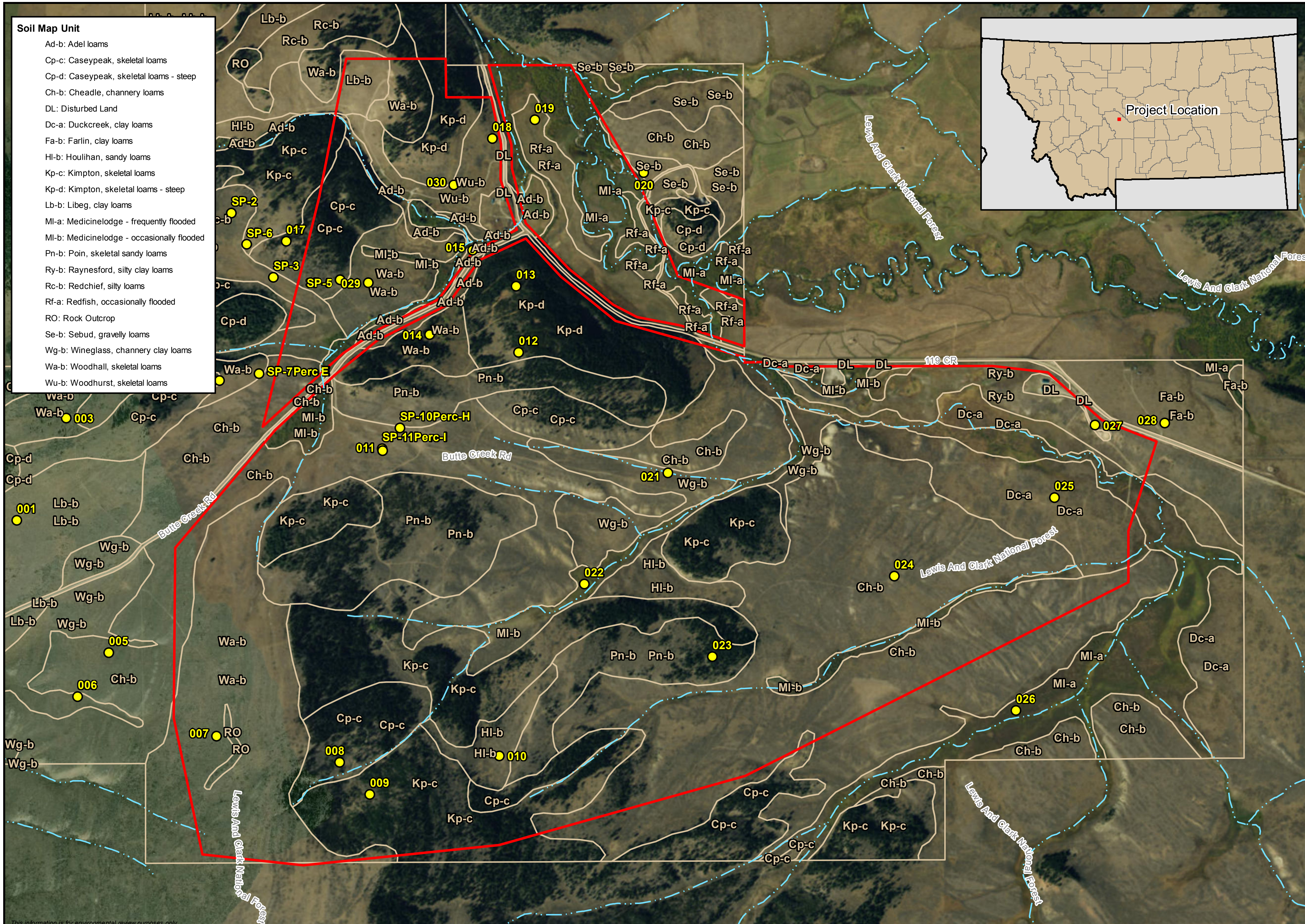


Figure 3.10-1
Black Butte
Copper Project
Baseline Soil Survey Map
Meagher County, Montana

Soil Sample Point
Project Area
Soil Boundary
Stream

N W E S

0 1,000 2,000
Feet

1:15,000

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 that 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 mountainside 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 USEPA 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

	Soils to be Stockpiled		Soils to be Stored and Replaced on Site (No Stockpiling)	
Map Unit Name	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

Map Unit Name	Soils to be Stockpiled: Total Acres of Disturbance	Soils to be Stockpiled: Total Soil Volume (Topsoil and Subsoil) (yd^3)	Soils to be Stored and Replaced on Site (No Stockpiling): Total Acres of Disturbance	Soils to be Stored and Replaced on Site (No Stockpiling): Total Soil Volume (Topsoil and Subsoil) (yd^3)
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
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 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

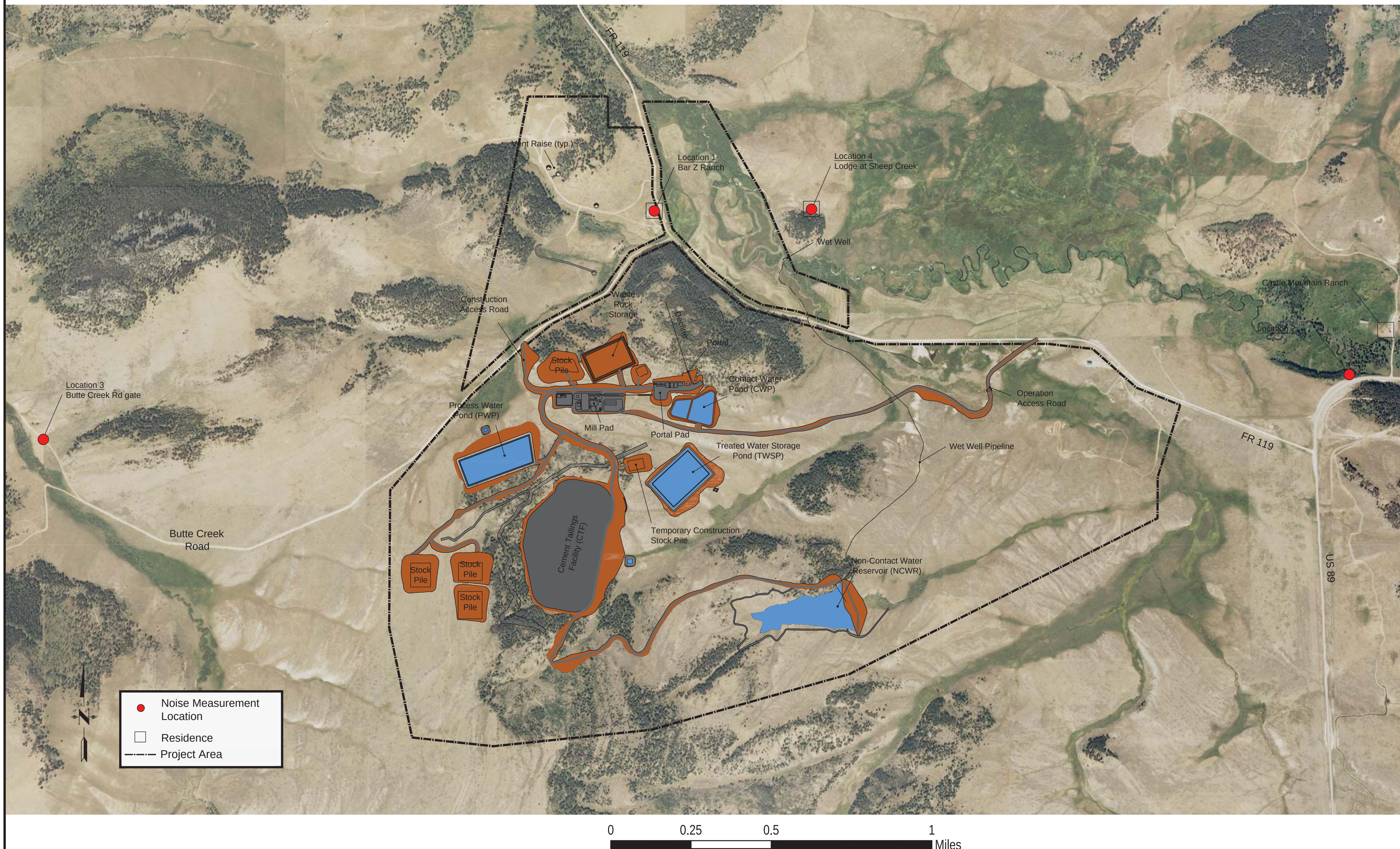
Sources: Menge 2005 and Cavanaugh 2002, as cited in Big Sky Acoustics 2017
L_{90} = ambient noise level; L_{eq} = equivalent noise level

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 pipeline 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
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 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, 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 (VMT). 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.

Table 3.12-1
2018 Average Annual Daily Traffic on Analysis Area Roads

Road	Location Milepost (MP)	2018 AADT		Truck Percent
		Total	Commercial	
North of Project area				
U.S. Route 89	North of Meagher County line, MP 28.95	393	52	13.2%
U.S. Route 89	0.5 mile east of Sheep Creek Road, MP 15.65	313	52	16.6%
South of Project area				
U.S. Route 89	0.5 mile north of U.S. Route 89/U.S. Route 12 merger, MP 0.51	541	52	9.6%
U.S. Route 12/ U.S. Route 89	Between Central and 1st Avenues, White Sulphur Springs, MP 42.30	2,479	73	2.9%
U.S. Route 12/ U.S. Route 89	East of 3rd Avenue, White Sulphur Springs, MP 42.15	3,452	73	2.1%
U.S. Route 12/ U.S. Route 89	South of Main Street, White Sulphur Springs, MP 42.06	1,600	73	4.6%
U.S. Route 12/ U.S. Route 89	0.5 mile north of U.S. Route 89/U.S. Route 12 split, MP 34.07	704	73	10.4%
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 32.91	578	171	29.6%
U.S. Route 12	Deep Creek Canyon,12 mi east of Townsend, MP 12.03	687	171	24.9%
U.S. Route 12	0.03 mile east of U.S. Route 287, Townsend, MP 0.04	3,058	171	5.6%
U.S. Route 287	North of U.S. Route 12, Townsend, MP 77.52	6,277	388	6.2%
U.S. Route 287	South of U.S. Route 12, Townsend, MP 77.60	5,860	441	7.5%
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	400	107	26.8%
U.S. Route 89	6 miles south of Ringling, MP 38.99	522	107	20.5%
U.S. Route 89	0.5 mile south of Wilsall, MP 22.99	1,128	72	6.4%
U.S. Route 89	Between 4th and 5th Streets, Clyde Park, MP 15.05	1,468	72	4.9%
U.S. Route 89	1 mile north of I-90, MP 1.43	2,052	72	3.5%
I-90	West of U.S. Route 89 and east of Exit 337, MP 338.46	12,476	1,892	15.2%
I-90B (U.S. Route 89)	West of I-90 Exit 337, Livingston, MP 57.64	2,535	248	9.8%
I-90B (U.S. Route 89)	West of Yellowstone River Bridge, Livingston, MP 55.77	4,855	248	5.1%

Source: MDT 2019

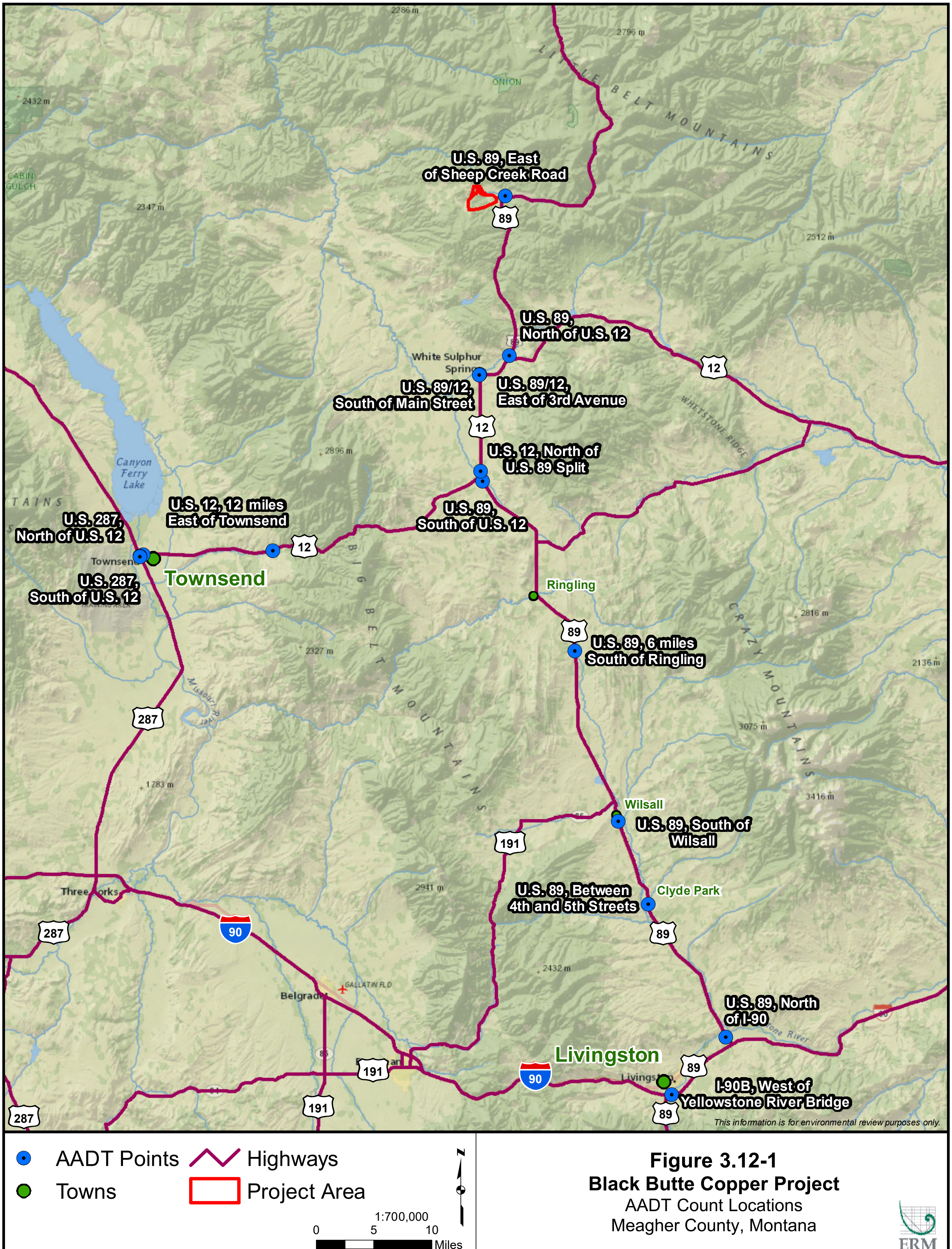


Figure 3.12-1
Black Butte Copper Project
AADT Count Locations
Meagher County, Montana

ERM

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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/East Park Street (Exit 337);
- I-90 Business/U.S. Route 89/East Park Street to a Montana Rail Link (MRL) railhead shipping facility that would be constructed for the proposed mine. The Proponent's traffic study states that the rail facility would be east of the Yellowstone River along the MRL tracks north of U.S. Route 89/East Park Street (Abelin Traffic Services 2018). The specific entry point for the rail yard has not been determined by the Proponent and 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 MRL rail yards.

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 volume on most major analysis area roads has declined since 2005. U.S. Route 89 experienced a modest increase in traffic volume north of White Sulphur Springs and a sharp increase within White Sulphur Springs in 2018; the 2018 total diverges from the trend over the previous 10 years, when volumes fluctuated between roughly 2,100 and 3,100 AADT. 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 2019).

Table 3.12-2
Historic Average Annual Daily Traffic on Analysis Area Roads

Road	Location	Historic Traffic Data (AADT)				
		2005	2008	2011	2014	2018
North of Project area						
U.S. Route 89	0.5 mile east of Sheep Creek Road	330	390	460	390	313
South of Project area						
U.S. Route 89	0.5 mile north of U.S. Route 89/U.S. Route 12 merger	410	320	360	510	541
U.S. Route 12/ U.S. Route 89	East of 3rd Avenue, White Sulphur Springs	2,540	2,130	3,120	2,120	3,452
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	704
South of Project area, route to Townsend						
U.S. Route 12	0.03 mile east of U.S. Route 287, Townsend	4,060	3,160	3,270	3,050	3,058
U.S. Route 287	North of U.S. Route 12, Townsend	7,010	6,090	6,300	6,670	6,277
U.S. Route 287	South of U.S. Route 12, Townsend	6,520	5,640	5,740	6,080	5,860

Road	Location	Historic Traffic Data (AADT)				
		2005	2008	2011	2014	2018
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	550	560	610	630	400
U.S. Route 89	1 mile north of I-90	1,840	1,840	1,830	1,900	2,052

Source: MDT 2019

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. Traffic volumes on U.S. Route 89 also increase south of the intersection with U.S. Route 12, toward the I-90 interchange. 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 U.S. Route 89/Park Street at Livingston (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 12,000 vehicles per day, of which more than 15 percent are heavy trucks.

I-90 near Livingston is frequently impacted by high winds, resulting in four levels of response, as determined by MDT (CDM Smith and MDT 2019):

1. A severe cross-wind warning is triggered when wind speeds reach 40 mph. This warning does not result in closures or other restrictions.
2. A partial I-90 closure between Exits 330 and 337 (west and east of Livingston) is triggered when wind speeds reach 50 mph. This closure requires trucks to exit I-90 and detour through Livingston.
3. A full I-90 closure between Exits 330 and 337 is triggered when wind speeds reach 60 mph, or as deemed necessary by MDT based on weather conditions. This closure requires all vehicles to exit I-90 and detour through Livingston.
4. Full closure of a longer segment of I-90 (i.e., extending east or west of Livingston) is a less common occurrence, and generally occurs due to blowing snow.

On average, partial or full detours on I-90 occur about two times per week from October through March. During partial or full closures, traffic is detoured onto U.S. Route 10 and I-90 Business/U.S. Route 89/Park Street through Livingston. Full closure results in traffic back-ups through the town and onto I-90, hindering travel through and within the town (CDM Smith and MDT 2019). Public comments on the Draft EIS described difficulties accessing Livingston Health Care, the hospital located on U.S. Route 89 east of the Yellowstone River (1.3 miles from the I-90 interchange, Exit 337) during these closures.

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 would end at a new rail yard east of the I-90 Business/U.S. Route 89 bridge over the Yellowstone River, before I-90 Business enters downtown Livingston.

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, crash rates (where different from the general rate of 0.5 to 1.0 crash per million VMT), and 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/U.S. Route 89 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, resulting in an accident rate of 2.13 accidents per million VMT. Wet, icy, or snow covered roads or dark conditions contributed to 41 of these crashes. 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, operating 24 hours per day[1];
  - An average of 9 truck round trips for supplies and other deliveries[2]; and
  - 300 employee vehicle trips (see below).

As stated in Section 3.9.3.2, Project operations would employ a total of 386 workers (Proponent employees, Proponent contractors, and associated support workers) at the mine site. This includes the 235 Proponent workers listed in the Proponents' Mine Operating Permit application, as well as 24 contractors and 127 support workers. The Mine Operating Permit application states that 104 of the 235 Proponent employees (44 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 386, a maximum of 170 total workers would be on site during the day shift and 66 would be on site during the night shift. These workers would generate a maximum of 472 total vehicle movements (trips to and from the Project site): 340 for the day shift and 132 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. If fully utilized, the shuttle bus and carpooling could eliminate at least 160 trips daily, although actual shuttle bus and carpool use would depend on employee preferences.

Based on this information, the Proponent's traffic study and MOP Application estimate 300 employee vehicle movements, 36 concentrate haul truck movements, and 12 to 18 other truck movements per day during operations.

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[1] The Proponent's traffic study (Abelin Traffic Services 2018) states that the daily truck trips along the haul routes would be distributed throughout the daylight period. The Proponent's application indicates haul trucks would operate 24 hours per day. Daylight-only activity would result in higher hourly truck volumes, but nighttime truck traffic could generate traffic safety concerns not present during daytime operations. As a result, this EIS evaluates 24-hour truck travel.

[2] The Proponent's MOP Application (Tintina 2017) states that supplies and services would generate 18 daily truck trips (9 round-trips), while the Proponent's traffic study assumes 12 daily trips (6 round-trips). This EIS evaluates the higher estimate: 18 daily truck trips.

Road Congestion

Table 3.12-3 shows Project-related increases, as cited in the Proponent's traffic study and MOP Application, 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	33%	31%
U.S. Route 12/U.S. Route 89	East of 3rd Avenue, White Sulphur Springs	178	16	5%	22%
U.S. Route 12/U.S. Route 89	South of Main Street, White Sulphur Springs	178	16	11%	22%
U.S. Route 12/U.S. Route 89	0.5 mile north of U.S. Route 89/U.S. Route 12 split	178	16	21%	22%

Source: Abelin Traffic Services 2018; Tintina 2017

Table 3.12-4
Increase in AADT during Project Operations (Compared to 2016 AADT)

		Number [a]		Percent Increase	
Road	**Location**	**Total**	**Truck**	**Total**	**Truck**
U.S. Route 89	North of the Project area	20	0	5%	0%
U.S. Route 89	South of the Project area	334	54	62%	104%
U.S. Route 12/U.S. Route 89	East of 3rd Avenue, White Sulphur Springs	334	54	10%	74%
U.S. Route 12/U.S. Route 89	South of Main Street, White Sulphur Springs	334	54	21%	74%
U.S. Route 12/U.S. Route 89	0.5 mile north of U.S. Route 89/U.S. Route 12 split	94	54	13%	74%
U.S. Route 12	0.5 mile west of U.S. Route 89/U.S. Route 12 split	74	54	13%	32%
U.S. Route 12	Deep Creek Canyon,12 mi east of Townsend	74	54	11%	32%
U.S. Route 89	0.5 mile south of U.S. Route 89/U.S. Route 12 split	74	54	19%	50%

Road	Location	Number [a]		Percent Increase	
		Total	Truck	Total	Truck
U.S. Route 89	1 mile north of I-90	74	54	4%	75%

Source: Abelin Traffic Services 2018; Tintina 2017

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 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), while traffic volumes are under 2,000 average vehicles per day on most of the impacted roads. Mine-related traffic would not result in traffic congestion; however, local communities would experience increased traffic, and the increase would feel more acute for residents and commuters who are accustomed to very low traffic volumes. Public comments on the Draft EIS expressed concern about traffic near the communities of Ringling, Wilsall, and Clyde Park, where U.S. Route 89 is used by residents for travelling to work, school, and services within and between these communities. As indicated by **Table 3.12.1**, traffic volumes near Wilsall and Clyde Park are higher than on the rural segments of U.S. Route 89, but still below the capacity of the highway. As a result, impacts in these communities would be similar to the impacts described above for the overall U.S. Route 89 corridor.

The Proponent states that the mine operation would have the option to stockpile containers of concentrate to transport on subsequent days if U.S. Route 12 through Deep Creek Canyon is closed, blocking shipments to Townsend. The Proponent also states that the mine would agree not to send concentrate haul trucks to the Livingston railroad facility during wind-related I-90 closures that route I-90 traffic through Livingston (Section 3.12.2.1, Existing Road Network). The number of haul trucks to both destinations (Livingston and Townsend) would average one truck every 80 minutes, so if a haul truck is on the road when a wind restriction occurs, it would not add significantly to traffic congestion east of Livingston.

Road Safety

As discussed in Section 3.12.1.3, Transportation Analysis, the number of highway incidents could increase in proportion to Project-related increases in traffic volumes during construction and operations. The proposed mine would generate traffic at night as well as during the day, for night shift workers and nighttime mine concentrate haul trucks.

The Proponent's traffic study (Abelin Traffic Services 2018) notes that a generally anticipated collision rate on rural roads is 0.5 to 1.0 incident per 1 million VMT. Based on the highest projections of Project-related traffic and the estimated incident rate (or the recorded incident rate cited in Section 3.12.2.2, Traffic Safety Data, if different), **Table 3.12-5** estimates the Project's potential traffic safety impacts. Because the distribution of truck traffic along U.S. Route 89 and U.S. Route 12 is not known, these estimates assume that all Project trucks would travel both to Townsend and Livingston. As a result, the calculations below overestimate the number of potential traffic incidents south and west of the U.S. Route 89/U.S. Route 12 split, south of White Sulphur Springs.

Table 3.12-5
Estimated Project-Related Traffic Safety Impacts

Road Segment	Miles	Project Annual VMT [a]	Incident Rate [b]	Potential Annual Project Incidents
U.S. Route 89 from Sheep Creek Road to White Sulphur Springs	18	2,194,000	1.0	2.2
U.S. Route 89/U.S. Route 12 from White Sulphur Springs to U.S. Route 89/U.S. Route 12 Split	9	309,000	1.0	0.3
U.S. Route 12 from U.S. Route 89 to Townsend	33	891,000	2.13 [c]	1.9
U.S. Route 89 from U.S. Route 12 to I-90	56	1,513,000	1.0	1.5
I-90 from U.S. 89 to Exit 337	2.5	68,000	1.0	0.1

Notes:
[a] Project VMT rounded to the nearest thousand miles.
[b] Incident rate expressed as the number of incidents per million VMT. Reflects the higher of observed crash rates or up to 1.0 incident per million VMT for rural routes (statewide average).
[c] Incident rate for U.S. Route 12 does not include safety improvements completed in 2016 (see Section 3.12.2.2); as a result, the current incident rate may be lower.

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.
- If issues occur between mine truck traffic and school buses, implement truck scheduling to limit interactions with school bus traffic. The Proponent's traffic study states that, "It is

unclear if the low amounts of anticipated heavy truck traffic from the mine would have any negative interactions with school bus traffic" (Abelin Traffic Services 2018).

- Use on-board systems to monitor truck speed and 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 load the mine concentrate into sealed shipping containers within an enclosed structure at the mine site. The sealed containers would be transported by truck to the MRL rail facilities, and transferred directly onto rail cars for transportation to smelters. The use of sealed containers reduces spill risk during transport, eliminates the need for material handling at rail stations or other intermediate points, and reduces the risk of spills if an accident occurs. According to the Proponent, the containers are "strong and rugged enough that they are unlikely to release concentrate during shipping accidents or mishandling" (Tintina 2017).

As noted in Section 2.2.3, Operations (Mine Years 3–15), the mine concentrate would not be a liquid, but rather would be thickened and pressed to remove water, with a moisture content of approximately 10 percent. The texture of the concentrate would be approximately comparable to wet sand, thus limiting its ability to spread or flow. As a result, it is likely that a crash severe enough to cause release of mine concentrate would have similar traffic impacts to a crash and release of other bulk materials, such as sand, concrete, or agricultural products. Impacts on other resources are discussed in their respective sections in Chapter 3 of this EIS.

General procedures for all spills, including concentrate spillage from a haul truck accident, are included in the "Emergency Response Plan" (Tintina 2017), which is included as Appendix P of the MOP Application (see specifically Section 4.2, General Rules for Responding to a Spill or Release, and Section 4.3, Reportable Quantities and Agency Notification). The Proponent's anticipated response to spills from sealed concentrate containers as a result of a haul truck crash are summarized below (Zieg 2019):

- The Proponent would initiate immediate response by trained safety and environmental personnel.
- The Proponent would isolate and contain the spilled material, notify appropriate agencies, clean and dispose of the spill material, and then conduct an investigation of the spill. The Proponent would use appropriate equipment to clean the spill, such as loaders, dump trucks, vacuum trucks, and hydro excavation trucks. The type of equipment used would depend upon the quantity and location of the spill, weather, and road conditions.
- The Proponent would remove all traces of the spill and properly dispose of the spilled material.
- The Proponent would conduct post-spill monitoring of the spill site where warranted, especially if the spill impacted a waterbody.
- Handling/cleanup procedures specific to mine concentrate spills from the sealed containers would be addressed in detail before mine operations begin. The Proponent is

in the process of formalizing a Safety Data Sheet for the Black Butte Copper concentrate that would include information critical to concentrate spill response. The Proponent is also preparing a Spill Prevention, Control, and Countermeasures Plan for submittal to the Montana State Fire Marshal and DEQ.

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, 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.

Spills

Haul truck incidents are not likely to result in breaching of the sealed containers; however, if a container is breached, resulting in a mine concentrate spill, the cleanup process would interrupt road travel. Depending on the severity of the incident and spill, the interruption could range from usage of the road shoulder by response vehicles up to complete road closure for several hours. Spills are a low-likelihood event, and the resulting impact on road traffic would be of low severity.

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 follows Sheep Creek for approximately 12 miles north of Sheep Creek Road, and crosses 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) and 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).

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.

★ Project Location
● Smith River Take Out Location
● Smith River Put In Location

Smith River
Highways

1:600,000

0 5 10 Miles

Figure 3.12-2
Black Butte Copper Project
Smith River Float Route and Major Roads
Meagher County, Montana

ERM

MPLS M:\Clients\M-O\MTDEQ_ArcGIS\2018\03\Transportation_Fig_3_12_2.mxd | REVISED: 03/15/2018 | SCALE: 1:600,000

DRAWN BY: JML

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 orthophotos. 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 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
- 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.

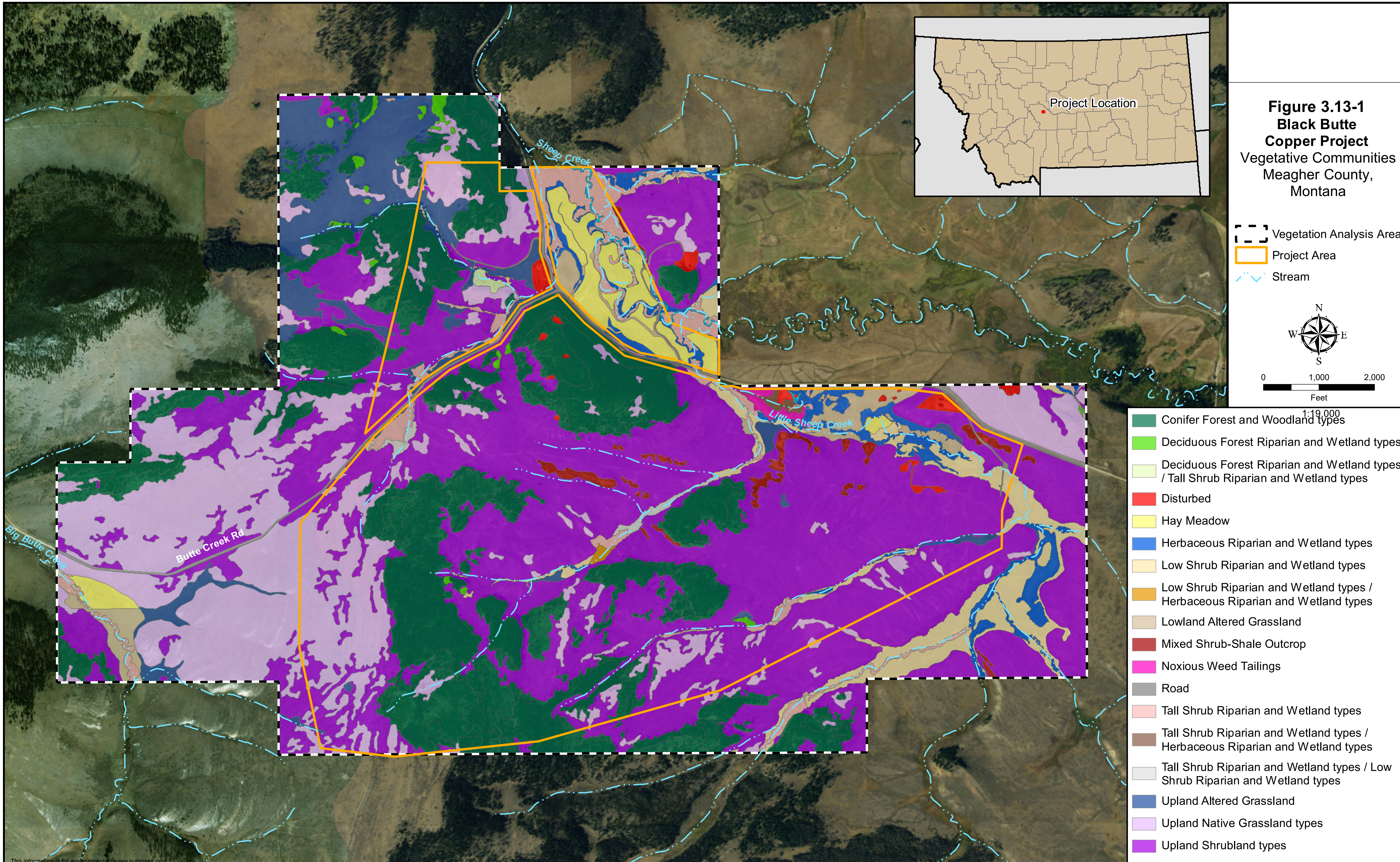
Since the results of “2015 Baseline Vegetation Inventory” were made available, a subsequent list of the Meagher County MTNHP data was updated to include 16 additional SOC plant species. None of the additional SOC species was documented within the vegetation analysis area during the field surveys. The 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



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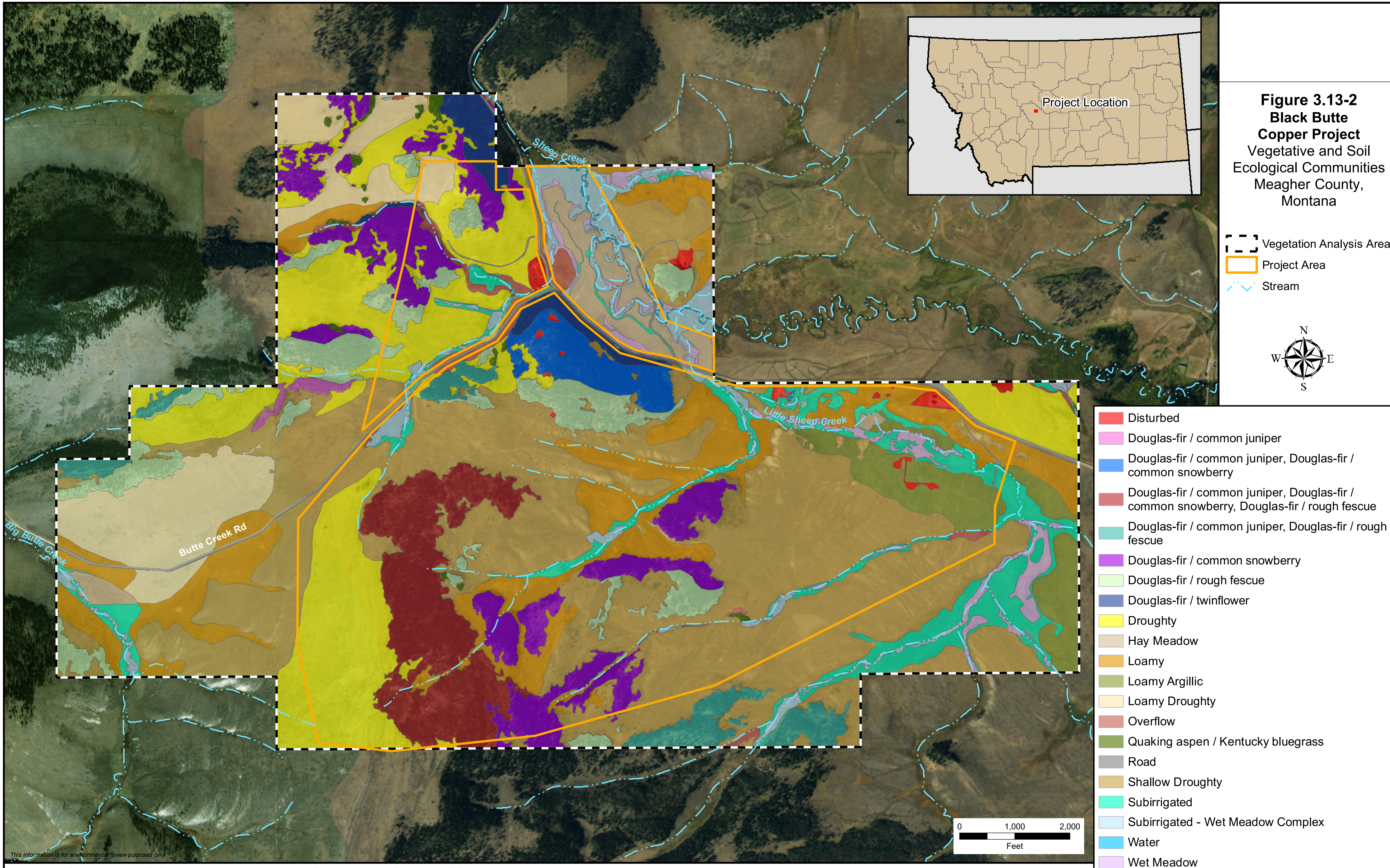


Figure 3.13-2
Black Butte Copper Project
Vegetative and Soil Ecological Communities
Meagher County, Montana

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	
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	

Scientific Name	Common Name	Habitat	Occurs within Analysis Area
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 a total of approximately 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** 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 tubelings 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 tubelings for trees;
- Initiate revegetation within 1 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** 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 "Noxious Weed Management Plan" (WESTECH 2016), which is included as Appendix O of the MOP Application (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
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 Hydrology.

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 “Noxious Weed Management Plan” (WESTECH 2016), which is included as Appendix O of the MOP Application (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 phases, and would reactively treat mechanically or with herbicide if new populations were 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 "Noxious Weed Management Plan" (WESTECH 2016), which is included as Appendix O of the MOP Application (Tintina 2017). 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 were 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 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 (USACE 1987).

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).

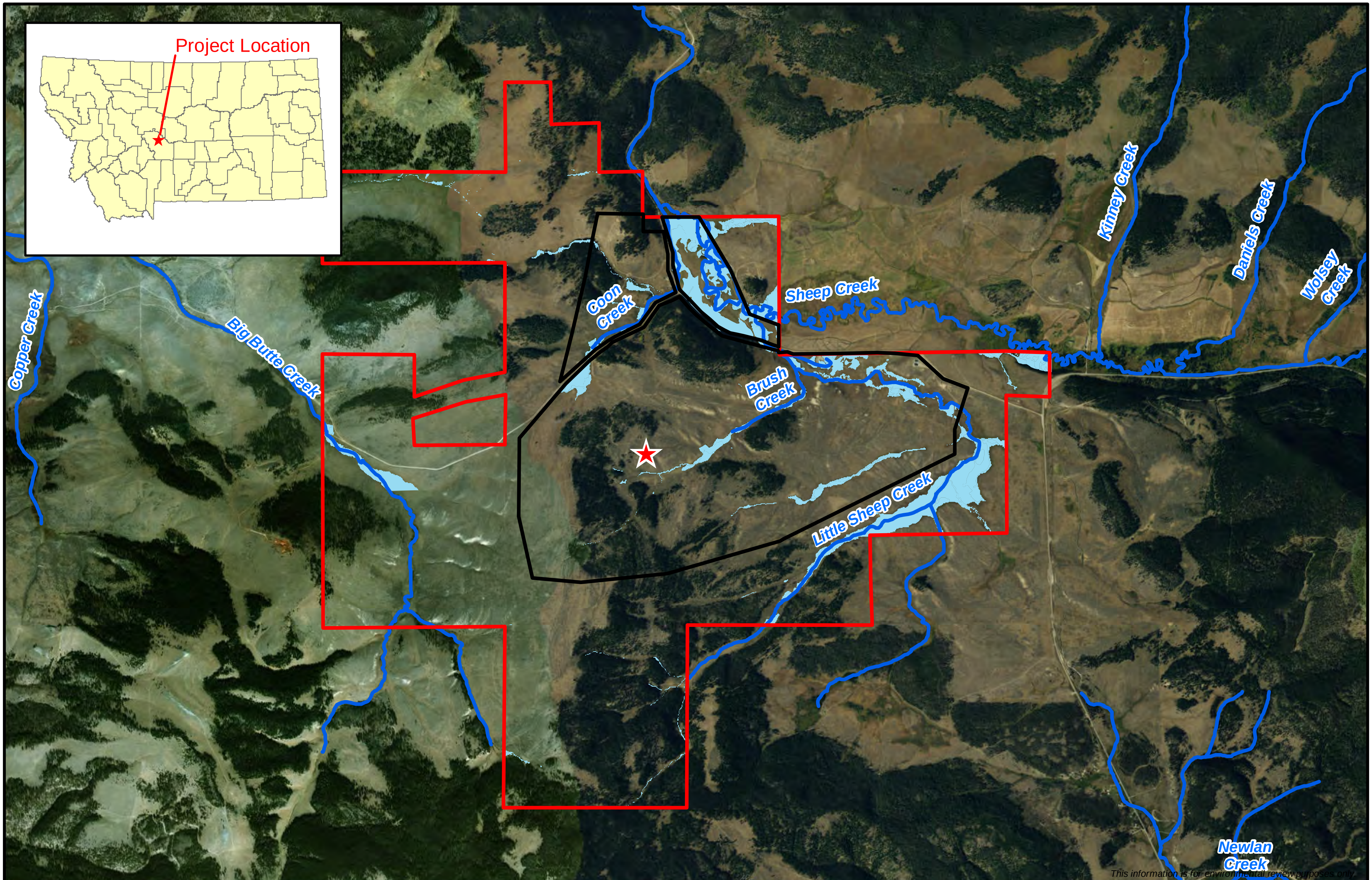
The Project wetlands that were surveyed and delineated by WESTECH in 2014 were evaluated for wetland function and values pursuant with methods developed by Montana DOT and DEQ (MDT 2008). The Project wetland functions assessment was summarized in 2015 by WESTECH in the "Functional Assessment Report" (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 snowmelt (WESTECH 2015a).

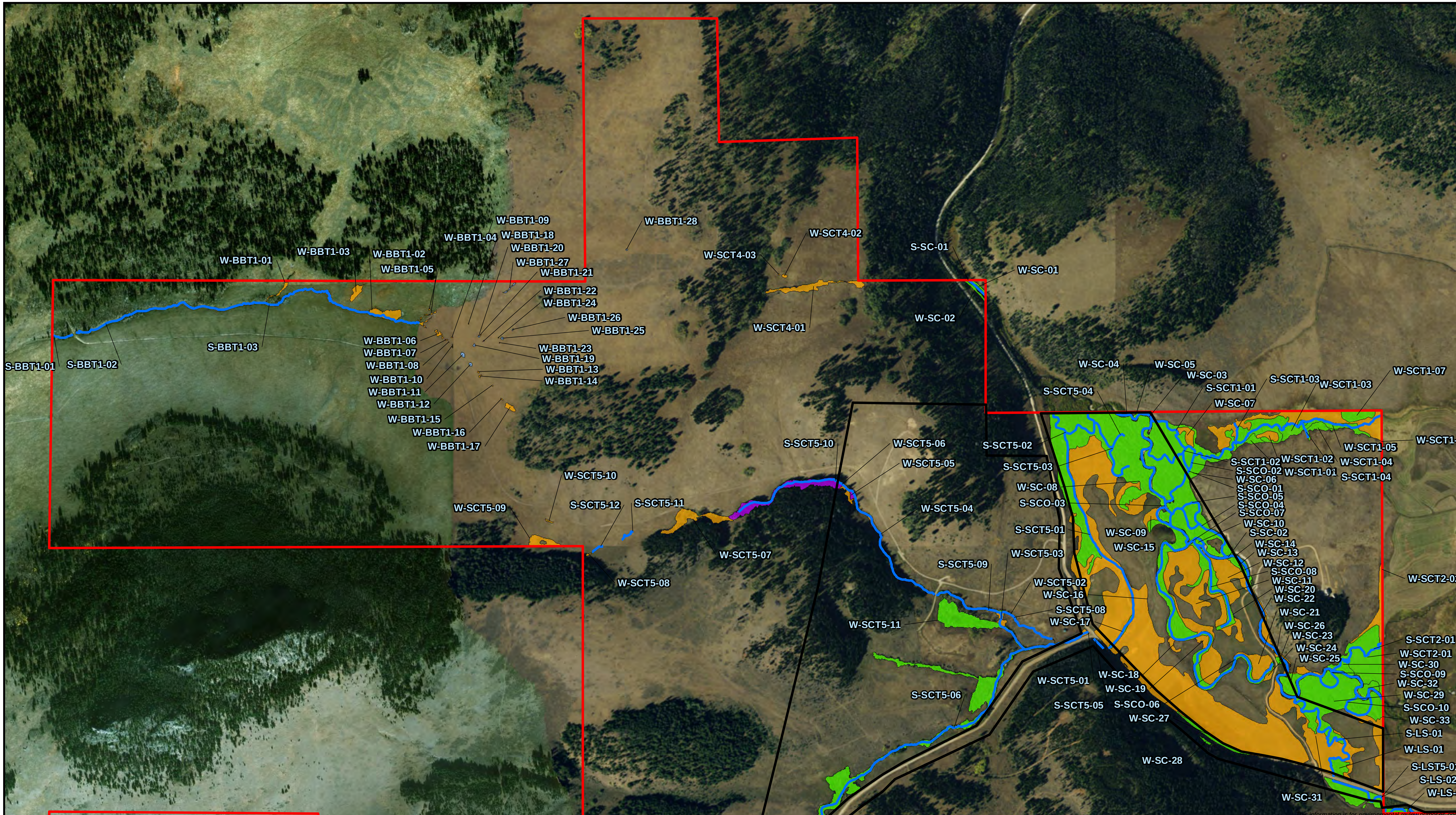
The wetland acreage and classifications for wetlands within the wetland analysis area are summarized in **Table 3.14-1**. The wetlands observed during the surveys are shown on **Figures 3.14-2** through **3.14-5**.

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.



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- Stream
- Wetland Analysis Area
- Project Area
- Palustrine Emergent
- Palustrine Forested
- Palustrine Scrub-Shrub
- Palustrine Unconsolidated Bottom

Figure 3.14-2
Black Butte Copper Project
Surveyed Wetland Classifications Area 1
Meagher County, Montana

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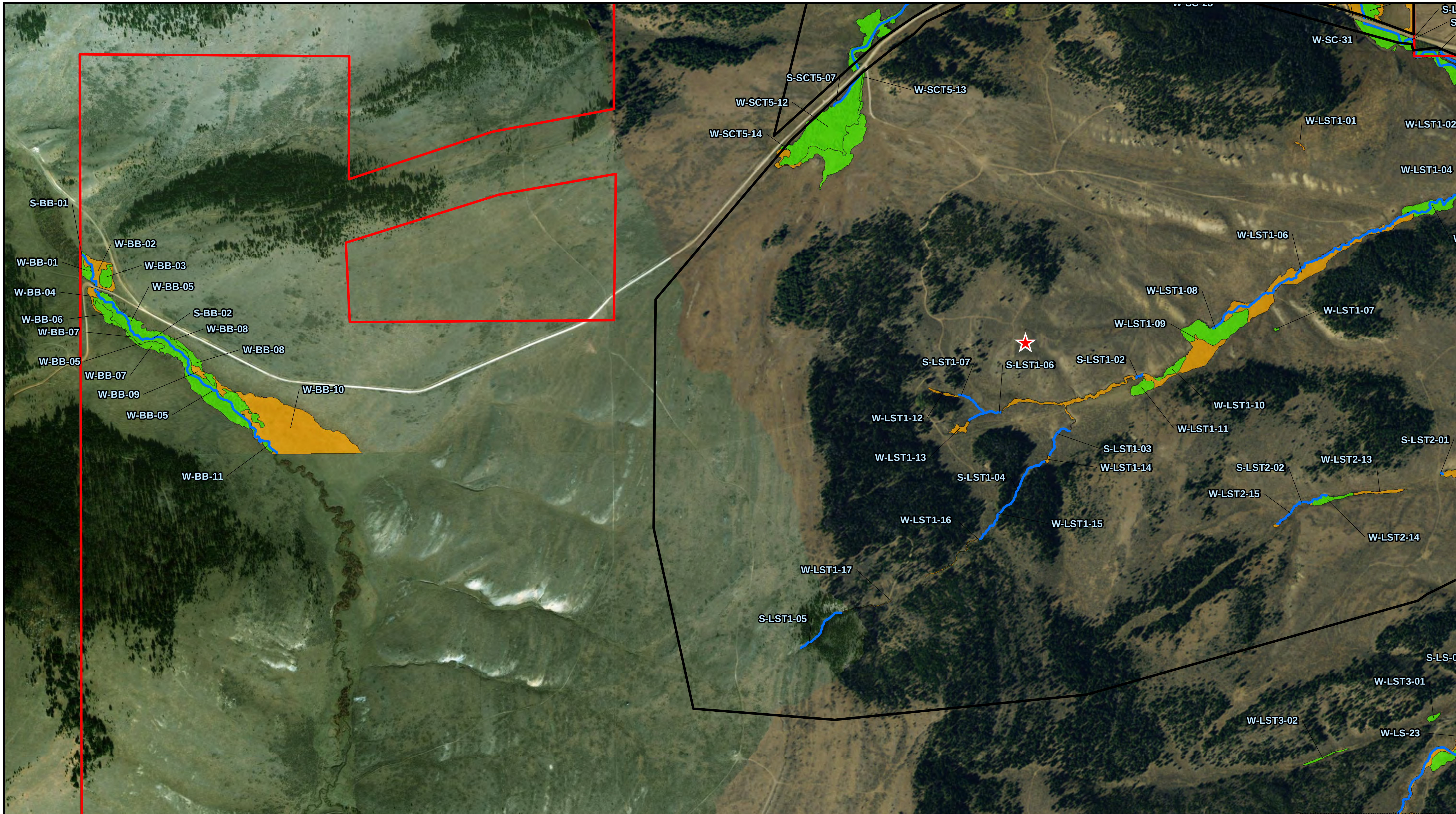

Stream

Wetland Analysis Area

Project Area

Palustrine Emergent

Palustrine Scrub-Shrub

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Feet

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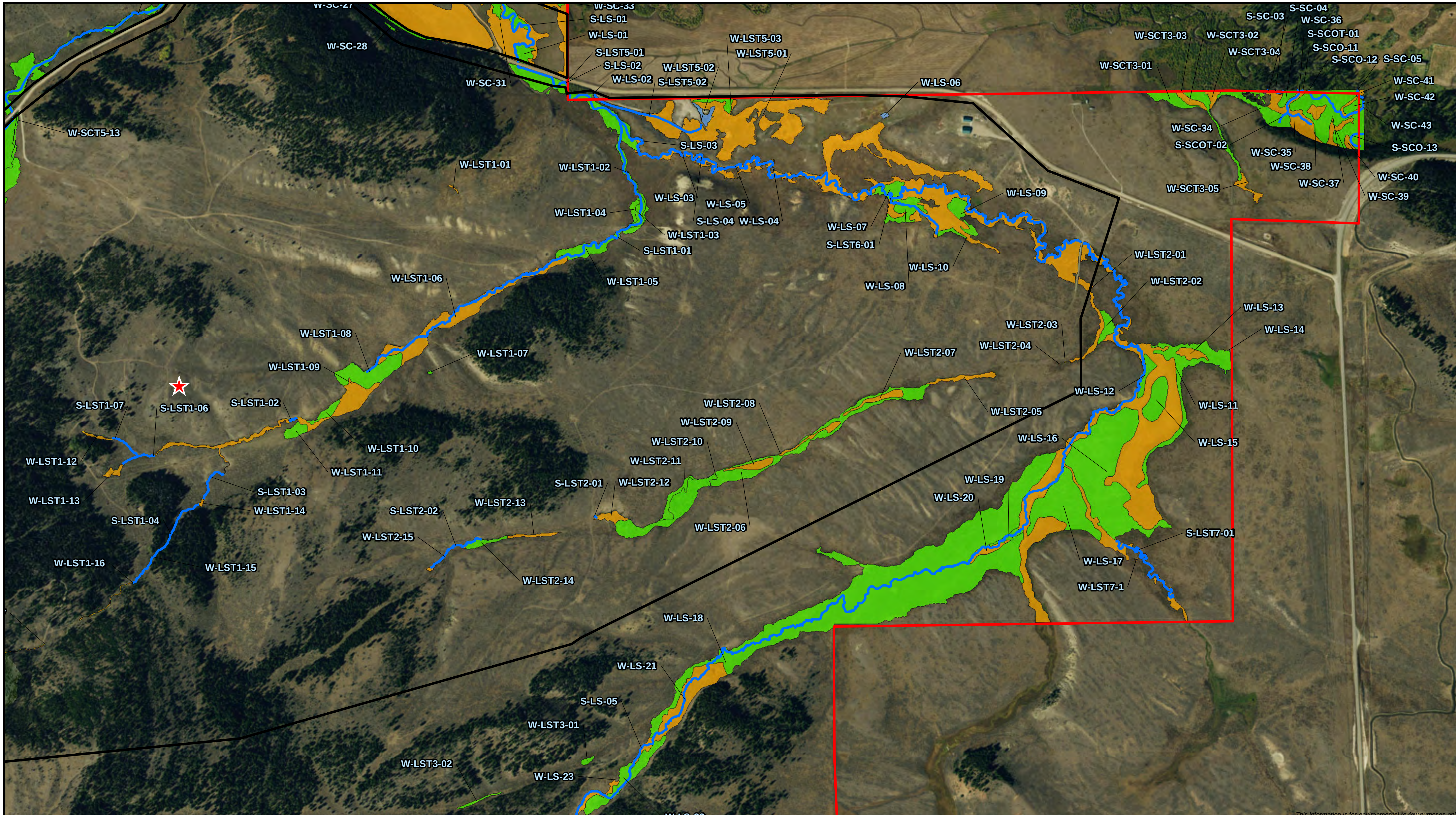
Figure 3.14-3
Black Butte Copper Project
Surveyed Wetland Classifications Area 2
Meagher County, Montana



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 Area 3
Meagher County, Montana

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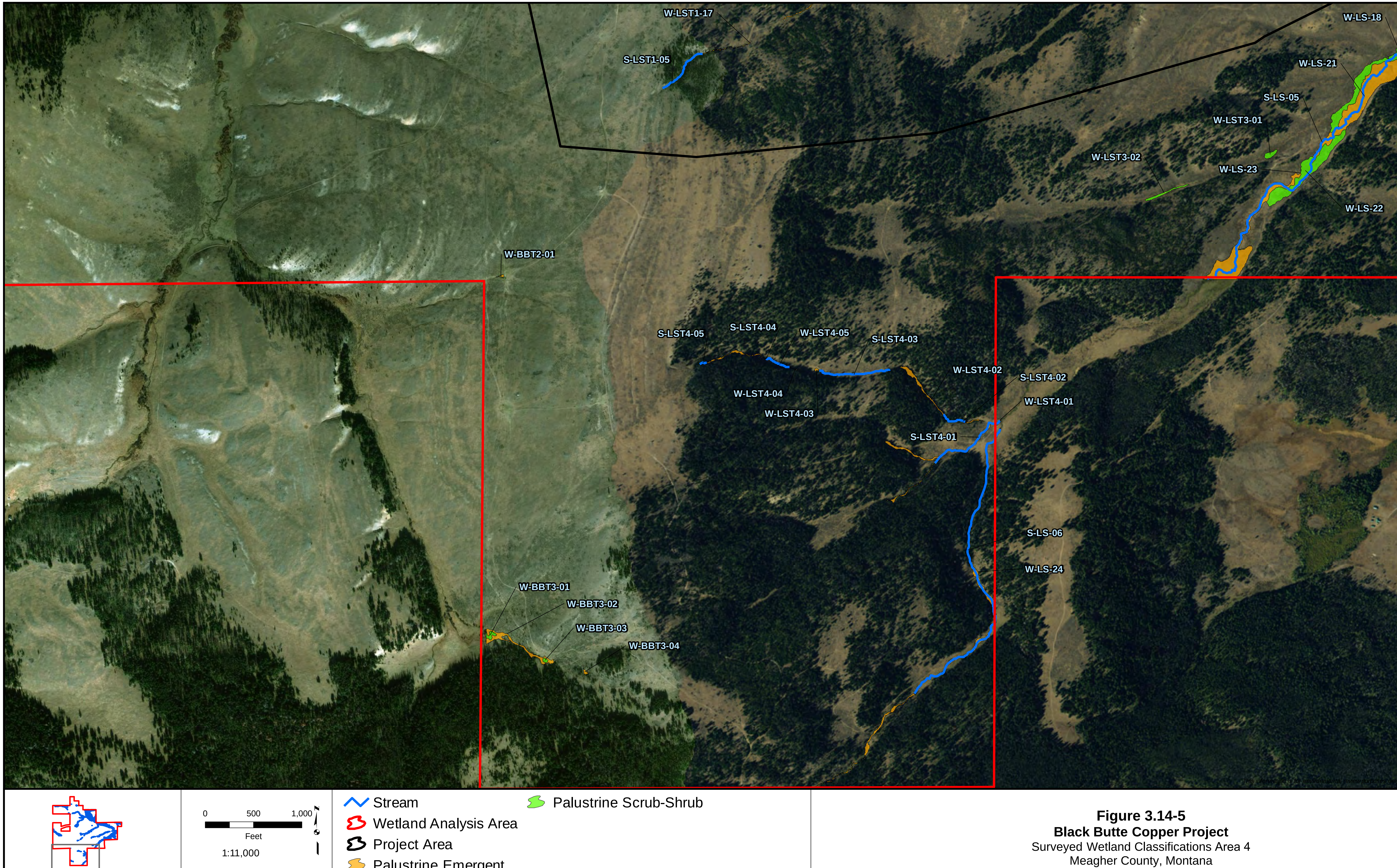

Figure 3.14-5
Black Butte Copper Project
Surveyed Wetland Classifications Area 4
Meagher County, Montana

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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.

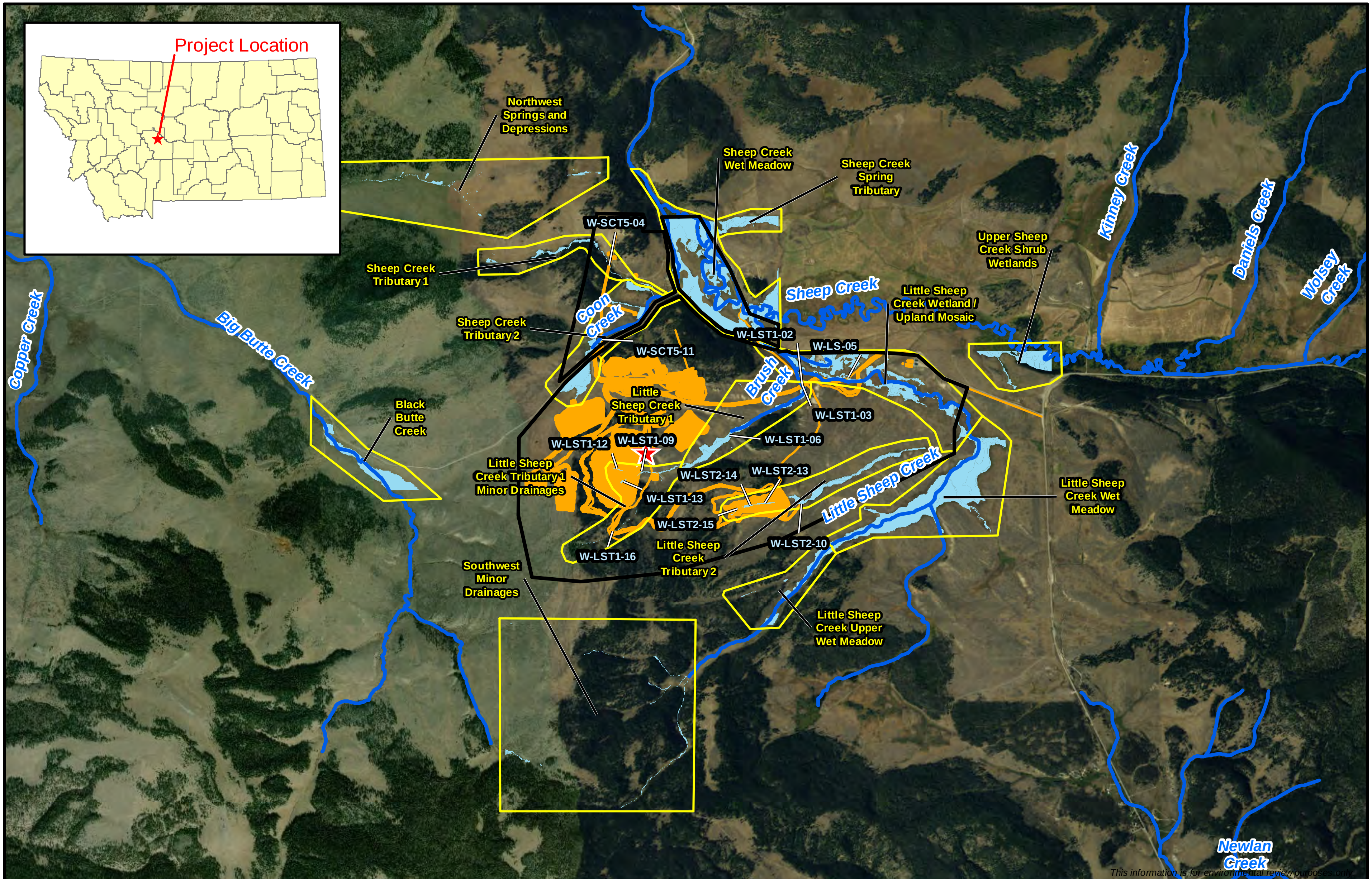
The results of the functional assessment are summarized in **Table 3.14-2** and indicate that 14 assessment areas are rated as Category I, II, or III. The associated area locations are shown on **Figure 3.14-6**. The Little Sheep Creek Wet Meadow and the Sheep Creek Spring Tributary assessment areas 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).



Project Location
Perennial NHD Stream
Project Area
Surveyed Wetlands
Wetland Functional Assessment Areas
Facilities Footprint

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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 used available regional data, groundwater monitoring wells, and piezometers to surmise that groundwater generally flows eastward, 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 affected 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

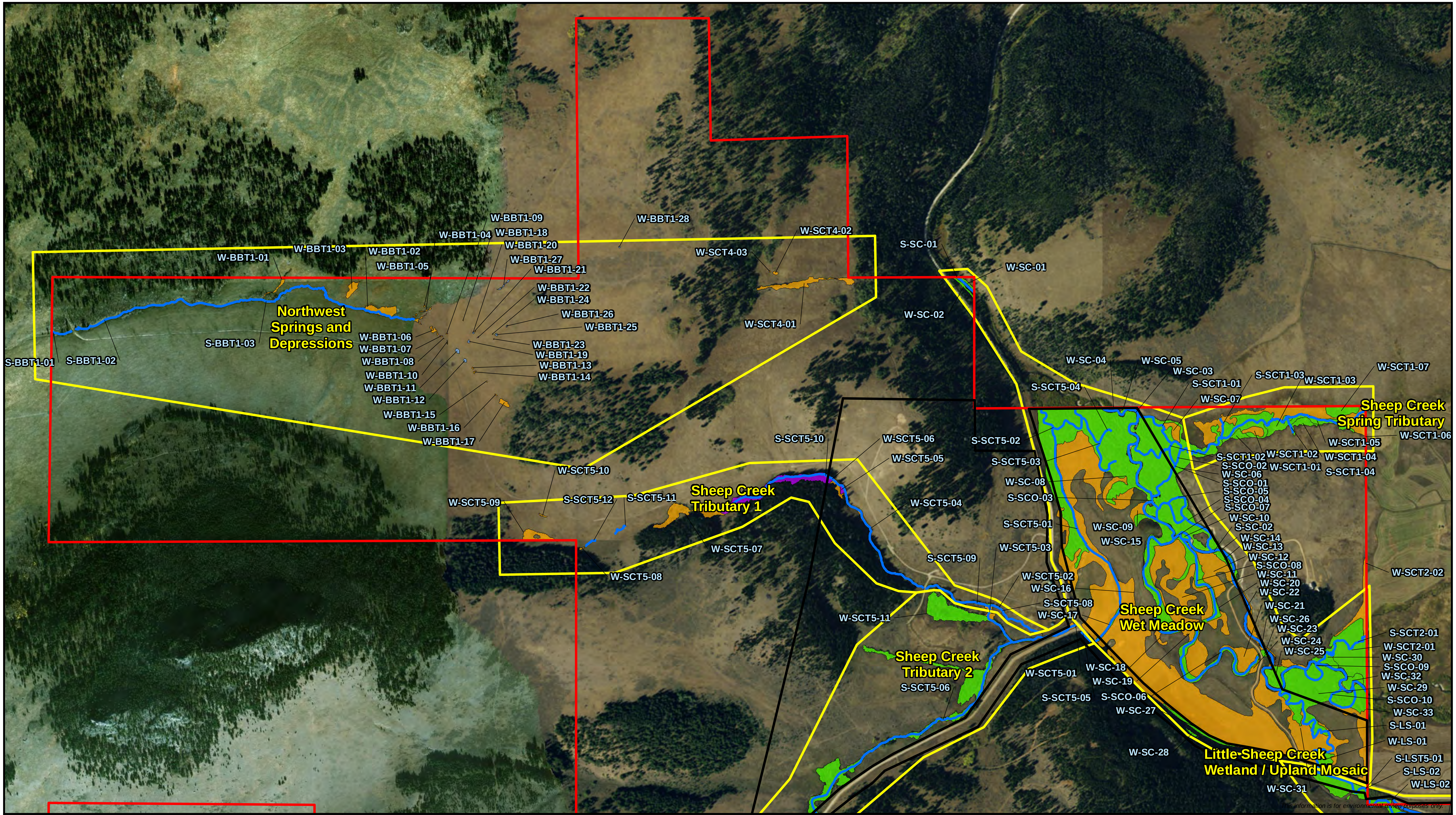
		Directly Impacted Wetlands		
Wetland Community Type [a, c]	**Project Facility**	**Acres**	**Percent of Analysis Area [b]**	**Wetland ID**
PSS6B	Access road	0.03	<1	W-LST1-02
PSS1B	Access road	0.03	<1	W-LST1-03
PEM1E	Access road	0.06	<1	W-LS-05
PEM1B	Cement Tailings Facility	0.27	<1	W-LST1-13
PEM1B	Cement 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**	

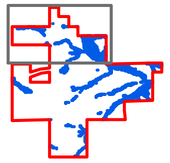
Notes:
[a] Cowardin 1979
[b] Wetland analysis area wetlands totaled 327.4 acres (Tintina 2017).
[c] PSS wetlands are palustrine scrub-shrub wetlands, PEM wetlands are palustrine emergent, herbaceous wetlands.

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 is classified as a Category II assessment area.

<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. An amended DEQ 401 Water Quality Certification was received on July 3, 2019, to include the additional 200 square feet of temporary wetland disturbance associated with the Sheep Creek water intake construction.





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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 Area 1
Meagher County, Montana

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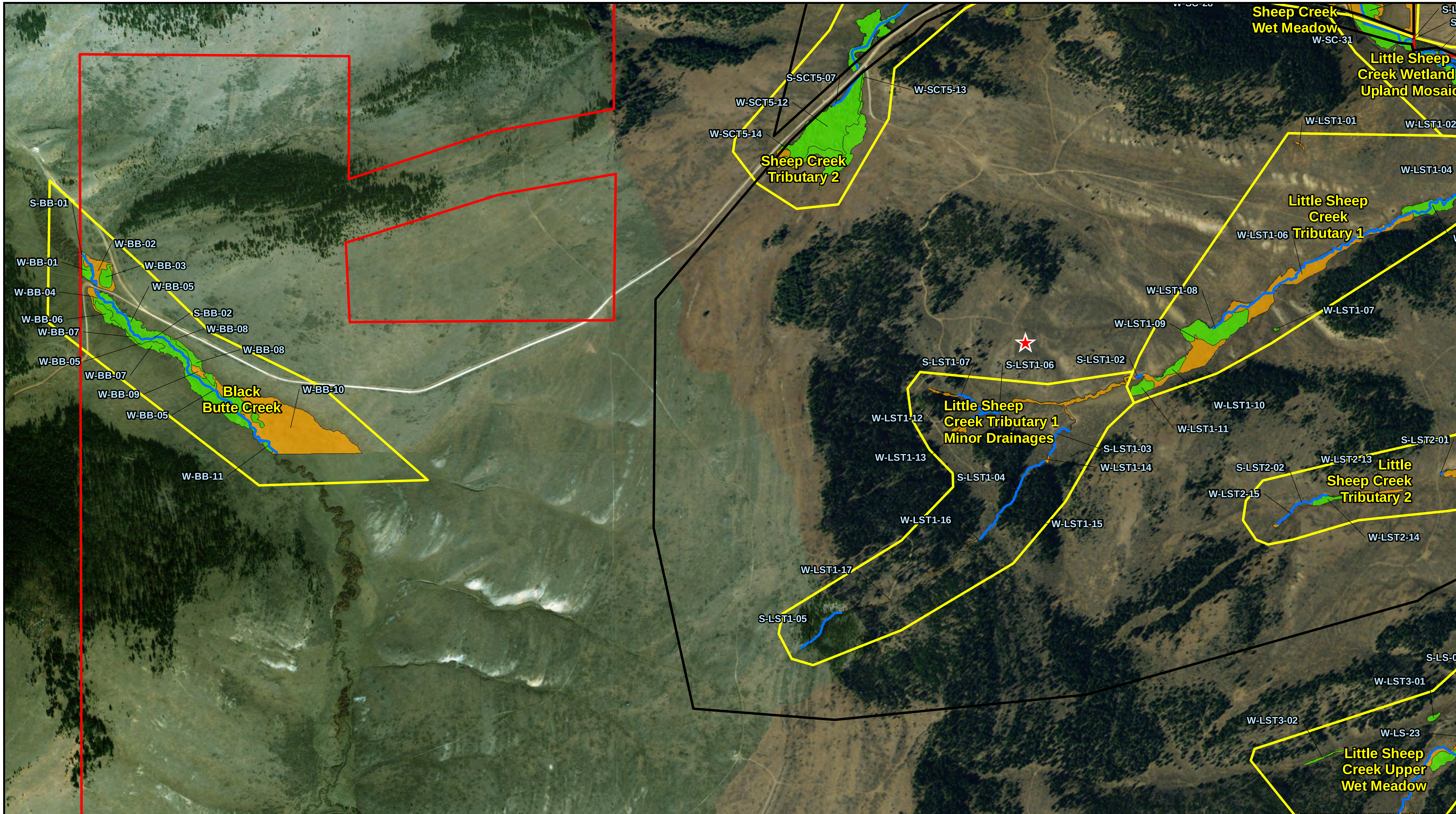

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Stream

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 Area 2

Meagher County, Montana

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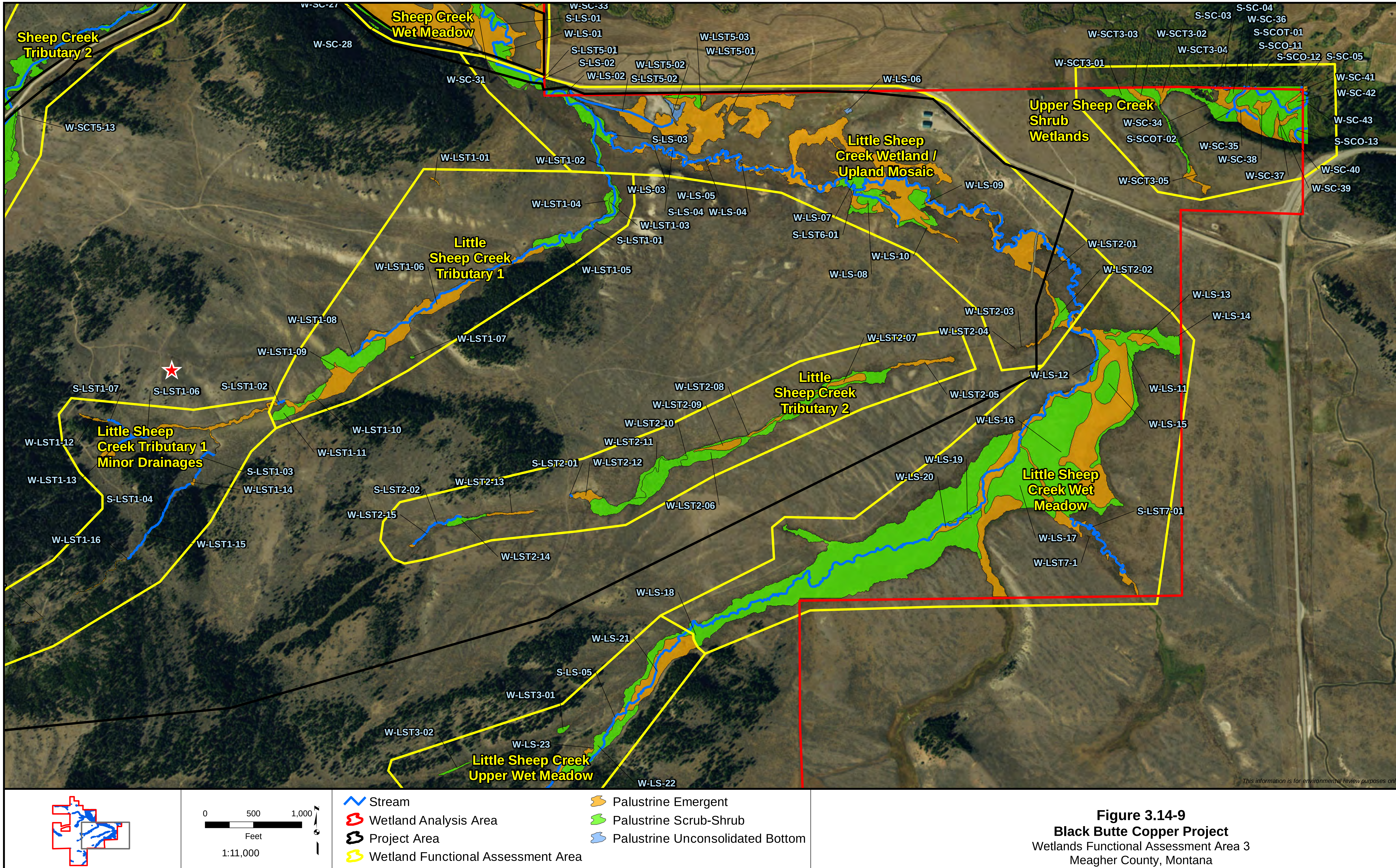

Stream
Wetland Analysis Area
Project Area
Wetland Functional Assessment Area
Palustrine Emergent
Palustrine Scrub-Shrub
Palustrine Unconsolidated Bottom

Figure 3.14-9
Black Butte Copper Project
Wetlands Functional Assessment Area 3
Meagher County, Montana

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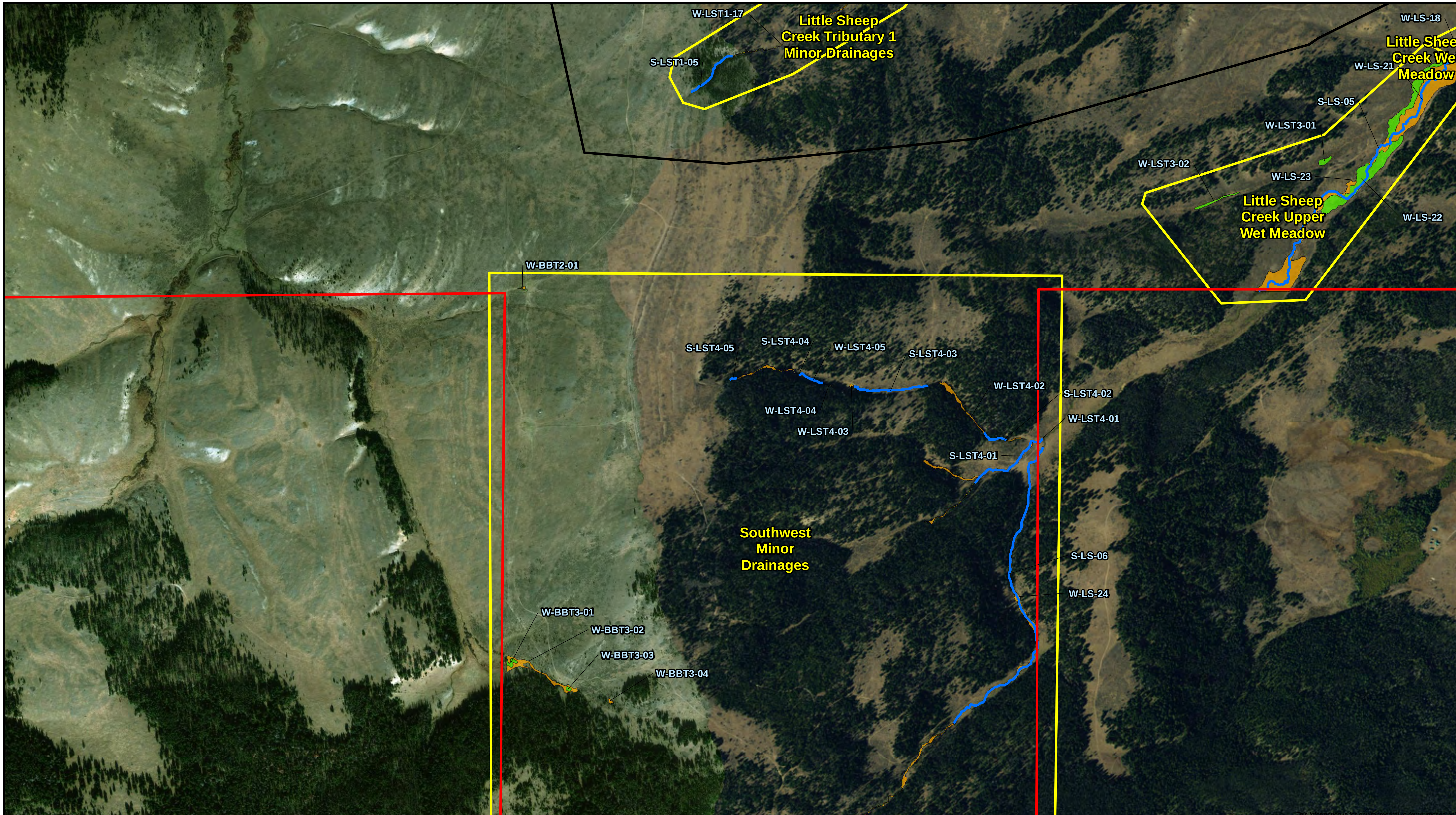

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- Stream
- Wetland Analysis Area
- Project Area
- Wetland Functional Assessment Area
- Palustrine Emergent
- Palustrine Scrub-Shrub

Figure 3.14-10
Black Butte Copper Project
Wetlands Functional Assessment Area 4
Meagher County, Montana

Mitigation

To compensate for the 0.85 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 (ILF) program. If an ILF is not a viable option for mitigation, then the Proponent would be required to address compensatory mitigation requirements through a permittee-responsible mitigation to the satisfaction of the USACE.

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 the 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 were 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, and no perched water table is present, 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 NCWR would mitigate these potential impacts (Tintina 2017). In instances where small, isolated wetlands exist outside of the area affected by the underground injection of groundwater, and no perched water table is available, reduction in available groundwater could cause these wetlands to dry up. If this scenario occurs, these wetland areas would likely become dominated by upland vegetation during this drawdown timeframe. However, they likely would revert back to a wetland vegetation-dominated wetland after mining ceases and the water table rises to the baseline levels. Section 3.4.3, Environmental Consequences, describes this in detail. Therefore, if Project operations are functioning as designed, measureable impacts to most 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 negligible.

Water Quality

Mine operations are not expected to affect 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 non-degradation standards indicated that, after its initial mixing with groundwater, the discharge water total nitrogen could reach values above the non-degradation 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 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 amsl (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. 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.

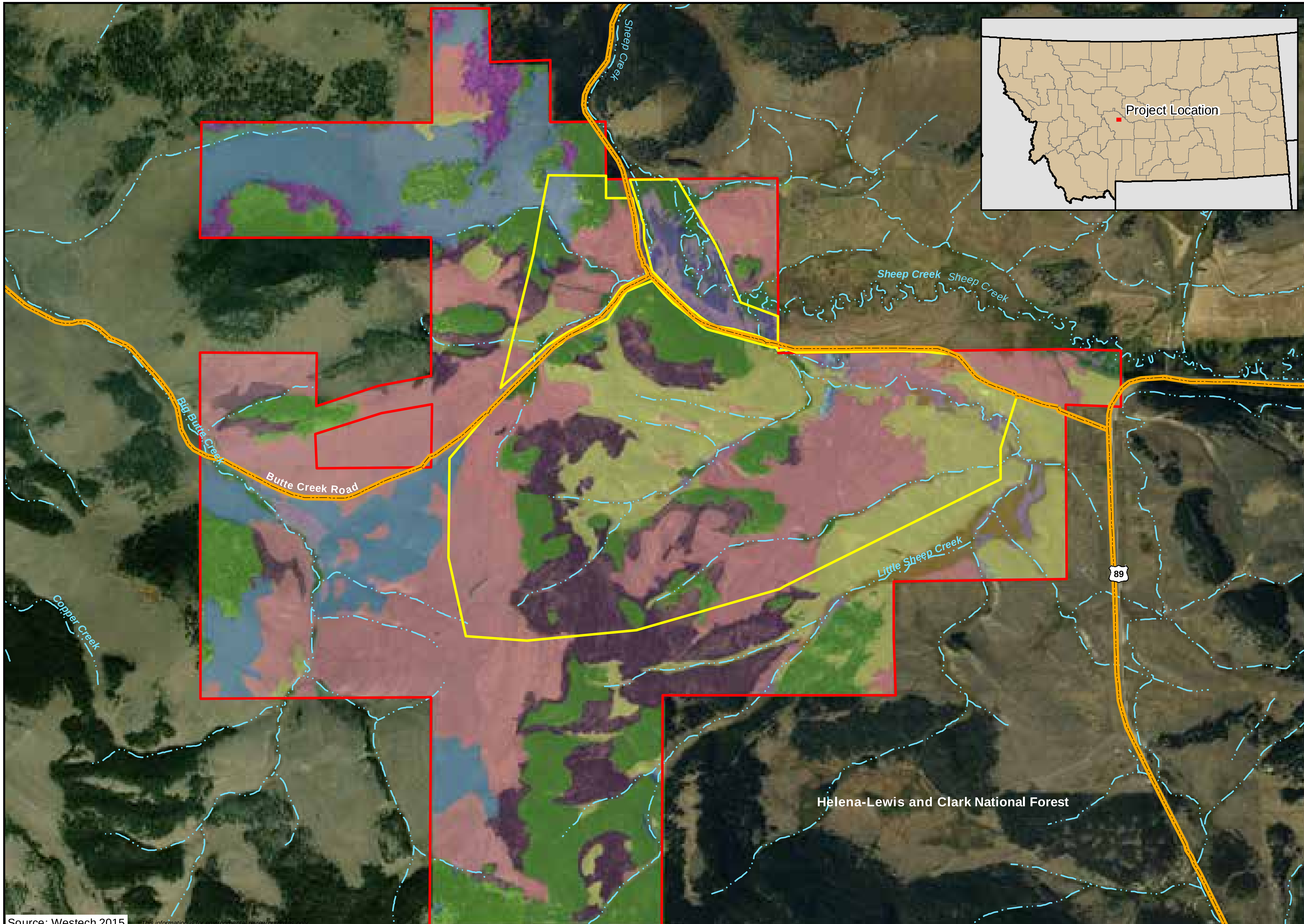

Figure 3.15-1
Black Butte Copper Project
Wildlife Analysis Area
Meagher County, Montana

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

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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**
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

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
Birds				
Greater sage-grouse	Yes		X	Moderate
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 to 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). Potential foraging habitat, but no nesting habitat, is 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 non-degradation 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 (not exposed to CO_2 in the atmosphere) 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 (Enviromin 2017, Table 7-1). However, the predictive model for the PWP is based on the principle of mass balance and does not include likely geochemical processes that would occur *in situ* to attenuate metal concentrations (e.g., sorption of metals to ferrihydrite, or metals removal via flocculation and settling of particulate matter). Thus, concentrations of these parameters may be overestimated. It is possible that bird species may drink from the PWP and ingest the slightly acidic water with elevated concentrations of salts and metals. Ongoing operational monitoring has been proposed to validate model predictions and identify potential impacts to water resources in a timely manner and trigger the implementation of operational changes or mitigation measures.

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 WTP would 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. 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.

Noise levels from the Project during construction and operations are modeled to attenuate to ambient levels within 1 to 2 miles of the disturbance. For example, **Table 3.11-7** states that there would be a maximum increase of +5 dBA L_{eq} over ambient levels during construction, and a maximum increase of +2 dBA L_{eq} during operations. Similarly, **Table 3.11-8** shows there would be a +3 dBA L_{eq} increase over ambient levels due to traffic within 300 feet of U.S. Route 89, and a +2 dBA L_{eq} increase from 400 feet out to 10,000 feet. 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. The Proponent proposed mitigation measures to reduce noise impacts near the mine site (Tintina 2017), including:

- 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 and operation activities to daytime hours (7:00 a.m. to 7:00 p.m.).
- Combine noisy operations to occur for short durations during the same periods.
- Turn idling equipment off.

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** 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 in **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 and mitigation measures would be used to reduce the noise impacts, 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). Further, the Proponent would implement mitigation measures to reduce noise impacts on sensitive wildlife species. For example, construction activities and operations would be restricted to daytime hours to avoid impacts on sensitive nocturnal species (e.g., bats, owls). To reduce effects on species active during the day, equipment would be muffled, idling engines would be turned off, and loud activities would be scheduled to occur simultaneously for short durations.

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. However, water quality in the PWP would be monitored and mitigation measures would be implemented if impacts to wildlife are expected. 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. Further, the Proponent would implement mitigation measures to reduce impacts due to noise, including scheduling loud activities to occur simultaneously for short durations and restricting outdoor operations to daytime hours.

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. However, water quality in the PWP would be monitored and mitigation measures would be implemented if impacts to wildlife are expected. 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. Water quality in the PWP would be monitored and mitigation measures would be implemented if impacts to wildlife are expected. 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 non-degradation 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 non-degradation 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.

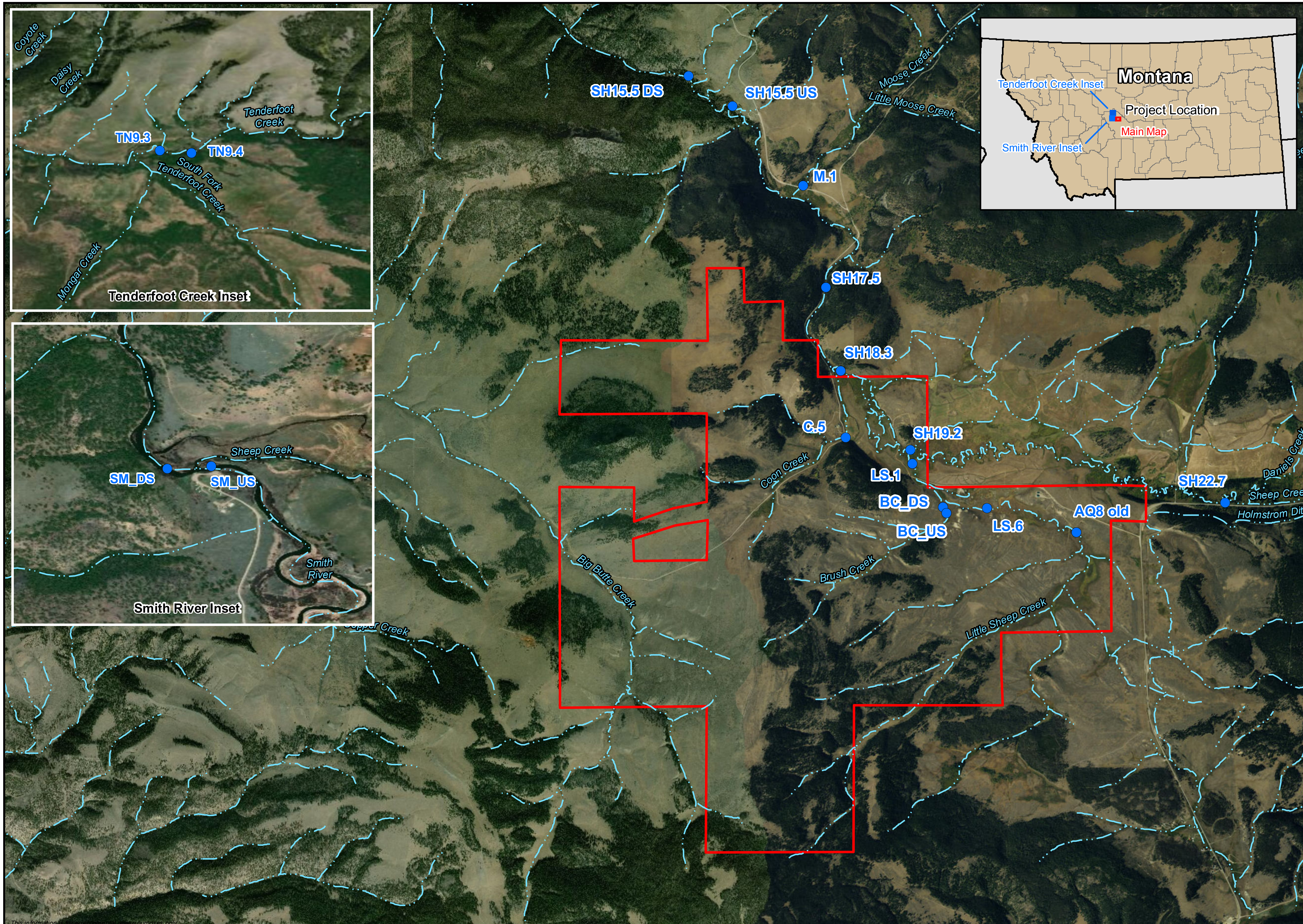

Figure 3.16-1
Black Butte Copper Project
Aquatic Monitoring Stations
Meagher County, Montana

- Aquatic Monitoring Station
- Aquatic Assessment Area
- Stream

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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 = meter; 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.

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). After submittal of the Draft EIS, additional baseline data for 2018 became available (Stagliano 2019), some of which has been incorporated into this Final EIS as Appendix K.

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.

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 [mm]), 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 mm 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, 2017, and 2018. 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). In 2018, the tissue samples were also analyzed to determine aluminum concentrations (Stagliano 2019).

3.16.1.5. Redd Counts

During the 2016 to 2018 aquatic baseline surveys, redd count surveys were completed in the fall for fall-spawning brown trout and brook 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 and 2018, 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 centimeters per 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 centimeters per 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, Inc. 2018b, Sheet 1).

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 (Hydrometrics, Inc. 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) (see **Table 3.16-3**) (Stagliano 2018a).

Table 3.16-3
Site Aquatic Ecological Community Integrity Ranks

Site RM Code	BACI Type	AES Code b	Fish	Macro-invertebrates	Algae	Habitat	Overall Rank	Integrity Comment
SH22.7	C	C003	3	2	3	5	3	Stream manipulation from road and cattle trampling
SH19.2	C	C003	1	5	5	3	3	Upper reach affected by a partial beaver dam
SH18.3	I	C003	2	5	5	2	3	Lower reach with some loss of riparian vegetation
SH17.5	I	C003	5	3	4	5	5	Stream manipulation from roadside stabilization
SH15.5U/S	I	C003	3	3	4	5	4	Mass trampling of some stream banks by cattle
SH15.5D/S	I	C003	5	5	4	5	5	Lower Reach with some streambank impairment
TN9.3	R	C003	3	2	2	4	2	Mass trampling of some stream banks by cattle
TN9.4	R	C003	3	1	1	1	1	Upper Reach with no streambank impairment
MO.1	R	D003	2	NA	NA	3	2	Great fish populations, but streambank impairments.
LS.1	I	D001	1	2	2	2	1	Mass wasting of some of the stream banks
LS.6	C	D001	2	3	1	3	3	Mass wasting of some of the stream banks
CN.5	I	D001	NA	2	NA	1	2	Fenced, not grazed

Stagliano 2018a

AES = Aquatic Ecological Systems; BACI = Before, After, Control (upstream and offsite reference), and Impact (within and downstream); D/S = downstream; C = Control; I = Impact; LS = Little Sheep Creek; NA = not analyzed; R = Reference; RM = River mile; SH = Sheep Creek; TN = Tenderfoot Creek; U/S = upstream

Notes:

[a] Community integrity ranks were scored 1 (highest) through 5 (lowest).

[b] AES types include Mountain Streams (C003), Small Forested Mountain Stream (D003), and Headwater Stream (D001).

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 3.16-4**). 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 3.16-4**).

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**, **Figure 3.16-4,** and **Figure 3.16-5**). 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 3.16-6**) 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 3.16-4**).

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 3.16-4**). 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).

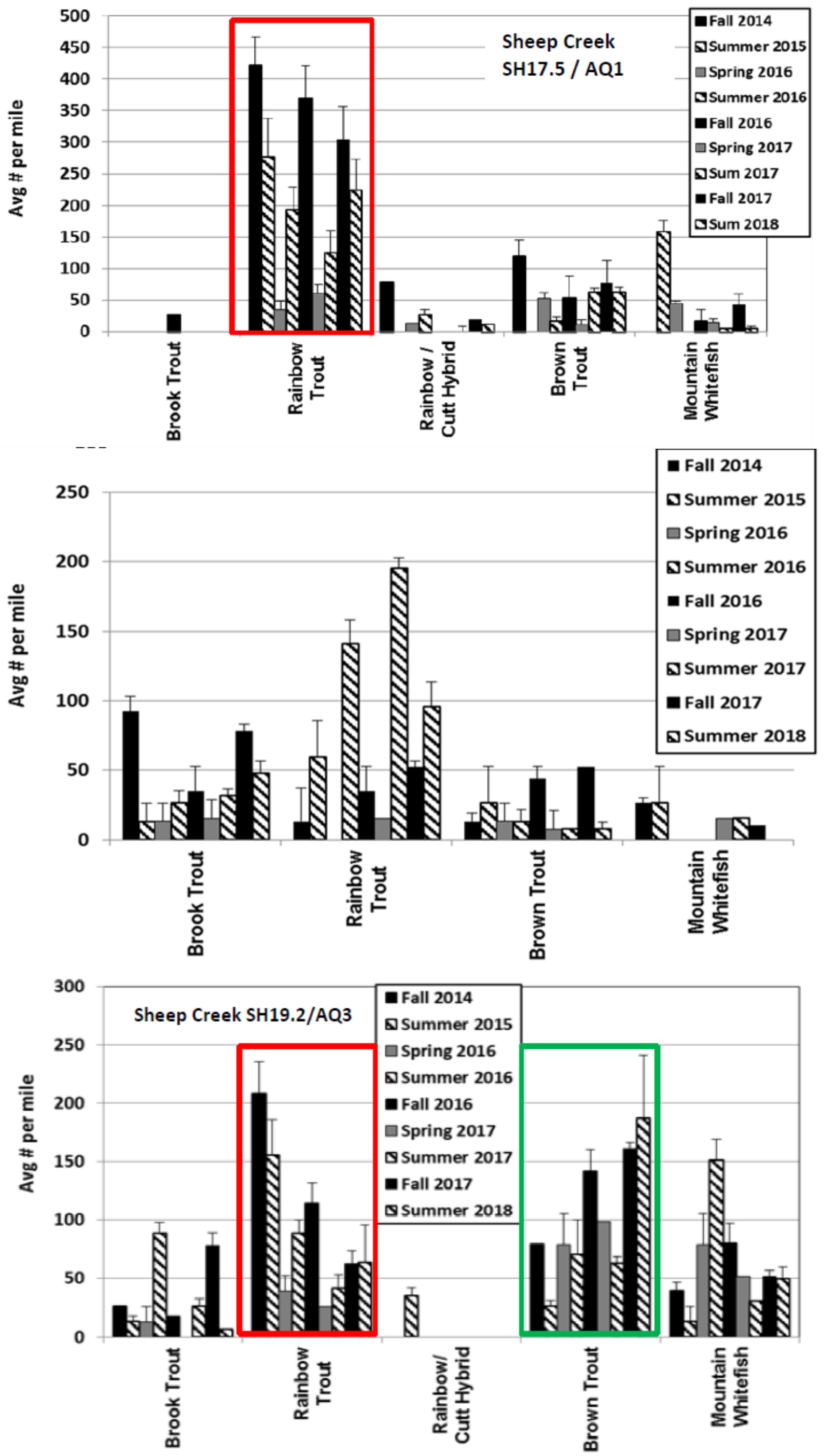
Trout and mountain whitefish were also tagged in the area of the Sheep Creek and Moose Creek confluence. These fish have been detected throughout the Smith River drainage, including in Benton Creek, Birch Creek, Camas Creek, Newlan Creek, Rock Creek, Tenderfoot Creek, and the Smith River from as far 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 3.16-4
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

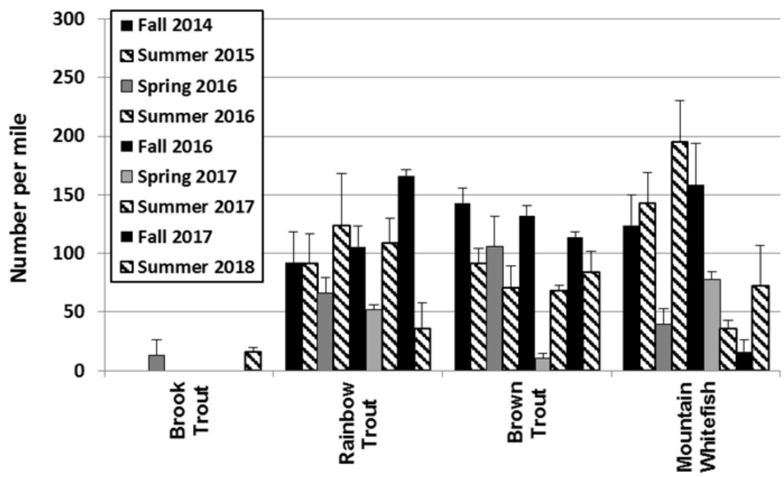
Source: Stagliano 2015, 2017a, 2018a

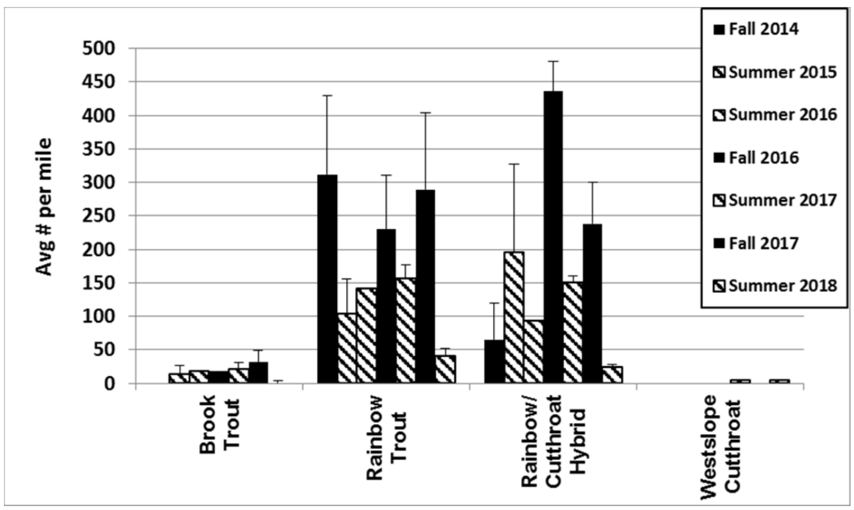
C = carnivore; D/S = downstream; I=introduced; INT = intermediate; INV = invertivore; LS = Little Sheep Creek; mm = millimeters; N = native; NR = not recorded; OM = omnivore; S = sensitive; SH = Sheep Creek; TOL = tolerant; TN = Tenderfoot Creek; U/S = upstream; X = documented in reach during 2014 to 2017 baseline surveys

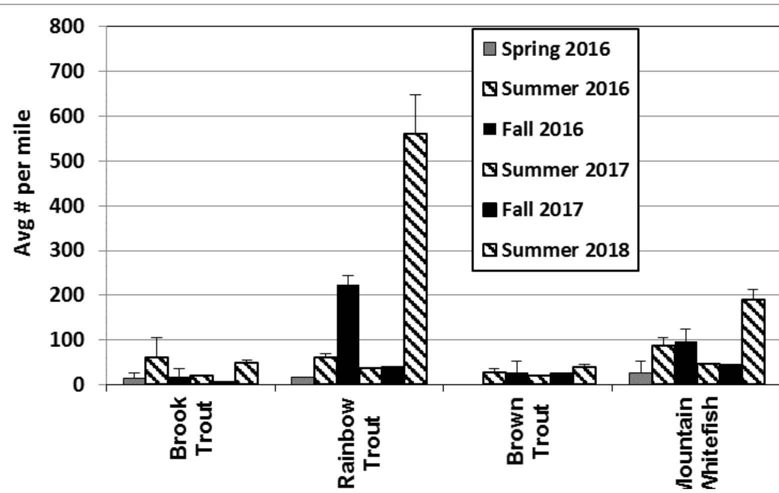


Source: Stagliano 2019

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)

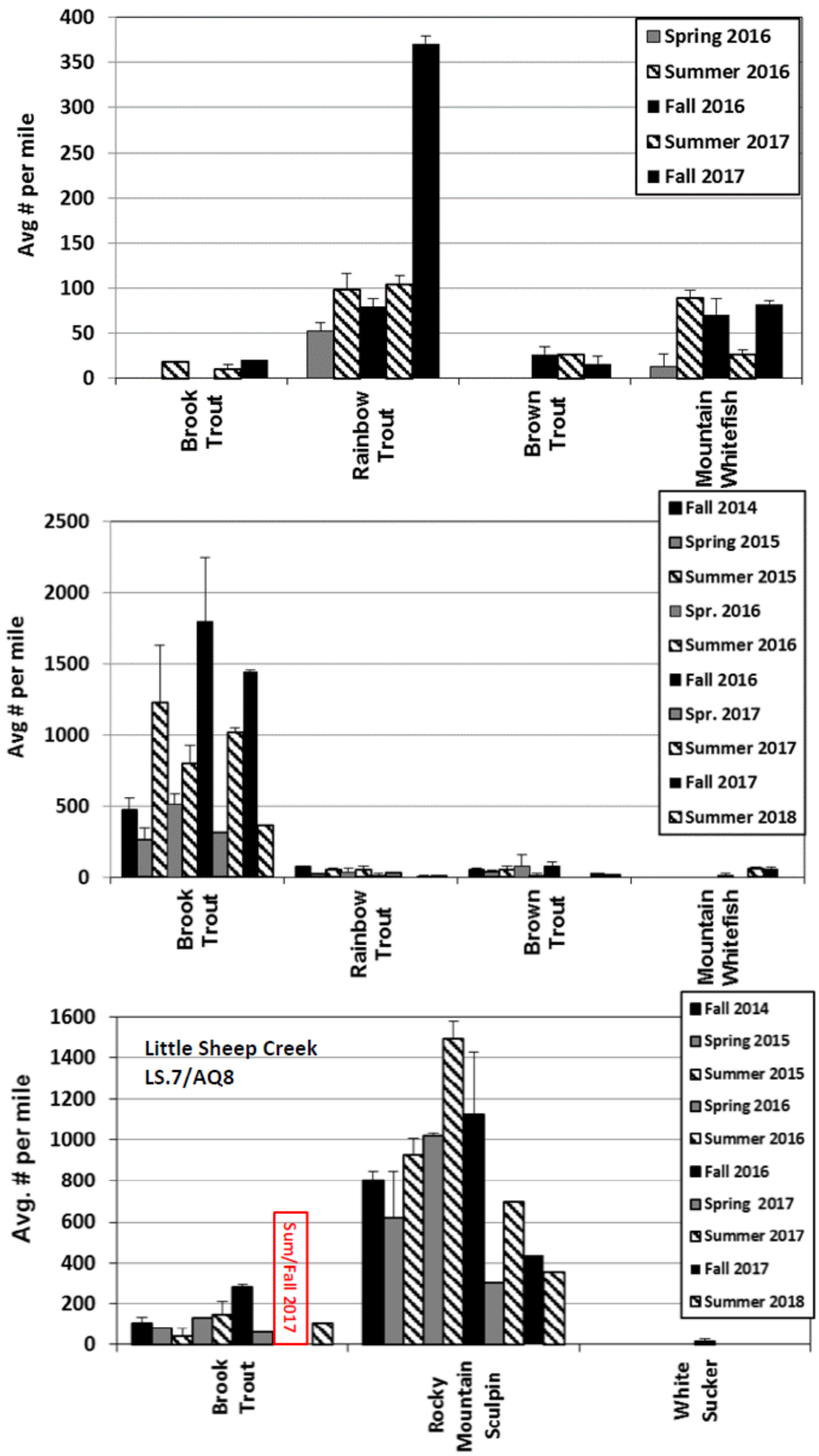






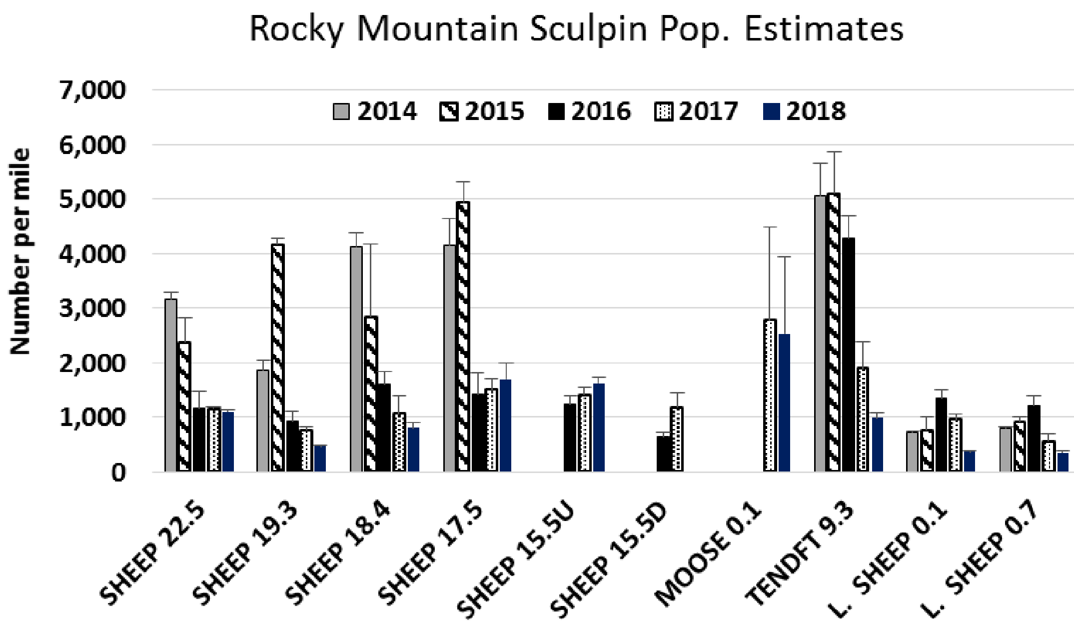
Source: Stagliano 2019

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)



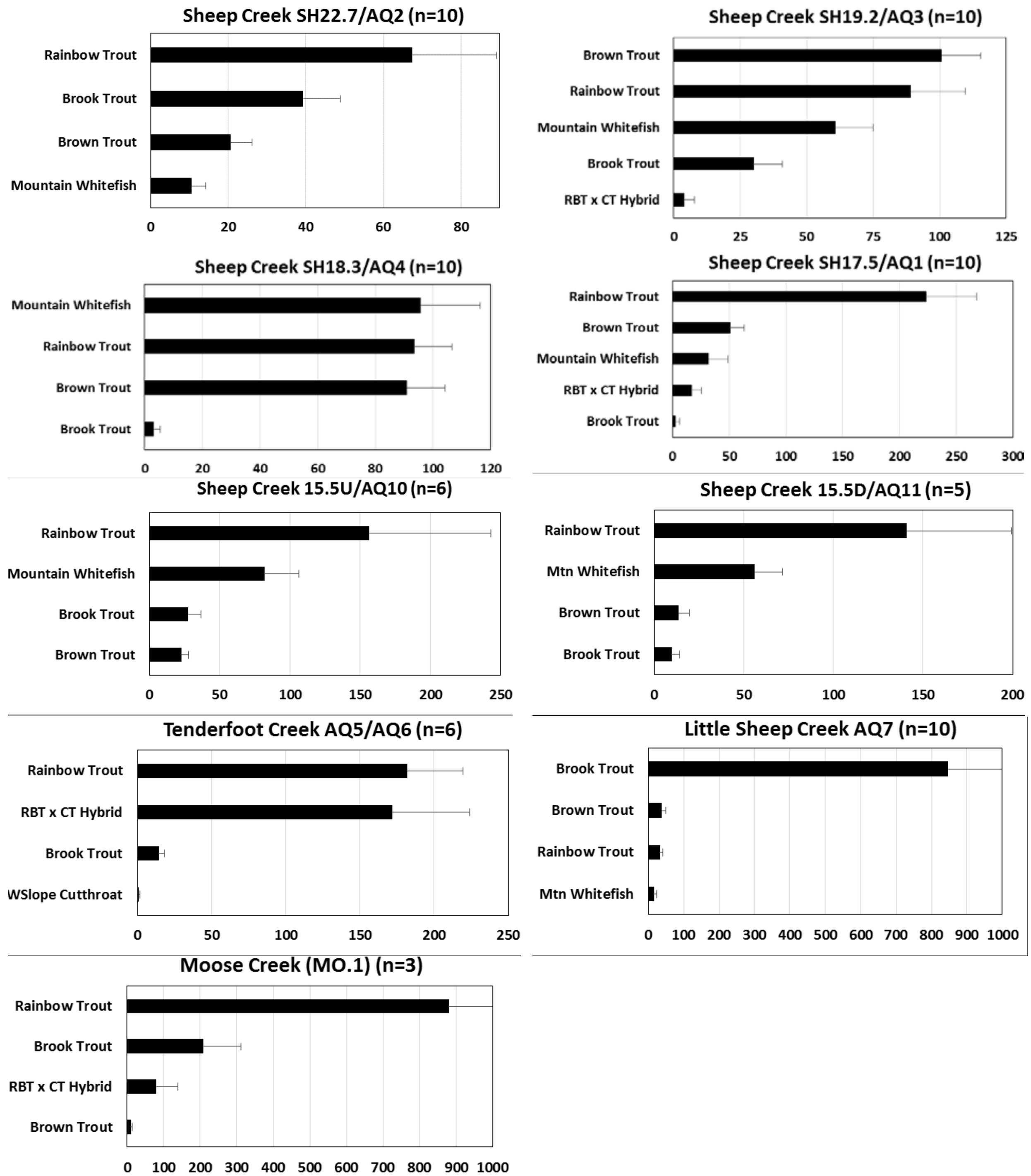
Source: Stagliano 2019
Note: The bottom figure is mislabeled as LS.7/AQ8 instead of LS.6.

Figure 3.16-4
Seasonal Average Fish Abundance per Mile with Standard Deviation Error Bars for Project Aquatic Sampling Locations on Sheep Creek SH15.5 DS (top), Little Sheep Creek LS.1 (middle), and Little Sheep Creek LS.6 (bottom)



Source: Stagliano 2019

Figure 3.16-5
Average Total Annual Sculpin Population Estimates for Sheep Creek Sites (SH22.7 and SH19.2) and the First Impact Site (SH18.3), 2014-2018



Source: Stagliano 2019

Figure 3.16-6
Overall Average Salmonid Abundance per Mile with Standard Deviation Error Bars for Sheep, Little Sheep, and Tenderfoot Creek Sampling Locations 2014-2018

The downstream Sheep Creek impact sites, SH15.5U and SH15.5D, added in 2016, had overall fish communities similar to SH18.3, SH19.2 and SH22.7, respectively (see **Figure 3.16-6** and **Table 3.16-4**). These sites, which qualitatively have similar pool habitat, also reported fewer catchable-sized fish (greater than 200 mm) than found in the Sheep Creek meadow reaches SH19.2 and SH18.3 (see Appendix K). Similar patterns were observed at the upper Sheep Creek site SH22.7, which has roadside fishing access and likely higher fishing pressure. Rainbow trout size-frequency numbers indicate the presence of four dominant size classes (age classes) in most Sheep Creek reaches, except those with abundant large brown trout where the first and second year classes (less than 100 mm) are missing (see Appendix K), likely due to predation (Stagliano 2018a, 2019). Brown trout size classes are eschewed toward larger fish across most Sheep Creek sites, especially at SH15.5U, which is the fishing access site (see Appendix K). Stagliano (2019) stated that Moose Creek is a salmonid production area with the highest densities of salmonids reported (approximately 1,000 and 2,400 per mile in 2017 and 2018, respectively [see Appendix K]). The high frequency of small size classes (less than 150 mm), including brook and rainbow trout juveniles (approximately 50 to 75 mm), in Moose Creek indicate that many fish are likely spawned and reared in this creek. The rainbow trout reared in Moose Creek are out-migrating and augmenting populations at the Sheep Creek sites downstream (SH15.5U/D) (Stagliano 2019).

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, 2017, and 2018 are presented in **Table 3.16-5**. The reported values for all metals in the fish tissue are below the impairment threshold for Aquatic

Life Standards (DEQ 2017b). Arsenic, cadmium, lead, mercury, and nickel were not reported at any site at detectable levels in 2016, 2017, or 2018.

Fall Redd Counts

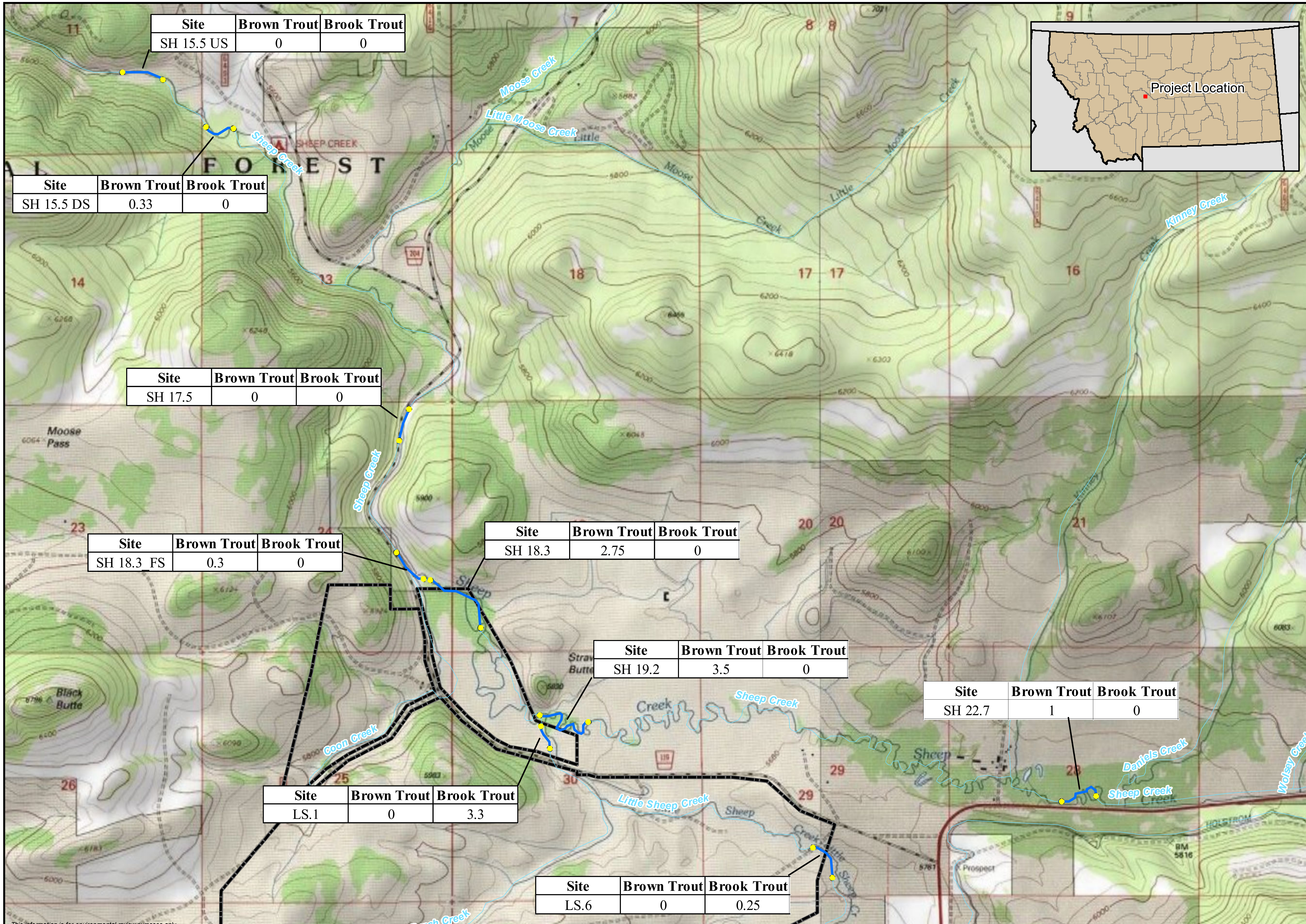
During the last week of October in 2016, 2017, and 2018, approximately 2.8, 3.1, and 3.2 miles, respectively, of stream channel encompassing the Sheep Creek and Little Sheep Creek monitoring sections were surveyed for brook and brown trout redds (see **Figures 3.16-7, 3.16-8, and 3.16-9**). **Figure 3.16-10** 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 3.5 and 2.8 redds per 100 meters, respectively. Redd counts at these same sites in 2017 and 2018 were less than one half of those densities reported in 2016 (see **Figure 3.16-8** and **Figure 3.16-9**). The highest number of brook trout redds were reported at Little Sheep Creek site LS.1 in 2016 and 2018 and averaged 3.3 redds and 1 redd per 100 meters, respectively.

Table 3.16-5
Baseline Whole Body Metal Values Downstream and Upstream of the Project Area

Stream Site	Al (mg/kg)	Cu (mg/kg)			Fe (mg/kg)		Mn (mg/kg)		Se (mg/kg)			Zn (mg/kg)		
	2018	2016	2017	2018	2016	2017	2016	2017	2016	2017	2018	2016	2017	2018
Sheep SH17.5 (D/S)	29 15	2	1	N/D	204	53	8	9	1	N/D	N/D	25	20	21
Sheep SH18.3 (D/S)		1	1	N/D	177	43	4	11	3	N/D	N/D	18	27	17
Average	22.0	**1.5**	**1.0**		**190.5**	**48.0**	**6.0**	**10.0**	**2.0**	**N/D**	**N/D**	**21.5**	**23.5**	**19.0**
Sheep SH22.7 (U/S)	25 23	1	1	N/D	171	24	7	6	2	N/D	N/D	22	20	16
L. Sheep LS.1 (U/S)		1	N/D	N/D	275	155	8	5	2	1	2	24	23	21
L. Sheep LS.1 (EBT)	NR	NR	1		NR	23	NR	3	NR	N/D	N/D	NR	22	22
Average	24.0	**1.0**	**0.7**		**223.0**	**67.3**	**7.5**	**4.7**	**2.0**	**0.5**	**0.5**	**23.0**	**21.7**	**19.7**
F-test, p-value (C x I)	0.4	**0.2**	**0.3**		**0.3**	**0.4**	**0.3**	**<0.1**	**0.5**	**0.3**	**0.3**	**0.4**	**0.3**	**0.4**
F-test, p-value (year)	NR	**0.1**	NR		**<0.1**	NR	**0.5**	NR	**0.1**	NR		**0.5**	0.1	0.1

Source: Stagliano 2018a

Al = aluminum; C = control; 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; NR = not reported; Se = selenium; U/S = upstream; Zn = zinc



Site	Brown Trout	Brook Trout
SH 15.5 US	0	0

Site	Brown Trout	Brook Trout
SH 15.5 DS	0.33	0

Site	Brown Trout	Brook Trout
SH 17.5	0	0

Site	Brown Trout	Brook Trout
SH 18.3_FS	0.3	0

Site	Brown Trout	Brook Trout
SH 18.3	2.75	0

Site	Brown Trout	Brook Trout
SH 19.2	3.5	0

Site	Brown Trout	Brook Trout
SH 22.7	1	0

Site	Brown Trout	Brook Trout
LS.1	0	3.3

Site	Brown Trout	Brook Trout
LS.6	0	0.25

Figure 3.16-7
Black Butte Copper Project
2016 Stream Redd Counts
Meagher County, Montana

Project Location

Creek Reach
Permit Boundary

N W E S

0 1,000 2,000
Feet

FILE: M:\Clients\M-O\MTDEQ\BlackBute_Copper_ArcGIS\2018\06\BBC_Aquatics_Figure_BBC_Aquatics_2016counts.mxd | REVISED: 09/06/2019 | SCALE: 1:24,000 when printed at 11x17

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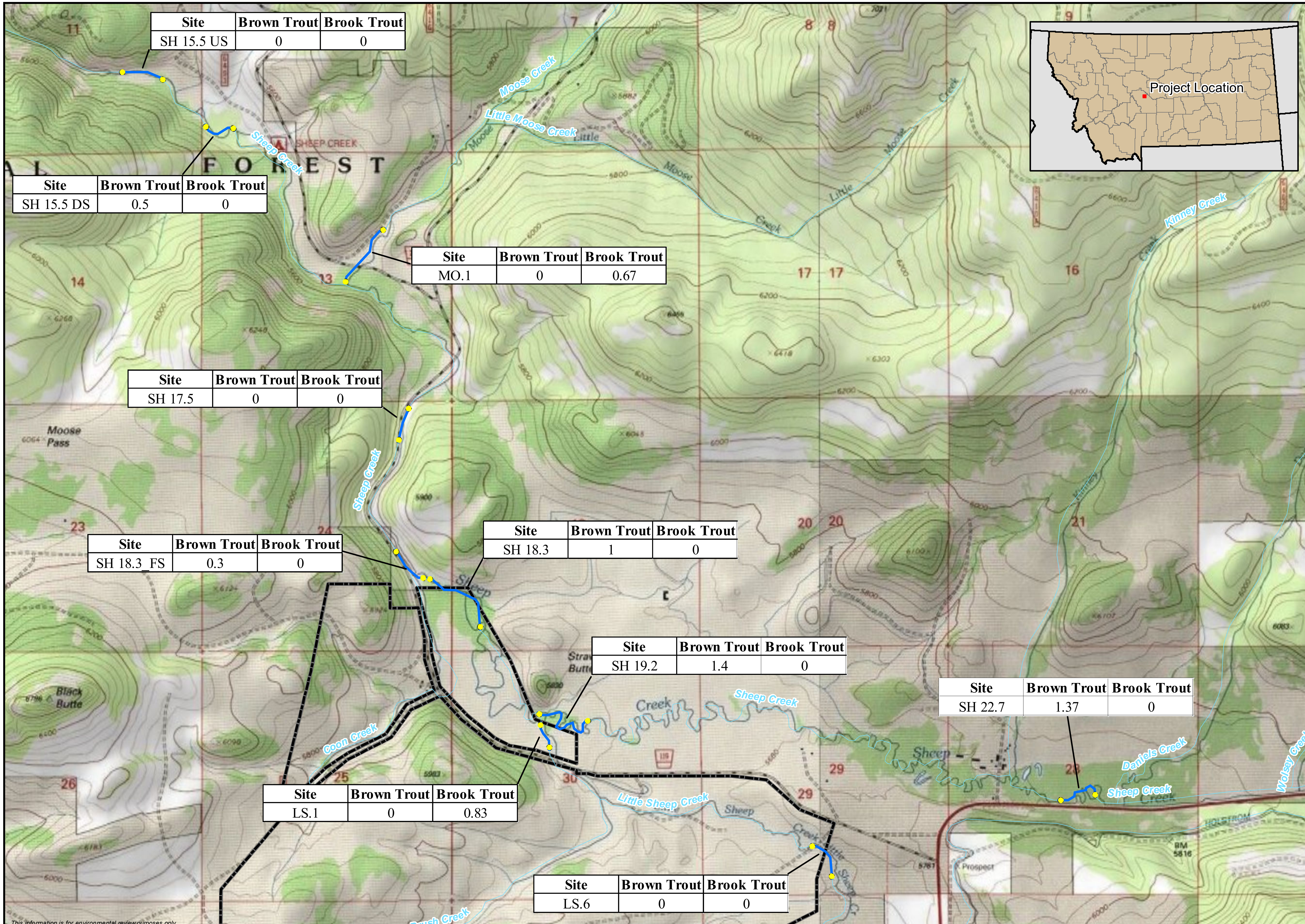


Figure 3.16-8
Black Butte Copper Project
2017 Stream Redd Counts
Meagher County, Montana

Creek Reach
Permit Boundary

All values of Redd Counts per 100 meters of Stream

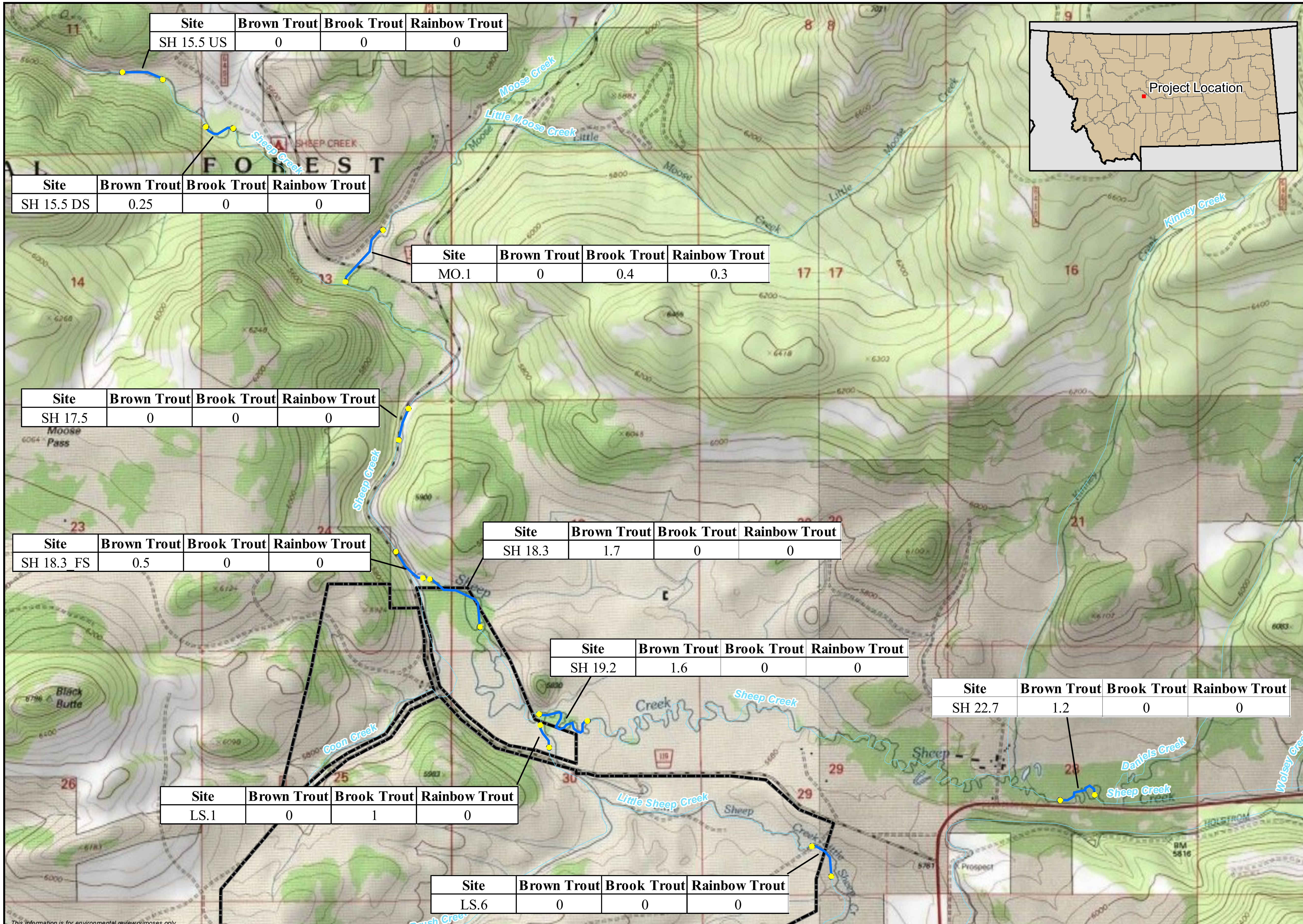
N W E S

0 1,000 2,000
Feet

FILE: M:\Clients\M-O\MTDEQ\BlackBute_Copper_ArcGIS\2018\06\BBC_Aquatics_Figure_BBC_Aquatics_2017counts.mxd | REVISED: 09/06/2019 | SCALE: 1:24,000 when printed at 11x17

DRAWN BY: SDB

Figure 3.16-9
Black Butte
Copper Project
2018 Stream Redd Counts
Meagher County, Montana



Site	Brown Trout	Brook Trout	Rainbow Trout
SH 15.5 US	0	0	0

Site	Brown Trout	Brook Trout	Rainbow Trout
SH 15.5 DS	0.25	0	0

Site	Brown Trout	Brook Trout	Rainbow Trout
MO.1	0	0.4	0.3

Site	Brown Trout	Brook Trout	Rainbow Trout
SH 17.5	0	0	0

Site	Brown Trout	Brook Trout	Rainbow Trout
SH 18.3_FS	0.5	0	0

Site	Brown Trout	Brook Trout	Rainbow Trout
SH 18.3	1.7	0	0

Site	Brown Trout	Brook Trout	Rainbow Trout
SH 19.2	1.6	0	0

Site	Brown Trout	Brook Trout	Rainbow Trout
SH 22.7	1.2	0	0

Site	Brown Trout	Brook Trout	Rainbow Trout
LS.1	0	1	0

Site	Brown Trout	Brook Trout	Rainbow Trout
LS.6	0	0	0

Creek Reach
Permit Boundary

All values of Redd Counts per 100 meters of Stream

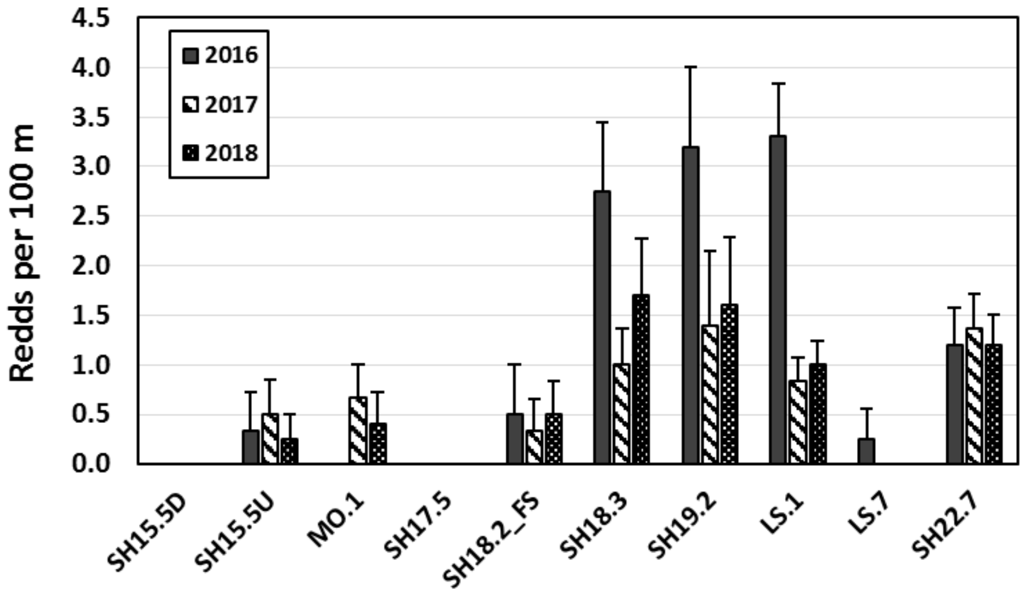
N W E S

0 1,000 2,000
Feet

FILE: M:\Clients\M-O\MTDEQ\BlackBute_Copper_ArcGIS\2018\06\BBC_Aquatics_Figure_BBC_Aquatics_2018counts.mxd | REVISED: 09/06/2019 | SCALE: 1:24,000 when printed at 11x17

DRAWN BY: SDB

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 3.16-10**). 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 3.16-10**). Redd counts of Moose Creek were added in 2017 and contained brook trout redds at densities of 0.67 per 100 meters (see **Figure 3.16-7**).



Source: Stagliano 2019

Notes:
[a] Sites are arranged from further downstream to upstream of the Project area.
[b] Number of redds includes brook, brown, and rainbow trout.

Figure 3.16-10
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 2018 aquatic baseline surveys reported 146 macroinvertebrate taxa in the assessment area. No Montana invertebrate SOCs were collected. Average macroinvertebrate richness across all sites over the 4 years surveyed was 50 taxa, while Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) (EPT) taxa averaged 20 per site. The highest taxa richness (64 species) was reported at SH18.3 (in 2016), while SH15.5US had the highest number of combined EPT (30 species in 2016). 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 and LS.6 Little Sheep Creek control sites reported much lower macroinvertebrate MMI scores than the Tenderfoot Creek reference sites (see **Table 3.16-6**).

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).

Smith River macroinvertebrate data were collected from upstream and downstream of Sheep Creek in 2016 and 2017 (Stagliano 2018b) and in lower Sheep Creek (RM 0.1) in 2018 (Stagliano 2019). 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) in 2016. 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 3,442 individuals per square meter in Sheep Creek approximately 16 miles upstream from the Smith River (see **Table 3.16-6** and **Figure 3.16-1**). Macroinvertebrate abundance at SM_DS was lower in 2017 and 2018 than in 2016; this may correspond to the higher stream flows in 2017 and 2018. The lower abundance, combined with lower total taxa richness and EPT taxa, has decreased these metrics to below the optimal levels (see **Figure 3.16-11**) (Stagliano 2019).

Tenderfoot Creek reported the highest integrity scores ranked by the DEQ MMI (averages above 70 all 4 years), while the Sheep Creek sites averaged 63.2, 63, 61.5 and 57.4 in 2014, 2016, 2017, and 2018, respectively, which is ranked slightly impaired by DEQ thresholds (impairment threshold of the Low Valley MMI is 63) (Stagliano 2018a). Both Little Sheep Creek sites, Sheep Creek SH19.2, and Coon Creek were ranked impaired by the DEQ MMI with scores below 63 in all years of the baseline studies. DEQ MMI scores from the Hess samples were typically lower than reach-wide samples, exceptions being the impact sites SH15.5U/S and 15.5D/S in 2016/2017 and LS.1 in 2018 (see **Figure 3.16-12**) (Stagliano 2019).

The HBI scores across all sites averaged 4.1, 3.4, 3.6, and 3.9 in 2014, 2016, 2017, and 2018, 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; Stagliano 2019; 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 3.16-13**). Little Sheep Creek sites LS.1 and LS.6 were the only sites reporting moderate organic pollution with HBI scores of greater than 4 during three of the surveys (2014, 2017, and 2018) (see **Figure 3.16-13**). 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 2018. Tenderfoot Creek TN9.3 and Little Sheep LS.1 reported the highest percentages of Heptageniidae in 2017 (see **Figure 3.16-13**). 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 3.16-6 contains macroinvertebrate metrics that were scored using the DEQ bioassessment criteria, and each sample was categorized as impaired or non-impaired according to threshold values (Stagliano 2019); these values are described in the table notes below.

Table 3.16-6
Macroinvertebrate Sample Characteristics and Metrics

Site RM Code	Date Collected	Ind/m^2	Mtn MMI Index [a]	Total Taxa [b]	EPT Taxa [c]	% EPT [d]	% Hept [e]	% NonIns [f]	HBI [g]
SH22.7	7/6–7/9 2018	3,320	69.2	57	24.2	**65.3**	**4.0**	8.2	3.2
SH19.2	7/6–7/9 2018	15,910	**48.9**	48	**17.8**	**43.4**	**0.8**	3.3	**4.0**
	Control avg.	9,615	59.1	52.5	21.0	54.3	2.4	5.7	3.6
SH17.5	7/6–7/9 2018	5,673	**45.7**	42	**16.7**	**32.4**	**1.4**	3.0	3.8
SH18.3	7/6–7/9 2018	4,776	**51.7**	46	21.4	**34.0**	**1.2**	2.4	**4.1**
SH15.5DS	7/6–7/9 2018	2,857	**62.4**	55	22.0	**59.3**	**0.9**	2.8	3.4
SH15.5US	7/6–7/9 2018	4,290	63.6	52	**18.5**	**40.9**	**1.1**	6.0	3.6
SH0.1	7/6–7/9 2018	3,340	63.8	43	24.6	**61.2**	**3.2**	2.0	3.6
	Impact avg.	4,187	57.4	47.6	20.6	45.6	1.6	3.3	3.7
TN9.3	7/6–7/9 2018	950	64.3	52	21.3	**67.3**	**4.3**	0.5	3.4
TN9.4	7/6–7/9 2018	1,110	73.2	50	22.0	70.0	**4.1**	0.3	3.2
	Reference avg.	1,030	68.7	51.0	21.6	68.6	4.2	0.4	3.3
LS0.1	7/6–7/9 2018	4,880	**42.4**	44	**11.0**	**17.0**	**1.8**	**22.8**	**5.1**
LS0.6	7/6–7/9 2018	1,008	**37.2**	43	**9.0**	**9.4**	**0.0**	**48.2**	**6.5**
	avg.	2,944	39.8	43.5	10.0	13.2	0.9	35.5	5.8
C0.5	7/6–7/9 2018	2,040	**43.3**	**39**	**12.0**	**22.9**	**0.8**	**13.4**	**4.1**
SH22.7	7/19–7/20 2017	2,392	64.6	57	29	**56.7**	**0.3**	5.0	3.0
SH19.2	7/19–7/20 2017	2,216	**55.1**	42	**17**	**42.4**	**<0.1**	1.6	3.5
	Control avg.	2,304	59.9	49.5	23.0	49.6	0.2	3.3	3.3
SH17.5	7/19-7/20 2017	4,288	**60.7**	42	21	**64.0**	**0.9**	2.6	3.0
SH18.3	7/19-7/20 2017	2,364	**61.9**	46	22	**47.2**	**1.0**	0.5	3.7
SH15.5DS	7/19-7/20 2017	3,256	65.1	47	27	**52.4**	**0.7**	1.0	3.7

Site RM Code	Date Collected	Ind/m²	Mtn MMI Index [a]	Total Taxa [b]	EPT Taxa [c]	% EPT [d]	% Hept [e]	% NonIns [f]	HBI [g]
SH15.5US	7/19-7/20 2017	4,808	**58.2**	55	22	**62.1**	**0.5**	2.0	3.4
	Impact avg.	3,679	61.5	47.5	23.0	56.4	0.8	1.5	3.5
TN9.3	7/19-7/20 2017	3,880	67.5	47	25	**51.4**	5.5	0.0	2.9
TN9.4	7/19-7/20 2017	3,515	72.8	48	23	**55.0**	5.1	0.1	2.8
	Reference avg.	3,698	70.1	47.5	24.0	53.2	5.3	0.1	2.9
LS0.1	7/19-7/20 2017	4,080	**47.4**	53	22	**37.6**	14.9	**18.1**	**4.5**
LS0.6	7/19-7/20 2017	1,152	**30.1**	45	**11**	**22.0**	**0.2**	**47.0**	**5.2**
	avg.	2,616	38.8	49.0	16.5	29.8	7.6	32.5	4.9
C0.5	7/19-7/20 2017	1,412	**56.0**	**39**	**14.0**	**47.6**	**0.0**	4.3	3.5
SH22.7	7/12/2016	5,632	70.1	59	27	**63.6**	**0.6**	0.6	2.8
SH19.2	7/12/2016	3,940	**53.7**	**35**	**16**	**36.8**	**0.0**	1.3	3.8
	Control avg.	4,786	61.9	47.0	21.5	50.2	0.3	0.9	3.3
SH17.5	7/14/2016	4,335	65.5	58	29	**65.2**	**0.4**	2.3	2.8
SH18.3	7/11/2016	4,630	**60.8**	64	24	**25.5**	**0.3**	4.1	**4.3**
SH15.5DS	7/12/2016	2,760	65.8	55	23	**53.9**	**0.3**	4.8	3.2
SH15.5US	7/12/2016	2,044	**65.8**	45	30	**51.6**	**0.6**	0.9	3.2
	Impact avg.	3,442	63.0	55.5	26.5	49.1	0.4	3.0	3.4
TN9.3	7/12/2016	2,224	68.1	46	24	**67.7**	**0.4**	0.2	3.2
TN9.4	7/12/2016	2,515	72.8	42	22	**62.6**	**0.6**	0.3	3.0
	Reference avg.	2,369.5	70.4	44.0	23	65.2	0.5	0.3	3.1
LS0.1	7/11/2016	2,612	**61.1**	45	21	**52.7**	**1.4**	5.2	3.1
LS0.6	7/12/2016	1,136	**39.7**	**29**	**9**	**9.9**	**0.0**	9.9	3.7
	avg.	1,874	50.4	37.0	15	31.3	0.7	7.5	3.4
C0.5	7/12/2016	1,992	**51.0**	**35**	**12**	**15.5**	**0.4**	3.4	3.9
SH22.7	8/15/2014	3,260	63.3	47	**19**	**60.0**	**0.0**	3.4	3.4
SH19.2	8/16/2014	3,158	**55.8**	**39**	**16**	**26.9**	**0.3**	0.5	3.9
	Control avg.	3,209	59.5	43.0	17.5	43.5	0.2	2.0	3.7
SH17.5	8/16/2014	2,952	63.7	44	21	**48.8**	**0.0**	1.9	**4.0**
SH18.3	8/16/2014	5,872	**62.7**	60	21	**47.0**	**0.3**	3.1	3.8
	Impact avg.	4,412	63.2	52.0	21	47.9	0.2	2.5	3.9
TN9.3	8/16/2014	6,080	68.6	53	23	**33.8**	**0.3**	1.1	**4.7**
TN9.4	8/16/2014	7,424	71.4	43	22	**48.4**	**0.5**	1.0	3.6
	avg.	6,752.0	70.0	48.0	22.5	41.1	0.4	1.1	4.1
LS0.1	8/16/2014	3,040	**39.7**	**35**	**9**	**12.1**	**1.3**	9.8	**4.9**
LS0.6	8/15/2014	1,132	**46.9**	**37**	**10**	**24.7**	**0.5**	**19.4**	**4.7**
	avg.	2,086.0	43.3	36.0	10	18.4	0.9	14.6	4.8
C0.5	7/8/2015	2,520	**48.5**	**36**	**14**	**35.5**	**0.0**	**17.0**	3.4

Source: Stagliano 2015, 2017b, 2019, 2020

avg. = average; EPT = Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies), see note d; Hept = Heptageniidae (mayflies); HBI = Hilsenhoff Biotic Index, see note g; Ind/m^2 = 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 (impaired) are bold and underlined.

[b] The impairment threshold for total taxa is 40, thus any scores below this threshold are impaired and bold and underlined.

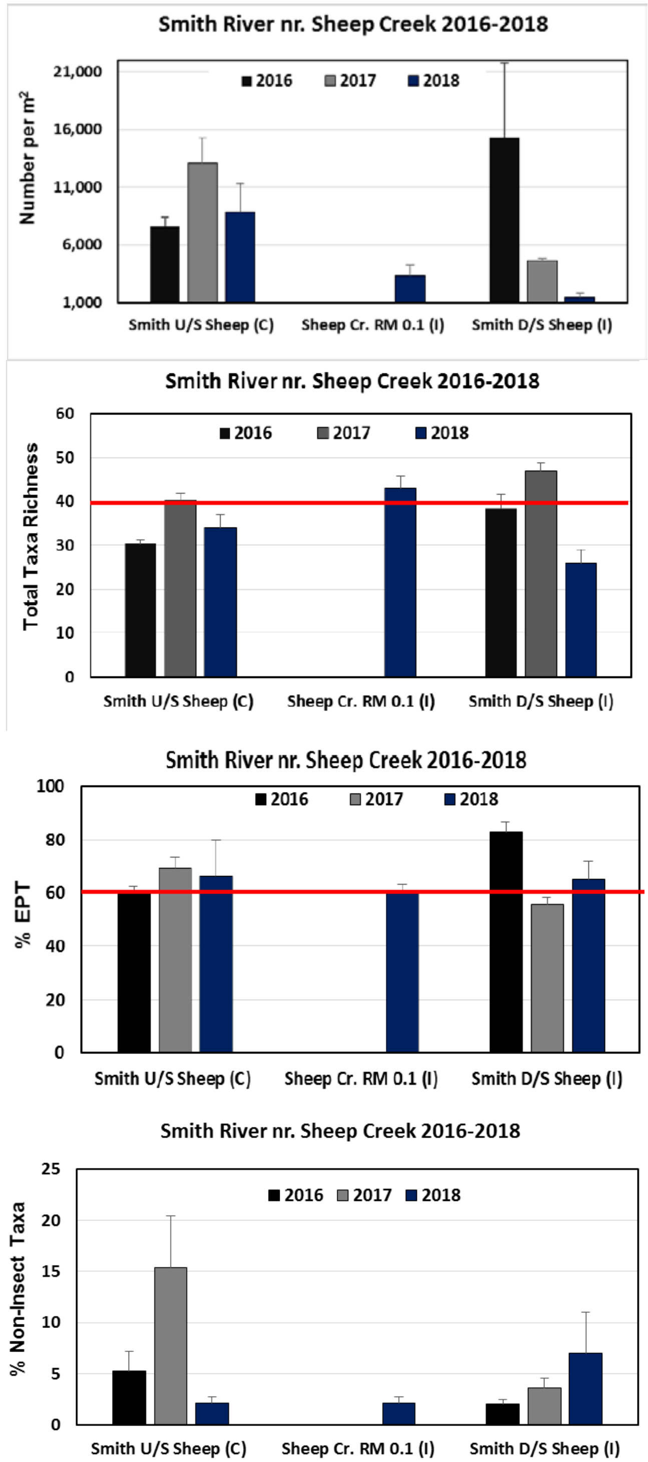
[c] The impairment threshold for EPT taxa is 20, thus any scores below this threshold are impaired and bold and underlined.

[d] % EPT indicates the percentage of mayflies, stoneflies, and caddisflies within the macroinvertebrate sample. High EPT percentages of the population typically indicate that degraded habitat conditions are not present, and scores above 70 percent are considered healthy communities. Thus, any scores below 70 percent are not considered healthy and are bold and underlined.

[e] % Hept indicates the average percentage of Heptageniidae per macroinvertebrate sample. Scores above 5 percent indicate healthy mountain stream communities. Thus, any scores below 5 percent are not considered healthy and are bold and underlined.

[f] % NonIns indicates the average percentage of non-insects per macroinvertebrate sample. Scores above 10 percent are considered impaired mountain stream communities, and are bold and underlined.

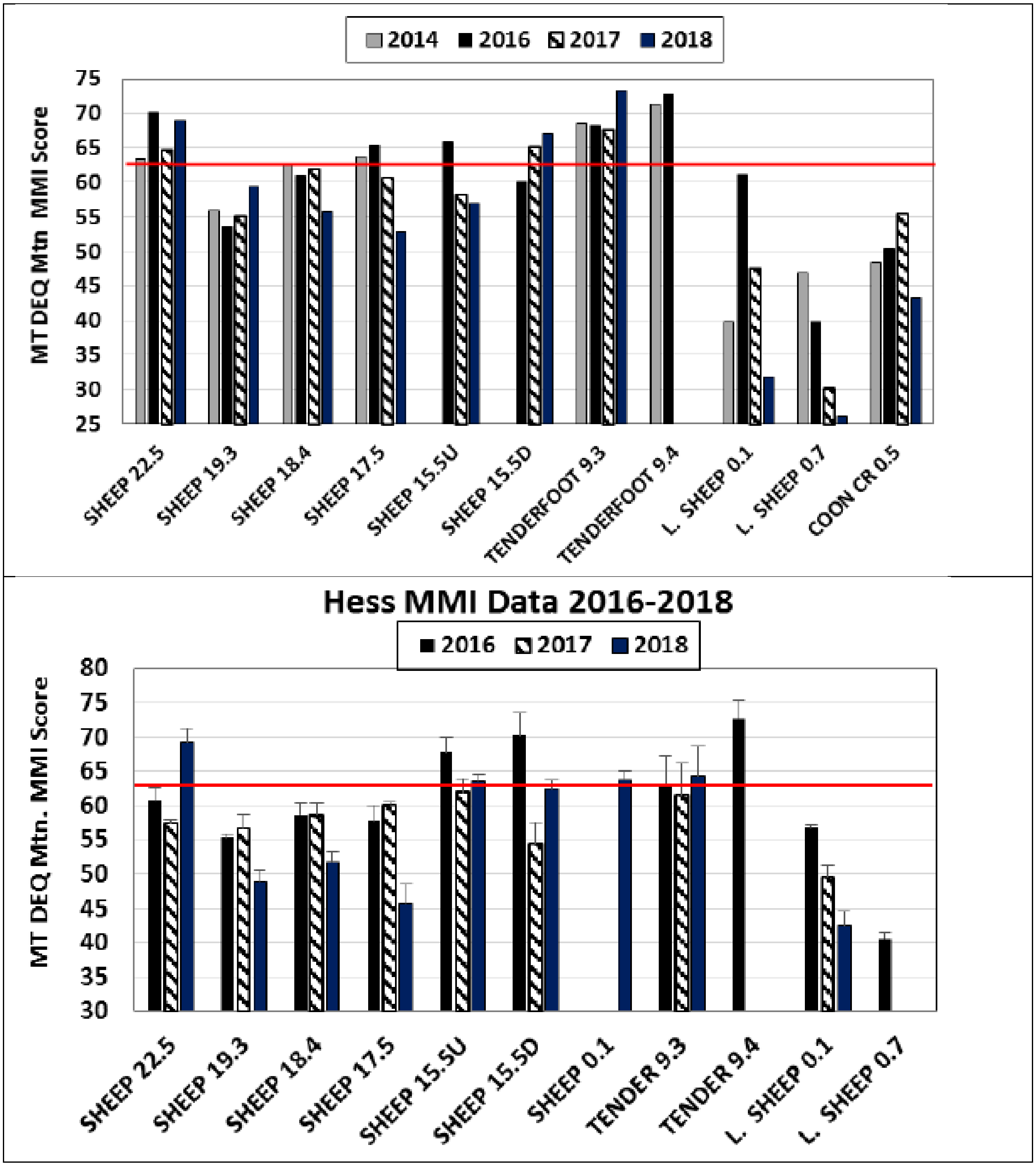
[g] HBI is the measure of macroinvertebrate assemblage’s tolerance toward organic (nutrient) enrichment. HBI tolerance values are based on a 0 to 10 scale, where 0-ranked taxa are most sensitive and 10-ranked taxa are most tolerant to pollutants. HBI values of 0 to 3.0 in mountain streams indicate no organic pollution (excellent conditions), and values of 3.0 to 4.0 indicate slight organic pollution (very good). Scores above 4.0 are considered moderately impaired communities and are bolded and underlined.



Source: Stagliano 2019

C = Control; I = Impact
Notes: Macroinvertebrate metrics calculated from Hess samples. Values above red line are optimal.

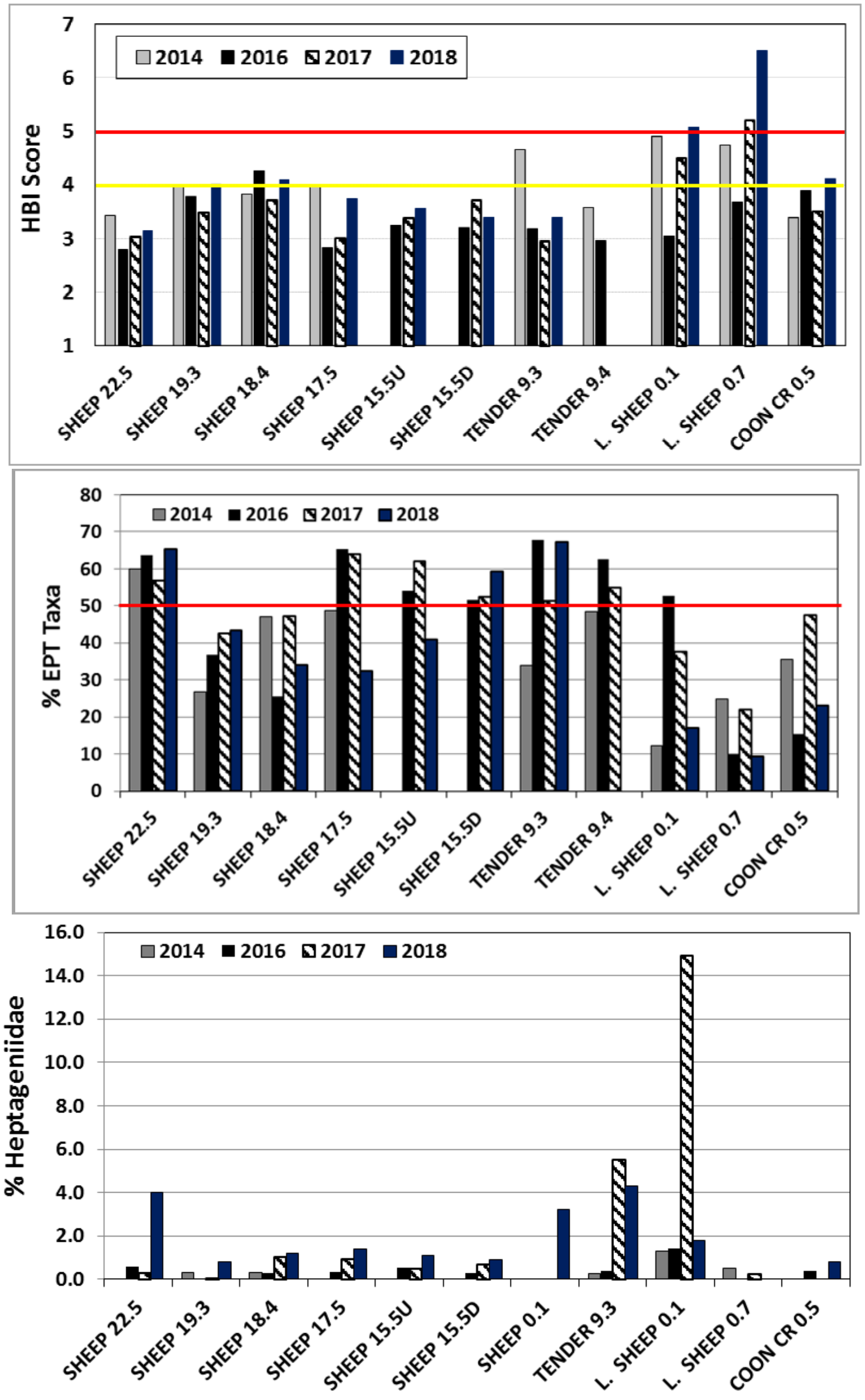
Figure 3.16-11
Macroinvertebrate Metrics in the Smith River Upstream to Downstream of Sheep Creek



Source: Stagliano 2019

MMI = multi-metric indices; Mtn = mountain
Notes: Red line represents the impairment threshold (63), below this indicates impairment.

Figure 3.16-12
Macroinvertebrate Reach-wide (top) and Hess (bottom) DEQ Mountain MMI Scores Upstream to Downstream



Source: Stagliano 2019

Notes:

[a] Red to yellow lines bracket the moderate organic impairment range (4.0 to 5.0); below 4.0 indicates slight impairment.

[b] Monitoring location SH19.2 is mislabeled as SH19.3 on the figure above from Stagliano 2019.

Figure 3.16-13
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 milligrams per square meter (mg/m^2) with the highest value in the assessment area recorded at SH17.5 (65.2 mg/m^2) (see **Table 3.16-7**). 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). In August 2018, chlorophyll-*a* levels were sampled in Sheep Creek sites upstream (C) and downstream (I) of the Project area by the Montana Biological Survey. Although only the weighted average at the upstream control site (SH22.7) exceeded the threshold level (120 mg/m^2), chlorophyll-*a* levels exceeded the nuisance levels of 150 mg/m^2 at two transects of the site (see **Table 3.16-8**). In addition, other impact transects downstream of the Project area, SH18.3 and SH17.5, also exhibited levels above the threshold (Stagliano 2019).

Table 3.16-7
Chlorophyll-*a* Levels Reported from 2015

Site RM Code (BACI Type)	Collection Date	Chlorophyll-*a* densities (mg/m^2)
SH15.5U (I)	8/19/2015	23.5
SH17.5 (I)	8/19/2015	65.2
SH18.3 (I)	8/19/2015	31.4
Moose 0.5 (R)	8/19/2015	53.7

Source: Stagliano 2019

BACI = Before, After, Control (upstream and offsite reference), and Impact (within and downstream); I = impact; mg/m^2 = milligrams per square meter; R = reference; RM = river mile
Note: Levels reported using the weighted average for 11 transect templates.

Table 3.16-8
Chlorophyll-*a* Levels Reported from 2018

Site RM Code (BACI Type)	Collection Date	Transect 1 Chl-*a* densities (mg/m^2)	Transect 2 Chl-*a* densities (mg/m^2)	Transect 3 Chl-*a* densities (mg/m^2)	Transect 4 Chl-*a* densities (mg/m^2)	Transect 5 Chl-*a* densities (mg/m^2)	Average Chl-*a* densities (mg/m^2)
SH22.7 (C)	8/22/2018	75.6	132.5	95.8	157.0	161.6	124.5
SH19.2 (C)	8/22/2018	102.1	54.8	122.6	95.7	148.2	104.7
SH18.3 (I)	8/22/2018	68.5	135.3	47.7	110.8	49.0	82.3
SH17.5 (I)	8/22/2018	130.0	107.0	91.4	118.4	NR	111.7
SH15.5U (I)	8/22/2018	58.6	53.8	110.8	78.6	96.8	79.7

Source: Stagliano 2019

BACI = Before, After, Control (upstream and offsite reference), and Impact (within and downstream); C= Control; Chl-*a* = Chlorophyll-*a*; I = impact; mg/m^2 = milligrams per square meter; RM = river mile
Note: Underlined values are above the threshold levels.

3.16.2.6. Periphyton Communities

The 2016 to 2018 aquatic baseline surveys reported 167 unique diatom and algae taxa from the 38 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 3.16-9**). 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. The trophic diatom index (TDI) is a relatively new index that was developed to monitor the trophic status of waterways. 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).

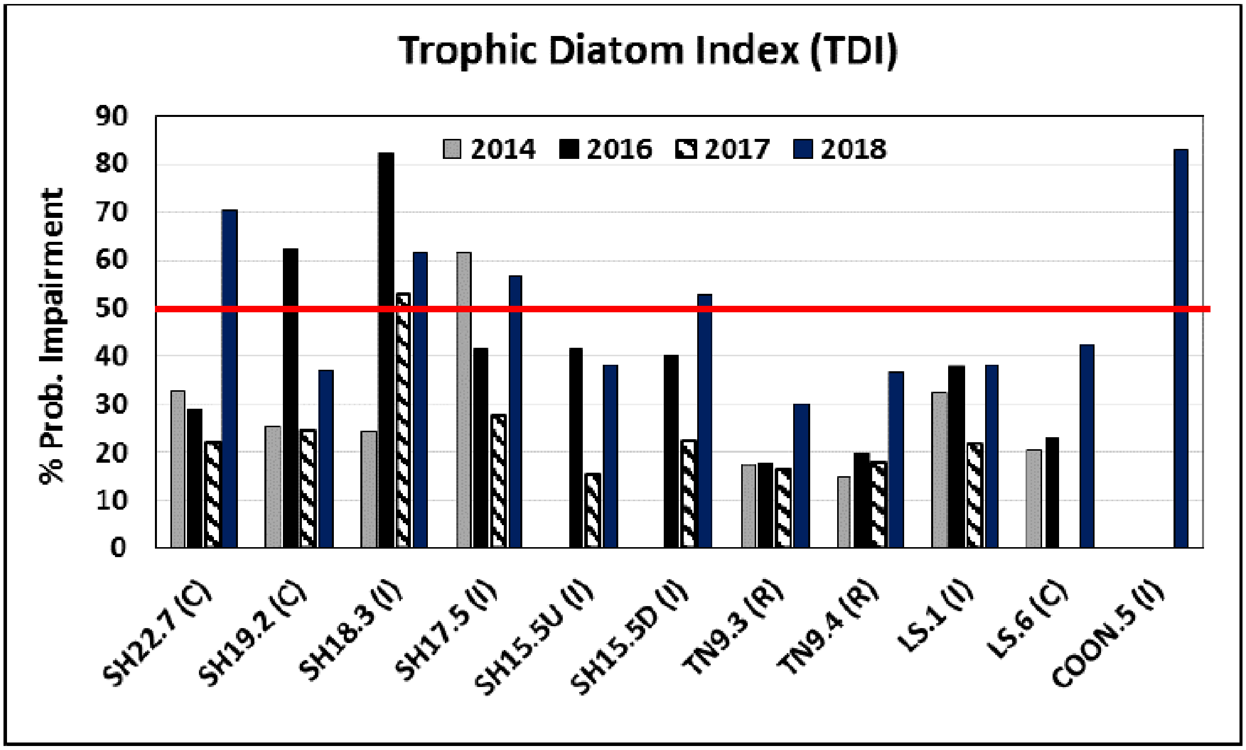
Based on Teply's interpretation of the TDI (2010), Sheep Creek site SH17.5 had the highest probability (61 percent) of sediment impairment in 2014; however, in 2017 this probability was reduced to 28 percent. The 2016 and 2017 analyses reported that Sheep Creek site SH18.3 had the highest probability of impairment (82 percent) followed by the Sheep Creek site SH19.2 at 62 percent (see **Table 3.16-9** and **Figure 3.16-14**). Based on the index, other Sheep Creek and Little Sheep Creek sites were below the impairment threshold (50 percent probability of impairment) and were less likely to be impaired. During all 4 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 3.16-9
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	62	54	6.5	24	*Cladophora*	*Tolypothrix*	Diatoms	*Phormidium*	*Phormidium*	Diatoms
SH18.3 (I)	57	6.5	24	82	27.5	82	69	16.7	53	Diatoms	*Homeothrix*	Diatoms	*Phormidium*	*Phormidium*	Diatoms
SH17.5 (I)	62	19.3	61	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 greater than 50 percent and based on the trophic diatom index (TDI) are underlined.



Source: Stagliano 2019

C = control site; I = impact site; R = reference site
Note: Above red line indicates impairment (50 percent probability of impairment).

Figure 3.16-14
TDI Calculated from the Peri-MOD Samples Arranged Upstream to Downstream

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 2.2, 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 acre 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, Inc. 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, Inc. 2016, 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, Inc. 2016). 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 post-mining. 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 on **Figure 2.2-1** (Hydrometrics, Inc. 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 due to the diversion of stream flow to fill the NCWR would be nominal, as the majority of the diversion would occur via a new water right limited to May through July and only when stream flow is in excess of all existing water rights and instream flow requirements (see Section 3.5.3.1, 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). The NCWR would be used for mitigation of depletion in surface waters during operations and for approximately 20 years after the end of mine dewatering (Hydrometrics, Inc. 2018a). Once the flow mitigation system is unnecessary, the wet well, intake pipeline, and transfer pipeline to the NCWR would be removed and 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 1 foot below grade (Tintina 2018b). Reclamation activities would have short-term impacts on aquatic biota similar to construction impacts, including increased turbidity near the intake pipe removal, degraded water quality, and substrate alteration. Following reclamation activities, the aquatic habitat should gradually recover until it is similar to pre-construction activities.

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; degradation of downstream shoreline and riparian habitats during construction and potentially longer, depending on if or how water flow rates and direction is modified by the intake structure; and potential alteration of aquatic community structure and diversity as a result of the aforementioned impacts over time by adding another source of mortality to the early life-stage, which affects recruitment and year-class strength. 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). It is generally assumed that for an aquatic organism to enter an intake structure, it must (1) be within the area where the structure influences the stream flow, (2) not receive a cue to trigger an avoidance response, and (3) be unable to swim faster than the intake velocity (Taft et al. 2007).

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 non-degradation 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 non-degradation 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 non-degradation criteria. Groundwater quality modeling showed that after the post-closure rinsing, only thallium would be dissolved in contact groundwater (i.e., water within flooded underground mine workings) at concentrations exceeding DEQ Groundwater Standards by a factor of two. However, thallium would be at concentrations below the estimated groundwater non-degradation 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, Post-closure Groundwater Quality, the combined flow rate of potential chemical sources (i.e., contact groundwater) 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 contact groundwater were to completely mix with Ynl A groundwater, and the Ynl A water does not have significant concentrations of the same solutes found in the contact groundwater, one would expect a 30:1 dilution of the solutes existing in the contact groundwater.

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 non-degradation 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 (Zieg 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

As part of mine operations, the Proponent anticipates discharging water seasonally from the WTP and/or TWSP via the UIG, which would discharge to the alluvial groundwater system associated with Sheep Creek prior to the water entering Sheep Creek itself. The discharge would be governed by an MPDES permit. Therefore, the Proponent has developed predictions regarding potential thermal effects resulting from the UIG discharge on Sheep Creek. Montana administrative rules applicable to B1 classified streams such as Sheep Creek restrict temperature changes to a 1 °F maximum increase above naturally occurring water temperatures, and a 2 °F decrease below naturally occurring water temperatures. A summary of conservative thermal analyses conducted by the Proponent indicating the absence of significant temperature effects on creeks is outlined in detail in Section 3.5.3.2, Surface Water Quality and Temperature (Water Temperature Thermal Analysis Methods and Results). 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.

Water stored in the NCWR would be allowed to seep from the reservoir floor to the downstream catchment to offset a portion of mine site consumptive use of groundwater. Analyses indicate that the seepage rate is expected to vary seasonally between 5 and 26 gpm (Zieg 2019). The predicted rate of seepage from the NCWR is not of sufficient volume 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 the mine site's consumptive use on a monthly basis.

Results of the thermal analyses indicate that water temperature in the NCWR would be greater than in Sheep Creek during the following 5 months: May (Mean Creek temperature 41.6 °F vs. NCWR water temperature 41.8 °F), June (Mean Creek temperature 49.6 °F vs. NCWR water temperature 49.7 °F), August (Mean Creek temperature 53.2 °F vs. NCWR water temperature 54.7 °F), September (Mean Creek temperature 46.9 °F vs. NCWR water temperature 51.9 °F) and October (Mean Creek temperature 39.7 °F vs. NCWR water temperature 51 °F). Of these 5 months, the Proponent only proposes to transfer water from the NCWR to Sheep Creek via the wet well during the month of October. Planned discharges to Sheep Creek via the wet well during October are estimated to represent a 1 to 2 percent increase in stream flow as measured at SW-1. Therefore, effects on stream temperatures during October are expected to be less than the 1 degree change allowed for per ARM 17.30.623(2)(e). Direct discharges from the NCWR to Sheep Creek during May to September are not proposed. Seepage from the reservoir (estimated to range from 22 to 26 gpm during summer months) would migrate to Little Sheep Creek via subsurface (groundwater) flow and is expected to equilibrate with ground temperatures prior to entering surface water; therefore, this seepage is not expected to have a detectable influence on the creek's water temperature. Water transfers from the NCWR to Coon Creek and Black Butte Creek are expected to equilibrate with groundwater temperatures as a result of (1) flow through buried pipelines, and (2) equilibration with subsurface temperatures following discharge to UIGs (Zieg 2019). Per the discussion above, discharge of water from the NCWR into the environment would not cause an increase in the creeks' water temperature, and impacts on aquatic life are not anticipated. If stream flow were to be augmented via direct discharge from the NCWR, the temperature would be monitored, and discharges limited as necessary 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, Table 3.16-1**, and **Table 3.16-10**). 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).

Table 3.16-10
Summary of Annual Aquatic Monitoring

Survey Type	Sampling Activity	Season Performed			Monitoring Locations (see Figure 3.16-1 and Table 3.16-1)
		Spring	Summer	Fall	
Habitat Survey	Channel bed morphology and fish habitat survey		X		All aquatic sampling locations, except C.5, SH.1, and Smith River sites
Substrate Analysis	Substrate size distribution, surface fines, benthic sediment		X		Conducted at Sheep Creek impact sites and control site SH19.3
Fish	Population sampling		X		All aquatic sampling locations, except C.5, SH.1, and Smith River sites
	Tissue analysis - metals		X		Aquatic sampling locations SH22.7, SH18.3, SH17.5, SH15.5, and LS.1
	Redd counts	X		X	Conducted only on Sheep Creek, Little Sheep Creek, Moose Creek
Macroinvertebrates	Hess sample		X		All aquatic sampling locations, except C.5
	Reach-wide dipnet		X		All aquatic sampling locations
Periphyton	Chlorophyll-*a* and Peri-Mod1		X		All aquatic sampling locations, except C.5, SH.1, and Smith River sites
Water Quality	Air & H_2O temperature (°C) pH, TDS, conductivity	X	X	X	All aquatic sampling locations, except C.5, SH.1, and Smith River sites and only in summer

Source: Stagliano 2017c

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. Redd counts for fall-spawning brown and brook trout and spring-spawning rainbow trout would be completed for all Sheep and Little Sheep Creek reaches. 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 some of the trout from the Smith River 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(4), MCA). The definition of cumulative impact in ARM 17.4.603(7) adds the additional provision that related future actions must also be considered when these actions are under concurrent consideration by any state agency through pre-impact studies, separate impact statement evaluation, or permit processing procedures. 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, in conjunction with the proposed Project, could collectively 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. Impacts to a resource may be significant when the impacts of the proposed Project and related future projects are cumulatively considered. 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, Inc. (2016) 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, Inc. 2016, 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. Given the limited influence on groundwater levels when considering the model-predicted drawdown from the Project in conjunction with the five nearby groundwater supply wells, cumulative impacts would be minimal.

In addition, the Proponent would acquire water rights under lease agreements with landowners, as stated in the MOP Application and as applied for with DNRC (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 are within close proximity to the Project or Project activities, 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 activities of the proposed Project that could have potential impacts on a resource in combination with activities of the remediation site would be transporting and transferring shipping containers for the Project; these activities were evaluated for potential cumulative impacts in conjunction with remedial activities at the Livingston rail superfund site.

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 occur within the same timeframe as 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/ U.S. Route 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 occur at the same time as 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 cumulative impacts within the wildlife analysis area are not expected to occur when considered in conjunction with potential impacts from the Gordon Butte project. Cumulative impacts on wildlife species with large home ranges (e.g., grizzly bear, Canada lynx, wolverine, and 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. Route 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. Route 12 or U.S. Route 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 cumulative impacts within the wildlife analysis area are not expected to occur when considered in conjunction with potential impacts from the restoration project. Cumulative impacts on wildlife species with large home ranges (e.g., grizzly bear, Canada lynx, wolverine, and 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 cumulative air quality impacts when considered in combination with each other.

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, and 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 non-degradation 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 1.3 acres of advanced or pre-certified wetland credits or purchase 0.85 acre of certified wetland credits from the ILF program. If an ILF is not a viable option for mitigation, then the Proponent would be required to address compensatory mitigation requirements through a permittee-responsible mitigation to the satisfaction of the USACE.

4.3.4. Wildlife

Unavoidable adverse impacts related to the wildlife analysis would primarily include habitat removal. Terrestrial wildlife habitat would be removed as a result of constructing the Project 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, Inc. 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 impacts proposed to be imposed on the use of private property, including whether alternatives that reduce, minimize, or eliminate the regulation of private property rights have been analyzed (§ 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 designed to meet minimum environmental standards specifically required by state or federal laws or consented to by the Proponent are excluded from evaluation under the Implementing Guidelines for § 75-1-201(1)(b)(iv)(D), MCA.

The Proponent needs DEQ approval of its proposed operating and reclamation plans prior to exercising its private property right to conduct the mining proposed in its MOP Application. DEQ has identified the AMA as its Preferred Alternative. The AMA is designed to make the Project meet the minimum environmental standard. Any addition mitigation measures have either been proposed by or agreed to by the Proponent. Thus, selection of the AMA should not constitute a compensable taking of private property.

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. Prior to the final flooding in 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, and the rinsing process would be performed repeatedly for a particular segment of the mine. 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 non-degradation 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 further reduce the potential for groundwater mixing between upper and lower aquifers, and further 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).
- Groundwater Quality: Backfilling would further reduce the potential for groundwater mixing between upper and lower aquifers, and further reduce potential groundwater contamination from exposed underground mine surfaces at closure compared to the Proposed Action.

Table 5-1
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	Historic properties have been impacted by subsurface archaeological testing and Project-related, ground-disturbing activities. Additional mitigation would not occur under the No Action Alternative.	Historic properties have been impacted by subsurface archaeological testing and Project-related, ground-disturbing activities. 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 of chemicals dissolved in contact groundwater would be retarded by process of adsorption; groundwater discharging to Sheep Creek would not affect its water quality.	Backfilling would further reduce the potential for groundwater mixing between upper and lower aquifers, and further reduce potential groundwater contamination from exposed underground mine surfaces at closure compared to the 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. Pending approval by the DNRC, this 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. The contact groundwater from 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 process of adsorption; groundwater discharging to Sheep Creek would not affect its water quality.	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.

Resource Area / Impact [a]	No Action Alternative	Proposed Action	Agency Modified Alternative
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.
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.	Noise from construction and operations would not likely be audible at the Smith River. However, temporary blasting associated with mine construction could result in some audible noise at nearby recreational receptors in the Smith River area. If audible, it would be below DEQ's noise threshold for noise sensitive areas.	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. Negligible and temporary secondary impacts to small, isolated, non-jurisdictional wetlands due to hydrology changes. No secondary impacts expected due to fragmentation 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.

Resource Area / Impact [a]	No Action Alternative	Proposed Action	Agency Modified Alternative
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.
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.
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.
Water Quality	No change from current condition.	Process water discharged to surface waters via the UIG would be treated to avoid impacts to wildlife.	Same as Proposed Action.
Thermal Impacts	No change from current condition.	As part of mine operations, the Proponent anticipates discharging water seasonally from the WTP and/or TWSP via the UIG, which would discharge to a segment of Sheep Creek after mixing with an alluvial groundwater system. The discharge would be governed by an MPDES permit. Montana administrative rules applicable to B1 classified streams such as Sheep Creek restrict temperature changes to a 1 °F maximum increase above naturally occurring water temperatures, and a 2 °F decrease below naturally occurring water temperatures. Under these requirements, impacts to aquatic life are not anticipated.	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 quantity and quality would be similar under the AMA, yet the AMA would have potential benefits over the Proposed Action. 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. As such, backfilling would further reduce the potential for groundwater mixing between upper and lower aquifers, and further reduce potential groundwater contamination from exposed underground mine surfaces at closure compared to 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, with some potential benefits to groundwater (**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

7. LIST OF PREPARERS

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Ashenbrenner, Kylie	Public Affairs	Bachelor of Science
Boentje, John	GIS	M.S., Geographic Information Systems B.S. Geography
Carlson, Erik	Project Manager	M.S., Urban and Regional Planning B.S., Planning
Cox, Mike	Partner in Charge	B.S., Geological Engineering
De Baere, Bart	Geochemistry	M.Sc., Oceanography (Geochemistry) Ph.D., Oceanography (Geochemistry)
DiNicolantonio, Lisa	Project Controller	B.S., Environmental Science and Management
Elliott, Amy	Geochemistry and Water Resources	B.Sc., Ecology and Evolutionary Biology Ph.D., Aqueous Biogeochemistry
Enright, Troy	Noise	B.S., Environmental Science
Evans, Cameron	Surface Water Hydrologist	B.A.Sc., Civil Engineering
Farmer, Bob	Air Quality	Ph.D., Chemical Engineering M.S., Chemical Engineering B.S., Chemical Engineering
Fickes, Morriah	Aquatics and Fisheries Biologist	B.S., Biology M.S., Fisheries Science
Fisher, Michelle	Document Production Technical Editor	B.A., Technical Writing
Gale, Tyler	Groundwater Hydrologist	B.A.Sc., Geological Engineering M.A.Sc., Geological Engineering (Hydrogeology)
Gaspard, Nathan	Visual Resources	Bachelor of Landscape Architecture
Hall, Coby	Surface Water Hydrologist	B.Sc., Geoscience (Hydrology)
Hiatt, Kris	Document Production	B.A., English
Huff, Jenifer	Transportation	B.S., Urban and Regional Planning
Kulczycki, Ezra	Geochemist	Ph.D., Geology M.S., Geology and Geochemistry B.S., Environmental Geoscience
Lisson, Ryan	Project Manager Wildlife Biologist	B.S., Biological Sciences
Main, Doyon	Engineer	B.S., Civil Engineering
Marinelli, Fred	Groundwater Hydrologist	Ph.D., Civil Engineering M.S., Hydrology B.A., Geology
Martin, Cianne	Document Production	M.S., Environmental Science B.S., Environmental Science

Name	Role	Education
Martin, Clory	Socioeconomics	B.S., Economics
Naghibi, Ali	Surface Water Hydrologist	Ph.D., Civil Engineering (Hydrotechnical) M.Sc., Civil Engineering (Hydraulic Structures) B.Sc., Civil Engineering
Parke, Mary	Wastewater	Ph.D., Civil Engineering M.S., Civil Engineering B.Sc., Biology/Chemistry
Rutledge, Chris	Senior Reviewer	M.S., Rangeland Ecosystem Science B.A., Biology
Rzepecki, Piotr	Groundwater Hydrologist	Ph.D., Geology M.Sc., Geology and Geography
Shoutis, Levia	Alternatives	M.S. Ecology B.S. Biology
Smit, James	Aquatics and Fisheries Biologist	M.S. Aquatic Biology B.S. Biology
Smith, Emily	Document Production Technical Editor	B.A., Journalism
Sussman, Ben	Public Affairs, Transportation	M.S., City and Regional Planning B.S., Technology and Society
Thornton, Andrea	Soils, Land Use, Recreation	B.A., Environmental Geology and Environmental Studies
Thyse, DeAnn	Archaeologist	M.A., Anthropology B.A., Anthropology
Todorov, Melinda	Aquatics and Fisheries Biologist	M.Sc., Aquatic Ecology B.S., Biology
Trippel, Alan	Alternatives	M.S., Geology B.S., Geology
Turner, Garrett	Cumulative Impacts	M.S. Natural Resources Management B.S. Biology
Widdes, Jason	Graphics	Diploma, Graphic Design
Williams, Jeff	Wetlands, Vegetation	B.S., Biology
Wilson, Dave	Geotechnical Stability	M.S., Civil Engineering B.S., Geological Engineering
Wolff, Gareth	Water Quality	B.S., Geological Sciences
Sacrison Engineering		
Sacrison, Ralph	Process Engineer	M.S., Mining Engineering B.A., Geology

8. RESPONSE TO COMMENTS

8.1. DRAFT EIS COMMENT PERIOD

The 60-day comment period on the Draft EIS started March 11, 2019, and ended May 10, 2019. During that time, DEQ received comments at the public meetings, by regular mail, and by electronic mail. This chapter presents a compilation of all substantive comments received as described below. Substantive comments pertained to the analysis and contained information or suggestions to be carried forward into the Final EIS. 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.

8.2. COMMENT RESPONSES

Written responses to substantive comments with specific questions or concerns related to the content of the Draft EIS are shown below. Many comments resulted in modifications to the EIS as reflected in the Final EIS. Substantive comments were organized into broad themes to respond to multiple comments received on the topic. Additional comments beyond these themes (and responses to them) are captured in Section 8.2.2, Draft EIS Comment Response Matrix.

8.2.1. Consolidated Responses to Comments on the Draft EIS

The consolidated responses presented below were grouped by broad themes. See **Table 8.2-1** for a list of the consolidated response topics, and the sections below for the responses to them.

Table 8.2-1
Issue Codes for Consolidated Responses to Comments on the Draft EIS

Code	Issue
ALT-1	Concerns Regarding Alternatives Screening Process and Dismissal Rationale
ALT-2	Concerns Regarding Elevating the CTF Above the Water Table
ALT-3	Concerns Regarding Alternative CTF Locations
ALT-4	Concerns Regarding De-Pyritization of Tailings
AQ-1	Concerns Regarding Impacts on Aquatic Life in Sheep Creek
AQ-2	Concerns Regarding Characterization of Aquatic Life in Sheep Creek
AQ-3	Concerns Regarding Fish Tissue Analysis
AQ-4	Concerns Regarding Increases in Temperature to Sheep Creek
CUM-1	Concerns Regarding Cumulative Effects Due to Expansion of the Project
CUM-2	Concerns Regarding Analysis of Additional Projects in Cumulative Assessment
CUM-3	Concerns Regarding Cumulative Effects Beyond the Sheep Creek Watershed
FIN-1	Concerns Regarding Bonding and Protection for Taxpayers
MEPA-1	Concerns Regarding Public Comment Periods

Code	Issue
MEPA-2	Concerns Regarding Climate Change
MEPA-3	Concerns Regarding Changes to the Project
PD-1	Concerns Regarding Tailings Storage Facility Design Documents
PD-2	Concerns Regarding Examples of Proposed Technology
PD-3	Concerns Regarding Failure Scenarios and Catastrophic Events
PD-4	Concerns Regarding Liner and Pipeline Performance
PD-5	Concerns Regarding Cement Breakdown Due to Acid Formation
WAT-1	Concerns Regarding Hydrogeological Model and Underestimation of Groundwater Inflows
WAT-2	Concerns Regarding Impacts on Surface Water Resources in The Project Area
WAT-3	Concerns Regarding Fracturing Resulting from Blasting
WAT-4	Concerns Regarding Sheep Creek Dewatering
WAT-5	Concerns Regarding Potential Thermal Effects on Water Resources and Ecosystems

Consolidated Response ALT-1

Concerns Regarding Alternatives Screening Process and Dismissal Rationale

DEQ received comments from the public expressing confusion about the process of screening alternatives for the Project, including suggestions from the public scoping period.

There was a rigorous screening process to assess potential ideas and alternatives, per the following criteria: meeting Project purpose and need and technical feasibility. Section 2.3.2, Alternatives Considered but Dismissed from Detailed Analysis, of the Final EIS (which was Section 2.4 of the Draft EIS) discusses alternatives that were considered for the Project, but were dismissed from detailed analysis. Subsequent sections discuss the rationale for dismissing the 12 alternatives proposed during scoping, including whether or not they would have environmental benefits over the Proposed Action. Text regarding the screening process and potential environmental benefits was reviewed to confirm it was sufficiently clear to the reader. Additional text was added to Section 2.3, Alternatives to the No Action and Proposed Action Alternatives, of the Final EIS.

Consolidated Response ALT-2

Concerns Regarding Elevating the CTF Above the Water Table

DEQ received comments from the public asking why the CTF could not be built above the water table so there would be no interaction between potential seepage from the liner and water table.

Appendix B and Section 2.3.2.7, Elevate the CTF above the Water Table, of the EIS describe why elevating the CTF above the water table was dismissed. In summary, there would be no net 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. As designed, the CTF underdrain would lower the water table such that there would be no groundwater pressure against the CTF liner. Therefore, potential impacts on groundwater would not necessarily be reduced by raising the elevation of the CTF. 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 U.S. Highway 89. As such, the Draft EIS dismissed this as a potential alternative.

Consolidated Response ALT-3

Concerns Regarding Alternative CTF Locations

The public proposed using alternative locations for the CTF.

The “Tailings Management Alternative Evaluation” (Geomin Resources, Inc. 2016), which is included as Appendix Q of the MOP Application (Tintina 2017a), presented and analyzed four potential locations for the CTF. (1) The West Impoundment location would be a short valley to the west of the other Project facilities, and it would be in a different drainage basin than other facilities. Within that drainage, the location of Black Butte Creek would limit the extent of the West Impoundment footprint, so the facility would only provide a fraction of the tailings storage capacity necessary for the Project. This site would have limited expansion capacity, requiring additional extensive excavation. As such, it would not achieve the purpose and need of the Project and was dismissed by DEQ. (2) The Central Impoundment location would provide adequate storage capacity for the Project, and it would require a disturbance footprint of 97.7 acres, the relocation of a county road, a tailings discharge pipeline length of 0.93 mile, and approximately 6.56 acres of disturbance to wetlands. (3) The East Impoundment location would provide similar storage capacity as the Central Impoundment site, but it would require a larger disturbance footprint of 128.9 acres, a tailings discharge pipeline length of 1.43 miles, and approximately 11.05 acres of disturbance to wetlands. (4) The fourth potential CTF location would provide adequate storage capacity for the Project, but it would require a smaller disturbance footprint of 87.7 acres, a tailings discharge pipeline length of 0.87 mile, and approximately 0.71 acre of disturbance to wetlands.

Regarding an alternative CTF design with a less steep embankment slope, a review of DEQ’s deficiency questions clarifies that the intent of considering a less steep slope was not to improve embankment stability, but rather to better blend the feature with natural landforms in the area, which tend to have slopes less steep than 2.5:1. DEQ did not pursue this as an alternative because the larger embankment would require more excavation to provide construction material, would disturb more land than the Proposed Action, and would impact more wetlands. Embankment failure due to the proposed design was not an issue. The alternative was not considered further due to the greater impacts it would have to other resources.

Based on the analysis of these alternative designs, the Central and East Impoundments were considered to have greater environmental impacts. DEQ concluded that the fourth CTF location, which was selected for the Proposed Action, would result in the least environmental impacts, particularly to wetlands. Therefore, the alternative impoundment locations were dismissed and not carried forward for further detailed analysis.

Consolidated Response ALT-4

Concerns Regarding De-Pyritization of Tailings

DEQ received comments asserting that full sulfide separation (i.e., de-pyritization) of tailings would be environmentally beneficial.

Appendix C and Section 2.3.2.8, Separate Sulfide Prior to Tailings Disposal, of the EIS discuss the consideration of full sulfide separation (de-pyritization) of tailings prior to disposal. This concept was screened through the process defined in Consolidated Response ALT-1 and Section 2.3, Alternatives to the No Action and Proposed Action Alternatives, of the EIS, but was ultimately dismissed as an Alternative Considered but Dismissed from Detailed Analysis. There is no net environmental benefit to full sulfide mineral separation prior to tailings disposal when compared to the Proposed Action. The appendix and EIS indicate 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.

The tailings de-pyritization process would generate a larger volume of non-Potentially Acid Generating (nPAG) tailings and a smaller fraction of Potentially Acid Generating (PAG) concentrated sulfides, the latter corresponding to a potentially more hazardous pyritic sulfide-rich waste stream in comparison to either the remaining tailings or the Proposed Action. The suitability of placing a concentrated (95 percent) pyrite tailing stream underground as either unconsolidated tailings or cemented tailings was not specifically tested as the environmental risks and potential impacts produced by creating a separate pyrite concentrate stream were deemed too significant. De-pyritization also poses a number of technical challenges. For example, while it might be possible to store and dispose of separated sulfide concentrate waste underground in the backfilled tailings, it may not be possible to use them as cemented structural support backfill because of the almost 100 percent pyrite character of the material. It would also be possible to store this material aboveground in the CTF, but either storage option would result in potentially greater environmental impacts compared to the disposal of the cemented paste tailings underground and in the CTF. For example, production of the concentrated pyritic sulfide-rich waste stream would require the use of considerably more chemicals (e.g., acids, bases, and organic flotation chemicals). Handling of these materials also requires an additional new, different, and larger pyrite flotation circuit in the mill, a separate tailing pumping system, a separate PWP similar in size and volume to the proposed PWP, and potentially a new and separate storage facility (tailings impoundment) for handling and disposal of the excess pyrite concentrate that could not be stored underground.

Only about 45 percent of the total tailings could be physically placed underground as backfill. Pyrite concentrate may not be feasible to convert into a paste that would set up and provide adequate ground support in the underground backfill. Full pyrite separation and backfill of sulfide tailings underground may thus require mining a significant amount of un-mineralized rock in order to provide room for its storage underground, thereby generating additional amounts of waste rock (perhaps as much as 7.6 million tons) to be disposed of on the surface.

Whether the sulfide-rich waste would be stored in a surface impoundment, as underground backfill, or both, additional management strategies would have to be developed for long-term storage to mitigate oxidation (i.e., acid 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 Project 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. Due to all these factors, an alternative requiring full pyrite separation was considered but dismissed from detailed analysis.

Consolidated Response AQ-1

Concerns Regarding Impacts on Aquatic Life in Sheep Creek

Several commenters asserted that the proposed Project would impact Sheep Creek aquatic life, as well as trout spawning that occurs in the tributary, due to changes in water quality or water quantity.

<u>Sheep Creek and Smith River Baseline Water Quality and Water Quantity</u>

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 (i.e., total nitrogen and phosphorous) and temperature conditions more favorable for algae growth.

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, Surface Water Quality, of the EIS), 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.

As stated in Section 3.4.3.2, Proposed Action: Post-closure Groundwater Quality, the combined flow rate of potential chemical sources (i.e., contact groundwater) 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 contact groundater were to completely mix with Ynl A groundwater, and the Ynl A water does not have significant concentrations of the same solutes found in the contact groundwater, one would expect a 30:1 dilution of the solutes existing in the contact groundwater.

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. Therefore, the Project would not likely have any direct or secondary impacts on aquatic life in Sheep Creek or further downstream in the Smith River.

<u>Nuisance Algae</u>

Any elevation in nitrate in surface waters in the Project area may increase 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 part of the MPDES permitting process, DEQ determined that during maximum discharge to the UIG, the concentration of total nitrogen in the ditched portion of Coon Creek and in Sheep Creek could exceed the non-degradation criteria. However, because all water would be collected for treatment to meet groundwater and surface water non-degradation criteria, the water management plan was revised to preclude nutrient impact on downgradient water. To avoid seasonal nutrient exceedances, a TWSP would be in place to store WTP effluent during periods when total nitrogen exceeds effluent limits, which are 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 before being discharged according to the MPDES permit (Zieg et al. 2018). Total nitrogen would be monitored year-round whenever there is a discharge to the UIG, per requirements of the MPDES permit. DEQ does not anticipate temperature impacts on surface water from the Project to exceed the limitations provided in rule ARM 17.30.623 (2)(e) for a B-1 stream. Monitoring of surface water temperature would be required to ensure temperature criteria are not exceeded for the Project. In addition, the water temperature in the NCWR and TWSP would be monitored, if needed, and engineering controls would be used to help control the temperature of the water that leaves the facilities. This would prevent impacts on aquatic life in Sheep Creek and downstream. Based on the above, the Proposed Action is unlikely to contribute to accumulation of nuisance algae (see also Consolidated Response AQ-2, Aquatic Monitoring).

Trout Fishery

During operations, the temperature of water in the NCWR and TWSP would continuously change in response to changing ambient air temperatures, solar radiation, evaporation, water inflows and outflows. On July 25, 2019, the Proponent delivered a technical memorandum evaluating potential thermal effects resulting from the NCWR discharge (Zieg 2019d). In the tables attached to the July 25 memorandum, the Proponent calculated monthly average temperatures of (1) water in the creek (NCWR Inlet Temperature), (2) volumes of water added to, discharged from, and stored in the NCWR, by month, and (3) the temperature of water discharged from the NCWR, by month. Water from the NCWR would be discharged, as necessary to maintain stream flows within required ranges, to Coon Creek (via a UIG), to Black Butte Creek (via a UIG), and to Sheep Creek (via the Wet Well) (final designs, including volume and discharge locations, pending review and approval by the DNRC). Discharges to these UIGs are expected to result in equilibration of water temperatures with ambient ground temperatures prior to entering surface water; therefore, thermal impacts are not anticipated.

On August 1, 2019, the Proponent delivered a separate memo addressing potential thermal effects resulting from discharge from the TWSP (Zieg 2019b). Water discharged from the WTP would be similar to the temperature of groundwater; however, as this water would be stored in the TWSP during the months of July through September (unless treatment achieves seasonal non-degradation criteria for nutrients), its temperature would increase during storage. The TWSP water would then be discharged to the Sheep Creek UIG in subsequent months in combination with water derived directly from the WTP. From October to February, the average water temperature leaving the TWSP would be slightly warmer than the average temperature in Sheep Creek (SW-1) (Zieg 2019a). The Proponent would be bound by legal requirements to not change the temperature of surface water beyond the range allowed by water quality rules (ARM 17.30.623(2)), so the water temperature in the mixed effluent (TWSP plus WTP) would be monitored to ensure surface water temperature exceedances are not occurring. Also, the MPDES permit would require that the discharge could not alter the temperature of groundwater, as compared to an observation well upgradient of the UIG. If needed, engineering controls would be used to help control the temperature of water discharged to the Sheep Creek UIG (see Consolidated Response AQ-4 for descriptions of the engineering controls). This would prevent impacts on aquatic life and the trout fishery in Sheep Creek and downstream.

Consolidated Response AQ-2

Concerns Regarding Characterization of Aquatic Life in Sheep Creek

Several commenters asserted that the fish populations and other aquatic life in Sheep Creek and other local tributaries were not adequately characterized.

Baseline Data

Baseline sampling reaches were established in the Sheep Creek and Little Sheep Creek basins upstream and downstream of the Project area from 2014 to 2017 (see **Figure 3.16-1** of the EIS) (Stagliano 2018). The survey locations are arranged in consideration of a Before, After, Control (upstream and offsite reference), and Impact (BACI) (within and downstream) sampling design (see **Table 3.16-1** of the EIS) in relation to proposed mine activity. The BACI sampling design means that upstream control sites and an offsite reference location are sampled in addition to the impact sites that are within and downstream of the Project area. This allows 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. As part of the BACI sampling design, a biological monitoring plan (Stagliano 2017c) was submitted (see Aquatic Monitoring below).

Baseline aquatic sampling was completed for 5 years and is ongoing to identify the existing natural variability and to document the current influence of water quality and other anthropogenic effects on stream communities and habitat. 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. These surveys are summarized in Section 3.16.2, Affected Environment, of the EIS, as referenced from Stagliano (2015, 2017a, 2018). 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 2018). These baseline aquatic surveys (Stagliano 2015, 2017a, 2018) 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. The EIS uses some existing tables and figures from the baseline reports. In response to comments, these tables and figures were reviewed for legibility and edited, if possible.

In response to comments, the Final EIS was edited to clarify the existing fish population and redd data, and to include additional fish population and length data from the baseline studies in Section 3.16.2.3, Fish Communities. Brook trout redds were included in **Figure 3.16-6** of the EIS and were restricted to Little Sheep Creek sites LS.1 and LS.7 in 2016, 2017, and 2018, and in Moose Creek (MO.1) in 2018. The map was updated to include 2017 and 2018 data as well as the Moose Creek redd counts. No fish were captured at Coon Creek in 2014 or 2015, so this tributary was only sampled for macroinvertebrates in 2016 and 2017.

Macroinvertebrate sample characteristics and metrics, including number of taxa and macroinvertebrate density, are listed in **Table 3.16-5** of the EIS. This table was compiled from data in Stagliano (2015 and 2017b), which included fractions for Ephemeroptera, Plecoptera, and Trichoptera taxa. The methodology was clarified in the Final EIS. Additional data were added to Section 3.16.2.5, Macroinvertebrate Communities, of the Final EIS in response to comments.

The baseline studies only reported chlorophyll-a levels from Sheep Creek sites sampled by MDEQ in 2015 (DEQ 2017a). No chlorophyll-a samples were collected by the Proponent in 2017 because benthic algal levels had been low (less than 50 mg/m^2, one-third the nuisance level of 150 mg/m^2) at all transects of the stream reaches. Additional chlorophyll-a data were added to Section 3.16.2.5, Macroinvertebrate Communities, of the Final EIS and are available in the sources cited in the EIS.

Given that ongoing data collection is using the BACI sampling design and a biological monitoring plan is being implemented, the 5 years of baseline data included in the Final EIS are adequate. The sampling techniques over the 5 years of sampling have evolved with FWP consultation to become more robust and to meet the needs of the Final EIS.

Aquatic Monitoring

Monitoring is discussed in Section 3.16.3.2, Proposed Action, of the EIS. Adequate monitoring is necessary to verify whether the required mitigations are effective in reducing environmental impacts on acceptable levels. Aquatic monitoring is outlined in the “Final Aquatic Biological Monitoring Plan for the Black Butte Copper Project in Sheep Creek Basin in Meagher County, MT” (Stagliano 2017c). The objective of the biological monitoring plan is to confirm that aquatic beneficial uses and fisheries are being protected and that non-degradation requirements (narrative and numeric standards) are being met in the Sheep Creek drainage during mine construction and operations, and after closure.

Aquatic monitoring would occur annually at 15 established sites, including 5 stations on Sheep Creek and 1 each on Little Sheep and Coon creeks that are within or downstream of the Project disturbance boundary lines. Fall-spawning brown and brook trout and spring-spawning rainbow trout redd counts would be completed for all Sheep and Little Sheep Creek reaches. Population densities of each salmonid species and size groups captured during the study would be estimated per unit length of stream, where adequate sample sizes permit. Non-salmonid fish species collected would be reported as total numbers per electrofishing time, and catch-per-unit effort. Length–frequency data collected would be analyzed to determine salmonid cohort strength, catchable size numbers, and whether species are reproducing in or near the stream reaches. These data would be used to monitor changes. Qualitative benthic chlorophyll-a samples would be collected annually at each site sampled for periphyton. In addition, two sites on the Smith River, upstream and downstream of the Sheep Creek confluence, 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).

Under the MPDES permit, the Proponent would be required to meet surface water standards for any water discharge to Sheep Creek. Additionally, MPDES limits require compliance with non-degradation, which sets maximum allowable concentrations in the effluent at only a fraction of the standard. The MPDES/surface water standards are protective of human health and aquatic species. Compliance with surface water standards would prevent impacts on aquatic life and fisheries in Sheep Creek and its tributaries.

The WTP discharge point would be sampled for water quality, including temperature (see Consolidated Response AQ-4). If stream flow were to be augmented via direct discharge from the NCWR, the temperature would be monitored, and discharges limited as necessary, to prevent impacts on aquatic life. In addition, water temperature would be monitored during the spring, summer, and fall at all surface water and aquatic monitoring stations.

In response to comments, the Final EIS was updated to include additional information on aquatic monitoring in Section 3.16.3.2, Proposed Action: Required Monitoring.

Consolidated Response AQ-3

Concerns Regarding Fish Tissue Analysis

Several commenters are concerned about the health impacts of metals in fish.

<u>Metals in Fish</u>

Metals in fish are discussed in Section 3.16.2.3, Fish Communities, of the EIS. Prior to the baseline surveys, no standardized biological sampling or monitoring had been conducted within the assessment area of Sheep Creek (Stagliano 2018). These baseline aquatic surveys (Stagliano 2015, 2017a, 2018) were the primary sources used to determine the fish distribution in the assessment area as well as the current exposure to metals.

Currently, there are no state-wide fish consumption advisories for Montana. However, the FWP, DEQ, and Montana Department of Health and Human Services (FWP et al. 2014) have published sport fish consumption guidelines with specific guidelines for some waterbodies. No waterbodies in the Project vicinity or 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** of the EIS. 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.

Baseline fish tissue analysis of aluminum was not reported in the baseline studies; however, it has been included for the 2018 fish tissue analysis and would be included for all future fish tissue analyses. Elevated levels of aluminum can affect some species’ ability to regulate ions and can inhibit respiratory functions. During the baseline studies, dissolved aluminum concentrations 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. Sheep Creek is included in DEQ’s 303(d) list of impaired streams for dissolved aluminum. 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 would be used for an aluminum TMDL.

Water from the facilities would be collected and treated by the RO 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 non-degradation standards before discharge to the alluvial UIG (see Sections 3.4, Groundwater Hydrology, and 3.5, Surface Water Hydrology, of the EIS). The quality of the groundwater reporting to Sheep Creek would be the same as, if not better than, baseline conditions. However, groundwater from the underground workings would not be treated after final closure (i.e., once non-degradation criteria are met). 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. Based on the above, the Proposed Action is not expected to increase aluminum (or other metal) concentrations in Sheep Creek or the Smith River. The Proponent would be required to implement a biological monitoring plan to confirm that aquatic beneficial uses and fisheries are being protected and that non-degradation requirements (narrative and numeric standards) are being met in the Sheep Creek drainage during and after mine construction and operations (see AQ-2 and Section 3.16.3.2, Proposed Action, of the EIS).

Consolidated Response AQ-4

Concerns Regarding Increases in Temperature to Sheep Creek

Several commenters asserted that aquatic life would be impacted by increases in water temperature due to the Proposed Action. See also Consolidated Response WAT-5 and Water Temperature Thermal Analysis Methods and Results in Section 3.5.3.2, Surface Water Quality and Temperature.

As part of the Proposed Action, the Proponent would discharge water from the NCWR and TWSP to creeks via UIG systems and direct discharge via the wet well. The Proposed Action and AMA require the Proponent to conduct water temperature monitoring related to TWSP discharge. Thermal analyses conducted by the Proponent (Zieg 2019d, 2019b) and outlined in Section 3.5.3.2, Surface Water Quality and Temperature: Water Temperature Thermal Analysis Methods and Results, supports the determination of no significant temperature effects on streams.

During operations, water temperatures in the NCWR and TWSP would continuously change in response to changing ambient air temperatures, solar radiation, evaporation, and water inflows and outflows. Water temperatures in the NCWR and TWSP facilities were estimated using measured groundwater and Sheep Creek water temperature data (2011 to 2016) (Zieg 2019a). This additional data have been incorporated into the Final EIS, as appropriate. In Table 1 of that Memorandum, the Proponent provides calculated monthly average temperatures of (1) water in the creek, and (2) water that would leave the NCWR. Comparison of those two sets of numbers indicates that for most of the year, the temperature of the water leaving the NCWR would be lower than the temperature of the creek's water. As such, discharge of water from the NCWR into the environment would not cause an increase in the creek's water temperature. Such discharge might in fact decrease its temperature.

During the fall and early winter, the temperature of the water leaving the NCWR is projected to be slightly warmer than the creeks (the water may be used to augment flows in Coon Creek, Black Butte Creek, and Sheep Creek). The temperature of water discharged from the NCWR is projected to exceed ambient stream temperature (as measured at SW-1 in Sheep Creek [Zieg 2019d]) during the months of October through February. Hydrometrics, Inc. (2019b) projects that discharge to Sheep Creek from the NCWR during these months has the potential to raise instream temperature in Sheep Creek only during the month of October (by 0.5°F). Water is not proposed to be discharged to Black Butte Creek during these months. Therefore, the potential for thermal impacts from NCWR discharges during these months would be limited to Coon Creek, where discharge would occur via UIG to alluvium connected to Coon Creek. This reach of Coon Creek does not support a fishery. Furthermore, upper Coon Creek (which is monitored above the Sheep Creek Road at SW-3) is normally frozen during winter months, and the addition of slightly warmer augmentation water via UIG during these months is not expected to prevent the creek from freezing. Any localized increases in temperature are not anticipated to persist downstream where fish may be present. Thus, because increases in temperature of the creeks' water would have negative effects on the ecosystem mainly during summer months, it is concluded that no impacts to ecosystems due to thermal alterations are likely as a result of discharging the NCWR water (Zieg 2019a). The Proponent would be bound by legal requirements to not change the temperature of creeks within 2 degrees of the naturally occurring surface water temperature (see ARM 17.30.623(2) for details). The water temperature in the NCWR and TWSP would be monitored and, if needed, engineering controls would be used to control the temperatures of the water that leaves the facilities, including but not limited to (1) changing the depth the water is pulled from the NCWR/TWSP, (2) managing the combined flows from the TWSP and treated groundwater, and/or (3) installing heat exchange unit(s). This would prevent impacts on aquatic life and the trout fishery in Sheep Creek and downstream.

During operations, excess water pumped from the mine would be treated to non-degradation 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 non-degradation standards (see Sections 3.4, Groundwater Hydrology, and 3.5, Surface Water Hydrology, of the EIS). The WTP discharge point would be sampled for water quality, including temperature (see Section 3.16.3.2, Proposed Action: Thermal Impacts). In addition, temperature would be monitored during the spring, summer, and fall at all surface water and aquatic monitoring stations (see Section 3.16.3.2, Proposed Action: Required Monitoring). Further discussion regarding thermal impacts is provided under Potential Thermal Effects Resulting from Discharging WTP and TWSP Water via UIG of the Consolidated Response WAT-5.

Water stored in the NCWR would be allowed to seep from the reservoir floor to the downstream catchment, which is a natural drainage area as described in Section 3.4, Groundwater Hydrology, of the EIS, to offset a portion of the mine's consumptive use of groundwater. Seepage from the reservoir (estimated to range from 22 to 26 gpm during summer months) would migrate to Little Sheep Creek via subsurface (groundwater) flow and is expected to equilibrate with ground temperatures prior to entering surface water; therefore, this seepage is not expected to have a detectable influence on the creek's water temperature and impacts on aquatic life are not anticipated. Water transfers from the NCWR to Coon Creek and Black Butte Creek are expected to equilibrate with groundwater temperatures as a result of (1) flow through buried pipelines, and (2) equilibration with subsurface temperatures following discharge to UIGs. If stream flow were to be augmented via direct discharge from the NCWR, the temperature would be monitored and discharges limited as necessary to prevent impacts on aquatic life.

Consolidated Response CUM-1

Concerns Regarding Cumulative Effects Due to Expansion of the Project

Some commenters suggested that the EIS should evaluate the entire Project, including analysis of mining additional deposits (e.g., Lowry Deposit) or an expanded 50-year mining district and not segment these out from the analysis.

Section 75-1-201(1), MCA, requires DEQ to evaluate environmental impacts of the Proposed Action and alternatives to the Proposed Action. The Proponent has proposed mining the Johnny Lee Deposit. Thus, DEQ is limited to evaluating the environmental impacts related to the mining of that deposit. Section 75-1-220(1), MCA, defines "alternatives analysis" to preclude DEQ from evaluating alternatives to the proposed project itself. Thus, DEQ is not allowed to evaluate the impacts of the Proponent mining a deposit that is not included in its Proposed Action.

Moreover, § 75-1-208(11), MCA, requires an agency, when appropriate, to evaluate the cumulative impacts of a proposed project. However, related 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. As mining of any other deposits or properties beyond that set forth in the MOP Application is not currently being proposed to or evaluated by any agency, it cannot be analyzed in the environmental review. If the Proponent is issued a permit, they would have to submit an application to amend the MOP to conduct any expanded mining. DEQ's action on the MOP amendment would be subject to its own environmental review under MEPA. Any further exploration would require the Proponent to submit an application to amend its exploration license. DEQ would be required to conduct an environmental review under MEPA prior to taking action on the application to amend the exploration license.

Consolidated Response CUM-2

Concerns Regarding Analysis of Additional Projects in Cumulative Assessment

Some commenters suggested that the cumulative impact assessment (Chapter 4 of the EIS) should evaluate other additional proposed or potential projects and activities in combination with Project activities. These additional projects and activities include:

- Controlled burns associated with the Castle Mountains Restoration Project in the nearby Helena-Lewis and Clark National Forest;
- Natural wildfires during the summer months;
- Open pit mining of nearby copper deposits;
- Expanded refinery output in Great Falls as a result of rezoning the West Gate Mall to heavy industrial use;
- Increased pollution from the development of the Giant Springs Industrial Park development as a result of rezoning the area above and adjacent to the Giant Springs State Park; and
- Increased truck traffic in the Missouri River corridor as a result of the approval of these two industrial rezones.

Section 75-1-208(11), MCA, requires an agency, when appropriate, to evaluate the cumulative impacts of a proposed project. However, related 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. As natural wildfires during future summer months are not planned activities and are not under concurrent consideration by any state agency, they cannot be analyzed in the environmental review. Similarly, other potential projects, such as development projects, cannot be analyzed in the environmental review if they are not currently being proposed to or evaluated by any state agency.

Consolidated Response CUM-3

Concerns Regarding Cumulative Effects Beyond the Sheep Creek Watershed

Some commenters suggested that the Draft EIS fails to include potential cumulative impacts on waters beyond the Sheep Creek Watershed, namely the Smith and Missouri rivers, located downstream of the proposed Project.

The predictions and impact assessment as presented are considered appropriate and sufficient to support the EIS and associated mitigation and mine planning. As is standard practice, the EIS includes quantitative predictive surface water and groundwater modeling, not arbitrary or qualitative criteria, to support the impacts assessment, including the delineation of appropriate assessment boundaries (see Section 3.4.1, Analysis Methods, Section 3.4.2, Affected Environment, Section 3.5.1, Analysis Methods, and Section 3.5.2, Affected Environment, of the EIS). The analysis area described in Section 3.5, Surface Water Hydrology, of the EIS includes the geographic extent to which water resources (surface water quantity and quality), may be impacted by the Project. For surface water resources, the analysis focused on the Sheep Creek watershed and its tributaries. As detailed in the EIS and summarized below, the surface water resources geographic extent (where cumulative impacts from past, present, and future projects and actions could potentially impact the resource) appropriately focuses on the Sheep Creek Watershed; effects beyond this boundary, including cumulative, are not predicted by modeling efforts and in light of planned mitigation and management measures.

As discussed in Section 3.4, Groundwater Hydrology, and Section 3.5, Surface Water Hydrology, of the EIS, the combined impacts on water resources based on the Proposed Action are expected to be minor; surface disturbance is less than 1 percent of local watershed area and base flow depletion for all streams except Coon Creek would be minimal (i.e., less than 10 percent). The Project is proposed to be an underground mine and the only significant amounts of Project contact water would be excess water sent from the WTP to the UIG. The water released to the alluvial aquifer via the UIG during the mine construction and operation phases would be treated to assure compliance with groundwater standards and non-degradation criteria per the MPDES permit (Hydrometrics, Inc. 2018a; Tintina 2018a). As such, no impacts on the receiving water quality (Sheep Creek and Coon Creek) are anticipated since water from all facilities would be collected and treated to meet non-degradation criteria prior to discharge to the alluvial UIG (Hydrometrics, Inc. 2017b). The quality of the groundwater reporting to Sheep Creek and Coon Creek would be the same, if not better, than baseline conditions because the treated water discharged to the alluvial UIG would meet groundwater non-degradation criteria (Hydrometrics, Inc. 2016b). 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). At the downstream monitoring location on Sheep Creek (SW-1), simulated base flow depletion was estimated at 2 percent (well within natural variability; Section 3.5.3.1, Surface Water Quantity, of the EIS) and no impacts on water quality are predicted (Section 3.5.3.2, Surface Water Quality and Temperature, of the EIS).

There is no direct hydrogeologic connection between groundwater in the Project area to the Smith River or its alluvium. Further, the only chemical pathway from the site downstream of the Sheep Creek watershed is via Sheep Creek's surface water itself. Since the proposed Project would not cause Sheep Creek's surface water to exceed water quality standards, the mine would also not cause standards to be exceeded downstream, directly or cumulatively, including in the Smith River (see discussion presented in Section 3.5.3.2, Surface Water Quality and Temperature, of the EIS). Ongoing operational monitoring would be required to validate model predictions. Monitoring would continue on Sheep Creek downstream of the MOP Application Boundary and along Coon Creek, as described in Section 3.5, Surface Water Hydrology, of the EIS.

Consolidated Response FIN-1

Concerns Regarding Bonding and Protection for Taxpayers

Several commenters have suggested that the Proponent be required to post a bond to ensure financial responsibility for construction, operation, closure, and post-closure, and that the bond information be included in the environmental review (Final EIS).

Under § 82-4-338(1), MCA, an applicant for an operating permit is required to file with DEQ a reclamation bond payable to the state of Montana with surety satisfactory to DEQ in the sum determined by and conditioned upon the faithful performance of the requirements of the MMRA, rules adopted under the MMRA, and the operating permit. The applicant's reclamation bond must be submitted and approved by DEQ before DEQ issues the operating permit.

The amount of the reclamation bond may not be less than the estimated cost to the state to ensure compliance with the Montana Air Quality Act, the Montana Water Quality Act, the MMRA, the administrative rules adopted under the MMRA, and the operating permit. Estimated costs would include the potential cost of DEQ management, operation, and maintenance of the site upon temporary or permanent operator insolvency or abandonment, until full bond liquidation can be affected. DEQ may not release or decrease a reclamation bond until the public has been provided an opportunity for a hearing and the hearing has been held, if requested. DEQ shall conduct a bond review annually and is required to conduct a comprehensive bond review every 5 years to make sure the amount of the bond remains sufficient to perform the required reclamation and adjusting for increases in costs.

An operator is required to maintain the reclamation bond for the life of the mine. If the operating permit is transferred to a new operator, the new operator is required to submit and gain DEQ approval of the new operator's bond before the permit is transferred.

Consolidated Response MEPA-1

Concerns Regarding Public Comment Periods

DEQ received comments requesting additional time to review the Draft EIS document.

ARM 17.4.620(2) requires that the agency shall allow 30 days for the public comment period of an EIS, which may be extended an additional 30 days. The comment period for the Project Draft EIS was extended to the maximum 60 days to allow the public additional review time. There were multiple methods to provide comments, including verbally at the public meetings, in writing on comment forms from the meetings, or electronically via email. All types were considered equally, and multiple methods could be submitted. DEQ believes that the public was given sufficient time to make meaningful comment on the Draft EIS.

Consolidated Response MEPA-2

Concerns Regarding Climate Change

Several commenters have suggested that the EIS consider impacts on and from the Project due to climate change and changing weather conditions.

Under § 75-1-201(2), MCA, an environmental review conducted under MEPA may not include a review of actual or potential impacts beyond Montana's borders. Nor may it include actual or potential impacts that are regional, national, or global in nature. Because effects of climate change are regional, national, or global in nature, MEPA does not allow consideration of climate change as direct, secondary, or cumulative impacts.

Consolidated Response MEPA-3

Concerns Regarding Changes to the Project

DEQ received comments asserting that important Project changes were not included in time for the public to review.

Pursuant to § 82-4-337(2)(a), MCA, after issuance of a draft permit but prior to receiving a final permit, an applicant may propose modifications to its application. If the proposed modifications substantially change the proposed plan of operation or reclamation, DEQ has the authority to terminate the draft permit and restart the application review process.

DEQ reviewed the Proponent's proposed modifications to its application and determined that the proposed modifications were not substantial. For example, the original MOP Application proposed the use of three UIGs for the disposal of treated water. Two UIGs were proposed in the upland areas adjacent to the proposed facilities and one UIG was proposed in the Sheep Creek alluvium. The Proponent proposed use of the upland UIGs to dispose the designed maximum discharge rate of 575 gpm of treated water. The alluvial UIG was proposed as a backup to dispose of treated water. The Proponent subsequently proposed discharge of the 575 gpm of treated water only to the alluvial UIG.

DEQ determined that shifting function of the alluvial UIG from serving as a contingent water disposal location to serving as the location where all treated water would be discharged was not a substantial change requiring DEQ to restart the permitting process under § 82-4-337(2)(a), MCA. The modification did not change the basic nature of the Proponent's proposed method of disposing of treated mine water (i.e., to UIGs). Nor did it change the quality or quantity of the treated water to be discharged. Moreover, the impacts associated with discharging treated water to the alluvial UIG would have to be analyzed to the same extent, whether the alluvial UIG was being proposed as a contingency or as the only location for disposal of treated water. While the analysis obviously reflects the increased volume of treated water that is proposed to be disposed at the alluvial UIG, the increase is reflected in the analysis and does not affect the nature of the analysis. The overall concern regarding the proposed underground disposal of treated water (i.e., potential impacts on surface or underground water resources) remains the same.

The proposed modifications also did not change DEQ's completeness and compliance determination when the draft permit was issued. Documentation for DEQ's review of each change is cited below and explained further in Section 1.3, Project Location and History, of the EIS.

- DEQ letter dated January 30, 2018 (DEQ 2018a), "Update to Proposed Treated Water Disposition for the Black Butte Project," which includes UIGs to Sheep Creek alluvium;
- DEQ letter dated January 30, 2018 (DEQ 2018b), "Update to Proposed Rail Load Out Facilities for Shipment of Containerized Copper Concentrates;" and
- DEQ letter dated November 21, 2018 (DEQ 2018c), "Update to Mine Operating Permit Application for the Black Butte Copper Project, Proposed Holding Pond Facility for Treated Water, Revision to Annual Water Balance, and Addition of a Wet Well."

These DEQ reviews and determinations were added to the Final EIS Project/permit history.

Consolidated Response PD-1

Concerns Regarding Tailings Storage Facility Design Documents

DEQ received several comments about the Draft EIS not including information about the legally mandated (§ 82-4-376, MCA) report and findings of the independent review panel for tailings storage.

Under § 82-4-376, MCA, a permit applicant proposing to construct a new tailings storage facility must submit a design document to DEQ containing a certification by an engineer of record. The design document must demonstrate compliance with the design requirements set forth in § 82-4-376, MCA, for tailings impoundment safety and stability, including a dam breach analysis, a failure modes and effects analysis or other appropriate detailed risk assessment, and an observational method plan addressing residual risk. The impoundment design must also demonstrate that the seismic response of the tailings storage facility would not result in the uncontrolled release of impounded materials when subject to the ground motion associated with the 1-in-10,000-year event or the maximum credible earthquake, whichever is greater. Under § 82-4-377, MCA, an independent review panel consisting of three independent review engineers is required to review the design document. The panel is required to submit its review and recommended modifications to the permit applicant. The panel's determination is conclusive. The engineer of record is required to modify the design document to address the recommendations of the independent review panel.

The Project's CTF does not meet the definition of "Tailings Storage Facility" as described in § 82-4-303(34), MCA, because it would store less than 50 acre-feet of water within it. However, the Proponent conducted a safety and stability review of the proposed CTF under §§ 82-4-376 and 377, MCA. Knight Piésold Consulting prepared a Tailings Storage Facility Design review in September 2017, which served as the tailings storage facility design document, pursuant to § 82-4-376, MCA (Knight Piésold 2017a). An independent review panel of three scientists or engineers reviewed the design document, pursuant to § 82-4-376, MCA. The design document was modified to incorporate the recommendations of the independent review panel. Section 9 of the Tailings Storage Facility Design document concludes, "The likelihood of embankment failure and uncontrolled loss of tailings due to foundation and slope instability under static conditions is 'Very Low'." It continues, "An earthquake could potentially induce deformations and settlement of the embankment crest, which could theoretically lead to a potential loss of freeboard and overtopping. However, this has a very low probability of occurrence as the CTF is designed to withstand the 1 in 10,000 year earthquake event, and would have to be simultaneously flooded by a storm event at the time of failure. Because the CTF is designed to retain the Probable Maximum Precipitation event of 22 inches (which is estimated to be a 1-in-10,000-year event as well) in addition to water derived from melting of the 1-in-100-year snowpack (equivalent to 11.4 inches) without discharging (and still retaining some freeboard), the odds of the combination of these extreme earthquake and storm events occurring within 1 month of each other is extremely low.

Additionally, Knight Piésold Consulting prepared a Tailings Operations, Maintenance, and Surveillance Manual in July 2017, which is included as Appendix I of the Tailings Storage Facility Design document, pursuant to § 82-4-379, MCA. Appendix G of the Tailings Storage Facility Design document also contains a dam breach risk assessment. Chapter 2, Description of Alternatives, of the Final EIS includes information about these design standards and documents referenced here.

Consolidated Response PD-2

Concerns Regarding Examples of Proposed Technology

Some commenters asserted that the technology and/or facilities proposed for the Project are experimental and not proven elsewhere.

<u>Surface Paste Tailings</u>

Enviromin (2018) noted in a white paper on surface placement of cemented paste tailings that, "studies of surface placement of cemented-paste tailings began in the early 2000s." Alakangas et al. (2013) noted, "With the recent developments in understanding the flow and the depositional behavior of the paste coupled with the availability of more advanced thickening equipment, the technology is evolving from being an underground disposal method to a more viable surface disposal method (Newman et al. 2001). The growing number of the thickened/paste tailings storage facilities around the world and reports of relatively successful results are the supporting evidence for the reliability of paste as a surface disposal method."

Surface paste tailings have been used in other mines or applications, including the Bulyanhulu Gold Mine in Tanzania and the Sunrise Dam Gold Mine in Australia. Alakangas et al. (2013) also explained, "Furthermore, personal communications with Rens Verburg at Golder Associates regarding the surface disposal of paste at Neves Corvo (which has been underway for about a year now) reveal that very little oxidation in the tailings profile (this is monitored through periodic coring of the paste and taking paste pH measurements) has taken place. However, the overlying water is acidic due to some oxidation occurring on the paste surface. The pH is being adjusted by adding lime. This was expected and not a surprise since the dikes and berms are made of acid generating waste rock as well. The key observation is that the bulk of the paste mass was unoxidized. Once a final paste layer has been placed in each cell, a low-flux cover will be constructed, thereby generating clean runoff while maintaining a high degree of saturation and preventing seepage. Evaluation of disposal of thickened paste as backfill at Kidd Creek, Ontario shows that the drainage have been improved, but this has not been sufficient to prevent ARD formation (MEND 2006 and references therein). As long as tailings are covered with a fresh layer within 12-18 months then acid generation does not become a problem."

These case study examples suggest that surface placement of cemented paste tailings shows little oxidation within the massive tailings. Potential acid runoff is caused by surficial reactions; however, this acidic water would be contained and captured by the CTF sump, to be routed to the PWP for potential pre-treatment and re-use in the milling process (Appendix N of the MOP Application [Enviromin 2017a]). The CTF would be operated with little to no water in the facility, with the exception of periods directly following storm events. Storage of water in the CTF is not proposed.

Cemented Paste Tailings as Backfill

Enviromin (2018) noted that many laboratory studies and case studies exist to document the implementation of cemented paste tailings as backfill material. They stated that, "Cemented-paste tailings backfill technology was used as early as 1957 (Tariq and Yanful 2013) and revolutionized mining. Today, it is a common method for underground tailings placement: as of 2010, at least 100 facilities were reported to employ paste or cemented-paste backfill techniques (Yumlu 2010), and that number has undoubtedly risen. A range of materials can be placed as fill, including waste rock, paste tailings, and cemented-paste tailings, using a variety of binders." Other mines that have used cemented paste tailings as backfill include: BHP Cannington mine in Australia, Stratoni Operations (Madem Lakkos and Macres Petres) in Greece, Zinkgruvan mine in Sweden, Langlois mine in Quebec, and the Barrick Goldstrike mine in Nevada (Moran et al. 2013). Using cemented paste tailings as backfill improves the stability of the underground workings, which reduces the risk of subsidence and reduces the oxidative weathering of rock surfaces (Alakangas et al. 2013; Enviromin 2018).

Hydraulic Plugs

Additionally, hydraulic plugs have been used successfully in underground mining operations for many years (Lang 1999; Chekan 1985). Section 7.3.3.5 of the MOP Application states, "Although hydraulic walls and hydraulic plugs are relatively common in mining operations and closure applications they are designed based on site-specific observable geotechnical and hydraulic conditions, and their construction locations are carefully chosen based on rock quality, and fracture patterns and density. Hydraulic walls and plugs would be designed for long-term stability by mining, geotechnical and hydraulic engineers." Additionally, this section explains that "Hydraulic plugs commonly are surrounded by both formation grouting out into adjacent rock to minimize groundwater flow in fractures around the plug, and contact grouting of the cement / bedrock contact around the entire perimeter of the plug for a tight seal." When combined with cemented paste tailings as backfill and grouting, the plugs provide an effective barrier to oxygen and water transmission, which can reduce or prevent acid rock drainage concerns and restore the pre-existing groundwater profile.

Consolidated Response PD-3

Concerns Regarding Failure Scenarios and Catastrophic Events

DEQ received comments asserting that the Draft EIS should include failure scenarios against unforeseen events, and an analysis of various technology or facilities against different threats (e.g., wildfires, earthquakes, polar vortex, terrorism/vandalism, inactive caldera/volcanos, etc.).

See Consolidated Response PD-1 for additional information about the CTF design document and assessment of seismic risks. See Submittal ID BBC00931, Comment Number 10 for more information about claims regarding an inactive caldera/volcano.

Reasonably foreseeable and/or potential environmental consequences and effects due to the Project have been analyzed in the EIS. The failure analysis of Project facilities and processes is described in more detail in the “Failure Modes Effects Analysis” (Geomin Resources, Inc. 2015), which is included as Appendix R of the MOP Application (Tintina 2017a). Knight Piésold Consulting prepared a Tailings Operations, Maintenance, and Surveillance Manual in July 2017, which is included as Appendix I of the Tailings Storage Facility Design document (Knight Piésold Consulting 2017b).

In addition, Appendix G (Dam Breach Risk Assessment) of the Tailings Storage Facility Design document analyzes the risk of seismic activity on the CTF. Appendix G states, “Tailings deposited in the CTF will be mixed with binding agents (cement and/or fly-ash) prior to deposition, and once set will be a non-flowable mass. In the very unlikely event of a breach of the CTF embankment and tearing of the liner system the tailings may slump in place, but will not flow out to the downstream receiving environment” (Knight Piésold Consulting 2017b). Although the probability of failure is very low, the consequence of failure under normal operating conditions or an earthquake event is considered to be “Moderate,” which means there could be serious deformation, but no uncontrolled release of containment (Knight Piésold Consulting 2017b).

Section 9.1 of the Tailings Storage Facility Design document concludes, “The probability of failure for the various hazards (foundation and slope instability, overtopping, internal erosion and piping) is either not credible or ‘Very Low’. The CTF is designed for the storage of non-flowable cemented tailings, and is not a water retaining impoundment. Therefore, the resulting consequences of failure for the credible but ‘Very Low’ probability items are ‘Moderate’. This indicates an overall ‘Very Low’ risk related to a breach of the CTF” (Knight Piésold Consulting 2017b).

Chapter 2, Description of Alternatives, of the Final EIS includes additional information about the potential risks associated with the Project facilities or processes.

Consolidated Response PD-4

Concerns Regarding Liner and Pipeline Performance

Some commenters asserted that liners and pipelines would leak due to manufacturing defects or installation errors, and the resulting seepage or spills would cause water quality issues.

Liner Performance

Section 2.2.2, Construction (Mine Years 0–2), of the EIS states, “Both the PWP and CTF impoundments would be double-lined. Each of the two liner layers would be constructed of 0.1-inch 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.” Section 3.5.7.2 of the MOP Application (Tintina 2017a) describes that the estimated potential seepage from a fully saturated CTF to the geonet layer would be approximately 4.2 gallons per day; however, the CTF would be operated with little to no stored water in the facility, and so seepage rates are expected to be less. Seepage through the lower liner of the CTF would be limited by the upper liner at the rate of 4.2 gallons per day (assuming inundated conditions). Seepage through the lower liner would be collected in the CTF foundation drain system. The PWP double liner system was estimated to produce potential seepage rates of 6.9 to 22.7 gallons per day to the foundation drain system, which would be collected and pumped back to the PWP.

The life expectancy of HDPE geomembrane liners was evaluated and reported in MOP Application Section 3.5.6, Longevity of HDPE Geomembranes, and Appendix K-3, Life Expectancy of HDPE Geomembrane Lining Systems (Knight Piésold Consulting 2017a). The 2003 published article referenced in Appendix B of the EIS (Technical Memorandum 2) states that HDPE geomembranes used in landfills should last for about 400 years (Peggs 2003). The last paragraph in Section 3.5.6.4, Project Liner Systems and Estimated Longevity, of the MOP Application states, “Based on the design details of the Black Butte Copper CTF HDPE lining system as described above, the ambient temperature range documented at the Project site (Table 2-2), and the recommended CTF construction method defined above (i.e., materials placed on top of the CTF lining system) that implements typical QA/QC and conformance testing protocols as defined above, Knight Piésold (2016d) estimates the service life of the CTF lining system to be in the order of 400 years or more.” Section 2.2.2, Construction (Mine Years 0–2), of the Final EIS includes this liner lifespan estimate.

Pipeline Performance and Pump Selection

Section 3.6.11 of the MOP Application states, “All pipelines carrying potentially contaminated water (WRS and copper-enriched stockpile to CWP, CTF to PWP, PWP to WTP, CWP/Brine pond to WTP, and CTF Foundation Pond to WTP or PWP) will have secondary containment.” Further, Section 3.6.8.11 of the MOP Application states, “The [CTF] pipeline will be constructed with secondary containment to capture and contain tailings in the event of a main pipeline leak, (one alternative includes a double-walled pipeline between the mill site and the CTF and between the mill and the portal, another such as a lined trench with a cover may be more appropriate for the project. Secondary containment will not be required on the CTF crest as tailings will flow onto the liner and into the CTF in the event of a leak. The pipeline will have an internal HDPE liner to prevent corrosion." Section 2.2.6, Pipelines and Ditches, of the Final EIS includes these design details.

The Proponent would utilize either GEHO® or Putzmeister® hydraulic dual piston pumps, which are both positive displacement pumps that would be equipped with pulsation dampeners, for the transport of cemented paste tailings from the paste plant to the CTF (Zieg 2019c).

Appendix A (Technical Memorandum 1) of the EIS presents information related to the "pumpability" of the tailings: "The cement contents have been developed through extensive bench tests run on exploration samples (MOP, Section 3.3.2.5, pp. 166–168; Section 3.5.9, pp. 205–211)." Also, "pumpability of the cement paste is critical for the success of this method. A long set or flash time can be critical in maintaining pumpable flow. Low to moderate cement contents are a primary means to achieve pumpability and avoid system upsets. Rheology and strength testing has been conducted to support the selected cement contents."

Cemented tailings would be deposited from several deposition locations around the CTF such that a uniform, sloping tailings beach would form. Active tailings beach management by mine operators would ensure even tailings distribution. Deposition in winter months would be managed so that deposition is closer to the water reclaim point, allowing water removal prior to freezing. Winter tailings deposition would be rotated more frequently around the CTF perimeter to account for reduced tailings runout in cold temperatures. Per the DEQ's deficiency review, the following text was also noted in the responses dated May 8, 2017 (Tintina 2017c): "Cemented paste would likely not flow over snow but would either melt it as the front of the tailings lobe advances or be dammed up behind it as it solidifies. Subsequent deposits of flowing paste could however, override deposits of snow. In the event that the tailings do not melt the snow on contact, but rather overflow it and compact it into ice lenses it still will not affect the ability of the CTF to contain tailings and contact water. The tailings will be cemented to the degree that they are non-flowable, but they are not rock solid, and it is expected that trapped ice lenses will eventually melt and the water will be reclaimed via the seepage reclaim system. The tailings will settle to fill the void space over time and would be subsequently covered by the deposition of overlying layers of cemented paste. If substantial build-up of snow drifts adversely affects tailings deposition the tailings offtake can be repositioned as needed to optimize tailings placement."

Section 3.6.8.11 of the MOP Application also states, "The Project will be operating in freezing temperatures for a significant portion of each year. The pipeline will be insulated or heat traced to protect against freezing. Additionally, the pipeline will be flushed with about 5,000 gallons of water per pumping cycle (every 6–7 days) and drained when not in use so that no standing water or tailings are left in the pipeline to freeze or set up."

Consolidated Response PD-5

Concerns Regarding Cement Breakdown Due to Acid Formation

Several commenters asserted that cement within the tailings stored in the surface CTF and underground backfill would degrade or break down over time due to acid formation, which would cause water quality issues.

Underground Backfill

These comments assume there is a structural breakdown or degradation of the cemented backfill, creating sufficient surface area available for the continual oxidation of sulfide minerals to produce acidity. It also relies on the presence of sufficient concentrations of oxygen and water to support sulfide oxidation. With the near-complete backfilling of the stopes and secondary access tunnels that cross sulfide zones, there would be very little exposed area for reactions to occur. During backfill, it is estimated that "flat lying stopes would have an average fill ratio of 96% and angled stopes would have an average fill ratio of 95%" (Appendix K-6 of the MOP Application [Knight Piésold Consulting. 2017a]). If there are any voids, it is expected that they would be a small, tight volume (perhaps due to an air pocket) rather than a long sloping void along the length of the backfill. Voids could be observed and filled when mining a secondary stope next to a primary stope. This backfill strategy would reduce exposure of backfill surfaces and the opportunity for oxidation to occur.

The construction of bulkheads and the lateral confinement of the backfill in the stope would minimize void space to allow for the expansion, degradation, and exposure of the backfill. Following the flooding and saturation of the backfilled workings post-closure, the availability of oxygen and potential for oxygen diffusion would be low. This is very similar to the pre-mining background conditions for the underground sulfide zones (i.e., saturated, low permeability, low-oxygen), which occur within a carbonate-rich formation that has available neutralizing potential. This hydrogeologic setting does not currently result in contamination of Sheep Creek or Smith River.

Per DEQ's second deficiency review and Section 7.3.3.5 of the MOP Application (Tintina 2017c), "Prior to backfilling the stopes or access drifts, a shotcrete wall will be built at the stope/access drift entrance as a retaining wall against which to pump and confine backfill. This structurally strong wall will consist of a design of wire mesh screen, rock bolted in place, faced with burlap and multiple layers of shotcrete. The wall will remain in place indefinitely, and will eliminate direct exposure of the cemented paste backfill to the open mine workings operationally and to flooded workings in closure. These walls will also prevent direct in situ erosion and degradation of the cemented paste backfill by providing lateral support and a chemical isolation across the wall. Construction of these types of backfill walls is standard industry practice and will prevent the risk of exposure anticipated by this comment." Further, "Oxygen will be very low at closure, and there will be very limited transport of what little is available into these materials, regardless of the availability of cement to provide alkalinity. For these reasons, sulfide oxidation during closure will be insignificant."

Levens et al. (1996) provided, “Greater water retention by cemented backfill (as compared to uncemented sandfill) reduces the surface area exposed to oxidation, which in turn reduces the amount of acid produced. The acid is neutralized by the cement and minerals contained in the backfill. The grain-size distribution of tailings used for backfill affects the structural integrity of cemented backfill under attack by acidic water; breakdown of the backfill structure releases neutralizing materials faster. Backfilled stopes in rock with low hydraulic conductivities will constitute preferential flow paths after mine flooding; however, the rate of flow through backfill will be much slower than when the stope is partially saturated during mine operation. Considering all factors, acid generation and release of metal ions from cemented backfill should be less than in uncemented sandfill.”

Additionally, the Proponent is proposing to treat water from the underground workings for a period of time after mining has ceased. Section 7.3.3.6 of the MOP Application states, “Tintina has committed to treating water from the underground mine until water quality meets non-degradation criteria for groundwater with respect to pre-mining background chemistry. Specifically, Tintina plans to flood portions of the workings with an initial rinse of unbuffered reverse osmosis (RO) permeate while pumping to remove the solute-affected water for treatment. This continual loop of injection and withdrawal of unbuffered and then buffered RO permeate will initially rinse the lower (Ynl B) decline between the VVF (Upper VVF plug) and the lower USZ (Below USZ, Figure 7.4, Figure 7.5, and Table 7-2). A hydraulic plug will be placed below the USZ, to isolate it for rinsing. In subsequent rinses, the RO permeate will be buffered and ultimately the injection rate will be reduced relative to groundwater inflow so that groundwater replaces the injected water as rinsing is completed.” The final flooding and saturation step would allow ambient groundwater to saturate the backfilled workings, creating hydrogeologic and geochemical conditions that are similar to pre-mining conditions. As a result, this setting would also not be expected to result in contamination of Sheep Creek or Smith River.

Surface Cemented Tailings Facility

As commenters suggested, the raw/unamended tailings produced acid quickly during the aggressive weathering conditions of humidity cell tests (HCT). However, the purpose of the cement and binders is not to delay or prevent ARD formation. Section 2.4.3.1 of the MOP Application (Tintina 2017a) states, “The neutralization potential resulting from the addition of 2 percent to 4 percent cement is not sufficient to neutralize the sulfide in the tailings; this was not the intent of cement addition, however. Cement was added 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.” Elevated sulfide content in the tailings does not necessarily equate to extreme acid production. For the internal sulfides to oxidize and produce sulfate, the right physical and chemical conditions for oxidation are required; this is precluded if the material limits sufficient ingress of water and oxygen. Section 4.3.2 of Appendix N (Enviromin 2017a) of the MOP Application states, “Kempton et al. (2009) point out that physical processes (i.e., oxygen diffusion) are more important than chemical processes for determining intrinsic rate coefficients for sulfide oxidation, as suggested by the ‘shrinking core’ model (Davis et al. 1986).”

For example, it has been observed that oxidation of paste backfill materials often occurs at the edges and on the surface (Alakangas et al. 2013). Further, Alakangas et al. (2013) found that, “The addition of alkaline binders can reduce the mobility of released metals and metalloids due to precipitation of secondary minerals or adsorption to particle surfaces. Cemented paste backfill (CPB) usually consists of 3-7 percent binders and 75-85 percent tailings and the remainder is water.”

According to Appendix K-5 of the MOP Application (Knight Piésold Consulting 2017a), “Among other benefits of using slag, or fly ash, as partial cement replacement compared to Portland Cement is their improved resistance to sulfate attack.” Slag as an additive, “provides good engineering performance at reduced costs and has significant improved resistance to sulfate attack over cement.” Further, Section 3.3.1.5 of the MOP Application states, “Tintina may seek to optimize performance of the cement and binder additions over time operationally. Other binders and different ratios of binders may be used. Binder content is used to provide strength characteristics in underground applications and to provide a mass with non-flowable characteristics in the surface CTF. Chemical constituents of the materials used remain locked in the rock mass in underground stopes or within a HDPE lined facility and the seepage from both facilities is treated.”

Appendix Q (Geomin Resources, Inc. 2016) of the 2017 MOP Application, and Appendix A and Sections 2.3.2.6, Increase Cement Content in Tailings, and 3.6.3.2, Proposed Action, of the EIS show that the cement and binder contents proposed for both the surface CTF (0.5 to 2 percent) and the cemented tailings backfill (4 percent) of the underground mine are sufficient to achieve necessary strength and comply with water quality protection requirements. Increasing the cement and binder content in the paste tailings in either location would not provide additional environmental benefits, and if too much cement and binder were added, it would not be possible to pump the tailings through a pipeline. Section 3.6.3.2, Proposed Action, states, “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.”

The quantity of cement and binder proposed to be added to the paste tailings is not intended to delay or prevent ARD formation. Rather, it is meant to provide structural strength and to change the physical properties of the solidified tailings to a stable, non-flowable material with low hydraulic conductivity. Elevated sulfide content in the tailings does not necessarily equate to acid production. In order for the internal sulfides to oxidize and produce sulfate, the right physical and chemical conditions for oxidation are required. This is precluded if the material has low hydraulic conductivity and it sufficiently limits ingress of water and/or oxygen.

The tested quantities of cement and binder (2 percent and 4 percent) were determined to be sufficient to limit blowing dust (i.e., in the CTF) and reduce the formation of acidity on the tailings surface, although the test cylinders were unsupported and eventually disaggregated and further oxidized. In the underground mine, the cemented paste tailings backfill would solidify in approximately 1 month, but the potential for expansion, disaggregation, and exposure of the backfill would be limited due to placement methods. The cemented paste tailings backfill would be confined by a shotcrete bulkhead. The backfill would solidify in the stope within low conductivity bedrock, further reducing the potential for physical degradation and oxidation of the tailings surfaces and the resulting impacts on water quality.

Enviromin (2018) noted in a white paper on surface placement of cemented paste tailings that, "In 2008, Deschamps et al. conducted a series of 30-week layered column leaching tests using varying proportions of Portland cement as a binder in sulfidic paste tailings. Their study included micro-scale investigation of porosity and surface area, as well as some geochemical characteristics. Overall, they determined that addition of modest amounts of Portland cement was an effective way to stabilize sulfide minerals in a surface placement scenario." Enviromin (2018) further stated, "Following the 2008 column study, Deschamps et al. (2011) published initial results of a long term study of lab-scale surface-placed cemented-paste tailings, which were placed in strategic layers within layers of paste tailings using the test apparatus described in Benzaazou et al., 2004. The authors observed that the pH did not drop despite the development of preferential oxidation paths and persistent desiccation cracking."

The tailings surface in the CTF would be covered by successive layers of paste tailings within 7 to 30 days, before extensive oxidation and degradation could occur. Near closure, whether permanent or temporary, the upper lift of cemented paste tailings would contain additional cement and binder (4 percent) (Tintina 2017a). This would decrease the potential for dust, increase the surface strength, and create a more durable surface for equipment to perform reclamation activities. No tailings would be left exposed near the surface in closure. Sections 2.2.2, Construction (Mine Years 0–2), and 2.2.8, Reclamation and Closure (Mine Years 16–19), of the EIS describe that the CTF foundation would be double lined with HDPE liners, and the top would be capped with a HDPE geomembrane liner covered by a minimum of 5 feet of non-reactive fill material and soil, which would then be revegetated. Any seepage or contact water within the liner during the reclamation steps or following closure would be captured by the internal sump and pumped to the WTP. As with the underground backfill, when the CTF has been encapsulated, there is very limited potential for breakdown or disaggregation of the cemented tailings. The vegetated reclamation cover and upper liner placement would also restrict water and oxygen from entering the CTF, precluding sulfide oxidation on exposed surfaces and impacts on water quality.

Consolidated Response WAT-1

Concerns Regarding Hydrogeological Model and Underestimation of Groundwater Inflows

Several commenters have suggested that the EIS significantly underestimates mine dewatering rates and groundwater inflows into the mine during operations.

The mine hydrogeological model was developed by Hydrometrics based upon years of on-site research, including well drilling and aquifer testing, examination of drill cores from exploration drilling, and geologic mapping. See Section 3.4.1.4, Baseline Monitoring, Aquifer, and Permeability Tests, of the EIS, which discusses a series of aquifer tests that were conducted at the site. This includes both slug tests and short-term and long-term pumping tests to characterize the hydrogeological characteristics of the principal stratigraphic units and the fault systems that bound the ore bodies (Hydrometrics, Inc. 2017a). The number and scope of the completed tests represent a standard practice for this type of a project. The development of the numerical groundwater model was informed by the results of those tests and other data (e.g., groundwater levels, discharge to streams, estimates of recharge) and the model was calibrated to measured values of various parameters. The reliability of the model predictions was assessed considering data limitations and results of a model sensitivity analysis (Hydrometrics, Inc. 2016a). The predictions and analyses as presented are considered appropriate and sufficient to support the EIS and the proposed mitigation measures are sufficient for handling of water during operations and closure.

Several commenters reference the "Myers model" (Myers 2019) as providing a more realistic assessment of the mine dewatering rates—the rates that are much higher than calculated by the regional groundwater model developed by Hydrometrics (Hydrometrics, Inc. 2017a).

On July 18, 2019, Hydrometrics published a technical memorandum discussing a subject titled "Initial Review Comments on the Tom Myers Black Butte Modeling Report" (Hydrometrics, Inc. 2019a). This memorandum offers a conclusion that the model "is fatally flawed and does not provide an accurate or realistic assessment of mine dewatering rates, effects to groundwater, or effects to surface water from the Black Butte Project." The memorandum enumerates the following main flaws in the Myers model:

- The use of an inappropriate (for the problem at hand) modeling code—MODFLOW 2000;
- The use of substantially thicker model layers compared to the Hydrometrics model;
- The use of parameter zones with detailed parametric assignments in portions of the model domain where there has been no hydrogeology characterization work completed;
- Assigning unrealistically low hydraulic conductivities to shallow units in the mine area and unrealistically high hydraulic conductivities to units surrounding the mine workings, which is counter to direct measurements at the site;
- The Buttress fault is not shown in the Myers model and is a significant consideration in estimating the mine inflow rates;
- The Myers model uses very high recharge rates applied locally in alluvium and much lower rates applied to the granitic unit in the Moose Creek Drainage; water level and flow disparities in the calibration analysis suggest recharge rates may not be accurate in those areas;
- The Myers model is inadequately calibrated in the vicinity of surface water to accurately assess the interactions of groundwater and surface water;
- Reported inflows in mine simulations include exaggerated short-term effects that are an artifact of the time steps used in implementing the drain cells;

- The high estimated mine inflows appear to be directly related to the exaggerated hydraulic conductivity assigned to the upper Newland and granite basement rock that is configured in that model to be in direct connection with the lower ore body; the assigned values of hydraulic conductivity are inconsistent with extensive drilling and testing results; and,
- While the Myers model predicts the higher mine water inflow rates, UIG infiltration rates are not correspondingly increased, thus creating water mass balance inaccuracy—part of the water pumped from the mine is effectively removed from the model domain, implying that it would be permanently removed from the watershed.

The Myers model appears to assume that the bedrock surrounding the deepest portion of the proposed mine is much more permeable than indicated by available site-specific data used in the Hydrometrics model. Myers' assumption appears to be based on higher permeability conditions observed at well PW-6N, which was drilled through the Volcano Valley Fault and then through the Buttress Fault and into the Neihart Quartzite, a geologic unit that is not present in the area proposed for mining. Well PW-7, which was drilled through the Volcano Valley Fault and into the Lower Newland Formation, which hosts the Lower Copper Zone, documented very low permeability conditions in this geologic unit.

The Lower Copper Zone occurs south of the Buttress fault, whereas the Neihart Quartzite (and the bottom of well PW-6N) are located north of this fault. Well PW-6N yielded a substantial quantity of water because the Neihart Quartzite is highly fractured in this area; this discovery led the Proponent to revise their mine plan, which had previously involved the construction of access tunnels within the Neihart Quartzite on the north side of the Buttress Fault. The revised plan avoids this area and keeps all development work within the Lower Newland formation on the south side of this fault. Myers' assumption that bedrock in the area of the Lower Copper Zone may have higher permeability similar to that of the Neihart Quartzite is not substantiated by available data, and is one example of how this model's reliability is diminished by a lack of familiarity with the site-specific conditions.

Recognizing that there is always some degree of uncertainty involved with groundwater model predictions, the Proponent proposed contingency plans that would mitigate higher than anticipated mine inflows. One is to grout water-bearing fractures encountered during underground development to limit the amount of water flowing into tunnels. Through grouting, the Proponent should be able to maintain mine inflow rates within desired levels. Also, the Proponent's proposed RO water treatment system is composed of units that can be operated in parallel. Anticipated mine inflows could be managed/treated by operating two RO treatment units, each sized for 250 gpm. A third unit would be kept in reserve, either for when one of the other units needs to be taken offline for maintenance, or for use during short-term periods when larger quantities of water require treatment. If inflows remain higher than anticipated, additional treatment units could be added to the RO system. It is important to recognize that the progressive development of underground mine tunnels results in incremental increases in groundwater inflow rates rather than inflow suddenly reaching a maximum rate. Therefore, increased flows can be managed as they develop and measures (e.g., grouting of fractures) to limit those flows to desired rates can be implemented as necessary.

Consolidated Response WAT-2

Concerns Regarding Impacts on Surface Water Resources in the Project Area

Several commenters have expressed concerns that the Project would adversely impact surface water resources and downstream water users.

As is industry standard practice, the EIS includes quantitative surface water and groundwater modeling to generate predictions to support the assessment application and, further, as tools to inform mitigation and management strategies (see Sections 3.4.1, Analysis Methods, 3.4.2, Affected Environment, 3.5.1, Analysis Methods, and 3.5.2, Affected Environment, of the EIS). The Project is proposed to be an underground mine, and a primary planned mitigation measure is that the only significant amounts of contact water would be excess water sent from the WTP to the UIG. The water released to the alluvial aquifer via the UIG during the construction and operations phases would be treated by RO to assure compliance with groundwater standards and non-degradation criteria per the MPDES permit (Hydrometrics, Inc. 2018a; Tintina 2018a). RO is a highly efficient treatment process that targets dissolved metals and nutrients, including nitrate. RO with pretreatment would be used to treat mine dewatering flow during operations and closure. Further, surface water diversions for the Project would be limited to the irrigation period of the year when water is available and leased water rights permit water withdrawal (Section 3.5.1, Analysis Methods, of the EIS).

In light of planned mitigation measures, the combined impacts on water resources based on the Proposed Action are predicted to be minor; the complete effects assessment is presented in Section 3.4, Groundwater Hydrology, and Section 3.5, Surface Water Hydrology, of the EIS. Surface disturbance is less than 1 percent of the local watershed area, and simulated base flow depletion for all streams except Coon Creek would be minimal (i.e., less than 10 percent). 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). The quality of the groundwater reporting to Sheep Creek and Coon Creek would be the same, if not better, than baseline conditions as the treated water discharged to the alluvial UIG would meet groundwater non-degradation criteria (Hydrometrics, Inc. 2016b). As such, no impacts on the receiving water quality (Sheep Creek and Coon Creek) are anticipated.

Consolidated Response WAT-3

Concerns Regarding Fracturing Resulting from Blasting

Several comments have expressed concern regarding the creation of fractures as a result of blasting activity in the underground mine. The common underlying concern is the creation of flow pathways for water to seep from the underground mine (containing ammonia and nitrate dissolved from blasting materials and oxidation products) to surface water, and thus affect surface water quality.

The fracturing that propagates into the host rock resulting from blasting in underground mines has been a topic of academic study since at least the 1970s. There are several methods that have been used to estimate the extent of fracturing, with consideration of the explosive material properties, blast-hole diameter, and rock mass properties (a summary is included in Silva et al. 2019). The extent of the fractured zones reported in the literature for low compressive and tensile strength rock ranges as high as 15 meters (e.g., Sun 2013), with shorter fracture zones for higher compressive and tensile strengths. Conditions more commonly found in underground mines (e.g., higher lithostatic pressure and higher rock strength) have been observed to have maximum extents of blasting-associated fracturing of 0.3 to 1 meter (Enviromin 2017a). Therefore, the fractures reasonably expected to develop in the bedrock beyond the extent of the underground mine as a result of blasting would not be long enough to create flow pathways connecting the underground mine with surface water.

The water quality modeling study included simulation of the fracturing associated with blasting, as discussed in the MOP Application, Appendix N, Section 4.3.2 (Enviromin 2017a). The fracture density and reactive zone thicknesses used to calculate the reactive mass of mine wall surfaces was assigned using the literature documenting blasting-associated fracturing observed at existing underground mines (Enviromin 2017a). The base case model used an extent of blasting-associated fracturing of 1 meter, and sensitivity analysis simulations were conducted varying the fracturing extent up to 2 meters.

Moreover, water with concentrations of blasting residues and oxidation products exceeding standards in the underground mine is not expected to seep into the groundwater system. Dewatering during construction and operations would create a sink for groundwater. In other words, groundwater near the underground mine would be directed radially inwards towards the mine as a result of dewatering, reporting to the sumps in the mine, then pumped to the surface and treated prior to discharge. This groundwater sink has been demonstrated in both numerical hydrogeological models that have been developed for the Project (i.e., the model prepared by Hydrometrics, Inc. on behalf of the Proponent, and the model prepared by Tom Myers on behalf of third-party reviewers [Myers 2019a]). Following closure, the mine would be flooded and water in the underground mine would seep into the bedrock, while bedrock groundwater levels would also generally rise and rebound following the operational dewatering. However, the closure mine flooding plan includes iterative flushing (Technical Memorandum 8, Appendix H of the EIS) that is expected to reduce blasting residue and oxidation product concentrations to within non-degradation criteria.

Consolidated Response WAT-4

Concerns Regarding Sheep Creek Dewatering

Several comments have expressed concern that mine dewatering would result in reduced flow in Sheep Creek.

Hydrological and hydrogeological studies conducted for the Project included an examination of the reduction in flows in Sheep Creek resulting from mine dewatering. The effects are discussed in Section 3.5.3.1, Surface Water Quantity, of the EIS, and were determined to be insignificant because the reduction in base flow is small, below the non-degradation threshold, reversible, and largely offset by discharge of mine inflows into Sheep Creek via the UIG.

Reduction in base flow to creeks is expected where these creeks flow within the area that mine dewatering would cause drawdown of the groundwater table. The hydrogeological modeling (documented in Hydrometrics, Inc. 2016a and discussed in Section 3.4, Groundwater Hydrology, of the EIS) simulated mine dewatering and the resulting groundwater table drawdown, as well as the flow rates for groundwater discharging to surface water (defined as base flow) while mine dewatering is underway.

The hydrogeological modeling indicated that mine dewatering would result in reductions in base flow in Sheep Creek reaching a maximum of 0.45 cfs (202 gpm), contrasting with total base flow of 32.2 cfs (14,452 gpm), as calculated for the watershed above the pour point in the model domain. This maximum base flow reduction corresponds with 1.4 percent of total base flow, which is less than the non-degradation threshold, and reverts to pre-construction conditions when mining stops and the underground mine is flooded.

The base flow reduction in Sheep Creek (202 gpm) is less than the quantity of water that would be returned to Sheep Creek via discharge of treated water through the UIG (398 gpm annual average), compensating for the reductions resulting from mine dewatering.

During summer months (July to September), however, discharge through the UIG is not planned. Without the compensating effect on flows associated with UIG discharge, the flow rates downstream are still expected to be reduced by less than the non-degradation limit. Under the rare 7Q10 low flow conditions, Sheep Creek flow is calculated to be 5.67 cfs (2,545 gpm) and non-degradation rules limit a decrease in flow to less than 255 gpm (greater than predicted base flow losses associated with mine dewatering).

The predicted decrease in flow in Sheep Creek resulting from mine dewatering (202 gpm across the hydrogeological model domain, or 157 gpm above monitoring station SW-1) does not account for contributions to flow resulting from seepage through the NCWR (the NCWR is designed to leak, with seepage providing recharge to the groundwater system). Water from the NCWR could also be returned to Sheep Creek via the wet well during summer months to augment stream flow as required. The rate of water discharge to the UIG and subsequently to Sheep Creek is nearly equal to the base flow reduction in Sheep Creek resulting from mine dewatering, nearly completely offsetting the total streamflow loss.

Consolidated Response WAT-5

Concerns Regarding Potential Thermal Effects on Water Resources and Ecosystems

Several commenters asserted that the discharge of water to Sheep Creek and the decrease in Sheep Creek's base flow may increase the temperature of the water in Sheep Creek. The commenters assert that the increase in temperature may cause algae growth and have other adverse temperature-related impacts including adverse impacts on trout.

Potential Thermal Effects in Sheep Creek Resulting from Mine Dewatering

The simulated loss of Sheep Creek's base flow caused by mine dewatering amounts to approximately 2 percent (Hydrometrics, Inc. 2017a). Myers (2019) provides higher estimates for base flow loss, but his alternative groundwater model used to derive those estimates is not supported by the site data (see Consolidated Response WAT-1: Concerns Regarding Hydrogeological Model and Underestimation of Groundwater Inflows). Groundwater contributions from the Project area represent only a small contributing proportion of Sheep Creek flow most of the year, and any losses due to dewatering would be compensated by discharge of TWSP water through the UIG and augmentation of groundwater via NCWR seepage. Given that the proportion of the creek's flow being lost by dewatering and replaced by augmentation is small relative to total flow most of the year, it is as unlikely that these activities would cause a detectable increase in Sheep Creek's water temperature.

Potential Thermal Effects Resulting from Discharging TWSP Water via UIG

The rate at which the Project would discharge water to the alluvial aquifer represents a small percentage of Sheep Creek's total discharge. In addition, water discharged via the UIG would migrate through the alluvial aquifer for some distance before discharging to the creek. During that migration, the UIG injected water would equilibrate with ambient groundwater and be influenced by the temperature of the sediments, which generally retain or approach the mean annual surface air temperature year-round. As a result, the difference in temperature between the discharge water and groundwater would decrease.

Regardless, future monthly TWSP water temperatures were estimated by calculating the total heat transferred into the pond for July, August, and September using (1) an overall heat transfer coefficient, (2) the average area of the pond, (3) the average temperature of groundwater being pumped into the reservoir following treatment, and (4) the average site ambient air temperature. The heat transfer coefficient accounts for heat lost by long-wave radiation, convection, and evaporation less the heat gained by short-wave radiation (Williams 1963). The end of the month temperature difference was calculated by dividing the total heat energy in the reservoir. The estimated temperature was calculated by subtracting the temperature difference by the temperature of the incoming water. For all other months (October through June), the TWSP temperature was calculated using the previous month's calculated TWSP water temperature. Known factors, inputs, and assumptions are outlined in an August 1, 2019, technical memorandum (Zieg 2019b).

Results indicate that water temperatures in the TWSP would be lower than the projected maximum allowable temperature for water being discharged to the UIG for all months except October and November. The thermal analysis does not account for equilibration with ambient subsurface temperature during seepage through the alluvial sediments after discharge. Water discharged via the UIG would migrate through the alluvial aquifer for some distance before discharging to the creek. The discharge would be governed by an MPDES permit. The rate at which the Project would discharge water to the alluvial aquifer represents a small percentage of Sheep Creek's total discharge. Thermal analyses conducted by the Proponent (Zieg 2019b) and outlined below supports the determination of no significant temperature effects on streams.

The higher water temperatures introduced by discharge from the TWSP in October and November are expected to be rapidly attenuated. For example, temperature differences between

TWSP discharge and the projected maximum allowable temperature in the UIG is 1.5°F in October and 3.6°F in November (Zieg 2019b). Considering the analyses, it is unlikely there would be thermal impacts as a result of discharging the TWSP water.

Regardless of the conclusions presented above, the final MPDES permit has been amended in response to comments and would require that discharge to the UIG be no more than 1°F above or 2°F below the temperature monitored in an upgradient groundwater monitoring well. This effluent limitation would ensure that the discharge does not change the existing temperature of the groundwater more than allowed by the surface water quality standard. By the time the discharge reaches Sheep Creek, buffering by the groundwater temperatures would ensure that the change to temperature in surface water is nonsignificant. Additionally, the Proposed Action and AMA require the Proponent to monitor water temperature in the TWSP discharge and at the stream monitoring sites (MOP Application Section 6.3.1; Tintina 2017a). If water temperatures violate the Montana Water Quality Act, including non-degradation standards, the Proponent would be required to implement engineering controls sufficient to avoid any temperature-related adverse effects, including, but not limited to:

- Engineering Control 1: Changing the depth at which water is pulled from the TWSP

  The Proponent plans to pull deeper water from the TWSP. As a result, water leaving the TWSP would consist of deeper, colder water. As long as depletion of water in the TWSP is insignificant, discharge of TWSP water would not result in rising creek temperature.

- Engineering Control 2: Managing the combined flows from the TWSP and treated groundwater

  Mixing TWSP water with water from the WTP represents another engineering control. The WTP would receive water from the following main sources (Tintina 2018b Figure 3.44):

  - Mill catchment runoff (at a rate of 13.1 gpm);
  - Water from the foundation drain of the CTF (at a rate of 20 gpm); and
  - Water pumped from the mine (at a rate of 499.7 gpm).

  Most of the water received by the WTP would be groundwater pumped from the mine and delivered to the WTP via underground pipes. Temperature of that groundwater would be close to average annual air temperature, thereby regulating any seasonal temperature variation. Subsequently, water temperature leaving the WTP is not expected to be significantly higher than the water pumped from the mine. Mixing TWSP water with WTP water at the appropriate proportion may allow for controlling the temperature of the water discharged to the Sheep Creek UIG, such that instream temperatures are not altered. Prior to discharge, the blended water would be sampled/monitored as required in the MPDES permit.

- Engineering Control 3: Installing heat exchange units

  If engineering controls 1 and 2 are insufficient to prevent thermal impacts on Sheep Creek, heat exchange units could be installed. Heat exchange units move heat from one medium where it is readily available to another medium that can accept it. Here, routing TWSP water through a refrigeration circuit is proposed. During this process, energy is absorbed from the refrigerant (here: TWSP water), thereby lowering the water temperature as needed to comply with set average monthly and maximum daily temperature changes as outlined in the MPDES permit.

Discharge of NCWR Water

Future monthly NCWR water temperatures were estimated using Newton's Law of cooling and mass flow equations to calculate (1) the total heat transferred into the reservoir in May and June using an overall heat transfer coefficient, (2) the average area of the reservoir (average of previous and current months), (3) the average temperature of the creek water coming into the reservoir (at station SW-1), and (4) the average site ambient air temperature. The heat transfer coefficient accounts for heat lost by long-wave radiation, convection, and evaporation less the heat gained by short-wave radiation (Williams 1963). The NCWR temperature was estimated July through April using similar methods; however, since the discharge to the reservoir would be small (estimated at 106 gpm during July through September [Zieg 2019d]) compared to the total volume, discharge to the reservoir was not considered during these months. Known factors, inputs, and assumptions are outlined in a July 25, 2019, technical memorandum (Zieg 2019d).

Results indicate that water temperature in the NCWR would be greater than in Sheep Creek during the following 5 months:

- May (mean creek temperature 41.6°F vs. NCWR water temperature 41.8°F)
- June (mean creek temperature 49.6°F vs. NCWR water temperature 49.7°F)
- August (mean creek temperature 53.2°F vs. NCWR water temperature 54.7°F)
- September (mean creek temperature 46.9°F vs. NCWR water temperature 51.9°F)
- October (mean creek temperature 39.7°F vs. NCWR water temperature 51°F).

Of these 5 months during which NCWR water temperature exceeds Sheep Creek water temperature, the Proponent only proposes to transfer water from the NCWR to Sheep Creek via the wet well during the month of October (Zieg 2019d). Mixing analysis shows that the NCWR discharge to Sheep Creek would only increase the temperature in Sheep Creek during the month of October, and the increase would be about 0.5 °F (Hydrometrics, Inc. 2019b), which is less than the 1 degree change allowed according to ARM 17.30.623(2)(e).

Direct discharges are not proposed from the NCWR via the wet well to Sheep Creek during May to September. Seepage from the reservoir (estimated from 22 to 26 gpm during summer months) would migrate to Little Sheep Creek via subsurface (groundwater) flow and is expected to equilibrate with ground temperatures before entering surface water; therefore, this seepage is not expected to have a detectable influence on the creek's water temperature. Water transfers from the NCWR to Coon Creek and Black Butte Creek are expected to equilibrate with groundwater temperatures as a result of (1) flow through buried pipelines and (2) equilibration with subsurface temperatures following discharge to the UIGs.

Regardless of the conclusions presented above, the Proposed Action and AMA require the Proponent to monitor water temperature in the NCWR and in the water leaving the facility (MOP Sections 3.6.9.5 and 6.3.1, Tintina 2017a). In the unlikely scenario that water transfers from the NCWR would cause water temperatures that violate the Montana Water Quality Act, including non-degradation standards, the Proponent would be required to implement engineering controls such as changing the depth the water is pulled from the NCWR. Changing the depth from which NCWR water is pulled represents a highly effective engineering control allowing for access to deeper, colder water. As long as depletion of water in the NCWR is insignificant, discharge of NCWR water would not result in rising creek temperature.

8.2.2. Draft EIS Comment Response Matrix

Beyond the consolidated response themes, DEQ received comments on the Draft EIS as individual or “unique” comment submissions and as “form letter” submissions. The comments were submitted in letters, postcards, emails, and compact disks.

8.2.2.1. Individual (Unique) Comment Submittals

The Draft EIS Comment Response Matrix table below presents the substantive comments received on the Draft EIS and responses to them. **Table 8.2-2** lists the Submittal ID number, comment number, name of the commenter, organization or affiliation, the source of the comments, the substantive comments submitted, and the DEQ responses to those substantive comments. Where appropriate, responses in the matrix refer to a consolidated response or other comment.

Table 8.2-2
Unique Comments on the Draft EIS

Submittal ID	Comment Number	Name of Sender	Organization	Source	Comment	Response
Air Quality						
HC-003	81	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS also ignores key issues concerning the mine's potential air quality impacts. The Draft EIS asserts that there will be no significant fugitive dust emissions from the surface of the CTF because the tailings "material would be moist ... and would be stabilized with cement additions to provide a non-flowable mass." Draft EIS at 3.2-27. The Draft EIS, however, fails to substantiate its claim that additions to the surface of the tailings facility will adequately prevent the surface from drying under warm and dry weather conditions, and thus prevent the facility from generating fugitive dust. Cf.Exhibit 48 (Sanderson eta!., Windblown fugitive dust emissions from smelter slag, 13 Aeolian Research 19 (Mar. 22, 2014)) (evaluating particulate emissions from smelter slag); Exhibit 49 at 9-12 (Hecla Greens Creek Mining Company, 2017 Annual Report (Apr. 15, 2018)) (discussing fugitive dust emissions from a tailings impoundment at the Greens Creek Mine). The EIS should therefore provide adequate data and analysis to support the conclusion that the CTF will not produce significant quantities of toxic fugitive dust.	A more complete description of the tailings processing for the Project was provided in Section 3.2.4.2, Proposed Action: Operations Phase Surface Operation Emission Sources, in the EIS: "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." Given the inclusion of a binder in the treated tailings, there is no need to "prevent the surface from drying." The cured surface of the cemented tailings would not become subject to dust emissions due to drying out in warm weather. The cemented crust of the completed tailings surfaces would more closely resemble cured concrete, and would not contribute significant quantities of dust. Ongoing facility inspections required by the Site Fugitive Dust Control Plan within the air quality permit would further validate that the CTF is not a source of wind-blown dust.
HC-003	82	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS further discounts potential air quality impacts from blasting operations within the mine. Although the Draft EIS acknowledges that blasting would result in the release of noxious gases and particulates, it nevertheless asserts that these emissions "would not be a significant contributor to total annual emissions for [particulates] and other pollutants" because blasting "occurs infrequently and is confined to the underground mine areas." Draft EIS at 3.2-25. The Draft EIS, however, provides no data or analysis to support this summary conclusion. Indeed, it seems implausible that these emissions will be confined to the underground workings, because Tintina plans to use external exhaust raises to, among other things, "clear fumes from blasting." Draft EIS at 3.2-24.	The underground emissions due to blasting are tabulated in Table 3.2-6 as source ID UG, ANFO underground explosive. It is generally found that larger particulates generated by the blasts would settle out within the underground workings; that is not necessarily the case for fine particulates and gaseous emissions. The emissions due to blasting were included in the modeled results presented in the Draft EIS as part of the mine vent point sources. The amount of explosive used is limited on an annual basis as a condition of the air quality permit. The air quality permit also regulates the exhaust ports as point sources for purposes of opacity restrictions and also must be included in the Site Fugitive Dust Control Plan.
HC-003	83	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS also omits critical information about air quality impacts caused by the use of emergency generators at the project site. The Draft EIS indicates that the emergency generators will produce particulate matter, but it does not disclose the levels of expected particulate emissions: the table summarizing "Emergency Generator Impacts" only lists the expected level of nitrogen dioxide emissions. Draft EIS at 3.2-32. In addition to omitting key information about the emergency generators' air quality impacts, the Draft EIS fails to analyze the potential for air quality exceedances due to the combination of emergency generator emissions and emissions from normal project operations. The Draft EIS indicates that ordinary mine operations will result in pollution levels up to 80% of the 10 micron particulate matter standard and up to 81% of the nitrogen dioxide standard. Draft EIS at 3.2-31. In turn, emergency generator emissions, which the Draft EIS "evaluated separately," are expected to produce emissions up to 85% of the nitrogen dioxide standard, as well as an unquantified amount of particulate emissions, independent of normal mine emissions. Draft EIS at 3.2-	The emergency generators are only required for emergency purposes and as such, normal mine operations would not continue when the emergency generators are being used for real emergency situations. The generators would require periodic testing to ensure their reliability but this use is incidental and minor in nature. Emissions for the emergency generators and other emergency engines are completely tabulated in Table 3.2-6 of the EIS for each criteria pollutant. These units were modeled separately in the assessment of NAAQS conformance because their schedule is limited to 500 hours per year, rather than the 8,760 hours assumed for other Project sources. The full results of this modeling were added to the Final EIS, and revised tables provided for the emergency engine modeling. They show that, with the exception of $PM_{2.5}$ 24-hour average, the highest receptor results are below the SIL for Class II areas, which is a concentration that is a small fraction of the NAAQS. Since the $PM_{2.5}$ 24-hour average was above the SIL, maximum modeling results were directly compared to the NAAQS. That result was found to be 30 percent of the standard, at a

Submittal ID	Comment Number	Name of Sender	Organization	Source	Comment	Response
					31-3.2-32. Thus, it seems likely that operating the emergency generators will, when combined with emissions from normal mine operations, cause exceedances of both particulate and nitrogen dioxide ambient air quality standards. The Draft EIS, however, does not analyze or discuss this possibility. Draft EIS at 3.2-31-3.2-32.	location that would not overlap with the highest impacts from other Project sources. A replacement Table 3.2-10 was included to document this result.
HC-003	91	Josh Purtle	Earth Justice	Hard Copy Letter	Finally, the Draft EIS fails to discuss the ways in which climate change may impact DEQ's predictions about the mine's environmental impacts. According to the 2017 Montana Climate Assessment: Montana is projected to continue to warm in all geographic locations, seasons, and under all emission scenarios throughout the 21st century. By mid century, Montana temperatures are projected to increase by approximately 4.5-6.0°F (2.5-3.30C) depending on the emission scenario .... These state-level changes are larger than the average changes projected globally and nationally. Exhibit 50 at 9. As a result of temperature increases, precipitation across the state "is projected to increase in winter, spring, and fall; precipitation is projected to decrease in summer." Id. at 10. "The largest decreases are expected to occur during summer in the central and southern parts of the state," in the region where the Black Butte Mine would be developed. Id. These changes in temperature and precipitation patterns may affect Tintina's ability to ensure that the Black Butte Mine does not cause significant environmental impacts over the long term.	See Consolidated Response MEPA-2.
HC-003	93	Josh Purtle	Earth Justice	Hard Copy Letter	It is reasonable to expect that the effects of climate change will be felt throughout mine construction, operation, closure, and post-closure, including more frequent and severe storm events, earlier snowmelt, more frequent rain-on-snow events, and higher temperatures. Yet the Draft EIS fails to consider the effects of climate change when evaluating the Black Butte Mine and its impacts. The EIS should include an additional section discussing these and any other impacts associated with climate change that could affect the EIS's predictions about the mine's environmental impacts.	See Consolidated Response MEPA-2.
HC-003	86	Josh Purtle	Earth Justice	Hard Copy Letter	For example, the Draft EIS fails to fully analyze the potential for cumulative impacts to air quality. DEQ's air quality model for the mine indicates that particulate emissions from mine facilities are likely to reach 80% of the national ambient air quality standard for the project area. Draft EIS at 3.2-31. The Draft EIS does not analyze, however, whether other potential sources in the region, combined with these high emissions from the mine, could cause an air quality standard exceedance. In fact, the Draft EIS acknowledges that controlled burns associated with the Castle Mountains Restoration Project in the nearby Helena-Lewis and Clark National Forest will also produce particulate emissions, but summarily dismisses these impacts because they will occur 15 to 20 miles away from the project site and will be "temporary." Draft EIS at 4-9-4-10. The Draft EIS does not explain, however, why the distance from the project site and temporary duration of particulate emissions from controlled fires will avoid any risk of an air quality standard violation, including a temporary violation. Similarly, it is likely that natural wildfires during the summer months could, when combined with emissions from the mine, cause significant levels of particulate pollution in the region. The EIS should analyze whether these and other pollutant sources in the area could cause the mine emissions to contribute	See Consolidated Response CUM-2. The impacts of existing projects and activities in the region are assumed to be included in the monitored air pollutant background concentrations that were included in the air modeling to assess conformance with NAAQS and MAAQS. The modeled Project impacts were added to the monitored background as a measure of air quality characteristics after implementation of the Project. As a result, the cumulative effects of the existing projects plus the Project sources are reflected in the NAAQS analysis results. See Section 3.2.2.2, Assessment of Direct and Secondary Impacts, through Section 3.2.2.3, Atmospheric Deposition and Regional Haze, as well as Tables 3.2-8 and 3.2-9 of the EIS. Fires, including controlled burns, can have adverse impacts that can temporarily exceed NAAQS, usually for PM_{10}. The impact of the Project would increase the likelihood that the added emissions from a controlled burn, even at some distance from the Project site, could result in cumulative local and temporary exceedances. However, controlled burns or uncontrolled wildfire may cause these temporary exceedances, with or without the Project.

Submittal ID	Comment Number	Name of Sender	Organization	Source	Comment	Response
					to a temporary violation of national ambient air quality standards for particulate emissions.	
Alternatives						
HC-003	9	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS further fails to consider and disclose several feasible project alternatives. These include alternatives that Tintina itself considered in developing its project proposal, but dismissed for reasons that are not clear from documents currently in the public record. DEQ must independently consider these alternatives, determine whether any are feasible under MEPA, and disclose the alternatives' expected environmental impacts. Most importantly, DEQ must disclose whether any of these feasible alternatives would avoid environmental impacts expected from the mine as currently proposed.	See Consolidated Response ALT-1.
HC-003	19	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS also fails to provide a reasonable analysis of feasible project alternatives. Under DEQ's MEPA regulations, an EIS must include "an analysis of reasonable alternatives to the proposed action, including the alternative of no action and other reasonable alternatives that may or may not be within the jurisdiction of the agency to implement." ARM 17.4.617(5). An "alternative" is "an alternate approach or course of action that would appreciably accomplish the same objectives or results as the proposed action," and includes alternate "design parameters, mitigation, or controls other than those incorporated into a proposed action by an applicant or by an agency prior to preparation of an EA or draft EIS." ARM 17.4.603(2)(a). Such alternatives must be discussed if they are "achievable under current technology" and "economically feasible as determined solely by the economic viability for similar projects having similar conditions and physical locations and determined without regard to the economic strength of the specific project sponsor." MCA § 75-1-201 (1)(b)(iv)(C). The Draft EIS discusses in detail only three project alternatives: a no action alternative, in which the Black Butte Mine would not go forward; Tintina's project as currently proposed; and an "agency modified alternative," which would adopt Tintina's proposal but require slightly more backfilling of the mine workings with cemented tailings before closure. See Draft EIS at 2- I -2-16. The Draft EIS briefly discusses additional alternatives, but dismisses them without analyzing their potential environmental impacts. Draft EIS at 2-17-2-23. The Draft EIS's treatment of only three alternatives-and one of those the no-action alternative that an EIS must always discuss-fails to comply with MEPA's requirement that the EIS analyze all "reasonable" and "feasible" alternatives to the proposed action. ARM 17.4.617(5); MCA § 75-1-201 (I)(b)(iv)(C). There are several alternatives that the Draft EIS should have carried forward to its environmental analysis. These include alternatives that Tintina considered and dismissed in developing its project proposal, though it is not clear from the public record why Tintina dismissed some of these alternatives. DEQ must consider all of the potentially feasible alternatives discussed below, including those dismissed by Tintina, and either explain why they are not reasonable under the circumstances, or analyze and disclose the expected environmental impacts of the omitted alternatives. See ARM 17.4.617(5).	See Consolidated Response ALT-1.

Submittal ID	Comment Number	Name of Sender	Organization	Source	Comment	Response
HC-003	20	Josh Purtle	Earth Justice	Hard Copy Letter	First, the Draft EIS fails to meaningfully consider alternative methods for processing and disposing tailings waste produced by the mine. Analyzing such alternatives is critical, because, as discussed, the tailings waste produced by the mine will contain high levels of toxic metals and acid-generating sulfide minerals. Whether Tintina successfully contains these materials, or a portion of the materials is discharged to groundwater or surface water in the Sheep Creek and Smith River watersheds, will depend on the success of Tintina's selected tailings disposal method. One of these omitted disposal methods is the use of a pyrite separation circuit, which would allow Tintina to separate acid-generating pyrite waste from non-acid-generating waste before disposal, and thus limit the amount of acid-generating waste stored aboveground in the CTF. See Draft EIS app. Cat 4; Exhibit 14 at 1 (Letter from David M. Chambers, Ph.D., Ctr. for Sci. in Pub. Participation, to Craig Jones, DEQ (May 1, 2019)). As the Draft EIS concedes, pyrite waste has "a higher acid potential ... compared to depyritized tailings." Draft EIS app. Cat 2. A release of pyrite waste would therefore be more harmful than a release of depyritized tailings. Further, storing acidic pyrite waste in the CTF creates a risk, discussed further below, that acidic mine waste could dissolve cement in the tailings, thus compromising CTF stability over the long term. See Exhibit 14 at I. As a result, storing pyrite waste in the CTF greatly increases the risk of acid mine drainage in the Smith River basin in the event that the CTF containment dam fails or the CTF liners leak. However, Tintina could mitigate this threat by separating out pyrite waste using a pyrite separation circuit and storing all or most of the pyrite waste underground. The Draft EIS nevertheless dismissed this alternative primarily on the ground that "long-term storage and disposal" of sulfide concentrate "would be challenging." Draft EIS at 2-2I. However, DEQ did not consider whether it would be feasible to store sulfide concentrate in the backfilled tailings underground, or whether doing so would provide environmental benefits over storing sulfide waste indefinitely in the aboveground CTF. See Exhibit I4 at 3. Indeed, because the use of a pyrite circuit would reduce the proportion of acid-generating tailings "from 100% to approximately 5%" of the total amount of tailings, it appears that it would be feasible to dispose of all of the acid-generating waste as mine backfill. Exhibit I4 at 3. Given the conceded environmental benefits of separating out sulfide waste, see Draft EIS at 2-2I, DEQ should have evaluated this alternative in more detail.	See Consolidated Response ALT-4.
HC-003	21	Josh Purtle	Earth Justice	Hard Copy Letter	Tintina also dismissed using a dry stack tailings method to dispose the tailings waste. According to Tintina's analysis, this disposal method would avoid some of the potential stability issues associated with the CTF: indeed, a dry stack "waste facility would be sufficiently stable to eliminate the need for a retaining dam." MOP Application Rev. 3, app. Qat 4. Tintina raised some concerns about using this method in practice, see id., but it is not clear whether these operational concerns would be more serious than those associated with the proposed cemented tailings facility. In the end, it is not clear why Tintina rejected this alternative, or what role cost played in that decision. See id. at 6, 17 (citing "[h]igher capital costs" and "[h]igher operating costs" associated with dry stack method). DEQ should analyze and disclose whether the dry stack method could be a feasible alternative to the CTF, and whether dry stack	Appendix C (Technical Memorandum 3) of the EIS discusses dry stacking tailings, indicating that there can be air quality issues due to dust and that separate storage of process water and contaminated water would also be required. A detailed assessment of tailings management is discussed in Appendix Q (Geomin Resources, Inc. 2016) of the MOP Application (Tintina 2017a; summarized here). There are additional environmental and operational cons associated with dry stack tailings (e.g., the need to store the contaminated process water, potential drying issues, and potential air quality issues). According to Appendix Q, "A large working group composed of 18 scientists and engineers from Tintina Resources, Inc., SRK Consulting, Geomin Resources Inc., Enviromin Inc., Knight Piésold, Tetra Tech Inc., and International Metallurgical Inc., was formed in 2015 to identify feasible tailings storage methods for the

Submittal ID	Comment Number	Name of Sender	Organization	Source	Comment	Response
					disposal would avoid some of the risks associated with a dammed tailings facility.	Black Butte Copper operations and rank the alternatives in order to select the most appropriate method specific to the project" (Geomin Resources, Inc. 2016). Given that the tailings are expected to be very fine, it may not be possible to dry the tailings sufficiently to implement dry stacking (i.e., the alternative would not be technically feasible, given site-specific factors). In conditions where the tailings could be adequately dried, they would be transported by trucks to a disposal site, where the very fine particles that comprise the majority of the tailings would be subject to wind erosion and could therefore generate excessive fugitive dust. With cemented paste tailings, the added cement and increased moisture content would minimize blowing dust. Appendix K (Knight Piésold Consulting 2017a) of the MOP Application (Tintina 2017a) also states that dewatered tailings may become unstable when they are saturated, due to ice lenses in winter or localized liquefaction in wet seasons. From the standpoint of geochemical reactivity, the dry stack tailings would behave similarly to the "raw" (non-amended) tailings that underwent sub-aerial kinetic testing (see MOP Application, Appendix D [Enviromin 2017b]). The dry, non-amended tailings exhibited the highest rates of acid and metals release, and reacted more quickly than any other scenarios that were tested for tailings disposal (i.e., non-amended subaqueous, amended with 2 percent or 4 percent cement and binder). It would not be feasible to prevent the exposure of tailings to air and wetting cycles in a dry stack facility. Making the tailings susceptible to oxidation through a dry stack facility would not be an environmental benefit, and in order to properly manage the contact water interacting with the tailings, further water containment, handling, and likely more-rigorous water treatment would be necessary. There are other factors why dry stack tailings would not provide benefits or better environmental protections than cemented paste tailings. While it was noted that dry stack tailings could be sufficiently stable to eliminate the need for a retaining dam (assuming the tailings could in practice be dewatered sufficiently), the same could also be said of cemented paste tailings (once paste tailings cure, they form a solid mass that would not need to be contained behind a dam). Paste tailings would at a minimum require berms to restrict how far they flow before they cure). Appendix Q does note that dry stack tailings would also require containment berms. While neither dry stack tailings nor paste tailings may require retaining dams for geotechnical reasons, both methods would likely require construction of dams for the purpose of water quality protection. In either case, the tailings storage facility would be exposed to rainfall, which would result in water infiltration, seepage, runoff, erosion, and transport of sediment (tailings) away from the storage site due to storm water runoff. To contain seepage and storm water that may impact water quality, either type of facility would have to be lined and would need lined embankments (i.e., dams) to retain storm water runoff prior to treatment.
HC-003	22	Josh Purtle	Earth Justice	Hard Copy Letter	First, the Draft EIS does not adequately address the alternative of using a higher cement content in the CTF tailings. Tintina plans to use only 2% cement in the tailings it will store in the CTF. Tintina's own tests indicate, however, that such tailings quickly degrade under weathering conditions, which may pose problems for the stability of the tailings and the CTF as a whole. See, e.g., MOP Application Rev. 3, app. Nat 44-45. Tailings containing 4% cement, by	Appendix A and Sections 2.3.2.6, Increase Cement Content in Tailings, and 3.6.3.2, Proposed Action, of the EIS indicate that increasing the cement content of the tailings in the CTF beyond the 2 percent proposed level would not offer any additional environmental benefits and that the proposed 2 percent cement mixture would be sufficient to achieve necessary strength and water quality protection. Section 3.6.3.2, Proposed Action, states, "To date, the testing regimen

Submittal ID	Comment Number	Name of Sender	Organization	Source	Comment	Response
					contrast, would be much more stable. See id. In particular, 4% tailings will be more resistant to attack by acids in the mine waste than 2% tailings. Exhibit 15 at 3-5 (Letter from Kendra Zamzow, Ph.D., Ctr. for Sci. in Pub. Participation, to Craig Jones, DEQ (May 9, 20 19)); Exhibit 16 at 13 (Aldhafeeri & Fall, Sulphate induced changes in the reactivity of cemented tailings backfill, 166 lnt'l J. of Min. Processing 13 (Sept. 10, 2017)) ("Regardless of the initial sulphate content, increasing the cement content and/or replacing cement with mineral admixtures leads to the reduction in the reactivity of the paste."). DEQ itself raised this issue in its comments on Tintina's mine operating permit application, writing: "Cemented paste tailings research indicates that changing the type of binder... and the binder content ... can have significant effects on the cemented paste's short-term strength and setting time, long-term strength, and resistance to internal expansion and fracturing." DEQ, First Deficiency Review, Pending Operating Permit 00 I 88 at 14 (Mar. 2016) ("First Deficiency Review"). DEQ, however, did not carry this concern forward to its analysis in the Draft EIS. Tintina's consultant dismissed this alternative as well, stating without supporting citation that "[t]o date, the testing regimen supports the selected cement content levels ... and does not indicate a need for or benefit from increased cement contents." Draft EIS app. A at 6; see also Draft EIS at 3.6-17. However, this statement ignores the evidence cited above that 2% tailings will be much less stable than 4% tailings. Indeed, the Draft EIS's asse1tion that the use of 4% cement "would not provide additional environmental benefits," Draft EIS at 2-20, appears to rest on DEQ's unsubstantiated assumption that the risk of CTF failure is essentially zero. See Part VILA, below. Tintina's permit application further suggests that Tintina may have dismissed using a higher percentage of cement in the tailings because of the greater cost, but the available documents are not clear on this point. See MOP Application Rev. 3, app. Q at 17 (noting that "[o]perating costs" of using 2% tailings are "lower" than for 4% tailings). Given the conceded benefits of using 4% tailings, DEQ should consider this alternative in more detail, including by disclosing the environmental benefits of adopting this alternative. Otherwise, DEQ should provide a rational explanation, supported by scientific evidence, why this more environmentally-protective alternative is not "feasible" for MEPA purposes. See Mont. Wildlife Fed' n, ~ 43 ("The agency must examine the relevant data and articulate a satisfactory explanation for its action, including a rational connection between the facts found and the choice made.") (quoting Clark Fork Coal.,~ 47).	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." This issue is further addressed in Appendix Q, Tailings Management Alternatives Evaluation, of the MOP Application, page 5, Sections 2.3.5 and 2.3.6. A reference to Appendix Q (Geomin Resources, Inc. 2016) of the MOP Application (Tintina 2017a) was added to Section 2.3.2.6, Increase Cement Content in Tailings, of the EIS. Both quantities of cement were determined to be sufficient to limit blowing dust and reduce the formation of acidity on the tailings surface for short periods of time, until the CTF surface is covered by the next layer of tailings. The small quantity of cement proposed to be added to the paste tailings is not intended to delay or prevent ARD formation; rather, it is to provide structural strength and to change the physical properties of the tailings to a stable, non-flowable material with low hydraulic conductivities. Elevated sulfide content in the tailings does not necessarily equate to extreme acid production. In order for the internal sulfides to oxidize and produce sulfate, the right physical and chemical conditions for oxidation are required; this is precluded if the material limits sufficient ingress of water and oxygen. These sections also note that either cement addition rate would result in a tailings deposit sufficiently stable to maintain structural integrity in the event of an embankment failure (i.e., the tailings deposit would remain in place even if the dam did not). Paste tailings do not present the risk of catastrophic failure that is associated with conventional saturated tailings impoundments. Appendix N (Enviromin 2017a) of the MOP Application, pages 44-45, referenced in this comment, does not indicate that degradation of tailings poses a stability risk for the CTF. This reference also notes that the method of testing that was employed (i.e., laterally unconfined cylinders) promotes rapid disaggregation of the cemented paste tailings, and this is not directly comparable to the way that this material would be placed in successive thin lifts and contained within the CTF. The additional compressive strength provided by higher cement and binder content would not be necessary for the material placed in the CTF, like it would be for the backfill placed underground. The CTF surfaces would be regularly covered by new layers of paste tailings, creating a low conductivity cover over the underlying layers, and maintaining low oxygen ingress within the cemented mass. Any contact water interacting with the tailings would be contained within the CTF and continuously removed for treatment, maintaining little to no water in the CTF. Near closure (whether permanent or temporary), the upper lift of cemented paste tailings would contain additional binder (4 percent) (Tintina 2017a). This would decrease the potential for dust, increase the surface strength, and create a durable surface for equipment to perform reclamation activities. No tailings would be left exposed near the surface in closure. Sections 2.2.2, Construction (Mine Years 0–2), and 2.2.8, Reclamation and Closure (Mine Years 16–19), of the EIS describe that the CTF foundation would be double-lined with HDPE liners, and the top would be capped with a HDPE geomembrane liner covered by a minimum of 5 feet of non-reactive fill material and soil, which would then be revegetated. Any seepage or contact water within the liner (during the reclamation steps or

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						following closure) would be captured by the internal sump and pumped to the WTP. As with the underground backfill, when the CTF has been encapsulated, there is very limited potential for breakdown or disaggregation of the cemented tailings. The vegetated reclamation cover and upper liner placement would also restrict water and oxygen from entering the CTF, precluding sulfide oxidation on exposed surfaces. See Consolidated Responses PD-2 and PD-5 for more information about the cement content and acid formation. Also, see Submittal ID BBC00830, Comment Number 3, for more information about sulfate attack on cemented tailings. Consolidated Responses PD-1 and PD-3 address comments about stability of the CTF and failure scenarios.
HC-003	23	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS also improperly dismisses the alternative of building the CTF above the water table. As currently designed, the CTF would sit within the water table, such that groundwater from the surrounding geology would flow against the liner on the bottom of the CTF. See Draft EIS at 2-20. This groundwater pressure threatens CTF stability and increases the risk that groundwater will enter the CTF through defects in the bottom CTF liner. Exhibit 14 at 4; Exhibit 15 at 16. Tintina's consultant dismissed placing the CTF above the water table because raising the CTF ten or more vertical feet would require more fill and create possible stability issues. See Draft EIS app. B at 3; see also Draft EIS at 2-20 (positing that "elevated CTF would have a larger footprint" and greater visual impacts). However, elevating the CTF at its currently planned location is not the only way to build it above the water table; Tintina could also move the CTF further up the hillside, or place it in a different location entirely. Exhibit 14 at 4. Indeed, Tintina's own analysis of the depth to groundwater in the project area suggests that it "may be possible to move the [CTF] upgradient until the bottom is above the water table. Id. at 4 (discussing Draft EIS app. B at 1 and MOP Application Rev. 3 at 249). DEQ should analyze and disclose whether it would be feasible to build the CTF above the water table by placing it at a different location. Alternative CTF locations may provide other environmental benefits as well. For example, the west impoundment site described in an appendix to Tintina's mine operating permit application may cause fewer environmental impacts, particularly to wetlands, than the proposed CTF site. See MOP Application Rev. 3, app. Q at 10. The Draft EIS inexplicably contradicts these conclusions in Tintina's own permit application, asserting that the alternative west impoundment location would actually cause greater impacts to wetlands and drainages, and on that basis declines to consider further the west impoundment site and other alternative CTF locations. Draft EIS at 2-17. Given this error, and the apparent environmental benefits of alternative tailings sites, the EIS should revisit its analysis of these sites and disclose whether any of them would provide a feasible alternative to Tintina's proposed CTF site. The Draft EIS further fails to consider an alternative that would decrease the slope of the CTF at closure, thus increasing long-term CTF stability. DEQ proposed this alternative specifically, a CTF slope at a 2.5:1 grade rather than the 3:1 grade Tintina proposed in its application-in its review of Tintina's mine	The commenter references Appendix B of the EIS when stating that the Proponent's consultant dismissed the option of elevating the CTF above the water table. Note that all Technical Memoranda attached as appendices to the EIS were prepared independently by DEQ's consultant and not by the Proponent's consultants. See Consolidated Responses ALT-2 and ALT-3. Lastly, the commenter references DEQ's second deficiency review of the MOP Application with regard to the potential development of an alternative CTF design with a less steep embankment slope. Review of DEQ's deficiency questions clarifies that the intent of considering a less steep slope was not to improve embankment stability but rather to better blend the feature with natural landforms in the area, which tend to have slopes less steep than 2.5:1. DEQ did not pursue this as an alternative because the larger embankment would require more excavation to provide construction material, would disturb more land than the Proposed Action, and would impact more wetlands. Embankment failure due to the proposed design was not an issue. The alternative was not considered further due to the greater impacts it would have to other resources.

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					operating permit application, DEQ, Second Deficiency Review, Pending Operating Permit 00188 at 33 (Dec. 15, 20 16) ("Second Deficiency Review"), but, without explanation, did not carry this recommendation forward to the Draft EIS. DEQ should explain whether reducing the CTF slope at closure would reduce the risk of CTF failure, and whether such a reduced slope would be "feasible" under the circumstances.	
HC-003	24	Josh Purtle	Earth Justice	Hard Copy Letter	In addition to the tailings waste disposal alternatives discussed above, the EIS further should consider requiring Tintina to grout the mine's access declines and tunnels during mine construction. The Draft EIS acknowledges that such grouting "could provide long-term benefits in reducing hydrologic impacts to the groundwater system" by decreasing "the magnitude and extent of groundwater drawdowns" and causing "smaller reductions in stream base flows associated with the Project." Draft EIS at 3.4-56. For example, grouting "would reduce the inflow to the Surface Decline by an order of magnitude during Phase I (from 220 [gallons per minute] without grouting to 22 [gallons per minute] with grouting)." Draft EIS at 3.4-56. During later stages of mine construction, the benefits of grouting Would be "less pronounced," but grouting would still reduce "the mine dewatering rate by ... 15 to 25 percent." Draft EIS at 3.4-56. The Draft EIS states, however, that grouting "may" occur, depending on "groundwater inflows and rock stability observed during the initial excavation of the mine openings." Draft EIS at 3.4-55. The Draft EIS does not explain how the decision to grout or not would be made, or who would make the decision. The Draft EIS should have considered an alternative requiring access decline and tunnel grouting, rather than leaving the decision whether to grout up in the air.	Appendix T, Pressure Grouting Plan, of the MOP Application (Geomin Resources undated) describes where and when mine access decline and tunnels would be grouted. A reference to Appendix T, and a description of when grouting would occur, were added to Section 3.4.3.2, Proposed Action: Grouting Access Decline and Tunnels During Construction, of the Final EIS.
HC-003	25	Josh Purtle	Earth Justice	Hard Copy Letter	The EIS should also consider alternative or additional measures to limit oxidation in the mine workings. Oxidation reactions will occur when the underground mine workings are exposed to air, producing harmful pollutants including acid mine drainage. There are proven and inexpensive methods for minimizing oxidation, however, including applying potassium permanganate or shotcrete to reactive substrates. See Exhibit 14 at 3; Exhibit 17 at 12 (Mem. from Ann Maest, Ph.D., Buka Environmental, to Craig Jones, DEQ (May 9, 2019)). DEQ raised the issue of mitigating oxidation reactions in its review of Tintina's mine operating permit application, asking Tintina whether there are "technologies that could be applied locally to high sulfide bedrock to prevent or limit oxidation up front?" Second Deficiency Review at 19. The Draft EIS, however, does not carry DEQ's inquiry forward, and ignores potential measures to mitigate oxidation reactions, including the use of potassium permanganate. The EIS should consider whether using potassium permanganate or other cost-effective methods to reduce oxidation reactions would be feasible under the circumstances, and whether the use of such chemicals and methods would reduce the mine's environmental impact to groundwater chemistry.	Technical Memorandum 6 (see Appendix F of this EIS) reviewed several additional potential methods for controlling groundwater inflow and applying surface treatments to limit oxidation during operations. Technical Memorandum 6 concluded that most of the commonly used methods in the mining industry to control inflow are already proposed for the Project, and other water source control options would be no more effective than the proposed best practice methods. The modeling of post-closure conditions demonstrates compliance with non-degradation groundwater criteria, so additional methods of inflow control are not deemed necessary. Further, EIS Appendix F (Technical Memorandum 6) and Section 2.3.2.9, Tunnel Operations: Add Water Source Controls to Limit Oxidation during Operations, discuss various options to limit oxidation of surfaces in the mine workings. The technical memorandum found that specifically, asphalt and wax could be somewhat successful to limit oxygen transfer on surfaces. While the application of asphalt, synthetic spray-on covers, or wax barriers could be used to limit oxidation on tunnel surfaces, they would be subject to degradation and would not be practical for underground mining. Polypropylene fiber reinforced shotcrete is proposed to be used to aid in ground support for underground stability, as well as a cementitious surface cover over the bulkheads used for sealing backfilled mine surfaces. The use of potassium permanganate was not reviewed in detail for its potential to prevent oxidation because the stopes that could primarily contribute to acid generation would be backfilled within a short timeframe of exposure (1 to

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						2 months). As demonstrated by kinetic testing of the mineralized bedrock (Appendix D of the MOP Application [Enviromin 2017b]), the surfaces that would be exposed by mining would have considerable buffering capacity to counteract the generation of acidity, even though there are elevated sulfide concentrations in the rock. These surfaces would be backfilled before sufficient oxidation could occur and result in net acid generation. The application of a reagent like potassium permanganate utilizes the oxidizing ability of the permanganate ion to create a manganese-iron oxide coating on sulfidic rock. All treated surfaces would still have potentially reactive rock below the coating, and oxidation could return if the outer manganese-iron oxide coating is removed, whether by physical or chemical means. The stope backfill approach is considered to be more permanent and effective at limiting the exposure and oxidation of reactive surfaces, than the application of a surface treatment. In developing its MOP Application (Tintina 2017a), the Proponent considered high-pressure washing of the mine walls to remove stored oxidation products and the placement of shotcrete on high-sulfide zones in the workings to cover and immobilize oxidation products. It is important to note that post-closure models predict non-degradation groundwater criteria would be achieved without either of these measures. However, high-pressure washing of the mine walls to remove stored oxidation products and the placement of shotcrete on high-sulfide zones in the workings could optimize the closure process. Implementation of one or both of these measures could allow the Proponent to conduct fewer rinsing cycles of the mine workings. The most technically appropriate approach would be to observe the evolution of water quality with respect to modeled predictions before using shotcrete or other surface applications on access tunnels that transect sulfide zones. The MOP Application proposes testing the proposed high-pressure washing and shotcrete mitigation strategies in localized individual heading scale once mining has begun in the USZ. If the Proponent decides to implement the high-pressure washing and/or shotcrete strategies based on the results of the testing, the Proponent would be required to request a modification of its permit and DEQ would conduct the appropriate level of environmental review.
HC-003	26	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS further dismisses the need for bird netting to prevent birds from accessing the mine's process water pond, which will contain high levels of acids and toxic chemicals throughout the life of the mine. Draft EIS at 3.15-21. Given the high toxicity of the process water pond and the low cost of bird netting, the EIS should evaluate whether installing netting over the process water pond would be a feasible method for reducing the project's impacts to wildlife.	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. Assessments of predicted water quality of the PWP during operations are provided in Section 3.5.3.2, Surface Water Quality and Temperature, and Section 3.15, Wildlife, of the EIS. The PWP would be drained at closure. Predicted water quality of the PWP is slightly acidic (pH of 5.81 s.u.), with concentrations of most water quality parameters predicted to be less than available DEQ numerical water quality standards. Minor exceptions were observed, where elevated concentrations were predicted for copper, nickel, lead, and zinc in operations. Note, the predictive model for the PWP is based on the principle of mass balance and, for example, does not include likely geochemical processes that would occur in situ to attenuate metal concentrations (e.g., sorption of metals to ferrihydrite, or metals removal via flocculation and settling of particulate matter). Thus concentrations of these parameters may be

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						overestimated. 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. However, ongoing operational monitoring is stipulated by DEQ and has been proposed to validate model predictions and to identify potential impacts on water resources in a timely manner and trigger the implementation of operational changes and/or mitigation measures (Section 6 of the MOP Application). Section 3.6.7 of the MOP Application (Tintina 2017a) states, “The CWP is designed to collect 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.” The CWP would normally store only a minimal volume of water during mine operations. Given the size of the 24-acre PWP, it would also not be possible to maintain netting over it. Netting is proposed for the much smaller (approximately 3 acres) CWP brine pond, which would contain poorer quality water. Additional text was added to Section 3.15, Wildlife, in the Final EIS to clarify why the PWP does not merit netting, and is not technically feasible.
BBC00830	23	Kendra Zamzow	Center for Science in Public Participation	Email	Depyritizing the tailings is an alternative that was discussed and dismissed. This alternative needs to be brought back with further discussion and analysis, as described in detail in other comments (Chambers 2019). This method was used at the Musselwhite Mine (Ontario) where sulfur was reduced from 1.5% to 0.3% before placing thickened tailings in a surface disposal site (Kam et al. 2010), and tested at the Doyon Mine (Quebec) where 5% cement/slag binder was added to desulfurized tailings and no sulfate attack was observed (Alakangas et al. 2013).	See Consolidated Response ALT-4.
BBC00830	24	Kendra Zamzow	Center for Science in Public Participation	Email	As planned, the CTF foundation would be within the water table at certain times of the year, with groundwater depth from 2 m below the CTF base to 9.5 m above it (DEIS Appendix B; Tintina 2017 Section 3.6.8.1; Tintina 2017 Appendix K Figure C2003). This placement risks contact between groundwater and waste if the liners are compromised. The design could be changed to avoid the water table: more tailings or waste rock placed as underground tunnel backfill or the embankments be raised above the original topography. The argument that changing the design would impair the view is disingenuous, particularly given the realistic expansion of the CTF to accommodate the Lowry deposit. Prior to a decision to place more backfill in tunnels, diffusion testing should be done for a much longer period of time, without replacing the test water and until geochemistry stabilizes, to determine whether internal sulfate attack will compromise the cement over time, and lead to serious groundwater contamination in the flooded tunnels.	See Consolidated Responses ALT-2, CUM-1, and PD-5. Longer diffusion testing: Binder addition is not solely meant to neutralize potential sulfide oxidation. For sulfide oxidation to occur, there must be sufficient water and oxygen present to react. The cemented tailings cylinders subjected to HCT and diffusion tests showed far more disaggregation than what would be anticipated in a backfilled stope or lift placed within the CTF. During diffusion testing, the pH dropped from 8.89 to 7.15, and the acidity rose from -1 to 22 mg/L (while alkalinity increased slightly from 7.8 to 9.4 mg/L) in the last two analyses (Appendix D of the MOP Application [Enviromin 2017b]). Considering the degree of disaggregation in the unsupported cylinder, this likely overestimates the dissolution/leaching potential of the tailings. This test exposes additional reactive surface area, overestimating the reaction and acid production potential of the cemented tailings. The water-quality prediction models used the laboratory data to demonstrate compliance with non-degradation criteria. Like other humidity cell testing, this is an aggressive treatment of samples (particularly when unsupported/unconfined) and 11 days of testing does not correlate directly to an equivalent length of time of field conditions. Replacement of diffusion testing water: The testing methodology called for the solution to be refreshed to develop a leaching profile. Although this does not

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						provide constant exposure to sulfate in the leach solution (which would increase within the solution until reaching an equilibrium point), the use of deionized water is a more aggressive leaching solution and provides a conservative estimate of leaching potential. Per DEQ's first deficiency review of the MOP Application, "ASTM-1308-08 (subsection 7.1) describes use of 'demineralized water' as an appropriate option: 'The leachant can be selected with regard to the material being tested and the information that is desired. Demineralized water, synthetic or actual groundwater, or chemical solutions can be used.'" (DEQ 2016)
BBC00849	4	David Chambers	Center for Science in Public Participation	Email	Separate Sulfide Prior to Tailings Disposal The benefits from placing only non-acid generating material on the surface are apparent. In addition, the gist from the DEIS is that the cement tailings storage facility (TSF) will remain cemented indefinitely. From the geochemical information in the DEIS it is readily apparent this material will remain "cemented" only temporarily, both above ground and underground. If the bulk tailings to be stored on the surface can be de-pyritized to the point where the buffering in the cement will provide more than enough neutralization capacity to prevent the remaining sulfide from eventually dissolving the cement, then any seepage from the tailings can be drained in the long-term without the need for metals removal. (This will not, however, prevent metals leaching, so this is still a concern for long-term contamination.) De-pyritized tailings on the surface provides multiple long-term management options. Yet in the EIS it is noted: "There is no net environmental benefit to full sulfide mineral separation prior to tailings disposal, when compared to the Proposed Action." And it then goes on to say: "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." The disconnect here is obvious. De-pyritization of tailings, and backfilling the pyritic tailings fraction underground, with the remaining de-pyritized tailings stored on the surface, is an option that is discussed in Technical Memorandum 3 (Appendix C).	See Consolidated Response ALT-4.
BBC00849	6	David Chambers	Center for Science in Public Participation	Email	Nevertheless, even if the rougher underflow is potentially acid-generating, it is still possible to install a separate pyrite removal circuit for this flow path. If a pyrite separation circuit is installed, the amount of PAG tailings could be reduced from 100% to approximately 5%, all of which could easily be backfilled in the underground mine. This means all of the tailings stored on the surface would be non-acid generating. This could lower the long-term risk of treating seepage water from the tailings in the case of liner leaks and/or depletion of the neutralizing cement in the impoundment. Also, if a dam failure were to occur, the material released would not be acid-generating. Since it is likely that the amount of sulfide tailings would not be enough to provide backfill material on their own, the EIS fails to consider the option of combining the sulfide tailings with de-pyritized tailings for backfill material. This would remove any requirement for the surface storage of the pyritic tailings, while the tailings remaining for surface storage would now be non-acid generating. MDEQ's own consultant made this recommendation in Technical	See Consolidated Response ALT-4.

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					Memorandum 3: “It is recommended that more consideration be given to technical feasibility and the pros/cons of the various tailings management alternatives rather than cost feasibility.” Recommendation: Since this alternative was not given any detailed analysis in the DEIS and supporting documents, it is not clear whether this approach would be more advantageous than the proposed closure. But, as is suggested in Technical Memorandum 3, sulfide separation deserves more detailed consideration.	
BBC00849	7	David Chambers	Center for Science in Public Participation	Email	Tunnel Operations: Add Water Source Controls to Limit Oxidation during Operations The EIS notes that: “Technical Memorandum 6 concluded that other water source control options would be no more effective than the best practice methods in the Proposed Action.” The materials considered in Technical Memorandum 6 included asphalt, wax, and a spray-on membrane. It was determined in Technical Memorandum 6 that all of these materials had fatal flaws, although the memorandum did not elaborate on why a spray-on-membrane would not work. It also failed to describe the type of the spray-on-membrane(s) that were considered. In particular, potassium permanganate should have been given consideration. Potassium permanganate has been used successfully to inhibit acid generation in the exposed walls of open pits. The primary disadvantage of potassium permanganate is that pit walls crumble and expose new rock faces that will oxidize, so that potassium permanganate needs to be re-applied to be effective. The use of potassium permanganate for underground workings might be more effective since tunnel walls do not crumble like pit walls, and the goal of the spray coating would only be to limit oxidation until the workings were backfilled and closed. Recommendation: The option of using potassium permanganate was not discussed in either the EIS or Technical Memorandum 6, and should be evaluated in more detail in the EIS itself.	See response to Submittal ID HC-003, Comment Number 25.
BBC00849	8	David Chambers	Center for Science in Public Participation	Email	Elevate the CTF above the Water Table Elevating the Cemented Tailings Facility (CTF) above the Water Table alternative is dismissed in the DEIS primarily on the basis that the liner system diverts, but does not intercept groundwater flow, and that the increased height required to raise the impoundment would cause visual disruption. This alternative is also dismissed because it reportedly does not provide any environmental advantage over the CTF as proposed. However, the DEIS analysis incorrectly assumed that the issue with keeping the liner system above the water table is interception/diversion of groundwater flow. The real concern is that when the liner system sits below the water table, it is susceptible to groundwater flow entering the seepage collection system, or even into the impoundment itself, if there are flaws, tears or breaks in the bottom liner. It is safer, with less potential for seepage complications, to keep the bottom of the liner system above the water table so there is no physical way water could enter the CTF from below. Instead of just raising the present structure at its planned location, which is the implementation analyzed, the location of the entire impoundment could be shifted uphill slightly, avoiding the problems with additional fill mentioned in the EIS. It is noted in Technical Memorandum 2	See Consolidated Responses ALT-2 and ALT-3.

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					that: "The pre-construction groundwater table ranges from 31 feet (9.5 meters) above the CTF base elevation on the west side of the impoundment to 6 feet (2 meters) below on the east side …" From the attached Figure: "Cemented Tailings Facility Grading Plan" it appears that it may be possible to move the Cemented Tailings Facility upgradient until the bottom is above the water table. This would probably necessitate relocating the road alignment, but that is not a major engineering consideration. It is not clear where the groundwater level contours fall in this area, but this is something that should have been given consideration in the DEIS. Recommendation: Moving the CTF so that it is above the water table should be given a more detailed analysis in the EIS, and should not be dismissed in the preliminary considerations of alternatives.	
BBC00933	22	Ann Maest	Buka Environmental	Email	Separation of pyrite in the flotation circuit should be reconsidered. Placement of cemented pyritic tailings and PAG waste rock below the water table would greatly improve the environmental performance of the project. Additional kinetic testing on this option should be conducted. Separation of pyrite in the flotation circuit and burying these highly reactive tailings below the water table with cement could be the only way to avoid severe water quality problems.	See Consolidated Response ALT-4.
BBC00884	5	Scott Bosse	American Rivers	Email	To reduce the potential for the mine tails to create acid mine drainage, Chambers, Maest and Zamzow suggest that the DEQ analyze an alternative in which the bulk tailings would be depyritized prior to surface tailings disposal. The DEQ earlier dismissed such an alternative, stating: "There is no net environmental benefit to full sulfide mineral separation prior to tailings disposal, when compared to the Proposed Action." We believe this alternative deserves another look.	See Consolidated Response ALT-4.
PM2-12	4	Bruce Farling		Public Meeting Transcript	Some ideas that you guys could analyze a little further or analyze for the first time, look at removing pyrite from all the surface tails before you stick them in that surface impoundment. You could definitely put the whole facility out of the groundwater table area there. And that might mean a couple things: Moving it further upstream; it might mean having it higher, as you have evaluated in the Draft EIS. The other thing you can do is you could take less material out of the ground and have a smaller footprint from your tailings impoundment.	See Consolidated Response ALT-4.
BBC00992	3	Michael Enk		Email	DEQ simply must insist on a back-up remediation plan for technologies which have yet to stand the test of time, especially when the threat of acid generation and toxic drainage is so high due to the geochemistry of the ore deposits and processed material.	The comment does not specify the technologies it is referring to, or what type of remediation plan is suggested, but a few potentially relevant items are described here. See Consolidated Responses PD-2 and PD-3. The DEQ would require the Proponent to adhere to a Reclamation Plan, pursuant to § 82-4-336, MCA, which states that all "disturbed lands must be reclaimed consistent with the requirements and standard set forth in this section." Monitoring would be required during construction, operation, closure, and post-closure, to confirm all parameters are within the appropriate range with regards to water quality and geotechnical stability.

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34_Combined	2	Doretta Reisenweber		Spreadsheet	Has dry-stacking been considered for this mine? That alternative was dismissed out of hand in Mn. It is not the cheapest method, but provides some measure of protection.	See response to Submittal ID HC-003, Comment Number 21.
Aquatic Resources						
PM1-06	5	Bonnie Gestring	Earthworks	Public Meeting Transcript	The bottom line is that this mine plan risks increasing pollution of the Smith River's most important trout spawning tributary. This EIS needs to be better. It needs to be better because this is a really special place.	See Consolidated Response AQ-1.
PM2-10	5	Mike Fiebig	Northern Rockies office of American Rivers	Public Meeting Transcript	The DEIS does not adequately characterize the fish populations and other aquatic life in Sheep Creek and other local tributaries. And the Smith River will be -- we are concerned that the Smith River will be impacted if the Black Butte Mine is built. Without this baseline information, it will be impossible to accurately gauge whether and to what extent the mine is adversely affecting aquatic life and what mitigation will need to be done.	See Consolidated Responses AQ-1 and AQ-2.
PM4-02	4	Malcolm Gilbert		Public Meeting Transcript	So there are glaring deficiencies in the, in the Draft EIS relating to the aquatic biology, the counting for macro invertebrates, the differentiation between the frequency of different trout species -- or different trout sizes and species.	See Consolidated Response AQ-2.
HC-001	3	Martha Williams	Montana Fish, Wildlife, and Parks	Hard Copy Letter	Given the DEIS acknowledges that some level of impact may occur to aquatic life in Sheep Creek (e .g., potential changes in water temp, nutrients, algae blooms and impacts on insects and fish, NCWR screened pump impacts on fish, etc.), FWP appreciates DEQ's consideration on whether those impacts might affect the aquatic resources in the Smith River due to its connectivity with Sheep Creek.	See Consolidated Responses AQ-1, AQ-4, and WAT-5. The Smith River is 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. Groundwater from the proposed mining area contributes only a small fraction of the base flow in Sheep Creek and is not predicted to significantly change in quality or quantity as a result of the proposed Project. Analyte concentrations in groundwater are predicted to decrease to within standards—as presently occurs under baseline conditions in the vicinity of the ore deposit—before discharging to Sheep Creek (see Figure 3.4-8, Section 3.4.3.2, Postclosure Groundwater Quality, and Section 3.16.3.2, Changes in Water Quality, of the EIS). Thus, the Proposed Action is unlikely to contribute to water quality impairments currently observed in the Smith River (see Section 3.16.3.2 in the Final EIS). Therefore, the Project would not likely have any direct or secondary impacts on aquatic life in the Smith River.
HC-001	4	Martha Williams	Montana Fish, Wildlife, and Parks	Hard Copy Letter	As noted in the DEIS, mitigation would take place if monitoring indicates that thermal limits in Sheep Creek have been exceeded, or if discharge from the Non-Contact Water Reservoir can't be used to augment stream flows. An effective thermal monitoring plan is needed to avoid impacts on aquatic life, and FWP is willing to consult with DEQ and contribute our expertise to DEQ's development of such a plan.	See Consolidated Responses AQ-4 and WAT-5. The WTP/TWSP discharges to alluvial groundwater would be regulated via the MPDES permit and would be sampled for water quality, including temperature. If stream flow were to be augmented via direct discharge from the NCWR, the temperature would be monitored, and discharges limited as necessary, to prevent impacts on aquatic life. In addition, water temperature would be monitored during the spring, summer, and fall at all surface water and aquatic monitoring stations (see Section 3.5.3.2, Water Temperature Thermal Analysis Methods and Results, of the EIS).

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HC-001	5	Martha Williams	Montana Fish, Wildlife, and Parks	Hard Copy Letter	FWP suggests that DEQ continue to examine the fisheries in Sheep Creek and its tributaries, and specifically the role Sheep creek may play in providing staging habitat, rearing habitat, or seasonal habitat, e.g., winter refuge to numerous fish species. We base this suggestion on our assessment that two years of baseline (pre-mine) fisheries monitoring in Sheep Creek may not provide enough information to make conclusions about the benefits that Sheep Creek and its tributaries provide to resident and migratory fish populations. This aquatic system has seasonal, annual and longer phases of fish use and provides different values and ecological services at different times. One or two seasons of initial fisheries assessments may not be indicative of a real baseline. For example, the reported lower fish densities in Sheep Creek could be a product of low efficiency in sampling the larger water of Sheep Creek. Similarly, FWP observes that high flows and turbidity may have impeded conducting accurate rainbow trout redd surveys.	See Consolidated Response AQ-2.
HC-003	11	Josh Purtle	Earth Justice	Hard Copy Letter	Trout, and in particular westslope cutthroat and rainbow trout, require very cold and clean water to reproduce, and therefore even a slight change in water quality or quantity in the Sheep Creek watershed could impair the survival of these fish species. See Exhibit 5 (Montana FWP, Rainbow Trout); Exhibit 2 at 5. Indeed, as discussed in more detail below, flows in Sheep Creek and the Smith River are already often insufficient to protect the fishery; the mine's impacts on surface water quantity will only exacerbate that problem. Exhibit 1 at 2. Likewise, Sheep Creek and the Smith River are at risk for algal blooms in the summer, which can deplete oxygen in surface water artd thus harm or kill resident fish. Exhibit 6 at 3 (DEQ, Mont. Dep't of Pub. Health & Human Res., Toxic Algae (Cyanotoxins) in Montana (July 20 17)). Any nitrogen pollution or temperature changes caused by the mine will make algal blooms larger and more prevalent in the future. Exhibit 7 (National Ocean Service, Why do harmful algal blooms occur?); Exhibit 8 at I (EPA, Climate Change and Harmful Algal Blooms). These potential impacts are particularly concerning for westslope cutthroat trout in the project area, which "have declined from historical levels over part or all of their historical range" in Montana. Exhibit 9 at ii (Shepard, FWP, Status ofWestslope Cutthroat Trout (Oncorhyncus clarki Iewisi) in the United States: 2002 (Feb. 2003)). As discussed, the Sheep Creek and Smith River fisheries are prized by people throughout the State. DEQ must therefore account for all potential impacts to these fisheries in the EIS, and further ensure to the maximum extent possible that the Black Butte Copper Mine will not degrade some ofMontana's most important trout streams.	See Consolidated Responses AQ-1, AQ-2, AQ-4, and MEPA-2. The westslope cutthroat trout (*Oncorhynchus clarkii lewisi*) is reported to occur in the Project area in Sheep Creek (MTNHP and FWP 2017). While there have been no documented occurrences, pure westslope cutthroat trout have been documented in Daniels Creek and Jumping Creek, upstream tributaries to Sheep Creek (FWP 2014). Therefore, pure westslope cutthroat trout are probably in the Project area at low densities.
HC-003	39	Josh Purtle	Earth Justice	Hard Copy Letter	The MPDES permit further ignores a Montana narrative water quality standard that prohibits discharges to surface waters that are harmful to fish and other aquatic life. ARM 17.30.637(1)(d). As discussed further below, several aspects of Tintina's plan of operations threaten impacts to water quality that are ignored in the Draft EIS and the MPDES permit. For example, Tintina's use of a treated water storage pond creates a risk that effluent discharges will impermissibly increase temperatures in Sheep Creek. Further, the omissions and errors in the MPDES permit described above threaten additional impacts to aquatic life in Sheep Creek and other surface waters. The EIS should analyze whether, in light of these deficiencies, Tintina's activities will impermissibly harm fish and other aquatic life.	See Consolidated Responses AQ-1, AQ-4, and WAT-5.

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HC-003	70	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS further does not adequately address potential impacts to fish and other aquatic organisms in the Sheep Creek watershed. At the outset, the Draft EIS fails to provide adequate baseline information about aquatic organisms in the project area. The Draft EIS first omits important data concerning "fish-length frequency [and] biomass." Exhibit 43 at 1 (Ken Knudsen, MS, A Critique of the Aquatic Biology Section of the Draft Environmental Impact Statement for the Proposed Black Butte Copper Project in Meagher County, Montana (May 1, 2019)). As Ken Knudsen states in his comments on the Draft EIS: This lack of length-frequency data is a major shortcoming because this information ... is often used by fisheries biologists to evaluate whether changes are occurring within size classes of the species at any section [of a creek] from year to year. This in turn can be used to estimate whether changes to the populations' age structures are occurring. The use of length/frequency graphs are especially useful as a way to confirm that reproduction is continuing to be successful at any given location, by documenting whether or not the frequency-occurrence of young-of-the-year (YOY) fish is remaining relatively constant from year to year. For example, if the number of YOY salmonids at locations downstream of the proposed mine were to suddenly drop, while remaining relatively constant at the upstream and reference sites, environmental contamination from the project area is a probable cause. Exhibit 43 at 4.	See Consolidated Response AQ-2.
HC-003	71	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS further omits any data about the numbers of aquatic macro invertebrates in waterbodies in the project area from 2017, as well as any data from sampling locations on Sheep Creek, and provides "inaccurate values for some of the metrics used the evaluate the condition" of macro invertebrate communities. Exhibit 43 at 1. Complete macroinvertebrate data is essential to gaging the baseline health of Sheep Creek and other surface waters in the project area, because macroinvertebrate diversity is a good proxy for the extent to which a stream is impaired. See Exhibit 44 at 2 (Kenney et al., Benthic macroinvertebrates as indicators of water quality: The intersection of science and policy 2 Terrestrial Arthropod Reviews 99 (2009)).	See Consolidated Response AQ-2. Text in Section 3.16.2.5 of the Final EIS has been corrected to read, "The 2014 to 2018 aquatic baseline surveys..."
HC-003	72	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS also provides no data about chlorophyll-a levels except in year 2015. Exhibit 43 at 1. "This is a major deficiency" in the Draft EIS' s baseline data, because if even a small amount of nitrate pollution from the mine enters "Sheep Creek via groundwater or surface runoff, nuisance levels ofperiphyton will likely develop." Exhibit 43 at 6. Data about current chlorophyll levels in surface water in the project area is therefore critical to evaluating the risk of adverse impacts to aquatic biology.	See Consolidated Responses AQ-1 and AQ-2.
HC-003	73	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS further provides no data about baseline habitat quality in Sheep Creek. Because both water quality and water quantity impacts can degrade stream habitat, this baseline data will be critical to ensuring that the mine does not impact important fish habitat, including spawning habitat, in Sheep Creek. The EIS must provide the missing or incomplete data about aquatic biology, so that the public may understand the current condition of surface waters in the project area, and so that DEQ and Tintina can determine whether mine operations are having an adverse impact on aquatic organisms in these waters.	The Final EIS includes additional data on site community integrity in Section 3.16.2.2, Habitat Evaluations.

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HC-003	74	Josh Purtle	Earth Justice	Hard Copy Letter	In addition to failing to provide adequate baseline data about aquatic organisms in the project area, the Draft EIS also does not rationally address impacts to fish and other aquatic organisms in Sheep Creek and the Smith River due to changes in surface water quantity. First, as discussed further above, the Draft EIS does not account for the possibility that drawdown from the mine will be much greater than Tintina anticipates, whether due to higher conductivity in fault zones adjacent to the mine site, greater flows through bedrock deep in the mine workings, or greater flows through the bedrock underlying Sheep Creek's alluvial aquifer. Such increased drawdown could exacerbate impacts to flows in Sheep Creek. Further, although Tintina has proposed to mitigate lost flows in Sheep Creek by discharging water through the UIG built in Sheep Creek's alluvial aquifer, the Draft EIS does not account for the fact that the UIG may not operate from July 1 to September 30, when the effluent may not be clean enough to meet stricter summer nitrate standards. Draft EIS at 2-8. Thus, the UIG will not mitigate flows for three months of the year, including months during which other appropriators will be withdrawing water from Sheep Creek for use in irrigation. See Draft EIS at 3.5-12 (irrigation occurs from May 1 through September 30). Tintina also plans to lease or purchase some existing Sheep Creek water rights for use in mine operations, but the Draft EIS does not evaluate whether these rights are not currently in use, such that Tintina's renewed use of these potentially longdormant water rights could impact actual total flows in Sheep Creek. Evaluating these potential surface water quantity impacts is important, because flows in Sheep Creek are already inadequate at certain times of year to support the creek's fishery. As FWP informed DEQ at an earlier stage of Tintina's project, FWP owns an instream flow water right of 30 cubic feet per second for Sheep Creek to ensure minimum flows necessary to sustain fish and wildlife habitat. See Exhibit 1 at 2. Because FWP's instream flow right is "often not met," FWP has recently called on junior water right holders to cease diversions from Sheep Creek. Id. "Such a request is unfortunately common in the Smith River basin where stream flow is too often not adequate to fully support the fishery." Id. Hydrology impacts from the mine may further contribute to a failure to meet FWP's instream flow right, for the reasons described above. The Draft EIS, however, ignores this potential violation ofFWP's flow right, and the accompanying impacts to the fishery.	See Consolidated Responses AQ-1, AQ-2, WAT-1, and WAT-4. See also responses to Submittal ID HC-003, Comment Numbers 44 and 75, and Submittal ID BBC00589, Comment Number 38. The 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 non-degradation effluent limits (0.097 mg/L). The total nitrogen effluent limit is only in effect 3 months per year (July 1 to September 30). 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, 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 (Zieg et al. 2018). During the 3 months when the total nitrogen effluent limit is in effect, any stream flow depletions in Sheep Creek would be mitigated by the discharge from the NCWR to Sheep Creek via the wet well. Therefore, FWP's in-stream flow water rights should not be impacted by the Proposed Project. Stream drawdowns resulting from mine dewatering were quantified in the hydrogeological modeling conducted by Hydrometrics (2016a) and are discussed in EIS Section 3.5.3.1. See Consolidated Response WAT-4 for details regarding the estimated drawdown in Sheep Creek, and Consolidated Response WAT-1 for discussion of the validity of the mine dewatering estimates. The hydrogeological model estimates a maximum reduction in flow in Black Butte Creek of 0.1 cfs (4 percent of base flow), 0.12 cfs in Coon Creek (70 percent of base flow), and no reduction in base flow in Moose Creek. The Proponent has committed to mitigate the base flow reduction in Coon Creek by pumping water from the NCWR into the headwaters of the creek to maintain flows within 15 percent of average monthly pre-construction flows. Impacts on aquatic life due to potential changes in water quantity are discussed in Section 3.16.3.2. Water rights are discussed in Section 3.5.3.1. Water diversion would be limited to the annual irrigation period when water is available and leased water rights allow/permit water withdrawal. Potential impacts due to the diversion of streamflow to fill the NCWR would be nominal, as diversion is based on using existing leased water rights along Sheep Creek (pending review and approval by the DNRC) and/or a new water right during high flow conditions when Sheep Creek flows exceed 85 cfs and withdrawals would not affect any existing rights.
HC-003	76	Josh Purtle	Earth Justice	Hard Copy Letter	All of these potential water quality impacts could harm fish and other aquatic organisms in Sheep Creek, but the Draft EIS fails to adequately address such potential impacts. Rainbow and westslope cutthroat trout in particular would be affected by even slight changes to surface water quality or temperature, because they require very cold and very clean water to reproduce. Exhibit 2; Exhibit 5; Exhibit 45 at 721 (Lessard & Hayes, Effects of elevated water temperature on fish and macroinvertebrate communities below small pams, 19 River Research & Applications 721 (Apr. 2, 2003)) (finding that "[i]ncreasing temperatures downstream coincided with lower densities of several cold-water fish species,"	See Consolidated Responses AQ-1, AQ-2, and AQ-4. Impacts to aquatic life due to potential changes in water quantity are discussed in Section 3.16.3.2 of the EIS.

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					including brown trout and brook trout). Increases in temperature, as well as pollutants such as nitrate, could also cause larger and more frequent algal blooms, which have already become a reoccurring problem in Sheep Creek and the Smith River. Such algal blooms can deoxygenate surface waters and thus kill or harm fish. Exhibit 6 at 3. The Draft EIS must therefore account for all potential impacts to Sheep Creek and the Smith River, so that the public can understand the extent to which these potential impacts will degrade the health of the region's most beloved trout fisheries.	
HC-003	92	Josh Purtle	Earth Justice	Hard Copy Letter	Climate change impacts are particularly concerning for the fishery. One study concluded that 65% ofwestslope cutthroat trout habitat in the United States will be impaired by the impacts of climate change-specifically "increased summer temperatures, uncharacteristic winter flooding, and increased wildfires." Exhibit 53 at 533 (Williams et'al., Potential Consequences of Climate Change to Persistence ofCutthroat Trout Populations, 29(3) N. Am. J. of Fisheries Mgmt. 533 (Jan. 8, 2011)). As discussed, Tintina's proposed mine will add even more stress to the Smith River watershed's struggling cutthroat trout population, thus exacerbating the impacts of climate change.	See Consolidated Response MEPA-2.
BBC00574	3	Ken Knudson	Prepared for: The Montana Chapter of Trout Unlimited	Email	This Aquatic Biology section of the dEIS must clearly describe the existing condition of the fish, macroinvertebrate and periphyton (attached algae) communities in Sheep Creek and its nearby tributaries. Without a clear and thorough description of the baseline condition of these aquatic communities, it would not be possible to determine if impacts to these aquatic resources would be occurring if or when the mine begins operation. Any potential environmental consequences of the Proposed Action to fish and other aquatic life must also be clearly presented in the dEIS.	See Consolidated Response AQ-2. Potential environmental consequences to aquatic life are discussed in Section 3.16.3 of the EIS.
BBC00574	4	Ken Knudson	Prepared for: The Montana Chapter of Trout Unlimited	Email	The most striking example of improper and poor presentation of fisheries data is with the population estimates. The dEIS attempts to present these data in Figures 3.16-3, 3.16-4 and 3.16-5, which are labeled as “Seasonal Average Fish Abundance per Mile with Standard Deviation Bars” for the electrofishing sections on Sheep Creek, Tenderfoot Creek and Little Sheep Creek. The most significant problem with these Figures is that the authors try to present the population estimates for rocky mountain sculpin, which numbered over several thousand individuals per mile, on the same graphs as the estimates for the salmonids (trout and mountain whitefish), which often numbered less than a hundred individuals per mile. This results in the salmonid values often being little more than small, incomprehensible blips on these Figures, while the sculpin numbers are so large that they exceeded the scale shown on the y-axis for average number per mile for most of the sections. Instead of presenting the fish population estimates (“or fish abundance” values) on largely illegible graphs as shown on Figures 3.16-3, 3.16-4 and 3.16-5, these data must be clearly summarized on a Table with the following columns shown for each sampling location and sample period: the exact day of the survey; the total measured length of the electrofishing section; the number of fish of each species collected during electrofishing pass 1, pass 2, and -if was necessary- pass 3; the population estimate (based on the number of fish that were collected during these sequential passes); the estimated number of fish per mile (based on the section length presented in the first column of this table); the standard	See Consolidated Response AQ-2.

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					deviation error for each population estimate; and finally, the average biomass (kg) per mile for each species. Without presenting the baseline electrofishing data on such a clear and concise Table, it will not be possible to ascertain whether or not changes are occurring to the fish populations at the "impact" sampling locations if or when the mine begins operation. Figures displaying fish abundance should be limited to values for the salmonid populations, with numbers on the y-axis ranging from 0-500 fish.	
BBC00574	5	Ken Knudson	Prepared for: The Montana Chapter of Trout Unlimited	Email	Figure 3.16-7, showing "Average Number of Redds per 100 meters within the Project Area", is also an unsuitable presentation of these data. First of all, this figure lumps the data for brown trout and brook trout together, rather than differentiating between the species. The six sentences that are devoted to redd counts only discuss the findings for two survey sites on Sheep Creek and the two on Little Sheep Creek. This limited discussion raises several questions. Were the redds found at SH22.7 and SH15.5 made by brown trout or brook trout? Where or what is sampling site 18.2_FS that is shown on this figure? Why are there standard deviation bars shown on this figure? What was the length of stream that was surveyed at each section? As with the fish population numbers, the results of the redd count surveys must be shown on a table that shows the following information: the exact day of the survey; the total length of the survey section; the number of redds of each species that were found; and, the redd density (number/100 meters) at each location.	See Consolidated Response AQ-2.
BBC00574	6	Ken Knudson	Prepared for: The Montana Chapter of Trout Unlimited	Email	Another way to monitor the viability of fish populations is to determine the length-frequency distributions, which are the number of fish of each species collected within selected size categories, at the various sampling locations. On page 3.16-6 it is stated that "Each fish collected was identified to species, weighed (grams) and measured (total length in millimeters)". Yet nowhere in the dEIS is any mention made regarding the number of fish of various size classes that were collected at any of the electrofishing sections. This lack of length-frequency data is a major shortcoming because this information, when plotted on a graph, is often used by fisheries biologists to evaluate whether changes are occurring within size classes of the species at any section from year to year. This in turn can be used to estimate whether changes to the populations' age structures are occurring. The use of length/frequency graphs are especially useful as a way to confirm that reproduction is continuing to be successful at any given location, by documenting whether or not the frequency-occurrence of young-of-the-year (YOY) fish is remaining relatively constant from year to year. For example, if the number of YOY salmonids at locations downstream of the proposed mine were to suddenly drop, while remaining relatively constant at the upstream and reference sites, environmental contamination from the project area is a probable cause. These graphs can also be used determine whether or not the number of fish in larger size classes are changing over time, which would also warrant further fisheries investigations.	See Consolidated Response AQ-2.
BBC00574	7	Ken Knudson	Prepared for: The Montana Chapter of Trout Unlimited	Email	Table 3.16-5 attempts to summarize "Macroinvertebrate Sample Characteristics and Metrics" for sampling locations in the project area, but contains several shortcomings and inaccuracies: (1) No data for the Smith River sample sites or for SH.1 near the mouth of Sheep Creek are presented. (2) No aquatic macroinvertebrate data from the 2017 field season are shown, and the only data	See Consolidated Response AQ-2. The text in Section 3.16.2.5 of the Final EIS has been corrected to read, "The 2014 to 2018 aquatic baseline surveys..." In addition, Section 3.16.2.5 has been updated to include Smith River macroinvertebrate data as well as 2017 and 2018

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					from 2015 are from the Coon Creek sample site. (3) How the numbers for the column titled "EPT Taxa" were derived is a total mystery, since the numbers given are presented as fractions (1/10th) of a taxa, which, of course, is impossible since a taxa (or kind of organism) is either present or not; furthermore, the range of numbers in this table are not even closely similar to the range of numbers of EPT Taxa shown in Stagliano (2018). (4) The average rows (shown as avg. on the table) are not useful as far as determining changes to the aquatic communities at any given sampling location. If averages are to be used they should instead be calculated for the years at each individual sampling site and arranged from upstream to downstream in the study area. Given the problem with the number of EPT taxa in Table 3.16-5 noted above, the values shown for the %EPT Taxa in Figure 3.16-8 should be carefully checked for their accuracy. This Figure should also be expanded to include graphs showing the total numbers of taxa (or "taxa richness") and total numbers of EPT taxa for all of the sampling locations.	data from the aquatic baseline surveys. Table 3.16-6 in Section 3.16.2.5 has also been updated to include the 2017 and 2018 data. More than one sample was taken at each location during each survey. The numbers were averaged, which is why decimals are presented in the table. For a more detailed description of the macroinvertebrate communities data analyses, refer to Stagliano 2019.
BBC00574	8	Ken Knudson	Prepared for: The Montana Chapter of Trout Unlimited	Email	Table 13.6-6 summarizes some periphyton metrics for samples collected in 2014, 2016 and 2017. This table displays numerical values for the percent probability of impairment (% PI), but there is no discussion as to what these values are based on (e.g. Teply's Trophic Diatom Index?). Nor does it give a threshold value above which impairment is indicated (i.e. 50%). Numeric values are also presented on the table for the percent relative abundance of the dominant taxa (%RI), but the threshold where impairment is indicated by this metric is not discussed. This is important, since the higher the %RI, the more likely that impairment is occurring. During 2014, stations 17.5 had the highest value for this metric (19.3%), and during 2016 and 2017, station SH 18.3 had the highest values- 27.5% and 16.7%, respectively. Since both the %PI and the %RI metrics have similar ranges of values (0-100%), it would also be useful if they were displayed as bar graphs in the dEIS, with lines showing the impairment thresholds for these metrics.	See Consolidated Response AQ-2. Prior to the baseline surveys, no standardized biological sampling or monitoring had been conducted within the assessment area of Sheep Creek (Stagliano 2018). These baseline aquatic surveys (Stagliano 2015, 2017a, 2018) were the primary sources used to determine the periphyton distribution in the assessment area. The Final EIS includes Figure 3.16-14, which shows the impairment threshold.
BBC00574	9	Ken Knudson	Prepared for: The Montana Chapter of Trout Unlimited	Email	On page 3.16-25 it is stated that chlorophyll-a (chl-a) samples were collected from Sheep Creek and Moose Creek in 2015 and that their concentrations were all well below the threshold indicative of nuisance levels for periphyton communities (150 milligrams per square meter), with the highest level being only 65.2 mg/sq m at SH 17.5. No information is presented for samples collected at the other sampling sites. Furthermore, no chl-a sample have been collected since 2015 to confirm the relatively nuisance-free, or low primary production baseline conditions for periphyton existing in Sheep Creek. This is a major deficiency of the baseline studies for the dEIS, since when or if the mine begins operation, hundreds, if not thousands, of pounds of explosives containing high levels of nitrogen compounds will be used for blasting at the project site. Even if a small portion of these compounds enter Sheep Creek via groundwater or surface runoff, nuisance levels of periphyton will likely develop. This underscores the need for more intensive chl-a monitoring within and downstream of the project area.	See Consolidated Responses AQ-1 and AQ-2.
BBC00574	11	Ken Knudson	Prepared for: The Montana Chapter of Trout Unlimited	Email	Regarding dewatering impacts, groundwater model simulations predict that the base flow of Coon Creek would be reduced by approximately 70%. Coon Creek is the smallest tributary in the project area, which is often totally diverted	See Consolidated Respones AQ-1, AQ-4, WAT-4, and WAT-5.

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					during the irrigation season and is mostly frozen during winter. It therefore supports very little fish habitat except for some YOY resting places near its mouth, which could be affected by the mine's disruption to local groundwater flows. The model also predicts about a 2% reduction in the base flow of Sheep Creek just downstream of the project area. If the model is correct, this small reduction in base flow in Sheep Creek should not measurably reduce the wetted perimeter and thus the habitat for fish and other associated aquatic life in the stream. As well, water diverted from Sheep Creek to the Non-Contact Water Reservoir should not significantly affect the flow regime or wetted perimeter (available aquatic habitat) of Sheep Creek if no more than 7 cfs is withdrawn during high streamflow periods, e.g., when the stream discharge of Sheep Creek exceeds 84 cfs. If water is withdrawn during other, lower streamflow periods, significant impacts to the wetted perimeter and possibly water temperatures would occur.	
BBC00574	12	Ken Knudson	Prepared for: The Montana Chapter of Trout Unlimited	Email	Except for the effects sediment runoff, other potential impacts to the water quality of Sheep Creek and the Smith River are not adequately described and are largely downplayed in the dEIS. On page 3.16-31 it is stated that during the mine's operation: "The quality of groundwater reporting to Sheep Creek would be the same if not better than baseline conditions" and "no changes to surface water quality are projected". However, any water that is present within the proposed project area would be dramatically altered by surface and underground mining activities, including the extensive use of nitrate-laden explosives. Also, much of the ore body contains sulfide ores, which would produce sulfuric acid when exposed to water and oxygen within the underground workings and/or when it is deposited on the surface. This acid would then dissolve heavy metals from the exposed ore (i.e., cadmium, copper, lead and zinc), which are very toxic to aquatic life. In theory, this toxic and nitrate-laden waste water would be pumped to a reverse osmosis treatment plant before eventually being discharged to the alluvium of Sheep Creek, but this tidy expectation assumes that 100% of the wastewater generated at the mine site would be captured and treated. However, underground workings are rarely, if ever, closed and impervious systems. Constant blasting causes fractures to happen in the bedrock that surrounds the ore body, which often allows acidic, untreated wastewater to eventually seep into local groundwater and then to surface waters. To suggest that fractures to bedrock, leading to contamination of groundwater wouldn't occur is being overly optimistic at best. It is also very optimistic to assume that no surface runoff would ever occur from the proposed mine site. Because of climate change, the frequency and intensity of largely unprecedented precipitation events will continue to increase in the future. The question is not whether any contamination to the surface waters of Sheep Creek would occur from the activities of the proposed mine, but rather how soon and how much. The bold predictions that "the quality of groundwater reporting to Sheep Creek would be the same if not better than baseline conditions" and that "no changes to surface water quality are expected" are very likely untrue and are highly unsubstantiated statements to make in an EIS for any proposed mine.	Please refer to Section 3.4, Groundwater Hydrology, of the EIS for a detailed discussion of potential impacts to groundwater. See Consolidated Responses MEPA-2, PD-5, WAT-2, and WAT-3. The portal pad, waste rock and ore storage pads, mill, and CTF, as well as the haul roads connecting these facilities, were planned such that all storm water runoff from these mine drainage areas would report to containment in either the CWP or PWP. Both ponds have the capacity to contain all runoff from very large storm events (see Section 2.2, Proposed Action, of the EIS).

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BBC00574	13	Ken Knudson	Prepared for: The Montana Chapter of Trout Unlimited	Email	To reduce algal growth and to comply with DEQ water quality standards for nitrate in Sheep Creek, the mine is proposing to hold treated mine water in a storage pond from July 1 through September 30. Yet, allowing water to be discharged to the stream during other times of the year will not remove the potential for outbreaks of nuisance algal growths like cladophora, since water temperatures in Sheep Creek and the Smith River are usually high enough from mid-April through late October to promote these nuisance growths. This is particularly true during years with higher than average air temperatures and lower than normal snow packs, which are conditions that are likely to increase in the future due to the effects of climate change. On page 3.16-33 it is stated that: "Abundant filamentous algae outbreaks have already been observed at the lower Sheep Creek sites (SH 15.5U and 15.5D) and confirmed with cladophora being the dominant periphyton taxa at both sites in 2016". It should also have been stated that cladophora out breaks also occurred on the Smith River downstream of Sheep Creek for the first time in anyone's memory during 2017 and 2018. If the mine is permitted to operate, wastewater containing relatively high concentrations of nitrate would be discharged into the alluvium of Sheep Creek during the majority of the year. It is therefore highly probable that nuisance growths of cladophora will only get worse on Sheep Creek and the Smith River during much of the growing season. Furthermore, discharging nitrogen-laden wastewater into infiltration basins will not provide any additional reduction in nitrate concentrations, since nitrogen compounds, unlike other algal-stimulating nutrients like phosphorus compounds, are not absorbed by soil particles in the alluvium. The resulting increase in nitrate concentrations in surface waters downstream of the mine would lead to corresponding increases in the abundance, frequency and spatial distribution of cladophora outbreaks. The increase in these unsightly algal growths would then lead to lowered instream dissolved oxygen concentrations, impacts to salmonid reproduction(by covering spawning gravels with filamentous growths), as well as changes to the diversity and abundance of aquatic macroinvertebrate populations.	Model predictions for underground water are described in detail in Appendix N (Enviromin 2017a) of the MOP Application (Tintina 2017a). Nitrate was predicted to exceed the DEQ groundwater quality standard in the operational base case as well as in several sensitivity scenarios (see Enviromin 2017a, Table 4-4). However, because all water would be collected for treatment to meet groundwater and surface water non-degradation criteria, the identified exceedances would not affect downgradient water. Further, DEQ (via Circular DEQ-12A [DEQ 2014]) has determined that streams such as upper Sheep Creek would be protected from nuisance algal growth if total nitrogen concentrations in stream are kept below 0.3 mg/L. The Proponent has included provisions in the mine plan specifically to address elevated nitrogen concentrations sourced in the underground contact water. In addition to RO water treatment upstream of the UIG, the mine plan includes diversion of treated water to storage in the TWSP if nitrogen concentrations exceed the effluent limit between July 1 and September 30. Starting October 1, the stored water would be blended with the WTP effluent prior to discharge, and the blended water sampled/monitored as required in the MPDES permit. As the MPDES permit does not authorize a mixing zone, it does not depend on mixing/diluting with either groundwater or surface water having low nitrogen concentrations to achieve nutrient standards in Sheep Creek. See Consolidated Responses AQ-1 and MEPA-2.
BBC00884	7	Scott Bosse	American Rivers	Email	The DEIS did not adequately characterize the fish populations and other aquatic life in Sheep Creek, other local tributary streams, and the Smith River that will be impacted if the Black Butte copper mine is built. Without this baseline information, it will be impossible to accurately gauge whether and to what extent the mine is adversely impacting aquatic life. In his critique of the DEIS, aquatic biologist Ken Knudson states: "Descriptions of the existing conditions for the aquatic communities of Sheep Creek and the Smith River are incomplete, poorly presented and, in some cases, inaccurate." Specifically, the DEIS did not include length-frequency data for fish that were sampled during electrofishing surveys. This information is critical because it is used to evaluate whether changes are occurring within certain size classes, which, in turn, can be used to estimate whether changes to the populations' age structures are occurring due to mining related impacts. Additionally, the DEIS did not include recent information about chlorophyll-a levels in Sheep Creek to confirm that low primary production baseline conditions for periphyton exist	See response to Submittal ID BBC00574, Comment Numbers 3 through 9, 12, and 13. Also, see additional information in the Consolidated Responses CUM-3 and AQ-1.

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					there. Knudson states in his critique: “This is a major deficiency of the baseline studies for the DEIS, since when or if the mine begins operation, hundreds, if not thousands, of pounds of explosives containing high levels of nitrogen compounds will be used for blasting at the project site. Even if a small portion of these compounds enter Sheep Creek via groundwater or surface runoff, nuisance levels of periphyton will likely develop.” Knudson concludes his critique of the DEIS by stating: “The overriding message in the Environmental Consequences section of Chapter 3.16 is that any potential impacts to the aquatic communities in Sheep Creek and the Smith River resulting from activities at the proposed mine would be minor, localized and short-term. However, as just discussed above, it is more likely that these impacts would be significant, basin-wide and long-term.”	
HC_044_William Adams_U	5	William Adams		Hard Copy Letter	5) The DEIS has not properly or sufficiently looked at the aquatic life in the Smith and its tributaries that this mine will threaten.	See Consolidated Responses AQ-1 and AQ-2.
BBC00574	1	Ken Knudson	Montana Chapter of Trout Unlimited	Email	However, I strongly believe that this chapter needs to be much better written so that everyone can clearly understand the existing condition of the aquatic communities of Sheep Creek, its tributaries and The Smith River. Without such a clear and concise baseline description of these resources, including easy to read tables and figures, it would not be possible to assess whether or not impacts to these communities are occurring when or if the mine were to begin operation.	Thank you for your comment. See Consolidated Response AQ-2.
BBC00584	7	Brian McCurdy		Email	An EIS is required to take “hard look” at the direct, indirect, and cumulative impacts of the proposed action. However, the DEIS has not properly or sufficiently examined threats to the aquatic life in the Smith River and its tributaries. The DEIS needs to be redone to properly look at the direct, indirect and cumulative impacts.	See Consolidated Responses AQ-1, AQ-2, and CUM-3. As shown in Table 4.1-1 of the EIS, the Smith River is outside the cumulative impacts assessment area for aquatic biology. The geographic extent of potential cumulative impacts includes the area or location of resources potentially impacted by the Project. MEPA requires the use of reasonable and rational spatial boundaries (e.g., hydrologic unit codes, wildlife management units, subbasins, areas of unique recreational opportunity, viewshed) that would result in a meaningful and realistic evaluation.
BBC00586	4	Nancy York		Email	The DEIS did not adequately characterize the fish populations and other aquatic life in Sheep Creek, other local tributary streams, and the Smith River that will be impacted if the Black Butte copper mine is built. Without this baseline information, it will be impossible to accurately gauge whether and to what extent the mine is adversely impacting aquatic life.	See Consolidated Response AQ-2.
BBC00726	2	Smith Wells		Email	Fish population analyses in the DEIS are incomplete and data is misrepresented. For example, brook trout and brown trout are lumped together in some reports and sculpin populations are presented in comparison to trout species.	See Consolidated Response AQ-2.
HC_036	3	Shelley Liknes	Fopp Family Trust	Hard Copy Letter	The DEIS fails to provide information for the minimum instream flows in Sheep Creek to maintain the minimum aquatic life. Please modify the effects and show the existing minimum flows that occur in the low flow periods in mid to late summer and fall in Sheep Creek when the Underground Infiltration Gallery will not be operated both during mining and at the end of mining and what the effects of the proposed project would be to aquatic life. Please also	See Consolidated Response AQ-1. See also responses to Submittal ID BBC00589, Comment Numbers 11 and 38. Surface water hydrology is discussed in Section 3.5.2, which includes a discussion of low flow statistics. Additional low flow data is available in “DEQ Low Flow Stats Calculations for the Black Butte Copper Project MPDES Permit”

Submittal ID	Comment Number	Name of Sender	Organization	Source	Comment	Response
					identify the mitigation measures that will be taken to eliminate these effects and provide discussion how the dewatering relates to surface water rights including water reservations.	(DEQ 2018e). The 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 non-degradation effluent limits (0.097 mg/L). The total nitrogen effluent limit is only in effect 3 months per year (July 1 to September 30). 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 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 (Zieg et al. 2018). Diversion of water from Sheep Creek when flows exceed 84 cfs would be based on a new water right and is subject to review and approval by the DNRC. Based on the baseline data collected for the Project, flows would exceed 84 cfs in May and June, providing the water to the NCWR required to address depletion of surface water flow in the affected watersheds associated with consumptive use of groundwater during operations. No adverse effects are predicted to occur to surface water and groundwater as a result of Project development based on results of the quantitative predictive models developed for the Project and the Proposed Action, which includes augmentation from the NCWR during low flow. The reliability of the model predictions was assessed considering data limitations and through completion of a model sensitivity analysis, as is standard practice. The Proposed Action and AMA require the Proponent to conduct groundwater and surface water monitoring.
BBC00510	1	Grayce Holzheimer		Email	Montana Fishing Guide - now signifies with a symbol of a skull and crossbones that every single lake in the state of Montana is contaminated with high levels of mercury and other toxic materials and mothers who are pregnant and infants and children should not eat the fish out of these lakes. Every single lake in Montana.	Thank you for your comment. Metals in fish are discussed in Section 3.16.2.3 of the EIS. Also refer to the "Montana Sport Fish Consumption Guidelines" (FWP et al. 2014.). Fish from many waterbodies have not been tested for contaminants; therefore, as a precaution, certain sensitive human populations should limit consumption of certain types of fish, particularly if it is not known whether the lake they are fishing in has been tested or not.
BBC00598	4	Kim Stromberg		Email	The DEIS did not adequately characterize the fish populations and other aquatic life in Sheep Creek, other local tributary streams, and the Smith River that will be impacted if the Black Butte copper mine is built. Without this baseline information, it will be impossible to accurately gauge whether and to what extent the mine is adversely impacting aquatic life.	See Consolidated Response AQ-2.
BBC00616	5	Jes Falvey		Email	10. Fish population analyses are incomplete, and existing data was misrepresented. Brook and brown trout were lumped together in some reports, and sculpin populations were presented in the same graphs as trout. 11. Size and frequency-of-length were not considered in evaluating the impact on fish populations—will a certain size class be harmed more substantially than another? This could significantly decrease reproductive success.	See Consolidated Response AQ-2.
BBC00967	5	Katie Gaut		Email	10. Fish population analyses are incomplete, and existing data was misrepresented. Brook and brown trout were lumped together in some reports, and sculpin populations were presented in the same graphs as trout. 11. Size and frequency-of-length were not considered in evaluating the impact on fish populations—will a certain size class be harmed more substantially than another? This could significantly decrease reproductive success.	See Consolidated Response AQ-2.

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BBC00973	3	Jim Parker		Email	Regarding the fish report. This section was done wrong. Fish population analyses are incomplete, and existing data was misrepresented and must be fixed. 1] Brook and brown trout were lumped together in some reports, and sculpin populations were presented in the same graphs as trout; 2] Size and frequency-of-length were not considered in evaluating the impact on fish populations—will a certain size class be harmed more substantially than another? This could significantly decrease reproductive success. Fully analysis is mandated. This must be fully acknowledged and completed correctly before any more steps are taken.	See Consolidated Response AQ-2.
BBC00978	5	Bruce Farling		Email	The DEIS indicates that the measures for collecting fishery data improved from the first report submitted for the mine permit application. Collecting population data using a multiple-pass depletion method with block nets and longer sample sections should have resulted in more confidence in the data. However the utility of the data displayed is constrained and thus poses challenges for determining potential effects from the mine. For instance: • Figures 3.16-2, 3-16-3 and 3.16.4, which purport to show abundance data for salmonids and Rocky Mountain sculpin are difficult to read in the electronic version of the DEIS. They are fuzzy and look like bad photocopies. Further, it's odd that sculpin are included in the same figures as the salmonids because the bar indicating their numbers can't even fit into the graphs, while the salmonid bars and error bars, in attempt to get all the fish data in one figure, look minuscule in comparison and thus misleading. Sculpin data should be in a separate figure. • In order to determine the effects of metals mining on fish it is important to consider how metals and other pollutants effect fish populations. Simple "abundance" is not enough. Generally, abundance can be adversely affected by the chronic and acute effects of total and dissolved metals in the water column, food chain impacts resulting from metals accumulation in sediments and organisms lower on the trophic scale, and avoidance of certain reaches because of the presence of warm water or high concentrations of metals in the water column can agitate gills or otherwise interfere with respiration. The literature is rife with good examples of these relationships, among the best produced was for the natural resource damage claim the State of Montana filed to compensate for damages in the upper Clark Fork River basin. In addition to metals contamination, nutrients generated by mining that trigger unnatural concentrations of algae contributing to reduced dissolved oxygen, as well as dewatering and temperature modifications caused by hydrological modifications, also adversely affect abundance. In order to determine whether the mine is harming a population of salmonids or other fishes, fishery data should be characterized for each species and, for salmonids at least, include information on length-frequency distribution, length/weight ratios (to determine condition), total biomass, observed fitness and fish distribution. Because mine-related impacts such as metals pollution can inordinately affect reproductive success as well as young fish, getting size class distribution information is important. Similarly, metals and other pollutants can reduce food resources, and thus condition factors in fish can be affected. Moreover, metals, temperature changes and reduced foraging can cumulatively cause stress that affect condition, ability to reproduce and health (making fish more susceptible	See Consolidated Responses AQ-1, AQ-2, AQ-3, and AQ-4. The Draft EIS was drafted prior to the release of the literature cited (Lance 2019) by the commentor, which does not seem to be publically available and therefore was not included in the Final EIS.

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					to pathogens). Yes, all these items can affect overall population abundance. However, in order to better track the direct influences of metals mining it is important to include data on length-frequency distribution, condition factors, distribution, total biomass and where the fish are encountered (distribution). These data are not in the DEIS, though the consultant might have collected them. If so, they should be included in the DEIS to more accurately identify a baseline for subsequent monitoring. • It is beneficial that Tintina collected redd count data. But it is not as helpful when the data displayed such as in 3.16-7 appears to combine data for brown and brook trout. Further, though the DEIS says that redd count data were collected in 2016 and 2017, the only location information shown is for 2016 (Figure 3.16-6). Where for example were the additional redd count reaches on Moose Creek? • The DEIS only briefly touches on fish movement within the upper Smith River watershed, including Sheep Creek and its tributaries. It mentions briefly an MTFWP telemetry study from 2012 (Grisak 2012), as well as fish encountered from a recent FWP/MSU PIT tag study (2014-2018). The DEIS mentions only in passing that fish move throughout the Smith River watershed, including in and out of Sheep Creek and its tributaries. However, the DEIS should have elaborated on findings that demonstrate exactly how important Sheep Creek and its tributaries are to recruitment of fish to the main stem Smith River (and possibly the Missouri River). It is important not to gloss over fish movement information, which the DEIS does, because it indicates that indeed Smith River resources – fish that people angle for there – can be affected by mining that can potentially harm one of the river's primary recruitment sources, Sheep Creek and its tributaries. A report from the primary investigator for the PIT study to FWP and project funding sources (Lance 2019) includes important information that should have been included in the DEIS and part of any evaluation of potential impacts on resident and migratory fish in Sheep Creek and the Smith River. Among the findings: • Since 2014, the study tagged 7,621 fish with unique PIT tags, including, among other species, brown and rainbow trout, mountain whitefish and burbot. This is a huge sample size, indicating conclusions on fish movement are on solid ground. 35,283 movements were logged, representing 5,763 fish – data that provide compelling insights about the importance of fish movement. • Migrant diversity was most pronounced in the main-stem Smith River and "along most of the length of Sheep Creek." This indicates a lot of different fish of varying species move in and out of Sheep Creek and disperse throughout the Smith River drainage. • Access for whitefish and rainbow trout into Tenderfoot Creek AND Sheep Creek is critical for the overall Smith River whitefish and rainbow populations. • "Juveniles (rainbows) tagged in Sheep Creek moved throughout the entire Smith River drainage from Birch Creek to Truly Bridge near the Missouri." This demonstrates that Sheep Creek is crucial for rainbow trout recruitment for much of the length of the Smith River. • Rainbow trout from throughout the watershed moved into Sheep Creek for spawning. Mountain whitefish moved into Sheep Creek during spring and summer for feeding and thermal refuge (indicating the importance of avoiding	

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					increasing temperatures in Sheep Creek). Mountain whitefish also moved into Sheep Creek to spawn, and…"Brown trout moved from upper Sheep Creek to spawn in Birch Creek." This information highlights how important Sheep Creek is to the fishery of the entire Smith River drainage, a finding that is not disclosed or evaluated appreciably in the DEIS. It also calls into question DEQ's premature conclusion that the Black Butte Mine will have no effect on the Smith River, its fishery and the anglers who visit it.	
BBC00978	5a	Bruce Farling		Email	The DEIS indicates that the measures for collecting fishery data improved from the first report submitted for the mine permit application. Collecting population data using a multiple-pass depletion method with block nets and longer sample sections should have resulted in more confidence in the data. However the utility of the data displayed is constrained and thus poses challenges for determining potential effects from the mine. For instance: • Figures 3.16-2, 3-16-3 and 3.16.4, which purport to show abundance data for salmonids and Rocky Mountain sculpin are difficult to read in the electronic version of the DEIS. They are fuzzy and look like bad photocopies. Further, it's odd that sculpin are included in the same figures as the salmonids because the bar indicating their numbers can't even fit into the graphs, while the salmonid bars and error bars, in attempt to get all the fish data in one figure, look minuscule in comparison and thus misleading. Sculpin data should be in a separate figure.	See Consolidated Response AQ-2.
BBC00978	5b	Bruce Farling		Email	In order to determine the effects of metals mining on fish it is important to consider how metals and other pollutants effect fish populations. Simple "abundance" is not enough. Generally, abundance can be adversely affected by the chronic and acute effects of total and dissolved metals in the water column, food chain impacts resulting from metals accumulation in sediments and organisms lower on the trophic scale, and avoidance of certain reaches because of the presence of warm water or high concentrations of metals in the water column can agitate gills or otherwise interfere with respiration. The literature is rife with good examples of these relationships, among the best produced was for the natural resource damage claim the State of Montana filed to compensate for damages in the upper Clark Fork River basin. In addition to metals contamination, nutrients generated by mining that trigger unnatural concentrations of algae contributing to reduced dissolved oxygen, as well as dewatering and temperature modifications caused by hydrological modifications, also adversely affect abundance. In order to determine whether the mine is harming a population of salmonids or other fishes, fishery data should be characterized for each species and, for salmonids at least, include information on length-frequency distribution, length/weight ratios (to determine condition), total biomass, observed fitness and fish distribution. Because mine-related impacts such as metals pollution can inordinately affect reproductive success as well as young fish, getting size class distribution information is important. Similarly, metals and other pollutants can reduce food resources, and thus condition factors in fish can be affected. Moreover, metals, temperature changes and reduced foraging can cumulatively cause stress that affect condition, ability to reproduce and health (making fish more susceptible to pathogens). Yes, all these items can affect overall population abundance.	See Consolidated Responses AQ-2, AQ-3, and AQ-4.

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					However, in order to better track the direct influences of metals mining it is important to include data on length-frequency distribution, condition factors, distribution, total biomass and where the fish are encountered (distribution). These data are not in the DEIS, though the consultant might have collected them. If so, they should be included in the DEIS to more accurately identify a baseline for subsequent monitoring.	
BBC00978	5c	Bruce Farling		Email	It is beneficial that Tintina collected redd count data. But it is not as helpful when the data displayed such as in 3.16-7 appears to combine data for brown and brook trout. Further, though the DEIS says that redd count data were collected in 2016 and 2017, the only location information shown is for 2016 (Figure 3.16-6). Where for example were the additional redd count reaches on Moose Creek?	See Consolidated Response AQ-2.
BBC00978	5d	Bruce Farling		Email	The DEIS only briefly touches on fish movement within the upper Smith River watershed, including Sheep Creek and its tributaries. It mentions briefly an MTFWP telemetry study from 2012 (Grisak 2012), as well as fish encountered from a recent FWP/MSU PIT tag study (2014-2018). The DEIS mentions only in passing that fish move throughout the Smith River watershed, including in and out of Sheep Creek and its tributaries. However, the DEIS should have elaborated on findings that demonstrate exactly how important Sheep Creek and its tributaries are to recruitment of fish to the main stem Smith River (and possibly the Missouri River). It is important not to gloss over fish movement information, which the DEIS does, because it indicates that indeed Smith River resources – fish that people angle for there – can be affected by mining that can potentially harm one of the river's primary recruitment sources, Sheep Creek and its tributaries. A report from the primary investigator for the PIT study to FWP and project funding sources (Lance 2019) includes important information that should have been included in the DEIS and part of any evaluation of potential impacts on resident and migratory fish in Sheep Creek and the Smith River. Among the findings: • Since 2014, the study tagged 7,621 fish with unique PIT tags, including, among other species, brown and rainbow trout, mountain whitefish and burbot. This is a huge sample size, indicating conclusions on fish movement are on solid ground. 35,283 movements were logged, representing 5,763 fish – data that provide compelling insights about the importance of fish movement. • Migrant diversity was most pronounced in the main-stem Smith River and "along most of the length of Sheep Creek." This indicates a lot of different fish of varying species move in and out of Sheep Creek and disperse throughout the Smith River drainage. • Access for whitefish and rainbow trout into Tenderfoot Creek AND Sheep Creek is critical for the overall Smith River whitefish and rainbow populations. • "Juveniles (rainbows) tagged in Sheep Creek moved throughout the entire Smith River drainage from Birch Creek to Truly Bridge near the Missouri." This demonstrates that Sheep Creek is crucial for rainbow trout recruitment for much of the length of the Smith River. • Rainbow trout from throughout the watershed moved into Sheep Creek for spawning. Mountain whitefish moved into Sheep Creek during spring and summer for feeding and thermal refuge (indicating the importance of avoiding increasing temperatures in Sheep Creek).	The Draft EIS was drafted prior to the release of the literature cited (Lance 2019) by the commentor, which does not seem to be publically available and therefore was not included in the Final EIS.

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					Mountain whitefish also moved into Sheep Creek to spawn, and…"Brown trout moved from upper Sheep Creek to spawn in Birch Creek." This information highlights how important Sheep Creek is to the fishery of the entire Smith River drainage, a finding that is not disclosed or evaluated appreciably in the DEIS. It also calls into question DEQ's premature conclusion that the Black Butte Mine will have no effect on the Smith River, its fishery and the anglers who visit it.	
BBC01014	2	Guido and Lee Rahr		Email	Lack of robust baseline for aquatic biota. There will be no way to measure the future impacts of this project without a more comprehensive baseline of aquatic fauna and flora in both Sheep Creek and the Smith River itself. Specifically, the impacts of temperature water temperature increases in July and August and pollution impacts of aquatic macro invertebrates and fish.	See Consolidated Responses AQ-2 and AQ-4.
BBC01067	5	John W. Herrin		Email	f. Is aluminum in fish in the area an health concern? g. What about the e coli. Is the source livestock and what health concern does it pose people like irrigators, fishermen or children coming in contact with the Sheep Creek Water.	See Consolidated Response AQ-3. 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. 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. Most strains of E. coli are harmless, but a few can cause severe abdominal cramps, diarrhea, and vomiting. 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; according to the DEQ TMDL Program website last updated in 2017 (DEQ 2017), the baseline data 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.
Cultural Resources						
HC-002	10	William Avey	USDA Forest Service	Hard Copy Letter	In response to a previous public notice for the same project, a letter was mailed to your office, dated December 15, 2016, accompanied by a confidential map. The information and concerns that it contains are still valid. Direct and indirect impacts to adjacent and line-of-site cultural resources, on National Forest lands, should be considered. Please reach out to one of the contacts listed below if you need another copy.	DEQ met with Forest Service archaeologist Mark Bodily on January 11, 2017, to discuss the Proposed Action and possible treatments and/or mitigations to sites of concern on Forest Service lands. This meeting was summarized by a follow-up letter dated January 11, 2017 from Mr. Bodily (USDA 2017). All of the suggested treatments and mitigations for sites with potential adverse effects, including 24ME1111, are still under consideration and have not been finalized. As was acknowledged in the January 12 letter, all actions being taken to minimize effects to cultural resources are being done on a voluntary basis by the proponent.
BBC00700	1	John Murray, THPO	Blackfeet Nation	Email	...as the Blackfeet THPO, I am requesting a traditional land use study (ethnography) be conducted of the area before construction can begin.	Under the requirements of the MMRA, MPDES, or a MAQP, DEQ cannot require an applicant to conduct a traditional land use study. The Proponent and the Blackfeet Nation are welcome to work together in conducting this study. DEQ has forwarded your request on to the Proponent.
BBC00843	4	Dave Keddell		Email	There is a statement in the DEQ EIS referencing a federal law (Section 106) which applies to federal agencies. The statement is "the project's location is on private land and there is no federal involvement therefore the federal laws relating to the protection of cultural resources (e.g. Section 106 of the National	Section 106 of the NHPA applies when there is a federal undertaking, which is a project, activity, or program either funded, permitted, licensed, or approved by a federal agency. The Black Butte Copper Project as a whole is not funded, permitted, licensed, or approved by a federal agency, so it does not fall under

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					Historic Preservation Act) do not apply." It is not a state responsibility to make the declaration that 106 does not apply. Section 106 applies to all land (federal, state or private). Why was there no information in the EIS from the federal agencies to confirm the 106 process was complete? One of the shortcomings of this EIS is the DEQ making declarations without the appropriate backup for actions taken by others. The federal involvement in this project consists of at least the EPA for Air quality, noise pollution and the Corps of Engineers wetland permit. The Corps permit is for wetland fills and stream crossings requiring fills which are the sole access to the project. When a Corps permit is controlling the access to the site then their permit area is the entire project area and not just the culvert. All federal entities such as the Corps and EPA involved in any way in a project must make their own declaration of applicability for 106. Since there is federal involvement for this project, Section 106 does appear to apply. Did the DEQ coordinate with the federal agencies before making their inappropriate declaration that 106 does not apply to the project? Why were the federal approvals and findings not documented in the EIS by adding those documents in the amendments of the EIS? The state comment about 106 with appropriate backup should be that……. the federal agencies involved have found that 106 does or does not apply, see attached approvals. Did the SHPO coordinate with Advisory Council on Historic Preservation (ACHP) and the federal agencies along with any interested tribes to address historic areas that may be included nationally under 106? If such properties exist then the SHPO should be coordinating with ACHP about those properties and cultural landscapes. Why is there no information about the SHPO work for determining potential effects on this project? Explanations of why there is or is not an effect is important. Were the owners of properties which are historic coordinated with and advised of the SHPO decisions on potential effects? Summary comments from DEQ do not provide enough information for the public to review and comment on.	requirements of Section 106 of the NHPA. Neither the USEPA nor USACE identified historic properties within their permitted areas within the Project area. The USACE consulted with the SHPO and Indian tribes, and no adverse effects to historic properties were identified within the Project area. The Advisory Council on Historic Preservation (ACHP) is consulted if a federal agency finds there is an adverse effect to a historic property (i.e., a cultural resource listed or eligible for listing in the NRHP) where impacts cannot be avoided, minimized, or mitigated. There are no adverse effects to historic properties under federal or state jurisdiction, so DEQ did not consult with the ACHP for the Project.
BBC00843	6	Dave Keddell		Email	After this primer, was any process initiated with ACHP at any government level? Are the properties and cultural areas of federal interest identified to ACHP so they know such properties will have issues? If the SHPO took the time to have properties nationally listed or identified as potentially nationally listable to ACHP, should ACHP be alerted to what will happen by the SHPO and DEQ? What a surprise it will be to ACHP if at some future time the national records at ACHP are a waste.	Section 106 of the NHPA applies when there is a federal undertaking, which is a project, activity, or program either funded, permitted, licensed, or approved by a federal agency. The Black Butte Copper Project as a whole is not funded, permitted, licensed, or approved by a federal agency so it does not fall under requirements of Section 106 of the NHPA. Neither the USEPA nor USACE identified historic properties within their permitted areas within the Project area. The USACE consulted with SHPO and Indian tribes, and no adverse effects to historic properties were identified within the Project area. The ACHP is consulted if a federal agency finds there is an adverse effect to a historic property (i.e., a cultural resource listed or eligible for listing in the NRHP) where impacts cannot be avoided, minimized, or mitigated. There are no adverse effects to historic properties under federal or state jurisdiction, so DEQ did not consult with the ACHP for the Project.

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Cumulative Impacts						
PM1-03	1	David Brooks	Montana Trout Unlimited	Public Meeting Transcript	I want to focus on one section of the draft EIS tonight, and that's the cumulative impact section. That section begins with this definition of cumulative impacts: Cumulative impacts are "changes to resources that can occur when incremental impacts from one project combine with impacts from other past, present, and future projects." Given that definition within the Draft EIS, it's clear that this document has failed to address risks that would be compounded by the expansion of this mine. A future action, as per the definition of cumulative impacts, that's related to this mine in terms of its expansion is far from being hypothetical. The company proposing this project promotes the expansion of this mine to shareholders. They've done so publicly, including claiming that this mine could be a 50-year project and a major mining complex, with a much bigger footprint and hence much bigger impacts to the environment. The company has identified additional ore bodies already that are in the Draft EIS. Once infrastructure has been built and investment has been made in the toehold project that is now being proposed, it's, quite frankly, ludicrous to expect that there would not be expansion, that that would not happen. And finally, the company has heavily invested in more than 500 mining claims on more than 10,000 acres of public land surrounding the current project, which is, again, an indication of intent to expand.	See Consolidated Response CUM-1. The Proponent's past exploration activities have identified another copper deposit (referred to as the Lowry deposit) in the area; it is not known at this time whether that deposit could be economically developed as a mine. From a practical standpoint, DEQ cannot evaluate the potential impacts associated with the development of this deposit at this time because no preliminary mine design information is available and any analysis would be far too speculative. No baseline hydrogeologic data have been collected at that site, and no geochemical testing is known to have occurred to date. The commenter cites a sentence generally characterizing "cumulative impacts." The statutory definition of "cumulative impacts" is set forth in § 75-1-220(4), MCA, as follows: "'Cumulative impacts' means 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." The definition of "cumulative impact" in ARM 17.4.603(7) adds the additional provision that, "Related future actions must also be considered when these actions are under concurrent consideration by any state agency through preimpact studies, separate impact statement evaluation, or permit processing procedures." While the Proponent may have made statements to its shareholders that it has identified an additional copper deposit and that the mine could be expanded to have a 50-year mine life, this is not a related future action under ARM 17.4.603(7) because it is not under concurrent consideration by any state agency through preimpact studies, separate impact statement evaluation, or permit processing procedures. Despite forward-looking statements made to shareholders, the Proponent may not pursue mining of the additional ore deposit. Should DEQ approve the Proponent's current permit application and the Proponent decides in the future to mine the Lowry deposit, the Proponent would have to apply for an amendment to the operating permit, which would involve a future state action requiring its own environmental review under MEPA.
PM1-03	2	David Brooks	Montana Trout Unlimited	Public Meeting Transcript	We will have similar other comments about other cumulative impacts, such as climate change, which the Draft EIS also ignores or dismisses, and the need to address those kind of impacts to water quality, water quantity, habitat, and even mine operations. The point I will leave with is that any expansion of this mine, as there is evidence will happen, will exacerbate or increase the risk of any other possible impacts that you may hear about tonight or during the other comments: Water quantity, water quality, mine operations.	See Consolidated Response CUM-1 and MEPA-2.
PM2-03	2	Jeannette Blank		Public Meeting Transcript	The other two that I think are really important are the -- one is related to subsequent development of existing mineral rights that this company has. I believe they're currently exploring those minerals right now, and I think that it's important to understand whether this mine is generating the income needed to further develop those mineral rights. And if that's so, then that is a connected action, and the impacts of that further exploration/development should be assessed as well.	See Consolidated Response CUM-1.

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PM2-10	6	Mike Fiebig	Northern Rockies office of American Rivers	Public Meeting Transcript	We also have concerns about the cumulative effects section of the EIS and the fact that Sandfire holds 525 mining claims on nearly 10,000 acres of adjacent federal lands in the vicinity. And the former CEO told potential investors that the company plans to create a 50-year industrial mining district in the vicinity. We believe that these cumulative effects should also be analyzed within the DEIS.	See Consolidated Response CUM-1.
PM2-11	2	Max Hjortsberg	Park County Environmental Council	Public Meeting Transcript	And also to add to that, the operations and everything that are spelled out are for the existing mine as it is, but as others have pointed out, there is a lot of room and a lot of potential for expansion. And if that expansion will continue to be handled by the facilities as they are, or if those facilities need to change and expand with the mine, and, with that, could that increase the impacts?	See Consolidated Response CUM-1.
PM4-05	1	Derf Johnson	MEIC	Public Meeting Transcript	I just wanted to raise one issue in particular that I think that the EIS really failed entirely in capturing, and that's that Tintina, now Sandfire, plans to turn this into a 50-year mining district. They've acquired the mineral leases from private parties. They have federal claims. They're selling this to investors as such. They've done additional mineral -- additional drilling over in the Lowry Deposit. For all intents and purposes, that's their end goal. And I think it's wrong to segment this out and only look at the smaller impacts associated with just the Johnny Lee copper deposit.	See Consolidated Response CUM-1.
PM4-11	1	Chris Phelps		Public Meeting Transcript	I want to second what Derf mentioned about establishing a 50-year mining district and that the DEIS should evaluate that as well. I'm aware of ranchers who have property that borders the Smith that have been approached three years ago about leasing their land to the mine. So I think it's a little bit disingenuous of Sandfire-slash-Tintina to say that they're protecting -- their plan is to protect the river, it's going to be environmentally safe, when they're going to be leasing mineral rights right on the riverbank of the Smith River.	See Consolidated Response CUM-1.
PM5-01	6	Linda Semones		Public Meeting Transcript	The company is saying that the permit will be for 15 years. And I looked on the website, and it shows a 50-year development plan. I also understand it's bought the mineral rights from landowners all around the currently mapped mine site. So why is this deception being allowed? Why are we not planning for 50 years and basing the impact statement on a 50-year time period? Are the liners in the tailing ponds guaranteed to last 50 years? As far as I know, liners always break; it's just a matter of time. And I feel like we're courting an environmental disaster here if this river -- if this mine is permitted.	See Consolidated Response CUM-1.
HC-003	8	Josh Purtle	Earth Justice	Hard Copy Letter	On the substance, the Draft EIS fails first to discuss the impacts of future mining operations Tintina has planned for the mine site, and which will be facilitated by the mine infrastructure Tintina would build according to the plan of operations now before DEQ.	See Consolidated Response CUM-1.
HC-003	17	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS improperly omits analysis of the full scope of Tintina's foreseeable operations. Documents available in the public record and statements by the company disclose Tintina's plans to expand the Black Butte mine in the future to encompass additional copper deposits in the project area, including the so-called Lowry deposit. See, e.g., Exhibit 13 at 3-4 (Sandfire Resources NL, Sandfire Secures Cornerstone Position in Advanced, High-Grade USA Copper Project (Aug. 28, 2014)) (describing Lowry deposit, which is separate from the Johnny Lee copper deposit described in Tintina's plan of	See Consolidated Response CUM-1.

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					operations). This expanded mining would, of course, involve significant additional impacts, including additional drawdown (due to expanded mine workings), additional waste production, and prolonged disturbance ofthe project area, among other impacts. DEQ declined to consider these impacts, however, because future expansion is not "currently proposed or under consideration by any agency." Draft EIS at 4-7.	
HC-003	85	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS fails to rationally analyze the potential cumulative impacts caused by the mine and other projects in the area. The Draft EIS dismisses several classes of cumulative impacts on the ground that impacts from the Black Butte Mine will not physically "overlap" with impacts from other activities in the region. See., e.g., Draft EIS at 4-11. However, cumulative impacts are not limited to impacts that cause overlapping harm to the same area or the same animals. Cumulative impacts under MEPA are broader, and include "the collective impacts on the human environment within the borders of Montana ofthe proposed action when considered in conjunction" with other state actions. MCA § 75-1-220(4). Thus, there is a cumulative impact if 600 acres of wildlife habitat are eliminated by one project in one area, and another 600 acres are eliminated by another project in another area: the collective effect on the environment in the region is a cumulative 1200 acres of lost habitat. DEQ should correct this error and disclose "the collective impacts" on the human environment of the Black Butte Mine and other projects in the region. MCA § 75-1-220(4).	Chapter 4, Cumulative, Unavoidable, Irreversible and Irretrievable, and Secondary Impacts and Regulatory Restrictions, of the Final EIS has been revised by replacing the term "overlap" and "overlapping" impacts with more encompassing terms such as, "in conjunction with," and "in combination with," or "cumulative" impacts to better reflect the extent to which cumulative impacts were evaluated. Cumulative impacts are defined under § 75-1-220(4), MCA, and are defined in Section 4.1, Methodology, of the Final EIS 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." The last portion of the definition that states, "...the past, present, and future actions related to the proposed action by location or generic type," determines the scope of the cumulative area under MEPA. In each resource section of the EIS, the cumulative study areas are defined by considering the location and generic type of activity that, in combination with the Project, could impact a particular resource. The commenter fails to quote the entire definition of cumulative impacts in their comment. The Final EIS includes the entire definition of cumulative impacts per MCA and ARM. The statutory definition of "cumulative impacts" is set forth in § 75-1-220(4), MCA, as follows: " 'Cumulative impacts' means 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." The definition of "cumulative impact" in ARM 17.4.603(7) adds the additional provision that, "Related future actions must also be considered when these actions are under concurrent consideration by any state agency through preimpact studies, separate impact statement evaluation, or permit processing procedures." The portion of the definition which states "...the past, present, and future actions related to the proposed action by location or generic type" narrows the scope of the cumulative area under MEPA and does not broaden it as the commenter would suggest. As an agency subject to the laws of Montana, DEQ has to look at the entire definition when conducting its analysis. In each resource section of the EIS, the cumulative study areas are defined by the location and generic type of activity, as provided in the definition of cumulative impacts.
HC-003	86	Josh Purtle	Earth Justice	Hard Copy Letter	For example, the Draft EIS fails to fully analyze the potential for cumulative impacts to air quality. DEQ's air quality model for the mine indicates that particulate emissions from mine facilities are likely to reach 80% of the national ambient air quality standard for the project area. Draft EIS at 3.2-31. The Draft EIS does not analyze, however, whether other potential sources in the region, combined with these high emissions from the mine, could cause an air quality standard exceedance. In fact, the Draft EIS acknowledges that	The impacts of existing projects and activities in the region are included in the monitored air pollutant background concentrations that were included in the air modeling to assess conformance with NAAQS and MAAQS. The modeled Project impacts were added to the monitored background as a measure of air quality characteristics after Project implementation. As a result, the cumulative effects of the existing projects plus the Project sources are reflected in the NAAQS analysis results. See Section 3.2.4.2, Proposed Action; Figures 3.2-2 and

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					controlled burns associated with the Castle Mountains Restoration Project in the nearby Helena-Lewis and Clark National Forest will also produce particulate emissions, but summarily dismisses these impacts because they will occur 15 to 20 miles away from the project site and will be "temporary." Draft EIS at 4-9-4-10. The Draft EIS does not explain, however, why the distance from the project site and temporary duration of particulate emissions from controlled fires will avoid any risk of an air quality standard violation, including a temporary violation. Similarly, it is likely that natural wildfires during the summer months could, when combined with emissions from the mine, cause significant levels of particulate pollution in the region. The EIS should analyze whether these and other pollutant sources in the area could cause the mine emissions to contribute to a temporary violation of national ambient air quality standards for particulate emissions.	3.2-5; and Tables 3.2-8 and 3.2-9 of the EIS. Fires, including controlled burns, can have adverse impacts that can temporarily exceed NAAQS, usually for PM_{10}; however, these temporary exceedances would occur with or without the Project. See also Consolidated Response CUM-2.
HC-003	87	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS should also consider the cumulative impacts of the Black Butte Mine in conjunction with the effects of climate change. For example, the Draft EIS does not consider the cumulative effects of flow reductions in surface waters due to mine operations together with the impacts of climate change on stream flows. In this regard, the Draft EIS predicts a 3-4% reduction in flows in Black Butte Creek due to mine drawdown, Draft EIS at 3.5-14, but does not provide any analysis of the cumulative effects of these reduced stream flows in conjunction with possible additional stream flow reductions associated with climate change. See Exhibit 50 at 14 (Mont. Inst. on Ecosystems, 2017 Montana Climate Assessment, Executive Summary (Sept. 2017)). In fact, the Draft EIS's analysis of cumulative impacts does not mention climate change at all. DEQ should evaluate and disclose these potential cumulative impacts as well.	See Consolidated Response MEPA-2.
BBC00830	18	Kendra Zamzow	Center for Science in Public Participation	Email	The steepness of the beach slope affects the total storage volume in the storage facility and the frequency with which perimeter dams need to be raised. It is not uncommon for tailings facilities to be expanded, including with the construction of upstream dams on the tailings. This is activity that could conceivably be considered if the Lowry deposit were to be mined; 3 Lowry is expected to add another 3 years to the mine operation life. Although the Lowry deposit is not considered in this DEIS, the potential for CTF expansion should be built into the design as a reasonable cumulative effect.	See Consolidated Response CUM-1.
BBC00884	9	Scott Bosse	American Rivers	Email	In chapter 4 of the DEIS, cumulative impacts are defined 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). While the cumulative effects chapter included a discussion of past mining activities in the project area dating back to 1973, and it examined potential impacts of the Black Butte Copper Project from the time it would be constructed until the anticipated end of its lifespan in 2037, it did not include a discussion of future impacts that would occur from additional mining in the vicinity beyond 2037. Such a discussion is of paramount importance because Tintina holds 525 mining claims on nearly 10,000 acres of adjacent federal lands, and the company's former CEO, Bruce Hooper, is on record telling	See Consolidated Response CUM-1.

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					potential investors that the company plans to create a 50-year industrial mining district in the vicinity. The cumulative effects analysis should reveal whether open pit mining of nearby copper deposits would be allowed, and if so, what environmental impacts that would have on land, water, fish and wildlife resources. In addition, the cumulative effects analysis did not consider a broad enough geography, particularly when it comes to the potential impacts of the project on aquatic life. Page 4-2 of the DEIS shows that the assessment area for aquatic biology impacts is limited to the Sheep Creek watershed, tributaries that feed Sheep Creek, and Black Butte Creek. This assessment area should be expanded to include the entire Smith River system, as recent research has demonstrated that rainbow trout and other fish species that utilize Sheep Creek migrate long distances, including to the Missouri River.	
HC_043_Jim Steitz_U	4	Jim Steitz		Hard Copy Letter	Moreover, the company's own representations to its investors conflict with the DEIS cumulative impact analysis. While DEIS evaluates impacts over a time horizon to 2037, the fmmer CEO has said, to his purely financially motivated audience, the company's intentions for a 50-year industrial mining district. Given Sandfire's possession of 525 mining claims on nearly 10,000 acres of adjacent federal lands, this is no idle threat, and MDEQ cannot ignore these explicit threats in delineating the scope of its analysis. The 'Lowry Deposit,' immediately adjacent to the existing ore, appears to be next in succession for Sandfire's plan for sequential, creeping exploitation. If this company is allowed to strike its first blow against the precious Smith River, its thirst for profitable Montana copper, regardless of the devastation to the vibrant ecosystems above, will become unquenchable.	See Consolidated Response CUM-1.
HC_044_William Adams_U	4	William Adams		Hard Copy Letter	4) The DEIS evaluates an artificially small mine footprint because it fails to consider the cumulative effects of mining the Lowry Deposit which is immediately adjacent to the existing ore deposit.	See Consolidated Response CUM-1.
BBC00727	1	William B Webb		Email	The cumulative effects section of the DEIS evaluated impacts of the Black Butte mine only until the year 2037, but Sandfire holds 525 mining claims on nearly 10,000 acres of adjacent federal lands and the former CEO told potential investors that the company plans to create a 50-year industrial mining district in the vicinity. Both the timescale and geographic scope of the cumulative effects analysis need to be broadened.	See Consolidated Response CUM-1.
BBC00884	7	Scott Bosse	American Rivers	Email	The cumulative effects analysis should reveal whether open pit mining of nearby copper deposits would be allowed, and if so, what environmental impacts that would have on land, water, fish and wildlife resources...This assessment area should be expanded to include the entire Smith River system, as recent research has demonstrated that rainbow trout and other fish species that utilize Sheep Creek migrate long distances, including to the Missouri River.	No existing or proposed open pit mines of copper deposits are in the proposed Project vicinity. Cumulative impacts related to the operation of existing mines was evaluated in Section 4.2.1.4, Existing Mines, of the EIS. Potential cumulative impacts were evaluated for air quality, transportation, and wildlife. As discussed in Section 3.4, Groundwater Hydrology, and Section 3.5, Surface Water Hydrology, of the EIS, 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. As further described in Consolidated Response AQ-1, the quantity of groundwater that currently flows through the underground copper deposits, and that would flow through the underground mine workings after mine closure, is very small compared with shallow groundwater flows or surface water flow rates. Geochemical predictions indicate that groundwater in these areas after mine closure would be similar in quality to existing conditions. Given that groundwater flow rates and quality near the

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						underground workings are projected to be similar post-closure to current conditions, the mine workings 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. Sections 3.5.3.1, Surface Water Quantity, and 3.5.3.2, Surface Water Quality and Temperature, of the EIS evaluated potential water quantity and quality impacts on surface water in the Smith River. Sheep Creek provides the only pathway of interaction for Project-related discharges to the Smith River. Water quantity impacts on the Smith River were evaluated as insignificant and water quality impacts were not identified. Similarly, Section 3.16.3.2, Proposed Action, of the EIS indicates that the Project would not likely have any direct or secondary impacts on aquatic life in the Smith River. The EIS also evaluates potential impacts on Smith River aquatic life that migrates into the Project area, which was identified as a potential minor impact with the use of BMPs and appropriate soil erosion and sediment controls. As such, cumulative impacts within the Smith River were identified as minor or less. Also, see additional information in the Consolidated Responses CUM-3 and AQ-1.
BBC00891	2	Robert Prince		Email	Sandfire has been clear about expanding and growing the operation into a 50-year mining district. The DEIS should evaluate the entirety of the project and its potential impacts, and not allow Sandfire to segment the analysis.	See Consolidated Response CUM-1.
BBC00992	5	Michael Enk		Email	The conclusion that environmental effects would therefore be minor when viewed from this larger perspective begins to lose credibility when the prospects of a more expansive, long-lived mining district is considered. Yet we are keenly aware of Tintina's acquisition of mineral rights for thousands of additional acres in the watershed and we've heard about their pitching to shareholders of potential future profits from the Black Butte area...At the very least, the DEIS should acknowledge this established interest in the broader area's mining potential and reassure the public that future proposals would be evaluated in the context of potential cumulative effects with this project.	See Consolidated Response CUM-1.
HC_036	2	Shelley Liknes	Fopp Family Trust	Hard Copy Letter	The spatial and temporal extent of cumulative impacts impacts for surface waters needs to include areas impacted by the proposed Tintina Montana's Black Butte Copper Mine Project. However, the effects analysis limited the surface water hydrology geographic extent where cumulative impacts from past, present, and future projects and actions could potentially impact the resource to just the Sheep Creek watershed. This is arbitrary and capricious based on the surface hydrology in the basin and lacks documentation that shows these extents used were based on the use of reasonable and rational boundaties.	The predictions and impact assessment as presented are considered appropriate and sufficient to support the EIS and associated mitigation and mine planning. As is standard practice, the EIS includes quantitative predictive surface water and groundwater modeling, not arbitrary or qualitative criteria, to support the impacts assessment, including the delineation of appropriate assessment boundaries. See additional information in the Consolidated Response CUM-3.
BBC00598	5	Kim Stromberg		Email	The cumulative effects section of the DEIS evaluated impacts of the Black Butte mine only until the year 2037, but Sandfire holds 525 mining claims on nearly 10,000 acres of adjacent federal lands and the former CEO told potential investors that the company plans to create a 50-year industrial mining district in the vicinity. Both the timescale and geographic scope of the cumulative effects analysis need to be broadened.	See Consolidated Response CUM-1.

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BBC00629	4	Cheryl C. Mitchell		Email	The cumulative effects section of the DEIS evaluated impacts of the Black Butte mine only until the year 2037, but Sandfire holds 525 mining claims on nearly 10,000 acres of adjacent federal lands and the former CEO told potential investors that the company plans to create a 50-year industrial mining district in the vicinity. Both the timescale and geographic scope of the cumulative effects analysis need to be broadened.	See Consolidated Response CUM-1.
BBC00787	4	Robin Tyner		Email	The cumulative effects section of the DEIS evaluated impacts of the Black Butte mine only until the year 2037, but Sandfire holds 525 mining claims on nearly 10,000 acres of adjacent federal lands and the former CEO told potential investors that the company plans to create a 50-year industrial mining district in the vicinity. Both the timescale and geographic scope of the cumulative effects analysis need to be broadened.	See Consolidated Response CUM-1.
BBC00847	3	Erin Sharaf		Email	• Sandfire has been clear about expanding and growing the operation into a 50-year mining district. The DEIS should evaluate the entirety of the project and its potential impacts, and not allow Sandfire to segment the analysis.	See Consolidated Response CUM-1.
BBC00917	2	John Rhodes		Email	5. Sandfire has been clear about expanding and growing the operation into a 50-year mining district. The DEIS should evaluate the entirety of the project and its potential impacts, and not allow Sandfire to segment the analysis	See Consolidated Response CUM-1.
BBC00919	4	Mark Giese		Email	The cumulative effects section of the DEIS evaluated impacts of the Black Butte mine only until the year 2037, but Sandfire holds 525 mining claims on nearly 10,000 acres of adjacent federal lands and the former CEO told potential investors that the company plans to create a 50-year industrial mining district in the vicinity. Both the timescale and geographic scope of the cumulative effects analysis need to be broadened.	See Consolidated Response CUM-1.
BBC00922	5	Chris Lish		Email	The DEIS evaluates an artificially small mine footprint because it fails to consider the cumulative effects of mining the Lowry Deposit that is immediately adjacent to the existing ore deposit even though the company is telling its investors that it is part of its mining plans for the area. The cumulative effects section of the DEIS evaluated impacts of the Black Butte mine only until the year 2037, but Sandfire holds 525 mining claims on nearly 10,000 acres of adjacent federal lands and the former CEO told potential investors that the company plans to create a 50-year industrial mining district in the vicinity. Both the timescale and geographic scope of the cumulative effects analysis need to be broadened.	See Consolidated Response CUM-1.
BBC00945	2	Michael Scott		Email	B. The environmental document does not analyze the potential impacts of full mine development. The environmental review is limited to the proposed action; an adit mine with a 10-14 year lifespan. However, Sandfire has secured rights to mine over a large area of private and public land in upper Sheep Creek. The company's filings with the SEC and prospectus for potential investors notes this opportunity. It's clear that a small underground mine is more of a prospecting opportunity than a reflection of buildout. The environmental document should be revised to include a thorough full-development scenario and an analysis of its potential impacts. This is only fair to the public and the company. For instance, it may be that proposed action analyzed in the environmental document uses up all the potential degradation increment allowable on Sheep Creek. If this is the case, subsequent development in the area could not be allowed. The company, and	See Consolidated Response CUM-1.

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					the public, need to know this up-front as it could well affect potential investor interest, the profitability of the company, and whether DEQ should grant a permit.	
BBC00931	3	Stuart Lewin		Email	The DRAFT EIS fails to cover the entire project at one time not just this initial phase. Further recently the mine and a citizen's group in Meager County has agreed there will be no open pit mining for 25 years. Does this mean that the mining company plans on open pit mining there after? This recent development and the potential for open pit mining in 25 years has not been considered in the draft EIS.	See Consolidated Response CUM-1.
BBC00931	7	Stuart Lewin		Email	The cumulative effects analysis in the DRAFT EIS is woefully inadequate. It fails to include the following analysis: 1. The cities of Great Falls and Fort Benton take their drinking water from the Missouri River (MR). The proposed mine is in the Sheep Creek drainage which is part of the headwaters of the Smith River which runs into the MR above the City of Great Falls intake pipes. 2. The MR below Great Falls but above Fort Benton is heavily impacted by mining waste from Belt Creek from underground mines around Belt. A million dollar study by the Butte School of Mines of the clean up costs concluded it was not economically feasible to stop the leakage from the underground mines into Belt Creek. 3. The City of Great Falls, Missouri River Corridor Plan (MRCP), listed 6 super fund sites some of which are migrating toward the MR on the City's bend of the river (see pages 24-26 of the MRCP). The DRAFT EIS does not consider the potential cumulative effects of mine leakage on the MR below these super fund sites, 7. The MR is heavily impacted from agricultural waste from the Sun River as it empties into the MR at Great Falls. The draft EIS does not consider acid drainage form the mines in the event of the failure of the mine's mitigation measures. 8. The Missouri River Urban Corridor Inventory and Assessment prepared by the Cascade County Conservation District and made a part of the MRCP mapped numerous discharge and withdrawal pipes on the 73,530 linear feet between White Bear Island and Black Eagle Dam. To date there has been no study of these pipes to determine what they are dumping in the river. The cumulative impact analysis under the DRAFT EIS has not considered the impact of these unregulated pipes to river quality when the potential of acid drainage from the mine is added into the mix.	Regarding comments 1, 2, 3, 7, and 8, 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, as discussed in Section 1.6.3.3, Cumulative Impacts, of the EIS. The impact assessment does not indicate that there would be a potential impact on the Missouri River as a result of the Project. See additional information in the Consolidated Response CUM-3.
BBC00931	8	Stuart Lewin		Email	The cumulative effects analysis in the DRAFT EIS is woefully inadequate. It fails to include the following analysis: 4. Recently the Great Falls Commissioners rezoned the West Gate Mall to heavy industrial use. This is resulting in doubling the output of the oil refinery (as reported in the Great Falls Tribune August 9, 2013). The refinery is a superfund site which under state law is currently permitted to leak into the MR because they are working to correct the problem (for many, many years we would add!!!). The DRAFT EIS fails to consider mine leakage on the pollution caused by the expanded refinery in Great Falls. 5. The Commissioners of Great Falls have also recently rezoned the area above	Regarding the other project comments (4, 5, and 6), see Consolidated Response CUM-2.

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					and adjacent to the Giant Springs State Park as heavy industrial and approved a TIFF to promote its development. The cumulative analysis of the DRAFT EIS fails to consider potential mine drainage on the increased pollution from the development of this Giant Springs Industrial Park development. 6. No environmental analysis by the state h·as been undertaken of which we are aware to consider the cumulative effects of both of these new industrial sites in the Missouri River Corridor to the MR. This analysis should consider the increased truck traffic in the MR corridor as a result of the approval of these two industrial rezones and the pollution caused to the river by this increased traffic when added to the potential acid drainage when the mines mitigation measure to prevent acid drainage fails.	
BBC00931	9	Stuart Lewin		Email	The cumulative effects analysis in the DRAFT EIS is woefully inadequate. It fails to include the following analysis: 9. Cumulative Impacts of the mine if all lands, mining claims currently owned by or leased to the mining company has not been analyzed under the EIS.	Regarding the mine expansion comment, see Consolidated Response CUM-1.
BBC00931	10	Stuart Lewin		Email	The cumulative effects analysis in the DRAFT EIS is woefully inadequate. It fails to include the following analysis: 10. The impact of beginning tremors etc of the nearby inactive caldera/ volcano on the cement technology proposed by Tentina to prevent acid drainage in not analyzed in the DRAFT EIS.	The MOP Application Section 1.4 (Tintina 2017a) and the Project EIS Section 3.6, Geology and Geochemistry, describe the geology of the region surrounding the Project area. Thrust faulting occurred near the Project area approximately 65 million years ago, and other igneous (volcanic) rocks intruded the much older Paleozoic and Belt Supergroup rocks that occur in the region. The most recent igneous activity occurred during the Eocene, between approximately 56 and 34 million years ago, meaning that the risk of current or future eruptions from these features is nonexistent. Caldera or volcanic features have not been identified in the region that could initiate seismic events (i.e., tremors) due to igneous activity. Movement along faults would be a more probable source of seismic events, and this was analyzed as part of the required stability analysis of the CTF (see Consolidated Responses PD-1 and PD-3).
BBC00931	11	Stuart Lewin		Email	The cumulative effects analysis in the DRAFT EIS is woefully inadequate. It fails to include the following analysis: 11 . The comment period does not allow the public adequate time to consider and meaningfully analyze this complex and long DRAFT EIS	Regarding the public comment process, see Consolidated Response MEPA-1.
BBC00957	4	Will Swearingen		Email	• Sandfire has been clear about expanding and growing the operation into a 50-year mining district. The DEIS should evaluate the entirety of the project and its potential impacts, and not allow Sandfire to segment the analysis. • The Australian-owned mining company pushing for this mine is cut-and-run when profitability ceases.	See Consolidated Response CUM-1.
BBC00960	3	Max Hjortsberg	Park County Environmental Council	Email	Connected Actions While the DEQ claims that there are no cumulative impacts, or related future actions due to there only being one proposal on the table, we think that is a narrow interpretation of the Montana Environmental Policy Act (MEPA). MEPA states: “Cumulative impacts” means 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. 75-1-208 (4) Sandfire has made statements, intimations and actions that imply the project will grow beyond its current scope and permitted plan. This clearly	See Consolidated Response CUM-1.

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					demonstrates that there will be cumulative impacts that need to be addressed prior to the commencement of the BBC mine operations. Sandfire has made statements that back this up. "Tintina's President and CEO Bruce Hooper has pitched interested investors in part on long-term exploration and mining potential for the area. Materials for prospective investors echo the possibilities, mentioning "numerous untested extensions along strike over 20km" and "district-wide potential to extend mine life and establish a 50-year district." (http://helenair.com/news/natural-resources/tintina-touts-potential-for--year-miningdistrict/article_17bef819-afa1-55d5-b8e7-2b72dfb52597.html) Hooper also added in the same Helena IR article that "Once it's in operation, then we'll certainly look to extend the mine life. That's a positive for the community we've invested in as well that it's not just a short-term operation and they'll benefit from any new discovery." Additionally, thousands of acres of mining claims outside of the current mine permit boundary on US Forest Service land back this prospect up. Mine expansion and longer term operations of the BBC are a significant concern. We recommend that the the DEQ and BBC address this concern in their Permit and in the DEIS as a future action and cumulative impact. All current operations, reclamation, and closure proposals can be considered inadequate and insufficient if BBC's mining operations are extended to a 50 year lifespan. Can a mine designed to operate for 20 years handle another 30 years without incident? Can reclamation and closure occur in the safe manner after the needed underground expansion to service the expanded operation? With an expanded mine operation, closure plans outlined in the DEIS are no longer sufficient. This issue needs to be addressed by DEQ prior to any authorizations to proceed with the BBC project.	
BBC00963	3	Brian S Smith		Email	Sandfire has been clear about expanding and growing the operation into a 50-year mining district. The DEIS should evaluate the entirety of the project and its potential impacts, and not allow Sandfire to segment the analysis.	See Consolidated Response CUM-1.
BBC00970	2	Jim Steitz		Email	Moreover, the company's own representations to its investors conflict with the DEIS cumulative impact analysis. While DEIS evaluates impacts over a time horizon to 2037, the former CEO has said, to his purely financially motivated audience, the company's intentions for a 50-year industrial mining district. Given Sandfire's possession of 525 mining claims on nearly 10,000 acres of adjacent federal lands, this is no idle threat, and MDEQ cannot ignore these explicit threats in delineating the scope of its analysis. The 'Lowry Deposit,' immediately adjacent to the existing ore, appears to be next in succession for Sandfire's plan for sequential, creeping exploitation. If this company is allowed to strike its first blow against the precious Smith River, its thirst for profitable Montana copper, regardless of the devastation to the vibrant ecosystems above, will become unquenchable.	See Consolidated Response CUM-1.
BBC00972	2	Jerry DeBacker		Email	Sandfire has been clear about expanding and growing the operation into a 50-year mining district. The DEIS should evaluate the entirety of the project and its potential impacts, and not allow Sandfire to segment the analysis.	See Consolidated Response CUM-1.
BBC00973	2	Jim Parker		Email	I am very concerned about the long term impacts of the proposed actions by Sandfire and they must ALL be accounted for. Sandfire has been clear about expanding and growing the operation into a 50-year mining district. The DEIS	See Consolidated Response CUM-1.

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					should evaluate the entirety of the project and its potential impacts, and not allow Sandfire to segment the analysis.	
BBC00974	2	Riley Meredith		Email	• Sandfire has been clear about expanding and growing the operation into a 50-year mining district. The DEIS should evaluate the entirety of the project and its potential impacts, and not allow Sandfire to segment the analysis.	See Consolidated Response CUM-1.
BBC00979	3	Alex Ohman		Email	• Sandfire has been clear about expanding and growing the operation into a 50-year mining district. The DEIS should evaluate the entirety of the project and its potential impacts, and not allow Sandfire to segment the analysis.	See Consolidated Response CUM-1.
BBC00997	4	Jennifer Swearingen		Email	4) The DEIS hugely underestimated impacts of this mining project by examining only a very small portion of the planned extraction. It is no secret that the Australian-owned mining corporation has made large investments to create a vast mining district, which would have far greater environmental impacts than those analyzed in the DEIS. It is imperative to consider the cumulative impacts of the entire project and not allow Sandfire to exploit the process by deceptively understating the size of the planned mining operation.	See Consolidated Response CUM-1.
BBC01010	4	Tomas M. Thompson		Email	• Sandfire has been clear about expanding and growing the operation into a 50-year mining district. The DEIS should evaluate the entirety of the project and its potential impacts, and not allow Sandfire to segment the analysis.	See Consolidated Response CUM-1.
BBC01014	3	Guido and Lee Rahr		Email	The DEIS fails to adequately address possible cumulative impacts of the mine to the health of the Smith river ecosystem. Tintina holds mining claims on almost 10,000 acres in the Smith River basin, and the company’s former CEO is on record telling investors that the company plans to create a 50-year mining district in the area. The cumulative impacts this scale of development must be evaluated	See Consolidated Response CUM-1.
BBC01019	4	Faye Bergan		Email	Authorizing the proposed project would be a decision in principle that would set a precedent that would commit the State to future actions - all with significant negative environmental impacts. ARM 17.4.608(f). DEQ is evaluating one proposed project, however, the permit applicant’s statements and actions indicate that a much broader mining operation is contemplated. This piecemeal approach to permitting is a strategic ploy to implement a more expansive mining project. It is essential that the precedential potential of this environmental review be recognized and addressed. Sandfire has been clear about growing this project into a mining district. The EIS must evaluate the entire project and its impacts. Piecemeal evaluation is contrary to the letter and spirit of Montana’s environmental legislation. This permit would be an irreversible and irretrievable commitment of resources.	See Consolidated Response CUM-1.
BBC00684	5	Willie Rahr		Email	I worry that this is only the early phase of a much bigger project. Tintina has hinted to investors of expansion plans. Do you know what those are? Do you know what the impacts will be of a larger mine? Is incremental expansion easier to get approval for than the first step? It is surely the camel’s nose under the tent! Would you approve this mine if it were several times larger than what Tintina is telling you now?	See Consolidated Response CUM-1.
BBC00419	3	Patricia Simmons		Email	What about the big picture of likely mine expansion to adjacent properties? You must consider forever and expansion and the money-making goal of the investors. They don’t care about the Smith River ecosystem. Your job uses my tax money and we fund you to protect us citizens 100% and not be beholden to	See Consolidated Response CUM-1.

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					a private developer's rape of the Earth! I totally disapprove your "Agency Modified Alternative" and the entire project.	
BBC00597	2	Elena Hodges		Email	Finally, Tintina is planning a major expansion from what they initially applied for. They have acquired additional mineral interests around the Smith River basin, and if they end up getting cleared to go ahead with the Black Butte mine, it could be just the beginning of large-scale industrialization and damage in the area. Please do the responsible thing, for our water and our environment, and do not allow this mine to go forward.	See Consolidated Response CUM-1.
HC_030	4	Curtis G. Thompson		Hard Copy Letter	The company has made it clear that it intends to mine much more than is intially announced and evaluated. Mineral rights have been obtained beyond the project addressed by the draft EIS. The company has reportedly advised investors that it intends to expand mining operations over the years. The intention to develop this mining operation far beyond that which has been initially proposed and evaluated is no secret; it is known to the company, known to the public, and critically, known to the Montana DEQ. It is beyond dispute that the potential for the environmental impacts grows as the size of the project grows. Yet, no consideration is given to expansion of the mining operations and the impact to the environment by that expansion. Again, with this information known, Montana DEQ is acting irresponsibility by not including consideration of the future expansion in the draft EIS.	See Consolidated Response CUM-1.
Financial Assurance						
PM1-04	1	Richard Liebert		Public Meeting Transcript	With that said, accountability is foremost, because whenever this mine stops operating, there's got to be reclamation or cleanup. And as we all know in Montana, we've got a lot of Superfund sites right in our own community: The smelter, Zortman-Landusky, all these other places that taxpayers -- And all of us are taxpayers, and I don't care where you are on the political spectrum, we all have to end up paying for this. And also, I want to know -- And it's not in the EIS. I know the EIS crunches numbers, like over $8 million for the local school district in White Sulphur Springs, which is tremendous. I can understand the aspirations and also what it does for ranchers and leasing and stuff like that. But what is the cost estimate for reclaiming and for cleaning up this site? In 15 years, 20 years, 25 years, what's it going to be? Is it going to a lockbox? What's the bonding procedure? We have to know this so the taxpayers have a clear understanding what we're going to be left on the hook for. Because these corporations, they change hands. Remember when ARCO was in town and they went bankrupt? Or what if Sandfire Resources out of Australia -- I know they have a U.S. subsidiary, Sandfire Resources America. But look at the corporate structure and how often a corporation changes. So we have to look at that to make sure accountability is transferred to the next corporate owner and so forth. If they go out of business, we've got to make sure that this is cleaned up. Hopefully, we have the proper science, due diligence, oversights to make sure this is all done properly.	See Consolidated Response FIN-1.
PM1-05	3	Curtis Thompson		Public Meeting Transcript	The Draft Environmental Impact Statement fails to address the costs of cleanup in that event. Once the toxic release starts to occur, how will it be cleaned up? Once the environmental disaster starts and becomes observable, Tintina or any other mining company will be long gone. The Smith River Canyon is very unique. It is generally inaccessible. When the time comes for cleanup, as it will,	See Consolidated Response FIN-1.

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					of this mine, as it has with all others, the cost of cleanup will be astronomical. Simply carving access into the Smith River Canyon, which is generally inaccessible, will be cost prohibitive to remediate an environmental catastrophe, not to mention the further rape of the Smith River Corridor which will occur when these roadways and access sites are created.	
PM1-07	2	Lita Sharone		Public Meeting Transcript	And my other comment is Tintina is a foreign company, so no matter what they promise in terms of money to be held accountable for mitigation later on and cleanup and monitoring, the monitoring is only planned for after everything is done and cleaned up. No planning for later on when things happen, cement cracks, plastic cracks. There will be leakage. Perhaps we have an earthquake. We can't predict all those things. But what we can predict is that there will be pollution and problems further down in the future. And where will Tintina be? It's a foreign company from Australia. They can return to Australia. How do we know if they're not bought by another company and another company and another company, and how can we hold them accountable?	See Consolidated Response FIN-1.
PM1-12	2	Kathy Gessaman		Public Meeting Transcript	I'd like to see some, some hard numbers about if this is going to work. Basically, you know, we the taxpayers, other people have said, are going to be responsible, and I think it's critical that we know what we're in for.	See Consolidated Response FIN-1.
PM1-13	3	Stuart Lewin	Missouri River Citizens	Public Meeting Transcript	I also am not happy about the fact that the bonding situation appears that you guys are going to eventually create a bond that supposedly is going to cover whatever you approve, yet, we the public do not have any real input into what that bond ought to be. And do we have input into whether the bond is adequate? Who is backing up the bond? And if it doesn't work and you have to come back later, how do we know you people are still going to be here?	See Consolidated Response FIN-1.
PM4-12	4	Dave Ewan		Public Meeting Transcript	Our state has got places all over the state, Landusky, Beal Mountain, Butte, you can just go on and on and on and point out the places that the copper mining companies come in and say, well, we'll just take this out of here, you'll never know it. And then 20 years, 30 years down the road, our grandkids and our grandkids' grandkids are paying for the cleanup of all these misappropriated and misguided mining companies.	See Consolidated Response FIN-1.
PM5-01	9	Linda Semones		Public Meeting Transcript	We should ask for a gigantic, responsible bond before they're even allowed to start their mine.	See Consolidated Response FIN-1.
HC-003	69	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS must also provide an estimate of the cost of post-closure reclamation, maintenance, and monitoring activities for purposes of establishing an appropriate bond amount. DEQ must provide detailed, site-specific cost estimates for post-operational reclamation and long-term treatment that will substantiate any conclusion about the appropriate amount of the bond. Given the issues with Tintina's reclamation plan identified above and the long history of perpetual hard rock mining pollution in this state, such information is critical to ensuring that Tintina is adequately bonded to address and remedy all potential postclosure impacts.	See Consolidated Response FIN-1.
BBC00584	1	Brian McCurdy		Email	The draft EIS discusses a number of solutions that will be implemented after the closure of the mine. And in Section 3.5.3.2, the EIS mentions that "the limited variation between the base case and sensitivity scenarios reflects the robust design and plan for management of the UG..." However, there is no financial assurance that the Black Butte mine will implement the solutions at	See Consolidated Response FIN-1.

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					closure. If the mine is uneconomic, and therefore closes, the owner of the mine will not commit financial resources to implement the closure plan. Montana DEQ must require Sandfire to put the entire cost of the closure in an escrow account to ensure funds will be available for the closure plan.	
BBC00708	1	Ron Glovan		Email	Any EIS for the proposed copper/gold mine along Sheep Creek, a major tributary to the Smith River, should take into account the cost of treating copper contaminated acid mine drainage into perpetuity, and have a large enough developer paid fund dedicated to the treatment of the contaminated water, that will generate funds into perpetuity. This money should be paid up front	See Consolidated Response FIN-1.
BBC00850	1	Mayor Bob Kelly	Great Falls	Email	If the mine goes forward I would ask that the City of Great Falls be “covered” regarding any environmental cleanup bonding or insurance that Tintina may have to put in place. The potential for downstream damage should qualify us for inclusion in the risk assessment. Please keep us informed as to how we can be in that discussion going forward.	See Consolidated Response FIN-1.
HC_030	6	Curtis G. Thompson		Hard Copy Letter	The gap in bonds posted for environmental remediation and the actual costs of clean up related to past projects is huge and growing. This is known to Montana DEQ. The gap is the result of companies being allowed to post bonds which are not sufficient in the amount to assure the funding of eventually needed work to address environmental impacts from mining operations. Often, these impacts are incurred or observed long after the mining company has exited the site, the jurisdiction of the country. In Montana alone, based on past mining operations, the bond hap - the amount the Montana taxpayer may have to pay - is potentially $30 Million to $50 Million. This is not a problem unique to Montana. Other states have had the same experience with the same result of huge expenses being passed on to the taxpayer. The fact that Montana taxpayers are paying and will continue to pay huge sums due to past mining operations, and the fact that this is a recurring theme anywhere hard rock mining is performed in the United States and is indisputable and is known to Montana DEQ. In light of that information, it is irresponsible and a breach of the public trust to fail to include that analysis in any draft EIR for the hard rock mining, including the subject one. The draft EIS is woefully deficient in that respect.	See Consolidated Response FIN-1.
HC_030	7	Curtis G. Thompson		Hard Copy Letter	Noting the significant bond gap addressed above, and recognizing that the mining company will eventually pack up and leave the state and the country, when the inevitable pollution occurs, what is that remedy? The bond for clean up will be insufficient, as all past bonds have been insufficient. The mining company will be beyond the reach of the administrative and judicial power of this jurisdiction. The draft EIS does not address the subject of future liabilities and enforcement of liabilities. This suggests that Montana DEQ embraces the default of tax payer liability for acts and omissions of the mining company. This renders the draft EIS incomplete and evinces a bias in favor of the mining company in disregard of the interests of the State of Montana and the Montana taxpayer.	See Consolidated Response FIN-1.
HC_016	2	Steven D. Taylor		Hard Copy Letter	I do question why bonding for potential future problems are not discussed! This is a concern for many because of tax payer burdens from past projects. Why is the bonding issue held secret only to the company and the DEQ?	See Consolidated Response FIN-1.

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BBC00843	3	Dave Keddell		Email	Part of the DEQ plan is the company will post bonds to cover perceived costs if this project starts, fails or goes out of business. Is the security bond a one-time amount? The bond should not be a one-time donation. Is the DEQ requiring a yearly contribution to a bond account? How is the bond amount determined? This project has already applied to adjust their work efforts because of their long range mining plan for the area. Their long term plan does not appear in this project application. Why not? Their plans extend far beyond this phase one. My understanding is that the plan is for the next 100 years, growing in size and location all the while. If authorized there should be a yearly commitment to add monies to any security bond by the current mine owner(s), the land owner(s) and any other entity that becomes part of this project in the future. The landowner(s) needs to be made liable for any recovery costs if the mining operation is a failure because the landowner(s) are leasing this property to the mining interest. If a new owner(s) and or mining interest(s) come into the picture then they must all agree to the conditions of the DEQ permit or the DEQ permit should automatically be revoked until an application process is completed by the new owner(s) and mining interest(s). One time donation protections are never enough to cover future costs. How many times have financial problems revolving around mining activities been played out in Montana? Enforcement of restoration and or recovery operations involve many years and legal processes when a mine is either abandoned requiring cleanup. The goal of any bond is to avoid another project that has an accident and or is abandoned with not enough or no financial resources to repair the inevitable environmental and economic damage to the environment as well as area businesses from the mining operation. Montana has suffered many setbacks in their environment and the state environment and its people deserve better protection than what they have been given in the past. How many superfund sites come to mind with issues because of the lack of funds from the past mining operations? Why was a copy of the proposed security bond not attached to the EIS? Would the applicant and the public be better served by joint reviews of overlapping regulatory agencies? Certainly the cracks the DEQ process has in this EIS project review would be better filled.	See Consolidated Response FIN-1 for information about the bonding process. See Consolidated Response CUM-1 for information about any potential future mining projects.
BBC00945	5	Michael Scott		Email	E. The company promises state of the art mitigation that will protect Sheep Creek and the Smith River, yet does not offer the full resources or its parent companies to back up the assertion Sandfire's only asset is the proposed mine. Should there be a mitigation failure it is likely that Sandfire would file for bankruptcy, leaving Montana taxpayers on the hook for remediation costs. I understand that approval of the permit would come with a bond but the bond that will be posted is highly unlikely to cover the costs of mitigation failure. By their nature such failures are unanticipated, as is the cost. If the company is so confident in its plans, and DEQ agrees, DEQ should require its parent company, Sandfire Resources Australia, to agree to assume any failure liability. Failure to do so on DEQ's part means that Montana taxpayers would have to foot the bill for extensive, and expensive, litigation that seeks to establish parent company liability. Montana taxpayers already pay tens of millions of dollars a year because mining shell companies have filed bankruptcy and walked away from their responsibilities. DEQ has an obligation to ensure this will not happen here.	See Consolidated Response FIN-1.

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BBC00931	4	Stuart Lewin		Email	The DRAFT EIS does not determine how much of a bond should be required to pay for cleanup of spills and acid drainage and how it can be insured that Tintina will have moneys available for cleanup if Tintina goes bankrupt. The DRAFT EIS should require that the mine deposit actual cash with the state rather than simply purchasing a bond from a bonding company which could fail. F. The current plan is to determine the bond required after the preferred alternative has been approved. This prevents the public from providing adequate comment time, meaningful input and oversite.	See Consolidated Response FIN-1.
BBC00960	5	Max Hjortsberg	Park County Environmental Council	Email	Additional bonding must be secured for any and all potential haul routes from the mine site, as well as for the multiple proposed railhead locations. Bonding currently in place for the mine operation does not take into account potential costs resulting from environmental impacts that may occur when transporting the ore from the mine site.	See Consolidated Response FIN-1.
BBC00425	1	Kyle Paulson		Email	I would like to voice my opposition to the Black Butte Copper Project. Growing up in Montana I understand the value that mining can have on local communities and the justifiable need for pulling resources from the earth. However, after listening to several representatives from Sandfire Resources and also taking the time to hear out local pro's and con's on the project, I am unconvinced that Sandfire's vision for the mine project, especially it's goals pertaining to reclamation can be realized. Hearing the same rhetoric from the mining proponents in Libby when I was growing up, the so-called commitment to "responsible development" vanished once the resource was extracted. The aftermath, no different than Butte, Zortman, Soda Butte, and Anaconda will fall on the EPA shoulders. Unless Sandfire can front the entire reclamation funding to the EPA prior to putting their first shovel in the ground this project should not be permitted to move forward. The history of mining projects degrading Montana natural environment is long and storied. There have been a few reclamation and revegetation success sites in Montana, always on a smaller scale, and nothing in the size and scope that the Black Butte Copper Project will impact. There are still too many unfinished mine and mill sites in Montana that need to be reclaimed by the EPA before we can begin planning another one in the Little Belts.	See Consolidated Response FIN-1.
General Topics						
HC-003	10	Josh Purtle	Earth Justice	Hard Copy Letter	In addition, the Draft EIS fails to consider and disclose potential environmental impacts that could be caused by the proposed mine, including, but not limited to (1) impacts caused by catastrophic events, such as failure of Tintina's cemented tailings facility; (2) impacts to surface and groundwater quality; (2) impacts to hydrology, including groundwater drawdown caused by mining operations; (3) impacts to fish and other aquatic organisms; (4) air quality impacts; and (5) cumulative impacts. DEQ must analyze and disclose all of these impacts to the public before approving Tintina's proposal, so that Montana citizens may fully understand the environmental consequences of moving forward with the Black Butte Mine.	See Consolidated Response PD-3. Reasonably foreseeable and/or potential environmental consequences and effects due to the Project have been analyzed in the EIS, including Section 3.4, Groundwater Hydrology, and Section 3.5, Surface Water Hydrology, Section 3.16, Aquatic Biology, Section 3.2, Air Quality, and Section 4, Cumulative, Unavoidable, Irreversible and Irretrievable, and Secondary Impacts and Regulatory Restrictions.
BBC00933	19	Ann Maest	Buka Environmental	Email	To improve the transparency and clarity in the Final EIS, the following additions are recommended:	Thank you for your comment. Individual Draft EIS sections are provided on the MDEQ website (http://deq.mt.gov/Mining/hardrock/Tintina-EIS). A full, compiled PDF exceeds the maximum upload size limit for the website.

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					• Provide a unified DEIS (all chapters, without appendices) on the MDEQ website	
BBC00397	1	David Saslav		Email	Would it be possible to get a list of the DEQ representatives / researchers who: - organized last night's paper handouts and CDs - worked on the visual aids and charts on display during the open house - reviewed and passed the initial EIS from the Scoping Phase without requiring any additional disclosures or contingency plans from the Australian mining company - performed the actual EIS analysis, and who can explain to the public the measures taken to conduct failure analysis in subsequent polar vortex, fire, earthquake, acts of terrorism or vandalism, or other anticipatable failure scenarios?	See Consolidated Response PD-3. Chapter 7, List of Preparers, of the EIS includes a list of preparers for those who were involved in the development of the EIS and those who conducted the public meetings. After the scoping period in Fall of 2017, the EIS was developed per the environmental review procedure described in § 75-1-208 (4), MCA. The Draft EIS considered comments received from the public during the scoping period.
BBC00397	2	David Saslav		Email	I was a little disappointed that the very first document I was handed last night was an agenda for a previous meeting (the Public Scoping meeting) - the first 20-25 of us to arrive at 6pm last night could easily have been misled into thinking we were in an earlier project phase than we actually are. Was another, correct agenda document prepared for last night, and then simply not printed out or made available, by accident? Also - are the public comments made at last night's meeting going to be transcribed and posted anywhere during the public comment period? I had to leave the event before the public comments got started.	The incorrect agenda was mistakenly printed for the Great Falls meeting. All other materials were correct for the EIS review phase. The public comments gathered during the public comment period (including transcriptions from the public meetings) and responses to comments are available in the Final EIS.
BBC00400	1	Al Hayes		Email	I completely disagree with the latest EIS results. The Smith River is not the only concern with any mine. If you look at Montana mining history it is disgusting. There are about 20 EPA superfund sites in Montana. Who pays for this? The government. The citizens hire the government to take care of business. City, county, state, federal, including the agency you work for. Apparently there is great concern over many of our mines. East Pacific, Republic, Butte Silver Bow Creek, Zortman, Landusky. The list goes on and on. Zortman and Landusky were touted as great successes after millions of dollars were spent treating water. And millions more to be spent in perpetuity. Millions of public taxpayer dollars forever. 52 U.S. mines have had spills since 1980 using modern mining techniques. I sincerely hope additional study goes into the Black Butte Copper Mine. It is time to take a 50 and 100 year look of all mines.	See Consolidated Response FIN-1.
BBC00584	2	Brian McCurdy		Email	The draft EIS mentions in a number of locations that the water quality would be seriously diminished without the closure plan in place. The Gold King Mine accident in Colorado is a reminder that closure plans are subject to failure and risk. The EIS should require planning for a scenario where the primary closure plan fails; that was not considered in the draft EIS and must be considered so that my kids and grandkids can access the same resource in the Smith River that I am trying to access with my kids.	See Consolidated Response PD-3.
BBC00884	4	Scott Bosse	American Rivers	Email	Rather than make these overly optimistic assumptions, the DEIS should evaluate what will happen when the cement in the tailings is dissolved by acid, which is inevitable due to the fact that the tailings from the Black Butte Project would have a 26% sulfide content, which is extremely acidic.	See Consolidated Response PD-5.
BBC01033	2	Dana Field		Email	Please ensure the water quality effects on these economic issues are properly evaluated. Request an endowment to support agency oversight staff positions.	All reasonably foreseeable and/or potential water quality or socioeconomic effects are analyzed in the EIS (Section 3.4, Groundwater Hydrology,

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					If there is not clear and convincing state agency capacity to properly manage the water quality threats of this project, the mining permits should be denied.	Section 3.5, Surface Water Hydrology, and Section 3.9, Socioeconomics, respectively). Although an endowment for the DEQ is not included, an estimated bond amount would include the potential cost of DEQ management, operation, and maintenance of the site upon temporary or permanent operator insolvency or abandonment, until full bond liquidation could be effected. DEQ would be required to conduct a comprehensive bond review every 5 years to make sure the amount of the bond remains sufficient to perform the required reclamation, adjusting for increases in costs, etc.
HC_030	1	Curtis G. Thompson		Hard Copy Letter	The spirit and purpose of required public comment is undermined and rendered unfair by the unreasonable time contraints imposed in public meetings. Three (3) minutes is not a realistic amount of time for anyone to make a meaningful substantive comment. The draft EIS is lengthy and technical. Citizens desiring to verbally comment are unduly prevented from doing so due to the three (3) minute time constraint. The time allowed for written comments is unfairly insufficient. The draft EIS is lengthy and complicated. It is unrealistic to believe that accurate and researched comments on the document of that length and depth can be provided in the short time between the release of the draft EIS and the deadline for comments.	See Consolidated Response MEPA-1.
BBC00424	2	Patricia Ames		Email	It is troubling that you have only allowed the public 60 days for review of a technical document containing over 800 pages. An adequate comment period is essential to guarantee that the public can adequately review the document and comment on it. I request the DEQ and Sandfire extend the comment deadline.	See Consolidated Response MEPA-1.
BBC00532	1	Douglas Dodge		Email	I am retired, with over 35 years experience working for BLM and the USFS, including working as a District Ranger on the Lewis & Clark NF. A large part of my career was dealing with mining issues (including writing mining regulations for the Bodie ACEC in eastern California; and teaching classes in environmental analysis and land use planning for BLM). I would like to see your draft EIS - can you either mail it or email it to me? My biggest concern is that I have never seen any mining operation (on public or private lands) that lived up to its hype about its ability to protect the watershed within which it lies. This is a very real concern when we're talking about a proposal within the headwaters of a river like the Smith.	Thank you for your comment. Individual EIS sections are provided on the MDEQ website (http://deq.mt.gov/Mining/hardrock/Tintina-EIS).
BBC00537	1	Dave Keddell		Email	I was just wondering, is it possible to get the EIS in word so I can copy and paste for my comments?	Thank you for your comment. Individual EIS sections are provided in PDF format on the MDEQ website (http://deq.mt.gov/Mining/hardrock/Tintina-EIS). Copies of the EIS are not available in Microsoft Word format.
BBC00977	1	Daniel A. Horgan		Email	It is my strong belief that permitting the establishment of a new major hard rock mining operation owned by Sandfire Resources in the Smith River drainage would be a short-sighted action by the agency tasked with ensuring the environmental health of the citizens of Montana. The permit would fail to take into account the well documented history of mineral extraction operations in our State and the legacy of injurious public health impacts and state-wide economic hardships that could have been avoided if government agencies had been more forward thinking, and historically conscious, about a less destructive future for Montana land-use. Even if there is only a percent possibility for the harm envisioned, that should	See Consolidated Response PD-3.

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					be enough to choose caution as the correct course of action because the risk of failure is unnecessary. The evidence of those past failures litters our State. It is time that the leadership of Montana, entrusted in our State agencies, leave behind the historically destructive industries that ruined our communities and landscape for short term profits that enriched a few. Find new, less ruinous ways of bringing economic growth to our State. If you permit this operation and it fails and destroys a cherished and valuable natural resource it will not be enough to say that "it was unforeseen." It was foreseen and you were asked to proceed with prudence.	
Geotechnical Stability						
PC-01	2	Cory Beattie		Public Meeting Comment Form	The EIS doesn't evaluate impacts of an "unforeseen" event. Many tailings dams that claimed a breach or leak was unforeseen and they leaked.	See Consolidated Responses PD-1 and PD-3.
HC-003	29	Josh Purtle	Earth Justice	Hard Copy Letter	Further, as Tintina has conceded, "mixing cement into tailings prior to surface storage is a relatively new and still-innovative technique." Draft EIS app. A at 4. Tintina asserts that the CTF design "follows logically" from other disposal methods, but cites no prior experience with this method which could substantiate Tintina's claims that the CTF will succeed in holding the tailings in place. Indeed, in a report prepared for the Black Butte Mine project, Tintina's consultant acknowledged that "[w]idespread implementation of cemented-paste tailings placement in surface facilities is limited by insufficient long-term evidence of predicted benefits, as well as a lack of defined testing framework for generating reliable predictions of performance." Exhibit 25 at 17 (Enviromin, Inc., Surface-Placed Cemented-Paste Tailings); see also Exhibit 15 at 5 ("No mine has ever used" the technique Tintina proposes "for surface disposal."). As discussed in detail in the Zamzow Comments, Tintina's proposed CTF design presents a host oflogistical problems, all of which DEQ and Tintina have failed to address in the Draft EIS and the mine operating permit process. Exhibit 15 at 5-16; see also Exhibit 26 at 31 (Davies, Tailings Impoundment Failures: Are Geotechnical Engineers Listening?, Waste Geotechnics (Sept. 2002)) (describing myriad technical problems facing tailings impoundment designers). Given the fact that the safety and effectiveness ofTintina's new tailings disposal method is untested, DEQ must analyze and disclose the risk that the CTF dam will fail. See San Luis Obispo Mothers for Peace, 449 F.3d at 1033 (concluding that risk of a terrorist attack on a nuclear facility was not so "speculative" that the Nuclear Regulatory Commission could ignore it for purposes of a NEPA analysis). One of the specific potential issues for long-term CTF containment ignored in the Draft EIS is degradation ofthe cement binder in the cemented tailings. "The 'cement' tailings facility will remain cement for only a short time," because acid in the tailings will eventually dissolve the cement. Exhibit 14 at 1. According to Kendra Zamzow's comments on the Draft EIS: Cemented tailings can undergo external attack-in which the surface oxidizes and forms acid-or internal attack-in which sulfate attacks the cement. Both of these cause cement to disaggregate and fall apart. . . . Portland cement is particularly susceptible to	See Consolidated Responses PD-1, PD-2, PD-3, and PD-5.

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					internal sulfate attack ... and may not prevent reactivity even for underground backfill[.] Exhibit 15 at 3; Exhibit 27 at 140 (Tariq & Yanful, A review ofbinders used in cemented paste tailings for underground and surface disposal practices, 131 J. of Envtl. Mgmt. 138 (20 13)); Exhibit 28 at 507 (Wu et al., Compressive strength behaviour of sulphur tailings paste backfill: effects ofbinders and additives (2018)). In addition to compromising CTF stability, cement dissolution could also cause subsidence of the ground surface above the CTF, potentially compromising the top CTF liner and allowing water to seep into the facility after closure. Exhibit 15 at 15-16. The Draft EIS, however, does not discuss the implications of cement breakdown for the long-term stability of the CTF, or assess whether the CTF will adequately prevent tailings release in the event that the tailings lose this key structural element.	
HC-003	30	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS also ignores the impact of mine subsidence on the stability ofthe CTF over the long-term. Subsidence in the underground mine workings could propagate to the surface and impact the integrity of the CTF tailings dam or the CTF liner, thus causing a release of tailings. See Exhibit 29 (Aitun et al., A short review on the surficial impacts of underground mining, 5(21) Sci. Research & Essays 3206 (Nov. 4, 2010)) (describing impacts of subsidence in underground mines on the surface). An analysis of the risk of CTF failure, and the environmental consequences of such failure, is critical because ofthe severe impacts that could occur in the event of failure. The CTF will contain approximately half of all tailings waste produced by the mine. The waste will be laced with sulfide minerals-which produce acid mine drainage when exposed to air and water-as well as toxic metals including nickel, thallium, strontium, copper, lead, arsenic, and uranium. Given the severity of these potential impacts, DEQ must also provide "reasonable assurance" that tailings CTF impoundment failure "will not occur." ARM 17.4.608(1)(b). Conducting a thorough risk analysis would not be difficult. Indeed, several researchers have offered methods for evaluating the risk and consequences of tailings dam failure. See Exhibit 23; Exhibit 30 (Larrauri & Lall, Tailings Dam Failures: Updated Statistical Model for Discharge Volume and Runout, Environments (Feb. 15, 20 18)); Exhibit 31 (Pastor et al., Modelling tailings dams and mine waste dumps failures, 52(8) Geotechnigue 579 (Oct. 2002)); Exhibit 32 (Rico et al., Floods from tailings dam failures, 154 J. Hazardous Materials 79 (Oct. 2, 2007)). DEQ should therefore provide a risk analysis of CTF dam failure, consistent with methods published in the scientific literature. As part of meeting this requirement, DEQ must at a minimum disclose for public review the tailings facility design document Tintina is required to prepare under MCA § 82-4-376. This document should contain critical information about the CTF's stability, including "a dam breach analysis, a failure modes and effects analysis or other appropriate detailed risk assessment." Id. § 82-4-376(2)(n). The design document will therefore help the public understand the risks associated with the CTF, as well as the analysis underlying Tintina and DEQ's belief that the risk of CTF failure outweighs the facility's potential benefits. Unless and until this document is prepared and disclosed, neither DEQ nor the public can fully evaluate the potentially significant environmental consequences ofTintina's proposed CTF design.	See Consolidated Responses PD-1, PD-2, PD-3, and PD-5. Regarding the risk of subsidence impacting the integrity of the CTF dam or liner, the AMA proposes additional backfill of the mineralized zones with cemented paste tailings, which should increase stability and reduce risks of subsidence (see Section 2.3.1, Agency Modified Alternative: Additional Backfill of Mine Workings, of the EIS). Additionally, even if subsidence of underground mine workings were to occur, the CTF is not located above the mine workings, so no subsidence could occur in the area of the CTF.

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HC-003	77	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS relies on Tintina's proposed CTF, which will store half of the mine's tailings in perpetuity, to avoid potentially catastrophic, long-term contamination, yet irrationally fails to acknowledge or evaluate practical problems with the CTF's untested design. At the outset, the Draft EIS fails to describe how the CTF meets the requirements of MCA §§ 82-4-376 and 82-4-377. These provisions, which require a mine operator proposing to construct a new tailings storage facility to submit a tailings facility design document to DEQ and an independent expert panel for review, was developed in the wake of the Mount Polley tailings dam failure with the intent to reduce the potential for catastrophic tailings failures. The analysis of the independent tailings review panel required under these provisions must be incorporated into the Draft EIS and made available for public review. Further, Tintina's CTF design relies on the fact that cemented tailings will flow freely across the surface of the CTF during mine operations, such that each layer of tailings does not remain exposed to oxidizing air for extended periods of time. See Draft EIS at 3.6-21; MOP Application Rev. 3 at 101. However, as DEQ asserted in a deficiency notice concerning Tintina's mine permit application, free tailings flow may be impeded by snow or ice on the tailings surface, thus potentially causing the tailings surface to degrade in ways that Tintina has not anticipated. Second Deficiency Review at 3. The Draft EIS, however, ignores this potential problem entirely. And although Tintina asserted in a revised mine permit application that the tailings flow would somehow melt any ice or snow on the surface of the facility, it provided nothing to substantiate that prediction. Indeed, this is just one of several potential issues identified in the literature with operating a cemented paste facility in a cold climate. See Exhibit 46 (Alakangas et a!., Literature Review on Potential Geochemical and Geotechnical Effects of Adopting Paste Technology under Cold Climate Conditions (Aug. 13, 20 13)). Given the fact that proper operation of the CTF is essential to ensuring that the Black Butte Mine does not cause pollution in the Smith River basin, DEQ should evaluate whether operating the CTF in cold weather conditions will create operational problems that may lead to additional environmental impacts.	See Consolidated Responses PD-1, PD-2, PD-3, and PD-4.
HC-003	78	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS also ignored concerns associated with incorporating brine into the tailings disposed in the CTF. Tintina plans to dispose of brine-that is, reverse osmosis reject produced by the water treatment plant "in the tailings thickener." Draft EIS at 2-12. As DEQ asserted in its review of Tintina's mine operating permit application, brine in the cemented tailings could have an "adverse effect" on their "strength and stability." Second Deficiency Review at 17; see also Exhibit 47 at 62 (Wang & Villaescusa, Influence of water salinity on the properties of cemented tailings backfill, II 0 Transactions of the Insts. of Mining & Metallurgy 62 (Sept. 5, 20I3)). The Draft EIS, however, does not address the stability impact of incorporating brine into the tailings. The EIS should analyze this potential stability issue.	Section 3.3.2.5 of the MOP Application discusses RO brine to be added to the tailings thickener: "RO brine can be added to the tailings thickener as means of brine disposal. This will control the brine addition prior to entering the paste thickener. The effect on concrete properties from high concentrations of chloride, sulfate, and other deleterious ions in the brine would be expected to be minor and will have no effect on the final strength or structure of the cemented tailings. However, the preferred method for brine disposition will be returning it to the PWP for reuse in the mill with ultimate salt disposal with the cemented paste either underground or in the CTF." Further, Response to Deficiency Review Comment 2-DEQ-53 (May 8, 2017) states: "after conducting a further review of this issue with them [the paste tailings engineers], it was determined that the solids content of the brine is the more important factor rather than water content. The dissolved salts present in the RO brine is approximately 2.88 dry tons/day, which is less than 0.1% of the total

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						solids (3,197 tons/day of tailings). ...the dissolved salt content of any brine produced by the RO treatment system for this project will be a very small fraction of the total solids load in the paste facility.”
HC-003	79	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS further fails to analyze the long-term consequences of the deterioration of the CTF liners. Because the liners do not have an infinite lifespan, such deterioration is inevitable. See Exhibit 34 at 372. Yet the CTF-which must function in perpetuity in order to prevent pollution in the Smith River watershed-will no longer effectively contain the tailings after the liners inevitably degrade. See id. at 373. The Draft EIS, however, does not disclose when the CTF liners will break down, such that they will no longer provide an effective barrier to groundwater or precipitation entering the CTF tailings. DEQ must disclose the expected lifespan of the liners, and what the consequences of their inevitable degradation will be for the prospects of long-term tailings storage at the mine site.	See Consolidated Response PD-4.
HC_030	10	Curtis G. Thompson		Hard Copy Letter	Water takes the path of least resistance drived by gravity and hydrological force. Water, as a constant force, carves through the path of least resistence. The mining company asserts contaminants will be contained by the plugging material. However, the plugging material is softer than the hard rock layers from which the copper ore will be mined. And, the seams of the plugging material are not impermeable. The seams are teh weak spot. The force of water is tremendous both in the instant and over time. The draft EIS fails to accurately evaluate the integrity of the plugging material and its resistance to break down. The draft EIS fails to accurately evaluate the impact of the release of toxins due to the break down of the plugging material and break down of the seals created at the seams of the plugs.	See Consolidated Responses PD-2 and PD-5.
HC_030	11	Curtis G. Thompson		Hard Copy Letter	That seismic activity has been increasing is documented. Greater frequencies and increased magnitude of seismic activtiy is not included in the draft EIS. Of course, significant earthquakes change the subterranean structures. Plates and laters of rock shift. New fissures and pathways are opened or closed. The draft EIS fails to address the integrity of the pivotal “plugging material” in light of increased seismic activity. Compared to other formations and subterranean substances, the “plugging material” will have the least strength and integrity. It is the weak link, and its seam or edges the weakest point. Seismic activity has the potential to render the entire “plugging material” approach impotent to restrain the releases of toxins. The failure of the draft EIS to address this known fact renders it incomplete and inadequate.	The hydraulic plugs were not analyzed against seismic activity by the Proponent or its consultants. However, the seismic stability of the hydraulic barriers would not be a major concern because the estimated time to rinse and flood the mine only ranges from 7 to 13 months (Section 3.5.3.2, Surface Water Quality and Temperature, of the EIS; Section 7.3.3.5 of the MOP Application [Tintina 2017a]). In addition, after the rinsing/flushing has been completed, the regional groundwater table would re-equilibrate with pre-mining conditions and would flood the majority of the remaining open underground mine workings, including the installed hydraulic barriers. Increased seismic activity in the region has not been documented, and there are no geologic reasons to expect greater frequencies or magnitudes of earthquakes in the future. Also, given that the AMA would require that all underground mine openings within the Upper and Lower Sulfide zones be backfilled with low permeability cemented paste tailings during mine closure, all spaces between hydraulic plugs in these regions would become filled with low permeability material comparable to the plugs themselves, and they would not provide conduits for migration of groundwater, regardless of the integrity of the plugs or the occurrence of seismic activity.
HC_030	12	Curtis G. Thompson		Hard Copy Letter	The draft EIS fails to address the impact of increased seismic activity on surface collection, storage and treatment facilities. One significant earthquake may result in breaches with catastrophic environmental impacts. The draft EIS	See Consolidated Responses PD-1 and PD-3.

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					must address this eventuality and assess the project with the assumption that there will be a significant breach and release of toxins. It is a foreseeable and likely environment impact which has not been addressed.	
BBC00978	3	Bruce Farling		Email	The proposed application of cement-paste tailings is, in theory, an improvement over standard subaqueous or dry-stack disposal. In fact, it makes sense for underground disposal that occurs in sequence with mining, especially when tailings will ultimately be placed in a reducing environment in groundwater in plugged mine workings. However, the proposals for both underground and surface disposal include shortcomings. They include: A. Rinsing oxidized material from the underground workings to reduce acid mine drainage seems like asking for trouble because it is possible, if not probable, the volume of effluent will overwhelm the collection and treatment systems, likely creating “emergencies” that result in unlawful discharges of acid and metals-bearing solution. DEQ should instead require Tintina to apply shotcrete to sulfide bearing walls to arrest oxidation. B. The location and design of the surface tailings impoundment is very problematic. Disposing tailings below the groundwater table is simply a bad idea. It is inherently risky. DEQ assumes in the DEIS that the lining and drainage system will be installed and operate perfectly, and thus they will prevent groundwater from seeping into the tailings, or, it will prevent potential leachate from leaking out. Here’s the problem: There is nothing special in this liner system design, or the BMPs proposed to be used in its construction that haven’t been used elsewhere. The odds are very good the liner system will not be installed perfectly. Liners get tears in them. Seams are not completely sealed. That’s the history of tailings impoundment and leach pad liners. And it’s obvious why: They are installed in imperfect conditions, they cover large surface areas using heavy equipment, and, they are meant to contain hard, sharp particles that abrade and tear. Tintina, however, has several other available options: They can move the impoundment further upstream to avoid groundwater (and wetlands); or, it can design a smaller footprint for the facility, which simply means storing less material above ground, perhaps meaning less can be mined. The point is DEQ should accommodate the lowest-risk design before it accommodates the company’s desired high-risk location. Move the impoundment or shrink the footprint and get the tailings above the groundwater table. C. The amount of sulfides and acid generation potential in the tailings Tintina proposes to place in the surface tailings facility is a significant problem. A twenty-six percent sulfide content merits special handling. That this material will be mixed with a cement or fly ash paste does not entirely remedy the potential for releases of acidic and metals-bearing discharges to groundwater. The DEIS admits that the paste cement will not significantly offset the pyrite content (in both the underground and surface tailings). The DEIS and technical memoranda pretty much admit that the proposal is experimental (Technical Memorandum, Appendix A). No data are disclosed indicating with any confidence what the long-term fate is of cement-paste tails in a surface facility. It is, at best, a guess. Moisture will reach the material, cracking will occur, oxidation will ensue, and leachate is likely to escape. In the long run it is probable that in both the short-term and undoubtedly after mining that the	A. Shotcrete: Under the Proposed Action, polypropylene fiber reinforced shotcrete would be used as a cementitious surface cover for sealing mined surfaces. In addition, see Section 7.3.3.9 of the MOP Application (Tintina 2017a): “Tintina has considered both high pressure washing of the mine walls to remove stored oxidation products as well as the possibility of shotcreting high sulfide zones in the workings to cover and immobilize oxidation products. These potential mitigation measures could be used prior to rinsing and water treatment described above, and would likely reduce the time required to meet closure goals. However, the best scientific and technically most appropriate approach would be to observe the evolution of water quality with respect to modeled predictions before using shotcrete in sulfide zones, which could change chemistry sufficiently to interfere with changes in predicted geochemistry. It will be possible to test the proposed high pressure washing and shotcrete mitigation strategies in localized individual heading scale once mining has begun in the USZ. The rinsing closure model could also be tested during mining operations on a controlled and smaller scale within a bulkheaded portion of a sulfide-rich heading. Thus, the testing and consideration of mitigation measures to optimize the closure of the underground workings during the operational life of the mine will ensure that any mitigation measures are necessary and effective before they are incorporated into the closure procedures. Such mitigation would only be implemented to further optimize the closure process, as the models indicate that non-degradation standards to groundwater will be achieved without such additional mitigation.” B. CTF location, water table, and liner: See Consolidated Responses ALT-2, ALT-3, and PD-4. C. Integrity of CTF: See Consolidated Responses PD-1, PD-2, PD-3, PD-4, and PD-5. Pyrite Separation: See Consolidated Response ALT-4. Also, see response to Submittal ID HC-003, Comment Number 25 for more information.

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					tailings impoundment will be a serious environmental hazard. This implicates long-term liability for the landowner and a risk to public waters. Preventing acid generation during disposal depends on the ability of the operators to provide subsequent lifts on top of previous lifts in time to retard oxidation. This, of course, will be complicated by weather, equipment breakdowns and interruptions in the tailings and concentrate circuits. Nothing in the DEIS or supporting materials indicate that the company has tested, even at a bench scale, a paste plant, nor how easily the proposed cement-paste tails mix can be pumped and transported. The consistency of the paste-tails will undoubtedly be tested by changes in how they are handled during flocculant addition and agitation, by cementmix consistency and possibly even by slight changes in mineralogy. The DEIS does not evaluate the potential for tailings line spills, nor what will happen should there be a breakdown in the needed timing for depositing lifts so that previous lifts are covered before oxidation occurs (a matter of a few weeks). • Removing pyrite from the tailings before they are placed in the tailings impoundment could alleviate the potential for short-and long-term acid generation in the tailings facility (assuming that the waste rock has been amply evaluated to have zero AMD potential – one of the analyses that should be handled by a third-party review panel). As the DEIS and associated technical memorandum indicate, this is quite feasible technically. In fact, pyrite is removed during the flotation circuit that produces the copper concentrate. The pyrite could be removed and mixed with cement-paste tails that are deposited underground below the groundwater table. DEQ should require de-pyritization. • The DEIS is largely silent on the post-reclamation and closure fate of the disturbed areas, including the tailings impoundment. It simply says that after closure the landowner is expected to go back to using the site for cattle grazing. This ignores important issues regarding long-term impacts and environmental liability for the landowner. Instead of ignoring post-mining management, he DEIS should have analyzed and recommended that the tailings repository upon satisfactory closure be treated as a hazardous waste facility, fenced off and managed in perpetuity under legally enforceable institutional controls that help ensure it will not be disturbed by future activities, including road construction, well drilling, buildings, excavation (say, to access waste rock for construction purposes), off-road vehicle use, human-caused fire and, possibly for livestock grazing. In addition a plan should be in place to monitor in perpetuity impoundment stability, erosion and ground and surface water in the area. Without required long-term monitoring and prevention of disturbance, the likelihood of contaminant release from the tailings impoundment in the future, and potential pollution of public waters and wildlife, will be a high probability certainty.	
BBC01057	2-E	Bonnie Gestring		Email	There are many inadequacies in the DEIS, including but not limited to: 6) Failure to consider operational failures of the Cement Tailings Facility even though this technology has not been implemented at any other mine (Enviromin). 8) Failure to consider liner system failures, pipeline spills and other equipment failures that are common occurrences at mining operations. Failure to demonstrate that the water quality monitoring sites are appropriately sited to	6) See Consolidated Responses PD-1, PD-2, PD-3, and PD-4. 8) Monitoring locations established for baseline studies and ongoing monitoring (Section 3.5.1, Analysis Methods, of the EIS) have been selected to provide the best quality data possible, including capture of potential effects from the Project. Upstream of SW-1, Sheep Creek is braided as it flows across an alluvial plain and the unstable nature of the channel is not conducive for establishing a continuous

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					detect water quality impacts. The DEIS fails to describe how the CTF meets the requirements of 82-4-376 and 82-4-337. The analysis of the independent tailings review panel must be incorporated and made available for public review.	monitoring gauging station. Additionally, operational monitoring is stipulated by DEQ and has been proposed to identify potential impacts on water resources in a timely manner and trigger the implementation of operational changes and / or mitigation measures (Section 6 of the MOP Application [Tintina 2017a]). Monitoring would continue on Sheep Creek downstream of the MOP Application Boundary and along Coon Creek as described in Section 3.5, Surface Water Hydrology, of the EIS. Additional monitoring would be implemented on Upper Coon Creek as described in Section 6 of the MOP Application.
Hazardous Materials						
HC_030	9	Curtis G. Thompson		Hard Copy Letter	The entire draft EIS is premised on the viability of the plugging technique of backfill in the proposed mine. There has been no demonstrated success of this technique. At this point, it is simply a new version of mining company snake oil. All mining companies promise minimal environmental impact and each has its own new idea to sell to the public and regulatory agencies. Time and again, the sales pitch has proven to be hollow and the environment catastrophically impacted. The new “plugging technique” proposed and forming the foundation of the draft EIS is simply another pitch. And while it may be a sophisticated pitch, it is nevertheless unproven. Montana DEQ should not endanger precious natural resources on the premise of an unproven experimental mode of plugging. The draft EIS is insufficient and defective in that it does not require actual proof of the viability of the new “plugging technique.”	See Consolidated Response PD-2.
HC_025	3	John Kowalski		Hard Copy Letter	Toxic waste. Given the history of storing toxic waste from mines, I don’t feel comfortable buying into the “newest technology available” story the mine is selling. We have been told this by every new mining venture that comes along and unless you can prove otherwise, they all end up leaking at some point. Can DEQ and the company guarantee this mine will not create acid mine drainage that will eventually find it’s way into Sheep Creek and the Smith River?	See Consolidated Responses PD-2, PD-4, and PD-5.
BBC00510	2	Grayce Holzheimer		Email	I have researched this “new” method being used by Copper Mines across the country and there is not one single Copper Mine in the entire USA that has NOT contaminated the groundwater of the area of the Copper Mine in question. I would send you links, but the Copper Mines now have taken down their information on their web sites so I no longer can link you to the source. They all have to comply and report, so I ask you to do your due diligence and look at all the Copper Mines currently in the USA that are using this “new” technique and how they are contaminating the groundwater of the area involved. You have the capability to ask and them and they will comply to a state inquiry. Minnesota has one of the largest newer Copper Mines currently running in the U.S.A. 3. Recently Carl Puckett, Tribune Reporter highlighted the challenges of cleaning up Belt Creek from the toxic tailings from the old Coal Mines near Stocket and Sand Coulee which affect the town of Belt. He did not mention the recent Fish, Wildlife and Parks Fish Cage Study in which they put trout in cages in various points along upper Belt Creek to see how long they lived and then do scientific research on the bodies of the fish to see what they absorbed while they were in the cages. a. The fish in the cages up Hughesville lived 15 minutes. (study was done 5 years ago.)	See Consolidated Response PD-2. There are currently no copper mines in operation in Minnesota to compare against, although the PolyMet NorthMet Mine has secured permits to begin construction. Additionally, DEQ is unaware of any copper mines currently in operation using the exact same combination of technologies proposed by the Black Butte Copper Project. However, components of the technologies referenced have been used successfully around the world.

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					b. The fish in the cages up Carpenter Creek lived 12 minutes. (About 20 old abandoned silver mines are up Carpenter Creek.) c. The fish in cages set below the bridge at FS road 6511 lived 5 hours. (This is the area below my cabin and land.) d. The fish in cages set up above Neihart lived 5 hours. e. The fish in cages below the Sluice Boxes, before the toxic run off comes in from Stockett lived 3 days. Lesson learned? Only eat the fish below the Sluice Boxes and before the run off from the old Coal Mines. The theory is that the limestone from the Sluice Boxes filter most of the arsenic, mercery and lead out of the water so the fish live longer and are safer to eat. I will not eat them. Neither will my family. I also tell everyone I know with small children not to go swimming in Belt Creek, Carpenter Creek and Dry Fork Creek. Therefore, because of the knowledge of the mines and toxic legacy they left behind, my family only fishes and eat the fish on the south side of King's Hill. What stream do we fish? The Smith River and tributaries and Sheep Creek respectively. Once this mine goes in, we will no longer be able to fish and eat the fish with trust that we are not being poisoned by toxic exposure.	
BBC00518	1	James Spaulding		Email	Section 2.4.1.8 of the Draft EIS discusses the possibility of fully separating rock that contains sulfide from the tailings of the project prior to disposing of them in either the double-lined Cement Tailings Facility or within the mine itself as backfill. I was pleased to see that this option, raised during scoping, was fully addressed and finally dismissed. While it sounds like a sensible solution to dealing with ARD, your analysis illuminates the technical and environmental challenges sulfide removal would present. Technical Memorandum 3 concludes that issues such as onsite or offsite storage and ultimate disposal may not be technically feasible and would not be environmentally safer than the ARD protection processes proposed by Tintina	Thank you for your comment.
BBC00629	2	Cheryl C. Mitchell		Email	Sandfire's plans to keep mine tailings and toxic waste in place for decades is very experimental. Neither the mining company nor the DEQ provided evidence that this will work. I remember two winters ago when thousands of snow geese died when they landed on a body of water in Montana that consisted of mining wastes. Here is the link to the article: www.theguardian.com/us-news/2016/dec/07/thousands-of-snow-geese-die-in-montana-after-landing-on-contaminated-water But you are aware of what happened, I am sure. The reality is, there is no such thing as a leak-proof tailings pond, even if the pond has a double-lined bottom and the tailings are rendered "non-flowable." And an open pond is an invitation to disaster. Wasn't it such a pond that was breached in Colorado several years ago that allowed toxic chemicals to flow into the public water system? I clearly remember reading about this in the newspaper.	See Consolidated Responses PD-1, PD-2, and PD-3. The CTF would consist of cemented paste tailings (with 0.5 to 2 percent cement content) rather than an open tailings pond. The ultra-thickened, cemented paste tailings would be dewatered to approximately 79 percent solids (Appendix K of the MOP Application). Any water that collects on the CTF surface would be pumped to the WTP for treatment. Additionally, no surficial mining-related water features are proposed to remain post-closure. The incident at the Gold King Mine in Colorado was not caused by the failure of an open pond. It was related to a draining mine adit that collapsed; the Black Butte Copper Project is designed such that no draining adits would be created.
BBC00777	3	William Adams		Email	The Black Butte Project presents a significant long-term risk to water quality because the mine waste must be isolated from air and water in perpetuity to prevent the formation of acid mine drainage. Yet, the proposed cement tailings	See Consolidated Responses PD-2, PD-3, and PD-5.

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					facility is new technology that is entirely untested. The DEIS fails to take a hard look at the potential for operational failures.	
Human Health and Safety						
HC-003	84	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS further declines to provide a human health risk assessment associated with hazardous air pollutants produced at the project site, including “arsenic, antimony, cadmium, chromium, and lead.” Draft EIS at 3.2-32. The Draft EIS notes that such a risk assessment “is not explicitly required by Montana air quality regulations,” and that “[n]o Montana risk assessment guidance exists for this source type.” Draft EIS at 3.2-32. Nevertheless, MEPA requires DEQ to disclose all the project’s environmental impacts, including potential impacts to human health. See ARM 17.4.609(3)(e); 17.4.617(4)(a). Therefore, the EIS should analyze the human health risks caused by hazardous air pollution associated with the project pursuant to MEPA, whether or not such a risk assessment is also required under Montana air quality regulations.	The cited language in the Draft EIS has been updated in Section 3.2.4.2, Proposed Action, of the Final EIS to state, “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.” This section also states, “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.” ARM 17.8.4.609 requires an evaluation of impacts on human health, and quantification of the low levels of HAP emissions satisfies that element. Criteria pollutants were modeled to comply with NAAQS and MAAQS, and HAP emissions are estimated to be even lower, so marginal impact on human health is expected. Any site exposure risks are further mitigated by the remote mine location and infrequent use of the area by the general public. As required by all mines, following occupational safety and health rules would be required to protect employees working on the site.
HC-003	89	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS also ignores scientific literature documenting human health impacts associated with the boom-bust cycle of mining, including increased prevalence of “acute cardiovascular disease and mental disorders during decline and bust periods.” Exhibit 52 at 62 (Shandro, The Demographic, Economic, and Health Fabric of Mining Communities in British Columbia, Canada (2011)). The Draft EIS should evaluate these impacts as well.	Section 3.9.3.2, Proposed Action, of the EIS discusses the potential effects of the Project on human health and quality of life, as it relates to the boom-bust cycle of mining.
BBC00510	5	Grayce Holzheimer		Email	The owners say that an accident will NEVER HAPPEN. How can they say this? They have no idea. An accident is called an accident. I am actually more afraid and concerned about the owners attitude and ability to shrug off any idea that an accident can happen. So that means to me that they do not even have an adequate accident plan if the are not covering all their bases and considering all the possibilities of how an accident could happen based about their own “new” type of copper extraction. 9. I grew up swimming and playing Belt Creek and so did my sisters. We all have developed neurological challenges. What affects neurological aspects of the human body? Mercury, lead, arsenic and who knows what else.	See Consolidated Response PD-3. The EIS does not state that an accident would never happen; however, the Project is not anticipated to cause significant impacts (e.g., release of mercury, lead, arsenic, or other contaminants) to Sheep Creek or the surrounding environment. Failure modes analysis is discussed in Chapter 2, Description of Alternatives, of the Final EIS for additional clarity.
Land Use, Recreation, and Visual Resources						
HC-002	3	William Avey	USDA Forest Service	Hard Copy Letter	The Moose Creek Road, County Road 119, provides important, year-round recreational and management access to public land users and Forest Service land managers. This route accesses numerous federal recreation facilities including a campground, rental cabin, motorized, non-motorized, and winter trails, public land hunting, the Sheep Creek fishing access, as well as providing access for forest management activities such as wood cutting, timber harvest, prescribed burning, and livestock grazing. Please ensure project permitting of the proposed activities continues to provide safe and appropriate access to public lands.	County Road 119 is the primary access to the Project area and would remain open to the public during construction and operations of the Project. Increases in traffic and road congestion associated with the Project can be found in Section 3.12.3.2, Proposed Action, of the EIS.

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HC-002	5	William Avey	USDA Forest Service	Hard Copy Letter	There are property boundary fences between private lands of the project area and federal lands. Private-federal land boundary fences are the responsibility of the private landowner. The fence line locations need to be verified to ensure project activities do not result in encroachments on federal lands. Where fences do not occur on landownership boundaries, it is equally important to ensure accurate property boundary locations so that encroachments do not occur.	The Project would be located entirely on private lands, and a fence would be installed around the surface facilities. No Project activities would occur on federal lands.
HC-003	49	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS should also consider potential pollutant discharges from the soil Tintina plans to use for reclamation. Draft EIS at 3.6-14. During mine operations, Tintina plans to stockpile large amounts of soil for use in reclaiming the mine site after closure. See Draft EIS at 3.10-10. These soils exhibit levels of lead, zinc, copper, arsenic, and cadmium that “exceed DEQ baseline background values for these inorganic elements.” Draft EIS at 3.10-13-3.10-14. Although the Draft EIS acknowledges that “stockpiled soil would be susceptible to erosion,” it does not discuss the possibility that such erosion may cause toxic metal discharges to surface water or groundwater, or harmful sedimentation of surface water. DEQ must consider these potential impacts.	Per § 82-4-336, MCA, the Project would require erosion control practices throughout the life of the mine, including during reclamation. Section 7 of the MOP Application (Tintina 2017a) states that one of the objectives of reclamation is, “Stabilization of disturbed areas using erosion and sediment control BMPs, and revegetation measures to prevent air and water pollution.” Erosion control measures would be used throughout operations, during short-term temporary closure, and during permanent closure. Soils used for reclamation would be sourced onsite and would not reflect a difference in the amount of metals than currently exists. The referenced background study involved the analysis of two soil samples per county throughout Montana, and avoided areas associated with historic mining; therefore, it is logical that the background values are not representative of soils in naturally mineralized areas. BMPs would be used to minimize erosion and sedimentation. Storm water outfalls would be monitored to verify compliance with water quality criteria.
BBC00356	1	Brady Richardson		Email	I am writing on behalf of the proposed Tintina mine. My family owns land directly adjacent to the proposed mine site north of white Sulphur springs. My family has been ranching on this land for over a hundred years. I have multiple concerns with this company and their proposed plans. First, they did not notify us of a new water treatment pond that they are required to build now. This makes me very nervous about what else they are not telling us. Next, they ask us for our opinions on roads, buildings etc., and they end up doing it the way they want to build regardless of the input we have. Additionally, I am very concerned about the water quality our cattle will be consuming out of sheep creek and the creeks that will be having water pumped into them from the mine treated water. I ask that the Montana DEQ considers landowners concerns on the proposed mine, as any flaw on their plan or mistake on their part can ruin our family’s way of life and our ranching operation.	See Consolidated Response MEPA-3. As is standard practice, the EIS includes extensive quantitative predictive surface water and groundwater modeling to generate predictions to support the assessment application and further, as tools to inform mitigation and management strategies, including design of the water treatment facilities to minimize potential impacts on surface and groundwater (see Section 3.4.1, Analysis Methods, Section 3.4.2, Affected Environment, Section 3.5.1, Analysis Methods, and Section 3.5.2, Affected Environment, of the EIS). Note, the Project is proposed to be an underground mine and a primary planned mitigation measure is that the only significant amounts of Project contact water would be excess water sent from the WTP to an UIG; the water released to the alluvial aquifer via the UIG during the mine construction and operations phases would be treated to assure compliance with groundwater standards and non-degradation criteria per the MPDES permit (Hydrometrics, Inc. 2018a; Tintina 2018a). As detailed in the EIS and summarized below, there are no significant impacts on surface water hydrology/flows due to the Project, and water quality of Sheep Creek is predicted to comply with water quality standards. Ongoing operational monitoring is stipulated by DEQ and has been proposed to validate model predictions and to identify potential impacts on water resources in a timely manner and trigger the implementation of operational changes and/or mitigation measures (Section 6 of the MOP Application, Tintina 2017a). Monitoring would continue on Sheep Creek downstream of the MOP Application Boundary and along Coon Creek as described in Section 3.5, Surface Water Hydrology, of the EIS. As discussed in Section 3.4, Groundwater Hydrology, and Section 3.5, Surface Water Hydrology, of the EIS, the combined impacts on water resources based on the Proposed Action are expected to be minor; surface disturbance is less than

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						1 percent of local watershed area, and base flow depletion for all streams except Coon Creek are within surface base flow measurement error (±10 percent). 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). Similarly, no impacts on the receiving water quality (Sheep Creek and Coon Creek) are anticipated since water from all facilities would be collected and treated to meet non-degradation criteria prior to discharge to the alluvial UIG (Hydrometrics, Inc. 2017b). The quality of the groundwater reporting to Sheep Creek and Coon Creek would be the same, if not better, than baseline conditions as the treated water discharged to the alluvial UIG would meet groundwater non-degradation criteria (Hydrometrics, Inc. 2016b). At the downstream monitoring location on Sheep Creek (SW-1), simulated base flow depletion was estimated at 2 percent (very little and well within natural variability; see Section 3.5.3.1, Surface Water Quantity, of the EIS) and no impacts on water quality were predicted (see Section 3.5.3.2, Surface Water Quality and Temperature, of the EIS).
BBC00978	7	Bruce Farling		Email	The DEIS gives short shrift to the potential impact of the mine and the increase in population on recreation. For example: • The only discussion related to potential increase in use or conflicts on the Smith River is limited to the 59-mile reach requiring a permit to float. And potential impacts are summarily dismissed because floating (but not wade fishing) is by permit only. The river, however, is 125 miles long and 36 miles of it are between Camp Baker and Buckingham Bridge, where the North Fork and South Fork join. The DEIS completely ignores potential impacts to the non-regulated reaches of the Smith, which currently do support recreation. It also ignores potential effects on existing recreation, mainly angling, on the South and North Forks, as well as other tributaries. Further, the DEIS completely ignores whether non-floating recreation will increase from other landownerships, including private properties, within the permit-only-for floating corridor. • The DEIS considers effects on recreation only within a 15 mile radius of the mine site even though the majority of workers and their families are projected be commuting from as far as 110 miles away. Subsequently, the DEIS ignores the majority of the potential effects mine workers and their families will bring to bear on existing hunting, fishing, hiking, horseback riding and camping opportunities in the region. Curiously, the DEIS does include figures showing hunting pressure that currently occurs within several hunting districts that stretch far beyond the 15-mile radius. It is unclear what to take from this. The DEIS should have examined all existing recreational data available, including angling pressure on local waters available from FWP, hunting pressure and number of special licenses and permits available on all hunting districts in the region, and recreational data available from the Forest Service and projected how these numbers will be affected by an influx of workers and their families to the region. • Nowhere in the DEIS are there data or projections on how much more wildlife law enforcement and public land maintenance needs will be required to absorb a potential significant increase in recreational use. Nor is there any evaluation of the potential for increased private land trespass, which is likely to	Comment noted. Section 3.7, Land Use and Recreation, of the EIS focuses on the 15-mile radius around the mine site for impacts on recreation that could occur from the increase in activity at the site itself related to noise and visual impacts. As discussed in Section 3.7.3, Environmental Consequences, of the EIS, the population increase from mine employees and contractors may increase the number of people using recreation areas around the Project area. Recreational resource demands may be higher during construction and operations given the increase in local population from construction workers and mine operators.

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					increase with the population influx in the region. This information could help inform recreationists within the impact area as to what they can expect for changes in their current recreational experiences.	
MEPA						
HC-003	7	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS DEQ has prepared for the Black Butte Mine is deficient in several respects. At the outset, DEQ should provide a new scoping period, and provide an additional round of mine operating permit review, so that the public has an adequate opportunity to comment on significant recent changes in Tintina's plan of operations that fundamentally alter the project's expected environmental impacts. The Draft EIS also fails to address the state's public trust obligations concerning state-owned minerals under Sheep Creek, which Tintina may access during its planned mine excavation.	One purpose of scoping is to identify the issues related to the Proposed Action that are likely to involve significant impacts that will be analyzed in depth in the EIS. DEQ determined that the changes to the Proponent's plan of operations were not significant and did not fundamentally change the project's expected environmental impacts. DEQ specifically determined that the changes did not substantially change the proposed plan of operation or reclamation and, therefore, DEQ did not have the discretion to restart the permitting process under § 82-4-337(2)(a), MCA. See Consolidated Response MEPA-1. Moreover, all the changes were incorporated into the Proposed Action, the expected environmental impacts of the changes were disclosed in the Draft EIS, and the public has had an opportunity to comment on the impact analysis of the changes set forth in the Draft EIS. The mine plan that DEQ analyzed during this environmental review includes mining of potential ore under Sheep Creek. The Proponent, however, has indicated that inclusion of mining under Sheep Creek is the result of statistical modeling of drill results from drill testing further to the west, and is not a direct indication of a minable resource under Sheep Creek. Without considerable additional drill data, the Proponent does not know if an economically minable copper resource exists under the creek. The Proponent also asserts that it is not established that the State of Montana owns any mineral deposit under Sheep Creek. If the state does not own the minerals, the Proponent asserts that it holds valid mineral leases from the private landowner covering the minerals under Sheep Creek. In its letter to DNRC dated January 23, 2017 (Zieg 2017), the Proponent proposed to DNRC to defer the question of state leasable minerals under Sheep Creek until additional drill data has been collected. However, in this same letter, the Proponent also stated they had no current plans to collect additional drilling data in that area. While DEQ included reviewing the environmental impacts resulting from mining under Sheep Creek, issuance of an operating permit would not confer to the Proponent a legal right to mine under Sheep Creek. If it is determined that a minable resource extends under Sheep Creek and that the state owns the mineral interest, the Proponent would be required to obtain a lease from DNRC before it could mine ore under Sheep Creek.
HC-003	12	Josh Purtle	Earth Justice	Hard Copy Letter	First, DEQ should provide for an additional round of public comment on Tintina's mine operating permit application. Under the Metal Mine Reclamation Act ("MMRA"), if "[a]fter issuance of a draft [mine operating] permit but prior to receiving a final permit," the permit applicant makes modifications to its application that "substantially change the proposed plan of operation or reclamation, the department may terminate the draft permit" and conduct a further review ofthe permit application to determine if it is complete and it complies with MMRA requirements. MCA § 82-4-337(2)(a).	See Consolidated Response MEPA-1 and MEPA-3. In the Proponent's original application, treated water would be discharged into Sheep Creek for 12 months of the year, assuming that the concentration of nitrogen would satisfy MPDES limits for nitrogen year-round. During analysis in connection with the Proponent's MPDES application (Hydrometrics, Inc. 2018a), DEQ determined that the more stringent nutrient standards in effect during the summer months would not be met. As a result, the Proponent changed its mining

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					Termination ofTintina's draft permit followed by an additional round of public comment is warranted here, because the plan of operations described in the Draft EIS differs substantially from the plan of operations DEQ approved in issuing a draft mine operating permit to Tintina in September 2017. Further, because the public was not apprised of these changes before the last MEPA scoping process, which occurred about 18 months ago, DEQ should conduct a new scoping process so that the public has an adequate opportunity to provide feedback on Tintina's modified plan of operations prior to DEQ's environmental review. The significant changes to Tintina's plan of operations that have occurred in the last 18 months include: (1) the addition of major mine facilities (including the 20-acre Water Storage Pond), (2) the addition of underground infiltration galleries in the alluvium of Sheep Creek, rather than UIGs upland from the creek, (3) water withdrawals from Sheep Creek, (4) revisions to the annual water balance for the project site, and (5) a wet well adjacent to Sheep Creek to divert water to the non-contact water reservoir. These changes constitute major changes to the mine plan that were not subject to the public MEPA scoping process and warrant further permit review under the MMRA.	permit application to include the TWSP, which would store the treated water during the summer months when the more stringent nitrogen standards would be in effect. Addition of the TWSP, however, does not change the environmental issue being analyzed, namely, the environmental impact resulting from the discharge of treated water into the Sheep Creek alluvium. Nor does the change affect the type of water treatment to be used or the volume and quality of treated water to be discharged. Water stored in the TWSP would comply with all non-degradation criteria for groundwater. Regarding the water balance, as initially proposed, 55 gpm of process water from the PWP was to be sent to the WTP where it would be treated and discharged via the UIG. To avoid the mine process water discharge, the Proponent changed its proposed water handling to direct the 55 gpm of process water directly to the mill for reuse. In turn, 55 gpm of treated water would be sent from the WTP to the mill. Thus, the change in the water balance constituted a rerouting of water internal to Project operations. The change in the water balance did not increase the volume of water needing treatment or the volume of treated water discharged via the UIG. DEQ believes that the "water withdrawals from Sheep Creek" and the "wet well" refer to the same change in the Proponent's application. The information that DEQ received on the wet well adjacent to Sheep Creek was not a change in the Proponent's MOP Application (Tintina 2017a). The wet well was conceptually described in the original application. Subsequent to submission of the application, the Proponent submitted a design for the wet well that would withdraw water from Sheep Creek. As discussed above and in Consolidated Response MEPA-3, the changes to the Proponent's initial MOP Application are not substantial and do not affect DEQ's completeness and compliance determination under § 82-4-337, MCA, or additional scoping under MEPA.
HC-003	16	Josh Purtle	Earth Justice	Hard Copy Letter	Tintina's proposal includes plans to mine state-owned minerals underlying Sheep Creek, which requires a lease from the Montana Board of Land Commissioners. To the extent that the state intends to rely on DEQ's Draft EJS for the mine operating permit to satisfy the Land Board's MEPA obligations related to leasing state-owned minerals, the EIS also must evaluate whether the lease is consistent with the Land Board's statutory and constitutional public trust obligations. The Land Board is bound by the constitutional requirement that "[t]he state and each person shall maintain and improve a clean and healthful environment in Montana for present and future generations." Mont. Const., art. IX, § 1. This mandate is particularly meaningful for the Land Board, which serves as the public's trustee of state lands. Id., art. X, § 11(1) (state lands are "held in trust for the people"); MCA § 77-1-202 (state lands "are held in trust for the support of education and for the attainment of other worthy objects helpful to the well-being of the people of this state"); MCA § 77-3-301 (Land Board shall manage state resources in a manner that is "in the best interests of the state"). The Land Board's obligation "to protect the best interests of the state ... necessarily includes considering consequences to ... the	DEQ did not prepare this EIS to serve as a basis for any state action that may or may not be required by the Montana Board of Land Commissioners or the DNRC. Rather, this EIS has been prepared to evaluate DEQ's action on the Proponent's application for an operating permit under the MMRA. DEQ is not segmenting or piecemealing its action on the Proponent's MOP Application (Tintina 2017a) to avoid consideration of the environmental impacts of the entire mining Project as described by the Proponent in its application.

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					environment." Ravalli Cnty. Fish & Game Ass'n v. Mont. Dep't of State Lands, 273 Mont. 371, 379 (1995). The Land Board's "duty to avoid environmental harm is mandatory." Id. at 387. The Draft EIS, however, fails to evaluate whether Tintina's proposal is consistent with these obligations. In a letter to the Department of Natural Resources and Conservation dated January 23, 2017, Tintina asked the state to defer addressing this issue "until after the permit process has been completed and additional drill date [sic] has been collected," Exhibit 12 (Letter from Jerry Zieg, Tintina Resources Inc., to Danna Jackson, Dep't ofNat. Res. & Conservation (Jan. 23, 20 17)), but failing to address this issue in the Draft EIS would unlawfully segment DEQ's environmental review of the proposed project, contrary to MEPA requirements. See W. Radio Servs. Co. v. Glickman, 123 F.3d 1189, 1194 (9th Cir. 1997) (noting that courts applying MEPA's federal analogue, NEPA, had rejected "agency attempts to bypass NEPA's protections by illegally segmenting projects in order to avoid consideration of an entire action's effects on the environment"). The EIS should therefore evaluate the state's public trust obligations in state-owned minerals under Sheep Creek now.	
HC-003	18	Josh Purtle	Earth Justice	Hard Copy Letter	DEQ ignored, however, MEPA's requirement to evaluate a project's secondary environmental impacts, ARM 17.4.609(3)(d), including any "further impact to the human environment that may be stimulated or induced by or otherwise result from a direct impact of the action." Id. 17.4.603(18); see also 40 C.F.R. § 1508.8 (an action's "indirect" environmental effects are those that "are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable"). Here, the proposed mine would provide all the infrastructure necessary for Tintina's planned mine expansion, and as a result facilitate that expansion. Indeed, Tintina has indicated in the media that it intends to pursue the Lowry deposit together with the copper deposits it identified in its plan of operations. See, e.g., Exhibit 13. Given that the current mining proposal would enable and induce future mine expansion, DEQ should consider the impacts of such mine expansion as a secondary impact of the currently proposed project. See ARM 17.4.609(3)(d), 17.4.603(18).	ARM 17.4.603 defines "secondary impact" to mean "a further impact to the human environment that may be stimulated or induced by or otherwise result from a direct impact of the action." MEPA's definition of "secondary impact" is different from the definition of "indirect effects" set forth in NEPA. The state definition set forth in MEPA governs. Any future expansion to access the Lowry Deposit is not a secondary impact because it is not stimulated or induced or otherwise does not result from a direct impact of the mining proposed in the MOP Application (Tintina 2017a) currently before DEQ. To conduct any mining of the Lowry Deposit, the Proponent would be required to submit an application to DEQ to amend its operating permit to allow such mining. DEQ's action on the application to amend the operating permit would be subject to its own environmental review. DEQ would retain the authority to either approve or deny the permit amendment application. See Consolidated Response CUM-1.
HC-003	94	Josh Purtle	Earth Justice	Hard Copy Letter	In sum, the Draft EIS fails to provide a meaningful evaluation of project alternatives and further omits critical information about potential environmental impacts caused by the proposed Black Butte Copper Mine. DEQ should provide the missing analysis and recirculate a revised Draft EIS for public review that fully evaluates and discloses all the project's environmental impacts and feasible alternatives. Further, given the significant changes in Tintina's proposal since the MEPA scoping period ended 18 months ago, DEQ should provide an additional opportunity for public comment on the revised Draft EIS. If DEQ declines to prepare and recirculate an adequate Draft EIS that rationally supports a conclusion that mining in the Smith River watershed will not cause unacceptable degradation to water quality and fisheries, DEQ must select the "no action" alternative to avoid apparently significant environmental consequences. See Mont. Const., art. IX, § 1 (1) ("The state and each person shall maintain and improve a clean and healthful environment in Montana for present and future generations."). The importance ofthis watershed to the	See Consolidated Response MEPA-1 and MEPA-3. The Montana Legislature enacted the MMRA mindful of its constitutional obligations under Article II, Section 3, and Article IX of the Montana Constitution (§ 82-4-301(1), MCA). DEQ understands the importance of the Smith River and its watershed to the people of Montana. DEQ will not approve the Project unless it determines that the requirements of the MMRA are satisfied.

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					people of Montana demands that DEQ take every possible measure to protect Sheep Creek and the Smith River from the threat of perpetual mine pollution.	
BBC00830	25	Kendra Zamzow	Center for Science in Public Participation	Email	Climate change There appears to be no assessment of climate change, although it was brought up in Scoping. It does not appear to be addressed in the DEIS, including in the DEIS cumulative impacts section, or in the MOP, or in specific Appendices such as MOP Appendix A-2 (Design for Storm Events) or MOP Appendix M (Hydrologic Modeling). These are areas in which climate needs to be considered to reasonably reduce risk through mitigation and engineering and to assess the cumulative impacts that the mine would add to climate-related impacts that vegetation, soil, waters, and wildlife may already be or will be experiencing. Climate also needs to be considered with respect to tailings management. For example, a very small increase in rainfall – as predicted for this area – can have large impacts on road systems.6 It will also impact the ability to capture, divert, and control storm runoff and increase the flows entering the WTP. Increased temperatures could increase the risk of wildfire, with potential impacts on general operations and, for in-perpetuity post-closure, the CTF cover system. Sporadic rainfall with longer periods of dry spells, along with increased temperatures and changing landscape ecology, may affect the success of revegetation post-closure. Consulting firms have been addressing engineering and water management issues with respect to mine design for climate change for nearly a decade (Journeaux 2012, Wobus et al. 2015, Rykaart et al. 2016, Munoz et al. 2017). Munoz and Rykaart address design for water management, Wobus et al. integrate climate scenarios into hydrologic modeling at a specific mine site. Journeaux recommends "dry stacking" waste as underground backfill as much as possible in cold regions; the Black Butte Mine proposal to backfill tunnels with cemented-paste tailings falls in line with this recommendation (although the reactivity of flooded cemented-paste tails with high sulfide content should be better researched), the surface disposal does not. The lack of attention to climate change is inexcusable. The lack of field studies to determine real-world operational issues, compounded by ignoring anticipated climate changes, increases the risk of operational upset and potential water contamination.	See Consolidated Response MEPA-2 for the topic of climate change. Climate change has been added to the issues not considered for detailed analysis in Chapter 2, Description of Alternatives, of the Final EIS. The probable maximum precipitation of the Project area is estimated to be 22 inches. The probable maximum flood is defined as the largest flood that could occur (estimated to be the probable maximum flood event plus the 1 in 100-year snow accumulation of 11.4 inches), which is estimated to be a combined 33.46 inches (or 1.5 times the total annual precipitation of the Project area). Section 3.7.5.1 of the MOP Application (Tintina 2017a) states that, "The Project facilities including the CWP, PWP, and CTF were designed to store the [probable maximum flood] volume in addition to their normal operations volume." Given the excess capacity of the facilities, it is unlikely that additional precipitation due to climate change would cause a failure during operations. The Project is proposed to use RO to treat water at the WTP. RO treatment is known to scale well by simply adding more units, and the Proponent proposes to have a backup unit available to treat up to 750 gpm (Section 1 of the MOP Application). If there is a need to treat additional water due to higher than anticipated precipitation levels, it should be evident with enough time to secure additional units given the proposed monitoring protocols. See Consolidated Response WAT-1 for information about the RO treatment system. In closure, all facilities would be reclaimed and capped, and the CTF diversion ditch/channel would direct storm flows off and away from the CTF. See Consolidated Response PD-2 and PD-5 for information about tailings storage in the CTF and underground, and the performance of cemented sulfide tailings.
BBC00777	2	William Adams		Email	1. The DEIS for this project was unacceptable reushed and it was based on an incomplete mine plan. Major changes were made to the mine plan after the public scoping process.	See Consolidated Response MEPA-3 and response to Submittal ID HC-003, Comment Number 12.
BBC00922	2	Chris Lish		Email	Montana has a long history of mining projects that have promised no impacts to water quality or quantity; only to result in substantial harm. The proposed Black Butte copper mine is no different. Specifically, I believe the DEQ's draft Environmental Impact Statement (DEIS) contained the following serious flaws that must be addressed: 1) The DEIS for this project was unacceptably rushed and it was based on an incomplete mine plan. Major changes were made to the mine plan after the public scoping process. These changes need to be addressed in the DEIS.	See Consolidated Response MEPA-3 and response to Submittal ID HC-003, Comment Number 12.

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BBC01057	2-B	Bonnie Gestring		Email	There are many inadequacies in the DEIS, including but not limited to: 3) Incorporation of major changes to the mine plan that were not subject to public scoping.	See Consolidated Response MEPA-3 and response to Submittal ID HC-003, Comment Number 12.
BBC01057	2-C	Bonnie Gestring		Email	There are many inadequacies in the DEIS, including but not limited to: 4) Failure to consider the effects of climate change in mine operations, design and management.	See Consolidated Response MEPA-2.
BBC01057	2-D	Bonnie Gestring		Email	There are many inadequacies in the DEIS, including but not limited to: 5) Failure to evaluate the potential effects of the project during closure and postclosure.	The resource sections in Chapter 3, Affected Environment and Environmental Consequences, of the Draft EIS evaluate the potential environmental consequences throughout each phase of the mine (i.e., construction, operation, closure, and post-closure).
BBC01057	2-F	Bonnie Gestring		Email	There are many inadequacies in the DEIS, including but not limited to: 7) Failure to consider the potential for mine expansion into the Lowry deposit.	See Consolidated Response CUM-1.
BBC00933	24	Ann Maest	Buka Environmental	Email	In general, insufficient information from the MOP is reproduced in the DEIS. All pertinent information needed to evaluate the potential environmental impacts of the project should be included in the body of the EIS. For example, the basis for selecting the 2012 metal mobility samples is described in Appendix A to Appendix D of the MOP and is not reproduced in the DEIS. The method used for selecting the 2015 samples for metal mobility is unclear. The basis for selecting the samples is important because it determines the outcome of the water quality predictions and the resulting impacts to groundwater and surface water. The FEIS must include all information needed to determine whether a “hard look” at metal mobility and water quality impacts has taken place.	Environmental reviews conducted under MEPA are intended to provide an analytical review of potential effects; the analysis is not intended to be encyclopedic. Appendix D-1 and Appendix K of the MOP Application provide additional information to support the conclusions made in the Draft EIS, including the basis for selecting the 2015 metal mobility samples.
Noise and Vibration						
PM1-09	1	Larry Antonich		Public Meeting Transcript	And my concern is noise that the mine is going to produce, unacceptable continual noise generated by the mine, audible at a subdivision on Little Moose Creek during both the construction and operation phase of the mine. My greater concern is based on the unprofessional and incomplete investigation and conclusions reached by the DEQ EIS. The words and the charts have been thrown together in an incomplete attempt to gloss over the subdivision and the adverse environmental quality, noise, that the mine will generate. Noise field studies and measurements were not conducted at the subdivision to the mine. The EIS concerning noise has been accomplished in a less than professional manner. The subdivision within the affected area was not even mentioned in the preliminary EA or EIS. It appears to me that the Montana DEQ, Tintina, and the noise study contractor had little concern about the noise and the effect on destroying the quiet and calm at the subdivision. I can state for fact that there will be 24/7 continuous audible and irritable noise from crushers and numerous other noise-producing equipment that will sincerely affect the quality of life that we now enjoy in the subdivision. Common sense justifies the fact, as I tolerated many drilling and associated noises during the exploratory phase of the project over the past few years. The fact that the noises generated from the construction and operation phases of the mine will be further separated from my property than the exploratory work is not another excuse to face the facts.	As described in Section 3.11.3, Environmental Consequences, of the EIS, noise levels associated with construction and operation of the Project would be only occasionally audible within 1 to 2 miles of the Project area. Because the Little Moose Subdivision is greater than 2 miles from the Project area (approximately 3 miles from the mill pad), the noise attributable to the Project construction and operation at the Little Moose Subdivision would be less than the noise levels estimated for Location 2 outlined in Section 3.11.3, Environmental Consequences, of the EIS. Therefore, the EIS concluded that noise attributable to the Project would only be occasionally audible at the Little Moose Subdivision. Blasting noise associated with construction of the Project may also be audible at the Little Moose Subdivision. The analysis presented in the EIS adequately characterizes the potential noise associated with Project construction and operation and the associated impacts on nearby noise sensitive areas, including the Little Moose Subdivision.

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					The analysis encompasses an area potentially affected by project facilities along Sheep Creek and Butte Creek, with no mention of the Little Moose Creek Subdivision. The subdivision is an inhabited area, with each residence spaced within a 40-acre plot. Noise is virtually nonexistent other than an occasional snowmobile or ATV.	
BBC00378	1	Lawrence Antonich		Email	I am extremely concerned with the inevitable and unacceptable continuous noise generated from the mine, audible at my Lodge on Little Moose Creek, during both the construction and the operation phase of the proposed mine… the EIS addressing NOISE is incomplete, inaccurate and will severely impact the quality of life at my Lodge and devalue the property substantially	As described in Section 3.11.3, Environmental Consequences, of the EIS, noise levels associated with construction and operation of the Project would be only occasionally audible within 1 to 2 miles of the Project area. Because the Little Moose Subdivision is greater than 2 miles from the Project area (approximately 3 miles from the mill pad), the noise attributable to the Project construction and operation at the Little Moose Subdivision would be less than the noise levels estimated for Location 2 outlined in Section 3.11.3, Environmental Consequences, of the EIS. Therefore, the EIS concluded that noise attributable to the Project would only be occasionally audible at the Little Moose Subdivision. Blasting noise associated with construction of the Project may also be audible at the Little Moose Subdivision. The analysis presented in the EIS adequately characterizes the potential noise associated with Project construction and operations and the associated impacts on nearby noise sensitive areas, including the Little Moose Subdivision.
HC_030	2	Curtis G. Thompson		Hard Copy Letter	While there is an evaluation of noise in the draft EIS, the evaluation does not particularly considered the noise level on nearby cabins and a nearby development with capacity for additional cabins. For those individuals and families with cabins and camping sites nearby the site, their ability to enjoy the outdoors and remoteness in peace and quiet would be permanently destroyed.	The noise analysis presented in Section 3.11, Noise, of the EIS presents the potential noise impacts associated with Project construction and operations on existing noise sensitive areas, which includes cabins, located between approximately 0.5 to 2.5 miles from the Project site. Any future developments added to the region would experience similar noise levels associated with the Project as the noise sensitive areas presented in the EIS. The MMRA does not give DEQ any regulatory authority over noise impacts. Furthermore, while MEPA requires DEQ to disclose impacts, MEPA is procedural in nature and does not give DEQ any authority to withhold, deny, or impose conditions on any permit under § 75-1-201(4), MCA.
Permitting and Regulatory Considerations						
HC-003	15	Josh Purtle	Earth Justice	Hard Copy Letter	These changes in Tintina's mine operating plan may also require an amendment to Tintina's federal Clean Water Act section 404 permit, which authorizes Tintina to fill certain wetlands and waterways at the project site. See 33 U.S.C. § 1344. DEQ should therefore evaluate and disclose whether the additional and reconfigured facilities proposed in Tintina's new plan of operations will involve additional dredge-and-fill, such that another round of consultation with the U.S. Army Corps of Engineers is warranted. DEQ should also coordinate with the Army Corps of Engineers in developing the federal NEPA documentation that will be required for Tintina's section 404 permit.	The Proponent was issued a Department of the Army permit (NWO-2013-01385-MTH) under Section 404 on November 27, 2017. The proposed modifications to the MOP Application did not include any additional wetland disturbance. Because there would be no new impacts, a new Section 404 permit and consultation were not required. On July 3, 2019, DEQ issued a joint public notice with the USACE, certifying that the Project amendments/changes would not violate water quality standards under Section 401, which are special conditions of the Section 404 permit (DEQ 2019).
HC-003	34	Josh Purtle	Earth Justice	Hard Copy Letter	First, DEQ in developing the draft MPDES permit failed to establish technology-based effluent limitations for multiple pollutants of concern. All MPDES permits must contain technology-based effluent limitations, also known as "pretreatment standards" or "pre-discharge treatment standards," that are based on the use of available pollution-control technology that is determined to be cost-effective under standards established in the Clean Water Act. 33 U.S.C. § 1311(b); MCA § 75-5-401(2); 40 C.F.R. § 125.3(a); ARM 17.30.1203(1). Technology-based effluent limitations "prevent degradation of	The MPDES permit typically includes two types of wastewater control, Technology-based Effluent Limitations (TBELs) and Water Quality-based Effluent Limitations (WQBELs). USEPA promulgated TBELs in the Effluent Limit Guidelines (ELG) for the Ore Mining and Dressing point source category, including the Copper, Lead, Zinc, Gold, Silver, and Molybdenum Ores subcategory (40 CFR 440 Subpart J). The ELG addresses three types of wastewater generated from this industry:

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					water quality by requiring treatment before discharging wastewater into the receiving waterways." N. Cheyenne Tribe v. Mont. Dep't of Envtl. Quality, 20 I 0 MT 111, 22, 356 Mont. 296, 234 P.3d 51. Despite this requirement, the draft MPDES permit omits technology-based effluent limitations for multiple pollutants of concern, including total nitrogen, total phosphorous, ammonia, temperature, aluminum, arsenic, iron, selenium, thallium, uranium, cyanide, and several others. DEQ, Mont. Pollutant Discharge Elimination Sys., Permit Fact Sheet, Permit No. MT0031909 at 23 ("MPDES Fact Sheet"). The EIS should explain why technology-based effluent limitations are not required for these pollutants of concern. The EIS should further analyze the environmental consequences of failing to establish technology-based effluent limitations for these parameters, including whether the absence of such limitations will cause greater pollution in Sheep Creek and groundwater underlying the mine.	• Process wastewater, • Mine drainage, and • Industrial storm water. ARM 17.30.1203(5)(a) directs DEQ to include TBELs in the MPDES permit. The Proponent is authorized to discharge mine drainage from Outfall 001 that complies with the final effluent limits found in Part 2.1, Table 2 of the final permit. The permittee is prohibited from discharging process wastewater from Outfall 001 except under two limited exceptions found in the permit. If the permittee discharges process wastewater under one of these limited exceptions, the discharge still must comply with the final effluent limits found in Part 2.1, Table 2 of the final permit. When implemented, the process wastewater zero discharge prohibition controls all pollutants present in the waste stream. None of the mine drainage TBELs, except pH, are implemented as final limits in the permit because TBELs are all significantly less stringent than the WQBELs also developed in the Fact Sheet (40 CFR § 124.56). As described in the USEPA-developed 2010 NPDES Permit Writers' Manual (USEPA 2010), the purposes of TBELs, particularly for new sources subject to NSPS, is for permittees to choose and install state-of-the-art, most-efficient production processes during new facility planning and construction. The TBEL selection is typically set through USEPA-developed national, uniform ELGs. ELGs are based on the technological and economic ability of dischargers in the same industry category to control the pollutant discharges in the production process wastewater. This uniform industry-wide approach maximizes achievable pollutant reductions based on affordability and availability of technology across an entire industry. NSPS require, where practicable, no pollutant discharges. In the MPDES permit, DEQ disagrees that additional TBELs are required because the Proponent: • Proposes the waste stream receive RO treatment twice, and • Is held to the most stringent TBEL available, typically referred to as zero discharge of process wastewater or 100 percent recycle (excluding two limited exceptions). Both of these technologies represent state-of-the-art TBELs implemented in MPDES permits. When USEPA re-examined the issued ELGs, USEPA also found additional TBELs are not required for the Ore Mining and Dressing point source category ELG in the September 2011 Ore Mining and Dressing Preliminary Study Report (USEPA 2011) and again in 2018. On May 2, 2018, USEPA published the Final 2016 Effluent Guidelines Program Plan, 83 *Federal Register* 85 19281 (May 2, 2018). The 2016 Plan identified any new or existing industrial categories selected for updating or development. The Ore Mining and Dressing point source category ELG was not identified as needing any updates or changes.

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						During development of the TBELs, USEPA considered a large group of parameters, including all 129 priority pollutants plus conventional and non-conventional pollutants, and determined many of them did not warrant TBELs for the Ore Mining and Dressing point source category. The development document describes the parameters considered and the process for either establishing TBELs or exclusion from TBEL development. Of the specific parameters listed in the comment, USEPA in its development document specifically noted, ammonia, antimony, arsenic, beryllium, chromium, iron, nickel, selenium, silver, thallium, and cyanide. The development of best professional judgment TBELs is unnecessary because doing so would result in no additional control of the pollutants listed in the comment. Regarding flow, there is no numeric water quality standard for flow. MPDES permits regulate point source discharges of pollutants to state waters. Flow is not a pollutant. The comment also misunderstands the purpose of identifying pollutants of concern. The list of the parameters of concern is a list of pollutants that might be present within the discharge. The possible occurrence of a pollutant does not necessarily mean that it poses a risk to public health and the environment. As a result, a pollutant merely being recognized as a possibility does not mandate limit development, but simply suggests further consideration. Analyses behind WQBELs identify which parameters of concern may pose a risk if left untreated in the discharge. Assuming that there is a requirement to do case-by-case TBELs for the additional parameters listed in the comment, DEQ has already concluded that the zero-discharge requirements, combined with the proposed water storage, double-RO, and groundwater infiltration technology to reach nearly nondetectable, nonsignificant WQBELs is equal to, or better than, any technology demonstrated for similar sources. Additionally, 40 CFR § 122.44(d) requires DEQ to implement effluent limitations in addition to, or more stringent than, promulgated ELGs (TBELs) to achieve water quality standards, including narrative standards; DEQ must control all pollutants with a reasonable potential to cause or contribute to an exceedance of state water quality standards. This permit has no mixing zone or dilution allowance. Thus, when assessing the need for WQBELs, DEQ must impose effluent limits at the end of pipe that would comply with the water quality standard. DEQ developed WQBELs for all pollutants of concern. The promulgated TBELs for cadmium, copper, lead, mercury, and zinc were compared to the WQBELs and the more stringent limit was implemented in the permit. The WQBELs ranged from 125 to 4,000 times more stringent than the TBELs for those parameters. Additionally, the WQBELs in this permit are so stringent that they would require double-RO treatment, which is generally considered the limit of technology. In the case of total nitrogen, the WQBEL is so stringent that it may not be achievable with technology and would require the permittee to hold wastewater during the period when the total nitrogen standard applies.

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HC-003	35	Josh Purtle	Earth Justice	Hard Copy Letter	Relatedly, the draft permit fails to provide numeric or narrative technology-based effluent limitations for stormwater discharges from the mine facility. Instead, the permit provides for Tintina to implement best management practices (“BMPs”) to manage stormwater, and to document these practices in a stormwater plan submitted to DEQ after the MPDES permit is finalized. MPDES Fact Sheet at 17, 41-50. At the outset, permitting Tintina to submit a stormwater discharge plan after the permit is issued vitiates public participation in the MEPA and MPDES process, because the public will not have access to key information about Tintina’s plan for managing stormwater until after DEQ approves the MPDES permit. See Bryan v. Yellowstone Cnty. Elementary Sch. Dist. No.2, 2002 MT 264, P 45-46, 312 Mont. 257, 60 P.3d 381 (public participation in government decision was a “mere formality” where citizen “participated under a distorted perspective in light of the [government’s] partial disclosure of information”). Further, DEQ has not justified the use of best management practices in place of technology-based effluent limitations in this case. DEQ may dispense with numeric effluent limitations only if it rationally demonstrates that such limits “are infeasible,” 40 C.F.R. § 122.44(k)(3); ARM 17.30.1344(2) (adopting federal rule), but neither the Draft EIS nor the MPDES permit Fact Sheet explain why numeric limitations for Tintina’s stormwater discharges would be infeasible under these circumstances. Further, the draft MPDES permit does not mandate implementation of any particular BMPs as enforceable permit conditions, but provides instead that Tintina will select the BMPs after the MPDES permit is final. This approach of allowing a discharger to select its own pollution controls constitutes impermissible self-regulation in violation of the Clean Water Act. See Waterkeeper All., Inc. v. EPA, 399 F.3d 486, 500 (2d Cir. 2005) (invalidating EPA rule that allowed livestock operations to select BMPs that functioned as technology-based effluent limitations without agency oversight). Moreover, it falls short of requirements in DEQ’s MEPA rules, which allow the agency to deem impacts insignificant based on mitigation only where “enforceable controls or stipulations or both imposed by the agency or other government agencies” are in place to prevent or minimize harms. See ARM 17.4.607(4) (emphasis added). Mitigation is not enforceable if it is not even identified. Further, “[w]hile it is true that mitigation measures can justify an agency’s conclusions that a project’s impact is not significant, an agency must explain exactly how the measures will mitigate the project’s impact.” Ravalli Cnty. Fish & Game Ass’n, 273 Mont. at 383, 903 P.2d at 1370 (citation omitted). Thus, even if BMPs were an adequate substitute for technology-based effluent limitations in Tintina’s MPDES permit-and they are not-MEPA requires DEQ to identify such BMPs in the Draft EIS, demonstrate their enforceability, and explain how they will prevent significant impacts from stormwater discharges.	BMPs are technology-based effluent limitations at Outfalls 002 through 014, as allowed by ARM 17.30.1345 and 40 CFR § 122.44(k). The Fact Sheet (40 CFR § 124.56) and the draft MPDES permit (Hydrometrics, Inc. 2018a) specify several TBEL BMP requirements that the permittee must design and submit for approval before construction of storm water outfalls may commence. The permit requires the submission and approval of a storm water pollution prevention plan (SWPPP) that must implement at least the minimum BMP requirements outlined in the permit. The act of a permittee choosing between BMP requirements in an MPDES permit does not constitute a new effluent limit requiring further public participation before the permit can take effect (Upper Missouri Water Keeper v. DEQ, 2019 MT 81, ¶20). The established BMPs for industrial storm water include long-standing practices developed and required by the USEPA. The MPDES requirements for storm water discharges in the permit are compatible with those established by the USEPA and incorporated federal regulations. The permit and the Fact Sheet disclose the BMP requirements the permittee must address and include in the SWPPP. These minimum requirements were available for public review and comment satisfying all MPDES and related MEPA requirements. Further, DEQ did identify the minimum requirements that must be addressed in the permittee’s SWPPP. DEQ determined that the implementation of BMPs would result in storm water discharge compliance with the water quality standards. Also, to ensure no degradation of state waters occurs, DEQ imposed an additional water quality-based requirement that BMPs must be designed to detain all storm water from a 10-year, 24-hour event or produce a storm water effluent quality equivalent to storm water discharge after detention of the 10-year, 24-hour event. BMPs are implemented in lieu of numeric effluent limitations as allowed by 40 CFR § 122.44(k). Storm water discharges are variable and unpredictable, depending on the severity of the storm event. Due to this variability, storm water is typically regulated with BMP requirements because of the difficulty in quantifying the expected pollutant concentration, flow rates, and receiving water conditions that make the numeric demonstration of reasonable potential to exceed the water quality standards difficult to perform with accuracy. This permit requires the permittee to monitor storm water discharges and compare those results to background conditions during at least two storm events each year. Background storm water quality is the natural storm water quality that the receiving waters collect in the absence of the mining Project. The 10-year, 24-hour requirements prevent pollutants from most storm water events from reaching the receiving waters. Where storm water effluent values exceed background, the permit requires the permittee to make improvements to storm water BMPs, revise the SWPPP, and notify DEQ of the improvement to meet natural, background levels. Because the Project runoff must meet background water quality, there is no reasonable potential to exceed water quality standards or degrade water quality. The permit requirements are much more

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						stringent than typical storm water requirements, which allows the discharge of pollutants that may be above background concentrations.
HC-003	36	Josh Purtle	Earth Justice	Hard Copy Letter	The draft MPDES permit also does not appear to comply with the so-called “zero discharge” federal effluent limitation guideline, which provides that a mine may not discharge any process wastewater unless an established exception applies. See MPDES Fact Sheet at 15. “Process wastewater,” as defined in the MPDES Fact Sheet, is “any water which, during manufacturing or processing, comes into direct contact with, or results from the production or use of any raw material, intermediate product, finished product, by-product, or waste product.” Id. at 15. The draft MPDES permit appears to consider only “water introduced into the mill process” to be process wastewater subject to the discharge prohibition, id., but that narrow treatment does not appear to be consistent with the broad definition of such wastewater stated in the Fact Sheet. Indeed, water produced by the CTF and waste rock storage facility drains, and even groundwater pumped from the mine itself, all qualify as water that has “come[] into direct contact with ... raw material, ... by-product, or waste product.” Id. The EIS should therefore explain why it is lawful to exclude these additional water sources from the “zero discharge” requirement. The EIS should further evaluate the environmental impacts of allowing discharges of water produced by the CTF, the waste rock storage facility, and the mine workings themselves, and analyze the potential environmental benefits of prohibiting discharges of water from these sources.	The NSPS allow the discharge of mine drainage. Table 1-1 titled Categories of Discharges from Mining Operations found in the Ore Mining and Dressing Preliminary Study Report, USEPA, 2011, states that mine drainage includes water drainage from refuse, storage piles, wastes, rock dumps, and mill tailings derived from the mining, cleaning, or concentration of metal ores. Mine drainage may include process water still contained in the mine. Storm water runoff and infiltration can contribute to mine drainage. The permit properly regulates the water produced by the CTF and waste rock storage facility drains as mine drainage.
HC-003	62	Josh Purtle	Earth Justice	Hard Copy Letter	Moreover, the Draft EIS does not indicate whether the project will satisfy requirements under Clean Water Act section 404, which regulates activities that fill or drain wetlands. Tintina represented in its permit application that it will “work with [the U.S. Army Corps of Engineers] to evaluate and develop mitigation strategies for the permanent impacts to jurisdictional wetlands and streams,” MOP Application Rev. 3 at 319, but until such consultation is complete, any finding that the project’s wetlands impacts will not be significant, and that mitigation Tintina implements will comply with section 404, is premature. At a minimum, DEQ must’ incorporate any mitigation measures required by the Corps into Tintina’s mine operating permit and evaluate their enforceability and efficacy.	The proposed modifications to its application that the Proponent made after issuance of the draft permit did not include any additional wetland disturbance. Because there would be no new impacts, a new Section 404 permit and consultation were not required. Section 3.14.3, Environmental Consequences, of the EIS states, “To compensate for the 0.85 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 acres 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 2017).”
BBC01024	4	Jeannette Blank		Email	In addition to understanding how the proposed Rule [Revised Final Rule for the Waters of the U.S.] change could affect your analysis of the proposed project, DEQ needs to understand what this Rule change will mean for your departments; how this proposed Rule change will shift liability onto the State; and how the State will handle these changes administratively. All of this needs to be clearly understood before DEQ issues a Final EIS or approves a subsequent discharge permit.	The Final EIS considers any new rule changes to the definition of the Waters of the United States as it relates to the water or wetlands analysis. However, at the time of publishing the Final EIS, the Revised Final Rule has not been made effective in the *Federal Register*.

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Project Description						
BBC00978	2	Bruce Farling		Email	The DEIS fails in its disclosure of many potential impacts by not including a number of key items requiring analysis that will require decisions significantly affecting the human environment. These include: The DEIS does not include the legally mandated (MCA 82-4-376) report and findings of the independent review panel for tailings storage. The DEIS should include the group's findings and allow the public to examine them before a final EIS is issued. Importantly, the Metal Mine Reclamation Act requires the review panel to "…assess the practicable application of current technology in the proposed design." This is critical given the experimental nature of Tintina's proposal to bury cement-paste sulfide-bearing tailings in a surface repository. The Metal Mine Reclamation Act also requires Tintina to produce an operational, maintenance and surveillance manual (MCA 82-4-379) prior to issuance of a draft permit. It must include a number of required actions and performance parameters. This manual is supposed to have been produced – and perhaps it has -- but it is not disclosed for public consideration in the DEIS. It should have been included. • The DEIS does not disclose nor analyze the details of Tintina's reclamation plan. It should have. The DEIS should also include an evaluation of plans that would be necessitated by temporary cessation of mining, which is not an unlikely development given the history of mining economics and fluctuating markets. • The DEIS does not include a plan for closure or long-term monitoring of the site, especially the proposed surface tailings facility. This is a major failing of the DEIS. • The DEIS does not include a proposed performance and reclamation bond, which given the State's history of chronically falling short in its bonding, is a matter of acute interest that the public should be allowed to evaluate. There is nothing in statute that says bonds can only be calculated after a final permit is issued, which has been the State's standard practice. DEQ would benefit by having more eyes involved in this process. A proposed bond should have been included in the DEIS. Finally, because regulatory agencies and even industry have identified tailings impoundments as particularly problematic items at hardrock mines, Montana adopted a statute requiring third party review of these facilities. It would behoove DEQ, though the law does not require it, to farm out objective third-party reviews of other technical matters that have had large negative consequences when predictions commonly went awry.	See Consolidated Responses PD-1 and FIN-1. Section 2.2.8, Reclamation and Closure (Mine Years 16–19), of the EIS discusses the reclamation plan components, and states, "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 is also discussed in Section 7 of the MOP Application (Tintina 2017a). Section 7.1 of the MOP Application states, "Monitoring programs will continue during construction, operations, temporary closure, and in permanent closure until closure objectives have been met." DEQ would require the Proponent to adhere to a Reclamation Plan, pursuant to § 82-4-336, MCA, which states that all "disturbed lands must be reclaimed consistent with the requirements and standard set forth in this section."
PM1-06	3	Bonnie Gestring	Earthworks	Public Meeting Transcript	We are also concerned about the cement tailings facility. The Black Butte Project is a sulfide deposit, so it presents a particularly high risk to water quality because the mine waste must be isolated from air and water in perpetuity to prevent the formation of acid mine drainage. Yet, the cement tailings facility is relatively new technology that hasn't been tested over time. The Draft EIS also fails to consider the potential for liner failures and spills. Both are common occurrences at mining operations.	See Consolidated Responses PD-1, PD-2, and PD-3.

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PM2-10	4	Mike Fiebig	Northern Rockies office of American Rivers	Public Meeting Transcript	We also have concerns about the tailings. Tintina's plan to keep mine tailings and toxic waste in place for decades is experimental. Neither the mining company nor DEQ provided evidence guaranteeing that it will work. The reality is there is no such thing as a leak-proof tailings pond, even if the pond has a double-lined bottom and the tailings are non-flowable. Acid mine drainage is a huge risk in an ore body like this.	See Consolidated Responses PD-1, PD-2, and PD-3.
PM2-11	1	Max Hjortsberg	Park County Environmental Council	Public Meeting Transcript	My primary concerns coming out of reading the Draft EIS are the assumptions that are made that everything will work according to plan and exactly as they're spelling out. Which one hopes they will, but there are no sections that address the potential for systems failures, the plugs not holding the water back, the backfilling, the cemented tailings confinements potentially failing and releasing acid mine drainage in perpetuity. So I would like to see some more concrete analysis of contingency plans in that respect.	See Consolidated Response PD-3.
PM2-12	2	Bruce Farling		Public Meeting Transcript	The main thing I really want to focus on tonight is the proposal for tailings disposal. I think putting a bunch of the tailings underground is a really excellent proposal. It's a really good idea, and I've complimented the company for that in the past. However, leaving 55 percent of the tailings that are produced on the surface, as you've already heard, is experimental. Even the technical memoranda that you guys included in your Draft EIS says that. You only cite one literature -- or every literature source in that memoranda talks about backfill situations. There's nothing in there in terms of a literature cite showing that it has worked, especially in a complex situation like this, on the surface. Therefore, we don't have any analysis on the life cycle or degradation rate of these cemented paste tails on the surface. And largely, the conclusion you guys have come up with is kind of conjecture, and I think we can do a better job on that.	See Consolidated Responses PD-1, PD-2, and PD-3.
PM4-05	3	Derf Johnson	MEIC	Public Meeting Transcript	[I don't think that you're going to capture] the potential for them to go open pit on other places on the mine, which is as simple as the change of a contract and an amendment to their permit;	To date, only the Black Butte Copper Project has been proposed for mining. Any future proposed mines or expansions would require a separate MEPA environmental review and permitting, which would include public disclosure and input. See Consolidated Response CUM-1.
HC-003	28	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS must analyze and disclose the risk of catastrophic events at the mine, which could cause significant and long-lasting pollution in the Smith River basin. Under MEPA, DEQ is required to evaluate "the probability that the impact will occur if the proposed action occurs," ARM 17 .4.608(1)(b), and where the environmental consequences of an impact are "potential[ly] sever[e)," DEQ is required to provide "reasonable assurance .. . that the impact will not occur." Id. This analysis is similar to what is required under the National Environmental Policy Act ("NEPA"), the federal MEPA analogue: under NEPA, agencies must consider and disclose "potentially catastrophic consequences 'even if their probability of occurrence is low.'" See San Luis Obispo Mothers for Peace v. Nuclear Regulatory Comm'n, 449 F.3d 1016, 1033 (9th Cir. 2006) (quoting 40 C.F.R. § 1502.22(b)(4)). Thus, an EIS cannot ignore potential environmental impacts merely because the probability those impacts will occur may be low. See id. The Draft EIS, however, does not rationally analyze potentially high-	See Consolidated Responses PD-1, PD-2, and PD-3.

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					consequence environmental impacts associated with the mine. In particular, the Draft EIS arbitrarily ignores the potential that the CTF containment system will fail. The Draft EIS appears to acknowledge that a “release of tailings” is possible “in response to impoundment failure or seismic events,” Draft EIS at 3.5-24, but the Draft EIS makes no attempt to quantify the risk of such failure, characterize the environmental consequences of tailings release, or provide “reasonable assurance” that tailings CTF impoundment failure “will not occur.” ARM 17.4.608(1)(b). Tintina’s mine operating permit application does provide a perfunctory analysis of the risk of CTF failure, but this analysis does not pass muster under MEPA. See MOP Application Rev. 3, app. R. Tintina’s analysis concludes that CTF embankment failure is “Unlikely” and that the impacts of failure would be “Modest” at most, but provides no analysis or citations to support these conclusions. ld. at 8-9. Tintina’s qualitative risk analysis also makes no attempt to quantify the likelihood of CTF failure or the extent of impacts associated with such failure. See id. Further, this analysis reflects no independent determination by DEQ that the risk of CTF embankment failure is low and the potential impacts of such failure are insignificant. DEQ must perform its own evaluation of this risk, including by quantifying the risk and the potential impacts to the extent possible, in order to comply with its obligations under MEPA.	
HC-003	32	Josh Purtle	Earth Justice	Hard Copy Letter	Further, the Draft EIS does not address the risk of seepage through the liners under the CTF and process water ponds. The Draft EIS assumes that such seepage will be “minimal to non-measurable.” Draft EIS at 3.4-52. However, as Tintina’s mine operating permit application acknowledged, there is a quantifiable risk that defects in these liners will allow contaminated water to seep into groundwater. See MOP Application Rev. 3 at 201-03. Defects are inherent in any geomembrane liner, and further defects may form when the liner is installed. Exhibit 34 at 373 (La Touche & Garrick, Hydraulic performance of liners in tailings management and heap leach facilities (2012)); Exhibit 35 (Pakzad, Research Update on Geomembranes at Tailings Storage Facilities, Geotechpedia blog (Sept. 6, 2017)). The Draft EIS does not elaborate on the risk of seepage at all. Tintina’s permit application did discuss this issue, but Tintina inexplicably assumed there would be one defect per acre, each two millimeters in size, purportedly based on industry-standard assumptions provided in publications by Giroud and Boneparte (1989) and Giroud (1997). Exhibit 36 at 9 (Geomin Resources, Inc., A Summary of CTF Design Features and Seepage Analysis during Operations and Closure, Black Butte Copper Project, Meagher County, MT (Oct. 17, 2018)). However, these assumptions do not account for holes of 10 millimeters or larger that cannot be observed by quality assurance personnel, yet commonly occur due to punctures during installation of the drainage layer over the liner or from other post-installation causes, such as wildlife. See Exhibit 37 at 64 (Giroud and Boneparte, Leakage through Liners Constructed with Geomembranes, 8 Geotextiles & Geomembranes 27 (1989)). Thus, there is a risk that significant liner defects, whether due to installation error or manufacturing error, could cause seepage that is much greater than what Tintina predicted in its permit application.	See Consolidated Responses PD-1, PD-3, and PD-4.

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					Seepage does not need to be catastrophic to cause negative impacts to waters downstream from the mine. One study of a uranium mine in Australia found that while seepage from the mine's waste storage facility was "insignificant (e.g., -5 kg of [uranium] per year), surface waters downstream of the tailings impoundment possess [total dissolved solids], [uranium] and [sulfate] concentrations" that exceeded governing water quality standards. Exhibit 38 at 119 (Lottermoser & Ashley, Tailings dam seepage at the rehabilitated Mary Kathleen uranium mine, Australia, 85(3) J. of Geochemical Exploration 119 (Apr. 2005)). "Thus, in areas with a semiarid climate, even insignificant load releases of contaminants from capped tailings repositories can still cause deterioration of water quality ...." ld. DEQ must therefore fully analyze the potential effects of liner system failure throughout mine operations and after mine closure. See San Luis Obispo Mothers for Peace, 449 F.3d at 1033. DEQ should also provide reasonable assurance that these potentially severe impacts will not occur, as required by the MEPA regulations. ARM 17.4.608(1)(b).	
HC-003	42	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS further fails to address impacts due to leaks and seepage through liners and pipelines at the facility. At the outset, the Draft EIS fails to consider the effect of seepage through the liners of various holding facilities at the mine, including the process water pond and the CTF. DEQ's analysis essentially assumes that there will be no meaningful seepage from any of these facilities. See Draft EIS at 3.4-9. However, as Tintina's permit application acknowledged, some seepage through the liners is anticipated, whether due to defects in the liner system or failure to properly install the liner. See MOP Application Rev. 3 at 201-203. Such seepage could impact DEQ's assessment of potential harmful discharges to groundwater. See Exhibit 15 at 14-15; see also Part VILA, above. The Draft EIS also fails to discuss the risk that seepage from the non-contact water reservoir will leach contaminants from the soil and bedrock underneath that reservoir. The non-contact water reservoir would, according to Tintina's plan of operations, store water pumped from Sheep Creek, which Tintina will later use to mitigate diminished flows in Coon Creek. See Draft EIS at 2-8, 2-11. Tintina does not plan to line this reservoir, and water will seep freely through the bottom ofthe facility. Draft EIS at 3.4-52. This is by design, because Tintina intends that the seepage will "offset a portion of mine site water consumptive use." Draft EIS at 3.4-52. However, it is possible that the seepage will dissolve harmful minerals and pollutants while passing through the soil and bedrock on its way to the water table. According to Tintina's own testing, soil and near-surface bedrock contain an assortment of harmful chemicals, including zinc, copper, arsenic, and cadmium. See Draft EIS at 3.10-13-3.10-14. Thus, seepage from the non-contact water reservoir presents another possible source of pollution for Sheep Creek, which the EIS should consider.	See Consolidated Response PD-4. According to Section 3.6.9.5 of the MOP Application (Tintina 2017a), seepage rates from the NCWR are estimated at approximately 26 to 68 gpm when it is at full capacity, and lower when the NCWR drains. Soils, bedrock, and construction fill (weathered bedrock from the CTF excavation) used for construction of the NCWR would be sourced from on site and would not reflect a difference in the amount of metals than currently exists.
HC-003	43	Josh Purtle	Earth Justice	Hard Copy Letter	Similarly, the Draft EIS does not address potential pipeline spills or leaks at the facility. As described in the Draft EIS, Tintina plans to pump wastewater and tailings among different facilities at the project site as a part of normal mine operations. See, e.g., Draft EIS at 2-7-2-8; 2-10. The Draft EIS, however, ignores the possibility that these pipes will leak, thus causing unanticipated discharges to groundwater or surface water. See Exhibit 4 at 4. As discussed in	See Consolidated Response PD-4.

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					the Zamzow comments, Tintina's proposed pipeline design, which it believes will prevent such leaks, has not been tested with "actual tailings material." Exhibit 15 at 9. Further, a 2013 Earthworks report on copper porphyry mines in the United States found that all 14 mines evaluated in the study experienced "pipeline spills or other accidental releases" of mine pollution. Exhibit 4 at 4. The Draft EIS therefore has not substantiated its implicit assumption that discharges from pipelines will be minimal. The EIS should evaluate the risk of such discharges and the potential impacts if the discharges do occur.	
HC-003	67	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS fails to rationally evaluate Tintina's reclamation plan, which Tintina has claimed will avoid long-term pollution due to contamination in groundwater in the mine workings and permanent aboveground tailings storage at the project site. The reclamation plan is a major component of any mine operating permit application, see MCA §§ 82-4-335(5)(c), 82-4-336, but the Draft EIS either ignores entirely or fails to adequately address potential environmental issues associated with Tintina's proposed reclamation. At the outset, Tintina's reclamation plan does not comply with governing legal requirements concerning postclosure monitoring. MCA § 82-4-336(13) requires that a reclamation plan include "the requirements for postclosure monitoring of a tailings storage facility agreed to by a panel pursuant to 82-4-377." The Draft EIS provides no indication that an independent panel has even been established, let alone that it has reviewed the design ofthe CTF or other long-term storage facilities and recommended monitoring. To comply with MCA §§ 82-4-336 and 82-4-377, the reclamation plan must be amended to include findings and recommendations of an independent review panel with respect to all proposed tailings storage facilities. The Draft EIS further ignores several practical issues with Tintina's proposed reclamation plan. First, as discussed, Tintina's plan for long-term storage of tailings in the CTF does not adequately ensure that tailings and water that has contacted tailings will not be discharged to the Sheep Creek watershed. The Draft EIS does not account for the possibility of CTF containment failure, such as through cement disintegration due to the presence of sulfide minerals in the tailings, or through failure of the CTF embankment. The Draft EIS further does not address the risk of seepage through the CTF liners, or estimate, according to accepted methods, the number of defects expected to occur in the liners and the rate of potential seepage through those defects. An analysis of these issues is required for DEQ and the public to fully understand whether Tintina's reclamation plan will be adequate to ensure tailings waste stays in the tailings waste facility over the long term·.	Section 2.2.8, Reclamation and Closure (Mine Years 16–19), of the EIS discusses the Reclamation Plan components, and states, "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 is also discussed in Section 7 of the MOP Application (Tintina 2017a). Section 7.1 of the MOP Application states, "Monitoring programs will continue during construction, operations, temporary closure and in permanent closure until closure objectives have been met." The DEQ would require the Proponent to adhere to a Reclamation Plan, pursuant to § 82-4-336, MCA, which states that all "disturbed lands must be reclaimed consistent with the requirements and standards set forth in this section." See Consolidated Responses PD-1, PD-3, and PD-4.
BBC00574	14	Ken Knudson	Prepared for: The Montana Chapter of Trout Unlimited	Email	Finally, a great deal of discussion and public relation efforts have been made by Tintina about their plans to encapsulate the proposed mine's tailings with cement, as well as backfilling portions of the underground workings with these cemented paste tailings as part of the mine's closure plans. What is not adequately discussed by the company or within the dEIS is that this cementing process is not a permanent fix. Over time, the cement paste will break down, leaving the tailings and the underground workings susceptible to corrosion and acidification as if nothing had been done in the first place. Again, it is not a question of whether or not this will happen, but rather how soon and how much. Since Tintina is not proposing to treat any water originating from the	See Consolidated Responses PD-5 and FIN-1.

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					proposed project area after closure, it is very likely that Sheep Creek and the Smith River would be faced with perpetual water quality contamination problems or, more likely, that the State of Montana would be faced with perpetual waste treatment costs.	
BBC00589	3	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers	Email	Liner tears were not considered in the analysis of the project (DEIS, 3.4-9). The calculated seepage rates were therefore miniscule and have little effect on groundwater quality, which is discussed below. Failing to consider liner tearts and therefore subsequent higher discharge rates means the DEIS assumed perfect operation and has not considered any contingencies beyond its engineering working perfectly. The DEIS should consider the effect of a substantial leak reaching the groundwater from various locations on the minesite.	See Consolidated Response PD-4.
BBC00589	24	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers	Email	Second, during closure, the proposal is to harden the upper layers with additional cement paste, but the same concern manifests in that the cement will break down and any decreased permeability or sealing will be lost.	See Consolidated Response PD-5.
BBC00589	25	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers	Email	Third, the surface of the CTF will be capped with an HDPE cover (DEIS, p3.4-52). The DEIS does not address the fact that HDPE liners break down so that in the future the liner will not prevent seepage from reaching the cemented tails, which will have begun to break down, as described above.	See Consolidated Responses PD-4 and PD-5.
BBC00830	2	Kendra Zamzow	Center for Science in Public Participation	Email	The project proposes to mine copper ore that contains highly potential acid generating (PAG) material. The resulting tailings waste will produce acid and release metals. This will occur whether the tailings are stored dry (as dry stack or paste tailings) or subaqueously (as traditional tailings slurry). Highly acidic tailings can combust, but creating paste tails reduces the risk: Paste based on sulphide-rich tailings can reduce the potential of the tailings to produce ARD, as oxygen diffusion into the sulphides decrease due to the high water content and reduced porosity. Uncemented backfill of pyrrhotite-rich slimes at Brunswick Mine in New Brunswick resulted in self-combustion in the upper surface, which resulted in ARD production for two decades that could not be controlled. (MEND 2006) To delay the onset of acid drainage, and presumably to prevent combustion, cemented-paste tailings will be manufactured. Tailings will have water	See Consolidated Responses PD-2 and PD-5.

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					removed through filter presses to create a paste consistency, after which cement and fly ash or slag will be added to create "cemented-paste tailings." The material will be thin enough to pump while maintaining enough structure to allow for additional lifts in the surface impoundment. As each lift is deposited, oxygen diffusion to the lower lift(s) is impeded, slowing surface oxidation and the onset of acid drainage. The material will be pumped to the double-lined Cement Tailings Facility (CTF) every one to four weeks, and on off periods will be pumped as cement backfill into underground tunnels. While cemented tails backfill has been used for underground disposal, and paste tailings disposed in surface facilities, cemented-paste tailings surface disposal is a new concept which has not been attempted at any mine site.	
BBC00830	3	Kendra Zamzow	Center for Science in Public Participation	Email	Tailings at the Black Butte Project, with 18%-30% sulfide content, will be extremely acidic, with a net neutralizing potential of -800 t CaCO3/1000t and NP:AP of 0.01 (Tintina 2017 Appendix D Table 4-2). They essentially produce acid immediately. To delay the onset of acid, the project proposes to mix the tailings with binder (0.5% to 4% by weight). The mixture proposed is 50% Portland cement and 50% slag (Tintina 2017 Appendix D Section 4.1), that is, for a 4% binder paste tailings, 96% would be tailings, 2% would be cement, and 2% would be slag. This reduces the sulfide content slightly, to 22% (DEIS Appendix C). However, the extreme acidity of the tailings poses serious issues that the cement mixture does not alleviate. Cemented tailings can undergo external attack – in which the surface oxidizes and forms acid – or internal attack – in which sulfate attacks the cement. Both of these cause cement to disaggregate and fall apart. While the sulfate in the cement could come from other sources, the oxidation of sulfides in the PAG tailings will add a large amount of sulfate to the cement and enhance its degradation. Portland cement is particularly susceptible to internal sulfate attack (Alakangas et al. 2013; Tariq and Yanful 2013; Wu et al. 2018), and may not prevent reactivity even for underground backfill: The underground cement content of 4 percent is not expected to significantly offset the pyrite contents (DEIS 2019 Appendix A p6)	See Consolidated Response PD-5.
BBC00830	4	Kendra Zamzow	Center for Science in Public Participation	Email	While the statement above was made with respect to why arsenic would likely not migrate from the backfill – cement was not expected to raise pH enough to mobilize it – it could also be construed as an indication that pyrite could overcome any neutralization provided by the cement and release sulfuric acid and metals. This seems to be at odds with the statement in the same document that the cement binder would render the material inert. The project expects slag material, which could be part of the cementing mix, to mitigate internal attack: The paste backfill test program indicated the 4% binder samples continued to develop strength in the 28-56 day time period. If internal sulfide oxidation was an issue, we would normally see the 28 day strength start to reduce in the 28-56 day time period. The addition of slag provides superior protection from sulfate attack. (Tintina 2016 Section 9 p469) The statement above refers to underground cemented tailings fill, proposed to have 4% cement mix binder. Diffusion testing was conducted to represent flooded backfilled tunnels by placing cemented paste tailings or a mixture of cemented paste tailings and waste rock under saturated conditions to determine	See Consolidated Response PD-5. Binder addition is not solely meant to neutralize potential sulfide oxidation. In order for sulfide oxidation to occur, there must be sufficient water and oxygen present to react. The cemented tailings cylinders subjected to HCT and diffusion tests showed far more disaggregation than what would be anticipated in a backfilled stope or lift placed within the CTF. During diffusion testing, the pH dropped from 8.89 to 7.15, and the acidity rose from -1 to 22 mg/L (while alkalinity increased slightly from 7.8 to 9.4 mg/L) in the last two analyses (Appendix D of the MOP Application; Tintina 2017a). Considering the degree of disaggregation in the unsupported cylinder, this likely overestimates the dissolution/leaching potential of the tailings. This test exposes additional reactive surface area, overestimating the reaction and acid production potential of the cemented tailings. The water quality prediction models used the laboratory data to demonstrate compliance with non-degradation criteria. Like other HCT, this is an aggressive treatment of samples (particularly when unsupported/confined) and 11 days of testing does not correlate directly to an equivalent length of time of

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					oxidation rates. However, diffusion tests were only conducted for 11 days (Tintina 2017 Appendix D Sec 4.1.2 and Table 4-3), not nearly long enough to understand the rate of potential sulfate attack. In addition, deionized water was used in the test and regularly refreshed (Tintina 2017 Appendix D Section 4.1.2). This approach would minimize the sulfate content of water in the diffusion tests. Diffusion testing was terminated as pH sharply dropped and acidity sharply rose in the cylinder of tailings with 4% binder, and there was a trend of acidity increasing faster than alkalinity for tailings with waste rock and a 4% binder (Tintina 2017 Appendix D Fig 4-1 and Subappendix D Table D-1).	field conditions. The testing methodology called for the solution to be refreshed to develop a leaching profile. Although this does not provide constant exposure to sulfate in the leach solution (which would increase within the solution until reaching an equilibrium point), the use of deionized water is a more aggressive leaching solution and provides a conservative estimate of leaching potential. Per DEQ's first deficiency review of the MOP Application, "ASTM-1308-08 (subsection 7.1) describes use of 'demineralized water'as an appropriate option: 'The leachant can be selected with regard to the material being tested and the information that is desired. Demineralized water, synthetic or actual groundwater, or chemical solutions can be used.' Prior to initiating these tests, Enviromin consulted on this topic with WETLab (Western Environmental Testing Laboratory, Sparks, Nevada), which is certified by the state of Nevada to conduct diffusion testing with the intention of gathering geochemical data for mining operations. WETLab conducted these tests for the Black Butte Copper Project. Enviromin agreed to use deionized water based on feasibility of accessing and shipping groundwater in a timely fashion, as well as the fact that all other tests (static and HCTs) had been or were being conducted with deionized water. Use of deionized water in all tests thus facilitates comparison of the data. It should be noted that the weakly acidic and unbuffered quality of deionized water is a more aggressive [leaching solution] than buffered groundwater. Enviromin's decision to use deionized water was therefore appropriate in estimating solute release rates." (DEQ 2016) The sample of tailings with waste rock and a 4 percent binder (i.e., 4 percent plus ROM) does not represent a scenario/facility proposed for the project. Per the DEQ's second deficiency review of the MOP Application (May 8, 2017), "Enviromin does not believe that the 4 percent plus ROM sample is representative of Tintina's final designs for paste placement. These data were thus not used in any of the modeling and they have been removed from the MOP discussion to avoid further confusion."
BBC00830	5	Kendra Zamzow	Center for Science in Public Participation	Email	While there are documents that suggest underground cement tailings backfill with high sulfide content may maintain integrity for decades (Ouellet et al. 2006), there is very little long-term geochemistry information available on surface or underground cemented paste tail reactivity. A report titled "Paste Backfill Geochemistry - Environmental Effects of Leaching and Weathering" [MEND 2006]….was to summarize the current practice in geochemical characterization of uncemented and cemented paste backfill based on a literature review and also on a survey of mines that were known to use paste backfill. It was concluded that there was a lack of detailed information at the mine sites as well as a lack of monitoring for evaluation of former performance predictions…. It was also concluded that few studies have been performed about the long-term effect on surface and groundwater quality related to the use of paste backfill…..The situation regarding the lack of information has not changed much up to this date despite the fact that backfill from non-ferrous mines have the potential to generate contaminated drainage in long term….(Alakangas et al. 2013)	See Consolidated Responses PD-2 and PD-5. The Alakangas et al. (2013) report also states, "In spite of the lack of information on surface and groundwater monitoring from paste backfill, the impact of paste technology on the environment is being advocated as an advantage (MEND, 2006)." Long-term, field-scale tests provide meaningful data, but until this technology is implemented at other sites, case studies/investigations are limited. Larger scale tests often necessitate the approval/permitting of the facilities that are needed to establish the test area. To meaningfully simulate the specific conditions of the Project site, the components of the Project would need to be approved and implemented (i.e., it would require a mill and paste plant, construction of an impoundment, placement of cemented tailings to the surface, development of underground workings within representative ore lithology and backfilling stopes, and monitoring/sampling those facilities for a long period). The Proponent has noted the need to optimize

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					…The difference between conditions in an underground mine and laboratory experiments complicate the interpretation of laboratory results ….The water contained within rock walls have different temperature and air quality from the water used while paste production. These factors have been shown to interact. Conditions may also change from the time of backfilling when the underground voids are dry until they become flooded upon closure. The change in the geochemical properties of the paste caused by these effects is not well known. (Alakangas et al. 2013) The extreme acidity of the waste material at the Black Butte Project strongly suggests that samples should undergo pilot plant testing that would better simulate real world conditions and for a much longer period of time. Cemented-paste tailings placed in the CTF will have less binder (0.5% to 2%) and react even faster.	the paste plant and cement/binder composition during operations, and perform monitoring of contact water and oxidation within the mine during operations (see Sections 3.3.2.5, 3.5.8, and 6 of the MOP Application; Tintina 2017a).
BBC00830	6	Kendra Zamzow	Center for Science in Public Participation	Email	A considerable amount of literature is coming out with regards to both cemented-paste backfill and some literature more recently on paste tailings surface disposal. No mine has ever used a technique that combines the two methods, cemented-paste backfill and surface paste, into “cemented-paste tailings” for surface disposal (Enviromin, 2018). Although the MOP states that “feasibility level designs have been prepared for the waste and water management facilities” (Tintina 2017 Appendix K Summary), quite a bit of necessary ground work has not been conducted. In short, they do not appear to have the information they need to actually build and operate a cemented-paste facility.	See Consolidated Response PD-2.
BBC00830	7	Kendra Zamzow	Center for Science in Public Participation	Email	Disposal of (un-cemented) paste tails in a surface facility is itself a new technique, with only a handful of mines in the world employing the technology. “On a global scale, surface paste disposal is very rare…. At the present time, paste is relatively unproven compared to other methods of surface tailings disposal”.1 [http://www.tailings.info/disposal/paste.htm Accessed April 28, 2019] In 2006, there were three mines placing paste tailings on the surface: Myra Falls, British Columbia; Bulyanhulu, Tanzania; and Kubaka, Russia. An additional five mines in Canada and the US were intending to dispose of tailings in this manner (MEND 2006). By 2013, surface paste disposal was occurring at Snap Lake and was planned at Nunavik and NICO, all cold-climate Canadian locations (Alakangas et al. 2013). By 2015, the Nunavik mine was in operation (Kam et al. 2015) and by 2017 the Siilinjarvi mine in Finland began surface paste disposal (Fitton et al. 2018, Ruhanen et al. 2018, Vlot and Riihimaki 2018). [See Table 1 in original comment letter]	See Consolidated Response PD-2.
BBC00830	8	Kendra Zamzow	Center for Science in Public Participation	Email	Paste plant The processes of thickening tails (with flocculant), adding cement, and adding slag or fly ash are all separate processes subject to disruption from differences in tailings mineralogy and differences in binder consistency. Simply maintaining paste solids consistency, without the added complication of cement, requires significant design work prior to starting up the plant, and may require significant daily management (Ruhanen et al. 2018, Fitton et al. 2018, www.tailings.info). At the Siilinjarvi Mine, they proceeded from a pilot plant (2012) to a demonstration plant before adopting technology at full scale (2017).	See Consolidated Responses PD-2, PD-4, and PD-5.

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					Slurry freezing in the feed and underflow lines, and water freezing in the cone thickener were some of the issues that had to be resolved. At Neves Corvo Mine, laboratory testing in 2000 was expanded to field tests in 2002-2005 before a pilot plant was built to test paste tailings with waste rock (Alakangas et al. 2013). There is no discussion or analysis in the Black Butte Project DEIS of the complexities that may be involved with the paste plant, nor has any pilot plant work has been conducted. At this stage, there should be significant progress towards a paste plant design.	
BBC00830	9	Kendra Zamzow	Center for Science in Public Participation	Email	Tailings delivery system The MOP states that tailings will be delivered as 79% solids (Tintina 2017 Section 3.6.8.11; Tintinta 2017 Appendix K Section 4.4) or 74% solids (Tintina 2017 Appendix K Subappendix E Table 1) as the optimum percent solids based on cone slump tests (Tintina 2017 Appendix K-5). However, only paste consistencies of 75%-85% were tested and only results from material with 79%-84% solids are shown (Tintina 2017 Appendix K-5C Tables 3-1, 3-6, 3-7). Mines that currently have surface paste tailings disposal facilities appear to thicken them to only 67-74% solids, not 79%. In underground mines, cemented tailings thickened to 75%-85% have been used for backfill; however, delivery is aided by gravity. Even so, plugging of the borehole or pipeline can be an issue. The pumping and pipeline systems are an important piece of mine operations, and the challenges are not seriously discussed in the DEIS or the MOP.	See Consolidated Responses PD-4 and PD-5.
BBC00830	10	Kendra Zamzow	Center for Science in Public Participation	Email	Pumping and pipeline Small scale laboratory testing generally does not provide good information on tailings behavior in the field (Alakangas et al. 2013); it should be followed by scaled up field or pilot testing. When the Siilinjarvi Mine switched recently from traditional slurry tailings (45-48% solids) to paste (66-72% solids), considerable work went into designing the tailings delivery system (Vlot et al. 2018). Initial testing determined that a centrifugal pump, the type used to deliver slurry tailings, was ineffective. Thick paste required a positive displacement (PD) pump. In two places, the Black Butte Project MOP notes the high cost of PD pumps, mentioning they “significantly impact capital and operating costs” (Tintina 2017 Appendix K Section 3.2). While the MOP says PD pumps are “often required” to transport cement tailings, they fall short of saying they will use PD pumps; in the “preferred option” section, there is no mention of pumps (Tintina 2017 Appendix K Section 3.2.4). Plant operating conditions can lead to large changes in pumping behavior, including higher discharge pressure (Vlot et al. 2018) (Table 2). Enough testing has been done at Black Butte to know that rheology is expected to be sensitive to water content, which can affect the pipeline pressure gradient (Tintina 2017 Appendix K Subappendix E Section 7). [See Table 2 in original comment letter]	See Consolidated Responses PD-2 and PD-4.
BBC00830	11	Kendra Zamzow	Center for Science in Public Participation	Email	The required pumping pressure will increase with the percent solids. Too much pressure when placing cement backfill in underground stopes can lead to pipelines bursting.2 At Siilinjarvi Mine in Finland, the pump operating pressure	See Consolidated Response PD-4.

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					to move tailings 3,000 m over a lift of 100 m (later reduced to 40 m) was determined to be 5,400 kPa for 70% solids and 7,800 kPa for 72% solids was 7,800 kPa; they designed the pump pressure for 11,000 kPa (Vlot et al. 2018). The Black Butte Project intends to pump 79% solids over 1,300 m with an 18 m vertical lift (Tintina 2017 Appendix K Subappendix E), which is roughly similar to the operations in Finland. However, the Black Butte pumping/pipeline system has unique issues due not only to the cement content, not present in Siilinjarvi or any other surface tailings disposal operation, but also to the intent to pump cemented tailings to both surface and underground disposal sites. Tailings intended for the surface impoundment will contain less cement binder (0.5%-2%) than the underground tailings (4%). The general idea is to pump for some number of days to the CTF, and then for some number of days to the underground tunnels. There is no discussion of the operational challenges this could pose. Since the pipelines will have cement material in them, they cannot just be shut off. Pipelines need to be flushed, and the project anticipates using 5,000 gallons of water to do this, likely on a weekly basis (Tintina 2017 Section 3.6.8.11). For five or six months out of the year, they need to ensure that flushing does not leave water in the pipeline where it can freeze and cause ruptures. This means that in addition to optimizing the operating pressure for the pump and pipeline system, they need to test design systems for water pressure and restart pressure (Tintina 2017 Appendix K Subappendix E).	
BBC00830	12	Kendra Zamzow	Center for Science in Public Participation	Email	The MOP also notes that overland pipelines may be subject to internal and external corrosion, leading to leaks or rupture (Tintina 2017 Appendix K Subappendix E). An HDPE liner in the steel pipe is intended to stave off corrosion. However, there have been no tests pumping actual tailings material. “No corrosion information is available on the Black Butte tailings or process water. However ….potentially acid generating sulfide minerals often lead to corrosive slurry/water. The paste and water will be assumed to be corrosive to carbon steel until proven otherwise by corrosion testing. A cased pipe may also be subjected to corrosion of the metal forming the walls of the annulus and spacers…” (Tintina 2017 Appendix K Subappendix E) The pumping system needs to be chosen and tested with pipeline designs prior to full scale operation, as the paste plant and tailings delivery system need to be designed together for optimal function. A pilot plant should be set up to do the testing.	See Consolidated Responses PD-3 and PD-4.
BBC00830	14	Kendra Zamzow	Center for Science in Public Participation	Email	The time it will take for cement to disaggregate under field conditions is not known, as field tests have not been conducted. Kinetic lab testing indicates the pH of tailings with 2% binder began dropping within 2 weeks, and was at pH 3.6 by week 4 (Tintina 2017 Appendix D Subappendix D Table D-2). Although the MOP states that the kinetic humidity cell testing (HCT) represents very aggressive conditions unlikely to be experienced in the actual facility, this ignores the fact that there will likely be as little as 0.5% binder, which was not tested, and that no testing was conducted on oxidation rates for a block or cylinder of cement tailings exposed only to air. Additionally, when the CTF surface is exposed to wetting and drying conditions (rain or melting snow followed by a dry spell), this is similar to HCT conditions. Therefore, we should assume, until or unless field conditions are simulated and show	See Consolidated Responses PD-2 and PD-5. See response to Submittal ID BBC00830, Comment Number 4 for more information about kinetic lab tests. A test conducted with a block or cylinder of cement tailings exposed only to air would not be representative of expected field conditions (wet and dry cycles). According to Appendix N of the MOP Application (Tintina 2017a), “Tintina proposes to place 0.5 to 2% cemented paste tailings in its surface CTF, and to continuously collect and remove water from that impoundment. Importantly, the observed disaggregation in the 2% HCT did not occur immediately, and the rate of weathering in a HCT is recognized to be greater than in the field, particularly

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					otherwise, that the kinetic tests do in fact represent the reactivity of the surface placement of cemented-paste tailings. Tailings mixed with only 0.5% binder could react similarly to raw tailings, which under HCT conditions went acidic immediately (Tintina 2017 Appendix D Figure 4-1 and Subappendix D Table D-2).	for the small, unconfined cylinder of paste cement with a high surface area to mass ratio as was used in the HCTs. Therefore, in the CTF, each newly added lift of cemented paste tailings will behave as a massive block of material with low transmissivity, with a thin upper surface that will be exposed to some degree of oxidation before being covered by fresh paste tails within 60 days of placement. If material is covered in the manner described in the mine operation plan (generally within a week but never more than 60 days), oxidation, acidity, and leaching of metals would be limited to the immediate surface of the cemented paste tailings. Any water interacting with oxidized tailings will subsequently travel through the ramp and rock drain, where it will react with waste rock as it is collected for treatment to meet water quality standards prior to discharge in the infiltration galleries.”
BBC00830	15	Kendra Zamzow	Center for Science in Public Participation	Email	Attempting to solve the problem by frequent addition of new lifts ignores internal sulfate attack within the cement tailings. By adding cement the mining company is balancing two opposing issues: creating a paste that is liquid enough to pump, and creating a material that will set up like cement to slow tailings and waste rock oxidation and resulting acid generation. However, they are also balancing another set of opposing issues: cement takes time to set up, and the tailings material is so acidic it doesn’t afford that time. Testing shows that tailings with a 2% binder do not set up for 28 days; tailings with a 4% binder set up in 4 days (Tintina 2017 Appendix K-5 Section 4.0). As noted above, the 2% binder paste tailings go acid in as little as 2 weeks, and 4% binder tailings within 3-5 weeks (Tintina 2017 Appendix D Subappendix D Table D-2), with consequent metal release	See Consolidated Response PD-5. See response to Submittal ID BBC00830, Comment Number 4 for more information about kinetic lab tests. Additionally, the 2 percent binder cylinder that is noted to “go acid in as little as two weeks,” is derived from testing that was performed on a cylinder that already achieved “final set.” The same applies to the 4 percent binder cylinder, which was allowed to set up prior to testing. The cylinders were not observed to produce acidic leachate, or be precluded from setting up, due to premature oxidation during the curing time. HCT time is not equivalent to real time.
BBC00830	16	Kendra Zamzow	Center for Science in Public Participation	Email	A white paper written by Enviromin, the geochemistry firm contracted for the Black Butte Project, specifically says that “site-specific binders” need to be researched to reduce sulfate attack (Enviromin 2018)– yet no site specific work has been done outside of some laboratory testing (Tintina 2017 Appendix K-5). The acidic paste tailings at Bulyanhulu developed sulfate salts on the surface, which could then be flushed and produce sulfate-rich water during rain events (Alakangas et al. 2013). Is this a possibility with cemented-paste tails, and was this considered when determining operations water quality?	See Consolidated Responses PD-2 and PD-5. The laboratory testing cited in Enviromin (2018) white paper was site-specific in the sense that a small batch of tailings was produced from representative core sections from the site. The cement/binder materials used to create the samples were representative of what would be used in the Project (i.e., the materials were sourced from Montana). Enviromin (2018) also explained, “the inclusion of pozzolanic material, such as fly ash or slag, with the cement improves strength and reduces negative risks of internal disaggregation due to recrystallization of sulfate minerals (also known as ‘sulfate attack‘). The benefits of this binary approach to binder mixing were confirmed by Yilmaz et al. (2015), who reported that cemented/paste-containing slag binders performed better, with respect to consolidation, than paste with Portland cement alone or Portland cement with fly ash.” There is potential for the surface tailings to oxidize and release some species (including sulfate) within the lined facility. However, oxidation would likely only occur on the surface where water would be routed to the WTP for treatment. According to Alakangas (2013), “Monitoring of the water quality from the pilot cells during two years showed that a cover system decreased the sulfide oxidation compared to uncovered paste tailings. The pH decreased to 2 in uncovered tailings, and in the covered tailings pH was retained above 6.5. The only indicator of sulfide oxidation measured was pH.”

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BBC00830	17	Kendra Zamzow	Center for Science in Public Participation	Email	The final CTF lift is to have 4% cement binder mixed into the tailings. The HCT results show that the 4% binder mixed into the paste tailings and possibly waste rock, would begin to go acidic in 3-5 weeks as noted above. Within this period of time reclamation intended to isolate the cemented-paste tailings from the environment would need to occur to limit oxidation: laying and welding the geomembrane cover, adding 5 feet of fill, and revegetating 72 acres. However, site reclamation is expected to take several years, and no progressive reclamation of the CTF was mentioned in the DEIS. While the cement may reduce hydraulic conductivity, laboratory testing clearly shows that the material will be reactive subaerially. This becomes an issue if there are interruptions in tailings delivery (e.g. mechanical breakdowns, pipeline rupture). It also becomes an issue if there is temporary closure, where the 4% cemented-paste tailings lift is not put in place in a timely fashion, or is put in place but left exposed to air due to reluctance to place reclamation cover and fill over the surface disposal site. Similarly, disaggregation could occur in the cemented layers in the tunnels during temporary closure due to reluctance to flood underground workings. This also changes the expected water quality; constituent concentrations were modeled using HCT data from weeks 0-4 of the 4% binder cement tails. It was after week 4 that the pH dropped and metal concentrations increased (Tintina 2017 Appendix D Subappendix D Table D-2 and D-3).	See Consolidated Response PD-5. See Submittal ID BBC00830, Comment Number 14 for more information about HCT data. Section 7.1.2 of the MOP Application (Tintina 2017a) explains that temporary suspension/closure conditions would not persist; the operator would implement final closure actions after 1 year. “When a temporary closure has continued for one year, Tintina will start implementing the permanent closure plan outlined in Section 7.1.3, below. Tintina will continue mine dewatering and the WTP operations (i.e., water treatment and brine generation and proper disposal) as they prepare to close the underground mine, draw down water levels in the PWP and implement the permanent closure plan as described below in Section 7.1.3.” Additionally, after the placement of a cushion rock layer and HDPE liner, there should be minimal seepage into the CTF. Any seepage within the tailings mass would still be contained by the double HDPE liner foundation and collected by the CTF sump. The placement of fill, soil, and vegetation would then follow; however, the primary sealing step would have already been completed.
BBC00830	19	Kendra Zamzow	Center for Science in Public Participation	Email	How tailings settle is affected by plant operations, including changes in ore mineralogy, and mill and pipeline upsets. Tailings beaches are affected by how tailings are discharged and the duration of discharge. Discharging from multiple spigots provides a more uniform beach than end of pipe discharge, but spigots can clog in cold environments. At the Musselwhite Mine (Ontario), the deposition point was moved closer to the thickener site during freezing conditions to minimize clogging (Kam et al. 2015). At Black Butte, the pipeline will extend the entire length of the CTF before depositing, which may substantially increase the risk of clogging; there was no discussion on potential for freezing or clogging. Uncemented paste tailing operations in cold climates are expected to need to shift discharge locations more frequently than slurry tailings operations to avoid exaggerated mounds near discharge points in freezing conditions (Journeaux 2012). Undulations and depressions in the slope may affect the extent to which water pools on the surface or is directed against perimeter berms. These add more operational complexity not discussed in the DEIS. At Siilinjarvi, the beach slope ranged from 6% (near the discharge) to 1.6% (at runout) with tailings percent solids of 66-68% (Fitton et al. 2018) (Figure 1). Bulyanhulu had a reported 7.4% slope, one of the highest in the reported literature in 2013 (Alakangas et al. 2013). Both mines used the method of discharging from a central tower. In general at paste tailings disposal facilities slopes are 2% to 4%, with laboratory results suggesting they may go as high as 10%.4 The MOP expects an even, gentle slope of 0.5% to 2% (Tintina 2017 Figure 3.33 and 3.34) at the Black Butte Project through “selective spigot placement” (Tintina 2017 Section 3.6.8.11) which is not defined other than it appears to be	See Consolidated Response PD-4.

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					designed to discharge from the perimeter. Meteoric and bleed water are anticipated to flow towards the sump at the north end of the facility (Figure 2).	
BBC00830	20	Kendra Zamzow	Center for Science in Public Participation	Email	An imperfect installment or leaks in the liner would release much more contamination. The CTF basin as proposed would be built partly below the level of the water table. If groundwater entered the CTF through tears, abrasion, or degradation of the bottom liner over time, the tailings and waste rock material would be exposed to the fluctuations of a water table rising and falling seasonally. These are conditions that are similar to laboratory HCT conditions, and could result in metal release within a matter of weeks (Table 3). [See Table 3 in original comment letter]	See Consolidated Response PD-4.
BBC00830	21	Kendra Zamzow	Center for Science in Public Participation	Email	The CTF cover will include a final lift of 4% cemented-paste tailings, a geomembrane cover, and 5 feet of fill topped with vegetation. In addition to the risk of imperfect installment, leading to unanticipated higher seepage into the basin or foundation drains, there are additional ways in which geomembrane covers could be compromised. The MOP mentions in passing the potential for ice damage to covers or liners. There is also mention that geomembranes are susceptible to thermal degradation (Tintina 2017 Section 3.5.6), but no mention of the potential damage due to wildfire. Increasing risk from wildfire may occur as climate change drives hotter summers with potentially longer periods between rain events, depending on location. This may be a risk for the cover, which will need to last in perpetuity, particularly if subsidence, erosion, or human activity decreases the depth from surface to cover. An additional risk occurs if cement degrades. If it degrades after placing the cover, the fill layer covering the CTF is likely to slump or subside, potentially tearing the cover. If this occurs, meteoric water will enter and flush through the waste material, exiting out the foundation drain or entering groundwater. A CTF saturated with water would have a higher rate of seepage in even an intact bottom liner, roughly ten times the rate of an unsaturated CTF. A related risk is damage from human activity, particularly if subsidence or erosion has already compromised the liner or decreased the fill depth above the cover. The DEIS has no discussion of post-closure institutional controls, or potential complications of placing institutional controls on private land.	See Consolidated Responses PD-3, PD-4, and PD-5.
BBC00830	22	Kendra Zamzow	Center for Science in Public Participation	Email	Given that waste will be highly acid generating with or without cement, regulators should consider the CTF as if it were an uncemented paste surface disposal facility, and until there is longer term diffusion testing or field testing, MDEQ should more seriously consider the risks of cemented-paste tailings as underground backfill when sulfide content is this high.	See Consolidated Response PD-5. The EIS does not predict that the CTF would be highly acid generating.
BBC00830	26	Kendra Zamzow	Center for Science in Public Participation	Email	The original design for the WTP appeared to be undersized, intended to treat 510 gpm (Tintina 2016). The size has been increased, to treat 588 gpm, but this is still based on an annual average flow (Table 4). The mine site and treatment plant design need to ensure that there is room to treat or contain additional water should mining hit an area with high hydraulic conductivity, which would increase the flow rate and volume of dewatering water, potentially to as high as 2,000 gpm (Myers 2019). Dewatering water makes up 90% of the anticipated inflow to the water treatment plant; an unanticipated sustained increase above the average annual flow, or a very high short term increase would overwhelm the WTP and storage systems.	See Consolidated Response WAT-1 for information about the assumptions in the hydrogeological model and more information about the RO treatment system. The Project is proposed to use RO to treat water. RO treatment is known to scale well by simply adding more units, and the Proponent proposes they would have a back-up unit available to treat up to 750 gpm (see Section 1 of the MOP Application; Tintina 2017a). If there is a need to treat additional water, it should be evident with enough time to secure additional units given the proposed monitoring protocols.

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					The DEIS notes that if additional capacity is needed, the 250 gpm construction WTP will be on hand, and the company can simply buy more equipment. However, systems do not always scale up smoothly.	
BBC00830	27	Kendra Zamzow	Center for Science in Public Participation	Email	Near-surface lithologies Ynl Ex and Tgd were tested for potential to leach contaminants. Tgd is unlikely to go acidic, but Ynl Ex is more complicated (Maest 2019) and did leach selenium in the first four weeks of testing (DEIS p3.6-14 and Appendix D). This should not be discounted. As construction material undergoes repeated wetting and drying cycles, selenium could continue to leach with each cycle. About 2 million cubic yards of Ynl Ex is expected to be used in construction (DEIS p3.6.-17). One lithology remained untested. This was labeled Yne and was described as material that might be used in construction (Figure 3) and is he Neihart Quartzite. Lithology Yne is no longer mentioned in the MOP (Tintina 2017 Appendix D) or the DEIS. No valid testing for metal leaching has been conducted on the Yne material. ... If mining is no longer expected to encounter this lithology, this should be stated. If Yne will be encountered, the expected disposition of the waste rock should be stated (e.g. whether it goes to the CTF or is used in construction) and geochemical testing appropriate to understand the environmental impact of the end use should be conducted.	Section 3.6, Geology and Geochemistry, of the EIS discusses the Neihart Quartzite lithology, labeled as Yne on Figure 3.6-3. Figure 3.6-3 shows that Yne is unlikely to be encountered during construction of the mine workings. It is estimated to represent less than 1 percent of the total waste rock units. Due to its close proximity to the mine workings, it was discussed in the geochemical characterization in Appendix D of the MOP Application (Tintina 2017a). As stated in Section 3.4.2.6 of the MOP Application (Tintina 2017a), "Excavated granodiorite will be used to construct the sub-grade bedding layer below the CTF HDPE liner system, while excavated granodiorite (Tgd), excavated Ynl Ex, and/or preproduction waste rock will be utilized to construct the sub-grade bedding layer above the CTF HDPE liner system." The Ynl Ex material would potentially be used as sub-grade bedding only above the CTF liner system, meaning that any water interacting with this rock would be contained in the facility prior to being collected in the CTF sump and pumped to the treatment facility. See additional information regarding this clarification in the responses to Submittal ID BBC00933 (Comment Number 17) and Submittal ID BBC00933 (Comment Number 18), as well as information about the potential for seepage from the Ynl Ex as construction material.
BBC00830	28	Kendra Zamzow	Center for Science in Public Participation	Email	In a 2012 study, 14 of the 16 operating copper mines in the US experienced pipeline spills or accidental releases; the other two mines were not surveyed (Gestring 2012). Twelve of these had pipeline or other accidental release failures that occurred between 2007 and 2012. All 14 had impacts on surface and/or groundwater quality. There is a high likelihood that spills and leaks will happen at every mine site; the only question is the extent of the damage. This emphasizes the need for backup systems, secondary containment, shut off valves, and other mitigation measures. It also emphasizes the importance of understanding – before operations begin – the complex tailings disposal system proposed at this site. Without robust testing of the components that will be required to manufacture and pump cemented-paste tailings, preferably in a pilot plant, there may be a higher risk of pipeline ruptures. There may also be long delays if equipment – not thoroughly vetted ahead of time – needs to be replaced or requires unexpected long periods of maintenance. Extended periods of down time would prevent the regular laying down of new cemented-paste tailings at the CTF and underground workings required to prevent cement disaggregation and the release of acid drainage.	See Consolidated Responses PD-2, PD-3, and PD-5.
BBC00830	29	Kendra Zamzow	Center for Science in Public Participation	Email	The proponents of the Black Butte Project would take highly acid-producing waste material and, using a disposal system which is not used at any other mine, place the disposal facility partly below the level of the water table, relying entirely on geomembranes to prevent highly contaminated water from moving into groundwater and streams in perpetuity. The development and use of a surface cemented-paste tailings system as a disposal concept is one that is worthy of further investigation, but for the first attempt to be under these	See Consolidated Responses PD-2, PD-5, and ALT-4

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					conditions is foolhardy. Neither does the failure of the proponent to do necessary groundwork for the development of the paste tailings manufacturing and delivery system inspire confidence. Pilot scale testing should be done to better understand the components that would need to go into a surface cemented-paste tailings facility and the operational limits of the tailings delivery system, but in the end the overall concept of placing highly acidic tailings in the CTF should be reconsidered. Consideration should be given to adding 4% cement binder to surface-disposed tailings to allow them to set up more quickly. The alternative to depyritize the tailings should be reconsidered. Additionally, further work is required to understand the long-term leaching potential of underground cemented-paste tailings backfill using tailings with this high of a sulfide content.	
BBC00849	5	David Chambers	Center for Science in Public Participation	Email	The present Mine Operating Permit Application (MOP) calls for both rougher and cleaner flotation (Tintina 2017, Figure 3.10). The cleaner flotation circuit is essentially producing a high-sulfur tailings – i.e. a pyrite separation circuit. I was not able to determine the sulfur concentration in the rougher circuit tailings (underflow) from any of the documents associated with the DEIS or the MOP. A similar situation exists for the underflow for the 1st and 2nd cleaner circuits. This information is certainly available in the reports on the metallurgical testing for the mine, but is not available in the EIS or supporting documents. Are the rougher tailings non-acid generating? Why aren't the 1st and 2nd cleaner tailings thickened separately and diverted to the backfill plant? These are important questions that are not addressed in the DEIS.	The Project would use a flotation process to recover and upgrade copper values to produce a saleable copper concentrate. The generalized flotation circuit description for the Project is described in Section 3.3.2.4 of the MOP Application (Tintina 2017a) and is also illustrated on Figure 3.8 (Simplified Process Flowsheet Showing Key Unit Operations) in the MOP Application. The generalized process flow sheet (plant) is described in the Executive Summary of the EIS on page ES-4 in Section 5.2, Proposed Action, and in Section 2.2.3, Operations (Mine Years 3–15), of the EIS, on page 2-10. The flotation process acts as a pyrite separation circuit by depressing the pyrite over chalcopyrite recovery. The flotation process would remove approximately 10 percent of the sulfide mass as part of the final concentrate, which would include a makeup of chalcopyrite/chalcocite/tennantite/pyrite. The remaining pyrite would report to the tailings streams. By distribution, the final tailings stream would contain approximately 87 percent of the iron in the final tailings stream, while recovering 13 percent to the concentrate. If all copper losses to the final tailings are assumed to be associated with 100 percent chalcopyrite composition, then almost 98 percent of the iron in the tailings stream can be associated with iron sulfides. The reality is that both the iron and sulfur content would drop only slightly from the actual feed grades from the mass loss associated with the final concentrate. Therefore the tailings sulfur content is actually not being concentrated, as it would be lower than the original feed valves. Sulfide tailings, especially pyrite, are subject to sulfide oxidation and therefore "acid generating." This is limited by the oxidation rate of the sulfides when saturated by water; hence it is slow when first depositing the tailings, as the oxygen is limited to dissolved oxygen content in water. It is also slow under high pH conditions, as those found when exiting the circuit. Adding cement to the tailings would also limit the ability for oxidation to occur. The second cleaner tailings report back to Cleaner 1, so only the cleaner scavenger tails exit the process. While this stream would have a higher iron and sulfur content, the mass is approximately 19 percent, compared to approximately 71 percent for the rougher tails. Separately thickening the cleaner tailings streams

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						would complicate the circuit design adding additional capital and operating cost aspects and would likely not have much of a material effect to the final process. For example, rougher tailings assayed at approximately 21.6 percent iron and 27.3 percent sulfur compared to the final tailings (23.2 percent iron, 28.9 percent sulfur).
BBC00849	9	David Chambers	Center for Science in Public Participation	Email	Reclamation Plan There is no reclamation plan included in the supporting documents in the DEIS. A reclamation plan is important because provides a space in which to develop a logical closure plan. It appears from the DEIS that there is an assumption that this facility will just be decommissioned and then abandoned. This clearly cannot be the case, yet there is no discussion in the DEIS of long-term closure management, including water treatment, long-term monitoring and maintenance, and the costs associated with these activities. Recommendation: A reclamation plan and associated cost analysis should be included in the DEIS.	Section 2.2.8, Reclamation and Closure (Mine Years 16–19), of the EIS discusses the reclamation plan components, and states, "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 is also discussed in Section 7 of the MOP Application (Tintina 2017a). Section 7.1 of the MOP Application states, "Monitoring programs will continue during construction, operations, temporary closure and in permanent closure until closure objectives have been met." The DEQ would require the Proponent to adhere to a Reclamation Plan, pursuant to § 82-4-336, MCA, which states that all "disturbed lands must be reclaimed consistent with the requirements and standard set forth in this section."
BBC00933	16	Ann Maest	Buka Environmental	Email	A high-level Failure Modes and Effects Analysis (FMEA) is presented as Appendix R of the MOP (Tintina Montana, 2017). The FMEA primarily examines physical failure scenarios (overfilling, embankment failure, inadequate or no liner) and concludes that with mitigation, all failure scenarios are reduced to low or very low risk, as shown in Figures 2 – 12 of Appendix R (green or blue areas in the schematic probability vs. consequence plots). In general, the probabilities decrease with mitigation, but the consequences do not. The summary in Table 5 does not always match the rosier Figures. Specifically, the failure to collect contact water or leakage and the failure to trap sediments probability after mitigation in Table 5 are labeled "Infrequent," but in Figure 9 they are shown as having lower probability (remote or unlikely). One of these is incorrect. The FMEA does not examine any failure scenarios as a modeling exercise. The predicted pH and concentrations in CTF leachate and the Process Water Pond (PWP) during Year 6 of mining are shown in Table 2. Both waters are predicted to be acidic, and concentrations of the constituents shown in Table 2 exceed Montana groundwater or surface water standards (or both for copper, nickel, and lead), often by many times, especially for the CTF. If the liners do fail during mining, or the facilities overtop, or capture is not complete, the contaminants could be transported to shallow groundwater and to Sheep Creek via Coon Creek or Brush Creek. The mitigated consequences for all PWP failure scenarios are Critical or Catastrophic (see Table 5, App. R), indicating that failure of this facility presents a high environmental risk. Mitigated consequences for overfilling and discharge of the CTF also remain Catastrophic. Because of the high risk, a modeling scenario should be completed for the Final EIS that examines overtopping and leakage without capture for the CTF and the WP facilities. The scenario would assume leakage of PWP and CTP water with the concentrations in Table 2 and the effects on groundwater and surface water quality.	See Consolidated Responses PD-1 and PD-3.
BBC00933	17	Ann Maest	Buka Environmental	Email	The two units tested for construction fill were Ynl Ex and Tgd. Ynl Ex is only defined as near-surface Lower Newland Formation (elsewhere it is described as	Appendix D-1 (Enviromin 2017c) of the MOP Application (Tintina 2017a) states that the shallow, weathered, highly-fractured, and oxidized near-surface bedrock

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					a shale), and Tgd is described as near-surface granodiorite intrusions (MOP, App. D-1, Table 2-1). Static results from the Tgd suggest that is is non-PAG. All construction materials are assumed to be non-PAG and to leach low concentrations of metals and other contaminants (MOP, App. D-1). However, many of the Ynl Ex samples have %S values >1 (Figure 2-1 in MOP App. D-1). As with the waste rock units, the HCTs are composites, and the only leachate information is from the single HCTs. No information is given on the distribution of materials in the HCTs, and no static tests were conducted on the composites. Therefore, it is not known if more reactive areas are present in the Ynl Ex unit that would potentially leach higher concentrations. Even with the compositing, the one HCT for Ynl Ex had peaks in arsenic and selenium in the early weeks of testing. Selenium concentrations exceeded Montana surface water quality standards, and arsenic concentrations were 6 µg/L (groundwater standard is 10 µg/L). No mineralogy was performed on the construction fill materials. The NAG pH values are unusually high (many are pH 10-11; see Table 303 in MOP App. D-1), but this is not discussed in the text. An explanation should be provided.	zones of the Lower Newland Formation (Ynl Ex) and sill-form granodiorite intrusive rocks (Tgd) would be excavated and used for sub-grade bedding under lined facilities. The appendix states that the Tgd exhibited no acid generation or metal release during kinetic HCTs. Section 3.4.2.3 of the MOP Application also states that the upper 20 meters of the Ynl formation is oxidized, deeply weathered, and leached, and that HCT results indicate that the material is unlikely to generate acid. Although Ynl rock released low concentrations of selenium (exceeding surface water standards) in the early weeks of testing, HCT testing time is not equivalent to real time. As explained in Appendix D-1 of the MOP Application, "Representative subsets of the Tgd and Ynl Ex samples were selected for environmental geochemical testing through analysis of static multi-element geochemical data. Subsamples were identified to represent the mean concentrations of 10 select elements exhibited by the larger pool of available data for each lithotype using a method based on Runnells et al. (1997)." Information regarding mineralogy is provided in Appendix D-1 and appendices therein, particularly with regard to acid base accounting, asbestiform minerals, and analysis of kinetic testing residues. The range of sulfur concentrations in Figure 2-1 of Appendix D-1 (as referenced by the comment) show that although some samples of Ynl Ex contained >1 percent sulfur, the average sulfur content for all Ynl Ex samples was 0.59 percent. Appendix D-1 further states, "The kinetic HCT of Ynl Ex remained consistent with the static geochemistry results. This representative composite is primarily comprised of samples with very low sulfur content, but also included a few samples with higher sulfur content (as confirmed by ABA)." Within Appendix D-1 of the MOP Application, Table A2 of sub-Appendix A presents a complete list of samples selected for analysis, along with multi-element data and averages by rock unit. Sampling locations are shown in Figures 1-1 and 1-2. The relatively high NAG pH values (approximately 10 to 11 s.u.) that were observed in both the Tgd and Ynl Ex samples do not seem unusual when considering the available neutralizing potential that was consistently measured in these rock units. The neutralizing potential exceeded acid potential in each Ynl Ex sample, even those with relatively elevated sulfur content. The net alkaline nature of this unit was further demonstrated through kinetic testing. For the Ynl Ex, "alkalinity was detected in all weekly extracts and concentrations ranged from 34 (week 34) to 109 (week 0) mg CaCO3 equivalents/L. Maximum available alkalinity in the Ynl Ex sample was 199,000 mg/kg, but only 891.07 mg CaCO3/kg was consumed (0.45 percent of total) during the HCT." "Acidity was not detected in any weekly extract." (Enviromin 2017c) Regarding the potential for contaminant leaching, the kinetic testing of Ynl Ex released concentrations of selenium in weeks 0 through 4 (0.005 to 0.011 mg/L) that met or exceeded the surface water standard (0.005 mg/L), but not the groundwater standard (0.05 mg/L). Appendix D-1 of the MOP Application further states: "Early exceedances of selenium surface water standards were followed by declining concentrations that were eventually below the method

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						detection limit, which suggests that elevated selenium release is linked to weathering of freshly exposed surfaces, and not long-term leaching potential." Although the arsenic concentrations measured for Ynl Ex leachate increased slightly during Weeks 1 and 2, the measured leachate concentrations did not exceed any water quality standards. As stated in Section 3.4.2.6 of the MOP Application, "Excavated granodiorite will be used to construct the sub-grade bedding layer below the CTF HDPE liner system, while excavated granodiorite (Tgd), excavated Ynl Ex, and/or preproduction waste rock will be utilized to construct the sub-grade bedding layer above the CTF HDPE liner system." With the Ynl Ex material being used only above the CTF liner system, any water interacting with this rock would be contained in the facility prior to being collected in the CTF sump and pumped to the treatment facility. See additional information regarding this clarification in the response to Submittal ID BBC00933, Comment Number 18. As stated in Section 3.6.8.3 of the MOP Application, "The embankment material is expected to consist of fresh to moderately weathered Ynl Ex and Tgd rock fill and will be placed and compacted to 95% Modified Proctor laboratory density as described in Section 3.4.2.1." The MOP Application, Section 4.3.3 further states, "Tintina proposes to construct embankments for multiple facilities using near-surface rock to be excavated from highly weathered and oxidized surface exposures of Ynl Ex and Tgd. Infiltration of precipitation and snowmelt through embankment construction materials derived from near-surface materials has the potential to affect downgradient water. Compliance with non-degradation criteria was evaluated for operations at all facilities and in closure for the CTF. The relative magnitude of any discharge to groundwater beneath constructed embankments depends on the rate of infiltration and the quality of consequent seepage. The acid generation and metal release potential of the near surface Ynl Ex and Tgd has shown to be low using static and kinetic test methods." The potential for seepage through embankments was described in MOP Application, Section 4.3.3.1: "The HELP model estimates very low percolation rates through the CTF, WRS, PWP, and CWP embankments and the mill and WRS pads. Predicted values range from 0.01 to 0.11 gpm (0.03 to 0.42 Lpm) for the different facilities. The highest modeled percolation rate results of 0.11 gpm (0.42 Lpm) were for the CTF and the mill pad embankments whereas the lowest modeled percolation rate (0.009 gpm; 0.034 L/min.) is associated with the CWP embankment (2017c). The modeled percolation rate associated with the PWP embankment is 0.07 gpm (0.27 Lpm). When the modeled percolation results for each facility are reported as a flow per unit area (gpm/square foot), they range from 2 x 10^{-6} to 3 x 10^{-6} gpm/ft^2. These very low modeled embankment seepage percolation rates indicates that embankment seepage will not significantly impact the regional groundwater system. There is therefore no need for the embankment seepage to be considered further as it is a non-issue."
BBC00884	4	Scott Bosse	American Rivers	Email	Tintina's plan to keep the cemented mine tailings and toxic waste in place for decades is experimental and unproven. As Zamzow points out in her critique of the DEIS:	See Consolidated Responses PD-1, PD-2, PD-3, PD-4, and PD-5.

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					“While cement tails backfill has been used or underground disposal, cement-paste tailings surface disposal is a new concept which has not been attempted at any mine site.” Neither Tintina nor the DEQ provided evidence that it will work, particularly over the long-term and after the mine site has been abandoned. The DEIS assumes that the double-liner underlying the mine tailings will be installed perfectly, perform exactly as designed, never tear, and therefore not leak any acid mine drainage. Rather than make these overly optimistic assumptions, the DEIS should evaluate what will happen when the cement in the tailings is dissolved by acid, which is inevitable due to the fact that the tailings from the Black Butte Project would have a 26% sulfide content, which is extremely acidic. In his critique of the DEIS, geophysicist Dave Chambers of the Center for Science in Public Participation states: “The cement tailings facility will remain cement for only a short time. After the acid in the tailings neutralizes/dissolves the cement, the cement tailings facility must become either a dry drained tailings storage facility (TSF), or a wet TSF. There is no discussion of how this facility will be managed when degradation of the cement in the TSF happens.” In his critique of the DEIS, hydrologist Tom Myers states: “Failing to consider liner defects and therefore subsequent higher discharge rates means the DEIS assumed perfect operation and has not considered any contingencies beyond its engineering working perfectly. The DEIS should consider the effect of a substantial leak reaching the groundwater from various locations on the mine site.”	
BBC00884	8	Scott Bosse	American Rivers	Email	In the section entitled “Issues Considered but Not Studied in Detail” on page I-13, the DEIS states, “No Wild and Scenic Rivers would be affected by any of the alternatives.” While this statement is factually correct, there are two waterways – the public lands reaches of Tenderfoot Creek and the Smith River – that have been found to be “eligible” for Wild and Scenic designation by the Helena – Lewis and Clark National Forest (the Forest). Under the Wild and Scenic Rivers Act, no federal agency may issue permits for any projects or activities that would degrade the free-flowing character, water quality and outstandingly remarkable values (ORVs) that exist on these two waterways. On the Smith River, these ORVs include scenery, recreation (especially fishing), geology, wildlife and cultural. On Tenderfoot Creek, ORVs include scenery, recreation and fisheries. The DEIS should include a discussion on how the Black Butte Copper Project might adversely impact water quality and ORVs on these two Wild and Scenic eligible waterways, especially if acid mine drainage and other pollutants enter Sheep Creek.	Section 3.5, Surface Water Hydrology, of the EIS explains that 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. Additionally, because adverse impacts on Sheep Creek water quality due to the Proposed Action are not predicted, no impacts on the Smith River are anticipated. Because the Smith River is not expected to be affected, no “eligible” Wild and Scenic Rivers would be affected. On the Smith River, there would be no effects to the following outstandingly remarkable values (ORVs): scenery, recreation, geology, wildlife, and cultural. Portions of Tenderfoot Creek are also listed as eligible for Wild and Scenic River designation, but this river would not be affected by the Project as it is located about 15 miles north of the Project area and is not connected to Sheep Creek. As such, no eligible Wild and Scenic Rivers would be affected.
34_Combined	1	Bruce Thompson		Spreadsheet	Despite Sandfire’s assurances to the contrary, we all know that long term attempts to contain toxic waste from the operation are at-best well meaning, but not guaranteed-- and given the worldwide track record of the mining industry, likely doomed to failure before even begun. I think little or no weight should be attributed to “new methods” until there has been a lengthy trial period looking at durability, potential effects of “unexpected” catastrophic events (eg. earthquakes, forest fires, flooding), and taking into account the impact on the micro-environment of the excavation of so much surface area in the creation of	See Consolidated Responses PD-2 and PD-3.

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					the holding system. Also, the size of the holding areas would need to be immense to handle the amount of tailings from such a large operation as could eventually develop.	
Socioeconomics						
PM1-05	4	Curtis Thompson		Public Meeting Transcript	The Draft Environmental Impact Statement fails to address the significant adverse economic impact which will occur as a result of contamination. Even the town of White Sulphur Springs enjoys significant economic benefits from recreation involving the Smith River. When the company is gone and the leakage is polluting the Smith River, that community, as well as others, will suffer the loss of significant activity, economic activity, because people do not pay to float in toxic water.	DEQ does not predict contamination/pollution of the Sheep Creek or any other surface water. See Section 3.4.3.2, Proposed Action, Section 3.5.3.1, Surface Water Quantity, and Section 3.5.3.2, Surface Water Quality and Temperature, of the EIS. Process water discharged to surface waters via the UIG would be treated to avoid impacts. Although contamination/pollution is not predicted, DEQ is requiring operational monitoring to verify that surface waters are being protected. See Section 6 of the MOP Application.
PM1-09	2	Larry Antonich		Public Meeting Transcript	To summarize, the EIS addressing noise is incomplete, inaccurate, and severely impacts the quality of life at the subdivision and also devalues the property substantially. Contributing to the noise not addressed in my comment is the armada of very large trucks hauling continuously.	Noise is addressed in Section 3.11, Noise, of the EIS, which includes assessment of impact on nearby receptors, including the Little Moose Subdivision. Noise associated with the construction phase of the Project would be audible for several miles around the Project area. 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. See Section 3.11.3.2, Proposed Action, of the EIS.
PM1-10	2	Roger Peffer		Public Meeting Transcript	They say that about 220 good-paying mining jobs will come from this mine. How many jobs will be lost from the people that guide float trips down the Missouri River? Down the Smith River? They're going to be trashed, basically. People won't float it. And then the other thing you have to look at is the farms and ranches. What's the economic impact there when the spill occurs? We have to consider all these things. They're looking at short-term gains versus long-term detriments. The long-term detriments outweigh those short-term gains.	Recreation and use of the Smith River are addressed in Section 3.7, Land Use and Recreation, and Section 3.8, Visuals and Aesthetics, of the EIS. Socioeconomic resources are addressed in Section 3.9, Socioeconomics, of the EIS. DEQ does not predict contamination/pollution of the Sheep Creek or any other surface water. See Section 3.4.3.2, Proposed Action, Section 3.5.3.1, Surface Water Quantity, and Section 3.5.3.2, Surface Water Quality and Temperature, of the EIS. Process water discharged to surface waters via the UIG would be treated to avoid impacts. Although contamination/pollution is not predicted, DEQ is requiring operational monitoring to verify that surface waters are being protected. See Section 6 of the MOP Application.
PM2-03	1	Jeannette Blank		Public Meeting Transcript	I kind of glanced through the EIS, and the areas I see -- that I would like to see more work done on this that I see lacking are related to connected actions. So there's kind of three areas of connected actions. One I would say, and this is probably the lesser of the three, although very important, is assessment of the current infrastructure in White Sulphur to be able to realistically handle the major uptick in the number of people that will be there, the number of additional housing and supported services, all the way leading up to water rights, what their waste -- all of their systems are going to be able to handle; and whether those local agencies and governments can handle the major influx that's going to be happening in that town. We've seen that boom-bust cycle happening across small towns where natural resources extractions happen. So that's a major impact to those towns. And some of it's beneficial, but, at the same time, when they're not prepared to handle that, that's where a lot of unforeseen impacts occur.	The provisions of the Montana Hard Rock Mining Impact Act, as referenced in Section 3.9, Socioeconomics, of the EIS, are intended to mitigate fiscal impacts of a hard rock mineral development and assist affected local governments in preparing for, and mitigating, area worker influx, infrastructure needs, and fiscal and economic impacts.
PM2-03	3	Jeannette Blank		Public Meeting Transcript	And then coming back kind of to this community of Livingston and also Townsend, I feel like the transportation section is woefully underdeveloped. There's no detailed route maps of where these trucks would go to in these towns. Here in Livingston in particular, I know I did see it talked about going	See the response to Submittal ID HC-040, Comment Number 3.

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					down Park Street and down to the east end of town. That goes by our hospital. I would want to know how this is going to affect the rail traffic. Are we going to get held up on the south end of town longer and more often? Do we anticipate that there's going to be more train traffic in the middle of the night that's going to keep a lot of us up in the middle of the night? I'd be interested in knowing the timing and hours of the loading activity. Is there potential for that mine-related traffic to impact local traffic patterns? We have a high congestion on Park Street, and emergency services, would that impact our emergency systems?	
PM2-11	4	Max Hjortsberg	Park County Environmental Council	Public Meeting Transcript	And then to address an issue a little more locally, the transportation plan really doesn't address much in the way of the increased vehicular traffic and heavy truck traffic. They do state that the railroads are not that crowded, can handle additional traffic, which may be the case, but can they handle the type of traffic that this mine will be producing? Also, for the Livingston section, there's nothing mentioned in there for a very frequent occurrence that happens here, which is when I-90 is closed due to high winds and all traffic is routed through Livingston, and how the additional mining traffic coming into town would play into that scenario. There is no opportunity for trucks to wait for a train crossing at Bennett Street. In the case of a wind closure, you have traffic backed up onto the interstate. How would that affect people getting through to emergency services? And also the general concerns around health and safety and wellbeing of all the communities this traffic would travel through.	Rail capacity was not within the scope of the EIS. Loaded mining haul trucks would enter I-90 at Exit 340, travel 2.3 miles west, then turn onto Highway 89/Park Street at Exit 337. A 2018 study commissioned by MDT found that I-90 in the vicinity of Livingston is impacted by high winds two to three times per week from October through March (CDM Smith and MDT 2019). Impacts can result in four potential levels of restrictions: (1) severe cross-winds warnings; (2) partial I-90 closure between Exits 330 and 337 (west and east of Livingston), requiring that trucks exit the highway and go through Livingston instead; (3) full I-90 closure between Exits 330 and 337, requiring that all vehicles exit the highway and travel through Livingston instead; and (4) full I-90 closure for a longer portion extending east or west of Livingston, a less common occurrence generally due to blowing snow. During such closures, congestion at Exit 337 (U.S. Route 89), which would be used by haul trucks traveling to and from Livingston, causes backups onto the interstate and throughout Livingston.
PM4-02	2	Malcolm Gilbert		Public Meeting Transcript	These are people that will be impacted by the mine. These are jobs that we can count on to be around for decades, maybe longer, where with the mine we can't count on the fact that they'll be there for, you know, more than a decade or two. And where does that leave all these people that have good work that bring money back to the state? All the money we make stays here -- And just to make it clear, I guide on the Smith River as well as work for MEIC. All the money that we make stays here in the state, and there aren't foreign companies reaping the profits.	The provisions of the Montana Hard Rock Mining Impact Act, as referenced in Section 3.9, Socioeconomics, of the EIS, are intended to mitigate fiscal impacts of a hard rock mineral development and assist affected local governments in preparing for, and mitigating, area worker influx, infrastructure needs, and fiscal and economic impacts.
PM4-06	1	Metta Barnhart		Public Meeting Transcript	The Smith River is predictable. Millions of dollars are brought in to the state of Montana through outfitters and everything that the tourists do on their way, spending money in the towns buying groceries and getting to the river. It's one of the most beautiful places on Earth and it is one of the most important places to me; often one of the first things I tell my out-of-state friends about, and, coincidentally, one of the things that brings my friends to the state of Montana.	DEQ acknowledges the outstanding recreational opportunities afforded by the Smith River and recognizes its economic contribution. Recreation and use of the Smith River are addressed in Section 3.7, Land Use and Recreation, and Section 3.8, Visuals and Aesthetics, of the EIS. Socioeconomic resources are addressed in Section 3.9, Socioeconomics, of the EIS. The Final EIS has been amended to include publicly available information on the economic contribution of the outdoor recreation industry, particularly the contribution attributable to the Smith River. DEQ does not predict contamination/pollution of the Sheep Creek or any other surface water. See Section 3.4.3.2, Proposed Action, Section 3.5.3.1, Surface Water Quantity, and Section 3.5.3.2, Surface Water Quality and Temperature, of the EIS. Process water discharged to surface waters via the UIG would be treated to avoid impacts. Although contamination/pollution is not predicted, DEQ is requiring operational monitoring to verify that surface waters are being protected. See Section 6 of the MOP Application.

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PM4-12	3	Dave Ewan		Public Meeting Transcript	The amount of jobs that it's going to produce has been way exaggerated by the mining company.	Employment projections are estimates. However, accurate workforce projections are critical to effective budgeting and planning.
HC-001	6	Martha Williams	Montana Fish, Wildlife, and Parks	Hard Copy Letter	FWP suggests that the Socioeconomic section of the Affected Environment, 3.9-1, include·information on angler expenditures associated with the Smith River, which FWP estimates to be $9.1 million annually based on the number of angler days and angler expenditures for the Smith River and its North and South fork tributaries.	The Final EIS has been amended to include publicly available information on angler expenditures.
HC-002	11	William Avey	USDA Forest Service	Hard Copy Letter	The U.S. Highway 89 corridor from White Sulphur Springs to the junction of US 89 and US 87 near Belt, Montana is a nationally designated Scenic Byway, as designated in 1991. The outstanding scenery of this corridor helps to enhance the economic viability of the small rural communities along its 70 miles stretch. Options for maintaining or enhancing the scenery along this corridor should be considered.	The Project would impact views along this road segment only at the intersection with Sheep Creek Road, where intersection improvements would be made to improve sight distance and intersection safety. The improvements would not affect the scenic views from the road.
HC-003	31	Josh Purtle	Earth Justice	Hard Copy Letter	The mine creates other risks that the Draft EIS ignores or dismisses without making any attempt to quantify the risks, explain the consequences if the project's safeguards fail, or provide reasonable assurance that the impacts will not come about. Tintina plans to ship copper concentrate produced by the mine by truck to rail terminals in Livingston and/or Townsend. See Draft EIS at 2-10. The concentrate will be shipped in sealed containers that, according to the Draft EIS, will "minimize or avoid potential leakage or spillage during transport and eliminate dust potential and spills." Draft EIS at 2-10. The Draft EIS does not, however, attempt to quantify the risk of a spill, which could contaminate surface water and groundwater with toxic metals and sulfide minerals contained in the copper concentrate. See id. Instead, the Draft EIS states that "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." Draft EIS at 3.12-11. Given the sheer quantity of material Tintina proposes to ship from the mine every day, totaling 6,570 truck trips each year, it is not reasonable to conclude that the risk of a spill, whether due to mishandling of the shipping containers or a traffic accident, would be negligible. See Exhibit 33 (Oliver, Cleanup underway on zinc concentrate spill near Red Dog Mine, The Arctic Sounder (Jan. 27, 2017)). DEQ must quantify this risk as well. In particular, because the Draft EIS acknowledges that a severe accident could compromise the shipping containers, DEQ must disclose the risk that such an accident would occur as well as the potential consequences of such an accident for groundwater and surface water. See San Luis Obispo Mothers for Peace, 449 F.3d at 1033 (requiring analysis of high-impact, low-probability event in EIS).	The chance of traffic collisions generally increases with increased vehicle miles travelled. The following estimates of the frequency of a crash involving Project vehicles (regardless of outcome) are based on the highest projections of traffic estimated to be generated by mine operations, and the higher of either (1) generally anticipated accident rate on rural roads of 0.5 to 1 incident per 1 million vehicle miles traveled, or (2) the recorded rate of incidents. • U.S. Route 89 from Sheep Creek Road to White Sulphur Springs: estimated 2,194,380 vehicle miles per year; 1 to 2 traffic incidents or collisions per year. • U.S. Route 12/89 from White Sulphur Spring south to U.S. Route 12 intersection: 254,040 vehicle miles per year; estimated 0.1 to 0.2 incident or collisions per year (i.e., one accident every 5 to 10 years). • U.S. Route 12 from U.S. Route 89 west to Townsend: 888,629 vehicle miles per year; at the past accident rate of 2.13 accidents per million vehicle miles, 1.9 collisions per year. Safety improvements completed in 2016 may reduce the accident rate, as noted in Section 3.12.2.2, Traffic Safety Data, of the EIS. • U.S. Route 89 from U.S. Route 12 south to I-90: 1,526,065 vehicle miles per year; estimated 0.75 to 1.5 incidents or collisions per year. • I-90 and U.S. Route 89 to the Yellowstone River (4 miles): 108,040 vehicle miles per year; estimated 0.05 to 0.1 incident or collisions per year (i.e., one accident every 10 to 20 years). The mode of transporting mine concentrate would minimize the risk of mine concentrate spills. The use of sealed containers would eliminate the need for material handling at rail stations or other intermediate points, and reduce the risk of spills if an accident occurs. According to the Proponent, the containers are "strong and rugged enough that they are unlikely to release concentrate during shipping accidents or mishandling" (Tintina 2017a). As noted in Section 2.2.3, Operations (Mine Years 3–15), of the EIS, the mine concentrate would not be a liquid, but rather would be thickened and pressed to remove water, with a moisture content of approximately 10 percent. The texture of the concentrate would be roughly comparable to wet sand, thus limiting its

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						ability to spread or flow. Based the limited available information, a crash severe enough to cause release of mine concentrate would have similar traffic impacts on a crash and release of other bulk materials, such as sand, concrete, or agricultural products. Depending on the severity and nature of the crash, roads could be partially or fully closed for an hour or more. The MOP Application Appendix P (Emergency Response Plan; Tintina 2017b) has general procedures for all spills, including concentrate spillage from a haul truck accident (specifically, see Section 4.2, General Rules for Responding to a Spill or Release, and 4.3, Reportable Quantities and Agency Notification, in MOP Application Appendix P). The Proponent's anticipated response to spills from sealed concentrate containers as a result of a haul truck crash are summarized below (Zieg 2019c): • The Proponent would have trained safety and environmental personnel respond immediately. • The Proponent would isolate and contain the spilled material, notify appropriate agencies, clean and dispose of the spill material, and then conduct an investigation of the spill. Appropriate equipment would be used to clean the spill, such as loaders, dump trucks, vacuum trucks, and hydro excavation trucks. The type of equipment used would depend upon the quantity and location of the spill, weather, and road conditions. • The Proponent would remove all traces of the spill and properly dispose. • The Proponent would conduct post-spill monitoring of the spill site where it is warranted, especially if a stream was impacted by the spill. • Handling/cleanup procedures specific to mine concentrate spills from the sealed containers would be addressed in detail before mine operations begin. The Proponent is in the process of formalizing a Safety Data Sheet for the Black Butte Copper concentrate that would include information critical to concentrate spill response. The Proponent is also preparing a formal Spill Prevention, Control, and Countermeasures Plan that would be submitted to the Montana State Fire Marshal and DEQ.
HC-003	88	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS does not adequately analyze socioeconomic impacts that will be caused by the mine, especially after the mine closes. ARM 17.4.609(3)(e); 17.4.617(4)(a) (MEPA regulations requiring evaluation of impacts to "social and economic circumstances"). The Draft EIS predicts that the mine will cause an approximately 23% population increase in White Sulphur Springs, the city closest to the mine. Draft EIS at 3.9-16. Significant changes in infrastructure will likely accompany this population boom: For example, many more housing units will likely be built to accommodate the predicted population increase. See Draft EIS at 3.9-17 ("The Montana Business Assistance Connection estimates that an additional 112 housing units may be needed as a result of the Project ...."). The Draft EIS, however, does not analyze the impacts to the local community that will result when the mine closes and the population boom subsides, leaving excess infrastructure and unused housing in White Sulphur	The provisions of the Montana Hard Rock Mining Impact Act, as referenced in Section 3.9, Socioeconomics, of the EIS, are intended to mitigate fiscal impacts of a hard rock mineral development and assist affected local governments in preparing for, and mitigating, area worker influx, infrastructure needs, and fiscal and economic impacts.

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					Springs and elsewhere in the region. See Exhibit 51 at 2 (Pembina Inst., Boom to Bust, Social and Cultural Impacts of the Mining Cycle (Feb. 2008)).	
HC-003	90	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS briefly refers to an increased number of car collisions in the region due to greatly increased traffic associated with trucks and employees traveling to and from the mine site. Draft EIS at 3.12-10. However, the Draft EIS makes no attempt to quantify this increase in traffic incidents, or even give a qualitative estimate of the increase. The EIS should provide additional analysis of this impact. The Draft EIS also fails to consider the potential impacts along the transportation corridors from the release of mine concentrate from the shipping containers as a result of truck accidents severe enough to compromise the integrity of the containers. Draft EIS at 3.12-11; Exhibit 33.	See response to Submittal ID HC-003, Comment Number 31.
HC-040	3	Nancy S. Kessler		Hard Copy Letter	Finally, my hometown of Livingston is one of two destinations along with Townsend selected through which the copper ore would be transported from the mine and transferred to shipment by rail to the west coast. Health and safety concerns are myriad around heavy truck traffic traveling down Highway 89, through the communities of Wilsall and Clyde Park, to the final destination of the rail yard in Livingston. These concerns arise not only from possible accidents involving such large trucks, but also from potential injury caused by exposure to the ore dust. And, Livingston already is challenged by difficult cross-railroad track traffic issues, which would only be further exacerbated by these trucks.	Mine products would be transported in sealed shipping containers (EIS Section 3.12.3.2, Proposed Action). The sealed containers would be transferred to rail cars, eliminating any material handling at the rail yards. The response to Submittal ID HC-003, Comment Number 31, addresses accident rates. Haul traffic would exit I-90 at Exit 337 and enter Livingston on Highway 89 (Park St.). The specific location of the Livingston railhead shipping facility was not identified in the application, and the EIS (Section 3.12.2.1, Existing Road Network) assumed that the Livingston haul route would terminate west of the Yellowstone River in the vicinity of existing rail yards. However, the Proponent's traffic study (Abelin Traffic Services 2018) states that the Proponent would create a new railhead shipping facility along the Montana Rail Link tracks east of the Yellowstone River at a location to be determined. This option would minimize the distance that haul traffic would travel within Livingston and avoid haul truck traffic within the town's commercial and residential areas. The Livingston Health Care Center is on the south side of Highway 89 (Park Street) approximately 1,800 feet (0.35 miles) east of the Yellowstone River.
BBC00704	1	Norman A. Bishop		Email	The Smith River generates $10 million in annual economic activity to the State of Montana. The Outdoor Recreation Industry generates $7 billion in state revenue. Further, outfitters will launch 73 of 1,361 total Smith River permits in 2019. Outfitters create Montana jobs, are responsible stewards, and the money they generate stays in the state and has a substantial ripple effect on the economy—airfare, hotels, travel, etc. The draft EIS should evaluate any potential impacts to this burgeoning and sustainable industry.	DEQ acknowledges the outstanding recreational opportunities afforded by the Smith River and recognizes its economic contribution. Recreation and use of the Smith River are addressed in Section 3.7, Land Use and Recreation, and Section 3.8, Visuals and Aesthetics, of the EIS. Socioeconomic resources are addressed in Section 3.9, Socioeconomics, of the EIS. The Final EIS has been amended to include publicly available information on the economic contribution of the outdoor recreation industry, particularly the contribution attributable to the Smith River.
BBC00716	2	Gregory Dibble		Email	• The Smith River generates $10 million in annual economic activity to the State of Montana. The Outdoor Recreation Industry generates $7 billion in state revenue. Further, outfitters will launch 73 of 1,361 total Smith River permits in 2019. Outfitters create Montana jobs, are responsible stewards, and the money they generate stays in the state and has a substantial ripple effect on the economy—airfare, hotels, travel, etc. The draft EIS should evaluate any potential impacts to this burgeoning and sustainable industry.	DEQ acknowledges the outstanding recreational opportunities afforded by the Smith River and recognizes its economic contribution. Recreation and use of the Smith River are addressed in Section 3.7, Land Use and Recreation, and Section 3.8, Visuals and Aesthetics, of the EIS. Socioeconomic resources are addressed in Section 3.9, Socioeconomics, of the EIS. Section 3.9.2.2, Employment and Income, of the Final EIS was amended to include publicly available information on the economic contribution of the outdoor recreation industry, particularly the contribution attributable to the Smith River.
BBC01048	5	David and Nike Stevens		Email	The Smith River generates $10 million in annual economic activity to the State of Montana. The Outdoor Recreation Industry generates $7 billion in state revenue. Outfitters will launch 73 of 1,361 total Smith River permits in 2019. Outfitters create Montana jobs, are responsible stewards, and the money they	DEQ acknowledges the outstanding recreational opportunities afforded by the Smith River and recognizes its economic contribution. Recreation and use of the Smith River are addressed in Section 3.7, Land Use and Recreation, and Section 3.8, Visuals and Aesthetics, of the EIS. Socioeconomic resources are

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					generate stays in the state and has a substantial ripple effect on the economy—airfare, hotels, travel, etc. The draft EIS should evaluate impacts to this increasing and sustainable industry.	addressed in Section 3.9, Socioeconomics, of the EIS. Section 3.9.2.2, Employment and Income, of the Final EIS was amended to include publicly available information on the economic contribution of the outdoor recreation industry, particularly the contribution attributable to the Smith River.
HC_036	6	Shelley Liknes	Fopp Family Trust	Hard Copy Letter	The DEIS demonstrates that the proposed project's decrease in flow at 0.35 cfs along will have an adverse effect that rises to a significant level on the Fopp Family Trust water rights in late summer and adversely affect features of the property that affect the land's value. The Draft EIS failed to consider these effects and no mitigation measures were identified.	As described in Section 3.5.1, Analysis Methods, of the EIS, surface water quantity data were collected from May 2011 through December 2017. Monthly flow measurements and automated gauging stations on Sheep Creek provide detailed seasonal baseline data. There are no adverse effects predicted to occur to surface water and groundwater as a result of Project development based on results of the quantitative predictive models developed for the Project and in light of planned mitigation measures. As is standard practice, the EIS includes quantitative predictive surface water and groundwater modeling to generate predictions to support the assessment application and further, as tools to inform mitigation and management strategies. See Section 3.4.1, Analysis Methods, Section 3.4.2, Affected Environment, Section 3.5.1, Analysis Methods, and Section 3.5.2, Affected Environment, of the EIS. UIG recharge and the loss of base flow in Sheep Creek (approximately 0.35 cfs or 2 percent of the average base flow) caused by mine dewatering would partially offset each other and thus further minimize the predicted changes to stream flow. For example, Section 3.5.3.1, Surface Water Quantity, of the Draft EIS states, "Predicted depletion of 0.35 cfs (157 gallons per minute [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)." This section also states, "The predicted decrease in flow (157 gpm) does not account for additions to base flow from seepage from the NCWR." Simulated base flow depletion for all streams except Coon Creek are within surface base flow measurement error (± 10 percent). In 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. See Section 3.5.3, Environmental Consequences, of the EIS.
HC_030	8	Curtis G. Thompson		Hard Copy Letter	The release of toxins into down gradient waterways is statistical certainty based on all hard rock mining operations in Montana history. The economic benefits of the Smith River from its recreational allure are well known and documents. The draft EIS includes no consideration of the adverse economic impact of the proposed mining operation from the loss of the recreational revenues.	DEQ does not predict contamination/pollution of the Sheep Creek or any other surface water. See Section 3.4.3.2, Proposed Action, Section 3.5.3.1, Surface Water Quantity, and Section 3.5.3.2, Surface Water Quality and Temperature, of the EIS. Process water discharged to surface waters via the UIG would be treated to avoid impacts. Although contamination/pollution is not predicted, DEQ is requiring operational monitoring to verify that surface waters are being protected. See Section 6 of the MOP Application. DEQ acknowledges the outstanding recreational opportunities afforded by the Smith River and recognizes its economic contribution. Recreation and use of the Smith River are addressed in Sections 3.7, Land Use and Recreation, and 3.8, Visuals and Aesthetics, of the EIS. Socioeconomic resources are addressed in Section 3.9, Socioeconomics. The Final EIS has been amended to include publicly available information on the economic contribution of the outdoor recreation industry, particularly the contribution attributable to the Smith River.

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BBC00024	2	Tim and Miriam Barth		Email	As business owners, we welcome the possibility of a stable, strong business to our community. We welcome the much needed tax revenue both for our county as well as the State of Montana. We have owned Stageline Pizza and the Strand Theatre located on main street, White Sulphur Springs for nearly 31 years and we look forward to the positive challenges of expanding our kitchen to better serve the incoming mine work force. We look forward to again showing a movie to a full theater and we look forward to having a larger employee work pool from which to keep our hiring needs fulfilled!	Thank you for your comment.
BBC00048	1	Butch Kallem		Email	Your job is to assure that a mine is properly setup, properly managed and that safety and clean-up is financed and paid for by fees on mined product. Instead you have turned into the worst thing that we can have happen in this country. You try to harass companies, rather than assist them. Rather than working for the people of this country and State you actually work for the nuts that wish no human being were alive. To approve a mine, it should take no more than 3 months after plans, projections and operations testing is completed. Not years. Once you passed 6 months you just want to see how many people you can put on a payroll. Already we have seen several mines just go away that were good designs, properly setup and would have had very good cleanup and safety. Like the one in the Paradise Valley. That was a good mine, and we now allow China to import several minerals that could have come from that mine alone. Time for the Government to start working for the people they represent, not some eco-terrorist group. It is like you are afraid of them and refuse to do your job, or just do not know how to do your job.	DEQ takes seriously its purpose to thoroughly review the Proponent's Project as set forth in its operating permit application to determine whether the proposed operating and reclamation plans comply with the Montana Air Quality Act, the Montana Water Quality Act, and the MMRA.
BBC00057	1	David Hebert		Email	The Draft EIS is very complete and includes an analysis of the potential impact the project might have on the transportation systems in the area. For those who live in the area, studying the increase in traffic that will come with constructing and operating of the Black Butte Mine is important. In Section 3.12, Pages 1 through 12, accomplishes this task in a responsible manner. Thank you. As the study revealed, when the mine is operating, the road system in the area that would receive the most incremental increase in traffic compared to 2016 is US Route 89. Table 3.12-2 shows that average traffic on this road, except for a few areas just north of I-90 near Livingston, has remained fairly static since 2005. Section 3.12.3, Page 8, explains that: "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." In other words, even with the increase in traffic from the badly needed economic development the area would enjoy during the mine's operation, the existing road system is more than capable of handling the increase in use.	Thank you for your comment.
BBC00057	2	David Hebert		Email	I was pleased to see that Tintina Montana proposes to encourage carpooling and would provide a shuttle service out of White Sulphur Springs as mitigation for these small increases in traffic. I was also pleased to see that the company intends to work with the Montana Department of Transportation in addressing possible safety concerns at the intersection of U.S. Highway 89 and Sheep	Thank you for your comment.

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					Creek Road; U.S. Route 12 (Milepost 28.0 to 29.9); will review school bus schedules and project truck traffic to limit the risk of interactions with school bus traffic; and will use on-board systems to monitor and limit concentrate truck speeds on their routes (Section 3.12, Page 11). In an area that has suffered through years of economic malaise, the socioeconomic impact of over 200 family-wage jobs is a huge positive compared to the small increase in road traffic the project will bring to road systems that are being utilized far below carrying capacities. This is especially true when Tintina Montana's plan is to be pro-active in mitigating for the increase.	
BBC00062	1	Joshua Juarez		Email	In reviewing the socioeconomic portion of the DEIS (3.9) it is abundantly clear that Meagher County is in dire need of the economic stimulus that the BBCP could provide. Meagher County ranks in the bottom categories of nearly every measurement in the socioeconomic analysis area. In looking at the five measures used in the analysis, unemployment, average earnings per job, per capita personal income, and families with income below the poverty level, it is clear that the DEQ made the right conclusion. The data indicates a "less healthy economy" in Meagher than that of the surrounding counties (3.9-5). With the median wage in MT being $32,750 in 2016 (Montana DLI 2016), any new mining jobs anywhere in our state will raise that very poor number. This is due to the average median wage of a mining sector job being nearly double the state's median wage at $60,190 (3.9-4). These are just the kinds of jobs that a county like Meagher needs. With an aging demographic that is ten years higher than the states' median age (3.9-3), the skilled labor positions making family wages will lower that number and significantly contribute to the goals of the White Sulphur Springs Growth Policy articulated on page (3.9-9). While there are certainly going to be some front-end strains on public infrastructure and services with the influx of these skilled workers (3.9-17), the Hard Rock Impact Plan will help prepare Meagher County for these stresses through the prepayment of Metal Mine License Taxes. Once up and running, the county is estimated to receive 1.4 million a year in these taxes on top of an additional 8 million in taxable valuation at peak copper production (3.9-17).	Thank you for your comment.
BBC00075	3	Janet Carlson		Email	The conclusion, reached by me and by the DEQ, appears quite simple. The environmental impacts of the proposed mine have been avoided or mitigated by the proposed, worldclass, plan of operation and the mine should be permitted as soon as possible. The activity of creating family-wage jobs in economically depressed Meagher County should get under way immediately upon a positive decision and the posting of the required bond.	Thank you for your comment.
BBC00076	1	David Philpott		Email	The Socioeconomic Section 3.9 does a good job of underscoring the need for this project in Meagher County. The area has seen out-migration of young families due to the lack of jobs that can pay a family sustaining wage and include full benefit packages providing good family insurance, ample vacation and personal days, contributions to retirement plans, wellness programs, etc. The population of Meagher County has decreased over the last decade and those that have remained in the area are faced with a per-capita income that is 30% less than the Montana average (Section 3.9, page 5, table 3). Thank you for including in the Draft EIS a thorough discussion of the area's quality of life	Thank you for your comment.

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					(Section 3.9, pages 1 through 11). This analysis clearly shows that the vitality of the area is compromised with the lack of economic development and that the impacts go far beyond paychecks. As the Draft EIS notes, "Health and quality of life are dependent on a number of factors, particularly access to education, public services, healthcare, recreation, and social services." The Draft EIS also correctly states that, "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)." The average income of miners in Montana, $60,190, is nearly double the income of the average job in Meagher County (Section 3.9, page 4) and would be a huge game-changer for the individuals and the families that call the area home. The Black Butte Project will directly employ 235 individuals and another 151 would find employment with contractors or other employers servicing the mine (Section 3.9, page 13, Table 9). Goods and services purchased by the miners themselves throughout the local area and state will create additional jobs for Montanans. In addition, taxes that will be paid by the mining company while in production will add millions to local government coffers. For instance, the metal mines tax is estimated to be $4 million per year to the State of Montana (Section 3.9, page 17) with over $1.4 million of that amount to be distributed to Meagher County each year during the projected 11 years of production. Thankfully, the unique-to-Montana Hard Rock Mining Impact Act, the local area will be able to prepare for the influx of workers. The provisions of this act, as spelled out in Section 3.9, page 17, 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.	
BBC00077	2	Carlina Quintero		Email	The area certainly needs the jobs. Sawmill closures and logging job losses have contributed to a prolonged contraction of economic vitality in the White Sulphur Springs area. Meagher County has, sadly, some 18.3% of the population base living below the poverty level (Section 3.9, Table 3) and a median household income that is $11,000 less than Montana's average. Wage earners with families have been forced to look elsewhere for family-wage jobs and K-12 school enrollment has decreased by over 20% between 2010 and 2016 (Section 3.9, Page 8). This project would substantially change the economic well-being of Meagher County. Section 3.9, Table 10 shows that as many as 165 of the 235 projected mine employees would move into the area during the years of mine operations. Those in-migrating employees are projected to have an average of 2.46 people per household (Section 3.9, Page 14) and I assume that some of the 1.46 non-employees in those households will be school children. In 2016, the average wages earned by Montana mine workers was $60,190 (Section 3.9, Page 4) or over 300% of the current per-capita personal income of the area (Section 3.9, Table 3). When these individuals and families spend their earnings and pay their taxes the entire area will benefit. Thankfully, this economic development can and will be able to occur without significantly impacting the local environment (Sections 3.1 through 3.16), including the locally cherished and nationally renowned Smith River.	Thank you for your comment.

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BBC00104	2	Janet Carlson Krob		Email	The application produced by Tintina Montana, reviewed by the DEQ, and the subsequent EIS conducted by a 3rd party and DEQ to assure that the tough rules are either met or exceeded by the mining company, proves that we do not have to choose. We can have a healthy environment and the jobs that come from the modern mine being proposed in Meagher County. The area certainly needs the jobs. Sawmill closures and logging job losses have contributed to a prolonged contraction of economic vitality in the White Sulphur Springs area. Meagher County has, sadly, some 18.3% of the population base living below the poverty level (Section 3.9, Table 3) and a median household income that is $11,000 less than Montana's average. Wage earners with families have been forced to look elsewhere for family-wage jobs and K-12 school enrollment has decreased by over 20% between 2010 and 2016 (Section 3.9, Page 8). This project would substantially change the economic well-being of Meagher County. Section 3.9, Table 10 shows that as many as 165 of the 235 projected mine employees would move into the area during the years of mine operations. Those in-migrating employees are projected to have an average of 2.46 people per household (Section 3.9, Page 14) and I assume that some of the 1.46 non-employees in those households will be school children. In 2016, the average wages earned by Montana mine workers was $60,190 (Section 3.9, Page 4) or over 300% of the current per-capita personal income of the area (Section 3.9, Table 3). When these individuals and families spend their earnings and pay their taxes the entire area will benefit.	Thank you for your comment.
BBC00107	2	Mark Cheshier		Email	I would like to provide comments regarding the incredible economic boost the Black Butte Copper Project will bring to Meagher County. In reviewing the socioeconomic portion of the DEIS (3.9) it is abundantly clear that Meagher County is in dire need of the economic stimulus that the BBCP could provide. Meagher County ranks in the bottom categories of nearly every measurement in the socioeconomic analysis area. In looking at the five measures used in the analysis, unemployment, average earnings per job, per capita personal income, and families with income below the poverty level, it is clear that the DEQ made the right conclusion. The data indicates a "less healthy economy" in Meagher than that of the surrounding counties (3.9-5). With the median wage in MT being $32,750 in 2016 (Montana DLI 2016), any new mining jobs anywhere in our state will raise that very poor number. This is due to the average median wage of a mining sector job being nearly double the state's median wage at $60,190 (3.9-4). These are just the kinds of jobs that a county like Meagher needs. With an aging demographic that is ten years higher than the states' median age (3.9-3), the skilled labor positions making family wages will lower that number and significantly contribute to the goals of the White Sulphur Springs Growth Policy articulated on page (3.9-9). While there are certainly going to be some front-end strains on public infrastructure and services with the influx of these skilled workers (3.9-17), the Hard Rock Impact Plan will help prepare Meagher County for these stresses through the prepayment of Metal Mine License Taxes. Once up and running, the county is estimated to receive 1.4 million a year in these taxes on top of an additional 8 million in taxable valuation at peak copper production (3.9-17). This project will be an incredible stimulus for Meagher County. My hope is the DEQ gets	Thank you for your comment.

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					through the public review process as quickly as possible to give Sandfire a permit and get this project into construction.	
BBC00210	4	Sandra Salisbury		Email	Please approve the proposed project. The Black Butte Project will protect the environment, create some great jobs, benefit the area with spending on main street and increase the needed tax revenue at both the local and state level. If this project is vetoed by people who do not live in Meagher County, perhaps this lost revenue by the governments and the local individuals should be considered a "unlawful taking" by the state government. Lost revenues should then be paid to the local governments and the Meagher residents. Monies could be raised by a tax (user fee) on floats, sportsmen/women and a general recreation tax place on all those living in other counties. Just a rough idea but it could refined as necessary.	Thank you for your comment.
BBC00222	2	Jed Munday		Email	The Socioeconomic Section 3.9 does a good job of underscoring the need for this project in Meagher County. The area has seen out-migration of young families due to the lack of jobs that can pay a family sustaining wage and include full benefit packages providing good family insurance, ample vacation and personal days, contributions to retirement plans, wellness programs, etc. The population of Meagher County has decreased over the last decade and those that have remained in the area are faced with a per-capita income that is 30% less than the Montana average (Section 3.9, page 5, table 3). Thank you for including in the Draft EIS a thorough discussion of the area's quality of life (Section 3.9, pages 1 through 11). This analysis clearly shows that the vitality of the area is compromised with the lack of economic development and that the impacts go far beyond paychecks. As the Draft EIS notes, "Health and quality of life are dependent on a number of factors, particularly access to education, public services, healthcare, recreation, and social services." The Draft EIS also correctly states that, "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)." The average income of miners in Montana, $60,190, is nearly double the income of the average job in Meagher County (Section 3.9, page 4) and would be a huge game-changer for the individuals and the families that call the area home. The Black Butte Project will directly employ 235 individuals and another 151 would find employment with contractors or other employers servicing the mine (Section 3.9, page 13, Table 9). Goods and services purchased by the miners themselves throughout the local area and state will create additional jobs for Montanans. In addition, taxes that will be paid by the mining company while in production will add millions to local government coffers. For instance, the metal mines tax is estimated to be $4 million per year to the State of Montana (Section 3.9, page 17) with over $1.4 million of that amount to be distributed to Meagher County each year during the projected 11 years of production. Thankfully, the unique-to-Montana Hard Rock Mining Impact Act, the local area will be able to prepare for the influx of workers. The provisions of this act, as spelled out in Section 3.9, page 17, are intended to mitigate fiscal impacts of	Thank you for your comment.

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					a hard rock mineral development and assist affected local governments in preparing for, and mitigating, area fiscal and economic impacts.	
BBC00222	4	Jed Munday		Email	I have worked the mining industry for 15 years at several different properties across Montana. But due to a lot of the cut backs in the industry here in Montana in past years I have been forced to look for work else where. I would like to get back to work in the mining industry here in Montana again. With this being a new mine and creating so many new jobs I hope to be part of the project in some way in the near future. Mines create great jobs for people and it does a lot of good for local communities along with the state of Montana. Mining can be done safely for the people, the communities, the state of Montana, and the environment too!	Thank you for your comment.
BBC00413	2	Mark Ahlborn		Email	Much has already been made by opponents of this proposal to largely unsubstantiated adverse impacts to the area's socioeconomic and recreational opportunities which can broadly summarized in one category – the Smith River. Having floated the Smith many times, both pre and post lottery, I have always enjoyed the float, the fishing and the overall experience. However, those of us who do know the river must acknowledge that just because there is 60 miles between put in and take out does not mean there is 60 miles of pristine wild river. There are homes and cabins, working and dude ranches, and all manner of recreation seekers. So it must be noted that the Smith is already an impacted stream, a victim of its own popularity.	Thank you for your comment.
BBC00440	1	Jeff Buszmann	Streamline Appraisals, LLC	Email	Montana has been abused time and time again by mining companies. We have several large superfund sites that the taxpayers of Montana are on the hook for and we don't need another. If we can't learn from our past mistakes, we will fail. The few jobs this might create are temporary and the profits will leave the area immediately. The risks way out weigh the benefits and in no way should this mine move forward. Thinking this time will be different is the definition of insanity: doing the same thing over and over and expecting different results.	DEQ takes seriously its purpose to thoroughly review the Proponent's Project as set forth in its operating permit application to determine whether the proposed operating and reclamation plans comply with the Montana Air Quality Act, the Montana Water Quality Act, and the MMRA.
BBC00503	2	Tim and Joanne Linehan	Linehan Outfitting Company	Email	My wife and I own Linehan Outfitting Company and have been in business for 27 years as a Montana fly fishing outfitter. Our life and business relies on the absolute health of Montana's rivers and streams. Montana's outdoor industry and the economic driving force that surrounds it are critically important to small, family owned businesses. As a body, the resident and non-resident recreationists that enjoy the Smith River, make a living oaring its currents, and enjoy multi-generation family experiences, deserve more of an opportunity to comment on the draft EIS for the following reasons.	DEQ acknowledges the outstanding outdoor recreational opportunities afforded by Montana's rivers and streams and recognizes their economic contribution. Recreation and use of the Smith River are addressed in Sections 3.7, Land Use and Recreation, and 3.8, Visuals and Aesthetics, of the EIS. Socioeconomic resources are addressed in Section 3.9, Socioeconomics. The Final EIS has been amended to include publicly available information on the economic contribution of the outdoor recreation industry, particularly the contribution attributable to the Smith River. DEQ does not predict contamination/pollution of the Sheep Creek or any other surface water. See Section 3.4.3.2, Proposed Action, Section 3.5.3.1, Surface Water Quantity, and Section 3.5.3.2, Surface Water Quality and Temperature, of the EIS. Process water discharged to surface waters via the UIG would be treated to avoid impacts. Although contamination/pollution is not predicted, DEQ is requiring operational monitoring to verify that surface waters are being protected. See Section 6 of the MOP Application. Public participation is addressed in Section 1.6.1, Public Participation, of the EIS. Also, see Consolidated Response MEPA-1.

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BBC00505	2	Todd O'Hair	President & CEO Montana Chamber of Commerce	Email	Simply put, this copper mine is set to deliver economic opportunity for central Montana and the state overall. Some of the benefits include: - employment for up to 200 people during the mine's consturction phase; - 204 full time jobs and 50 full time contractors during its operational phase; - approximately $218 million of direct investment in mine construction, according to the Pre Economic Assessment (PEA); - significant revenue for Meagher County and the State of Montana in the form of production taxes and single income taxes, including a countywide taxable value increase of more than $20 million during operation; - projected annual retail sales increase of $3.4 million in Meagher County during the life of the mine.	Thank you for your comment.
BBC00505	4	Todd O'Hair	President & CEO Montana Chamber of Commerce	Email	The Montana Chamber of Commerce is a not-for-profit, 501 (c)(6) and member-driven organization, representing small mom-and-pop operations to large companies, from retail to manufacturing to tourism to agriculture. Envision 2026, the Montana Chamber's 10-year strategic plan for Montana's future, endorses responsible natural resource development to bolster our state's economy.	Thank you for your comment.
BBC00507	1	Becky Townsend	Executive Director Meagher County Stewardship Council	Email	The Meagher County Stewardship Council is a non-profit citizens group that champions the long-term environmental, cultural, and economic interests of county residents, and advocates for a vibrant and sustainable future for all of Meagher County. The Council is to be open to the public, the voice of the community, and will act on the interests and concerns of the citizens of Meagher County. The Council is invested in ensuring that Sandfire Resources America, Inc. is held to the highest standard and that Black Butte Copper has a net positive impact on the community. The Council is made up of 11 members: Chad Evans (Rocking C's Ranch-Manager), Dan Vermillion (Sweetwater Travel Company), David Voldseth (Ranch Owner), Gordon Doig (Community Leader), Jay Kolbe (Wildlife Biologist, MT FWP), Katie Boedecker (Council Chair and General Manager, Showdown Montana), Lacey Rasmussen (Meagher County Conservation District-District Administrator), Megan Shroyer (MT President for Northwest Farm Credit Services), Nicolle Sereday (Pharmacist, Owner of Castle Mtn Drug & Castle Mtn Grocery), Rob Brandt (CEO, Mountainview Medical Center), Ron Burns (Rancher/Ranch Manager for Canyon Ranch), Sarah Calhoun (Owner, Red Ants Pants) and Becky Townsend (Executive Director of Meagher County Stewardship Council and Rancher). The Council has been aided in its organization by Bill Bryan of One Montana, Jackson Rose (MSU Grad Student), and Julia Haggerty (MSU Geography Professor).	Thank you for your comment.
BBC00539	2	Evan Youngblood		Email	As a guide on the Smith River, I can personally attest to its value to the state both economically and culturally. In recent research, the Smith has been shown to bring approximately $10 million in revenue to the state annually. This includes wages for guides like me, money spent in the town of White Sulfur Springs, and tax revenue that directly benefits the state. In addition, the Smith River is an incredibly popular float that is shared by many Montanans every year. It's popularity has led to it being the only permitted river in Montana and it is easy to see why. Soaring limestone walls, peregrine falcons, and abundant	DEQ acknowledges the outstanding recreational opportunities afforded by the Smith River and recognizes its economic contribution. Recreation and use of the Smith River are addressed in Sections 3.7, Land Use and Recreation, and 3.8, Visuals and Aesthetics, of the EIS. Socioeconomic resources are addressed in Section 3.9, Socioeconomics. The Final EIS includes publicly available information on the economic contribution of the outdoor recreation industry, particularly the contribution attributable to the Smith River.

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					brown and rainbow trout make this river a truly special place that we need to preserve for generations of Montanans to enjoy.	
BBC00616	2	Jes Falvey		Email	1. The Smith River generates $10 million in annual economic activity to the State of Montana. The Outdoor Recreation Industry generates $7 billion in state revenue. 2. Outfitters will launch 73 of 1,361 total Smith River permits in 2019. Outfitters create Montana jobs, are responsible stewards, and the money they generate stays in the state and has a substantial ripple effect on the economy—airfare, hotels, travel, etc. 3. Sandfire is an Australian-owned mining company that will pocket the lionshare of profits and cut-and-run when profitability ceases. 4. $50 million in Montana tax dollars already goes to mine clean-up. Do we want to add a failed mining experiment on the Smith River to the list, at the cost of existing, perpetual Montana jobs? 5. Sandfire has been clear about expanding and growing the operation into a 50-year mining district. The DEIS should evaluate the entirety of the project and its potential impacts, and not allow Sandfire to segment the analysis.	DEQ takes seriously its purpose to thoroughly review the Proponent's Project as set forth in its MOP Application to determine whether the proposed operating and reclamation plans comply with the Montana Air Quality Act, the Montana Water Quality Act, and the MMRA. DEQ acknowledges the outstanding recreational opportunities afforded by the Smith River and recognizes its economic contribution. Recreation and use of the Smith River are addressed in Sections 3.7, Land Use and Recreation, and 3.8, Visuals and Aesthetics, of the EIS. Socioeconomic resources are addressed in Section 3.9, Socioeconomics. The Final EIS has been amended to include publicly available information on the economic contribution of the outdoor recreation industry, particularly the contribution attributable to the Smith River. The provisions of the Montana Hard Rock Mining Impact Act, as referenced in Section 3.9, Socioeconomics, of the EIS, are intended to mitigate fiscal impacts of a hard rock mineral development and assist affected local governments in preparing for, and mitigating, area worker influx, infrastructure needs, and fiscal and economic impacts. See Consolidated Responses CUM-1 and FIN-1.
BBC00628	2	Susan Thomas		Email	My second concern is transportation, both the hauling of ore in sealed containers down the Shields Valley and/or through the narrow Deep Creek Canyon to Townsend. The potential for acceidents, leekage, damage to the containers and spills along these routs and the proximity of the rivers is of concern. All of our roads around LIvingston are seeing an increase in traffic and the population of our town is projected to keep increasing during the life of this mine. I therefore think your estimates for increased traffic, based on previous year's traffic, seems too low. Also, even though Hwy 89 has been widen and now has shoulders in places where there were none, the highway still has no dedicated turn lanes. As traffic increases, I could see this becoming a huge problem with 18 heavy trucks hauling ore to town. And what happens when the weather is so hazardous that they can't haul ore? Does that mean somedays will see double or triple the truck traffic? There is also the problem of Hwy 90 closures due to high winds in Livingston. This backs traffic up on Hwy 10, the same route these ore trucks would be taking, and there are no turn lanes for any vehicles making right of left turns off Hwy 10. This includes the at-grade railroad crossing which these trucks would be using. The potential problems this traffic would cause along that route to and from our hospital is worrisome.	The risk of spills is addressed in the response to Submittal ID HC-003, Comment Number 31. The response to Submittal ID PM2-11, Comment Number 4 addresses weather closures. As indicated in Section 3.12.2.1, Existing Road Network, of the EIS, Highway 89 traffic volumes are low. Project-related traffic would not result in congestion, as indicated in Section 3.12.3.2, Proposed Action, and Proponent's traffic study (Abelin Traffic Services 2018).
BBC00660	1	Jackie Singer		Email	Montana's major resource is natural beauty, clean water and clean air. The tourist industry is critical to the state's economy. No one will be trout fishing on the Smith River when it is contaminated with toxins from the Sandfire mine. The Smith River generates $10 million in annual economic activity to the State of Montana. The Outdoor Recreation Industry generates $7 billion in state revenue. Further, outfitters will launch 73 of 1,361 total Smith River permits in	DEQ takes seriously its purpose to thoroughly review the Proponent's Project as set forth in its MOP Application to determine whether the proposed operating and reclamation plans comply with the Montana Air Quality Act, the Montana Water Quality Act, and the MMRA. DEQ does not predict contamination/pollution of the Sheep Creek or any other surface water. See Section 3.4.3.2, Proposed Action, Section 3.5.3.1, Surface

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					2019. Outfitters create Montana jobs, are responsible stewards, and the money they generate stays in the state and has a substantial ripple effect on the economy—airfare, hotels, travel, etc. The draft EIS should evaluate any potential impacts to this burgeoning and sustainable industry. Sandfire is an Australian-owned mining company that will pocket the lionshare of profits and cut-and-run when profitability ceases. Please look to the future and protect the environment from industrial contamination. It is really appalling that a copper mine is even being considered. This must be stopped!	Water Quantity, and Section 3.5.3.2, Surface Water Quality and Temperature, of the EIS. Process water discharged to surface waters via the UIG would be treated to avoid impacts. Although contamination/pollution is not predicted, DEQ is requiring operational monitoring to verify that surface waters are being protected. See Section 6 of the MOP Application. DEQ acknowledges the outstanding recreational opportunities afforded by the Smith River and recognizes its economic contribution. Recreation and use of the Smith River are addressed in Section 3.7, Land Use and Recreation, and Section 3.8, Visuals and Aesthetics, of the EIS. Socioeconomic resources are addressed in Section 3.9, Socioeconomics, of the EIS. The Final EIS has been amended to include publicly available information on the economic contribution of the outdoor recreation industry, particularly the contribution attributable to the Smith River. See Consolidated Response FIN-1.
BBC00804	1	Cathy Baumbauer		Email	I have followed the discussion on the proposed Black Butte Mine, and taken the tour they offer on a monthly basis. It was very interesting, but I support the Trout Unlimited position. However, that is not why I am writing. During the tour of the proposed mine site, Jerry Zeig said there will be semi-trucks with tanks of “copper slurry” going to Livingston or Townsend 24 hours a day, 7 days a week, all year round. They will transport the slurry to a railroad so it can be shipped to the west coast for overseas processing. In the discussions of the impact of the mine, I have not heard anyone questioning the effect of this truck traffic on two lane highways through farm and ranch country, and/or National Forest. The obvious problems are: - increased traffic which raises danger for farm equipment moving along the road - high school drivers traveling to and from school and events will have to negotiate these large trucks - serious wear and tear on the highway surface - the need for more winter maintenance to accommodate increased truck and employee traffic - the high potential for environmental damage as a result of crashes and/or spills, particularly in the National Forest. Please take these ripple effects into consideration when making a decision on the mine. They are not specific to the mine itself, geographically, but they are legitimate concerns that result from the mine’s development.	The EIS (Section 3.12.3.2, Proposed Action) addresses the capacity of the rural highways to handle the mine traffic without resulting in congestion. Safety concerns have not been identified, except at the intersection of Sheep Creek Road and Highway 89, where improvements are needed to increase sight distance. All drivers, including teens and farm equipment, would continue to share the road with a modest increase in volume and an increase in truck traffic. This increase is proportionally high (compared to existing traffic), but still modest in comparison to the capacity of the roadway to accommodate traffic. The risk of spills is addressed in the response to Submittal ID HC-003, Comment Number 31. In addition, description of the concentrate as a “slurry” appears to have been an error. The copper concentrate would contain approximately 10 percent moisture after dewatering and being sent through a filter press, which is roughly equivalent to damp sand.
BBC00932	2	Andy Johnson		Email	The project proposed by Tintina Montana Black Butte Copper Project will be a significant economic boost for this area of Montana and I strongly recommend it be allowed to proceed as planned.	Thank you for your comment.
BBC00944	1	Taya Cromley		Email	The transportation study outlined in the draft EIS is insufficient and requires greater analysis, specifically the proposed route to transport ore to Livingston via highway 89. The transportation study took data at 0.5 mile south of U.S.	The EIS relied on traffic data available from MDT. The Final EIS includes traffic counts for U.S. Route 89 in Wilsall and Clyde Park, as well as a traffic count location 6 miles south of Ringling. Generally, traffic volumes increase along U.S.

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					Route 12 and south of the Yellowstone River bridge. These two points do not account for the daily commuting that occurs between the three communities that exist within these two data collection points: Ringling, Wilsall, and Clyde Park. Many of the residents who live between these two data collection points both live and work in this area and use Hwy 89 for daily commuting and transport (as well as moving cattle). The transportation study does not account for the significant amount of daily commuting that occurs WITHIN this section of highway. This commuting activity, because it takes place within the two data collection points, would not be accounted for in the current study. This commuting It is not only adults who are commuting on this section of highway, but also children who either commute via Hwy 89 by bus and car to the Shields Valley Elementary School located in Wilsall or the Shields Valley high school in Clyde Park. The amount of traffic added by trucks transporting ore between the mine site and Livingston would significantly disrupt the daily commuting that occurs on this section of road, as well as put children and families at risk who commute each day to school along this section of highway. The study also does not account for additional traffic occurring in this area since approval of a large logging project in the Crazy Mountains (just north of Wilsall) in 2017. The increased number of logging trucks between Wilsall and the junction of Interstate 90 is missing from the 2016 data and needs to be analyzed if an informed decision is to be made.	Route 89 as the highway travels south, towards I-90. The Final EIS explains that the local communities would experience increased traffic, which may feel more acute in communities accustomed to low traffic levels, but the traffic volumes would not result in traffic congestion.
BBC00947	1	Fred Thomas	Montana State Senate	Email	As Montana State Senate Majority, we are writing to you today in support of Black Butte Copper project. This mine will provide Montana with 240 high quality jobs for the next 14 years. We ask for your support of the project by distributing the proper permits required for keeping the progress on track. Black Butte mine places equal importance on protecting Montana’s environment, while being economically sustainable source of income for the state. In 2017, Mental Mines Gross Proceeds for Tax Collections totaled $16.7 million; Black Butte Copper project would significant increase this revenue. According to the Montana Business Assistance Connection, the countywide taxable value may quadruple, to approximately $12 million. Furthermore, the average wage at the mine would be $65,000 per year for the new 240 employees. THis number does not include the more than 20 contractors and businesses this project would employ. Black Butte mine has assured they would be focused on hiring local Montanans to fill these high quality jobs.	Thank you for your comment.
BBC00960	4	Max Hjortsberg	Park County Environmental Council	Email	Transportation The proposed BBC mine will affect Park County directly if Livingston is chosen as the proposed railhead for ore being trucked from the mine site. There are serious environmental concerns regarding the proposed mine operation itself, and those issues, in the form of concentrated copper sulfide ore that will be subsequently traveling through Park County on a daily basis for approximately 15 years, and up to 50 years if the mine operations are expanded. If Livingston is the chosen railhead, haul trucks will travel down Highway 89 through the Shields Valley and right through the Main Street and the heart of the communities of Wilsall and Clyde Park. This type of traffic will pose	Regarding specific communities, see the response to Submittal ID BBC00944, Comment Number 1. Spills are addressed in the response to Submittal ID HC-003, Comment Number 31. Weather closures are addressed in the response to Submittal ID PM11-2, Comment Number 4. The sealed shipping containers would be transferred directly from trucks to railcars, avoiding any need for material handling at the rail yards.

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					serious health and safety concerns for everyone who lives and works in northern Park County and Livingston. In Section 3.12.1.2 of the DEIS it suggests that, "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)." We believe that because of the very nature of these rural roads the impacts from increased traffic will be profound and have an even greater effect on the areas and communities the roads pass through. The DEIS does not even recognize, or take into consideration that these routes are often the only road between communities, the only way to access homes. If an accident were to occur that blocks the highway emergency personnel would be cut of from responding to an emergency call. In fact, entire communities could be isolated in this respect. The DEIS needs to recognize and address this matter. An all too familiar picture from the Bakken Oil Fields in eastern Montana and North Dakota comes to mind when thinking about the impacts of heavy industrial traffic moving through small, rural communities and along two-lane highways. It is no stretch of the imagination to presume a similar impact to the towns and roads on the chosen haul route to become equally congested and as dangerous as they are in the Bakken. All of the proposed transport routes repeatedly cross and/or run next to streams and rivers. The proposed route on Highway 89 through the Shields Valley crosses the Shields River and its tributaries multiple times. The concentrated copper ore being transported poses a serious risk, especially to aquatic environments, which the DEIS completely ignores. The DEIS states in Section 3.12.3.2 that the copper ore concentrate will be transported in enclosed shipping containers, stating "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." This statement is vague in its language and offers no important detail with regard to the integrity of the containers in question. The DEIS needs to address the potential impacts from an accident "severe" enough to cause a spill, especially if that accident were to occur next to a waterway, or other sensitive environment. The DEIS will need to address the impacts of heavy industrial traffic on an already congested at grade railroad crossing and major travel route in Livingston. Ore truck traffic traveling from the north to Livingston will need to access the Montana Rail Link (MRL) facilities via the Bennet Street crossing off of East Park Street. Major traffic studies have evaluated the issues of Livingston's railroad crossings and documented increased congestion already at the existing crossings due to growth in the city and increasing tourist and commercial traffic. Little room exists currently at the Bennet St. crossing for west bound vehicles waiting for passing train traffic. The addition of ore trucks to this congestion, with no feasible alternative crossing location in Livingston, would exacerbate the existing issues and cause traffic to be backed up and halted while waiting	

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					for the crossing to clear. This situation could impact emergency vehicle traffic and public health and safety as East Park St. and Highway 89 routinely experience heavy traffic and delays when Interstate 90 is closed due to frequent high winds in the Livingston area. This is also the primary route to our hospital, Livingston Healthcare. Additionally, the route will take the heavy truck traffic from Bennett St. to Gallatin St., which is a residential street, and the only access to the NW neighborhood of Livingston. Increased congestion, related air pollution and noise (not to mention negatively affecting property values) from this traffic has the real potential to disrupt the quality of life for residents of this neighborhood who moved there, and live there, with the assumption that a major shipping and receiving operation was not a part of the fabric of that neighborhood. The DEIS needs to take into more consideration the current remediation status of the MLR railyard when evaluating the potential for using Livingston as the designated railhead. The Livingston rail yard was until August, 2017 classified as State Superfund site. Using the Livingston MRL rail facilities as a railhead for offloading hazardous materials in the form of concentrated copper ore could have the potential to add negative and adverse conditions to a site already undergoing extensive cleanup and remediation resulting from a legacy of environmental neglect.	
BBC00960	6	Max Hjortsberg	Park County Environmental Council	Email	Local government, including County Commissioners, City Commissioners, Town Councils, City Managers and Mayors, and Emergency Response Officials along any and all haul routes and railhead locations need to be engaged and aware of the ongoing permitting process and included in all communications and decisions relating to any and all future mine operation plans and activities that will impact neighboring communities. According to Chapter 6 of the DEIS, no one in Park County, or the Cities of Wilsall, Clyde Park and Livingston (as well as Townsend) have been consulted regarding the impacts, and the potential thereof, to the health and safety of our communities. Coordination and communication with neighboring counties and communities need to occur prior to any mine operations and before subsequent mine traffic commences.	Chapter 6, Consultation and Coordination, of the EIS addresses this topic. Section 3.12, Transportation, of the EIS discloses the Project’s potential traffic impacts in Livingston, Montana, as well as in Wilsall and Clyde Park, as part of the U.S. Route 89 corridor.
BBC00966	1	Matthew Ellsworth	American Exploration and Mining Association	Email	The American Exploration & Mining Association (AEMA) appreciates the opportunity to submit unique comments on the Montana Department of Environmental Quality (MDEQ) Draft Environmental Impact Statement (DEIS) for the proposed Black Butte Copper Mine Project proposed by Tintina Montana, Inc. When the world-class mine is operating, it will support 240 full-time employees and up to 50 full-time contractors. These jobs will provide a significant and positive economic foundation for Meagher County and Central Montana in an environmentally responsible manner. Current and future local hires will remain critical in helping ensure a stable work force and supporting the local economy. These jobs are critical to the rural areas of Montana. Furthermore, the mine will produce critical and strategic minerals helping to secure the American manufacturing supply chain and reduce dangerous dependence of foreign sources.	Thank you for your comment.
BBC00967	2	Katie Gaut		Email	While experts continue digging into details of the DEIS so that we can more specifically address deficiencies within the narrow scope of the analysis, there	DEQ acknowledges the outstanding recreational opportunities afforded by the Smith River and recognizes its economic contribution. Recreation and use of the

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					are a number of issues that stand out. As the public weighs-in on the DEIS in comments to DEQ, there are a number of things to consider: 1. The Smith River generates $10 million in annual economic activity to the State of Montana. The Outdoor Recreation Industry generates $7 billion in state revenue. 2. Outfitters will launch 73 of 1,361 total Smith River permits in 2019. Outfitters create Montana jobs, are responsible stewards, and the money they generate stays in the state and has a substantial ripple effect on the economy—airfare, hotels, travel, etc. 3. Sandfire is an Australian-owned mining company that will pocket the lionshare of profits and cut-and-run when profitability ceases. 4. $50 million in Montana tax dollars already goes to mine clean-up. Do we want to add a failed mining experiment on the Smith River to the list, at the cost of existing, perpetual Montana jobs?	Smith River are addressed in Sections 3.7, Land Use and Recreation, and 3.8, Visuals and Aesthetics, of the EIS. Socioeconomic resources are addressed in Section 3.9, Socioeconomics. The Final EIS has been amended to include publicly available information on the economic contribution of the outdoor recreation industry, particularly the contribution attributable to the Smith River. DEQ does not predict contamination/pollution of the Sheep Creek or any other surface water. See Section 3.4.3.2, Proposed Action, Section 3.5.3.1, Surface Water Quantity, and Section 3.5.3.2, Surface Water Quality and Temperature, of the EIS. Process water discharged to surface waters via the UIG would be treated to avoid impacts. Although contamination/pollution is not predicted, DEQ is requiring operational monitoring to verify that surface waters are being protected. See Section 6 of the MOP Application. See Consolidated Response FIN-1.
BBC00968	1	Ronda Wiggers		Email	My comments are primarily focused on the socioeconomic portion of the DEIS (3.9). Having had the opportunity to work with the County Treasurer, the Commissioners, local ranchers and those involved in this project, it is abundantly clear that Meagher County is in need of the economic stimulus that the mine will provide. With the median wage in MT being $32,750 in 2016, any new mining jobs anywhere in our state will raise that number. This is due to the average median wage of a mining sector job being nearly double the state's median wage at $60,190 (3.9-4). These are just the kinds of jobs that Meagher County needs. With an aging demographic that is ten years higher than the states' median age (3.9-3), the people employed by this project, and their families will lower this number. With wages high enough to support a family, young skilled labor and their families will likely move to the area, significantly contributing to the goals of the White Sulphur Springs Growth Policy articulated on page (3.9-9). Unlike other industries, the mine will assist the County with the up-front strains on public infrastructure and services with the influx of these skilled workers (3.9-17), thru the Hard Rock Impact Plan and the prepayment of Metal Mine License Taxes. Once up and running, the county is estimated to receive 1.4 million a year in these taxes on top of an additional 8 million in taxable valuation at peak copper production (3.9-17). This is a huge economic boom to a county that is financially struggling. Along with increasing the county tax revenue, it will allow the property taxes to decrease for the area ranchers.	Thank you for your comment.
BBC00972	1	Jerry DeBacker		Email	I have a fair amount of experience with mitigation projects and corporate obligations having secured and stewarded conservation easements that allowed Agrium, Union Pacific Railroad, Monsanto, and Simplot to secure necessary permits. I am this week finalizing the sixth conservation easement required of Crown Resources for their gold mining activity, and its impacts on the watershed, in the Kettle River drainage of north central Washington state. I am old enough to know that these corporations do not do these mitigation obligations willingly, but instead were drug kicking and screaming to the table of societal responsibility.	DEQ takes seriously its purpose to thoroughly review the Proponent's Project as set forth in its MOP Application to determine whether the proposed operating and reclamation plans comply with the Montana Air Quality Act, the Montana Water Quality Act, and the MMRA.

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					Sandfire is an Australian-owned mining company that will pocket the profits and leave when profitability ceases. In Bellingham WA the community is still paying the expense of cleaning up a Georgia Pacific site- if we can't secure responsibility from an American company what might be the challenges of dealing with an Australian corporation? $50 million in Montana tax dollars already goes to mine clean-up. Do we want to add a failed mining experiment on the Smith River to the list?	
BBC00973	4	Jim Parker		Email	Finally, Sandfire is an Australian-owned mining company that will pocket the lionshare of profits and cut-and-run when profitability ceases. We have seen this from extractive industries in the past. $50 million annually in Montana tax dollars already goes to mine clean-up. I do not want to add a failed mining experiment on the Smith River to the list, at the cost of existing, perpetual Montana jobs. Do NOT agree to allow this operation to further deteriorate our pristine Smith River.	DEQ does not predict contamination/pollution of the Sheep Creek or any other surface water. See Section 3.4.3.2, Proposed Action, Section 3.5.3.1, Surface Water Quantity, and Section 3.5.3.2, Surface Water Quality and Temperature, of the EIS. Process water discharged to surface waters via the UIG would be treated to avoid impacts. Although contamination/pollution is not predicted, DEQ is requiring operational monitoring to verify that surface waters are being protected. See Section 6 of the MOP Application. See Consolidated Response FIN-1.
BBC00974	1	Riley Meredith		Email	• The Smith River generates $10 million in annual economic activity to the State of Montana. The Outdoor Recreation Industry generates $7 billion in state revenue. • Outfitters will launch 73 of 1,361 total Smith River permits in 2019. Outfitters create Montana jobs, are responsible stewards, and the money they generate stays in the state and has a substantial ripple effect on the economy—airfare, hotels, travel, etc. • Sandfire is an Australian-owned mining company that will pocket the lionshare of profits and cut-and-run when profitability ceases. • $50 million in Montana tax dollars already goes to mine clean-up. Do we want to add a failed mining experiment on the Smith River to the list, at the cost of existing, perpetual Montana jobs?	DEQ acknowledges the outstanding recreational opportunities afforded by the Smith River and recognizes its economic contribution. Recreation and use of the Smith River are addressed in Section 3.7, Land Use and Recreation, and Section 3.8, Visuals and Aesthetics, of the EIS. Socioeconomic resources are addressed in Section 3.9, Socioeconomics. The Final EIS has been amended to include publicly available information on the economic contribution of the outdoor recreation industry, particularly the contribution attributable to the Smith River. DEQ does not predict contamination/pollution of the Sheep Creek or any other surface water. See Section 3.4.3.2, Proposed Action, Section 3.5.3.1, Surface Water Quantity, and Section 3.5.3.2, Surface Water Quality and Temperature, of the EIS. Process water discharged to surface waters via the UIG would be treated to avoid impacts. Although contamination/pollution is not predicted, DEQ is requiring operational monitoring to verify that surface waters are being protected. See Section 6 of the MOP Application. See Consolidated Response FIN-1.
BBC00978	6	Bruce Farling		Email	The DEIS's section purporting to analyze transportation impacts is wholly unsatisfactory. For example: • The only data depicting daily traffic is from 2016 (Figure 3.12-1). There is no way to determine if data from this single year represents the average annual traffic volume on the select routes. The DEIS analysis should include several years data. It is also unclear if these data include local traffic within the select reaches, or, if it only covers traffic that moves from the select points, or intersections, that describe the routes. For instance, do these data cover daily local traffic, say, on Highway 89 between Wilsall and Clyde Park? • Because the DEIS concludes that a majority of the contractors and Tintina employees working at the mine, especially during the peak employment years, will not be living in White Sulphur Springs, it means they will be commuting	See Table 3.12-2 in the EIS for historic annual average daily traffic. Traffic data were taken at the specific count locations shown on Figure 3.12-1. The Proponent's traffic study assumed that most employee and contractor commuter traffic would occur between White Sulphur Springs and the mine site, including a Proponent-provided shuttle (Abelin Traffic Services 2018). Traffic study findings are briefly summarized in Section 3.12.3.2, Proposed Action, of the EIS. Section 3.12.2.2, Traffic Safety Data, of the EIS provides accident data for Highway 12 and notes the safety improvements installed by Montana Department of Transportation in 2016. Concerns about shipping container breakage are addressed in the response to Submittal ID HC-003, Comment Number 31.

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					from other communities. But the DEIS does not determine exactly from which communities, and thus it is impossible to conclude which routes in the region will be affected by the increased traffic associated with mine workers and their families. • The DEIS neglected taking a hard look at how the increase in daily truck traffic – 36 daily trips at least -- with half involving hazardous materials – could cause problems on particularly perilous road reaches, such as Highway 12 between Townsend and the top of the divide above Deep Creek. Deep Creek canyon is an extremely dangerous route, especially in winter with icy road conditions, marginal space between the road and the creek and many curves with limited site distance. It is not unreasonable to expect accidents with trucks hauling concentrate, especially during winter, in this reach over the life of the mine. The DEIS completely ignores evaluating winter conditions on Highway 12, including factoring in the increase in traffic that occurs during winter on weekends when skiers from Helena, Townsend and other communities use Highway 287 are headed to Showdown Ski Area. • The DEIS does not disclose any analysis on the integrity of the containers that will be used to ship the ore. For example, how will they fare should a truck overturn and the containers bounce off the rocky sidewalls of Deep Creek Canyon and into Deep Creek? This is not an unlikely possibility. • The DEIS does not include any spill response plan should trucks hauling concentrate topple into surface waters, including into Deep Creek or at crossings on the Shields River.	
BBC00978	8	Bruce Farling		Email	While it is certainly up to the residents of White Sulphur Springs and Meagher County to determine how much they want their communities to change, it certainly seems they would have been better served if the DEIS didn't leave some of the descriptions of impacts and mitigation to a draft Hardrock Mine Impact Act plan that is referenced but not included in the DEIS. Similarly, the DEIS should have included whatever constitutes Meagher County's growth management policy and plan. Besides enumerating potential effects on population, income and tax revenue, the DEIS should have detailed more specifically where workers and their families will be housed, how specifically local services (schools, law enforcement, fire, public water, etc.) will be affected, and how local businesses will benefit or be adversely affected. Including this information in the DEIS would certainly increase the comfort – or discomfort – levels of local residents as they attempt to evaluate the effects of this mine proposal.	Section 3.9, Socioeconomics, of the EIS addresses this topic. The provisions of the Montana Hard Rock Mining Impact Act, as referenced in Section 3.9, Socioeconomics, of the EIS, are intended to mitigate fiscal impacts of a hard rock mineral development and assist affected local governments in preparing for, and mitigating, area worker influx, infrastructure needs and fiscal and economic impacts. The Meagher County Growth Policy was reviewed and referenced in Section 3.9, Socioeconomics, of the EIS. The Final EIS has been amended to include more specific information regarding how the Project is consistent with the Meagher County Growth Policy.
BBC00991	1	Hayley Couture		Email	As a member of the Confederated Kootenai Salish Tribes and a geologist, I feel compelled to comment on the Black Butte Copper Project in central Montana. My Tribal heritage, and my own life experiences, has given me a deep connect and respect for our environment. I want to make sure we protect animals, plants and nature. However, I also want to make sure we give people opportunities to support themselves and their families. The Black Butte Copper Project was designed with the environment in mind and will provide more than 200 well-paying jobs. This project is a win for Montana in my mind. Tintina Montana has already spent more than $60 million to get their project to this point. This investment in Meagher County has had a positive impact on the	Thank you for your comment.

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					community. If the project moves forward, the company believes they will spend another $300 million to bring the Black Butte Copper into production and hire 240 full-time employees. These are stable, family-wage jobs and can help build a solid economic foundation across the region. Not only will Tintina Montana invest in the company and local businesses but employees will have more money to spend in the community. Tintina Montana can help build a strong local economy and that will benefit the entire community, whether they work for the company or not.	
BBC01003	1	Erica Evans Mita		Email	I oppose all mining permits near pristine habits, including the Smith River. My husband and I moved to Montana from New York City because of the outstanding outdoor recreation and wildlife opportunities that Montana still has to offer. Pristine, unpolluted environments are a rare resource that: • draw 12 million visitors annually to our State • directly supported 34,670 jobs statewide • generated $181 million in state & local taxes • lowered taxes on each Montana household by over $426 • The Smith River generates $10 million in economic activity alone. I am 100% against the SandFire mine. Montanans taxes are already covering $50 million of environmental cleanup from mines. Stating that the SandFire mine won't negatively impact the environment is not accurate - just look at the history of mining. No mines should be allowed to to diminish the great asset we have or the financial benefits of protecting it.	DEQ takes seriously its purpose to thoroughly review the Proponent's Project as set forth in its operating permit application to determine whether the proposed operating and reclamation plans comply with the Montana Air Quality Act, the Montana Water Quality Act, and the MMRA. The provisions of the Montana Hard Rock Mining Impact Act, as referenced in Section 3.9, Socioeconomics, of the EIS, are intended to mitigate fiscal impacts of a hard rock mineral development and assist affected local governments in preparing for, and mitigating, area worker influx, infrastructure needs and fiscal and economic impacts. DEQ acknowledges the outstanding recreational opportunities afforded by the Smith River and recognizes its economic contribution. Recreation and use of the Smith River are addressed in Section 3.7, Land Use and Recreation, and Section 3.8, Visuals and Aesthetics, of the EIS. Socioeconomic resources are addressed in Section 3.9, Socioeconomics. The Final EIS has been amended to include publicly available information on the economic contribution of the outdoor recreation industry, particularly the contribution attributable to the Smith River. DEQ does not predict contamination/pollution of the Sheep Creek or any other surface water. See Section 3.4.3.2, Proposed Action, Section 3.5.3.1, Surface Water Quantity, and Section 3.5.3.2, Surface Water Quality and Temperature, of the EIS. Process water discharged to surface waters via the UIG would be treated to avoid impacts. Although contamination/pollution is not predicted, DEQ is requiring operational monitoring to verify that surface waters are being protected. See Section 6 of the MOP Application. See Consolidated Response FIN-1.
BBC01010	3	Tomas M. Thompson		Email	• The Smith River generates $10 million in annual economic activity to the State of Montana. The Outdoor Recreation Industry generates $7 billion in state revenue. Further, outfitters will launch 73 of 1,361 total Smith River permits in 2019. Outfitters create Montana jobs, are responsible stewards, and the money they generate stays in the state and has a substantial ripple effect on the economy—airfare, hotels, travel, etc. The draft EIS should evaluate any potential impacts to this burgeoning and sustainable industry. • Sandfire is an Australian-owned mining company that will pocket the lionshare of profits and cut-and-run when profitability ceases. • $50 million annually in Montana tax dollars already goes to mine clean-up. Do we want to add a failed mining experiment on the Smith River to the list?	DEQ takes seriously its purpose to thoroughly review the Proponent's Project as set forth in its operating permit application to determine whether the proposed operating and reclamation plans comply with the Montana Air Quality Act, the Montana Water Quality Act, and the MMRA. The provisions of the Montana Hard Rock Mining Impact Act, as referenced in Section 3.9, Socioeconomics, of the EIS, are intended to mitigate fiscal impacts of a hard rock mineral development and assist affected local governments in preparing for, and mitigating, area worker influx, infrastructure needs, and fiscal and economic impacts.

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						DEQ acknowledges the outstanding recreational opportunities afforded by the Smith River and recognizes its economic contribution. Recreation and use of the Smith River are addressed in Sections 3.7, Land Use and Recreation, and 3.8, Visuals and Aesthetics, of the EIS. Socioeconomic resources are addressed in Section 3.9, Socioeconomics. The Final EIS has been amended to include publicly available information on the economic contribution of the outdoor recreation industry, particularly the contribution attributable to the Smith River. DEQ does not predict contamination/pollution of the Sheep Creek or any other surface water. See Sections 3.4.3.2, Proposed Action, Section 3.5.3.1, Surface Water Quantity, and Section 3.5.3.2, Surface Water Quality and Temperature, of the EIS. Process water discharged to surface waters via the UIG would be treated to avoid impacts. Although contamination/pollution is not predicted, DEQ is requiring operational monitoring to verify that surface waters are being protected. See Section 6 of the MOP Application. See Consolidated Response FIN-1.
BBC01054	2	Scott Bischke and Katie Gibson		Email	Please include these facts as part of registering our comments against permitting the Tintina operations (data provided by the Save our Smith Coalition of Concerned Montanans): 1. The Smith River generates $10 million in annual economic activity to the State of Montana, including the small town of White Sulphur Springs. The outdoor recreation industry generates $7 billion in state revenue. 2. Outfitters will launch 73 of 1,361 total Smith River permits in 2019. Outfitters create Montana jobs, are responsible stewards, and the money they generate stays in the state and has a substantial ripple effect on the economy—airfare, hotels, travel, etc.	DEQ acknowledges the outstanding recreational opportunities afforded by the Smith River and recognizes its economic contribution. Recreation and use of the Smith River are addressed in Section 3.7, Land Use and Recreation, and Section 3.8, Visuals and Aesthetics, of the EIS. Socioeconomic resources are addressed in Section 3.9, Socioeconomics. The Final EIS has been amended to include publicly available information on the economic contribution of the outdoor recreation industry, particularly the contribution attributable to the Smith River. DEQ does not predict contamination/pollution of the Sheep Creek or any other surface water. See Section 3.4.3.2, Proposed Action, Section 3.5.3.1, Surface Water Quantity, and Section 3.5.3.2, Surface Water Quality and Temperature, of the EIS. Process water discharged to surface waters via the UIG would be treated to avoid impacts. Although contamination/pollution is not predicted, DEQ is requiring operational monitoring to verify that surface waters are being protected. See Section 6 of the MOP Application.
BBC01061	2	Ronald C. McGlennen		Email	In this time when industries based outside of the United States enjoy unreasonable tax incentives to extract resources from our own country, it is therefore reasonable to look at the impact of the Black Butte mine from a global economic view. From research hosted by The National Science Foundation of China and reported by the American Chemical Society, the cost effectiveness of "urban mining" to reclaim copper and gold, principally from electronic waste, is "13 times less costly" than to extract ore for the same metals. A recent study from Tsinghua University Beizing, China shows that, with some government subsidies, urban mining in China could recover copper at less than US$2 a kilogram (2 pounds), which is less than a third of the international market price. It makes better economic sense to reclaim our own waste and bring those longstanding profits back to our state and community. By contrast, Tintina has failed to show their interest in doing the right thing for the environment, with their reliance on age-old approaches to extraction of ores from places far away from their corporate home. The simple fact that Tintina	Section 75-1-220(1), MCA, defines "alternatives analysis" as "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. For a project that is not a state-sponsored project, it does not include an alternative facility or an alternative to the proposed project itself." DEQ cannot consider "urban mining" in its analysis of the alternatives because it does not accomplish the same objectives as those included in the Proposed Action by the Proponent. See Consolidated Response FIN-1.

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					was compelled to change their corporate name to obfuscate their national origins, and to potentially hide the money trail from their proposed profits is typical of the hard-rock mining industry, in general. The same cryptic behavior has been shown by PolyMet, the Swiss-based mining interest seeking to develop copper mining in northern Minnesota. Additionally, the failure to pass the Montana referendum I-186 last November, which sought to ensure that the mining interest would at least do the right thing and secure the money to reclaim the site of their mining operations for perpetuity, was fought strenuously be Tintina and other industry advocates. Based on that history, the intentions to make right with Montana were made clear. We, as residents of this community expect that Tintina will take their profits and run, leaving us with the polluted mess in their wake.	
BBC01061	4	Ronald C. McGlennen		Email	The numbers speak for themselves. More the 10 million in revenue to the state of Montana and that amount is growing. Furthermore, the Outdoor Recreation Industry generates $7 billion in state revenue. Outfitters will launch 73 of 1,361 total Smith River permits in 2019. Outfitters create Montana jobs, are responsible stewards, and the revenues they generate remain in the state creating a ripple effect on the economy—airfare, hotels, travel, etc. The draft EIS should evaluate any potential impacts to this burgeoning and sustainable industry. So, doing the math, it is apparent that more jobs are created with the recreational industry that also seek to preserve of the Smith River then the temporary employment that the Tintina mine proposes, with the obvious risk to the environment, lifestyle and health of Montana at stake. Lastly, consider the stresses of our daily lives. Is it work the risk to compromise the natural treasure that is the Smith or any other Montana waterway, as a place of refuge and escape? Our citizenry say no. We say preserve the Smith from the insult of the Tintina mine. In summary, our family is opposed to the Tintina mine. We do entrust our environment, our economy, and frankly our national security to this foreign company to do the right things to preserve the Smith River. We thank you for the opportunity to make comments and we urge the Montana Department of Environmental Quality to require added study and analysis to the current findings within the environmental Impact Statement for the proposed Black Butte Mine.	DEQ takes seriously its purpose to thoroughly review the Proponent's Project as set forth in its operating permit application to determine whether the proposed operating and reclamation plans comply with the Montana Air Quality Act, the Montana Water Quality Act, and the MMRA. The provisions of the Montana Hard Rock Mining Impact Act, as referenced in Section 3.9, Socioeconomics, of the EIS, are intended to mitigate fiscal impacts of a hard rock mineral development and assist affected local governments in preparing for, and mitigating, area worker influx, infrastructure needs and fiscal and economic impacts. DEQ acknowledges the outstanding recreational opportunities afforded by the Smith River and recognizes its economic contribution. Recreation and use of the Smith River are addressed in Section 3.7, Land Use and Recreation, and Section 3.8, Visuals and Aesthetics, of the EIS. Socioeconomic resources are addressed in Section 3.9, Socioeconomics. The Final EIS has been amended to include publicly available information on the economic contribution of the outdoor recreation industry, particularly the contribution attributable to the Smith River. DEQ does not predict contamination/pollution of the Sheep Creek or any other surface water. See Section 3.4.3.2, Proposed Action, Section 3.5.3.1, Surface Water Quantity, and Section 3.5.3.2, Surface Water Quality and Temperature, of the EIS. Process water discharged to surface waters via the UIG would be treated to avoid impacts. Although contamination/pollution is not predicted, DEQ is requiring operational monitoring to verify that surface waters are being protected. See Section 6 of the MOP Application. See Consolidated Response FIN-1.
Wetlands						
HC-002	8	William Avey	USDA Forest Service	Hard Copy Letter	The maps of the groundwater modeling results in Appendix M only display out to the 10 foot contour for draw down and do not show the full spatial extent of lesser drawdown (0.01ft- 9.99ft). On National Forest lands adjacent to the project, decreases of as little as 1 to 2 feet of drawdown have the potential to impact wetlands and associated plant/wildlife habitat, as well as livestock watering from developed springs. Project development and operational	Section 3.4 of the EIS summarizes the potential impacts of the mine dewatering on the groundwater and surface water system in the Project area. Elements of the referenced analysis indicate that loss of base flow in the nearby creeks would be minimal, while the water table would be lowered more than 2 feet for thousands of feet around the mine workings. Those drawdowns and small loss of base flow are predicted to dissipate within a few years after completion of mine dewatering.

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					activities should not result in a reduction of wetland area or quality on National Forest lands.	It is unlikely that the drawdowns and the lateral extent of a cone of depression would be much larger than predicted by the groundwater model. However, if secondary impacts develop that are associated with the loss of wetlands from groundwater drawdown, the wetland monitoring during the construction, operations, and closure phases would capture the extent of the secondary wetland impacts. If the spring has a beneficial use and DEQ determines that a loss in the quantity of the water in the spring is caused by Tintina's mining operation, DEQ may order Tintina to provide the needed water immediately on a temporary basis and replace the water supply within a reasonable time. The springs associated with these wetlands on Forest Service lands are currently being monitored and would continue until DEQ determines monitoring is no longer required. Moreover, baseline groundwater monitoring indicates that 2 feet of seasonal fluctuations of the water table are now occurring and are within the typical range of seasonal groundwater fluctuations, so the predicted potential drawdown of groundwater by 2 feet would not permanently affect the groundwater-dependent wetlands, as indicated by existing conditions. The wetlands that are dependent on perched groundwater or surface water flow would not be affected by mine dewatering and are not expected to be affected from loss of stream base flow. Furthermore, it is not feasible to model accurate impacts of drawdown from a groundwater model to the 1-foot contour level.
HC-003	61	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS fails to adequately analyze the potential impacts of mine drawdown on wetlands in the project area. As Tom Myers discusses further in his comments on the Draft EIS, "lowering the water table in the bedrock could reduce the upward gradient . .. and make less water available" for wetlands. Exhibit 39 at 29. The Draft EIS agrees that "lowering groundwater elevations for Project operations," which is expected to occur due to dewatering of the mine void, "could result in a reduction of the primary water source for these wetlands." Draft EIS at 3.14-18; see also id. at 3.14-11 ("The wetlands delineated within the analysis area exhibit hydrology that is primarily groundwater-dependent."). The Draft EIS predicts, however, that any impacts to wetlands will be mitigated by water inputs to Coon Creek and the underground infiltration gallery. Draft EIS at 3.14-18. Inputs to Coon Creek are unlikely to mitigate wetland impacts, however, because the wetlands are fed by groundwater-not surface water in Coon Creek and Sheep Creek. See Draft EIS at 3.14-11. As to the underground infiltration galleries, the Draft EIS provides no modeling or other data to support its prediction that flow in these galleries will protect all wetlands impacted by mine drawdown. See Draft EIS at 3.14-18. The Draft EIS's prediction in this regard seems implausible, because a significant portion of the wetlands-in particular the wetlands adjacent to Little Sheep Creek-appear to be within the drawdown cone but far from the underground infiltration gallery. Compare Draft EIS at 3.14-10 with Draft EIS at 2-3. The EIS should provide a complete analysis of potential drawdown impacts to wetlands, including sufficient evidence to support DEQ's prediction that the proposed mitigation measures will prevent significant wetland impacts.	Mine dewatering would result in lowering groundwater levels within the Project area (LSA). Figures 3.4-9 and 3.4-10 in Section 3.4.1.5 of the EIS show model-predicted drawdowns in the shallow and deeper HSUs at mine Years 4 and 15, respectively. Groundwater and surface water modeling analysis indicates that loss of base flow in the nearby creeks would be minimal, while the water table would be lowered more than 2 feet for thousands of feet around the mine workings. Water inputs back to the groundwater and surface water from underground injection and the NCWR would mitigate these potential impacts (groundwater drawdown). It is acknowledged that lowering the water table for the duration of the operations phase of mining may impact some ecosystems, even if drawdown is less than 2 feet. However, in the Project area, ecosystems depend not only on groundwater (defined as water below the water table), but on perched water (which is water in the ground but above the regional water table). As such, lowering the regional water table, or deep groundwater associated with mine dewatering, has often only a limited effect on ecosystems. In instances where small, isolated wetlands exist outside the area affected by the underground injection of groundwater, and no perched water table is available, reduction in available groundwater could cause these wetlands to dry up. If this scenario occurs, these wetland areas would likely become dominated by upland vegetation during this drawdown timeframe. However, they likely would revert back to a wetland vegetation-dominated wetland after mining ceases and the water table rises to the baseline levels. However, if secondary impacts develop associated with the loss of wetlands from groundwater drawdown, wetland monitoring during the construction, operations, and closure phases would capture the extent of the secondary wetland impacts and the Proponent would be required to report the monitoring results with

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						USACE and DEQ, as conditions of both the Section 404 and 401 permits, and mitigation of these secondary impacts could be required.
BBC00589	42	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers	Email	The wetlands analysis area, shown in DEIR Figures 3.14-1 and -2, is rectangular. It includes only the lands leased for the Project (DEIS, p 3.14-1). This is completely inappropriate because wetland edges do not follow straight lines and the potential impacts to wetlands, especially that caused by drawdown, will also not follow a straight line. The survey identified approximately 328 acres of wetlands within the rectangular area, the majority of which are along Sheep Creek (DEIS, Figure 3.14-2).; existing modeling indicates (from DEIS conclusion) that "..... water inputs back to the groundwater and surface water from underground injection and the non-contact water reservoir would mitigate these potential impacts (groundwater drawdown)"	The wetland analysis area shown in Figures 3.14-1 and 3.14-2 of the EIS includes the 329 acres of wetlands and indicates the detailed polygons, separated by wetland type. These mapped wetlands resulted from the wetland delineation performed within the survey area where survey access was allowed by landowner permission. Further mapping by desktop interpretation and extrapolation could be completed to indicate approximate wetland locations beyond the study area; however, this level of detail would not be needed as adequate information was presented to evaluate direct and indirect wetland impacts. Within the wetland analysis area, only 0.85 acre of direct impacts would occur of the 329 acres of wetlands present. To compensate for the 0.85 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 ILF program. If an ILF is not a viable option for mitigation, then the Proponent would be required to address compensatory mitigation requirements through a permittee-responsible mitigation to the satisfaction of the USACE. Since no indirect impacts are anticipated within the wetland analysis area, mapping wetlands outside the wetland analysis area is not needed. Furthermore, if secondary impacts develop associated with the loss of wetlands from groundwater drawdown, monitoring wetlands within the wetland analysis area during the construction, operations, and closure phases would capture the extent of the secondary wetland impacts. The Proponent would be required to report the monitoring results to USACE and DEQ, as conditions of both the Section 404 and 401 Water Quality Certification permits, and wetland mitigation could be required.
BBC00589	43	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers	Email	The hydrology for the wetlands in groundwater-driven, meaning groundwater feeds the wetlands. The wetland areas are "too large of a surface area to exhibit wetland hydrology that is dependent on-stream flow" (DEIS, p 3.14-11). The wetlands depend on the upward flow of groundwater, as represented by the observed upward gradient in much of the groundwater, not infiltration of streamflow. Groundwater discharges into the wetlands from which some would evapotranspire, but neither the DEIS nor Hydrometrics (2016) accounts for this. The DEIS describes modeling of groundwater flow that is toward Little Sheep Creek and Sheep Creek, but does not acknowledge ET (DEIS p 3.14-11). Implied is that all groundwater reaching the riparian zone reaches the streams. Hydrometrics (2016) simulates groundwater discharge to the streams using the Stream boundary which accounts for flow in the streams. It does not account for ET, which means the DEIS also does not account for ET. Calibration is for stream flow, so it is not appropriate to suggest that the Stream boundary accounts for ET. The wetlands have not been modeled for this DEIS.	The groundwater modeling included the site-wide water balance data derived from the various baseline studies as described in Section 2.1, Climate, Meteorological Data, and Air Quality, of the MOP Application. The water balance determination included the meteorological-derived data, which included both precipitation and evaporation. The meteorological study generated long-term estimates of both precipitation and evaporation for the Project area. The MOP Application states, "Given the level of uncertainty in the evaporation estimates, as with the precipitation, the study applied the most conservative approach to the water balance analyses, and used the highest evaporation estimate (20.2 inches, 513 mm) for the Project site for modeling purposes." Although evapotranspiration was not directly included within the modeling calculations, the conservative estimates used for the evaporation parameter should also account for evapotranspiration. Moreover, existing modeling in the EIS 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." However, if secondary impacts develop associated with the loss of wetlands from groundwater drawdown, wetland monitoring during the construction, operations, and closure phases would capture the extent of the secondary wetland impacts, and the Proponent would be required to report the monitoring results with USACE and DEQ, as conditions of both the Section 404 and 401 permits, and mitigation of these secondary impacts could be required.

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BBC00589	44	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers	Email	Secondary wetlands effects (DEIS, p 3.14-17 to -19) would impact a much larger wetland area. Mine dewatering would have a most deleterious effect because it would cause drawdown or gradient that removes water from the wetland. Most immediately obvious on the streamflow reductions, the DEIS at least proposes a plan to replace the water lost from the streams. It completely dismisses the effect mine dewatering would have on wetlands (DEIS, p 3.14-18). Any wetland area that has drawdown will be impacted. As the water table lowers beneath a wetland due to drawdown, wetlands would have more difficulty accessing its necessary groundwater. At some point usually wetland species dependent, the wetland would dry up. However, it does not require even measurable drawdown to affect the flow of water into the wetlands. If there is reduced flow to the creek due even to a change in gradient, there would be much decreased flow to the wetlands along the creek. The wetlands discharge water as ET which would not show up as a loss to the river. The DEIS only presented drawdown to ten feet on its maps, but as discussed above, dewatering affects surface water, and wetlands, with a lesser drawdown. Simply lowering the water table in the bedrock could reduce the upward gradient, which the DEIS notes supports the wetlands, and make less water available. The DEIS grossly underestimates the impacts due to mine dewatering. The alluvial groundwater model simulated mounding due to discharge into the UIGs. This mounding may replace some of the water loss to the wetlands, but it is not analyzed that way. The only way to estimate an accurate drawdown impact to the wetlands is to complete a model that simulates both dewatering and UIG discharge with ET boundaries. Actual drawdown compared with wetland boundaries would show the impacts. Recommendation: Develop a detailed alluvial groundwater model that includes both wetland function simulated as ET and that simulates the effect of dewatering in the bedrock on the alluvium. The DEIS could provide a complete estimate of secondary wetland effects. Tintina could then prepare adequate mitigation plans.	Mine dewatering would result in lowering groundwater levels within the Project area (LSA). Figures 3.4-9 and 3.4-10 in Section 3.4.1.5 of the EIS show model-predicted drawdowns in the shallow and deeper HSUs at mine Years 4 and 15, respectively. Groundwater and surface water modeling analyses indicate that loss of base flow in the nearby creeks would be minimal, while the water table would be lowered more than 2 feet for thousands of feet around the mine workings. Water inputs back to the groundwater and surface water from underground injection and the NCWR would mitigate these potential impacts (groundwater drawdown). It is acknowledged that lowering the water table for the duration of mining may impact some ecosystems, even if drawdown is less than 2 feet. However, in the Project area, ecosystems depend not only on groundwater (defined as water below the water table), but on perched water (which is water in the ground but above the regional water table). As such, lowering the regional water table, or deep groundwater associated with mine dewatering, often has only a limited effect on ecosystems. In instances where small, isolated wetlands exist outside the area affected by the underground injection of groundwater, and no perched water table is available, reduction in available groundwater could cause these wetlands to dry up. If this scenario occurs, these wetland areas would likely become dominated by upland vegetation during this drawdown timeframe. However, they likely would revert back to a wetland-vegetation-dominated wetland after mining ceases and the water table rises to the baseline levels. Drawdowns predicted by the groundwater model and a small loss of base flow are predicted to dissipate within a few years after completion of mine dewatering. Further details on mine flooding and groundwater level recovery are provided in Section 3.4.3.2. It is unlikely that the drawdowns and the lateral extent of a cone of depression would be much larger than predicted by the groundwater model.
BBC00049	1	Deborah Johnston		Email	Thank you for analyzing and ultimately dismissing come of the alternatives presented to you during the public scoping process. It is apparent that the MDEQ and Tintina listened to the public comment, carefully analyzed the thoughts presented, acted on those ideas that had merit and did not act on those that would present more environmental harm than good. A good example of this is the suggestion in Section 2.4.1.5 - “Use Wetlands as Part of the Water Treatment System.” The suggestion that this is a better alternative than the treatment plant proposed by Tintina was studied by the MDEQ for environmental benefit. In Section 2.4.1.5, Page 20, the MDEQ rightfully maintains that there is no reason to assume that the treatment plant cannot be ‘maintained in operating order’ for as long as it is needed. The MDEQ also pointed out that wetlands are often only effective for ‘polishing’ waters primarily treated in an active system and that the effluent standards required by law would not be able to be met using this alternative.	As described in Section 2.3.2.5 of the EIS, this alternative (use of wetlands as part of the water treatment system) was not considered due to concern for wetlands not being able to remove all contaminants and discharge to wetlands would exceed MPDES discharge permit standards.

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Vegetation						
HC-002	2	William Avey	USDA Forest Service	Hard Copy Letter	The project area, and adjacent National Forest lands, include localized infestations of noxious weeds. The HLCNF would like assurance of a cooperative relationship with the project proponents to mutually address noxious weeds in the project area during the life of the project.	Under § 82-4-336(8), MCA, a reclamation plan must include provisions for vegetative cover appropriate to the future use of the land as specified in the reclamation plan. The re-established vegetation must meet county standards for noxious weed control. To comply with § 82-4-336(8), MCA, the Proponent submitted a "Noxious Weed Management Plan" (WESTECH 2016) for managing noxious weeds during the Project. Objectives of the noxious weed control plan include (1) coordination and consultation with designated county, state, and federal (where applicable) weed personnel regarding noxious weed control activities to ensure compatibility with existing weed control protocols and (2) responding to landowner and/or regulatory agency reports of weeds during reclamation. The noxious weed control plan would become an enforceable provision of the reclamation plan should the Proponent be issued an operating permit.
Terrestrial Wildlife						
BBC01012	6	Amy Seaman	Montana Audubon	Email	we would suggest estimating the potential extents of damages under each scenario rather than brushing off risks to wildlife as unlikely. There is not enough consideration of the consequences given failure to attain standards. The amount of research on wildlife appears minimal to support a no effect conclusion throughout the EIS. Riparian areas are disproportionately valuable to wildlife, and so adjacent habitat should not be assumed to be commensurate with habitat within the project footprint.	Reasonably foreseeable and/or potential environmental consequences and effects due to the Project have been analyzed in the EIS. The Final EIS includes additional information about the potential risks associated with the Project facilities or processes. Appendix R of the MOP Application (Failure Modes Effects Analysis) describes the failure analysis of Project facilities and processes (Geomin Resources 2015). Section 3.15, Wildlife, of the EIS describes that the Wildlife Analysis Area includes approximately 165 acres of riparian grass habitats, of which 1.4 acres (approximately 0.03 percent of the total analysis area) would be affected by the Project. Section 3.14, Wetlands, of the EIS describes that there would be approximately 0.85 acre of directly impacted wetlands as a result of the Project. Although terrestrial wild animals utilize riparian corridors and wetlands, this is a nominal impact level.
BBC01012	7	Amy Seaman	Montana Audubon	Email	• Analysis for the impact to wildlife regarding the sound and artificial lighting of the project are absent and should be considered to minimize potential impacts within the 1-2 mile area the EIS suggests would be affected by noise. This consideration should be taken into account for nesting raptor species, and other species assumed to be sensitive to noise disturbance.	Section 3.15, Wildlife, of the EIS includes an analysis of noise and light pollution on various wildlife species throughout the Project area, including those within 1 to 2 miles of Project activities. The Final EIS analyzes the effectiveness of noise mitigation measures proposed by the Proponent in the MOP Application, which includes: • 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 and operation 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.
BBC01012	8	Amy Seaman	Montana Audubon	Email	• Further consideration should be given to potential impacts caused by the increased amount of toxic surface water available to migratory birds and bats (additional bat information appears warranted for collection). Though project	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. Assessments of predicted water quality of the PWP

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					proponents suggest water salinity levels will not pose a threat to avian wildlife, and netting is proposed as a mitigation technique, no alternatives are considered in the event mortality is witnessed.	during Operations are provided in Sections 3.5.3.2, Surface Water Quality, and Section 3.15, Wildlife, of the EIS. The PWP would be drained at Closure. Predicted water quality of the PWP is slightly acidic, with concentrations of most water quality parameters predicted to be less than available DEQ numerical water quality standards. Minor exceptions were observed, where elevated concentrations were predicted for copper, nickel, lead, and zinc in operations. Note, the predictive model for the PWP is based on the principle of mass balance and, for example, does not include likely geochemical processes that would occur in situ to attenuate metal concentrations (e.g., sorption of metals to ferrihydrite, or metals removal via flocculation and settling of particulate matter). Thus, concentrations of these parameters may be overestimated. Ongoing operational monitoring has been proposed to validate model predictions and to identify potential impacts on water resources in a timely manner and trigger the implementation of operational changes and / or mitigation measures (Section 6 of the MOP Application). Section 3.6.7 of the MOP Application states, "The CWP is designed to collect 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." The CWP would normally store only a minimal volume of water during Operations. Section 3.15, Wildlife, of the EIS states that the brine cell (approximately 3 acres) of the CWP is the only exposed water feature that may contain potentially harmful constituents of concern. For that reason, the CWP brine cell is proposed to have bird netting to avoid avian and bat use of it.
BBC01012	9	Amy Seaman	Montana Audubon	Email	• Monitoring of wildlife during the project life should be proposed to evaluation assumptions of the mining permit.	Section 3.15, Wildlife, of the EIS does not identify any significant impacts on wildlife species due to the Proposed Action. As such, no additional monitoring would be required.
Water Resources						
PC-01	1	Cory Beattie		Public Meeting Comment Form	A. The project will dewater Sheep Creek, a stream on the 303d list of impaired streams for aluminum and E. Coli pollution. The dewatering will lead to higher temperatures, causing the E. Coli to become more prevalent. The project should not be developed unless they can do so without dewatering any of the nearby streams.	Section 3.5.3.1, Surface Water Quantity, of the EIS provides a discussion of the impacts that mine dewatering would have on the base flow of nearby streams (see the subsection titled "Dewatering Associated with Underground Mine Operations"). Groundwater model results indicate that base flow depletion would be approximately 2 percent of the total base flow in Sheep Creek. This is within analytical uncertainty of measurement and would be less than the limit established in non-degradation rules; see Consolidated Response WAT-4. As discussed in Section 3.4.2.5, Groundwater–Surface Water Interactions, of the EIS, under baseline (pre-mining) conditions, groundwater is discharging from the proposed mine site to Sheep Creek at a rate of about 3 percent of the base flow in the creek (Hydrometrics, Inc. 2016a). Sheep Creek base flow is primarily supplied by groundwater discharge, but the majority of this base flow (estimated 97 percent) discharges to Sheep Creek from groundwater in other portions of the watershed that would not be dewatered by the mining operation. Even if all the groundwater discharge to the creek around the proposed mine is eliminated due to the cone of depression from mine dewatering, the loss of base flow in the creek

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						would be 3 percent or less. This decrease in flow is within analytical uncertainty of measurement and would be less than the limit established in non-degradation rules. Such a small loss of base flow (approximately 3 percent or less) is highly unlikely to result in a rise of Sheep Creek's water temperature, nor would such a small change in base flow be expected to affect, directly or indirectly, algal and bacterial biomass (including *E. coli*). It is expected that the temperature of Sheep Creek would remain within the range of natural variation of the system. Management methods for preventing alteration of stream temperature as a result of discharge from the UIG include: (1) changing the depth the water is pulled from the TWSP; (2) managing the combined flows from the TWSP and treated groundwater; and/or (3) installing heat exchange unit(s). Discharges to the Sheep Creek alluvial UIG from the WTP and/or TWSP would offset any dewatering impacts on Sheep Creek. During summer months when discharges from these sources may not occur, stream flow depletion would be offset, if necessary, via discharge to Sheep Creek from the NCWR via the wet well. Impacts on surface water resources are not predicted. To confirm this prediction, the Proposed Action and AMA requires the Proponent to conduct groundwater and surface water monitoring. With respect to the issue of rising surface water temperatures, causing algal growth, and affecting fish populations, refer to Consolidated Response WAT-5.
PM1-05	2	Curtis Thompson		Public Meeting Transcript	The Draft Environmental Impact Statement fails to address the statistical certainty that this will contaminate adjacent waterways downstream, downgradient. Ultimately, the Smith River will be polluted. Maybe not in our lifetime, but it will happen. All hard rock mines in Montana history have polluted downgradient waterways. This Environmental Impact Statement is premised on the assumption that that will not happen here even though it has always happened.	See Consolidated Responses WAT-2 and CUM-3.
PM1-05	5	Curtis Thompson		Public Meeting Transcript	The Draft Environmental Impact Statement fails to address the impact on drinking water in the event of contamination.	A comparison of groundwater quality to Montana human health standards is provided in Section 3.4.2.6 and Section 3.4.2.7 of the EIS. Section 3.4.3.2 discusses water supply and drinking water quality at the mine site area. No impacts on surface water quality or groundwater quality are predicted during operations and post-closure of the Project (Section 3.4.3.2; Section 3.5.3.2 of the EIS).
PM1-06	2	Bonnie Gestring	Earthworks	Public Meeting Transcript	One of our primary concerns is that the Draft EIS significantly underestimates how much groundwater could flow into the underground tunnels during mining operations. An independent hydrologic review and model conducted by Dr. Tom Myers estimates that it could intercept two to three times the volume of groundwater that the Draft EIS predicts. This means that vastly more water will have to be captured and discharged into the infiltration trenches that are now being proposed directly adjacent to Sheep Creek. This volume of water would overwhelm the proposed infiltration system and result in the likely degradation of water quality.	See Consolidated Response WAT-1.

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PM1-06	4	Bonnie Gestring	Earthworks	Public Meeting Transcript	And what's particularly troubling to me is that the mining company and the Draft EIS are proposing a single monitoring site on Sheep Creek downstream from the mine. And if you look at the map, it looks like it's roughly over a mile downstream. Water quality impacts, particularly from seepage from leaking mine facilities, will simply not be identified in a timely manner.	Monitoring locations established for baseline studies and ongoing monitoring (Section 3.5.1, Analysis Methods, of the EIS) have been selected to provide the best quality data possible, including capture of potential effects from the Project. Upstream of SW-1, Sheep Creek is braided as it flows across an alluvial plain, and the unstable nature of the channel is not conducive for establishing a continuous monitoring gaging station. Note that water quality would be routinely monitored at multiple locations downgradient of the proposed mine facilities, and that these locations would be much closer to potential sources of seepage than site SW-1 on Sheep Creek. For example, treated water discharged from the mine to the infiltration gallery adjacent to Sheep Creek would be sampled before it is discharged. Seepage from the CTF, if it were to occur, would enter an engineered underdrain system beneath the facility, and the effluent from this drain would be monitored. Groundwater monitoring wells have been installed downgradient of the proposed mine facilities. Monitoring of these wells would identify contamination in groundwater, if it were to occur, before that water reached surface waters. Tributary watersheds to Sheep Creek in which mine facilities would be located would also be monitored for surface water quality. For example, the CTF and mill site would be located in the Brush Creek watershed, and surface water quality has been and would continue to be monitored in Brush Creek. Brush Creek is a tributary to Little Sheep Creek, which in turn is a tributary to Sheep Creek. Therefore, water quality impacts, if they were to occur, would be identified in a timely manner through the water quality monitoring program, which includes sampling locations very close to the proposed mine facilities. Site SW-1 on Sheep Creek would not be the nearest monitoring location to these facilities, but rather the farthest from them. The location was chosen because Sheep Creek enters a narrow canyon downstream of the Project area, causing groundwater beneath the creek to upwell and enter the stream above SW-1. Further upstream of SW-1, water discharged from the mining project into groundwater would not have entered the stream, and any potential water quality impacts from the Project on Sheep Creek may not be detected at locations farther upstream. Impacts on groundwater and surface water resources are not predicted. To confirm this prediction, the Proposed Action and AMA require the Proponent to conduct groundwater and surface water monitoring. Monitoring would continue on Sheep Creek downstream of the Project area and along Coon Creek as described in Section 3.5, Surface Water Hydrology, of the EIS.
PM1-10	1	Roger Peffer		Public Meeting Transcript	And I have a huge concern about water quality with this project. Sheep Creek flows into the Smith, as everyone has mentioned. Excellent trout fishing stream. But then it flows into the Missouri. And there's Great Falls, with a population of almost 60,000 people who will be impacted when these toxic chemicals flow into the river. And when will we find out? We're going to find out two months, three months, six months after they have contaminated our drinking water. You know, what's the system in place for protecting our drinking water? If -- when this spill occurs, there is no way to clean it up. Those toxins will be in those rivers forever, in our lifetime. I want to see	See the Consolidated Response CUM-3. Further, spill containment is addressed in the Proponent's MOP Application (Appendix P, Emergency Response Plan, Section 4.0, Spill Response Plan), and the reader is referred to this document for additional details. Immediate reporting of spills would be required. The risks of various types of spills occurring, and their potential consequences, are also discussed in the Proponent's MOP Application, Appendix R, Failure Modes Effects Analysis. Due to planning for spill containment during mine design, quantities of materials that might be

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					protection for our children, for our grandchildren, and for ourselves by protecting these.	released in the event of a spill are expected to be small enough to be completely contained on the mine site and subsequently cleaned up. Impacts on Sheep Creek are unlikely, and the potential for a spill to cause measureable changes to water quality further downstream in the Smith or Missouri rivers is negligible.
PM1-12	1	Kathy Gessaman		Public Meeting Transcript	What I would like to see, though, here is, from the DEQ, some confidence level numbers, percentages, or something of what kind of confidence you have in these experimental models that are being proposed and, you know, the reliability of the assumptions used when they're making these. And the confidence level in, you know, the equations used for the whole water treatment facility.	It is standard practice to develop quantitative, predictive models to evaluate potential water quality and quantity effects associated with proposed development projects. The EIS includes quantitative predictive surface water and groundwater modeling to generate predictions to support the assessment application and inform mitigation and management strategies (see Section 3.4.1, Section 3.4.2, Section 3.5.1, and Section 3.5.2). The reliability of the model predictions was assessed considering data limitations and through completion of a model sensitivity analysis, as is standard practice. Impacts on groundwater and surface water resources are not predicted. To confirm the model predictions, the Proposed Action and AMA requires the Proponent to conduct groundwater and surface water monitoring. Monitoring would continue on Sheep Creek downstream of the Project area and along Coon Creek as described in Section 3.5, Surface Water Hydrology, of the EIS.
PM1-13	1	Stuart Lewin	Missouri River Citizens	Public Meeting Transcript	We spent a lot of time working on the growth policy plan for the City of Great Falls. When we did that, we discovered that there were five Superfund sites just in this bend of the river. Yet, the City takes its water out of the Missouri. And, in fact, recently, the water quality has been to the point where the City has been notifying us that we haven't met standards. We are on the edge of not having the water that we need for this city, yet you are proposing a mine just upstream from us. The impacts you're talking about need to take into account what's going on here in Great Falls. It doesn't approach it at all. In fact, when I took a look at the first map that I saw there, the city of Great Falls looks like just sort of a pin dot. That whole area there is not even being shown. And you didn't even mark the Missouri River. You didn't even show where the Missouri River is.	Section 4.1.1, Identification of Geographic Extent, of the EIS identifies the study area for surface water that could be affected by the proposed Project. The proposed mine site is more than 130 river miles upstream of the city of Great Falls. Great Falls is outside the study area as it would have no direct, secondary, or cumulative impact from the proposed Project. See the Consolidated Response CUM-3.
PM2-02	1	Jim Bell	Madison-Gallatin Chapter of Trout Unlimited	Public Meeting Transcript	As I read the statement, the environmental statement, I saw that there is a great deal of baseline biological data that has been gathered. I also saw that there is a biomonitoring program that is supposed to follow up throughout this mine. What I did not see -- and I was speed-reading, I will admit, but what I did not see is whether there are any biological triggers, if you will, for remediation if there is some sort of episodic event. For example, just pulling it out of the air, but what if Sheep Creek went to 10 cubic feet per second? I could not find any remediation, anything that would be done to try to solve that short-term episodic event. Without some sort of safeguards, biological safeguards, there's no way I could endorse the statement as it exists now.	Refer to Consolidated Responses WAT-4 and AQ-2. The impacts on Sheep Creek are discussed in Section 3.5.3.1, Surface Water Quantity, of the EIS, and were determined to be insignificant. The predicted reduction in base flow would be small, below the non-degradation threshold, reversible, and largely offset by mine inflow discharges into Sheep Creek via the UIG. In Coon Creek, base flow reduction would be mitigated with water from the NCWR and through an agreement with the water rights holder to utilize the water rights (see Section 3.5.3, Environmental Consequences, of the EIS). Aquatic monitoring is discussed in Section 3.16.3.2, Proposed Action–Required Monitoring, and 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 2017a). 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. Episodic events were not considered in the monitoring program.

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						Impacts on groundwater and surface water resources are not predicted. To confirm this prediction, the Proposed Action and AMA require the Proponent to conduct groundwater and surface water monitoring.
PM2-06	1	David Brooks	Montana Trout Unlimited	Public Meeting Transcript	Our mission, in representing thousands of Montanans, is to care for coldwater fisheries, which means our focus on this EIS is largely on water quantity and water quality. We believe that this Draft EIS fails largely on both of those accounts. The Draft EIS fails to properly or accurately model dewatering and other water quantity issues, which I've spoken about previously in Great Falls, and you'll hear more from us in our written comments. Of equal concern and what I want to focus on tonight is water quality, which means focusing on waste, waste rock, and sources of potential water contamination. This Draft EIS fails to analyze geochemistry properly. Whatever company ends up owning and operating this mine -- And many of us have seen the pattern of mines changing hands regularly, and so whether it's the current company or a new as of yet unknown owner, they'll be dealing with waste material that's highly acidic and metalliferous. The potential for creating perpetual acid mine drainage has not been properly taken into account in this Draft EIS. Questions of how mobile will these contaminates be remains. Can the water treatment facility actually deal with the geochemistry they'll be facing when, not if, there's more water and more highly contaminated water than this cursory Draft EIS predicts? These are just some of the critical questions that warrant going back to the drawing board to answer in this Draft EIS.	No adverse or long-term effects are predicted to occur to surface water or groundwater as a result of Project development based on results of the quantitative predictive models developed for the Project and in light of planned mitigation measures, including treatment of mine dewatering flows by RO. As is standard practice, the EIS includes quantitative predictive surface water and groundwater modeling to generate predictions to support the assessment application and inform mitigation and management strategies (see Section 3.4.1, Section 3.4.2, Section 3.5.1, and Section 3.5.2 of the EIS). The water released to the alluvial aquifer via the UIG during the construction and operations phases would be treated by RO to assure compliance with surface water and groundwater standards and non-degradation criteria according to the MPDES permit (Hydrometrics, Inc. 2018a; Tintina 2018a). RO is a highly efficient treatment processes that targets dissolved metals and nutrients, including nitrate; RO with pretreatment would be used to treat mine dewatering flow during operations and closure. The accuracy of the hydrological model (including predictions of mine dewatering rates) and RO treatment systems is addressed in Consolidated Response WAT-1. The impact of the Project on surface water quality is addressed in Consolidated Response WAT-2.
PM2-06	2	David Brooks	Montana Trout Unlimited	Public Meeting Transcript	We've heard about the modern technology that will prevent waste from contaminating water. We've heard about the plan of mixing cement with the tailings paste to stabilize and neutralize the tailings. But one of the problems with this new concept is its newness. Storing this highly acidic waste, full of toxic metals and other toxins, in an aboveground tailings impoundment, that's still sited below the water table and across a few acres of wetlands, is virtually untested. Are there aboveground cemented tailings facilities in the world? And at the ones that exist, have they used the cemented tailings technology being proposed here? And furthermore, have they done so for high-sulfide-bearing waste as this mine will create? Are any proven in post-closure effectiveness? The Draft EIS covers none of the literature or answers none of these questions. It simply takes the company at its word. What's being proposed in the headwaters of the Smith River is an experiment on this front. It's faith-based planning and not scientifically sound, and the EIS should do better.	See Consolidated Response PD-2 for examples of other mines that have used similar technologies. One of the first uses of cemented backfill in the mining industry occurred at the BHP Mount Isa mine in Australia where, since the early 1930s, large blocks of waste rock were thrown into a vertical shaft along with hydrolysed cement to fill open stopes and accommodate their particular mining sequence. An overview of the Canadian experience with the various types of backfill is given by Udd (1989). Today, cemented paste tailings are widely used in underground mining to provide backfill for ground support to allow mining of adjacent areas. Disposal of paste tailings in surface impoundments is much less common due to the relatively high associated costs compared with conventional slurry deposition of tailings. The primary benefit of paste deposition in a surface impoundment is that the process extracts much of the water from the tailings and causes the sand and silt particles that comprise tailings to pack together much more tightly than when deposited by water. This causes the material to have a low permeability, which restricts the flow of water and movement of oxygen through the tailings and precludes liquefaction during earthquakes because there is not sufficient water stored between the tailings grains to allow the material to move as a fluid in response to sudden agitation. The low permeability of paste tailings greatly reduces its potential for causing water pollution because very little water can move through the tailings, and restricting the flow of oxygen through the material

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						greatly limits the potential for sulfide minerals to oxidize and produce acidity. Addition of small quantities of cement to paste tailings, as proposed by the Proponent, only increases the stability of the tailings. The primary purpose for adding cement to paste tailings deposited in a surface impoundment is to bind together very fine-grained material in the tailings as it dries out and before it is covered by a fresh layer of tailings. In this way, the cement minimizes the potential for wind erosion and resultant blowing dust from the dry tailings surface. Also note that the proposed CTF would not be sited below the water table. Excavation during site preparation would extend a few feet below the water table; however, site grading and underdrain construction during preliminary construction would permanently lower the water table beneath the facility such that groundwater would not be in contact with the liner beneath the tailings.
PM2-10	3	Mike Fiebig	Northern Rockies office of American Rivers	Public Meeting Transcript	The Black Butte Copper Mine seriously risks pollution from sulfide ore and reducing flows in Sheep Creek, the most important spawning tributary on the Smith. And both Sandfire and Montana DEQ grossly underestimated how much groundwater that's connected to the Smith River headwaters will flow in the mine and have to be treated for toxic contamination before being pumped back into the ground.	The groundwater model developed by Hydrometrics (2016a) for the Project was based upon years of on-site research, including well drilling and aquifer testing, examination of drill core from exploration drilling, and geologic mapping (see EIS Section 3.4: Groundwater Hydrology). The combined impacts on water resources based on the Proposed Action are predicted to be minor; the complete effects assessment is presented in EIS Section 3.4, Groundwater Hydrology, and EIS Section 3.5, Surface Water Hydrology. See Consolidated Response WAT-1.
PM4-11	2	Chris Phelps		Public Meeting Transcript	I also think -- I'm also aware of water rights that have been leased already from ranchers along Sheep Creek and what impacts that may have on dewatering as well as spawning habitat as well as all the other things that are of concern concerning water flowing down Sheep Creek.	Surface water diversion for the Project is subject to review and approval by the DNRC. Diversion would be limited to the irrigation period of the year when water is available and leased water rights (pending approval by the DNRC) permit water withdrawal (see EIS Section 3.5.1).
PM5-01	7	Linda Semones		Public Meeting Transcript	The DEIS grossly underestimates the amount of water this mine will use out of the trout spawning tributaries running into the Smith. It doesn't mention the possibility of pollution from the mine moving from the groundwater to the surface water of Sheep Creek and Smith River. The mine plans to pump warm water highly likely to contain acidity, nitrates, and toxins back into the Smith River tributaries so they don't dry up.	The Proposed Action is not expected to affect stream flow (EIS Section 3.5.3). Minimal surface disturbance would result in insignificant impacts on surface runoff. Simulated base flow depletion for all streams except Coon Creek are relatively minor (less than 10 percent). In 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 (EIS Section 3.5.1). Based on the relatively small (within natural variability of the system) predicted changes to streamflow, impacts on the natural geomorphic processes and integrity of stream channels are not expected. No significant increases or decreases to stream flow resulting from the operation of the UIG are expected. An average rate of 398 gpm (0.89 cfs) of treated water would be discharged to the UIG, which is approximately 6 percent of the estimated average base flow of 15.3 cfs in Sheep Creek at SW-1. UIG recharge and the loss of base flow in Sheep Creek (approximately 0.35 cfs or 2 percent of the average base flow) caused by mine dewatering would partially offset each other and thus further minimize the predicted changes to stream flow. The Proposed Action would return treated water that complies with all water quality criteria to the alluvium adjacent to Sheep Creek. Further information is provided in Consolidated Response CUM-3.
HC-002	4	William Avey	USDA Forest Service	Hard Copy Letter	The Forest Service administers livestock allotments on the federal and private lands of Black Butte Section 26 and on the federal lands of the Moose Creek	Impacts on groundwater and surface water resources are not predicted. To confirm this prediction, the Proposed Action and AMA require the Proponent to

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					allotment in Section 18 to the north of the proposed project area. Livestock utilizing Section 26 get their water from a developed spring in the northeast quarter of Section 26 on a tributary to Coon Creek. There is a federal water right on this water development. Livestock utilizing Section 18 get their water from Sheep Creek. We would like assurance of continued access to provide for administration of these allotments during your project activities and assurance that your project activities will not affect the quantity, quality, and suitability of these surface waters for watering livestock and wildlife.	conduct groundwater and surface water monitoring. Baseline data have been collected at the developed stock watering spring (e.g., DS-2) in Section 26, and this spring would continue to be monitored during operations. The spring is within the area of projected drawdown predicted by the groundwater model. If flow of the spring is diminished due to mine dewatering, the MMRA requires the operator to replace the water supply (see § 82-4-355, MCA). Sheep Creek intersects Section 18 downstream of the Project near monitoring station SW-1 (see Consolidated Response WAT-2). No water quality impacts on the receiving waters (Sheep Creek and Coon Creek) are anticipated since water from all facilities would be collected and treated to meet non-degradation criteria before discharging to the alluvial UIG (Section 3.5.3 of the EIS).
HC-002	6	William Avey	USDA Forest Service	Hard Copy Letter	Because of the public's recreational use of Sheep Creek downstream of the project area, the Forest Service requests that DEQ require a surface water continuous monitoring station be established on Sheep Creek at the NFS/private boundary to determine baseline and project area conditions for surface water quality and quantity as it leaves private land of the project area and enters public lands. The station should include field parameters (Temperature, Conductivity, pH, Dissolved Oxygen, Turbidity), laboratory analyses, and stream flow data. This station should be continuously monitored and data provided to the Forest Service on a regular monthly/quarterly basis. We also request that discharge on the Forest Service developed livestock watering spring on the Coon Creek tributary in Section 26 be monitored twice a year prior to operations to determine baseline and project area flow conditions for this spring and to provide monitoring information during operations to ensure project development activities will not result in a reduction of surface flows and water quality.	The continuous monitoring locations established for baseline studies and ongoing monitoring (Section 3.5.1 of the EIS) have been selected to provide the best quality data possible. Upstream of SW-1, Sheep Creek is braided as it flows across an alluvial plain, and the unstable nature of the channel is not conducive for establishing a continuous monitoring gaging station. Impacts on groundwater and surface water resources are not predicted. To confirm this prediction, the Proposed Action and AMA require the Proponent to conduct groundwater and surface water monitoring. Monitoring would continue on Sheep Creek downstream of the Project area and along Coon Creek, as described in Section 3.5 of the EIS. Additional monitoring would be implemented on Upper Coon Creek as described in Section 6 of the MOP Application. Note that the existing monitoring station SW-1 on Sheep Creek is located at or near a boundary between the Forest Service and private lands, at the bridge near the boundary between Sections 13 and 18. Along the reach of Sheep Creek up to 1 mile upstream of SW-1, the creek crosses Forest Service/private boundaries several times. Site SW-1 appears to be better situated for accurate monitoring of flow and water quality in Sheep Creek than any of the other upstream locations where the creek crosses between private and Forest Service lands. Discharges of treated water to the proposed alluvial UIG system adjacent to Sheep Creek are not predicted to enter surface water prior to the first private/Forest Service boundary. Also, baseline data have been collected at the developed stock watering spring (e.g., DS-2) in Section 26, and this spring would continue to be monitored during operations.
HC-002	7	William Avey	USDA Forest Service	Hard Copy Letter	The Forest Service manages lands directly downstream of the proposed project. Water withdrawals or discharges in the vicinity of stream systems should not affect the natural geomorphic processes and integrity of stream channels. Increases in stream flows would be just as impactful to aquatic resources and habitat as would be low water levels. All discharges and runoff to streams should be monitored to ensure the mine operation is within the natural range of variability. The EIS should include provisions to study the possible effect by the operation (increases or decreases) to natural stream flows and stream channels downstream ofthe project area.	See Consolidated Response WAT-2 regarding impacts on surface water resources. The Proposed Action is not predicted to affect stream flow (Section 3.5.3 of the EIS). Based on the relatively small (within natural variability of the system) predicted changes to streamflow, impacts on the natural geomorphic processes and integrity of stream channels are not expected.

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HC-003	13	Josh Purtle	Earth Justice	Hard Copy Letter	DEQ has attempted to wave offthe possibility of further permit review, arguing that "[s]hifting the function of the alluvial UIG from serving as a contingent water disposal location to serving as the location where all treated water will be discharged is not a substantial change requiring DEQ to restart the permitting process under Section 82-4-337, MCA." Exhibit 10 at 1 (Letter from Herb Rolfes, DEQ, to John Shanahan, Tintina Resources Inc. (Jan. 30, 2018)). DEQ is wrong, however, because, as discussed below, use of an alluvial UIG fundamentally changes the nature of the mine's potential environmental impacts. Unlike an upland UIG, which would allow effluent to filter through soil before discharging to surface water and groundwater, the alluvial UIG discharges effluent directly to the aquifer under Sheep Creek, which has a direct hydrologic connection to surface water in the stream channel. Further, changing the location of the UIG alters mine hydrology, and, therefore, the anticipated impacts of groundwater drawdown in the project area. In fact, as discussed below, Tintina's hydrological model, which provides the entire basis for Tintina's prediction that the company will be able to mitigate any impacts due to drawdown associated with the mine, does not account for the changed UIG location.	See Consolidated Response MEPA-3.
HC-003	14	Josh Purtle	Earth Justice	Hard Copy Letter	DEQ further concluded that Tintina's newly proposed use of a treated water storage pond to comply with surface water nitrate standards will "not raise any additional issues to those that would have been analyzed in an environmental review of the original application." Exhibit 11 at 1 (Letter from Herb Rolfes, DEQ, to Jerry Zieg, Tintina Resources Inc. [Nov. 21, 2018]). However, as discussed below, use of a treated water storage pond creates a significant risk that effluent discharges from the mine will change the temperature of Sheep Creek, in violation of non-degradation standards for the creek. Therefore, a new scoping process and additional MMRA review, including adequate time for meaningful public comment on these new proposals, is warranted, so that the public and DEQ may fully analyze and understand the import of the significant changes to Tintina's modified plan of operations.	The Proponent has used hydro-geochemical monitoring, hydrogeological modeling, and geochemical testing data to design its underground workings and TWSP to minimize potential impacts on water quality. Apart from groundwater in the underground workings at the end of the closure phase, water from all facilities would be collected and treated to meet non-degradation criteria prior to discharge (Hydrometrics, Inc. 2016b). The 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 non-degradation effluent limits (0.097 mg/L). The total nitrogen effluent limit is only in effect 3 months per year (July 1 to September 30). 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, 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 (Zieg et al. 2018). See Consolidated Response WAT-5 for information about thermal effects on aquatic systems.
HC-003	37	Josh Purtle	Earth Justice	Hard Copy Letter	The draft MPDES permit also fails to rationally address a "pending" total maximum daily load standard for aluminum in Sheep Creek. Id. at 22. Total maximum daily load is the "maximum quantity of a pollutant the water body can receive on a daily basis without violating the water quality standard" for the waterbody. San Francisco BayKeeper v. Whitman, 297 F.3d 877, 880 (9th Cir. 2002). The Fact Sheet acknowledges that a new total maximum daily load standard for aluminum in Sheep Creek is in development, but fails to evaluate whether the project as proposed will comply with that standard. MPDES Fact Sheet at 22. Unless and until the total maximum daily load is established for aluminum in Sheep Creek, it is impossible as a practical matter for DEQ to conclude that the project will avoid adverse impacts to water quality in Sheep Creek. DEQ should recirculate a new Draft EIS that demonstrates the project's compliance with the new aluminum standard once it is developed, or at a	The chronic aquatic standard for aluminum is 0.087 mg/L and the non-degradation limit for aluminum is a fraction of that, as estimated in the Proponent's MPDES application. DEQ predicts that aluminum in the RO water treatment effluent would be <0.001 mg/L, well below non-significance criteria. Section 75-5-703(10)(b), MCA, states, "the issuance of a discharge permit may not be precluded because a TMDL is pending." The prohibition of issuance of MPDES affecting impaired waters was a temporary condition imposed in *Friends of the Wild Swan vs. EPA*. DEQ satisfied the terms of the Court judgement in this case. The prohibition is no longer applicable.

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					minimum addresses this critical gap in DEQ's analysis. Among other things, the EIS should evaluate whether additional measures should be required to meet the aluminum standard; if such additional measures will not be required, DEQ should explain why the existing MPDES standards are adequate for this purpose. Absent such analysis, DEQ cannot rationally conclude that the project will comply with governing water quality standards.	
HC-003	38	Josh Purtle	Earth Justice	Hard Copy Letter	In addition to failing to address the pending aluminum total maximum daily load standard, the draft MPDES permit also deals irrationally with whole effluent toxicity. Whole effluent toxicity "refers to the fact that effluent can contain many different pollutants" and "[e]ven if no one pollutant is likely to cause harm ... the combination of several pollutants may have an adverse result." S. Cal. All. Of Publicly Owned Treatment Works v. EPA, 853 F.3d 1076, 1080 n.2 (9th Cir. 2017). The Fact Sheet asserts on one page that whole effluent toxicity is not expected in part because the mine's discharges "first pass[] through the ground." MPDES Fact Sheet at 29. But on the very next page, the Fact Sheet casts doubt on this rationale, stating, " [a]Ithough the discharge will pass through the ground before reaching surface water, the ground water discharge will be in close proximity to Sheep and Coon Creeks and the Permittee has not requested a mixing zone." Id. at 30. Further, the Fact Sheet states in one place that "[w]hole effluent toxicity has not been assessed for the Facility discharge," id. at 35, while purporting to conduct that very analysis in another place, id. at 29-30. The EIS should address these inconsistencies in the MPDES permit's analysis, and explain whether, given these inconsistencies, DEQ's conclusion that the mine discharges will not generate whole effluent toxicity is adequately supported.	Whole effluent toxicity (WET) is a measurement of the aggregate toxic effects of effluent on aquatic organisms. This is measured in laboratory methods of exposing aquatic life to the effluent at varying concentrations and recording the effects of survival, reproduction, and growth. Montana does not have a numeric standard so DEQ performed a narrative reasonable potential analysis. DEQ imposed stringent effluent limitations on all significant pollutants of concern so that the effluent does not have reasonable potential for WET. The numeric limits on all pollutants of concern are based on the nonsignificance criteria, which are set at a fraction of the lowest applicable water quality standards. DEQ determined that compliance with the nonsignificance criteria would result in no reasonable potential for WET and that the effluent would not be toxic or cause toxic effects in the receiving water. 40 CFR 122.44(d) allows DEQ to determine that limitations on WET are not necessary because these stringent chemical-specific limitations are sufficient to attain and maintain the narrative standard at ARM 17.30.637(1)(d). The permit requires the Proponent to collect and pass a chronic pre-discharge WET test to demonstrate no chronic toxicity prior to initiating discharge from Outfall 001 (see the final MPDES permit [Hydrometrics, Inc. 2018a]). After discharge commences from the facility, chronic WET tests are required quarterly. If the permittee reports a failed WET test, the Proponent must resample within 14 days. If the permittee reports the resample as a failed WET test, the permit requires the permittee must begin to investigate, identify, and correct the cause of toxicity (Toxicity Identification Evaluation/Toxicity Reduction Evaluation) and report these findings to DEQ (Hydrometrics, Inc. 2018a). Based on the results of the WET testing and any TIE/TRE analysis, DEQ may reopen the permit and add additional WET requirements, and add or adjust effluent limits or any other portion of the permit determined appropriate (Hydrometrics, Inc. 2018a). The language in the Fact Sheet regarding the effluent first passing through the ground is referring to the fact that the water quality standard on which WET requirements are based does not apply to groundwater. In this case, the UIG is in close proximity to surface water and WET monitoring would be required as a tool to measure aggregate toxicity of the effluent. This would provide additional assurance that the effluent would not create concentrations or combinations of materials that are toxic or harmful to human, animal, plant, or aquatic life in surface water.
HC-003	40	Josh Purtle	Earth Justice	Hard Copy Letter	In addition to the deficiencies in the MPDES permit discussed above, DEQ fails in the Draft EIS to rationally evaluate the project's other potential impacts to surface water quality. First, DEQ has failed to provide adequate baseline water quality data for Sheep Creek, undermining the Draft EIS's water quality analysis at the very outset. In this regard, Tintina has developed very few	Extensive baseline water quality and flow data have been gathered from Sheep Creek since 2011. Site SW-1 is located approximately 1.35 river miles downstream from the nearest proposed alluvial UIG (note that a single effluent discharge point is not proposed, but rather a series of seven drainfields to be constructed in Sheep Creek alluvial valley over a distance of approximately

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					surface water monitoring sites on Sheep Creek. One, labelled SW-1, is about two miles away from the project's effluent discharge point. See Draft EIS at 3.5-7. The other, SW-2, is several river miles upstream of the project site. See Draft EIS at 3.5-4 (Figure 3.5-2). These two monitoring sites, both of which are miles from the proposed mine site, are inadequate to accurately characterize water quality in Sheep Creek near the project. DEQ should require Tintina to gather data at additional monitoring sites to provide adequate baseline data concerning existing water quality in Sheep Creek. Without such data, DEQ and the public cannot adequately evaluate the project's water quality impacts. See N. Plains Res. Council, Inc. v. Surface Transp. Bd., 668 F.3d 1067, 1085 (9th Cir. 2011 (holding under NEPA that complete data on existing environmental conditions is necessary to allow agency to "carefully consider information about significant environment impacts." . In addition, DEQ should require Tintina to install "a USGS real-time discharge gage with seasonal thermal recording near" monitoring site SW-1, as FWP recommended in a comment letter at an earlier stage of Tintina's permitting process. Exhibit 1 at 3. As FWP has stated, "[i]ndependent flow data gathered by USGS may be used to establish correlations to help determine if changes in the fishery are due to non-mine related impacts on stream flow or due to mine-related impacts." ld. The USGS gage recommended by FWP, along with additional monitoring sites discussed above, would therefore be essential to determining whether Tintina's mine operations are impacting surface water flows and quality in Sheep Creek downstream from the mine site.	0.5 mile). Because effluent is proposed to be discharged to groundwater within a section of Sheep Creek's alluvial valley in which some stream flow is expected to seep into the alluvium, monitoring water quality within this reach of Sheep Creek would not likely detect any impacts from the discharge of mine water because the groundwater is not likely to enter the stream channel in this area. To detect any impacts from mine discharges on Sheep Creek, monitoring must be conducted at a location where groundwater upwelling into the stream has occurred. Downstream of the Project area, Sheep Creek flows out of the broad alluvial valley and into a narrow bedrock canyon, resulting in groundwater discharging from the alluvium into the stream. Site SW-1 is within a mile of this location. As no other tributaries enter Sheep Creek between the start of the canyon and SW-1, no dilution of stream flow would occur between the Project area and SW-1. Although no additional surface water monitoring sites are on Sheep Creek between SW-1 and the Project area, monitoring wells are located in this area that could detect changes in groundwater quality. Also, it is important to consider that no mine facilities or disturbances, other than the alluvial UIG system, are located immediately adjacent to Sheep Creek. Mining facilities, such as the CTF, PWP, mill, and ventilation raises would be within tributary watersheds to Sheep Creek, specifically Brush Creek and Coon Creek. Any potential water quality impacts on Sheep Creek from these areas would enter Sheep Creek via these tributaries, and surface water quality monitoring stations have been established and would continue to be monitored on these streams. Groundwater monitoring wells are also located downgradient of proposed mine facilities in these drainages.
HC-003	41	Josh Purtle	Earth Justice	Hard Copy Letter	Relatedly, Tintina apparently did not gather any information about surface water hardness at monitoring locations SW-4, SW-8, SW-9, SW-12, and SW-13. Draft EIS at 3.5-9. DEQ must require Tintina to gather this additional data in order to adequately characterize existing water quality and determine compliance requirements for all applicable water quality standards.	Because baseline data collection began during the early Project development phase before locations were selected for some of the mine facilities or water discharge areas, some water sampling was conducted at locations not in the Project area or on streams that would not be affected. Not all sites for which baseline water quality data were collected need to be retained in the long-term water monitoring program. Different monitoring sites have different reasons to be monitored; therefore, different parameters may be tested at different sites. Not all sites require sampling for all possible parameters. The baseline water quality dataset (Hydrometrics, Inc. 2018b) contains 300 hardness measurements collected at nine water quality monitoring sites between May 2011 and December 2017.
HC-003	44	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS does not adequately analyze several potential water quality impacts associated with operation of the alluvial underground infiltration gallery. First, the Draft EIS fails to address the risk that water flowing through the underground infiltration gallery will pick up harmful contaminants from the underground geology before discharging to the Sheep Creek alluvium. DEQ raised this issue during its review of Tintina's mine operating permit application, stating that "the treated water may leach contaminants from the in place or disturbed bedrock adjacent to or within the infiltration trenches." First Deficiency Review at 21. In particular, DEQ asserted that water flowing through the UIGs might leach selenium, which Tintina detected in near-surface bedrock in the mine area. Second Deficiency Review at 4. The Draft EIS,	There are no adverse or long-term effects predicted to occur to surface water and groundwater as a result of Project development based on results of the quantitative predictive models developed for the Project and in light of planned mitigation measures, including treatment of mine dewatering flows by RO. As is standard practice, the EIS includes quantitative predictive surface water and groundwater modeling to generate predictions to support the assessment application and further, as tools to inform mitigation and management strategies (See Section 3.4.1, Section 3.4.2, Section 3.5.1, and Section 3.5.2 of the Draft EIS). See the Consolidated Response WAT-2 for additional discussion of concerns regarding impacts on surface water resources in the Project area.

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					however, does not discuss this possibility, or explain why such leaching is not likely to happen. The Draft EIS should also analyze the potential for certain pollutants to "increase over time in the infiltration gallery area with long-term discharge over mine life." Second Deficiency Review at 28. DEQ raised this concern in its review ofTintina's mine operating permit application, noting that "with groundwater percolation there is potential increases in nitrogen compounds, electrical conductivity," and other parameters. Second Deficiency Review at 28. Once again, however, the Draft EIS inexplicably omits this concern. DEQ should analyze whether extended use of the underground infiltration gallery may cause certain pollutants to increase over time and, if necessary, propose measures to "prevent exceedances over time in the UIG soils and groundwater." Second Deficiency Review at 28. Tintina did discuss this issue in its mine operating permit application, but its analysis was based on a very different discharge system, in which treated water would be pumped into infiltration galleries constructed in the hills upland from Sheep Creek. See MOP Application Rev. 2 at 602. As discussed, Tintina has since abandoned this UIG design in favor of building an infiltration gallery in the alluvial aquifer directly underneath Sheep Creek. The EIS should analyze and disclose whether this change in Tintina's plan of operations will affect the likelihood that treated water will leach contaminants from the geology in which the infiltration galleries will actually be constructed. The Draft EIS further fails to evaluate whether the UIG design may create a lag between when water is discharged to the UIG and when it reaches Sheep Creek, such that Tintina could violate stricter summer nitrate standards. Water discharged to the UIG infiltrates at a median rate of about two feet per day. Draft EIS at 3.4-46. Given the fact that the infiltration gallery would be 1,450 feet long at "a minimum," Draft EIS at 3.4-46, it could take months for effluent to travel from the initial discharge location to Sheep Creek. As a result, water discharged in May, before the stricter nitrate standard goes into effect, may not reach the creek until July, when DEQ's analysis indicates the effluent may exceed the stricter summer nitrate standard. The EIS should analyze whether this feature of the UIG design could cause potential surface water standard exceedances in Sheep Creek.	The commenter incorrectly states that water flowing through the alluvial UIGs might pick up harmful contaminants from the underground geology prior to discharging to the Sheep Creek alluvium. The discharge would occur directly to the Sheep Creek alluvium. By its nature, alluvium has been eroded from elsewhere and transported by water before being deposited in the stream flood plain. It is frequently saturated during high water conditions. The material has reached geochemical equilibrium with surface water. DEQ raised the issue in the first deficiency review with regard to the then-proposed Upland UIGs, where water would have been discharged into trenches excavated into bedrock and the excavation had the potential to break up bedrock and expose fresh rock surfaces to weathering. The concerns noted in this comment were relevant to the analysis of the Upland UIG sites, which are no longer proposed, and are not concerns with the now-proposed discharge directly to alluvium for the reasons stated above. Water released to the environment via the UIGs would migrate toward Sheep Creek via alluvial sediments. This migration might take up to a few months. As such, the water released via the UIGs to the environment before July 1 might occasionally carry nitrogen at concentrations above the non-degradation effluent limits. However, the nitrogen dissolved in groundwater would be subject to attenuation (while filtrating through alluvial sands and wetland areas; this phenomenon is documented in literature), thereby lowering nitrogen levels before reaching the waters of Sheep Creek, where it would be strongly diluted with surface waters. See also: (1) Response to comment BBC00589, comment 38; (2) Proponent's Third Supplemental Response to Public Comments, Section C, Nitrate in Groundwater (Sandfire 2019a). Both of those sources/responses provide references to scientific publications focused on natural attenuation of nitrate. According to DEQ's response to Comment Number 25 on MPDES Permit MT0031909 (Tintina 2019), it is well established that total nitrogen is rapidly taken up or denitrified to harmless nitrogen gas by microbes. For total nitrogen, DEQ would prefer a slow rate of nitrogen-containing-groundwater migration from the UIG to the creek, making the seasonal discharge limits important.
HC-003	45	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS fails to evaluate potential impacts to Coon Creek and Little Sheep Creek. First, the Draft EIS ignores potential impacts to water quality in Coon Creek due to Tintina's plan to mitigate flows there. As discussed, Tintina plans to pump water from Sheep Creek during times when flows are high, store that water, and then discharge it to Coon Creek to mitigate for flows depleted by mine drawdown. However, as the Draft EIS acknowledges, Sheep Creek has been categorized by DEQ as "impaired" for aluminum and E. coli, and has exhibited exceedances of iron water quality standards. Draft EIS at 3.5-10. Thus, discharging impaired Sheep Creek water to Coon Creek may degrade water quality in Coon Creek. The Draft EIS, however, ignores this potential problem with Tintina's mitigation plan. As to surface water quantity, the Draft EIS fails to evaluate the impact of diminished surface runoff in the project area on Coon Creek and Little Sheep Creek. The Draft EIS acknowledges that "[s]urface runoff in these smaller	See Consolidated Response WAT-2 regarding impacts on surface water resources. Potential impacts on Coon Creek and Little Sheep Creek are discussed in Section 3.5.3 (Surface Water Quantity and Quality) in the EIS. The 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. The water released to the alluvial aquifer via the UIG during the construction and operations phases would be treated to assure compliance with surface water and groundwater standards and non-degradation criteria per the MPDES permit (Hydrometrics Inc. 2018a; Tintina 2018a). Surface runoff in smaller drainages (e.g., Coon Creek, Little Sheep Creek) could potentially be affected due to surface disturbance, but impacts would not extend outside the immediate area and are not substantial based on the proposed BMPs detailed in the MOP Application (Tintina 2017a).

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					drainages, could potentially be affected due to surface disturbance" associated with the mine, but concludes that "impacts would not extend outside the immediate area and therefore are considered low within the greater Sheep Creek watershed." Draft EIS at 3.5-11. Whether these impacts are significant on the scale ofthe entire Sheep Creek watershed says little, however, about the extent of the impacts in Coon Creek and Little Sheep Creek themselves. Under DEQ's approach, even a 100% reduction in flows in Coon Creek may be dismissed as insignificant for the watershed as a whole, even though the impacts for Coon Creek itself would obviously be severe. The EIS should provide more information about the potential for reduced runoff to diminish flows in Coon Creek and Little Sheep Creek, and disclose the extent to which such reduced flows will impact water quality and habitat in the creeks.	Sheep Creek is included in DEQ's 303(d) list of impaired streams for dissolved aluminum and *Escherichia coli* (*E. coli*). DEQ conducted a broad monitoring program in the Sheep Creek drainage area (Section 3.5.2.2 of the EIS). Data collected has been used to complete an *E. coli* TMDL, and 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). The completion schedule for the aluminum TMDL is linked to the MPDES surface water permit completion schedule to ensure internal DEQ consistency. 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 non-degradation criteria prior to discharge. Note that no project disturbances are proposed in the Little Sheep Creek watershed, but only within its relatively small tributary watershed known as Brush Creek. Impacts on Brush Creek, as noted in the EIS, would be minor and associated with a decrease in watershed-contributing storm water flows to the drainage (because portions of the watershed would be occupied by the CTF and other mine facilities that would retain storm water). Brush Creek is a very small stream (with base flows in the 20 to 40 gallon per minute range) flowing through a meadow dominated by grazing. A minor reduction in storm water flows is not likely to affect its status as prime cattle habitat.
HC-003	46	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS further fails to rationally analyze potential impacts to the temperature of surface water in Sheep Creek. Sheep Creek is at risk for the development of nuisance algae, and increased temperature encourages the growth of such algae. See Draft EIS at 3.16-33. Indeed, "[a]bundant filamentous algae outbreaks were visually observed at the lower Sheep Creek" monitoring sites "in 2015 and 20 16." Draft EIS at 3.16-33. The Draft EIS posits that effluent fi·om the UIG will not impact the temperature in Sheep Creek because "it is assumed that the temperature of the discharge would equilibrate to the ambient groundwater temperature prior to discharging to any surface water resources." Draft EIS at 3.16-32. The Draft EIS, however, provides no data or analysis to support this assumption, and in fact concedes that "[i]t is not known what the temperature difference between the UIG and existing groundwater would be." Draft EIS at 3.16-32. Contrary to DEQ's unsubstantiated prediction, the available evidence indicates that Tintina's mine operating plan creates a significant threat that the effluent will increase the temperature of Sheep Creek. As discussed, in order to meet surface water nitrate standards, Tintina plans to store all effluent produced by the mine in a reservoir at the surface during the summer months. It is likely that this water, like a shallow stagnant pond, will become much warmer than groundwater or surface water in the area. Tintina will then release this warm water to the UIG beginning October 1. Given the potential that this warm effluent will not equilibrate to groundwater temperature before it reaches Sheep Creek, DEQ should evaluate potential temperature impacts to the creek. Analyzing this potential impact is important because even a 1 °F increase in Sheep Creek's temperature would violate nondegradation standards. See ARM 17.30.623(2 (e (temperature requirements for B-1 streams, which include Sheep	No adverse or long-term effects are predicted to occur to surface water and groundwater as a result of Project development based on results of the quantitative predictive models developed for the Project and the Proposed Action which includes treatment of mine dewatering flows by RO. As is standard practice, the EIS includes quantitative predictive surface water and groundwater modeling (see Section 3.4.1, Section 3.4.2, Section 3.5.1, and Section 3.5.2 of the EIS). See also: Consolidated Response WAT-5 for additional data and discussion of potential thermal effects on water resources and ecosystems. Consolidated Response AQ-1 regarding impacts on aquatic life in Sheep Creek, including nuisance algae.

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					Creek ; ARM 17 .30. 705(2 (b (regulation stating nondegradation requirements . Thus, analyzing potential temperature impacts is required to ensure that Tintina's planned discharges meet Water Quality Act requirements.	
HC-003	47	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS fails to rationally account for potential quantity impacts to surface waters associated with Tintina's planned beneficial uses of those waters. Tintina proposes to lease existing water rights on Sheep Creek so that it can pump water from the creek to the non-contact water reservoir for use in surface water flow mitigation. See Draft EIS at 3.5-12. The Draft EIS predicts that use of these existing water rights will cause only "nominal" impacts to surface water flows. Draft EIS at 3.5-12. However, the Draft EIS ignores that some of these existing water rights may be mere paper rights that are not currently in use. Moreover, it appears that the Department of Natural Resources and Conservation has not yet evaluated the potential for adverse effects from Tintina's proposed change of use or whether water would be legally available for the proposed appropriation at different times of the year. Further, prior appropriators have not had an opportunity to evaluate such a change and its potential impact upon their existing rights. Therefore, without further analysis, the EIS cannot conclude that use of these existing rights will not change current water levels in Sheep Creek, thus harming habitat in Sheep Creek and causing adverse impacts to other water rights holders. The EIS should provide further analysis of this issue, and disclose whether the water rights Tintina seeks to use are not currently in use, such that Tintina's use of these rights in the future could reduce baseline flows in Sheep Creek.	Surface water diversion for the Project is subject to review and approval by the DNRC. It would be limited to the irrigation period of the year when water is available and leased water rights (pending approval by the DNRC) permit water withdrawal (EIS Section 3.5.1). Cattle ranching and associated irrigation and stream diversion is currently the dominant activity in the Project area. It is unlikely that existing water rights in the area are merely "paper rights that are not currently in use." However, this issue is for DNRC to evaluate. All water rights being acquired for the Black Butte Copper Project are currently being put to beneficial use and have been beneficially used with little to no interruption since their respective priority date. The use of these water rights is documented by sworn affidavits from John Hanson and Barbara Russell (see Section 9 of Part III through VIII of the Water Right Application Package).
HC-003	48	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS further does not discuss the potential surface water impacts of road improvements that will be necessary to accommodate mine operations. The Draft EIS in several places refers to planned improvements to the Sheep Creek road. See, e.g., Draft EIS at 3.12-11. Such road construction can create sediment and other pollution that can discharge to surface waters, particularly during rain events. Other construction activities may likewise contribute sediment pollution to surface waters. The Draft EIS, however, does not analyze these foreseeable impacts from the proposed project.	Surface runoff in smaller drainages (Coon Creek, Brush Creek, etc.) could potentially be affected due to surface disturbance, but impacts would not extend outside the immediate area and, based on the proposed BMPs detailed in the MOP Application, are not substantial (Section 3.5.3 of the EIS). Additional discussion of BMPs and water management are provided in Section 2.2, Section 3.5.3.1, and Section 3.16.3.2 of the EIS. The Sheep Creek road is already existing and heavily used; proposed improvements are not anticipated to cause impacts on water resources (e.g., erosion and sedimentation) in light of BMPs and planned mitigation and management measures. Impacts on groundwater and surface water resources are not predicted. To confirm this prediction, the Proposed Action and AMA require the Proponent to conduct groundwater and surface water monitoring.
HC-003	50	Josh Purtle	Earth Justice	Hard Copy Letter	DEQ and Tintina failed to provide adequate information about the geochemical properties of the geology Tintina is planning to mine. In particular, Tintina did not conduct sufficient geochemical testing to understand the properties of the waste rock and tailings produced by the mine. Exhibit 17 at 3-10. A full analysis of the geochemical properties of these materials, which will be the source of most ofthe mine's pollution, is essential to determining the mine's potential impacts to surface water and groundwater quality. Tintina's water quality model further applied some geochemical data selectively in a manner that potentially underestimates the concentration of certain mine pollutants. Exhibit 17 at 15. For example, Tintina excluded from its model water quality exceedances for lead, nickel, and thallium produced in tests of samples from the upper sulfide zone. Id. The Draft EIS should analyze	Extensive geological and geochemical analyses of rock types that would be excavated or exposed by the Project were conducted over multiple years to support the EIS and sufficiently support the assessment, associated mitigation, and management strategies. Details of these analyses are presented in Appendix N (Enviromin 2017a) of the Project MOP Application and Section 3.6, Geology and Geochemistry, of the EIS. For example, in addition to the LZ FW analyses noted here (15 ABA, 1 asbestos, and 1 HCT), 550 samples of this unit were submitted for whole rock geochemical analysis. Guidance within Maest et al. 2005 suggests a minimum number of samples that should be collected for geochemical characterization during initial sampling, based on the predicted mass of each rock type to be encountered by mining. For the LZ FW lithotype, the estimated mass of rock (35 percent of total) is approximately 247,000 tonnes,

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					whether excluding this and other data affected the outcome of Tintina's water quality model, and disclose whether including this data would alter the Draft EIS's predictions about water quality impacts.	which would require a minimum number of 8 to 26 samples. The guidance (Maest et al. 2005) suggests: 3 samples for less than 10,000 tonnes; 8 samples for less than 100,000 tonnes; 26 samples for less than 1,000,000 tonnes; 80 samples for 10,000,000 tonnes. The number of initial analyses for the LZ FW (550 whole rock and 15 ABA) are considered sufficient based on this guidance document. The number of samples analyzed from other lithotypes are also consistent with this guidance, based on the predicted mass of each rock type to be encountered by mining. See response to Submittal ID BBC00933, Comment Number 4, and BBC00933, Comment Number 6. Further information about the sample subsets used for geochemical testing are found in Appendix D (Enviromin 2017b) to MOP, sub-appendix B, and include details about the individual holes and depth intervals that were sampled and later used for other testing. Detailed discussion about sample representativity and sample subsets used for geochemical testing are also found in Appendix D to MOP, sub-appendix B.
HC-003	51	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS fails to rationally characterize the mine's potential groundwater quality impacts. As discussed below, the Draft EIS estimates that flows from deep in the mine workings, such as the lower copper zone, will be very small. Draft EIS at 3.4-39. This estimate, however, is based on very limited data, and there is significant uncertainty about how much flow the lower copper zone may actually produce. See Draft EIS at 3.4-25. As the Draft EIS acknowledges, the quality of water produced by the lower copper workings is expected to be much worse than that of water produced by other workings closer to the surface. See Draft EIS at 3.4-53. Therefore, if flows from the lower copper zone are greater than the Draft EIS estimates, that discrepancy could significantly change the Draft EIS's analysis of groundwater quality, including its prediction that groundwater in the mine workings will meet water quality standards after closure. See Draft EIS at 3.4-54. DEQ should acknowledge the uncertainty inherent in its calculations concerning flow from the lower mine workings, and disclose how greater flow from those workings could negatively impact groundwater conditions in the future. See ARM 17 .4.609(2 (c (environmental analysis should take into account "the degree of uncertainty that the proposed action will have a significant impact on the quality of the human environment" .	As is standard practice, the EIS includes quantitative predictive surface water and groundwater modeling to generate predictions to support the assessment application and inform mitigation and management strategies (see Section 3.4.1, Section 3.4.2, Section 3.5.1, and Section 3.5.2 of the EIS). See Consolidated Response WAT-1 for additional discussion of the groundwater model and potential groundwater quality impacts.
HC-003	52	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS also fails to rationally assess the levels of nitrate remaining in groundwater in the mine after closure. The Draft EIS predicts that nitrate levels will remain below groundwater quality standards after closure, relying on a model developed by Tintina's consultant and attached as Appendix N to Tintina's mine operating permit application. See Draft EIS at 3.5-19. The model in turn based this prediction on an assumption that "90% ofthe nitrate would be removed via denitrification" by native bacteria in the groundwater. MOP Application Rev. 3, app. Nat 35. Neither the Draft EISnor Appendix N, however, provides any evidence to substantiate this assumption. The EIS must explain the scientific basis for Tintina's prediction that denitrification by native bacteria will ensure that the mine will meet groundwater quality standards after closure without any further mitigation by Tintina.	Closure groundwater quality for the Proposed Action is assessed in EIS Section 3.4.3.2. Water quality modeling and analysis completed for the proposed mine underground workings (Enviromin 2017a) indicate that all the COCs, including nitrate, would be dissolved in post-mine contact groundwater at concentrations below the estimated groundwater non-degradation criteria (Hydrometrics, Inc. 2016b). Denitrification is an established natural process integral to nitrogen cycling. For example, the Encyclopedia of Ecology (Skiba 2008) indicates that "Denitrification is a process ubiquitous to all our terrestrial and aquatic ecosystems and occurs in tropical and temperate soils, in natural and intensively managed ecosystems, in marine and freshwater environments, in wastewater treatment plants, manure stores, and aquifers." Given that denitrification is an established natural process and that nitrate loading would cease to occur at closure (no further blasting), the approach used in the MOP Application, Appendix N (Enviromin 2017a), to predict that nitrate concentrations in the

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						flooded underground would meet the groundwater non-degradation criterion is regarded as adequate. Moreover, the Proposed Action includes iterative flushing of the underground mine at closure with RO permeate. The approach includes a commitment to continue flushing/treating until the groundwater non-degradation criteria are met.
HC-003	53	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS fails to rationally analyze the measures Tintina has proposed to remove oxidation products from the mine workings after closure. Rather than use mitigation measures to limit oxidation reactions during mine operations, Tintina proposes to flush oxidation products from the mine workings after closure by repeatedly rinsing and draining the mine workings. Draft EIS at 2-15. However, this method-unlike other measures discussed in the alternatives section, above-is untested. Indeed, there are serious questions about whether it would be as effective as Tintina believes: for example, "the abundant faults and fractures" in the mine workings "(from blasting and natural sources guarantees that Tintina will not be able to capture all the highly contaminated flushed water" during each cycle of the rinse and drain process. Exhibit 17 at 12. In response to a DEQ request to provide "analysis and/or case studies" to support Tintina's assertions that repeated rinsing would restore baseline groundwater chemistry, Tintina conceded that "this is a site specific process for which there are no case studies." MOP Application Rev. 2 at 590. Given this concession, the Draft EIS should analyze whether Tintina's proposed rinsing method could fail to restore baseline groundwater quality. The Draft EIS should further compare the effectiveness of Tintina's proposed method to more conventional means of reducing oxidation product pollution, such as applying potassium permanganate or shotcrete. This additional analysis is important, because Tintina's prediction that the mine will not result in permanent impacts to groundwater quality hinges on the success of Tintina's novel rinse-and-flood procedure.	At mine closure, much of the underground workings 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. Non-degradation criteria within the underground 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 underground workings 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 rinsing would occur) is 2 to 4 years. Importantly, only upon confirmation that the quality of contact groundwater meets the proposed groundwater non-degradation 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, Inc. 2016b). Additional detailed analysis would require simulating site-specific conditions of the Project (i.e., developing underground workings, producing paste tailings and placing backfill, testing surface coatings, or rinsing methods), which would only be possible through a permitted mine disturbance. See MOP Application Section 7.3.3.9 (Tintina 2017a). In developing its MOP Application, the Proponent considered high pressure washing of the mine walls to remove stored oxidation products and the placement of shotcrete on high-sulfide zones in the workings to cover and immobilize oxidation products. Potassium permanganate and shotcrete could reduce oxidation rates on exposed surfaces but would not reduce oxidation in faults and fractures. Post-closure models predict that non-degradation groundwater criteria would be achieved without either of these measures. However, high pressure washing of the mine walls to remove stored oxidation products and the placement of shotcrete on high-sulfide zones in the workings may optimize the closure process. Implementation of one or both of these measures may allow the Proponent to conduct fewer rinsing cycles of the mine workings. The MOP Application proposes testing the high pressure washing and shotcrete strategies in localized individual heading scales once mining has begun in the USZ. If the Proponent decides to implement the high pressure washing and/or shotcrete strategies based on the results of the testing, the Proponent would be required to request a modification of its permit and DEQ would conduct the appropriate level of environmental review.

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						Also, see Consolidated Response PD-5 for more information about capturing groundwater from underground workings. See response to Submittal ID HC-003, Comment Number 25 for more information regarding mine surface treatments.
HC-003	54	Josh Purtle	Earth Justice	Hard Copy Letter	Because dewatering of underground mine workings is inherent in Tintina's project design, the project necessarily will result in significant alteration of groundwater hydrology. Yet the Draft EIS fails to rationally analyze these hydrologic changes and their resulting environmental impacts. At the outset, a complete analysis of this issue is critical because of the need to protect fisheries in the region, as discussed in Part VILE, below. Further, the mine will be built in a closed basin, in which any new groundwater appropriations are subject to stringent requirements. See MCA § 85-2-360. Tintina's proposal to create a massive groundwater drawdown cone that will reduce groundwater levels miles away from the mine site should likewise be subject to close scrutiny, including through a careful evaluation of Tintina's groundwater modeling analysis and a full disclosure of potential water quantity impacts in the region, such as potential depletion of surface waters. See MCA § 85-2-362(1 (requiring an applicant for a new groundwater appropriation in a closed basin to submit a plan to mitigate any surface water depletion that will be caused by the new appropriation). The Draft EIS's hydrology analysis is deficient first because it ignores the possibility that groundwater drawdown caused by the construction of underground mine workings will be much greater than Tintina's model anticipates. The Draft EIS concludes that geological faults near the ore body, including the Volcano Valley Fault and the Black Butte Fault, will have low conductivity, such that they will limit the extent of groundwater drawdown in the mine area. However, the Draft EIS's conclusions about conductivity are based on very limited data. "The only quantitative data" concerning fault conductivity "comes from lab permeameter tests of five gouge samples taken from exploration core." Draft EIS at 3.4-17. For three of the faults near the project area, Tintina apparently collected no permeability data at all. See Draft EIS at 3.4-15 (table indicating hydraulic properties of Black Butte Fault, Buttress Fault, and Brush Creek Fault were "assumed"). Tintina further conducted no direct tests of flow rates across any of the faults. See Draft EIS at 3.4-17; Exhibit 39 at 6 (Tom Myers, Ph.D., Technical Mem., Review of Draft Environmental Impact Statement, Black Butte Copper Project, Meagher County, Montana (May 8, 20 19). Accordingly, Tintina's hydrologic analysis is insufficient to meet the MMRA requirements to obtain and disclose "ground water and surface water hydrologic data gathered from a sufficient number of sources and length oftime to characterize the hydrologic regime," MCA § 82-4-335(5 (k , let alone MEPA's environmental review requirements. This limited data set does not preclude the possibility that the faults may feature highconductivity fractures, through which large amounts of groundwater will flow under mine drawdown conditions. Indeed, Tintina's hydrological model concedes that, based on the limited data Tintina has gathered, "[t]here is sporadic evidence of high permeability damage zones in the Neihart [geology] associated with the Buttress Fault." MOP Application Rev. 3, app. Mat 3-19; see also Exhibit 40 at 171 (Bense et al., Fault zone	Much of Section 3.4 of the EIS is dedicated to summarizing effects of the mine dewatering on the groundwater and surface water system around the proposed Project. This summary is based on the results of groundwater modeling completed by Hydrometrics. Elements of the referenced analysis indicate that loss of base flow in the nearby creeks would be minimal, while the water table would be lowered more than 2 feet for thousands of feet around the mine workings. Those drawdowns and small loss of base flow are predicted to dissipate within a few years after completion of mine dewatering. Although it is unlikely that the drawdowns and the lateral extent of a cone of depression would be much larger than predicted by the groundwater model, any model predictions are associated with uncertainties. It is well known that faults can act as either groundwater conduits or barriers to groundwater flow. The Proponent collected data indicating that some faults intercepted by the drilling are filled with gouge, which limits transmissive capacity of the fault. Also, faults, even in hydraulically active areas, are often not fully expressed in zones of shallow and weathered bedrock close to ground surface, such that their capacity for providing hydraulic connection of the groundwater system with surficial waters is limited. Fracturing in Neihart quartzite near the Buttress Fault was considered during mine design and resulted in the Proponent avoiding developing access tunnels in that area. Characterizing hydraulic properties of faults and the extent of their transmissive capacities over longer distances is difficult. Additional tests requested by the commenter would be unlikely to reduce uncertainty associated with their role in the groundwater system of the area. Recognizing that there is always some degree of uncertainty involved with groundwater model predictions, the Proponent proposed contingency plans that would mitigate higher than anticipated mine inflows. Mitigations would include grouting to limit inflows to the mine workings and excess water storage and treatment capacity. Consolidated Response WAT-1 provides a discussion of the groundwater model, its strengths and limitations, and uncertainties associated with its predictions. It also addresses the possibility of the model underestimating the effects of mine dewatering (Myers 2019a).

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					hydrogeology, 127 Earth-Science Reviews 171 (20 13 (stating that "[f]ault zones have the capacity to be hydraulic conduits connecting shallow and deep geological environments" . The Draft EIS, however, fails to account for the possibility of high-conductivity fractures in the faults. Higher fault conductivity could cause more groundwater drawdown in the project area, causing greater impacts to Sheep Creek, Coon Creek, and wetlands adjacent to those waterbodies. See Exhibit 39 at 6, 30. If the drawdown is large enough, it may impact Tintina's ability to mitigate loss of flows to Coon Creek and Sheep Creek using the non-contact water reservoir and the underground infiltration gallery. DEQ should analyze a situation in which the faults adjacent to the mine may have much higher conductivity than Tintina has assumed, and disclose whether high conductivity in the faults may alter the Draft EIS's analysis of the impacts of drawdown in the mine area. At the very least, the EIS should acknowledge "the degree of uncertainty" that mine drawdown will be greater than the limited dataset Tintina has collected suggests. See ARM 17.4.609(2 (c). Drawdown effects in Sheep Creek in particular could also be more significant than Tintina anticipates if Tintina's estimate of the contribution of groundwater from shallow bedrock to the creek is too low. There is significant uncertainty concerning the flow rate from shallow bedrock underlying Sheep Creek, in particular because the shallow bedrock could contain waterbearing fractures that Tintina has not yet detected. Exhibit 39 at 7. "[I]fthe proportion of flow from the bedrock is higher, the effect of dewatering could also be much higher." Id. at 8. DEQ should evaluate this possibility, and disclose the expected impact to Sheep Creek if shallow bedrock fractures facilitate more dewatering of the creek bed.	
HC-003	55	Josh Purtle	Earth Justice	Hard Copy Letter	In addition to failing to account for the possibility that the mine will reduce flows in Sheep Creek to a greater extent than Tintina anticipates, the Draft EIS further fails to account for potential increased flows in Sheep Creek. Because Tintina plans to discharge the treated mine water to the underground infiltration gallery and, ultimately, to Sheep Creek, greater quantities of pumped water will increase the total amount of water discharged to Sheep Creek. If the water produced by the mine is much higher than anticipated, then these discharges could increase baseflows in Sheep Creek, which would violate DEQ nondegradation standards. See ARM 17.30. 715 ("activities that would increase or decrease the mean monthly flow of a surface water" by more than fifteen percent cause unlawful degradation). In addition, greater-than-anticipated quantities of pumped groundwater could exceed the capacity ofTintina's reverse osmosis plant, creating problems for Tintina's ability to handle all of the mine's wastewater. See Exhibit 15 at 17. The EIS should evaluate these potential environmental impacts as well.	Groundwater model simulations show that groundwater discharge to Sheep Creek would decrease at the end of mining by 0.35 cfs (157 gpm) as a result of the mine dewatering (Hydrometrics, Inc. 2016a). This represents about 2 percent of the base flow in the creek (as estimated for monitoring site SW-1 near the Project area). However, since the Project would at the same time be infiltrating water via the UIG at an average rate of 398 gpm, the creek would experience a net flow gain of 241 gpm, or 3.5 percent increase of flow under base flow conditions. That gain would be larger, 418 gpm, or 6.1 percent of the creek's flow under base flow conditions, if the UIG were to be operated at its maximum design capacity. Those increases are within a 10 percent flow non-degradation criterion threshold even under the conditions of base flow (Subchapter 7 of ARM 17.30 Rule 715). Note that Sheep Creek flow is much higher than base flow most of the time, resulting in less of a relative gain in flow than previously stated.
HC-003	56	Josh Purtle	Earth Justice	Hard Copy Letter	As in its analysis of fault hydrology, the Draft EIS predicts based on limited information that the lower copper zone--one of the two sulfide ore bodies Tintina plans to mine-will produce very low flows after mine closure. Draft EIS at 3.4-39. Indeed, based on this assumption, the lower workings "were not included in the closure model" Tintina developed. MOP Application Rev. 3, app. Nat iii. However, this prediction about flow rate from the lower copper zone appears to be based on data from a single well. See Draft EIS at 3.4-25.	See Consolidated Response WAT-1 for information about assumptions in the hydrogeological model. The higher values of hydraulic conductivity produced by early slug testing of PW-7 were inconsistent with the recovery of the well after its completion - see Hydrometrics (2016a) for a discussion.

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					And even some of the data from that one well suggest that the actual flow rate may be several orders of magnitude higher than the rate the Draft EIS cites. Compare MOP Application Rev. 3, app. M at 2-9 (noting that initial tests in the lower copper zone "yielded an estimated hydraulic conductivity of 0.1 to 0.2 feet per day" with Draft EIS at 3.4-16 (stating lower copper zone flow rate was estimated at 0.00019 feet per day). Tintina and DEQ's insufficient analysis of flow rates from the lower mine workings violates the MMRA's minimum information requirements, MCA § 82-4-335(5 (k), and undermines DEQ's conclusion in the Draft EIS about post-mine closure water quality. Indeed, the flow rate from the lower workings significantly influences the mine workings' expected water quality after closure, because the lower workings contain some of the highest concentrations of sulfides and toxic metals that occur anywhere in the mine. See Draft EIS at 3.4-53 ("The highest local contributions of acidity, metals, and sulfate would come from the LCZ."). Therefore, even a slightly higher flow rate from the lower copper zone could mean that groundwater in the mine will not meet groundwater quality standards after closure. The EIS should discuss the possibility that lower copper zone flows will be higher than anticipated, and further consider whether Tintina should gather additional data, such as through drilling additional monitoring wells, about the lower copper zone's flow properties to help accurately characterize post-closure groundwater conditions.	The initial test performed on well PW-7 was a slug test, a method that generally produces less reliable hydraulic conductivity estimates than pump tests do. The water level in the well did not return to pre-test conditions during the slug test, a further indication that the test results were not reliable. A subsequent pump test of the well yielded a much lower hydraulic conductivity estimate than the initial slug test did. The results of the later test are considered to be more representative of conditions in the LCZ. Under the AMA, during mine closure, all remaining mine openings in the LCZ would be backfilled with cemented paste tailings. As a result, even if mine inflows during operations were greater than predicted in this zone, post-closure groundwater flow through the area would become negligible and contributions of contaminants from this zone to groundwater would be insignificant. Flooding of the underground workings and/or backfill areas would result in exclusion of oxygen from these areas, halting sulfide oxidation and acidity production. Even if transmissive properties of the LCZ are underestimated in the groundwater model analysis, geochemical modeling of the quality of the post-rinsing, post-closure contact groundwater indicates that it would not contribute to acidity, metals, and sulfate above the groundwater quality non-degradation criteria. See Appendix N (Enviromin 2017a) of the MOP Application (Tintina 2017a). The Proponent's Second Supplemental Response to Public Comments, Section A, Groundwater Modeling, Subsection 1, Flow Rates in the Lower Copper Zone (Sandfire 2019b), provides a discussion of the issue of low flow rates in that zone. Sections "Simulation of Mining" in Hydrometrics 2019a and 2019c provide an extensive discussion of the merits and shortcomings of model-generated predictions groundwater mine inflow rates, comparing the Hydrometrics' and Myers' models. The Proponent's Third Supplemental Response to Public Comments, Section B, Discharges from the Lower Copper Zone (Sandfire 2019a), provides additional discussion of the hydrologic characterization and quality of the Lower Copper Zone's groundwater. The discussion supports the low transmissivity assessed for that zone. Furthermore, review of the collected data and completed modeling indicate that, if the groundwater flows in the Lower Copper Zone were to be higher than used in the modeling, the quality of groundwater from that zone would be better than reported in the Draft EIS.
HC-003	57	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS fails to address the effect of subsidence in the underground mine workings on groundwater flows after mine closure. "Subsidence is an inevitable consequence of underground mining[.]" Exhibit 41 at 5 (Blodgett Kuipers, Technical Report on Underground Hard-Rock Mining: Subsidence and Hydrological Impacts (Feb. 2002 (executive summary). Subsidence of the surface or of geology below the surface due to mining activity can cause "degraded water quality, lowering of the water table, and chronically unstable ground." Id. "Consequently, the environmental impacts from mining may worsen over time as the ground continues to settle and aquifers are de-watered	Impacts from subsidence would be limited by the proposed backfilling of mine workings. Subsidence occurs when bedrock or overburden overlying an underground mine void collapses into the void. This sometimes occurs during mining operations, but often may not occur until many years after a mine has closed. Subsidence can be minimized or eliminated if underground void spaces are kept small or are completely backfilled after extraction of the ore. A review of the referenced technical report (Blodgett and Kuipers 2002) reveals that the majority of case studies cited are pre-law (i.e., mines that operated prior to the development of regulations that might impose geotechnical limitations on where

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					or degraded." Id. Subsidence may therefore have impacts on both groundwater quantity and quality after closure, and may even cause surface water flows to be depleted to a greater extent than Tintina has predicted. See id. The Draft EIS, however, does not discuss the potential impacts of subsidence. DEQ should evaluate whether "inevitable" subsidence will affect Tintina's predictions about hydrology and groundwater quality, particularly after mine closure.	underground mine voids may be created or how large they may be). All the case studies cited appear to involve mines where backfilling of mine voids was not required and little if any filling of these voids actually occurred. The "Control and Prevention" sections of the technical report cited by the commenter mention that backfilling can limit subsidence; however, backfilling is only briefly mentioned in the report, and the report does not appear to contemplate a scenario where underground mine voids are completely backfilled, as is proposed for both the Upper and Lower Sulfide Zones of the Project. Indeed, no case studies may exist that involve existing underground mines that have been backfilled to the degree proposed for this Project, so the conclusion that subsidence is "inevitable" appears to be based only on examples where large underground voids were developed without adequate geotechnical precautions and/or large voids were left underground when the mining operations ceased. See also: the Proponent's Fourth Supplemental Response to Public Comments, Section D, Subsidence (Sandfire 2019c), which addresses the issues raised in the Earthjustice Exhibits 29 and 41 associated with a potential Project-caused subsidence. Exhibits 29 and 41 are not directly comparable or relevant for the Project. The proposed drift and fill techniques would fill underground mine voids up to 95 percent with cemented paste tailings, which would create a solid mass and minimize risks of surface subsidence. As such, effects on groundwater resources is not a reasonably foreseeable impact.
HC-003	58	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS arbitrarily dismisses impacts caused by drawdown of the water table by two feet or less, which will occur at the outer bounds of the project's groundwater drawdown cone. See Draft EIS at 3 .4-1. The Draft EIS posits that two feet of drawdown will not have a meaningful impact on hydrology, because it "is within the typical range of seasonal groundwater level fluctuations observed in the monitoring wells in the Project area." Draft EIS at 3.4-1. This analysis ignores, however, that drawdown caused by the mine will be additive to natural seasonal fluctuations in the water table. Therefore, two feet of drawdown added to drawdown caused by seasonal variation will not be similar to baseline conditions. The Draft EIS should therefore provide an analysis of impacts to all areas ofthe project site that will experience drawdown, rather than just those areas where the water table level will fall by greater than two feet. See Draft EIS at 3.4-1.	There are only a few water production wells within the RSA. RSA was defined in the Draft EIS as an area within which groundwater model predicts the mine-dewatering-caused water table drawdown of more than 2 feet. A few feet of drawdown represents only a small part of a drawdown available in a typical water supply well. If mine-induced drawdown impairs the use of a well covered by a water right, the Metal Mine Reclamation Act includes conditions (§ 82-4-355, MCA) specifying compensation for the well owner. Drawdown outside such a defined RSA would be decreasing with distance from the mine, from 2 feet to no drawdown. The regional groundwater model constructed by Hydrometrics is focused on the area of the proposed mine, and a close distance around it. Due to a pronounced orography of the area and a very limited number of points outside the RSA where there are any records of depth to groundwater, the model-predicted water table elevation outside the RSA is of an approximate nature. Asking such a model to produce an area with drawdown of less than 2 feet would result in a more or less arbitrary and likely inaccurately delineated area of influence. A note: Initial EIS analyses used a much larger area as the RSA and the results of those analyses were not different from the analysis using the RSA defined as 2 or less feet of drawdown. The regional groundwater model shows only a regional water table as all the details responsible for perched conditions are below such model's resolution. In the Project area, wetlands may depend not only on groundwater, defined as water below the regional water table, but on perched water, which is water in the

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						ground but above the regional water table, and also on surface water runoff and direct precipitation. As such, lowering the regional water table, or deep groundwater associated with mine dewatering, has often only a limited effect on wetland ecosystems. The EIS Section 3.14.3.2 (Subsection, Changes in Groundwater Hydrology) includes a discussion of potential impacts on wetlands not supported by perched groundwater, located within the mine-dewatering-caused cone of depression, and in areas with water table not compensated by water injection via UIG. Such areas would likely become dominated by upland vegetation during the period when the cone of depression is present, but would likely revert back to wetland vegetation, after mining ceases and the water table rises to the baseline levels. Drawdowns predicted by the groundwater model and small loss of base flow are predicted to dissipate within a few years after completion of mine dewatering. Further details on mine flooding and groundwater level recovery are provided in Section 3.4.3.2. It is unlikely that the drawdowns and the lateral extent of a cone of depression would be much larger than predicted by the groundwater model. Springs with a water right would require replacement water if impacted. The Proponent's Second Supplemental Response to Public Comments, Section B, Comments on Groundwater Impacts (Sandfire 2019b), provides an extensive discussion of seasonal groundwater level fluctuations, groundwater impacts on surface flows and analysis of groundwater impacts on wetlands. Material presented in that section addresses the comment posted by Earthjustice. See also: Response to Submittal HC-003, Comment Number 63
HC-003	59	Josh Purtle	Earth Justice	Hard Copy Letter	It also appears that Tintina's groundwater hydrology model failed to account for a change in the location ofthe mine's underground infiltration gallery. In earlier iterations of Tintina's plan of operations, Tintina proposed to locate two underground infiltration galleries upland of Sheep Creek, and Tintina's hydrological model assumed that the UIGs would be built in those locations. See MOP Application Rev. 3, app. Mat 5-5 (Figure 5.2). However, in the proposal currently before DEQ, Tintina plans to construct only one UIG in the alluvial aquifer beneath Sheep Creek. Draft EIS at 2-3 (Figure 2.2-1). The current proposed action involves no plan to use upland UIGs. Id. DEQ should evaluate whether this change in the UIG location affects Tintina's predictions about the hydrological impacts of mine operations and, if necessary, develop a new model that accounts for this change. The Draft EIS's analysis of groundwater drawdown impacts further fails to account for the fact that the underground infiltration gallery may not operate from July through September, because of the stricter nitrate surface water standard that is in force during those months. See Draft EIS at 2-8. Because Tintina is relying on the UIG to mitigate a loss of flow in Sheep Creek due to mine drawdown, the absence of UIG flow during the summer could change the Draft EIS's analysis of potential drawdown impacts to Sheep Creek. The EIS should analyze the effect of Tintina's modified discharge plan, and disclose	Note that MOP Application Rev. 3, cited in this comment, also included an alluvial UIG adjacent to Sheep Creek (MOP Section 3.7.4.2, page 304) (Tintina 2017a). The previously proposed upland UIGs would have increased groundwater table elevations in the Brush Creek watershed area where the UIGs were proposed. This additional groundwater would have discharged to surface water in Brush Creek or further downstream in Sheep Creek, and thus would have had minimal effects on groundwater elevations elsewhere in the modeled area. Average annual discharge rates to the alluvial UIG were estimated to be 398 gpm (Draft EIS, Page 3.4-48), resulting in groundwater mounding in the Sheep Creek alluvium of less than 1 foot on average. If discharge to the alluvial UIGs were to be suspended for up to 3 months, this slight groundwater mounding would be expected to dissipate during that period, and Sheep Creek stream flow may be reduced by up to 398 gpm. Total stream flow reduction would still remain well within limitations imposed by non-degradation rules. The Draft EIS Section 3.4 discusses only alluvial UIGs, as the upland UIGs originally considered for construction are no longer proposed. It is true that Hydrometrics did not update the Regional Groundwater Flow Model to reflect that change. The consequence of this modification in plans would be a small change in the shape of the cone of depression and the mine-dewatering-caused water table drawdown southeast of the proposed mine.

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					whether it substantially changes the Draft EIS's predictions about groundwater drawdown impacts.	Instead of updating the Regional Groundwater Flow Model, Hydrometrics developed an additional model to evaluate the impacts of operating the alluvial UIG: the Sheep Creek Alluvial Flow Model (Hydrometrics, Inc. 2017c). The analysts calibrated this model using the results of field testing (Hydrometrics, Inc. 2017d), then used it to simulate groundwater mounding that would result from a continuous discharge of treated water via the alluvial UIG. The discharge was simulated by applying a constant recharge at a maximum UIG design discharge rate of 575 gpm. This approach is conservative as the UIG would be operated part-time and water would be mostly discharged at a rate below the maximum design discharge rate. Therefore, this model most likely over-predicts the effects of operating the gallery.
HC-003	60	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS further fails to properly account for groundwater mounding in the underground infiltration gallery. Tintina's groundwater mounding model assumes that water discharged to the UIG will flow through the alluvial aquifer at a rate of 200 feet per day. Exhibit 39 at 16. However, as Tintina acknowledges, literature values for flow rate through a coarse sand aquifer like the alluvial aquifer under Sheep Creek could be almost an order of magnitude lower - as low as 30 feet per day. Id. If that were the case, and effluent moved through the alluvial aquifer much more slowly, groundwater mounding could be much greater than Tintina predicts. Exhibit 39 at 17. A greater extent of groundwater mounding could impact Tintina's predictions about hydrology in the project area. DEQ should assess whether Tintina's estimate of groundwater mounding appropriately accounts for the possibility oflow flow rates in the alluvial aquifer, and determine whether lower flow rates may affect Tintina's predictions about the effluent discharges' impact on groundwater chemistry.	As described in the EIS, 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, Inc. 2017c). The model was calibrated using measured groundwater levels, results of aquifer testing (Hydrometrics, Inc. 2017c), and results of the alluvium infiltration testing program (Hydrometrics, Inc. 2017d). The analyses simulated the maximum design discharge rate (575 gpm) distributed evenly within the proposed infiltration trenches. Regarding the permeability of the Sheep Creek alluvial aquifer, the commenter selectively quotes from a technical memorandum (Myers 2019b) implying that the 200-foot-per-day permeability used in modeling is unreasonably high compared with literature values. Fetter (2001) notes that coarse sand aquifers may have permeabilities ranging from 30 to 300 feet per day. The value used in the modeling falls within this range, but more importantly, it is not based on generic examples cited in literature, but rather on an actual pumping test conducted on a well installed in the Sheep Creek alluvium within the area where the UIGs are proposed to be constructed. It might be reasonable to assume that the aquifer has a permeability near the lower end of the range provided in literature. However, that is not the case here as the on-site testing was done with results indicating aquifer characteristics well within the expected range. A lower aquifer permeability would not alter predictions about groundwater chemistry; rather, it would result in excess groundwater mounding near the proposed drainfields. If this were to result in groundwater rising to the land surface, remedial actions could be initiated to address this issue. The field data collected supporting the analysis and modeling of injecting water via UIG is strong and adequate. The analysis based on that data shows that such injection would not cause excessive mounding or flooding of surface water. Since aquifer permeabilities may vary locally from one alluvial infiltration gallery to the next (seven are proposed), discharge rates to alluvial UIGs in lower permeability areas could be reduced while discharge rates to other galleries in higher permeability areas could be increased. This would result in more even

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						groundwater mounding throughout the aquifer (predicted to be less than 1 foot of mounding on average). Other remedial actions such as construction of additional UIG lines or decreasing the rate of injection might need to be undertaken. This would also have the effect of spreading the discharge out more evenly through the aquifer, resulting in less groundwater mounding at any given location.
HC-003	63	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS does not rationally evaluate the impacts of drawdown on groundwater dependent ecosystems in the project area. Groundwater dependent ecosystems are “(c)ommunities of plants, animals and other organisms whose extent and life processes are dependent on access to or discharge of groundwater,” including “[s]prings, seeps and many wetlands, . .. [m]ost perennial streams, [and] many lakes and their associated riparian areas.” Exhibit 42 at 3 (Christopher Carlson, U.S. Forest Serv., Groundwater Dependent Ecosystems on National Forest System Lands: Recognizing and Managing a Largely Overlooked Resource). According to the U.S. Forest Service, groundwater dependent ecosystems in many watersheds “support a disproportionately large percentage ofthe total biodiversity relative to their size.” Id. at 9. The Draft EIS states that “[b]aseline 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.” Draft EIS at 3.4-41. ... These general statements about potential impacts to groundwater dependent ecosystems, including springs and seeps, do not satisfy MEPA’s “hard look” requirement. See Mont. Wildlife Fed’n, P 43. The Draft EIS should clarify which springs and seeps in the project area will be dewatered due to mine operations. In particular, the EIS should specify which springs are connected to perched groundwater aquifers and which are connected to a deeper groundwater system that would be affected by mine drawdown. Without this hydrologic information, it is impossible to evaluate the potential impacts of this project. Further, the EIS should clarify which springs (if dewatered will require replacement water, as mentioned in the Draft EIS. The Draft EIS should also provide accurate baseline data to characterize all groundwater dependent ecosystems in order to evaluate the potential impacts to these important ecological communities. Such baseline data should include an inventory of all groundwater dependent ecosystems that could be affected by mine activities. Without such data, DEQ cannot rationally conclude that the project’s impacts to such ecosystems will be insignificant. See N. Plains Res. Council, Inc., 668 F.3d at 1085 (holding that significance analysis must be based on adequate baseline information).	The recharge to the groundwater system assumption used in the EIS is based on a hydrological modeling report by Hydrometrics (Hydrometrics, Inc. 2016a). Section 2.6.1 of that report provides a discussion, regional data, and rationale for using 10 percent precipitation as recharge. The report states that “Infiltration rates of 10 percent to 15 percent of annual precipitation are commonly assumed as a reasonable approximation of groundwater recharge rates in modeling analyses of intermountain basins in western Montana (Briar and Madison, 1992).” The approach to estimate recharge to groundwater adopted by Hydrometrics is a standard practice of groundwater modeling; it is based on the only available, recharge-relevant quantitative data. While Myers proposes to vary recharge rates across the modeled domain based upon various factors, there is no quantitative data to establish their quantitative influence upon recharge. Myers (2019a) also concludes (see Exhibit 39, Appendix A, Section 7.0 Summary of Notable Findings, page 73) that “the overall recharge was 2.5 inches per year, the same as determined by Hydrometrics.” The scientific literature proposed many methods for estimating the rate of groundwater recharge; many of these methods are debated by reviewers and are not well-verified (or verified at all) by field measurements. This is why a simplified approach is routinely adopted by analysts and modelers. The phrase “often” reflects the general experience with groundwater models and it is used to provide a wider context for these comments and responses. The environmental impact analysis referenced various reports that were reviewed for the analysis. The analysis and information in the Hydrometric’s reports about the model set up, its calibration, simulations, and simulation reports were assumed to be accurate. The actual model was not audited. Audits are sometimes carried out when the reviewers have substantial doubts about model report content. More detailed discussions could be provided in the EIS of the underlying assumptions and/or completed analysis; however, the EIS must balance between the opposing needs of the EIS text: a need to present as much relevant information as possible, and a need for clarity and easy understanding of the presented text for a non-technical readership. Section 3.14.3.2 of the EIS (Subsection, Changes in Groundwater Hydrology) includes a discussion of potential impacts on wetlands not supported by perched groundwater, located within the mine-dewatering-caused cone of depression, and in areas with the water table not compensated by water injection via UIG. Such areas would likely become dominated by upland vegetation during the period when the cone of depression is present, but would likely revert back to wetland vegetation after mining ceases and the water table rises to the baseline levels.

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						Drawdowns predicted by the groundwater model and small loss of base flow are predicted to dissipate within a few years after completion of mine dewatering. Further details on mine flooding and groundwater level recovery are provided in Section 3.4.3.2 of the EIS. It is unlikely that the drawdowns and the lateral extent of a cone of depression would be much larger than predicted by the groundwater model. Springs with a water right would require replacement water if impacted. The Final EIS has been updated to include assessment of wetlands that could be impacted by the Project (Section 3.4, Groundwater Hydrology; Section 3.14, Wetlands).
HC-003	64	Josh Purtle	Earth Justice	Hard Copy Letter	Further, the Draft EIS does not evaluate whether Tintina's proposed mine dewatering will comply with the Montana Water Use Act. Any company seeking to appropriate surface water in this state must normally apply for a beneficial water use permit under the Water Use Act. MCA § 85-2-302. A permit applicant must prove by a preponderance of the evidence that specific statutory criteria are met, including that water is "legally available during the period in which the applicant seeks to appropriate, in the amount requested." MCA § 85-2-3ll(l)(a)(ii). Legal availability ofwater demands a thorough analysis of not only the impact on existing water rights users from surface and groundwater drawdown, but also an analysis of other existing legal demands on the surface and groundwater, such as quantitative and qualitative water quality standards. See id. The Draft EIS should evaluate whether Tintina's proposal to pump groundwater from the mine void in a manner that will remove surface water from Coon Creek and Sheep Creek requires a water use permit under section 85-2-302. The Draft EIS should also evaluate whether Tintina can lawfully acquire a use permit for its planned dewatering, given the significant impacts on the quantity and quality of water in these bodies that the groundwater pumping will entail.	DNRC will review all applications for water rights permits.
HC-003	65	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS further fails to accurately characterize the expected rate of precipitation recharge to groundwater. The Draft EIS assumes that average groundwater recharge is equal to "10 percent of mean annual rainfall" in all areas of the project site. Draft EIS at 3.4-36. This assumption of uniform ten percent recharge ignores, however, that "different geology types will accept different percentages of precipitation," such that recharge in some parts of the project site will be much greater than in others; that "the proportion of recharge as a proportion of precipitation increases with precipitation amount"; and the effect of "mountain front recharge, which is the tendency of runoff from mountainous areas to become recharge at the base of the mountain," Exhibit 39 at 9-10. Because the amount and distribution of recharge affects Tintina's model concerning hydrology at the mine site and the impacts of groundwater drawdown, the EIS should revisit its unsubstantiated assumption about the expected amount of groundwater recharge and determine whether altering that assumption will change the results of Tintina's hydrology model. Exhibit 39 at 10.	The amount of recharge to groundwater used in the EIS is based on hydrologic modeling carried out by Hydrometrics (Hydrometrics, Inc. 2016b). Section 2.6.1 of that report provides a discussion, regional data, and rationale for using 10 percent of precipitation as recharge. This value closely matches observed steady state base flows of the creeks (Hydrometrics, Inc. 2016b, Table 2-2) and is consistent with typical infiltration rate estimates for other intermountain basins in this region. PRISM spatial climate datasets (Parameter-elevation Regressions on Independent Slopes Model) were used to derive a spatial distribution of precipitation over the model domain. Such data reflect many factors, including elevation (orographic effect) and aspect (slope orientation). Numerous other factors influence the rate of groundwater recharge. These include type of vegetation, steepness of slopes, soil type, land use, and depth to water table. It is not standard practice to consider the latter parameters as it is simply not practical or meaningful to quantitatively consider these factors. The most common and practical method used here evaluated recharge to groundwater using a general water balance derived from measured/estimated base flows of the creeks and rivers draining the model domain.

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						Recharge is most often a much less sensitive model parameter, compared to other parameters, like transmissive properties of the rock formations holding groundwater. Subsequently, divergence of the assumed values of recharge from the on-site values of recharge (which are difficult to measure on a smaller scale of a watershed) is of a lesser consequence for the model predictions compared to assumptions about the values of other model parameters. Actual on-site recharge rates would vary from one location to another based on various factors. Attempting to input variable recharge rates across the modeled area based on each individual slope, aspect, soil type, vegetation community, underlying geology, etc., would necessarily result in entering values into the model that are somewhat arbitrary and unverifiable. Instead, the average recharge rate across the entire model domain was estimated using actual precipitation and stream discharge data and was determined to be approximately 10 percent of mean annual precipitation averaged for the watershed. Specifically, average precipitation for the upper Sheep Creek watershed was calculated to be 25.1 inches per year, making the average recharge rate approximately 2.5 inches per year. Note that while Myers (2019a) argues that actual recharge rates would vary across the modeled domain based on the factors mentioned above, he also concludes (see Exhibit 39, Appendix A, Section 7.0 Summary of Notable Findings, page 73) that “the overall recharge was 2.5 inches per year, the same as determined by Hydrometrics.”
HC-003	66	Josh Purtle	Earth Justice	Hard Copy Letter	Finally, the Draft EIS should provide new figures to illustrate the results of Tintina’s hydrological modelling. Many of the figures currently in the Draft EIS’s groundwater section are almost illegible, and it is difficult to determine the geographic extent of the modeled drawdown from these figures. See. e.g., Draft EIS at 3.4-42-3.4-43. New figures are essential to the public’s understanding of the expected extent of drawdown impacts.	More legible figures are presented in the EIS.
HC-003	68	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS also fails to assess the effectiveness of Tintina’s proposal for ensuring that groundwater meets nondegradation standards after the mine is closed. Tintina plans to repeatedly rinse and drain the workings after mining is complete in order to eliminate pollutants in the contact groundwater. However, as discussed, this method has never been tested in another facility before, and it is not known whether the rinse-and-drain method will be adequate to restore baseline groundwater quality conditions. Relatedly, the Draft EIS fails to adequately address Tintina’s assumption that naturally-occurring bacteria will consume 90% of all the nitrate remaining in groundwater after closure, thus ensuring that groundwater eventually meets the nondegradation standard for nitrate. As discussed, Tintina has cited no evidence or scientific research to support this assumption.	At mine closure, much of the underground workings 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. Non-degradation criteria within the underground workings 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 underground workings would continue to be captured and treated. Treatment of water from the underground mine would likely occur late in the closure phase. Importantly, only upon confirmation that the quality of contact groundwater meets the proposed groundwater non-degradation 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, Inc. 2016b). Regardless of whether or not residual nitrate in the mine workings would be consumed by naturally occurring bacteria, the proposed rinsing of mine workings would effectively remove most nitrate from exposed surfaces underground. It is

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						also reasonable to assume that the proposed rinsing with unbuffered RO permeate (essentially, distilled water) would dissolve most soluble oxidation products from exposed surfaces underground, and that these minerals would be the primary sources of dissolved metals in the initially flooded mine workings. Once the rinsing is complete, paste backfilling of the remaining mine openings within the zones of sulfide bedrock would greatly limit the volumes of groundwater that could occupy these areas, and also the ability of that groundwater to migrate into nearby aquifers. Also, see response to Submittal ID HC-003, Comment Number 53. The Montana DEQ's experience with closure of underground mines by natural flooding indicates that nitrate levels in mine discharges typically decline to within groundwater non-degradation criteria within a year or two. Instead of natural flooding, the BBC Project proposes a more aggressive (with respect to lowering nitrate levels) method of closing the mine by intentional rinsing, draining, and reflooding cycles.
HC-003	75	Josh Purtle	Earth Justice	Hard Copy Letter	The Draft EIS further fails to give due consideration to potential water quality impacts in Sheep Creek and other surface waters in the project area. As discussed, DEQ's draft MPDES permit for the project fails to require compliance with all governing water quality requirements on Sheep Creek, including the implementation oftechnology-based effluent limitations for stormwater discharged from the project site; measures to comply with the pending total maximum daily load standard for aluminum in Sheep Creek; and measures to comply with the zero process wastewater discharge requirement. Further, the Draft EIS does not address potential temperature impacts to Sheep Creek due to mine discharges, including discharges from the treated wastewater storage pond, which will hold mine effluent during the hot summer months until Tintina can resume discharges to the UIG in October. Instead, the Draft EIS relies on an unsupported assumption that the UIG flows will equilibrate to groundwater temperature before they reach Sheep Creek. The Draft EIS further relies on Tintina's unsupported assumption that nitrates in groundwater will naturally disappear after mine closure in concluding that groundwater will not discharge nitrate pollution to surface waters in the project area. The Draft EIS also does not account for potential pollutant discharges due to pipeline leaks or seepage through liners underneath various mine facilities or the potential for flows in the underground infiltration gallery to leach pollutants from the surrounding geology. And most importantly, the Draft EIS does not evaluate the risk that the CTF will fail to hold tailings in place over the long term, thus causing a massive discharge of acid-generating mine waste to Sheep Creek and the Smith River.	Potential effects on surface water quality, including impacts on Sheep Creek, are discussed in Section 3.5.3.2, Surface Water Quality and Temperature, of the EIS. The Proponent has used hydro-geochemical monitoring, hydrogeological modeling, and geochemical testing data to design its underground workings, TWSP, and WTP to minimize potential impacts on water quality. Apart from groundwater in the underground workings at the end of the closure phase, water from all facilities would be collected and treated to meet non-degradation criteria prior to discharge (Hydrometrics, Inc. 2016b). The Project is proposed to be an underground mine and a primary planned mitigation measure is that the only significant amounts of Project contact water would be excess water sent from the WTP to the UIG; 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). See Consolidated Response WAT-5 for additional data and discussion of potential thermal effects on water resources in the Project area. Potential thermal effects resulting from the NCWR discharge are discussed in Zieg (2019d); potential thermal effects resulting from discharge from the TWSP are discussed in Zieg (2019b). Consolidated Responses PD-3, PD-4, and PD-5 address concerns regarding the CTF and its performance.
HC-003	80	Josh Purtle	Earth Justice	Hard Copy Letter	The EIS further fails to evaluate the real potential for long-term groundwater contamination associated with constructing the CTF foundation within the water table. As discussed above, the Draft EIS dismissed an alternative that would place the CTF above the groundwater table, thus avoiding groundwater pressure on the bottom liner of the CTF that could cause groundwater contamination if the liner were to fail. The Draft EIS asserted that any impacts caused by groundwater pressure on the bottom ofthe CTF would be "de	A summary of CTF design features and seepage analysis during operations and closure report produced by Geomin (Geomin 2018) states that "Operationally, and in closure, the CTF has a Foundation Drain System that transports groundwater from beneath the excavated facility in in a drainage collection system consisting of gravel and perforated pipes in trenches excavated into bedrock beneath the facility. This water is transferred from the collection system to a foundation drain pond outside of the CTF and pumped from there to the

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					minimus [sic].” Draft EIS app. B at 6. Yet the Draft EIS itself acknowledges the need, in determining the actual extent of such impacts, to evaluate the nature of the water table beneath the CTF (that is, whether it is part of a perched or regional system), as well as “whether [groundwater] mounding would occur.” Draft EIS app. Bat 5-6. The Draft EIS, however, does not perform the analysis it itself identifies as necessary to understand this potential impact. Further, as discussed in the Chambers and Zamzow comments, building the CTF within the water table creates a serious risk of groundwater contamination: “[W]hen the [CTF] liner system sits below the water table, it is susceptible to groundwater flow entering the seepage collection system, or even into the impoundment itself, if there are flaws, tears or breaks in the bottom liner.” Exhibit 14 at 4; Exhibit 15 at 16. Constructing the CTF within the water table thus greatly exacerbates the risk that defects in the CTF liner will lead to tailings material contaminating groundwater. See Exhibit I5 at 16. DEQ itself raised concerns about Tintina’s proposal to build the CTF and other facilities within the water table in its review of Tintina’s mine operating permit application, agreeing that this plan “may allow interaction with solutions within the impoundments and groundwater.” First Deficiency Review at 62. The Draft EIS, however, fails to address this concern, asserting implausibly and contrary to DEQ’s own permit application comments that “there would be no environmental benefit to water quality or flow by elevating the CTF” above the water table. Draft EIS at 2-20; see also Draft EIS app. B. DEQ should therefore reevaluate the potential impact of placing the CTF foundation within the water table.	WTP prior to discharge. By removing water from beneath the CTF, the foundation drain system prevents the build-up of any hydrostatic pressure or head beneath the CTF facility’s liner system and therefore eliminates the risk of upward migration of groundwater through the bottom HDPE liner of the CTF and any risk of floating the liner during construction.” This report also describes other CTF design features aimed at reducing risks of environmental impacts, and includes an investigation completed to evaluate groundwater below the proposed CTF. Short of major failure of the proposed design features, it is highly unlikely that the CTF-impacted water would cause significant groundwater contamination. Regardless, a long-term groundwater monitoring system would be implemented to signal any impacts. A remedy system would also be put in place to prescribe triggering criteria and methods of response. The Proposed Action and AMA require the Proponent to conduct groundwater and surface water monitoring. In summary, drilling at the proposed CTF site concluded that given the proposed depth of excavation to create the impoundment site, localized areas of the excavation would extend up to a few feet into bedrock that is currently saturated. It is likely but not certain whether that saturation is the result of localized recharge that would be eliminated by the placement of a liner over the CTF foundation (in which case, once the groundwater present in those areas is drained, no more would flow in). Regardless of whether construction of the impoundment would eliminate the source of this groundwater, the proposed foundation drain system would intercept any water beneath the impoundment and convey it out from beneath the facility. As a result, the drain system would lower the groundwater table such that it remains within the drains beneath the impoundment. Therefore, the CTF itself, including its liner system, would not be located within the water table and there would not be upward pressure on the liner system. The commenter notes that DEQ asked questions about the Proponents's proposed CTF foundation design during initial deficiency reviews. Responses to those reviews clarified the design details and addressed the concerns, which is not implausible—rather, it is the intended function of a deficiency review.
BBC00745	2	Mark Kuipers	WestSlope Chapter of Trout Unlimited	Email	This mine seriously risks reducing flows and increasing pollution of the Smith River’s most important trout spawning tributary. The company and the dEIS grossly underestimate how much groundwater connected to the Smith River headwaters will flow into the mine and must be treated for toxic contamination before being pumped back into the ground.	See Consolidated Response WAT-1 regarding hydrogeological model and underestimation of groundwater inflows, and WAT-4 regarding dewatering affecting Sheep Creek flows.
BBC00745	3	Mark Kuipers	WestSlope Chapter of Trout Unlimited	Email	The water the company plans to pump back into Smith River tributaries, so they don’t dry up due to mining activities, is highly likely to contain more acidity, nitrates, or toxic metals than the dEIS admits. Additionally, the replacement water will be much higher temperature than natural stream flow. All of those changes in water quality are harmful to aquatic life, fish, and stream habitat.	Potential effects on surface water, including impacts on the Smith River and its tributaries, are discussed in Section 3.5.3.1, Surface Water Quantity, and Section 3.5.3.2, Surface Water Quality and Temperature, of the EIS. The Proponent has used hydro-geochemical monitoring, hydrogeological modeling, and geochemical testing data to design its underground workings, TWSP, and WTP to minimize potential impacts on surface waters. Excess water sent from the WTP to the UIG represents the only significant amount of Project-related contact water. The water released to the alluvial aquifer via the UIG during the mine construction and production phases would be treated to guarantee compliance with groundwater standards and non-degradation criteria

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						per the MPDES permit (Hydrometrics, Inc. 2018a; Tintina 2018a). Refer to Consolidated Response WAT-5 for additional data and discussion of potential thermal effects on water resources in the Project area.
BBC00745	4	Mark Kuipers	WestSlope Chapter of Trout Unlimited	Email	The dEIS hasn't properly considered how to keep toxic waste from this mine out of groundwater and surface waer connected to the Smith River system. It also has failed to evaluate the high likelihood that waste from this mine will create acid mine drainage laden with heavy metals like arsenic.	Potential effects on surface water, including impacts on the Smith River and its tributaries, are discussed in Section 3.5.3.1, Surface Water Quantity, and Section 3.5.3.2, Surface Water Quality and Temperature, of the EIS. The Proponent has used hydro-geochemical monitoring, hydrogeological modeling, and geochemical testing data to design its underground workings, TWSP, and WTP to minimize potential impacts on surface waters, including any effects caused by development of ARD. Excess water sent from the WTP to the UIG represents the only significant amount of Project-related contact water. The water released to the alluvial aquifer via the UIG during the mine construction and production phases would be treated to guarantee compliance with groundwater standards and non-degradation criteria per the MPDES permit (Hydrometrics, Inc. 2018a; Tintina 2018a). See also Consolidated Response CUM-3.
BBC00589	2	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers	Email	The DEIS defines the regional study area (RSA as "an area that could experience groundwater drawdown of more than 2 feet due to mine dewatering, as computed by the groundwater model" (DEIS, p 3.4-1, emphasis added). This is the wrong way to define an RSA. A study area should include all areas within natural boundaries, which generally should be a no flow boundary such as a groundwater divide or a discharge boundary, such as to a river.	The EIS initially defined the RSA as the model domain area of the Hydrometrics Regional Groundwater Flow Model (Hydrometrics, Inc. 2016a), which encompasses the major watersheds in approximately the middle third of the Sheep Creek drainage. Later, the EIS considered this area no longer appropriate due to its large size. Unlike watersheds, natural boundaries of a groundwater system are often difficult to determine. The rationale used for defining the EIS RSA was based on considering an area within which the Project-related impacts on the groundwater system could occur. The definition of RSA in the Final EIS has been updated, excluding areas where no "significant Project-related impacts" on the groundwater system are expected (rather than "no impacts"). The results of groundwater impact analysis conducted using the original larger RSA were no different than the results obtained using a smaller RSA.
BBC00589	4	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers	Email	Pumping test or slug tests were the primary source of field-based data for estimated K at the site. Based on the Baseline Water Resources Report (Hydrometrics 2016), there were 25 tests completed of the seven different formation types at the site, or just over three property tests per formation type. Even if all the tests were equally valid in providing information regarding the properties, three tests per formation would not provide sufficient observations to estimate natural variability for the site. It certainly would not be enough to estimate flow paths. Slug tests and short-term pump tests represent a very small portion of the aquifer and provide very little information about the overall formation, therefore they are not very useful at describing flow in the study area, as described in the next paragraph. Short-term tests represent properties over a very small volume. In general, the representative volume is the amount of water pumped divided by the effective porosity (Schulz-Makuch et al. 1999); this effectively means a sample volume	The EIS analysis is based on the mine site-specific information gathered for the Project via monitoring, testing, and other methods. The collected information was sufficient and judged appropriate for issuance of the draft permit and suitable for the analysis in the EIS for disclosing potential impacts from the proposed Project. The Proponent's Second Supplemental Response to Public Comments (Sandfire 2019b) provides an extensive discussion addressing this comment. Section 2, Inadequate Testing of Permeability/Fault Conductivity, summarizes an extensive scope of hydraulic testing and hydrogeological investigations completed for the Project. That summary points out that: (1) The Proponent conducted long-term (24 to 72 hours) pumping tests on numerous wells with multiple wells used as observation points, covering all the

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					including all pore spaces affected by the pumping. Figure 1 shows an example from the literature of variability for a fracture-flow media, the type of media that controls the flow at Black Butte. K varies over seven orders of magnitude in this example; Schulz-Makuch et al. (1999 present data from other fracture flow examples. The single-well tests with water removed over only a few minutes (Hydrometrics 2017 would have volumes similar to those presented for packer tests in Figure 1. The K for those tests is about four orders of magnitude less than that observed at the point where the relation becomes stable. Becoming stable means that K is relatively constant even as volume is added to the sample for which K is being estimated. This is tantamount to the relative elemental volume concept which is the volume at which the effective porosity no longer changes as volume is added to the sample (Bear 1979). Small-scale measurements control local flow while the larger-scale measurements control regional flow, which can be estimated without understanding localized details. A mine that intersects and excavates significant portions of a formation affects flow at a regional level and therefore needs property measurements at the large scale. Large-scale measurements are needed to calibrate a groundwater model. Tintina presents just two large-scale pump tests that may provide a property estimate at the scale necessary to estimate the effects of dewatering.	hydrostratigraphic units of the mine workings (this addresses the issue of the scale of the test and the scope/number of tests completed). (2) Testing of wells near the faults (PW5 near the VVF fault, and PW-6 near the Buttress fault) indicated that there was no additional flow from the faults or fracturing in the immediate vicinity of the faults. This is consistent with the presence of low-permeability fault gouge commonly encountered in boreholes completed for the Project. (3) The groundwater model was subject to sensitivity analysis to the assumed/inferred hydraulic properties of the faults and the model-predicted mine groundwater inflow rates. Increasing permeability of the fault zones by one order of magnitude resulted in poorer model calibration and did not result in notable changes in the mine groundwater inflow rates.
BBC00589	5	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers	Email	PW-8 31-day Aquifer Test (Hydrometrics 2017, p 3-7 to 3-9 : PW-8 is completed in YNL-A shale just above the USZ, with perforations from 138.5 to 178.5 feet bgs, which spans the first zone from which water entered the well bore. PW-8 lies near the east boundary of the upper ore deposit. An observation well, PW-4, 23 feet to the NE, had maximum drawdown of 6.5 feet and PW-3, 709 feet south, had maximum drawdown of 2.4 feet. PW-4 and -3 were screened from 200-239 and 90-127 feet bgs in USZ and YNL-A, respectively. This test shows a connection between the formations. PW-9 19-day Aquifer Test (Hydrometrics 2017, p 3-9 to 3-11): PW-9 was completed in the USZ from 215.5 to 255.5 bgs, as well as MW-3 from 285 to 305 feet bgs. Observation wells MW-9 and -10 are completed above and below the USZ, with MW-9 completed in YNL-A from 108 to Myers Review of Black Butte Draft Environmental Impact Statement 5 128 feet bgs. There is no completion information for MW-10. The screen for MW-9 is vertically separated from that for PW-9 by more than 80 feet, so it may not be appropriate to attribute the small drawdown in MW-9 as evidence of a lack of connection between the formations. Otherwise, there is a significant drawdown of 12.4 feet in MW03 which is 380 feet west which suggests that drawdown would propagate through the USZ. Recommendation: Additional pump tests should be completed to increase the data set of large-scale formation properties. New monitoring wells should be located based on the need to determine aquifer properties for different formations at different aquifer levels, since properties change with depth. Tintina should perform pump tests designed to estimate aquifer properties in all flow zones identified by well logs and geophysical logs.	The EIS analysis used the results of years of on-site research, including borehole drilling, well installation, aquifer testing, examination of drill cores from exploration drilling, and geologic mapping. The collected information was judged sufficient and appropriate for issuance of the Draft Permit. The following response letters from the Proponent provide a substantial body of information addressing most of the details of the comment: • The Proponent's Second Supplemental Response to Public Comments, Section, Inadequate Testing of Permeability/Fault Conductivity (Sandfire 2019b). • The Proponent's Fourth Supplemental Response to Public Comments, Section F, Water: Exhibit 39 (Sandfire 2019c). • Technical Memorandum – Initial Review Comments on the Tom Myers Black Butte Modeling Report, Section "Geologic Formation Zones" (Hydrometrics, Inc. 2019a). • Technical Memorandum – Supplemental Comments on Myers' Modeling Report of Black Butte Copper Project – DRAFT, Section "Geologic Formation Zones" (Hydrometrics, Inc. 2019c). DEQ concurs with the information and conclusions submitted by the Proponent as listed above. Also, refer to Consolidated Response WAT-1 for additional discussion regarding accuracy of the "Myers model" (Myers 2019a).
BBC00589	6	Tom Myers	Prepared for: Montana Trout Unlimited, Trout	Email	The shallow Lower Newland Shales had boreholes that produced yields of 5 to 30 gpm (DEIS, p 3.4-16). These observations are meaningless without the well screen length. The mineralized shales have K lower than the surrounding shales	Hydrometrics' July 18, 2019 Technical Memorandum (Hydrometrics, Inc. 2019a) provides a discussion of the way Tom Myer conceptualized the Newland Formation and its hydraulic properties and represented it in his groundwater

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			Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers		(Id.), which means that groundwater would flow around the mineralized zones rather than through them during pre-mine conditions. The deeper Lower Newland Shales have even lower K, estimated to range from 0.001 to 0.007 ft/d. Mining the deep, low-K ore will create a high-flow zone and change natural flow paths substantially. Calibrated K values from the Hydrometrics groundwater model range from 0.0003 to 3.85 ft/d (DEIS, p 3.4-16). This formation is shallow and lies north of Sheep Creek. It controls both recharge locations and flow toward Sheep Creek from the north. With K varying over five orders of magnitude, there would be highly concentrated flow near the high K zones. However, there are no field tests that support such a range in K. Myers (2018 calibration yields a range as well, but not as extreme as Hydrometrics with the lowest K at 0.0107 ft/d (Myers 2018, Table 1).	model. That discussion points out several ways in which his representations are not supported by the field data and tests. It also points out inconsistencies between Table 1 and the graphics in Appendix C of the Myers (2019a) report. Hydrometrics notes that Myers' model accommodates a high level of complexity of formations outside the Project area where there is no data to support it, while not setting model parameter zones for key units within the immediate Project area. Hydrometrics also points out that hydraulic conductivity values assigned to various bedrock units in the immediate Project area vary significantly from the values assigned in the Hydrometrics' model. This is particularly the case for the Newland Formation. Hydrometrics makes a statement that "Myers appears to have utilized from tests in the unmineralized upper Newland to represent the upper 6 layers in his model which extend to a depth of 1,000 feet, disregarding the lower permeabilities representative of the mineralized zones and deeper (Ynl-B) strata. This would account for the higher rates of inflow in his model for the access tunnels through the upper ore zone." The Hydrometrics Technical Memorandum also provides a discussion of many other differences between the Myers and Hydrometrics models. The following response letters from the Proponent provide a substantial body of information addressing most of the details of the comment: • The Proponent's Second Supplemental Response to Public Comments, Section, Inadequate Testing of Permeability/Fault Conductivity (Sandfire 2019b). • The Proponent's Fourth Supplemental Response to Public Comments, Section F, Water: Exhibit 39 (Sandfire 2019c). • Technical Memorandum – Initial Review Comments on the Tom Myers Black Butte Modeling Report, Section "Geologic Formation Zones" (Hydrometrics, Inc. 2019a). • Technical Memorandum – Supplemental Comments on Myers' Modeling Report of Black Butte Copper Project – DRAFT, Section "Geologic Formation Zones" (Hydrometrics, Inc. 2019c). DEQ concurs with the information and conclusions submitted by the Proponent as listed above.
BBC00589	7	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center,	Email	DEIS Table 3.4-2 describes all four area faults, Volcano Valley Fault (VVF , Black Butte Fault, Buttress Fault, and Brush Creek Fault, as having a clay gouge core, with variable associated fracturing. The gouge is "finely pulverized rock that typically alters to clay and exhibits low permeability" (DEIS, p 3.4-17). Variable fracturing means the properties vary substantially along and across the fault. If consistent along the fault, the clay gouge core could limit flow across the fault but if it is not consistent, there would be concentrated flow at any point there is not clay. Based on lab permeameter tests of gouge samples, measured K ranged from 1.5x10-5 to 7.1x10-4 ft/d. The DEIS and modeling	Hydrometrics' Hydrologic Modeling report (Hydrometrics, Inc. 2016a), Horizontal Flow Barriers sub-section provides a discussion of the available lithologic data for the fault zones. It provides that, "Site data did not show increased permeability in the vicinity of the faults within the Newland shales and there is limited and mixed evidence for the presence of a well-developed damage zones in other units." And that "gouge that was present in all coreholes/boreholes which penetrated faults in the project area." The subsection titled "Buttress Fault" provides that test well PW-6 did "encounter a fractured interval in the Neihart approximately 175 feet after passing through the Buttress fault that produced high

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			EarthWorks, American Rivers		assumed the geometric mean, 2.8x10-5 ft/d, applies to the core of all major fault zones in the area. There was no directional difference in the K values meaning the faults are treated as not allowing for flow along their strike. These tests are representative of only a very small volume of the faults and are subject to scale issues discussed above. The DEIS references no tests that assess the flow across the fault, meaning that statements that the fault prevents flow have no evidence supporting them. Additionally, the DEIS failed to discuss the aquifer tests that were discussed by Tintina (2017, p 59). For the VVF and Buttress Fault, aquifer tests indicated K ranged from 0.004 to 0.09 ft/d, but they dismiss these results without reason due to effects well casing and annulus storage and rely on the permeability tests discussed above to assume the permeability is orders of magnitude lower. The DEIS and modeling should use K values from the pump tests described above, not the small-scale permeability tests. This is very important especially for the VVF because it separates the mineralized zone from shallower zones that would be affected by dewatering. Hydrometrics (2016, p 3-19 treats the faults as a horizontal flow barrier with K based on the permeameter test, confirming that there is little support for the model values. Using the higher K values for the analysis would result in a higher dewatering rate. Myers (2018 found that his model solutions were very sensitive to HFB conductance and recommended that much additional work be done to characterize the properties of the faults. Additional information demonstrates why the faults should not be considered such a flow barrier. Pumping an open bore-hole in the Neihart quartzite adjacent to the Buttress Fault yielded more than 500 gpm which confirms there are high permeability fractures at least within that formation (DEIS, p 3.4-19). This pumping also demonstrates the fallacy of the assumptions of low K in both the faults and deep bedrock. This rate exceeds groundwater model predicted dewatering rates which indicates the entire basis for predicted groundwater impacts could be completely wrong. Myers (2018) estimated dewatering rates overall could be as high as 2000 gpm due to the potential for fractures. However, there is variation that indicates there are variable confined and leaky confined conditions in the bedrock aquifer. Because these factors are highly indicative of the state of flow in the system and show where dewatering could have more connection to the surface, the DEIS should present a map showing the locations of leaky confined conditions. If there is insufficient data to complete a map, there is insufficient information to form an accurate conceptual flow model and to predict the impacts of the project.	yields and resulted in artesian flow conditions. This could be supplementary fracturing from the Buttress fault at a deeper interval in the Neihart, since the borehole is still in proximity to the Buttress fault at this depth. The fracturing and associated permeability encountered in the Neihart at depth at this location does not appear to extend vertically upward. There are 11 exploration boreholes that penetrate the Buttress fault and extend into the Neihart. The boreholes show variable degrees of fracturing in the Neihart associated with the Buttress Fault with some locations encountering competent rock with minor fracturing and others showing high angle fractures in the quartzite adjacent to the fault. Significant flow with artesian pressures was only noted at one of the exploration borehole sites.” Finally, the text of the report provides that, “The extent and effects of any vertical permeability components associated with Neihart in the Buttress fault zone cannot be fully determined and therefore will need to be assessed as part of the modeling analysis.” Subsection “Horizontal Flow Barriers” of the Hydrometrics model report includes a statement that, “There is sporadic evidence of high permeability damage zones in the Neihart associated with the Buttress Fault; however, the extent and connectivity of these zones are unknown. Both low permeability gouge and high permeability damage zones tend to limit the propagation of drawdown effects across a fault zone in bedrock systems; gouge being a no flow boundary and damage zones acting as constant head boundaries. Representing the faults as low permeability boundaries is an appropriate representation of the fault systems as gouge was present in all places where the faults were intersected. Site data did not show increased permeability in the vicinity of the faults within the Newland shales and there is limited and mixed evidence for the presence of a well-developed damage zones in other units.” Hydrometrics’ July 18, 2019 Technical Memorandum (Hydrometrics, Inc. 2019a) points out that, “the Buttress fault is not shown in the Myers model which is a significant omission and effectively places his higher permeability granitic unit in direct communication with the lower ore body. The offset in the VVF in the model is not configured to prevent leakage between offsets in the fault zone.” The following response letters from the Proponent provide a substantial body of information addressing most of the details of the comment: • The Proponent’s Second Supplemental Response to Public Comments, Section, Inadequate Testing of Permeability/Fault Conductivity (Sandfire 2019b). • The Proponent’s Fourth Supplemental Response to Public Comments, Section F, Water: Exhibit 39 (Sandfire 2019c). • Technical Memorandum – Initial Review Comments on the Tom Myers Black Butte Modeling Report, Section “Geologic Formation Zones” (Hydrometrics, Inc. 2019a) • Technical Memorandum – Supplemental Comments on Myers’ Modeling Report of Black Butte Copper Project – DRAFT, Section “Geologic Formation Zones” (Hydrometrics, Inc. 2019c).

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						DEQ concurs with the information and conclusions submitted by the Proponent as listed above.
BBC00589	8	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers	Email	The DEIS presents contours for a potentiometric map for the conceptual model domain based on the results of the regional numerical flow model (DEIS, p 3.4-18). This has the concept backwards. A numerical model is designed to match observed groundwater levels, not the other way around. This simply reflects how poorly Tintina and the agencies understand groundwater movement in the area. Differing water levels in the bedrock and shallow alluvial system generally indicate an upward gradient for flow into the alluvium (DEIS, p 3.4-21). Paired monitoring wells MW-1*, MW-2*, MW-4*, and MW-6* were intended to "document baseline conditions within the unconsolidated Quaternary/Tertiary clayey gravel deposits and in the underlying shallow bedrock groundwater system" (Hydrometrics 2017, p 2-12). Each pair included an A and B for shallow gravel deposits and the underlying shallow bedrock1.	It is true that the presented potentiometric map is generated by the Regional Groundwater Flow Model. However, this model was calibrated using all the available groundwater level measurements and in this respect does not mischaracterize what is measured. Manual drawing of a potentiometric map for a mountainous area with elevations of groundwater known at so few points scattered over such a large area would not produce a map more accurate than the one generated by the model. It is typical for most of the mountainous areas where mining projects are proposed, that little information is available about the exact configuration of the water table, other than that it more or less mimics the terrain topography. However, model sensitivity analysis shows that such exact configuration for the areas farther away from the Project is most often found to be of little consequence to model predictions.
BBC00589	9	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers	Email	Estimates of groundwater flow rates presented in DEIS Figure 3.4-8 based on simple Darcy's Law calculations (DEIS, p 3.4-21 are only as accurate as the K and gradients used to make the estimates. I discussed the variability in K above. Because the flow estimates represent a large area with K based on small-scale estimate, the estimated flow is probably low. The gradient is subject to the uncertainties in the water table, but the effect this variability would have on the estimated flow rates is also uncertain. The estimated baseflow in Sheep Creek is 6700 gpm (14.9 cfs and the groundwater discharge to Sheep Creek is 200 gpm (0.44 cfs which is about 3% of the flow in the stream channel (DEIS, p 3.4-21). About 45% of the 200 gpm originates in shallow bedrock with just 0.4 gpm originating in the underlying USZ formation (Id.). Because of the uncertainty in K, these values vary significantly. The amount from bedrock could vary substantially if a high-K fracture zone intersects the alluvium. The boreholes and mapping of the fractures is insufficient to make more accurate estimates if the proportion of flow from the bedrock is higher, the effect of dewatering could also be much higher. The claim that groundwater discharge at site is just 3% of Sheep Creek's baseflow and that deeper bedrock contributes just 0.1% of the water (DEIS, p 3.4-23) is highly fraught. The claim is part of the conceptual model which causes the numerical model to simulate these small amounts of flow originating in the bedrock.	The percentage values presented by Hydrometrics (Hydrometrics, Inc. 2016a) and quoted in the Draft EIS are estimates derived from tests completed using standard methods and procedures that were part of a standard groundwater characterization program. The results of those tests are associated with uncertainty and hydraulic conductivities used in the calculations and groundwater model set up may be underestimating or over-estimating the real conductivities. The following documents provide a substantial body of information addressing most of the details of the comment: • The Proponent's Second Supplemental Response to Public Comments, Section, Inadequate Testing of Permeability/Fault Conductivity (Sandfire 2019b). • The Proponent's Fourth Supplemental Response to Public Comments, Section F, Water: Exhibit 39 (Sandfire 2019c). • Technical Memorandum – Initial Review Comments on the Tom Myers Black Butte Modeling Report, Section "Geologic Formation Zones" (Hydrometrics, Inc. 2019a). • Technical Memorandum – Supplemental Comments on Myers' Modeling Report of Black Butte Copper Project – DRAFT, Section "Geologic Formation Zones" (Hydrometrics, Inc. 2019c). DEQ concurs with the information and conclusions submitted by the Proponent as listed above. Also see Consolidated Response WAT-1.
BBC00589	10	Tom Myers	Prepared for: Montana Trout Unlimited, Trout	Email	Alluvial and shallow bedrock wells show a substantial number of wells that have parameters that exceed health standards (DEIS, p 3.4-23). The exceedances include antimony, arsenic, iron, lead, manganese, strontium, and	These exceedances are characteristic of the natural baseline conditions of water quality in the Project vicinity.

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			Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers		thallium (Id.). There are few exceedances for deeper wells which means that deeper groundwater has fewer natural contaminants. Groundwater flow up through the bedrock probably dissolves and leaches metals.	
BBC00589	11	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers	Email	The DEIS assumed recharge equals 10% of the mean annual rainfall for the area (DEIS, p 3.4-36). This worked out to be about 2.59 in/y over the study area in the Hydrometrics model (Id.). Because this primarily was used in the numerical groundwater model, the following comments are based on the model report. The conceptualization of recharge and baseflow for the model is grossly inaccurate and leads to potentially major errors in the model calibration and predictive capacity. The model used a simple very low-flow baseflow estimate to justify the assumption of recharge being 10% of the annual precipitation (Hydrometrics 2017 p 2-22 – 2-27). Baseflow was calculated by assuming that 10% of annual precipitation becomes recharge and then becomes baseflow (Hydrometrics 2017, Table 2-2). The recharge depth multiplied by basin area gives a flow estimate referred to as the baseflow estimate at various locations (Table 2-3). Thus, rather than using baseflow to estimate recharge, Tintina assumed baseflow would equal their assumption of recharge without reference or other support. Tintina used one flow measurement on various streams to compare to the baseflow estimates, after accounting for the difference between September and late winter flows (Hydrometrics 2017, p 2-26). Because the adjusted flows are within 20% measurement error of the baseflow estimate, Tintina deemed it an accurate estimate of baseflow and that 10% of precipitation becomes recharge. A 20% error allows for a range in recharge of 8 to 12% of precipitation becoming recharge. It is likely that 10% is a low estimate of baseflow because Hydrometrics failed to account for all the baseflow. Baseflow is not just a late season or wintertime low flow, but is always part of the streamflow hydrograph. Baseflow is not a constant value throughout the year, but during wet periods, groundwater may discharge to the stream at much higher rates than it does during low flow or dry periods. This simply represents the higher recharge that may be occur near the stream during wet periods. This higher recharge reaches the stream while there is still some runoff occurring. The higher baseflow still should be counted as recharge (Cherkauer 2004). Assuming late winter flows represent baseflow, as done by Tintina's consultants, may discount groundwater flow from parts of the watershed close enough to the river that much of the higher recharge has already drained away to the river. Baseflow should be estimated based on measured streamflow hydrographs using baseflow separation techniques, and not estimated as some low flow occurring at the gage (Myers 2016, Cherkauer 2004). The recharge then equals the total baseflow from at the site (Myers 2009). Recommendation: Tintina should collect sufficient surface water flow data at the various sites to do regression analyses with a nearby gage station to extend the record. Tintina should account for the effect of diversions and return flow	See Consolidated Response WAT-1 for more information about the hydrogeological model. The recharge to the groundwater system assumption used in the EIS is based on a hydrological modeling report by Hydrometrics (Hydrometrics, Inc. 2016a). Section 2.6.1 of that report provides a discussion, regional data, and rationale for using 10 percent precipitation as recharge. The report states that "Infiltration rates of 10 percent to 15 percent of annual precipitation are commonly assumed as a reasonable approximation of groundwater recharge rates in modeling analyses of intermountain basins in western Montana (Briar and Madison, 1992)." Comparison of infiltration recharge base flow estimates to observed base flow (Hydrometrics, Inc. 2016b, Table 2-2) indicates that assuming a 10 percent infiltration rate of precipitation as recharge is reasonable. Modeled base flow estimates resulted in 15.2 cfs at SW-1, which closely represents the observed base flow of 15.0 cfs determined during baseline monitoring. As described in Section 3.5.1 of the EIS, surface water quantity data (used to determine the base flow of 15.0 cfs for SW-1) were collected from May 2011 through December 2017 and included monthly flow measurements and automated gaging stations on Sheep Creek, thus providing detailed seasonal baseline data. Recharge is not usually a sensitive model parameter compared to other parameters such as transmissive properties of the rock formations holding groundwater. Subsequently, divergence of the assumed values of recharge from on-site recharge, which are difficult to measure on a smaller scale of a watershed, is of a lesser consequence for the model predictions compared to assumptions about the values of other model parameters. Also, see response to Submittal ID HC-003, Comment Number 65.

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					as part of this streamflow reconstruction. Using the simulated hydrograph, baseflow should be estimated using an appropriate baseflow separation technique.	
BBC00589	12	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers	Email	The groundwater model used recharge based on 10% of the precipitation without regard to the total amount of precipitation falling at the site. Recharge therefore varied from 1.8 to 3.7 inches/year, depending on annual precipitation estimates which varied with elevation (higher precipitation at higher elevations (Hydrometrics 2017, Figure 3-6). There is no reference which justifies the broad assumption that 10% recharge occurs regardless of the precipitation rates. The assumptions regarding recharge totals and the distribution around the watershed, or model domain are wrong for at least three reasons. • The distribution of recharge ignores geology. Hydrometrics (2017 Figure 3-6 shows that recharge is forced into the model domain based on zones of approximately equal precipitation, varying from 1.8 to 3.7 in/y of recharge. The reality is that different geology types will accept different percentages of precipitation. Unfractured granite may reject almost all precipitation even at the highest annual precipitation rates whereas fractured carbonate rock may accept large proportions of the precipitation. The best evidence that failing to do this is an error was that initial model runs using assumed K values caused the heads to rise more than 1000 feet above ground surface (Hydrometrics 2017, p 3-11); this occurred because the model tried to push an amount of recharge into the ground that the geology would not accept. • The method also does not account for the general concept that the proportion of recharge as a proportion of precipitation increases with precipitation amount. This has been observed in many parts of the West (Maxey and Eakin 1949, Anderson et al. 1992) and should simply be expected as precipitation increases through semiarid and subhumid climate zones. Ten percent would be grossly low by comparison to the method formerly used in the Great Basin (Maxey and Eakin 1949 for which precipitation zones of 15 to 20 and greater than 20 inches/year were determined to have 15 and 25% of the total become recharge. • The method of evenly distributing recharge over an area also ignores mountainfront recharge, which is the tendency of runoff from mountainous areas to become recharge at the base of the mountain especially in drainages. Often the total from an area, as estimated using baseflow as equal to recharge, includes both distributed recharge and recharge occurring through the stream bottom. Flow relations and calibrated parameters are significantly affected by the location where recharge occurs. Recommendation: Tintina should make more appropriate estimates of recharge as based on accurate baseflow estimates. For modeling, they should distribute the recharge accounting for precipitation, geology, and the potential for runoff becoming recharge further down the topography and closer to the baseflow measurement point. Predictions should be redone based on a new calibration.	See the response provided for Submittal ID HC-003, Comment Number 65.
BBC00589	13	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental	Email	Predicting the rate of mine dewatering and its impacts on surface water was a primary goal of the development of the groundwater model. Tintina predicted average inflows to the surface decline at the end of Phase 1 would be 223 gpm (DEIS, p 3.4-39). Predicted dewatering increases to 497 gpm in year 4 (Id.). During the mining Phase 3, predicted dewatering decreases to 421 gpm as shallower units are depressurized (Id.). During most of the periods through year	See the responses to comments in: Submittal ID PM1-06, Comment Number 2 Submittal ID HC-003, Comment Number 55 Submittal ID BBC00589, Comment Number 4 Submittal ID BBC00589, Comment Number 6

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			Information Center, EarthWorks, American Rivers		15, more than 80% of the simulated dewatering comes from the Ynl A formation (Id.). At the end of mining, the predicted flow from the LCZ, the lower mineralized zone, is just 1 gpm which reflects the huge K contrasts (Id.). DEIS Table 3.4-6 summarizes the dewatering by mine structure and year. For example, in year 3, the UCZ Access/stopes drain 268 gpm from the USZ/UCZ formations. Myers (2018 predicted substantially higher dewatering rates than did the DEIS. As shown in Figure 2, dewatering temporarily exceeded 5000 gpm as mining in the deeper ore body commenced. Myers' model predicted dewatering rates so much higher than Hydrometrics' model due to hydrogeologic properties at depth. Myers wrote: Dewatering rates predicted herein exceed Tintina's predicted rates for three primary reasons. First, the storage coefficient calibrated herein was an order of magnitude higher in the shallow model layers so ten times the water is released for a unit drop of groundwater level. Second, this simulation assumed the complete construction of the decline or access occurred at the beginning of the year so there was a large initial gradient between the surrounding aquifer and the DRAIN which caused a high initial inflow. Hydrometrics did not describe the details of its method, so a comparison cannot be made. Third, dewatering rates for the DRAIN (reach 34 in deeper layer 8 are initially very high due to there being as much as 1500 feet of head on the DRAIN; in other words, the difference between the groundwater level and the level specified in the DRAIN is as much as 1500 feet over a short distance which creates a steep gradient to drive flow into the DRAIN. The high initial groundwater level occurs because dewatering shallow ore bodies (higher model layers during years 1 through 3 does not substantially dewater the underlying layers, partly due to the lower vertical conductivity. Dewatering layer 8, the lowest model level with ore being mined, also required high dewatering rates because conductivity north of the fault was calibrated to be about 0.1 ft/d, or higher than other zones in that layer and in shallower layers. Hydrometrics (2016 set conductivity of similar layers a couple orders of magnitude lower. It is not certain that its low value is justified because K equal to 0.1 ft/d is based on Hydrometrics' measured K values. Tintina (2017, p 56 noted that the "permeability of the LSZ is also low with hydraulic conductivities of 0.1 to 0.2 ft/day". Those values are based on published pump and slug tests of wells PW-7 and PW-6 (Tintina 2016, Table 2-12). Tintina also field tested the hydrogeology of the Neihart Formation quartzite near the Buttress fault after deepening well PW-6N. "Air testing of the open borehole in the Neihart Formation quartzite at this location produced 500 plus gallon (1,893 L per minute and confirmed that there are high permeability fractures within the Neihart Formation quartzite adjacent to the Buttress Fault. This resulted in a change in mine planning." (Tintina 2016, p 59). Dewatering rates could therefore be very high, at least until fractures full of groundwater drain. (Myers 2018, p 52) In other words, the Myers model used higher K values for the deep layers and for the fault near the ore bodies. Using a K higher than simulated by Hydrometrics has support from aquifer testing and boreholes as presented by Tintina or its consultants and resulted from calibration. It is the low K values in	

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					the Hydrometrics' model that have no support other than small-scale permeability tests (see the discussion above regarding the scale of K measurements). Also, the dewatering rates are highest at the beginning of the time period during which a model layer is first accessed because the head specified in the DRAIN equals the maximum depth needed for the specific structure and layer. Another consideration is the quality of dewatering water. The acid-producing properties of YNL rock is highly variable which means the quality of the dewatering water would vary substantially. The DEIS should account for the quality of the dewatering water and how if varies among formations and within formations. Otherwise, the predicted overall dewatering water quality could be substantially wrong.	
BBC00589	14	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers	Email	Tintina acknowledges the potential for much higher inflow to the mine voids in that it plans for grouting "substantial lengths of tunnels if inflow and rock stability issues are pervasive" (DEIS, p 3.4-56). This indicates that Tintina does not understand the hydrogeologic properties of the rock it will drill through as well as implied in the modeling. Grouting could also provide "long-term benefits in reducing hydrologic impacts" (DEIS, p 3.4-56 by reducing dewatering, limiting drawdown, and limiting the amount of water drawn from streams. The DEIS reports on a modeling scenario in which the K along the surface declines was reduced by two orders of magnitude to reflect grouting along the tunnels. There is no reference or any evidence provided to support the assumed change in K. Simulated grouting substantially reduced dewatering during the first two years when the tunnels were constructed through shallow bedrock, but longer term, the savings ranged from 15 to 25%. There would be benefits throughout the system. Grouting should be analyzed separately as a DEIS alternative.	Hydrometrics performed the analysis to evaluate potential mitigation alternatives, including grouting; those analyses were completed as a fulfilment of one of the stated model objectives (Hydrometrics, Inc. 2016a). The analysis completed to evaluate the model response assumed a decrease of hydraulic conductivity of the Surface Decline (as a result of grouting by two orders of magnitude). Grouting was not analyzed as a separate alternative as it is part of the Proposed Action.
BBC00589	15	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers	Email	Closure plans include backfilling of some primary and secondary access drifts and the installation of hydraulic plugs to prevent vertical flow among stratigraphic layers, particularly from sulfide layers upward to shallow aquifers (DEIS, p 2-15). Their purpose is primarily 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" (Id. . However, the DEIS when considering the environmental benefits states that "the decision to install plugs is dictated mainly by operational decisions" (DEIS, p 3.4-57), a statement which indicates that Tintina is not committed to installing the plugs. DEIS Appendix D analyzes the usefulness of a plug for which the DEIS states the usefulness depends on the properties of the bedrock surrounding the plug meaning that the plug is only as useful as the foundation into which it is installed (DEIS, p 3.4-57). Appendix D provides some analytic calculations regarding flow into the bedrock from the shaft on both side of a plug and for flow through the bedrock parallel to the shaft and perpendicular to the plug. The analytic calculations are conceptually correct; variability depends on the assumptions for the parameters used in the equations. The appendix assumes that mine construction damages a zone 8 feet thick into the surrounding bedrock; this zone would have a higher K than the undamaged bedrock. However, the increase in flow passing the plug does not increase linearly based	Comment noted. The hydraulic plugs are required in both EIS alternatives, the Proposed Action and the AMA.

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					on the increase in K because the gradient across the plug decreases. Appendix D calculated that upward flow through the shaft with and without a plug would be 0.27 and 0.08 gpm, respectively. This is not a very large difference according the Appendix (p 7), but considered over a day or a year the difference is many gallons of water. Appendix D downplays the difference between upward flow through the shaft and natural upward flow (DEIS Appendix D, p 8), but this discussion ignores the fact that shaft development enhances oxidation and the leaching of contaminants. If the water contains heavy metals resulting from acid conditions, the plug is the difference between clean water and contamination in the shallow aquifer, regardless of how the DEIS downplays its importance (described as "largely irrelevant from an environmental impact perspective (DEIS, p 3.4-57). The DEIS implicitly sets the stage for Tintina not installing the plugs, but this would allow significant contaminant transport and the DEIS not diminish the importance of plugs. Recommendation: The DEIS should emphasize the importance of the plugs and require they be installed, not giving Tintina an option regarding the plugs.	
BBC00589	16	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers	Email	Mine dewatering causes groundwater drawdown and decreases groundwater discharge to streams (or draws water from the streams). "Higher-end drawdowns adjacent to the mine" range from 100 to 200 feet and the maximum drawdown centered on the mine areas is approximately 290 feet (DEIS, p 3.4-39). This means the water level in the DRAIN boundaries used to simulate dewatering never reaches the mine level which is as much as 1500 feet BGS. Because the mine would be much deeper than the drawdown, the DEIS model would allow the bedrock near the mine to remain saturated. Because the simulated dewatering rate is so low, Tintina assumes there would be no problem with the rock remaining saturated. The previous section discussed the reasons for Tintina's low predicted dewatering rate - improperly low K and storage coefficients - and provided both modeling (Myers 2018 and field evidence for much higher dewatering rates. Underestimating the drawdown, as done for the DEIS, also affects the predicted surface effects of dewatering such as decreased stream flow. Myers' (2018) model simulations lowered the water table much closer to the mine level. Comparison of Myers Figures 44, 45, and 46 for groundwater elevations in his model layer 3 (100 to 260 feet below ground surface), layer 6 (800 to 1000 feet below ground surface), and layer 8 (1200 to 1600 feet below ground surface) shows that drawdown increases substantially with depth. It also reverses the pre-mine upward gradient creating a significant downward gradient during mining. Higher K and higher DRAIN conductance values causes a higher dewatering rate prediction but simulates a water table low enough for mining.	The Draft EIS provides that "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." This 500-foot drawdown is model-calculated for the perimeter of the mine workings, not their center. Figure 3.4-9 (copied figure of the Hydrometrics report on the Regional Groundwater Flow Model; Hydrometrics, Inc. 2016a) shows a drawdown in excess of 1,000 feet in model layer 11. The model-calculated drawdown is not much smaller than the mine's depth. Hydrometrics provides a statement in their Regional Groundwater Flow Model report (Hydrometrics, Inc. 2016a) that "The drain conductance for all mine workings was set at an excessively high value (33,000 feet per day) multiplied by the length of drain along the cell to ensure the drain conductance does not limit the discharge rate to the drains." As such, if the model predicts existence of saturated rock above the mine workings, it is a result of the hydraulic properties set in the model. See Consolidated Response WAT-1, which provides an assessment of the groundwater model.
BBC00589	17	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center,	Email	The DEIS also indicates the streams limit the drawdown. "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" (DEIS, p 3.4-39). Stream boundaries are head-controlled flux boundaries meaning they allow water to enter the groundwater domain based on the gradient between the nearby groundwater and the water level in the stream as controlled by the conductance of the boundary. However, the large difference between K in the alluvium (about 200 ft/d) and the bedrock (less than 0.1 ft/d) limits the connection and the amount of water drawn into	We acknowledge that part of the sentence in the Draft EIS, Section 3.4.3.2, "Sheep Creek operates as a fixed head boundary to the Alluvium…" (in Section 3.4 of the Draft EIS, second paragraph in the subsection "Lowering of Groundwater Levels") should be changed to "Sheep Creek operates as a recharge boundary to the Alluvium…" Hydrometrics provides that all the major streams within the Regional Groundwater Flow Model's domain are simulated using a stream package, not a prescribed head. We agree with the commenter's comments explaining the cone of depression and the factors shaping it. Section 3.4.3.2 of the Final EIS has been updated.

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			EarthWorks, American Rivers		bedrock and to the dewatering DRAIN boundaries. This limits both the drawdown in the alluvium and the amount of water drawn from the streams. Hydrogeologic properties control the shape of the drawdown cone as shown in DEIS Figures 3.4-9 and -10. These figures show drawdown cones for the top of the water table and model layers 3 (Ynl-A), 5 (UCZ), and 11 (LCZ) for mining year 4 and 15. Year 15 is the end of mining. For each year, there is little difference among the water table and layers 3 and 5 in the extent of drawdown. This reflects the extent of mining facilities in the layers and the similar hydrologic properties of the formations in those layers. The extent of drawdown is less in year 15 because some of the mining stopes would have been simulated as backfilled which would reduce the areas needed to be dewatered; some mine dewatering DRAIN boundaries would have been turned off in the model. This reduced the simulated dewatering and the consequent drawdown which reduced the effect on the streams.	
BBC00589	18	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers	Email	There was a large difference between layers 5 and 11 in DEIS Figures 3.4-9 and -10 due to the drawdown extent in layer 11 being much less than the layers nearer the ground surface. The simulated potentiometric surface gradient is very steep because the drawdown cone expanded only very little laterally away from the mine because of the very low K in those formations. As discussed above, the K values are unrealistically low in the DEIS model. Myers Figure 46 also shows the drawdown extends a couple miles further than the DEIS due to higher K values and deeper drawdown at the mine. The limited extend of drawdown in the DEIS model may limit the effects drawdown has on the streams and wetlands because it would not have affected the upward gradient into the alluvium far from the mine. Drawdown simulated with the Myers model, as shown in Myers Figures 46 through 48, extends further from the mine and can affect more of the stream and wetlands. Mine dewatering cones of depression would capture some groundwater that currently reports to perennial streams as baseflow if associated with the upper HSUs (DEIS, p 3.4-41), however this understates the connection with the bedrock. Lowering groundwater levels in the underlying bedrock would lower the upward gradient and decrease flow into the alluvium. The DEIS ignores this. DEIS Table presents simulated groundwater discharges to three streams, Sheep Creek upstream of SW-1, Black Butte, and Moose Creek. It shows essentially no change for Black Butte or Moose Creek, and discharge to the Sheep Creek reach decreases by about 0.3 cfs from a pre-mining flow rate is 5.76 cfs. Based on these simulations, the DEIS claims there is no effect. The DEIS also claims that dewatering substantially affects only Coon Creek with lost flow, but does not discuss that flow loss in the Groundwater section (DEIS Section 3.4).	The EIS does provide statements that mine dewatering would decrease groundwater discharge to the creeks and does provide an estimate of losses of base flow. Section 3.4 of the EIS discusses the issue of a potential significant loss of base flow in Coon Creek. See Consolidated Response WAT-1, which provides an assessment of the groundwater model.
BBC00589	19	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center,	Email	The lost flow on Coon Creek would affect water rights and require mitigation. Water would be diverted from Sheep Creek when the flow exceeds 84 cfs and stored in a non-contact water reservoir (NCWR) (DEIS, p 3.4-44). That minimum flow rate retained in Sheep Creek is based on the total appropriative water rights on the stream (Id.). Water stored in the NCWR would be pumped to the headwaters of Coon Creek to replenish flows lost in that creek. The objective would be to maintain baseflow within 15% of the monthly baseflow (Id.). The DEIS references a Tintina update to it MPDES application for	Surface water diversion for the Project is subject to review and approval by the DNRC. Specifically in Coon Creek, base flow reduction would be offset with water from the NCWR and change of use of water from irrigation to maintenance of instream flow through an agreement with the water rights holder to utilize the water rights (Section 3.5.1 of the EIS) pending approval from DNRC. Impacts on groundwater and surface water resources are not predicted. The water from the NCWR would be of the same quality as Sheep Creek.

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			EarthWorks, American Rivers		details. Specifically, Tintina (2018, p 3 and 4) describes the diversion with a little more detail, mostly regarding the pipeline. It merely states that the “NCWR will be used for mitigation of residual depletion in surface water during operations and for approximately 20 year after the cessation of mine dewatering” (Tintina 2018, p 4). It does not describe how they would determine when flow should be supplemented. At no point in the DEIS or supporting documents is there a description of how to determine when flow decreases are due to dewatering or simply due to dry conditions. There is also no mitigation plan in the DEIS or the mine operating plan (MOP). The DEIS also does not discuss the water quality implications of the mitigation water. Excess dewatering water, that is the dewatering water not used for consumptive uses at the mine, would be discharged into underground infiltration galleries located on the alluvium next to Sheep Creek (DEIS, p 3.4-46). This is a significant change from previous plans of operation which Myers (2018) analyzed showing the development of groundwater mounds in areas that had been proposed for reinfiltration basins. The plans for the infiltration basins along Sheep Creek are analyzed in Appendices E and F of Hydrometrics (2018). The following paragraphs review those documents, which are very important aspects of the current plan for discharging excess dewatering water.	
BBC00589	20	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers	Email	Hydrometrics (2018 estimated groundwater mounding and discharge to the creeks using a groundwater model prepared for the alluvial aquifer into which the underground infiltration galleries (UIGs would discharge. The model differed from the groundwater model for mine dewatering at the site (Hydrometrics 2017 which simulated that drawdown would lower the water table and draw 160 gpm (0.36 cfs from the alluvium. The alluvial model (Hydrometrics 2018, Appendix F does not describe a boundary condition under its lower model layer that pulls groundwater from the alluvium, so the model does not account for dewatering. In other words, it does not simulate water drawn into the bedrock. By ignoring dewatering, Hydrometrics (2018 claims the estimates of mounding are conservative, meaning overestimated, because of the lack of dewatering drawn from the alluvium. However, as will be discussed herein, the maps of mounds formed by the UIGs that are sums of the simulated mounds and drawdown. This superpositioning of the results of two separate models may not lead to accurate results.	It is true that the Sheep Creek Alluvial Model (the local model) is not linked with the Regional Groundwater Flow Model. The loss of water from the alluvial aquifer as a result of mine dewatering is not represented in that local model. Simulating interaction of the alluvial aquifer and the mine-dewatering cone of depression was not among the goals of that modeling project. The baseline dataset, model predictions, and analyses as presented are considered appropriate and sufficient to support the EIS as well as associated mitigation and mine planning. While simulating discharge of water to that aquifer via the UIG, not accounting for a drawdown in the alluvial aquifer caused by the mine dewatering can cause a potential overestimation of groundwater mounding around the UIG’s discharge lines. See also the Proponent’s Fourth Supplemental Response to Public Comments, last paragraph of Section F: Exhibit 39, Technical Memorandum on DEIS Groundwater Monitoring (Sandfire 2019c). There are several important differences between the information and assumptions presented in Exhibit 39 compared to the Project, including differences in the faults, mining methods, groundwater flow rates, and plug performance.
BBC00589	21	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center,	Email	The model assumed the aquifer to be about 20 to 25 feet thick and that it pinches out at a narrow bedrock canyon north of the valley. The pinch-out forces groundwater into the stream. The K of the alluvium in the model, and throughout the MPDES application analysis, was initially set at 200 ft/d based on a pump test at one monitoring well, MW-4A (Appendix F, p 2-3). Hydrometrics (2018 Appendix F) references literature values of 30 to 300 ft/d for coarse sand aquifer to justify the use of 200 ft/d. The literature values represent a range that would cause a 10x variability in the calculated flow rates. The final modeled K values for layers 1 through 4 are 100, 150, 225, and 225	The value of hydraulic conductivity derived from aquifer testing is 200 feet per day. Hydrometrics makes a statement that this value is within a range of values reported in literature for a coarse sand aquifer (Hydrometrics, Inc. 2018a). Using 200 feet per day and comparing it to literature reported range of values is verification of the results obtained from the aquifer test, rather than justification of using such value. Field testing measurement takes precedence over literature values. The final modeled K values for layers 1 through 4 were set to 100, 150, and 225 feet per day; the modelers arrived at those values using a process of model calibration. Successful model calibration with using the K values that

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			EarthWorks, American Rivers		ft/d, respectively (Hydrometrics 2018, Appendix F, Table 3-1). The model assumed the annual recharge rate on the alluvium is 1.8 in/y, or 10% of annual recharge, which they determine to contribute 22 gpm to the natural groundwater flow in the area (0.05 cfs). The model ignored dewatering which would pull water from the alluvium into the underlying groundwater. Dewatering would remove ambient groundwater with low total N concentrations which would result in mixed groundwater with higher total N, as discussed above. The mounding simulation used the maximum effluent discharge rate of 575 gpm. The simulated mounds ranged from 3 to 4 feet with the maximum being 5.2 feet. These mounds go above ground surface. The modeling did not include dewatering which caused drawdown on the alluvium. Therefore, the two maps showing the groundwater mound (Hydrometrics 2018, Figures 3-6 and 3-7 were completed essentially by adding the simulated mound with the simulated drawdown. The result was a mound of about 1 foot near the UIGs, 0.5 feet near the creek, and drawdown of 10 feet along the southwest boundary. In summary, the alluvial model may provide a false sense of security regarding the ability of the alluvium to accept the full discharge. If the K averages 30 ft/d instead of 200 ft/d, the flow rate would be much lower and simulated, and actual, mounds would be much further above ground surface.	embrace the measured value provides a degree of justification for using those values. Hydrometrics acknowledges that “It is likely that there are vertical and horizontal heterogeneities throughout the alluvial aquifer. However, the observed lithology from drilling MW-4A and trench excavations suggest the hydraulic conductivity near MW-4A is likely representative of the average permeability of the alluvial aquifer.” In addition to conducting aquifer test at MW-4A, Hydrometrics conducted infiltration testing in the alluvial system to evaluate the capacity of the proposed alluvial underground infiltration gallery (UIG; Hydrometrics, Inc. 2017d). The test trenches were dug in three areas of the alluvial aquifer, one of those areas around the aquifer-tested MW-4A. The results of this testing demonstrated that water can be infiltrated at the maximum design discharge rate of 575 gpm. That maximum rate would be applied only occasionally. The model assumed the annual recharge rate of the alluvium is 1.8 inches per year, or 10 percent of annual precipitation (not recharge in the vicinity of the alluvial aquifer). In summary, the UIG capacity was thoroughly evaluated to accept the maximum design discharge rate of 575 gpm.
BBC00589	22	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers	Email	The DEIS inappropriately assumes away any chance for groundwater pollution from the mine site by assuming the liners will work perfectly. Although the DEIS acknowledges many facilities have the potential to produce seepage that could seep into groundwater, its analysis is that there would be at most a few gallons of seepage. The MPDES permit application (Hydrometrics 2018 assumes that seepage will be zero because the facilities are lined; in other words, there is no planned seepage. The DEIS does not analyze the fate of a significant leak that would occur if the liner has a tear form in it. A leak at the Process Water Pond could cause significant contamination because the water quality within that pond would be very poor. The most problematic constituent would be nitrate for which the predicted concentration is 87 mg/l, but copper, nickel, lead, antimony, strontium, and thallium also would have concentrations that exceed standards (DEIS, Table 3.5-9). An exception is the non-contact water reservoir which is designed to leak (DEIS, p3.4-52). The DEIS predicts the rate to be 50 gpm that would help replace the consumptive use of water at the mine. The DEIS claims there would be no potential to affect groundwater quality because it is non-contact water, but it provides no analysis supporting this assumption. The DEIS should analyze whether the seepage would leach contaminants from the highly-weathered shale that underlies the reservoir. The MPDES permit application does not analyze the fate of this seepage which suggests it would be an illegal unpermitted discharge.	See Consolidated Response PD-4, which addresses concerns regarding liner and pipeline performance. The Proposed Action and AMA require the Proponent to conduct groundwater and surface water monitoring. Monitoring would continue on Sheep Creek downstream of the Project boundary and along Coon Creek as described in Section 3.5 of the EIS.
BBC00589	23	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana	Email	The DEIS also postulates an inconceivably low seepage rate through the temporary waste rock dump. Waste rock would be place on a liner for two years before it is incorporated into the CTF (DEIS p 3.5-21). The predicted seepage rate is just 0.9 gpm through 7.5 acres of waste rock (Tintina 2017, Table 3-33). This is too low because the waste rock will be mostly cobbles and	The HELP model used in the analysis (Hydrometrics, Inc. 2016a) considers not only material properties but also climatic factors and calculates a water balance of the whole rock storage facility. Table 2 presented by Hydrometrics (Hydrometrics, Inc. 2016a) enumerates percolation and flow rates for each of the 24 simulated months.

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			Environmental Information Center, EarthWorks, American Rivers		have little resistance to water entering the waste rock. Tintina (2017 claims the details of the modeling are in Appendix M-1, but that is not included in the available version of the MOP, so only Table 3-33 is available for review. HELP simulates percolation by month but the table provides percolation by month but for just 7 months in two years. The summary is of volume for those seven months. It is not conceivable that percolation would occur in just June and December of the first year and January, June, July, and December of the second year. The MOP description notes that three different lifts would be constructed, but lifts do not prevent water already in the waste from continuing to seep downwards. The total seepage should be based on the sum of percolation for 24 months, not just the seven presented in Table 3-33. Because it is unlikely the waste rock would be moved into the tailings instantaneously, seepage would continue into the third year; the DEIS and MOP (Tintina 2017) should include this in the seepage estimate. Numerous aspects of the surface CTF indicate that the DEIS grossly underestimates the potential for seepage and other surface drainage during both operations and closure. The seepage calculations presented by Tintina (2017, section 3.5.7.2) consider only manufacturer defects and not potential tears. During operations, the CTF would receive paste tailings with 2% cement to harden them. The incorrect implication is that will prevent the infiltration of water, but cement will break down due to interaction with acid generating tails and the permeability and porosity will increase and the tails will be become much wetter. The amount of drainage captured by the underlying leak detection system (DEIS, p 3.4-52) will be much higher than predicted. This could both overwhelm the treatment system and increase the head on the liner which could lead to additional seepage.	A total failure of a liner system is highly unlikely. The Proposed Action and AMA would require establishment of an adequate groundwater monitoring network, plans for remedial action, and triggers to initiate such action in an unlikely event of contaminant release from such a facility. The Proposed Action and AMA require the Proponent to conduct groundwater and surface water monitoring. Monitoring would continue on Sheep Creek downstream of the Project boundary and along Coon Creek as described in Section 3.5 of the EIS. Also, see response to Submittal ID BBC00589, Comment Number 40. Also, see the Proponent's Fourth Supplemental Response to Public Comments (Sandfire 2019c): • Section B.1.d: CTF Liner and Cover System; • Section B.1.g: Failure Analysis; • Section B.3: Exhibit 25 – Surface-Placed Cemented Paste Tailings; • Section B.3: Exhibit 26 – Tailings Impoundment Failures; • Section E: Seepage; • Section E.2: Exhibit 34 – Hydraulic Performance of Liners; • Section E.3: Exhibit 35 – Geomembrane at Tailings Storage Facilities; • Section E.4: Exhibit 37 – Leakage through Geomembrane Liners. Also see the Proponent's First Supplemental Response to Public Comments, Section A.8, Analysis of Environmental Impacts of Spills and Leaks (Sandfire 2019d).
BBC00589	26	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers	Email	Fourth, there is no provision for the long-term seepage from the drain system beneath the tailings. The DEIS does not disclose the potential contaminant issues with this seepage overflow and the MPDES permit does not address this seepage as an outfall or address the need for a groundwater mixing zone.	The CTF would contain two liner layers 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. 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 CTF 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. Further details are provided in Section 2.2.2, Construction (Mine Years 0–2), of the EIS. Impacts on groundwater and surface water resources are not predicted. To confirm this prediction, the Proposed Action and AMA require the Proponent to conduct groundwater and surface water monitoring. See Consolidated Response PD-3 and PD-4. Chapter 2 of the EIS includes additional information about the potential risks associated with the Project facilities or processes.
BBC00589	27	Tom Myers	Prepared for: Montana Trout	Email	Finally, there is no apparent consideration given to the drainage water from the CTF during closure. There would be a basin drain installed above the liners in	See Consolidated Response PD-5. Newly deposited cemented paste consolidation would occur rapidly, within days. Seepage water from paste dewatering would

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			Unlimited, Trout Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers		the bottom of the CTF to capture seepage (DEIS, p 2-7, -8). During operations, the drain water would report to the process water pond (DEIS, p 3.4-52) at rates of about 20 gpm (Tintina 2017, Figure 3.44). Its water quality would be very poor and the water would be transferred to the water treatment plant. The DEIS should disclose how this drainage water would be accommodated in closure. If the cover works as designed, long-term seepage should be reduced, but draindown could take a long time. The DEIS should include a discussion of draindown and how it would be treated during closure.	mix with incident precipitation during operations and report quickly to the CTF wet well sump; however, this volume of water flow would be eliminated at closure. The low-conductivity cemented mass in the CTF would not retain much water that could eventually seep out of the cemented tailings. The statement that “draindown could take a long time” at closure would be applicable in a conventional sub-aqueous tailings facility, but that is not the case for the proposed CTF. Seepage into the tailings mass would be mitigated by the overlying HDPE geomembrane placed over the top of the tailings, as described in Section 12.1 of Appendix K (Knight Piésold 2017a) and clearly shown in Figure 7.3 of the MOP Application (design drawing C8002)(Tintina 2017a). Waste rock placement inside the CTF would be completed by Year 9 in the mining operations (Table 3-5 of the MOP Application) and all waste rock should be encapsulated in cemented paste tailings by the end of the mine life. Draindown from the mass of consolidated cemented tailings is not expected. In closure, the length of time between placement of the composite HDPE/soil cover and the reduction of flow to the wet well sump to a volume that can no longer be pumped, cannot be calculated using the steady state hydrogeochemical model due to the resulting very low water flows. The time estimate for the CTF sump pumping in closure is expected to be on the order of 30 days since the CTF is designed to contain mostly solids (i.e., cemented tailings paste and waste rock) and only minor aqueous phases. Nevertheless, the Proponent intends to leave the CTF wet well sump pump in place during and following final closure of the facility so that any water collected in the sump could be pumped to the CWP for storage and then treated in the WTP. The flow to the sump would be measured by pumping in closure until the DEQ determines that flow rates are low enough that pumping is no longer necessary. This would presumably occur when any remaining water within the CTF no longer reports in large enough quantities to the CTF wet well sump for effective removal by pumping. In addition to the liner system and foundation drain, the case for negligible seepage from the CTF is also supported by the plan to remove as much water as possible continually from the CTF wet well sump during operations and in early closure. Note, the overall water quality is predicted to improve at closure, according to the models developed in Appendix N of the MOP application (Enviromin 2017a). The primary reason for the improvement is that the surface material at closure would be 4 percent cemented paste instead of 2 percent cemented paste.
BBC00589	28	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers	Email	The DEIS predicts that Sheep Creek upstream from station SW-1 would lose just over 0.3 cfs to mine dewatering, from a pre-mining steady rate of 5.76 cfs (DEIS, Table 3.4-7). The pre-mining steady state flow rate is based on the 7Q10 flow rate. The flow loss is about 2% and would be more than replaced by discharging effluent through the UIGs into Sheep Creek at rates average 398 gpm. Black Butte Creek would show a decrease of 0.1 cfs from a steady state baseflow ranging from 2.6 to 3.2 cfs (DEIS, p 3.5-13). The flow reduction in Coon Creek would be 0.12 cfs which is 70% of the 0.2 cfs steady state flow at the stream’s confluence with Sheep Creek (Id.). Myers (2018) simulated substantially more stream flow loss that is reported in	See Consolidated Responses WAT-2 and WAT-4 regarding impacts on surface water resources. Impacts on groundwater and surface water resources are not predicted. To confirm this prediction, the Proposed Action and AMA require the Proponent to conduct groundwater and surface water monitoring.

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					the DEIS. He simulated changes seasonally by assuming a seasonal distribution of recharge. Groundwater discharge to Sheep Creek decreased due to dewatering from about 19 to 17 cfs within 14 years during the recharge period as shown in Figure 3. Mine dewatering would take about 10% of the total baseflow estimate. Myers simulated that discharge to tributaries to Sheep Creek near the mine decreased from about 3.3 to 3 cfs during high recharge periods and 1.6 to 1.4 cfs during low recharge periods. Coon Creek, DRAIN Reach 10, suffered most of the loss (Figure 41). After year 4, it essentially goes dry.	
BBC00589	29	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers	Email	The proposal includes a non-contact water reservoir (NCWR) that would be filled with water from Sheep Creek to replenish water lost to mine dewatering. Specifically, the DEIS anticipates the water would replenish lost flow in Coon Creek. Water would be diverted from Sheep Creek when flows exceed the sum of water rights in the creek, although the description on DEIS page 3.5-12 is difficult to follow because it appears to describe a water rights application that has (apparently) been superseded by a more recent application. The diversion would be for up to 7.5 cfs during the irrigation season when the Sheep Creek flows exceed 84 cfs, the sum of water rights for the stream. The total annual volume would be limited to 291.9 acre-feet. The Sheep Creek hydrograph on DEIS Figure 3.5-4 indicates the flow exceeds 84 cfs often, so it should not be difficult to attain the water. At 7.5 cfs, it would take 19.6 days to divert the maximum volume. Stream depletions predicted by the model do not justify such a large diversion from Sheep Creek. Based on the DEIS, Coon Creek would experience a 0.12 cfs reduction. Totally replacing this for the entire year would require 101 af. Sheep Creek would experience a 0.35 cfs flow reduction, but discharge of mine water in to the alluvium via the UIGs would more than replace the loss (DEIS, p 3.5-13). Seepage from the NCWR would also replenish flows in the creek. The DEIS has not considered the impacts of removing up to 7.5 cfs from Sheep Creek flows. During dry years the flow may not exceed 84 cfs by much or for a long duration and the diversion would significantly decrease flows which could change the channel shape or affect the fish habitat. If the dewatering rates are substantially higher than Hydrometric's predictions, the amount of water needing to be discharged through the UIGs would be substantially higher. This could lead to much more mounding on the alluvium and much wetter conditions. The UIG discharge would be of mine dewatering water. It would mix with the ambient groundwater and discharge into Sheep Creek and the downstream portion of Coon Creek. The treated water would have effluent in which total N concentrations exceeds the surface water nondegradation limits (DEIS p 3.5-18). Water quality issues including the necessary mixing zone are discussed below.	The Proponent has used hydrogeochemical monitoring, hydrogeological modeling, and geochemical testing data to design the underground workings, the NCWR, and the TWSP to minimize potential impacts on water quality. Apart from groundwater in the underground workings at the end of the closure phase, water from all facilities would be collected and treated to meet non-degradation criteria before discharge (Hydrometrics, Inc. 2016b). The TWSP would be in place to store treated water during periods when total nitrogen in the treated water (estimated to be 0.57 mg/L) exceeds non-degradation effluent limits (0.097 mg/L). The total nitrogen effluent limit is only in effect 3 months per year (July 1 to September 30). 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, where it would be mixed with the WTP effluent. The blended water would be sampled before discharge to the alluvial UIG per the MPDES permit (Zieg et al. 2018). Diversion of water from Sheep Creek when flows exceed 84 cfs would be based on a new water right and is subject to DNRC review and approval. Based on the baseline data collected for the Project, it is expected that annual flows would exceed 84 cfs and provide water to the NCWR required to address depletion of surface water flow in the affected watersheds associated with consumptive use of groundwater during operations.
BBC00589	30	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information	Email	The chemistry of mine dewatering water depends on the source of water drawn to the mine DRAIN cells. Hydrometrics' simulations shows that the majority of dewatering water would be sourced from the surface decline in YNL-A formation, the upper access and stopes mostly in USZ/UCZ formation, and the lower decline developed in the YNL-B formations (Hydrometrics 2016, Table 5-1 . During year 6, of the total predicted mine inflow of 467 gpm, YNL-A would provide 97 gpm (21%), YSZ/YCZ would provide 261 gpm (56%), and	Section 3.4.1.4, Baseline Monitoring, Aquifer, and Permeability Tests, discusses a series of aquifer tests that were conducted at the site that include both slug tests and short-term and long-term pumping tests to characterize the hydrogeologic characteristics of the principal stratigraphic units and the fault systems that bound the ore bodies (Hydrometrics, Inc. 2017a). The number and scope of the completed tests represent a standard practice for this type of project. In the EIS, development of the numerical groundwater model was informed by the results of

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			Center, EarthWorks, American Rivers		YNL-B would provide 80 gpm (17%). Three location provide 94% of the dewatering water. The amount from the lower mine in LCZ and the surface decline in UCZ is negligible, according to Hydrometrics (2016). Water quality predictions depend on this mixture. As discussed above, there is a large uncertainty regarding the predicted dewatering rates based upon the uncertainty in the simulated conductivity for the formations. Myers (2018 simulated a much higher dewatering rate (Figure 2), in large part due to the higher rates expected from deep formations. The DEIS should consider how the chemistry would differ with respect to higher proportions from deep formations and whether the treatment facilities could handle the different chemistry and different flow rates.	those tests and other data (groundwater levels, discharge to streams, estimates of recharge), and the model was calibrated to measured values of various parameters. The reliability of the model predictions was assessed considering data limitations and results of a model sensitivity analysis (Hydrometrics, Inc. 2016a). Model predictions for dewatering rates and analyses as presented are considered appropriate and sufficient to support the EIS and associated mitigation and mine planning. The modelers and users of model results are increasingly aware that any number of model versions can be produced that would be "calibrated," and each model would produce somewhat different predictions, including prediction of the rates of groundwater inflow into the mine workings. Therefore, the presented model may be overestimating or underestimating those rates. See Consolidated Response WAT-1.
BBC00589	31	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers	Email	Once dewatering ends and the water level recovers, mine water would not be collected and treated (DEIS, p 3.5-18). The predicted UG water would violate groundwater nondegradation standards for nitrate, uranium, strontium, and thallium (Id.). If discharged directly to surface water, there would a high potential for degradation (DEIS, Table 3.5-5 , but it would be treated to surface water nondegradation standards, except for total N which would be treated to 0.57 mg/l. The discharge permit for the mine would provide for discharge of treated water to the UIGs, as discussed above, and a mixing zone in the streams, discussed below. For closure in an attempt to decrease the potential for long-term pollution of UG water, much of the mine would be backfilled. Open portions of the workings would be flooded with treated water to dissolve and rinse soluble minerals from the mine surfaces (DEIS, p 3.5-19). This would be repeated until nondegradation criteria are reached, which the DEIS estimates to take between six and ten cycles, or seven to thirteen months (Id.). The DEIS provides no reference or analysis to support the estimated time to reach nondegradation criteria. There is also no evidence that soluble minerals would not reform in workings that are not permanently flooded or that take a long time to flood. Although the simulations suggest that groundwater level recovery would occur quickly, the volume of the workings was not considered in the recovery calculations. The groundwater level will intersect and seep into the workings until they fill; while that occurs, oxidation will occur on the walls and the groundwater will continue to leach metals. It is therefore critical that the fate of groundwater leaching through the mine workings be considered.	The exceedances noted in this comment (Draft EIS p. 3.5-18) were identified for operational conditions, when water would be collected for treatment, and not for the post-closure conditions following the rinsing and flooding steps. Non-degradation criteria within the underground workings openings are expected to be achieved after repeated flooding/rinsing, which is conservatively estimated to take between 6 to 10 cycles. Until that time, water from the underground workings would continue to be captured and treated. Importantly, only upon confirmation that the quality of contact groundwater meets the proposed groundwater non-degradation 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, Inc. 2016b). In some cases, the non-degradation criteria are greater than the groundwater quality standards because the background concentration already exceeds the groundwater standard (e.g., thallium in Draft EIS Table 3.5-5). The Project has proposed monitoring during operations to identify potential impacts on water resources in a timely manner and would trigger the implementation of operational changes and/or mitigation measures (Section 6 of the MOP Application; Tintina 2017a). Monitoring would continue on Sheep Creek downstream of the Project area and along Coon Creek as described in Section 3.5 of the EIS.
BBC00589	32	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center,	Email	The DEIS claims that post-closure contact groundwater would probably not affect surface water based on mixing the small proportion of groundwater that sources from deep bedrock (DEIS, p 3.5-19 and Figure 3.4-8). As discussed above, the estimates of groundwater flow from depth depend on estimates of K, and those estimates are based on very little data and could be highly variable. The DEIS therefore relies on highly uncertain assumptions to assume that upward groundwater flow from depth will not affect surface water. Recommendation: the DEIS must require that Tintina prevent any direct discharge of UG water to surface water after closure to avoid degradation. This	Refer to response to Submittal ID BBC00589 (Comment Number 30 by Tom Myers). As discussed in answers to several other comments, the estimates of hydraulic properties are derived from a standard characterization program. Uncertainly exists with respect to the values of hydraulic conductivity. However, considering that hydraulic conductivities of shallow bedrock are considerably larger than conductivities of deep bedrock, these uncertainties are smaller. Therefore, the mixing of contact groundwater with other groundwater would be effective. In addition to mixing, contaminants in the post-mine contact groundwater would undergo a range of other attenuating processes, such as

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			EarthWorks, American Rivers		includes plugging the mine and collecting any water that could discharge. Recommendation: Tintina should monitor surface water and shallow groundwater in perpetuity and develop mitigation plans if it becomes apparent that groundwater is reaching surface water. In perpetuity is required because of the slow flow rate and because once mostly flooded, oxidation could occur slowly for a long time.	retardation (particularly strong for metals) or dispersion. Also, see responses to the following comments: Submittal ID BBC00884 (Comment Number 6) and Submittal ID HC-003 (Comment Number 56). Responses to the following comments also provide relevant information: Submittal ID HC-003, Comment Number 52 Submittal ID HC-003, Comment Number 68 Submittal ID BBC0589, Comment Number 31 Submittal ID BBC00933, Comment Number 14 Submittal ID BBC00933, Comment Number 15 The Proposed Action and AMAs require the Proponent to implement long-term groundwater and surface water monitoring plans. Long-term monitoring is defined here as monitoring that would be performed until the natural systems around the Project area are documented to have returned to baseline conditions; such monitoring might need to be continued for several years after the mine closure. Long-term monitoring would allow undertaking remedial action in an unlikely event of impacts detected at levels above the established triggers (the detected impacts exceeding the applicable water quantity/quality criteria).
BBC00589	33	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers	Email	Mitigation Water: Dewatering impacts on Coon Creek would be mitigated by discharging water from the non-contact water reservoir. The source of water in the NCWR is diversions from Sheep Creek during high flows. The DEIS fails to consider the water quality of the mitigation water, which would essentially be the same as water quality in Sheep Creek during high flows. The DEIS noted exceedances of the chronic aquatic criterion for total recoverable iron and dissolved aluminum at most surface water stations (DEIS, p 3.5-9). The compilation of surface water quality in DEIS Appendix I shows average values of Kjedldahl nitrogen and total persulfate nitrogen that as part of total N would cause the mixed values on Coon Creek to exceed the nondegradation standard. They would also add to the N load in Sheep Creek below the Coon Creek confluence. The DEIS has not considered the water quality impact of adding the mitigation water to Coon Creek.	As described in Section 3.5.3.2 of the EIS, Surface Water Quality and Temperature, the water quality of mitigation water was considered. The elevated iron and aluminum concentrations in Sheep Creek are largely related to elevated suspended sediment concentrations in the creek occurring during periods of snowmelt, with increased flow and turbidity (Section 3.5.2.2 of the EIS). Retention of water in the NCWR would allow time for suspended sediment to settle out of the water column prior to transfer of the water from the NCWR for flow augmentation. The expected result of settling time would be reduced aluminum and iron concentrations. Some occurrences of elevated aluminum in Sheep Creek were observed when suspended solids concentrations were low. In these cases, it is likely that the aluminum is dissolved from soils during snowmelt (which tends to be slightly acidic and may more aggressively dissolve aluminum from soils). In cases where elevated aluminum in Sheep Creek is not associated with elevated levels of suspended sediment that would settle out in the NCWR, it is expected that cold and slightly more acidic water diverted from Sheep Creek would equilibrate with water already stored in the NCWR, reducing solubility of aluminum and also causing precipitation of the aluminum within the reservoir. Regarding the nitrogen aspects of the comment, please see the Montana Water Quality Act. Per § 75-5-317 (2)(s), MCA, diversions, withdrawals, and water transfers associated with water rights are not subject to non-degradation rules.
BBC00589	35	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center,	Email	Tintina’s mixing analysis used the following assumptions: 1. The galleries are discharging at their maximum rate (575 gpm) and maximum concentration. 2. The receiving water, the streams, are at low flow or minimal dilution potential. 3. The discharge will equilibrate to the average flow and concentrations of total N discharging to surface water due to the distance between the UIGs and the point of discharge to the streams.	This comment involves mixing and dilution calculations. The MPDES permit does not authorize a mixing zone; therefore, the comment is not pertinent to the Proposed Action. The EIS provides a statement that “… based on the results of the analysis, the MPDES permit will not authorize a mixing zone.” The MPDES program denied the mixing zone request. Effluent limits for total nitrogen are based on achieving the non-significance criteria without dilution in the groundwater or surface water.

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			EarthWorks, American Rivers		4. Water captured from the alluvium by dewatering was not considered in the analysis. The first assumption is conservative if the rates are accurate. As noted elsewhere, dewatering rates could be temporarily or even permanently higher than these rates. If so, the concentration predicted from the mixing analysis would actually be higher. The second assumption is appropriately conservative, although the estimates of low flow on Sheep Creek may be inaccurate because the analysis failed to consider heterogeneities in the flow estimates. The third assumption assumes that discharge to the alluvium would balance the flows reaching the stream so that the mixing analysis uses just the average total N concentration; this also applies to temperature considerations. The validity of this assumption depends on travel time from the UIGs to the stream. Tintina should use the groundwater model with scenarios of varying flow rates to assess the variability of discharge to the stream. A significant variability could affect the actual concentration after mixing because the total N load would be larger during higher groundwater inflow rates. Effluent flow rates are expected to be about three times the ambient groundwater flow, so the effluent could reach the stream without as much mixing as assumed and cause stream reaches to have a higher load than the instantaneous mixing assumption would predict. Because the effluent flow rates would substantially exceed the ambient groundwater flow, contrary to the assumption expressed in the Fact Sheet, the temperature of groundwater discharge will reflect the temperature of the effluent more than that of the ambient groundwater. See the discussion in the next subsection on temperature.	
BBC00589	36	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers	Email	The fourth assumption would cause the groundwater mixing calculations to ignore the removal of low total N ambient groundwater which would cause the assumed groundwater discharge total N concentration to be too low. This is discussed below. Groundwater mixing calculations for the alluvial aquifer include the UIG discharge and the natural groundwater flow. The maximum effluent discharge considered in the application is 575 gpm (1.28 cfs with total N concentration equal to 0.57 mg/l. Combined with an ambient groundwater flow rate of 0.39 cfs and ambient concentration of 0.09 mg/l, the average groundwater concentration would be 0.46 mg/l. However, the groundwater concentration is probably underestimated for several reasons. 1. The effluent discharge rate could be underestimated. The expected average discharge rate is 398 gpm with a maximum rate of 575 gpm to the outfall if discharge occurs all year, but the alluvial UIG can infiltrate 1285 gpm of treated effluent into the alluvial system. Mine dewatering could be underestimated so that the required discharge rates could be higher either short or long-term. This could increase the N load discharging from the groundwater. If the UIGs discharge 1285 gpm, the total N concentration for groundwater discharging to the streams would be 0.51 mg/l. 2. If effluent discharge does not occur from July through September, the rate for the remainder of the year will be much higher – 530 gpm average and 708 gpm maximum (Fact Sheet, p 9). This would be closer to four times the ambient groundwater flow rate and the concentrations (and temperature	See response to Submittal ID BBC00589, Comment Number 35 for information about the mixing and dilution calculations. The predictions regarding groundwater flow, surface water discharges, and related analyses as presented are considered appropriate and sufficient to support the EIS and associated mitigation and mine planning. To support groundwater modeling, Section 3.4.1.4 discusses a series of aquifer tests that were conducted at the site that include both slug tests and short-term and long-term pumping tests to characterize the hydrogeologic characteristics of the principal stratigraphic units and the fault systems that bound the ore bodies (Hydrometrics, Inc. 2017a). The number and scope of the completed tests represent a standard practice for this type of project. In the EIS, development of the numerical groundwater model was informed by the results of those tests and other data (groundwater levels, discharge to streams, estimates of recharge), and the model was calibrated to measured values of various parameters. The reliability of the model predictions was assessed considering data limitations and results of a model sensitivity analysis (Hydrometrics, Inc. 2016a). Modelers and the users of model results are increasingly aware that any number of model versions can be produced that would be “calibrated,” and each model would produce somewhat different predictions, including prediction of the rates of groundwater inflow into the mine workings. As such, the presented model may be overestimating those rates, or underestimating them. See Consolidated Response WAT-1. The Proponent has used hydrogeochemical monitoring, hydrogeological

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					inherent in the effluent would dominate the groundwater discharge to the creeks. 3. The mixing calculation does not account for water lost to dewatering. Estimates are that 160 gpm (0.35 cfs) would be drawn from the alluvium in to the bedrock due to dewatering. Because this water would draw from the base of the alluvium, it would remove groundwater at the ambient concentration, or 0.09 mg/l. This would decrease the ambient groundwater available to dilute the effluent. This would increase the total N concentration for groundwater discharging to the streams to 0.56 mg/l. 4. The ambient groundwater flow also could be substantially overestimated. The Application used Darcy's Law assuming the aquifer is 15 feet thick2, 1420 feet wide, with a gradient equal to 0.008 and conductivity equal to 200 ft/d to estimate groundwater flux equals 177 gpm (0.39 cfs) (Application, Table 3-5). If K is estimated high, the mixing calculation would be using a flux that is too high which would result in an estimated concentration that is too low, or the natural groundwater would dilute the load from the infiltration galleries. For example, if instead of conductivity (K equaling 200 ft/d, K is 30 ft/d, the flow would be 27 gpm (0.06 cfs) and the total N concentration would be 0.55 mg/l.	modeling, surface water predictive modeling, and geochemical testing data to design its underground workings, the WTP, and TWSP to minimize potential impacts on water quality. Apart from groundwater in the underground workings at the end of the closure phase, water from all facilities would be collected and treated to meet non-degradation criteria prior to discharge (Hydrometrics, Inc. 2016b). The 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 non-degradation effluent limits (0.097 mg/L). The total nitrogen effluent limit is only in effect 3 months per year (July 1 to September 30). 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, 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 (Zieg et al. 2018). No adverse effects are predicted to occur to surface water and groundwater as a result of Project development based on results of the quantitative predictive models developed for the Project and in light of planned mitigation measures. The reliability of the model predictions was assessed considering data limitations and through completion of a model sensitivity analysis, as is standard practice. Impacts on groundwater and surface water resources are not predicted. The Proposed Action and AMA require the Proponent to conduct groundwater and surface water monitoring.
BBC00589	37	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers	Email	Tintina's estimated total N concentration at the downstream boundary of Sheep Creek would range from background to 0.118 mg/l, as N, which exceeds the 0.09 mg/l standard3. This estimate includes the combined Sheep Creek and Coon Creek flow. The critical point would be at the downstream because that is the point at which all of the groundwater discharge will have reached the stream due to the bedrock forcing it into the stream. The scenarios described above could potentially increase the total N concentration. The total N concentration at the downstream end of Coon Creek, which means at its confluence with Sheep Creek, would range from background to 0.119 mg/l as N, which is also just less than the 0.12 mg/l standard in Coon Creek (Application, Appendix D, p 4-4). This prediction results from mixing Coon Creek stream water with groundwater discharging into the creek. The stream water total N results from the combination of natural flow and mitigation water from the NCWR. Dewatering would deplete the natural flow which would be replenished with mitigation water. Total N in water entering the 400-foot mixing zone on Coon Creek would range from 0.104 to 0.106 mg/l during the first year and be less than 0.1 mg/l as N during subsequent years. Both estimates, for Sheep Creek and Coon Creek, are probably too low because of potential errors in the groundwater flow concentration described above. Effluent discharging at Outfall 001 would be as much as 0.57 mg/l and after mixing, the groundwater total N concentration would be close to that value, depending on the estimated groundwater flows in the alluvium. For example, if the effluent rate is actually 1285 gpm, the total N concentration would be 0.148 mg/l, as N.	This comment involves mixing and dilution calculations. The MPDES permit does not authorize a mixing zone; therefore, the comment is not pertinent to the Proposed Action. See response above regarding appropriateness of model predictions and certainty associated with analyses as well as predictions regarding nitrogen concentrations. Apart from groundwater in the underground workings at the end of the closure phase, water from all facilities would be collected and treated to meet non-degradation criteria prior to discharge (Hydrometrics, Inc. 2016b). No adverse effects are predicted to occur to surface water and groundwater as a result of Project development based on results of the quantitative predictive models developed for the Project and in light of planned mitigation measures. The reliability of the model predictions was assessed considering data limitations and through completion of a model sensitivity analysis, as is standard practice. Impacts on groundwater and surface water resources are not predicted. To confirm this prediction, the Proposed Action and AMA require the Proponent to conduct groundwater and surface water monitoring.
BBC00589	38	Tom Myers	Prepared for: Montana Trout	Email	MTDEQ (undated) and the DEIS also ignores important hydrology. MTDEQ properly requires Tintina to not discharge effluent into the UIGs if total N	The commenter switches back and forth between nitrate and total nitrogen in the comment. Nitrate has a year-round standard, so DEQ assumes the commenter

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			Unlimited, Trout Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers		exceeds 0.09 mg/l between July 1 and September 30 to avoid exceeding the non-degradation standard in Sheep Creek. MTDEQ requires Tintina to decide by June 15 whether they will discharge from the UIGs into Sheep Creek during the July through September period (MTDEQ undated, p 35). This is not sufficient to protect Sheep Creek from excessive total N loading because it ignores lag time for effluent to reach Sheep Creek. The groundwater model analysis (Hydrometrics 2018, Appendix F) shows flowlines from the UIGs to Sheep Creek. The flow paths from the southwest half of the UIGs follow most of the length of the alluvium before they reach Sheep Creek. Only the two UIGs at the downstream end of the outfall have short flow paths to the creek. Effluent discharge from much before June 15 could reach Sheep Creek during the summer period. MTDEQ should complete a travel time analysis to determine how long before July 1 the discharge should cease to avoid effluent discharge long before July 1 reaching Sheep Creek during the critical period.	meant total nitrogen instead of nitrate in this comment. The commenter oversimplifies the UIG, as well as fate and transport of total nitrogen. The length of the UIG does not mean that total nitrogen could be discharged up to 1,450 feet away from Sheep Creek, but instead the UIG is much closer because it runs alongside the creek. Furthermore, the slow rate of water infiltration is not a good indicator that total nitrogen could take months to reach surface water, but an indicator that total nitrogen would have time to attenuate in the soils and may never reach the creek. The well-established science behind total nitrogen in soils is that total nitrogen is rapidly taken up or denitrified to harmless nitrogen gas by microbes. For total nitrogen, DEQ would actually prefer slow infiltration and long detention time. Therefore, DEQ's main concern is where the UIGs are in close proximity to Sheep Creek so that the total nitrogen in the discharge might quickly interact with Sheep Creek. This is why the seasonal discharge limits are important.
BBC00589	39	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers	Email	The DEIS does not consider temperature a problem presumably because MTDEQ (undated) was wrong to claim there was no reasonable potential to exceed the temperature standard because it assumed the effluent discharge would “equilibrate with the ground water temperature before reaching surface water” (MTDEQ undated, p 28). The water quality standard for temperature for all three receiving waters is a 1° F increase above natural, not to exceed 67° F (MTDEQ undated, Table 1.A). The upper quartile temperature for Sheep Creek is 47.8° F (Fact Sheet Table 2.A.1) and for Coon Creek is 53.8° F (Id.). Groundwater ranges from 40.5 to 45.7° F for the 25th to 75th percentile (Id.) during the summer, Tintina would store effluent in a reservoir for up to three months before discharging it to the alluvium. The effluent water temperature would likely exceed the groundwater temperature and stream temperatures by a substantial amount by the time it is discharged to groundwater. As discussed elsewhere, the effluent discharge rate would exceed the groundwater flow rate by a substantial amount. Therefore, the effluent temperature will control the groundwater temperature. It is very likely that groundwater discharges into Sheep Creek will have a temperature that exceeds the Sheep Creek natural temperatures by more than a degree F. Recommendation: The DEIS should analyze how the discharge plans affect receiving water temperatures. Because the exceedances would likely occur in the autumn, after the end of the summer discharge moratorium, the reservoir water could be much warmer so discharge could warm Sheep Creek. The DEIS should consider a strategy that mixes mostly dewatering water with stored reservoir water.	No adverse or long-term effects are predicted to occur on surface water and groundwater as a result of Project development based on results of the quantitative predictive models developed for the Project and in light of planned mitigation measures, including treatment of mine dewatering flows by RO. As is standard practice, the EIS includes quantitative predictive surface water and groundwater modeling to generate predictions to support the assessment application and further, as tools to inform mitigation and management strategies (See Section 3.4.1, Section 3.4.2, Section 3.5.1, and Section 3.5.2 of the EIS). Refer to Consolidated Response WAT-5 for additional discussion regarding potential thermal effects on water resources, including Sheep Creek.
BBC00589	40	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center,	Email	Water quality discharging through the waste rock would be poor, with numerous standards violated (DEIS, Table 3.5-6). The DEIS does not worry about this because of the very low amount of water predicted to seep through the waste rock. The estimates may be incorrect, as discussed above (p 18).	The HELP model used in the analysis (Hydrometrics, Inc. 2016a) considers not only material properties, but also climatic factors and calculates a water balance of the waste rock storage facility. The predictions regarding groundwater flow and contact waters from this facility and related analyses as presented are considered appropriate and sufficient to support the EIS and associated mitigation and mine planning. Note, Table 2 presented by Hydrometrics (Hydrometrics, Inc. 2016a) enumerates percolation and flow rates for each of the 24 simulated months.

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			EarthWorks, American Rivers			Appendix N (Enviromin 2017), Section 5.4, provides that "The waste rock on the temporary WRS pad will be stored on a liner with a small estimated volume of water reporting from the WRS pad liner drainage system to the lined CWP where it will be collected for treatment until rock is placed into the CTF. Waste rock leachate will be treated to meet non-degradation criteria." A total failure of a liner system is highly unlikely. Both the Proposed Action and AMA would require the Proponent to conduct groundwater monitoring for seepage from the waste rock storage facility. Also see response to Submittal ID BBC00589, Comment Number 23.
BBC00589	41	Tom Myers	Prepared for: Montana Trout Unlimited, Trout Unlimited, Montana Environmental Information Center, EarthWorks, American Rivers	Email	The PWP would contain water from the mill with a little from the CTF, water treatment plant, precipitation and run-on mixed in (DEIS, p 3.5-9). The water would have elevated concentrations of nitrate, arsenic, copper, nickel, lead, antimony, strontium, and thallium (Id.). Nitrate would be at 87 mg/l. Prior to discharge, it would be treated in the water treatment plant. The PWP would be located in the headwaters of Coon Creek. Any leaks would enter the alluvium under Coon Creek and eventually discharge to it. Yet, the DEIS does not consider the potential for any tears in the liner of the PWP. Recommendation: Analyze the fate of leaks in the PWP. Because the facility is a pond and a leak might not be detected because it would be a small portion of the pond water volume and the inflow exceeds 1900 gpm (Hydrometrics 2018, figure 3.8), it would be reasonable to consider a leak equal to as much as 50 gpm for several months or a larger leak for a shorter time period.	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. As such, further analyses of this facility is considered not warranted. The Proposed Action and AMA require the Proponent to conduct groundwater and surface water monitoring. Monitoring would continue on Sheep Creek downstream of the Project boundary and along Coon Creek as described in Section 3.5 of the EIS. Also, see Consolidated Response PD-4 regarding liner performance.
BBC00933	3	Ann Maest	Buka Environmental	Email	Waste Rock: The types and numbers of geochemical tests conducted for major waste rock units are summarized in Table 1. Additional testing was conducted on minor waste rock types (Ynl 0, Yc, Yne, IG), including two HCTs, 37 ABA/NAG tests and 1 mineralogy sample (see Enviromin, 2017, Table 1-1). The sulfide content was used to guide the selection of samples for ABA analysis. A graph is presented in Enviromin and Tetra Tech (2013, Figure 3-1) showing the sulfide content for Ynl 0 samples as an example. But no samples were selected from Ynl 0 or USZ rocks with the highest %S values. Environmin and Tetra Tech (2013 chose to use Fe, S, As, and Zn to select samples for metal mobility tests (SPLP , but copper, lead, and thallium concentrations are probably more important in terms of leaching behavior, as seen later. The method for selecting samples was revised for the 2015 testing program, but It is unclear how it was modified for selecting samples for HCTs. The results from the HCTs are important because the SPLP testing failed (pH values too high), yet very few HCTs were conducted (see Table 1). No geochemical testing has been conducted on the Lower Sulfide Zone (LSZ), the Upper Newland Formation (Ynu), sulfide zones in the Ynu, and the upper sulfide zones in the Ynl (Sub0 SZ and 0/1 SZ). The LSZ hosts the Lower Copper Zone. The 2012 Johnny Lee Decline did not intercept Upper Newland Formation rocks (Ynu; Enviromin and Tetra Tech. 2013; Figure 1-2 and 1-3 ,	Extensive geological and geochemical analyses of rock types that would be excavated or exposed by the Project were conducted over multiple years to support the EIS and sufficiently supports the assessment application; detailed discussions of sample representativity and the multiple phases of sample selection and analysis are provided in Appendix D (Enviromin 2017b) and Appendix N (Enviromin 2017a) of the MOP Application (Tintina 2017a). Per Appendix D (Enviromin 2017b) to the MOP Application (Tintina 2017a): "To ensure representative sample selection for waste rock and construction materials, statistical sampling techniques were applied to the multi-element whole rock data (from the exploration database) in order to select sample subsets for environmental geochemical testing. Comparable, but not identical, methods were used in the identification of representative samples by Tetra Tech in 2012 for the Ynl A, Ynl B, and USZ lithotypes, and by Enviromin in 2015 for USZ, Ynl B, and LZ FW. Tetra Tech selected representative samples across the distribution of each multi-element data set visually, as described in the Final Black Butte Copper Project Baseline Environmental Geochemistry Evaluation for the 2012 Johnny Lee Decline, which is included as **Appendix A**. This approach was revised during the 2015 environmental geochemical testing program to determine the number of subsamples needed to represent the mean exhibited by the larger pool of available data for each lithotype using a method based on Runnells et al., 1997.

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					but this does not mean that Ynu rocks and the associated massive sulfide layers, especially those close to the Upper Sulfide Zone (USZ , will not be intersected during mining. [See Table 1 in original comment letter]	The number of samples identified for each lithotype is shown with boxplots comparing the sample subsets with the overall population in **Appendix B**." Further, in addition to Figure 3-1, other graphs are provided to show the different lithotypes and the subsamples that were selected to match the distribution of analytical data (Enviromin 2017b, Subappendix A-1 and A-2). The terminology of the geologic model (Ynu, Ynl-Sub 0 SZ, etc.) was not applied directly to the hydrologeologic model (and in turn the geochemical model). The unit described as "Ynu", and other smaller sub-units, are represented by samples of the Newland shale above the USZ (Ynl A) for geochemical and hydrologic modeling. The LSZ (as described in MOP Application Section 1.4.4.2) lies within the footwall, and is represented by the acronym LZ FW (lower zone foot wall) in geochemical modeling. Due to changes in the mine plan during 2014 and 2015, the Yne, Ynl 0, IG, and Yc were determined to represent less than 1 percent of waste rock tonnage. Therefore, while they have been characterized thoroughly, they are not relevant to the Proponent's final mine plan. Geochemical results from the Johnny Lee Deposit Lower Sulfide Zone are summarized in Section 3.6.1 of the EIS, Geology and Geochemistry, Analysis Methods. Further details of the LSZ are presented in Appendix D, Final Baseline Environmental Geochemistry Evaluation of Waste Rock and Tailings (Enviromin 2017b), of the 2017 MOP Application (Tintina 2017a).
BBC00933	4	Ann Maest	Buka Environmental	Email	The acid-base accounting (ABA) results for the major waste rock units are presented in Figure 2 and in Enviromin (2017, Table 3-3a). A summary of the results and the implications for additional testing follow: • LZ FW: The Lower Zone footwall samples are either potentially acid generating (PAG or have an uncertain potential to generate acid. This unit represents the highest percentage of waste rock tonnage (35%), yet fewer samples of this unit were tested than the other two important waste rock units (Ynl B and USZ). Only 15 ABA samples were tested, no mineralogy was examined, and only one humidity cell test (HCT) was run; more testing of the LZ FW is needed, including ABA, mineralogy, and HCTs. • Ynl B: The Ynl B unit is expected to be 32% of the total waste rock. Most of the Lower Newland Formation shale and conglomerates (Ynl B) are non-acid generating, but several samples had uncertain potential and two were PAG. As noted below for Ynl A, more samples should be taken close to where Ynl B intersects the USZ (see Figure 2) to help define the environmental behavior of what is likely the higher sulfide content material. Only two HCTs were run on this material. More HCTs should be conducted to evaluate the contaminant leaching behavior of the samples across the ABA spectrum. • USZ: The Upper Sulfide Zone is expected to account for 28% of the waste rock. Samples from this zone had high sulfide content (1.7 to 43% sulfide S) and low neutralization potential. Although two HCTs were run on this material, one test only lasted for XX weeks. The longer test produced acid and leached high concentrations of metals. Additional and longer kinetic testing is needed on this, the Lower Sulfide Zone (LSZ), which has had no testing, and the other sulfide layers shown in Figure 1.	Extensive geological and geochemical analyses of rock types that would be excavated or exposed by the Project were conducted over multiple years to support the EIS and sufficiently support the assessment as well as associated mitigation and management strategies. Details of these analyses are presented in Appendix N (Enviromin 2017a) of the MOP Application (Tintina 2017a) and Section 3.6, Geology and Geochemistry, of the EIS. The geochemical testing of waste rock for the Black Butte Copper Project was initially focused on the 2012 Johnny Lee Decline, which included static and/or kinetic testing of the relevant lithotypes: IG, Ynl A, Ynl 0, Ynl B, and USZ. When the focus was shifted from the 2012 Johnny Lee Decline to an operational-scale plan, the baseline geochemical testing program was updated to identify where the 2012 work had not fully characterized waste rock lithotypes and was based on site-wide Inductively Coupled Plasma Mass Spectrometry exploration data. For example, the 2012 analysis of Ynl A involved samples representative of multi-element chemistry site-wide, while the 2012 analyses of Ynl B and USZ did not. The Ynl A lithotype, thus, did not require additional testing, while the Ynl B and USZ lithotypes did. The LZ FW, Yne, and Yc were also added as lithotypes. In addition to the LZ FW analyses noted here (15 ABA, 1 asbestos, and 1 HCT), 550 samples of this unit were submitted for whole rock geochemical analysis. Guidance within Maest et al. 2005 suggests a minimum number of samples that should be collected for geochemical characterization during initial sampling, based on the predicted mass of each rock type to be encountered by mining. The

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					• Ynl A: The Ynl A waste rock unit represents only 4% of the total waste rock, but the ABA results show that the unit has not been properly divided into geochemical testing units. The results span the range from PAG, through uncertain, to non-PAG (see Figure 2). Enviromin attributes the uncertain and PAG characteristics to samples collected closer to sulfide stringers that become more common the closer the samples are to the USZ. This same reasoning applies to the much more extensive Ynl B and may explain the uncertain and PAG results for several of the samples. I could not find information on where the Ynl B samples were taken relative to the USZ, but this information should be provided. Because the ABA results were split, additional ABA sampling and testing is needed. The current plan for disposal of the waste rock is to incorporate it into the CTF with the cemented tailings. However, the more sulfidic and PAG waste rock would be better placed in the lower portions of the underground mine below the water table to minimize exposure to oxygen. Improved waste rock testing is needed to be able to distinguish these materials. Of special concern is waste rock units close to the sulfide zones and layers, most of which have not been tested.	guidance (Maest et al. 2005) states: 3 samples for <10,000 tonnes of rock; 8 samples for <100,000 tonnes; 26 samples for <1,000,000 tonnes; 80 samples for 10,000,000 tonnes. For the LZ FW lithotype, the estimated mass of rock (35 percent of total) is approximately 272,000 tonnes, which would require a minimum number of 8 to 26 samples. Therefore, the number of initial analyses for the LZ FW (550 whole rock and 15 ABA) are considered sufficient based on this guidance document. For the Ynl B lithotype, the estimated mass of rock (32 percent of total) is approximately 249,000 tonnes, which would require a minimum number of 8 to 26 samples. Therefore, the number of initial analyses for the LZ FW (1,412 whole rock and 34 ABA) are considered sufficient based on this guidance document. For the USZ lithotype, the estimated mass of rock (28 percent of total) is approximately 218,000 tonnes, which would require a minimum number of 8 to 26 samples. Therefore, the number of initial analyses for the LZ FW (2,542 whole rock and 41 ABA) are considered sufficient based on this guidance document. For the Ynl A lithotype, the estimated mass of rock (4 percent of total) is approximately 31,000 tonnes, which would require a minimum number of 8 samples. Therefore, the number of initial analyses for the LZ FW (1,138 whole rock and 48 ABA) are considered sufficient based on this guidance document. See also Response to Comment BBC00933-3. Further information about the sample subsets that were used for geochemical testing are found in Appendix D (Enviromin 2017b) to the MOP Application (Tintina 2017a), sub-appendix B, and include details about the individual holes and depth intervals that were sampled and later used for other testing.
BBC00933	5	Ann Maest	Buka Environmental	Email	Tailings: The static test results for the tailings are more consistent than for the waste rock samples: all tailings samples are PAG, including those with 2% and 4% cement. Environmin (2017; Table 4-2) shows that the NP:AP ratio of the tailings ranged from 0.003 to 0.11 (all well below the non-PAG cutoff of 3 , and the sulfide sulfur content was high (17.7 to 29.9% S). The total metals results are presented in Enviromin (2017), Table 4-1. The copper content of the tailings is approximately 3,000 ppm, and the arsenic content is nearly as high (2,160 ppm in the raw tailings). The cobalt concentration is also impressive: 1,580 ppm in the raw tailings. The high concentrations suggest that the tailings contain toxic constituents that could leach under acidic (metals) and non-acidic (arsenic, selenium, uranium, etc) conditions. The tailings require special handling, and the kinetic testing results discussed below raise questions about the protectiveness of the selected approaches. Additionally, separate analysis should be conducted on the cement. The DEIS states that the tailings would be thickened and sent to a paste plant where cement, slag, and/or fly ash may be added to the tailings (DEIS, p. 2-10). The tailings geochemical tests were conducted with a 50/50 mixture of cement	Comment noted. Extensive geological and geochemical analyses of rock types that would be excavated or exposed by the Project were conducted over multiple years to support the EIS and sufficiently support the assessment as well as associated mitigation and management strategies. Details of these analyses are presented the Appendix N (Enviromin 2017a) Project MOP Application (Tintina 2017a) and Section 3.6, Geology and Geochemistry, of the EIS. Importantly, note that there is no impact on groundwater quality from the CTF. The Proponent expects negligible seepage through the cemented paste tailings mass as the hydraulic conductivity for the tailings paste is very low (approximately 10^{-6} centimeters per second). The 100 mil HDPE liner specifications from the manufacturer have no defined hydraulic conductivity value but the robust design of the CTF liner system (See Figure 3.36, CTF Sections and Details of the MOP Application; Tintina 2017a) consists of two 100 mil HDPE liners with a geonet in between, and subgrade bedding layers above and below the liner system to allow any potential water flow. In addition, the cementing process should consume some available water from the tailing as it is deposited and sets up (taking a matter of days). Some tailing seepage (about 5 percent of the mass) would run off

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					and slag as the binder (Enviromin, 2017, p. 58). Separate leach testing of the slag or the cement + slag mixture has not been conducted. Appendix K-5 of the MOP contains results from laboratory testing of the cement, slag, and fly ash, but aside from analysis of chromium and vanadium oxides, no testing of total metal concentrations of environmental concern was conducted (e.g., arsenic, selenium, lead, and other metals). The slag is from an unspecified source in Asia (MOP, App. K-5, Table 4-1 and generally contains lower but detectable total metal concentrations than the cement (MOP, App. K-5, Table 5-6). Testing of the Portland cement shows that it contains Sb, As, Dr, Co, Pb, Tl, V, and Zn (MOP, App. K-5, Table 5-5; some are quite high, including Zn at 1,010 mg/kg , but no leach testing was performed on the cement or any of the binders. The results in Table 4-1 (Enviromin, 2017 suggest, based on relative concentrations in the raw tailings vs 2% and 4% cemented paste tailings, that the cement + slag could contain Ba, Ca, Cr, Cu, Ni, Pb, Fe, Sr, V, and Zn, but the results are not definitive. The potential impact to groundwater of contaminant leaching from the cement and especially the slag has not been evaluated. Leach testing of the cement any potential binders should be conducted, and their potential impact to groundwater quality should be evaluated as part of the Final EIS.	from the consolidated tailing surface to the drainage layer or to the internal sump as newly deposited tailings set up. Seepage around the tailing (along the liner/tailing interface) should report directly to the internal basin drain and via the drain to the seepage reclaim sump from which it is pumped to the PWP. All seepage from the tailings basin through the tailings mass would be intercepted by the basin drain system above the liner. The basin drain would convey seepage to the water reclaim sump and pump system at the north end of the impoundment. Refer to Consolidated Response PD-2, which discusses that surface placement of cemented paste tailings shows little oxidation within the massive tailings. Potential acid runoff is caused by surficial reactions; however, this acidic water would be contained within the CTF and treated (Enviromin 2017a, Appendix N of the MOP Application). Leach testing of cemented paste tailing cylinders already incorporated the cement and binder (slag) components that would be used in the cemented paste matrix, therefore accounting for those additives in subsequent modeling. The chemical compositions of various binders are included in the MOP Application, Appendix K-5 (Knight Piésold Consulting 2017a), but sole leach testing of the binder components would not be realistic or representative of the proposed use of those materials.
BBC00933	6	Ann Maest	Buka Environmental	Email	General Comments and Need for Additional Testing: A small number of HCTs were conducted on the four major waste rock types, two of the minor waste rock units, and the tailings. The HCTs are the only leach tests with usable results. The SPLP tests produced high pH values, which were attributed to supersaturation of the confined-headspace samples with carbon dioxide (Enviromin, 2017, p. 19). Enviromin wisely chose to base their metal mobility predictions on results from the HCTs and used results from all weeks rather than using average rates, which is often done as a way to minimize predicted concentrations. The HCTs were composed of composites of the waste rock lithologies. I see no static test results for these composites, and that information must be presented to aid in interpretation of the HCT results. A table should be created to show the origins of each HCT, with static test results (ABA, NAG, total metals, mineralogy). A composite HCT of different parts of the lithologic unit is not a substitute for conducting multiple tests of different geochemical test units within a given lithology. In fact, compositing lessens the ability to interpret the results because it does not supply information that would allow separate handling of different geochemical test units. The ABA results for the Ynl A unit is an example of the problem: the ABA results for the 48 different samples were variable, with a mix of non-PAG, uncertain, and PAG results (see Figure 2). Instead of running one HCT for the unit (the Ynl A HCT was run in 2012 for 88 weeks), different individual samples should have been run, or if insufficient sample volume was available, compositing should have only been done with the same ABA result (i.e. composite PAG samples into one HCT, uncertain into another HCT, and non-PAG into a third HCT). Total metals concentrations should have also been taken into account in creating the composites. Although it appears that ICP (total metals results were considered	Comment noted. Extensive geological and geochemical analyses of rock types that would be excavated or exposed by the Project were conducted over multiple years to support the EIS and sufficiently support the assessment as well as associated mitigation and management strategies. Details of this analysis are presented in Appendix N (Enviromin 2017a) of the MOP Application (Tintina 2017a) and Section 3.6, Geology and Geochemistry, of the EIS. Further note, static test results for the subsamples collected for composites, statistical summaries for thousands of whole rock tests, and the rationale for selecting subsamples for further testing are described in Appendix D (and subappendices therein; Enviromin 2017b) to the MOP Application. Some of the specific metals noted by the commenter (copper, lead, and thallium) were in fact included in these analyses (see Table B-2 within sub-appendix B of Appendix D to MOP Application). See Responses to Submittal ID BBC00933, Comment Number 3 and Submittal ID BBC00933, Comment Number 4.

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					for some of the early leach tests (possibly only the SPLP tests, although this isn't clear , some of the most important metals were not considered, including copper, lead, and thallium. Because of the merging of waste rock samples into composites, we don't have a good idea of the leaching behavior of any of the waste rock units. Recall that the HCTs are the only tests that can be used to evaluate the leaching behavior because the SPLP tests failed. The lack of appropriate numbers and compositing of HCTs is a major issue that needs to be resolved and will require additional testing.	
BBC00933	7	Ann Maest	Buka Environmental	Email	Waste Rock: Full HCT test results for all samples are included in Enviromin, 2017, Appendix C. The Montana groundwater standard exceedences for the HCTs are shown in Enviromin (2017; Table 3-6). The most groundwater exceedences were in the longer 2015 USZ test (for As, Be, Cd, Cu, Pb, Hg, Ni, Sr, Tl); this was also the only test that produced acid. Other HCT groundwater exceedences for other waste rock units included Sb and U; surface water exceedences included Al, Cd, Cu, Ni, Pb, Se, Tl, and Zn. Test for lithologies with two HCT samples are discussed below (USZ and Ynl B).	Comment noted.
BBC00933	8	Ann Maest	Buka Environmental	Email	USZ: Although two HCTs were run for USZ and Ynl B units (see Table 1 , the shorter USZ test was inconclusive and needed to be run for longer. The 2015 USZ HCT was run for 73 weeks but didn't start producing pH values consistently below 6 (considered acidic until after week 60; the shorter test was only run for 24 weeks and did not produce acid. Selected results for the longer 2015 USZ HCT are shown in Figure 3. These results show especially high concentrations for certain metals, including Cu (up to 50 mg/L), Pb (~300 µg/L , Ni (3.5 mg/L , SO4 (7,000 mg/L , Tl (400 µg/L , and Zn (1.3 mg/L). Concentrations peaked in the first week or two of the test and again after week 60; pH values were low during both of these periods. The results suggest that when the sulfide zones become acidic, they will release high concentrations of many metals, metalloids, and sulfate.	Comment noted. This length of time prior to acidification in the USZ HCT also suggests that the host rock has significant buffering capacity, which is also observed in background water quality conditions within the carbonate-rich deposit. The available alkalinity in the rock was only depleted after an extended period of aggressive weathering of crushed rock, which is not reflective of the conditions that would be encountered underground during operations or post-closure. Oxidation of host rock surfaces would be limited by fracture density, reactive surface areas, and the rates of diffusion and subsequent oxygen consumption. An oxidized rind would develop on host rock surfaces not covered by cemented paste backfill, rather than complete acidification of the lithologic unit, buffered by the aforementioned alkalinity of carbonates. Multiple oxidation scenarios were modeled as sensitivty analyses in Appendix N (Enviromin 2017a) of the MOP Application (Tintina 2017a).
BBC00933	9	Ann Maest	Buka Environmental	Email	Ynl B: For the two Ynl B HCTs, the 2012 test was run for 62 weeks and the 2015 test for 36 weeks. Results from the 2012 test showed neutral pH values throughout the test. Antimony and selenium concentrations were above Montana surface water standards in the first few weeks of testing, but other metal/metalloid concentrations were low (Enviromin, 2017, Figures 3-10a and b). The shorter 2015 Ynl B HCT also did not produce acid. Antimony concentrations rose in the early weeks but did not exceed standards; selenium concentrations exceeded surface water quality standards in the early weeks again, and thallium and lead concentrations slightly exceeded surface water quality standards in the early weeks. No information was provided on the location of the composited subsamples or the static testing results of either Ynl B composite sample.	Comment noted. Further information, like static test results for the subsamples collected for composites, statistical summaries for thousands of whole rock tests, and the rationale for selecting subsamples for further testing are described in Appendix D (and subappendices therein; Enviromin 2017a) to the MOP Application (Tintina 2017a). See responses to Submittal ID BBC00933, Comment Number 3 and Submittal ID BBC00933, Comment Number 4.
BBC00933	10	Ann Maest	Buka Environmental	Email	Tailings: HCTs were run for raw tailings, cemented tailings (2% and 4% cement added), 4% cemented tailings + waste rock (ROM), and saturated tailings. In general, metal and sulfate release rates and concentrations were highest for the raw tailings, but results for tailings with 2% cement were similar after only about four weeks (Enviromin, 2017, Figure 4-1 to 4-7). Results for 4% cemented tailings with ROM were mixed, with some leachate	Addition of cement to deposited tailings is not intended to serve as the primary mitigation and management measure for potential ARD and metal leaching effects, as seems to be suggested here by the reviewer. A "Summary of CTF Design Features and Seepage Analysis during operations and closure" report produced by Geomin (Geomin 2018) states that "Operationally, and in closure, the Cemented Tailings Facility (CTF) has a Foundation Drain System that

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					concentrations higher and lower than 4% tailings without ROM. Cemented tailings are not only used to provide structural support, although this is stated as the sole purpose in several documents (e.g., Enviromin, 2017, p. 74). For example, the Agency Modified Alternative (AMA would require backfilling additional mineralized mine workings in the sulfide zones to avoid groundwater contamination in areas outside these highly mineralized zones (DEIS, p. ES-6). In addition, the section on increasing the cement content in tailings in the description of alternatives (DEIS, Chapter 2, p. 2-10 states that this alternative was evaluated to "further reduce potential ARD and water quality impacts." Despite the results described in this section for cemented tailings, the DEIS states that the cement contents proposed for the surface CTF (0.5 to 2% and the backfill (4% are sufficient to achieve the necessary strength and water quality protection (DEIS, p. 2-20). Relying on rapid deposition of cemented paste tailings in the CTF is not a reliable approach, as discussed in Zamzow (2019). Results for selected parameters are shown in Figure 4. The pH values were low (<6 for all tailings samples except the saturated tailings. Concentrations of As, Cu, Ni, Pb, and Tl were especially high, as shown in Figure 4. The HCTs for tailings with 4% cement were cut off at ~20 weeks, but concentrations of many metals were high near the end of the test and were a proxy for physical breakdown of the cement (Enviromin, 2017, p. vi). The saturated tailings generally had the lowest concentrations, but concentrations still exceeded Montana groundwater or surface water standards, as shown in Figure 4. The results for the tailings tests suggest that materials with this high of a sulfide content require multiple mitigation measures to avoid the formation of acid mine drainage, including submerging below the water table and binding with a higher percentage of cement. Such a combination has not been tested but should be for the Final EIS. Separation of pyrite in the flotation circuit and burying these highly reactive tailings below the water table with cement could be the only way to avoid severe water quality problems. Pyrite separation was evaluated and rejected based on costs and space concerns in the underground mine (DEIS, App. Q, Section 2.3.3 and 2.3.4 and DEIS, App. C). Chambers (2019 discusses reviving this option in more detail.	transports groundwater from beneath the excavated facility in a drainage collection system consisting of gravel and perforated pipes in trenches excavated into bedrock beneath the facility. This water is transferred from the collection system to a foundation drain pond outside of the CTF and pumped from there to the Water Treatment Plant (WTP) prior to discharge. By removing water from beneath the CTF, the foundation drain system prevents the build-up of any hydrostatic pressure or head beneath the CTF facility's liner system and therefore eliminates the risk of upward migration of groundwater through the bottom HDPE liner of the CTF and any risk of floating the liner during construction." That report also describes other CTF design features aimed at reducing risks of environmental impacts, and describes an investigation completed to evaluate groundwater below the proposed CTF. Short of major failure of the proposed design features, it is unlikely that the CTF-impacted water would cause any significant groundwater contamination. Both the Proposed Action and Agency Mitigated Alternatives would require the Proponent to conduct groundwater and surface water monitoring. Similarly, monitoring during operations would be required to identify potential impacts on water resources in a timely manner and to trigger implementation of operational changes and/or mitigation measures (Section 6 of the MOP Application; Tintina 2017a). Monitoring would continue on Sheep Creek downstream of the Project area and along Coon Creek as described in Section 3.5, Surface Water Hydrology, of the EIS. See Consolidated Response PD-2 and Consolidated Response PD-5 for additional discussion of surface storage of tailings in the CTF and potential for weathering and oxidation/acid formation. See Consolidated Response ALT-4 that discusses pyrite separation (i.e., depyritization) as an alternative that was considered but ultimately rejected for the Project, both based on environmental concerns as well as technical feasibility.
BBC00933	11	Ann Maest	Buka Environmental	Email	The Executive Summary of the DEIS concludes that groundwater quality is expected to be impacted from underground mine water after mining, but that adsorption would limit concentrations, and groundwater discharging to Sheep Creek is not predicted to adversely affect its water quality (DEIS, p. ES-10). These results are based on water quality modeling presented in Appendix N of the MOP. Although the modeling has used some good approaches (using a non-proprietary code, PHREEQC, and doing sensitivity analyses with different fracture densities, etc.), several of the approaches are unsupported and affect the results. The modeling for the paste backfill in the underground workings used the results for diffusion tests conducted on 4% cemented tailings with and without waste rock (MOP, App. N, p. i). The diffusion tests with 2% cement failed (Enviromin, 2017, p. 59), so results for the 4% cement binder were the only ones available. The diffusion tests were only run for ~270 hours (~11 days), and results had not stabilized for several important parameters, including pH,	As is industry standard practice, the EIS includes quantitative surface water and groundwater modeling to generate water quality predictions to support the assessment application and inform mitigation and management strategies (see Section 3.4.1, Section 3.4.2, Section 3.5.1, and Section 3.5.2 of the EIS). The predictions and analyses as presented are considered appropriate and sufficient to support the EIS. Importantly, note that binder addition is not solely meant to neutralize potential sulfide oxidation. In order for sulfide oxidation to occur, there must be sufficient water and oxygen present to react. The cemented tailings cylinders subjected to HCTs and diffusion tests showed far more disaggregation than what would be anticipated in a backfilled stope or lift placed within the CTF. During diffusion testing, the pH dropped from 8.89 to 7.15, and the acidity rose from -1 to 22 mg/L (while alkalinity increased slightly from 7.8 to 9.4 mg/L) in the last two analyses (Appendix D [Enviromin 2017b] of the MOP Application). Considering

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					sulfate, and acidity, especially for cemented tailings without waste rock (MOP, App. D, Figure 4-1). In addition, the test water was replaced 13 times over the 11-day test (Enviromin, 2017, p. 59) and would not simulate the buildup of sulfate, which would produce additional cement attack (Zamzow, 2019).	the degree of disaggregation in the unsupported cylinder, this likely over-estimates the dissolution/leaching potential of the tailings. This test exposes additional reactive surface area, overestimating the reaction and acid production potential of the cemented tailings. The water quality prediction models used the laboratory data to demonstrate compliance with non-degradation criteria. Like other HCTs, this is an aggressive treatment of samples (particularly when cemented tailings cylinders were unsupported/confined), and 11 days of testing does not correlate directly to an equivalent length of time of field conditions. Further, the testing methodology for ASTM C1308-08 calls for the solution to be refreshed to develop a leaching profile, and it is not designed for the cylinder to stabilize or to reach equilibrium with the test solution. Although this does not provide constant exposure to sulfate in the leach solution (which would increase within the solution until reaching an equilibrium point), the use of deionized water (which is a more aggressive solvent) provides a conservative estimate of leaching potential, as explained in other responses. See Consolidated Response PD-2 and Consolidated Response PD-5 for additional discussion regarding the internal mitigations for the cement and the low permeability of the laterally supported cemented paste backfill, which would limit further oxidation and increase sulfate concentrations.
BBC00933	12	Ann Maest	Buka Environmental	Email	Modeling of the backfilled tailings used the average of all diffusion test results. Results were different for diffusion tests with and without waste rock (ROM). It is unclear why waste rock was added since it is not currently planned to be added to cemented tailings placed in the underground mine. However, as noted in Appendix A of the DEIS, cemented backfill placed in underground mines has included waste rock, and its inclusion in the tests suggests that the Black Butte Project has not ruled out its use. Diffusion cylinders with ROM had lower pH values, higher sulfate concentrations, and higher acidity. The pH values were decreasing and acidity was sharply increasing in the tests without ROM in the last hour of testing to be comparable to those in the tests with ROM (MOP, App, D, Figure 4-1), but the average of all results were used in modeling. Based on the input values shown in Appendices A and B of Appendix N, the results from the diffusion tests without ROM (the ones with higher pH and lower acidity) were used. This will underestimate potential concentrations for most constituents in the underground mine. Results from the diffusion tests with ROM should also be used as input values in an additional model run.	Extensive geological and geochemical analyses of rock types that would be excavated or exposed by the Project were conducted over multiple years to support the EIS and sufficiently support the assessment as well as associated mitigation and management strategies. Addition of cement/binder to tailings is not intended to serve as the primary mitigation and management measure for potential ARD and metal leaching effects, as seems to be suggested here by the reviewer. Further, note that because the 4 percent run-of-mine paste was made using a blended mixture before waste management decisions were finalized, the 4 percent plus run-of-mine cylinder tested during baseline studies is not representative of the Proponent's proposed underground use of cemented paste. Due to the importance of texture in cemented paste stability, and the fact that the blending of waste rock into the 4 percent plus run-of-mine cylinder enhanced the reactivity of the cemented paste by disrupting its otherwise massive character and increasing reactive surface area, the 4 percent plus run-of-mine sample is not representative of the Proponent's final designs for paste placement. These data were thus not used in any of the modeling and they have been removed from the MOP Application discussion to avoid further confusion. The 4 percent with run-of-mine test results in the Environmental Geochemistry Baseline report (Enviromin 2017b) were solely retained for completeness. Note that the chemical influence of waste rock exposed in the walls of the underground is already accounted for in the underground mixing models. See Consolidated Response PD-2 and Consolidated Response PD-5 for additional discussion of tailings storage and potential for weathering and oxidation/acid formation.
BBC00933	13	Ann Maest	Buka Environmental	Email	General Comments and Need for Additional Testing: A small number of HCTs were conducted on the four major waste rock types, two of the minor waste rock units, and the tailings. The HCTs are the only leach tests with usable results. The SPLP tests produced	Extensive geological and geochemical analyses of rock types that would be excavated or exposed by the Project were conducted over multiple years to support the EIS and sufficiently support the assessment as well as associated mitigation and management strategies. For example, LZ FW analyses included 15

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						ABA, 1 asbestos, and 1 HCT analyses; further, 550 samples of this unit were submitted for whole rock geochemical analysis. Guidance within Maest et al. 2005 suggests a minimum number of samples that should be collected for geochemical characterization for each rock type during initial sampling. For the LZ FW lithotype, the estimated mass (35 percent of total) is approximately 247,000 tonnes, which would require a minimum number of 8 to 26 samples. For example, the number of initial analyses for the LZ FW (550 whole rock and 15 ABA) are within the recommended range in this guidance. Detailed discussion about sample representativity and sample subsets that were used for geochemical testing are found in Appendix D (Enviromin 2017b) of the MOP Application, sub-appendix B, and includes details about the individual holes and depth intervals that were sampled. See Responses to Submittal ID BBC00933, Comment Number 3 and Submittal ID BBC00933, Comment Number 4.
BBC00933	14	Ann Maest	Buka Environmental	Email	Upon closure, Tintina proposes to flood the underground workings with treated water to flush out the stored oxidation products (MOP, App. N, p. 35). Enviromin conducted a simple analysis in Appendix N of MOP App. N using results from HCTs and estimated that three to six rinses would remove the oxidation products from the workings. The rinsing with RO-treated water is not included in the closure water quality model (MOP, App. N, p. 35). The rinsing would release high concentrations of sulfate, metals, and other contaminants from the underground workings, and the abundant faults and fractures (from blasting and natural sources guarantees that Tintina will not be able to capture all the highly contaminated flushed water. A more protective alternative, which was not evaluated, would be to shotcrete all PAG underground workings shortly after extracting the ore or waste rock to avoid formation of the highly soluble secondary salts in the first place.	In developing its MOP Application (see Section 7.3.3.9 of the MOP Application; Tintina 2017a), the Proponent considered high pressure washing of the mine walls to remove stored oxidation products and the placement of shotcrete on high-sulfide zones in the workings to cover and immobilize oxidation products. It is important to note that post-closure models predict non-degradation groundwater criteria would be achieved without either of these measures. However, high pressure washing of the mine walls to remove stored oxidation products and the placement of shotcrete on high-sulfide zones in the workings may optimize the closure process. Implementation of one or both of these measures may allow the Proponent to conduct fewer rinsing cycles of the mine workings. The MOP Application proposes testing the high pressure washing and shotcrete strategies in localized individual heading scale once mining has begun in the USZ. If the Proponent decides it wishes to implement the high pressure washing and/or shotcrete strategies based on testing results, the Proponent would be required to request a modification of its permit and DEQ would conduct the appropriate level of environmental review. Early in closure, the Proponent has committed to treating water from the underground mine until water quality meets non-degradation criteria for groundwater with respect to premining background chemistry. Specifically, the Proponent plans to flood portions of the workings with an initial rinse of unbuffered RO permeate while pumping to remove the solute-affected water for treatment. This injection and withdrawal of unbuffered and then buffered RO permeate would initially rinse the lower Ynl B decline between the VVF and the lower USZ. A hydraulic plug would then be placed below the USZ, to isolate it for rinsing. In subsequent rinses, the RO permeate would be buffered and ultimately the injection rate would be reduced relative to groundwater inflow so that groundwater replaces the injected water as rinsing is completed. As the mine workings are flooded with unbuffered RO permeate, limiting the availability of oxygen and reducing sulfide oxidation, accumulated oxidation products would be aggressively dissolved and rinsed from exposed surfaces. Salt accumulation on bedrock surfaces—the result of direct reaction of wall rock with

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						oxygen under humid operational conditions, as well as the evaporation of water at the wall interface—are expected to include oxide, hydroxide, and sulfate minerals. These minerals are likely to have variable solubility. Sulfates (e.g., alunite, jarosite, gypsum) are likely to be more soluble than iron oxides or barite, for example. Soluble salts would dissolve into the RO permeate that would be pumped through the workings; the most soluble minerals would dissolve rapidly, while others would dissolve more slowly, if at all. Initially, elevated concentrations are thus expected to decline with rinsing, ultimately achieving a steady state concentration based on equilibrium with bedrock. As the closure process continues, RO permeate would be buffered and then pumping rates would be adjusted so that groundwater infiltration would replace flooding with buffered RO permeate. Once the injection of RO permeate has ended, all subsequent inflow would be suboxic groundwater, which would react with rinsed bedrock surfaces and exposed paste backfill. The reaction of groundwater with bedrock (as represented by monitored groundwater and exposed paste backfill under sub-oxic conditions based on saturated diffusion tests) is the basis for long-term post-closure predictions addressed in the water quality model in Section 4.3.2 of Appendix N (Enviromin 2017a). Importantly, only upon confirmation that the quality of contact groundwater meets the proposed groundwater non-degradation 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, Inc. 2016b). As long as a cone of depression of groundwater surrounds the mine void, all groundwater would flow from surrounding faults and fractures into the void, where impacted water can be recovered and pumped from sumps up to the surface for treatment. See Consolidated Response WAT-3 for information about the extent of fractures resulting from blasting in the underground mine.
BBC00933	15	Ann Maest	Buka Environmental	Email	Finally, the assumption that constituents will adsorb to sulfide minerals was not well supported and is unusual. Results should be presented with and without this assumption.	See Appendix N (Enviromin 2017a) of the MOP Application, sub-appendix F: “At closure, the water table will rebound to the pre-mining level. Any solutes stored in the mined out workings will dissolve into groundwater and be collected for treatment during the initial flooding of the mine at closure. Under steady state, post-closure groundwater flow and chemistry conditions, the submerged wall rock will be exposed to reduced groundwater typical of the natural background environment. Sulfide oxidation and associated metal release from exposed rock in the mine back will drop to low levels. We assume groundwater flowing through remaining voids between the paste backfill and the back will continue to acquire solutes from the exposed paste surface and react with the fractured bedrock surface. At closure, pyrite within the relatively high-surface-area zone around the workings will be stable under reducing conditions. Pyrite is known to adsorb a variety of metals common to mining environments, including Pb, Hg, Cu, Cd, Cr, and As (Doyle et al. 2004; Borah and Senapati 2006; Oxverdi and Erdem 2006). In fact, pyrite has been proposed for use in reactive barrier technology to remove metals from contaminated groundwater (Brown et al. 1979). Of these metals, only Cd and Hg were predicted in post-closure groundwater. We therefore calculated the capacity for their sorption to pyrite in the USZ using this analytical model. Using the USZ pyrite concentration

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						(46 wt%) reported by CAMP, and surface area-adjusted isotherm data for comparable pH and metal concentrations (Borah and Senapati (2006) for Cd, and Bower et al. (2008) for Hg), we estimate that Hg will be completely removed via sorption to pyrite, with an attenuation capacity of over 20 thousand years. Likewise, we estimate that capacity exists for Cd will be completely attenuated within the bedrock fracture zone for millions of years. The concentration of metals used in these calculations are scaled, from surface area and water flux rates typical of the laboratory diffusion tests to conditions relevant to the post-closure mine setting. The concentrations measured in diffusion tests are scaled up due to the increased paste backfill surface area and reduced flow of groundwater post-closure. These calculations conservatively rely on constant, long-term release of metals by paste backfill (which are likely to decline over time) and rates published for experiments that were conducted at higher concentrations of Cd and Hg. Data are not available for experiments conducted at lower concentrations, because Cd and Hg removal efficiency is 100 percent and therefore, lower metal concentrations are not quantifiable in solution." Importantly, only upon confirmation that the quality of contact groundwater meets the proposed groundwater non-degradation 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, Inc. 2016b). As long as a cone of depression of groundwater surrounds the mine void, all groundwater would flow from surrounding faults and fractures into the void, where affected water can be recovered and pumped from sumps up to the surface for treatment.
BBC00933	18	Ann Maest	Buka Environmental	Email	The DEIS states that another alternative to using Ynl Ex and Tgd would be to use undefined "development mining waste rock" as bedding material for the basal layer of the CTF drain system (DEIS, p. 2-11). No leach testing of this undefined material is presented in the DEIS or the MOP. No failure scenarios were examined for leaching of contaminants from construction fill, and modeling of potential leachate from the impoundment foundations is not included in the Water Quality Modeling Report (App. N of the MOP). Additional leach testing (ideally HCTs) of the Ynl Ex unit should be performed that separate the unit into PAG and uncertain samples.	The EIS text has been clarified. The Draft EIS stated: "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." The last sentence was not correct, as the discussion of using mine waste rock on top of the liner (internally in the CTF) is not an alternative to the material for the basal layer under the CTF liners. Also note, as described in the MOP Application, Section 3.4.2.1 (Tintina 2017a): "Durable, weathered to fresh granodiorite bedrock excavated from the CTF and PWP basins will be used for liner sub-grade bedding material below all of the lined facilities." Further, as stated in Table 3-14b of the MOP Application, sub-grade bedding material placed above the liner (44,000 m^3) in the basin drain of the CTF has been identified as Tgd; however, the Proponent may alternatively use Ynl Ex or preproduction waste rock (these alternatives have been added as a new note under

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						Table 3-14b). The sub-grade bedding layers underlying the CTF HDPE liner and underlying the PWP liner would consist of crushed and screened granodiorite bedrock excavated from the CTF and PWP excavation footprints as shown in Table 3-14b. See consolidated Response PD-3 for additional discussion regarding evaluation of failure scenarios. Reasonably foreseeable and/or potential environmental consequences and effects due to the Project have been analyzed in the EIS. Appendix R of the MOP Application (Geomin Resources, Inc. 2015) describes the failure analysis of Project facilities and processes. The potential for seepage through embankments was described in Section 4.3.3.1 of the MOP Application (Tintina 2017a), “The HELP model estimates very low percolation rates through the CTF, WRS, PWP, and CWP embankments and the mill and WRS pads. Predicted values range from 0.01 to 0.11 gpm (0.03 to 0.42 Lpm) for the different facilities. The highest modeled percolation rate results of 0.11 gpm (0.42 Lpm) were for the CTF and the mill pad embankments whereas the lowest modeled percolation rate (0.009 gpm; 0.034 L/min.) is associated with the CWP embankment (2017c). The modeled percolation rate associated with the PWP embankment is 0.07 gpm (0.27 Lpm). When the modeled percolation results for each facility are reported as a flow per unit area (gpm/square foot), they range from 2 x 10^{-6} to 3 x 10^{-6} gpm/ft^2. These very low modeled embankment seepage percolation rates indicates that embankment seepage will not significantly impact the regional groundwater system. There is therefore no need for the embankment seepage to be considered further as it is a non-issue.” See additional information provided in response to Submittal ID BBC00933, Comment Number 17.
BBC00933	20	Ann Maest	Buka Environmental	Email	To improve the transparency and clarity in the Final EIS, the following additions are recommended: • Plots of HCT results for all samples in an appendix to Enviromin, 2017 • Location of ABA, HCT samples relative to stratigraphic column or a cross-section showing geologic units • Description of the basis for selecting subsamples for the HCTs (more detail on how the HCTs were composited • ABA, NAG, total metals results for composited HCTs (all are composited, and no static test results are provided • Improve the subheading for USZ/UCZ in Appendix B of MOP Appendix N (Water Quality Modeling to allow the reader to see that results this unit for all weeks are limited to week 54 of the HCT, and state this in the associated text in the main document.	Section 3.6 of the EIS summarizes key information regarding the geology and geochemistry assessment, approaches used by DEQ in analyzing potential impacts, and the environmental consequences of the proposed Project. Extensive geological and geochemical analyses were conducted over multiple years to support the EIS and sufficiently support the assessment application as well as associated mitigation and management strategies; this information is described in detail in Appendix D (Enviromin 2017b), Appendix N (Enviromin 2017a), and Appendix M (Hydrometrics, Inc. 2016a) of the MOP Application, and sub-appendices. For example, LZ FW analyses included 15 ABA, 1 asbestos, and 1 HCT analyses; further, 550 samples of this unit were submitted for whole rock geochemical analysis. Guidance within Maest et al. 2005 suggests a minimum number of samples that should be collected for geochemical characterization for each rock type during initial sampling. For the LZ FW lithotype, the estimated mass (35 percent of total) is approximately 247,000 tonnes, which would require a minimum number of 8 to 26 samples. For example, the number of initial analyses for the LZ FW (550 whole rock and 15 ABA) are within the recommended range in this guidance. Much of the additional details requested by the reviewer are included in Appendix D of the MOP Application (and sub-appendices therein). See also responses to Submittal ID BBC00933, Comment Numbers 3 and 4.

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BBC00933	23	Ann Maest	Buka Environmental	Email	The potential impact to groundwater of contaminant leaching from the cement and especially the slag has not been evaluated. Leach testing of the cement and any potential binders should be conducted, and their potential impact to groundwater quality should be evaluated as part of the Final EIS.	Leach testing of cemented paste tailings cylinders already incorporated the cement and binder (slag) components that would be used in the cemented paste matrix, therefore accounting for those additives in subsequent modeling. The chemical compositions of various binders are included in Appendix K-5 (Knight Piésold Consulting 2017a) of the MOP Application (Tintina 2017a), but sole leach testing of the binder components would not be realistic or representative of the proposed use of those materials. The CTF design includes seepage mitigation measures to prevent effects of metal leaching sourced in the cement, slag, and tailings, on groundwater quality. These features are described in EIS Section 3.4 (Groundwater Hydrology), along with an assessment of impacts of the CTF on groundwater quality. A detailed hydrogeological investigation of the CTF is presented in EIS Section 3.4.1.6. The Proposed Action and AMA would require establishment of an adequate groundwater monitoring network, plans for remedial action, and triggers to initiate such action in the unlikely event of a contaminant release from such a facility. The Proposed Action and AMA require the Proponent to conduct groundwater and surface water monitoring.
BBC00933	25	Ann Maest	Buka Environmental	Email	The lack of appropriate numbers and compositing of HCTs is a major issue that needs to be resolved and will require additional testing. Additional HCTs should be conducted on materials that do not compost across so many types of mineralization within a waste rock or construction fill unit. A table should be created to show the origins of each HCT, with static test results (ABA, NAG, total metals, mineralogy).	Section 3.6 of the EIS summarizes key information regarding the geology and geochemistry assessment, the approaches used by DEQ in analyzing potential impacts, and the environmental consequences of the proposed Project. Extensive geological and geochemical analyses were conducted over multiple years to support the EIS and sufficiently support the assessment application as well as associated mitigation and management strategies; this information is described in detail in Appendix D (Enviromin 2017b) and Appendix M (Hydrometrics, Inc. 2016a) of the MOP Application, and sub-appendices. See also responses to Submittal ID BBC00933, Comment Numbers 3 and 4.
BBC00933	26	Ann Maest	Buka Environmental	Email	Some of the assumptions used in water quality modeling will markedly underestimate predicted concentrations of mine contaminants, including: using the results from diffusion tests without waste rock; using results for the shorter USZ test that did not produce acid; excluding exceedences for Pb, Ni, and Tl in the early weeks of the shorter USZ test; and only using week 54 results for the longer USZ test results. Additional water quality modeling runs should be done to evaluate the effect of these approaches that will underestimate predicted concentrations. In addition, results should be presented without adsorption onto sulfide minerals. The basis for this assumption is not convincing.	As is industry standard practice, the EIS includes extensive geological and geochemical studies as well as quantitative surface water and groundwater modeling to generate predictions to support the assessment application and to inform mitigation and management strategies (see Section 3.4.1, Section 3.4.2, Section 3.5.1, and Section 3.5.2 of the EIS). The predictions and analyses as presented are considered appropriate and sufficient to support the EIS and the proposed mitigation measures are sufficient for handling water during operations and closure. Further, note the test materials that included waste rock in the tailings matrix (4 percent binder + run-of-mine) are not representative of conditions proposed in the Project. The shorter (2012) USZ test is more representative of the zones that would have been encountered by the initial decline (through the unit overlying the ore zone), while the 2015 USZ test used material more representative of the expanded mine plan and the lithology that would be encountered. Both USZ tests were used to represent different zones/flow contributions to the geochemical model. The data tables in Appendix N (Enviromin 2017a; sub-appendix A) of the MOP Application indicate that the 2012 HCT model input data included Pb, NI, and Tl for weeks 1 through 4 and all weeks. Further, Appendix N, Section 4.2.2 states: "We used an average of HCT data for weeks 1-

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						4. Due to the initially high solute release rate in weeks 1 and 2 of most HCT data, data from weeks 1-4 represents a reasonable, relatively conservative approach to modeling inputs because early solute release rates are often the high relative to subsequent weeks. To address model sensitivity to this approach, an average of all weeks (available at the time the modeling was conducted) was also used as a sensitivity analysis for the UG [underground workings] model.”
BBC00933	27	Ann Maest	Buka Environmental	Email	Because of the identified high risk, a modeling scenario should be completed for the Final EIS that examines overtopping and leakage without capture for the CTF and the PWP facilities. The scenario would assume leakage of PWP and CTP water with the concentrations in Table 2 and predict the resulting effects on groundwater and surface water quality. This scenario is needed to examine potential impacts to groundwater and surface water.	The CTF and PWP designs include collection of runoff into sumps and its conveyance to the WTP. The designs would include sump and conveyance (piping) sized using 1:100 year, 24-hour precipitation events, as specified in the Design Basis document (Appendix C of the Tailings Storage Facility Design Report [Knight Piésold 2017a]). This is a standard conservative approach used to ensure water management aspects of surface facilities are designed with the capacity to manage the water that may accumulate in response to large storms. See further discussion in Consolidated Responses PD-1 and PD-3. The CTF and PWP are designed as lined facilities with seepage collection systems (discussed in Section 3.4.3.2, subsection Surface Facilities, of the EIS). These designs are expected to reduce seepage escaping into the natural environment to negligible levels, which is the basis for the determination in the EIS (Section 3.4.3.4, Summary) that these facilities are unlikely to affect groundwater quality. Further discussion regarding liner performance is included in Consolidated Response PD-4.
BBC00884	3	Scott Bosse	American Rivers	Email	Based on our own analysis and our consultants’ critiques of the DEIS, we believe the Black Butte Copper Project poses serious risks to water quality in Sheep Creek, the single most important rainbow trout spawning tributary in the Smith River system, and the Smith River itself, which is located approximately 19 miles downstream from the proposed mine site. Both Tintina and the DEQ underestimated how much groundwater connected to the Smith River headwaters likely will flow into the mine and have to be treated for toxic contamination before being pumped back into the ground. In her critique of the DEIS, geochemist Ann Maest of Buka Environmental stated the following about the proposed mine’s likely impacts to water quality: “Leaching of the sulfide-rich zones after extraction is the most important water quality concern for the project. The geochemical testing results discussed in the following section indicate that the tailings, ore, and portions of the waste rock will produce poor water quality and that cementation of the tailings as proposed will only temporarily stall the production of acid mine drainage.” In her critique of the DEIS, environmental geochemist Kendra Zamzow of the Center for Science in Public Participation states the following regarding the proposed mine’s likely impacts to water quality: “However, any water that is present within the proposed project area would be dramatically altered by surface and underground mining activities, including the extensive use of nitrate-laden explosives. Also, much of the ore body contains sulfide ores, which would likely produce highly-acidic hydrogen sulfide when exposed to water and oxygen within the underground workings and when it is deposited on the surface. This acid would dissolve heavy metals from the exposed ore (i.e., cadmium, copper, lead and zinc), which are toxic to aquatic life. In theory, the toxic and nitrate-laden waste water would be pumped	The plugs would slow down, not prevent, the post-mine contact groundwater from migrating to surficial environments. The alternative groundwater model presented by Tom Myers (Myers 2019a and 2019b) does not prove that the Proponent or DEQ have underestimated how much groundwater would flow into the proposed mine; rather it only shows that a model that includes different assumptions (which are not supported by the site-specific tests that have been completed about bedrock hydraulic properties) would produce different predictions—see Consolidated Response WAT-1. It is correct to state that the proposed addition of cement to the paste tailings would only temporarily limit the formation of acidity. As explained in the EIS, the cement is only intended to have short-term benefits (minimizing production of dust and acid on the CTF surface until the next layer of paste tailings is deposited over the surface in a few weeks’ time). However, other factors are key to the predictions that water quality impacts would be limited and localized. Specifically, the permeability of paste tailings, whether or not cement is added, is extremely low, and minimal quantities of water would move through the material. Diffusion of oxygen into the cemented paste tailings mass would also be very limited due to the material’s low permeability. As a result, surficial reactions may occur, but the majority of the tailings mass would not be subjected to oxidation (or the release of acid or metals). Surficial oxidation would also be limited to short periods within the CTF, due to the placement of additional tailings. Also in the underground mine, the majority of exposed bedrock and previously backfilled surfaces would be covered by paste tailings backfill within months of excavation, greatly limiting their exposure to moisture and oxygen, and thus the period during

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					to a reverse osmosis treatment plant before eventually being discharged to the alluvium of Sheep Creek, but this tidy expectation assumes that 100% of the wastewater generated at the mine site would be captured and treated. However, underground workings are rarely, if ever, closed and impervious systems. Constant blasting causes fractures to happen in the bedrock that surrounds the ore body, which often allows acidic, untreated wastewater to eventually seep into local groundwater and then to surface waters. To suggest that fractures to bedrock, leading to contamination of groundwater wouldn't occur is being overly optimistic at best. It is also very optimistic to assume that no surface runoff would ever occur from the proposed mine site. Because of climate change, the frequency and intensity of largely unprecedented precipitation events will continue to increase in the future. The question is not whether any contamination to the surface waters of Sheep Creek would occur from the activities of the proposed mine, but rather how soon and how much. The bold predictions that "The quality of groundwater reporting to Sheep Creek would be the same if not better than baseline conditions" and that "no changes to surface water quality are expected" are very likely untrue and are highly unsubstantiated statements to make in an EIS for any proposed mine. Zamzow goes on to state: "Since Tintina is not proposing to treat any water originating from the proposed project area after closure, it is very likely that Sheep Creek and the Smith River would be faced with perpetual water quality contamination problems or, more likely, that the State of Montana would be faced with perpetual waste treatment costs."	which sulfide oxidation may occur. Specific case studies for the use of cemented tailings for surface and underground tailings placement are provided in Consolidated Response PD-2. During the phase of mine dewatering, until final closure, a cone of depression in the groundwater would be maintained surrounding the underground workings. Under these conditions, all groundwater near the mine voids would flow toward the mine. As such, 100 percent capture of mine-influenced water during this period is a reasonable assumption. The Proponent has proposed that this cone of depression surrounding the mine void would be maintained after the mining operations are completed, and water would continue to be treated and pumped from the mine until water quality in these areas approaches baseline conditions and is within non-degradation criteria. Once these areas are flooded, sulfide oxidation and associated acid production would essentially cease. It is important to recognize that this Project is different than the majority of underground mines, which historically have not been closed in such a way that all underground voids within areas of reactive bedrock are filled with very low permeability material and the groundwater table is fully restored to pre-mining conditions. Most underground mines historically were developed via tunnels having surface openings below the regional groundwater table, resulting in perpetual drainage of groundwater to the surface via these openings, which results in perpetual lowering of the groundwater table and continued exposure of sulfide minerals within the open workings underground to oxidation.
BBC00884	6	Scott Bosse	American Rivers	Hard Copy Letter	Finally, in order to ensure that water quality impacts do not occur after the mine is closed, Myers states that Tintina should be required to prevent any discharge of underground water to surface water by having the company plug the mine and collect any water that could discharge. He also recommends that Tintina be required to "monitor surface water and shallow groundwater in perpetuity and develop mitigation plans if it becomes apparent that groundwater is reaching surface water."	The Proponent has proposed to plug the mine workings in multiple locations and also to backfill the majority of the mining stopes with paste tailings, which would greatly restrict flow of groundwater through these areas. In addition, the AMA requires additional paste backfill of all remaining mine openings within the zones where sulfide bedrock occurs. Further, all accesses into the mine (the tunnel, decline, and ventilation raises) would have only openings that are higher in elevation than the groundwater table. As a result, when the water table has fully rebounded (returned to baseline conditions), all the openings would still be above the water table and no water would flow out of these openings, even if they were not plugged as is proposed. Treatment of water from the underground mine would likely occur late in the closure phase. Upon confirmation that the quality of contact groundwater meets the proposed groundwater non-degradation 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, Inc. 2016b). The Proponent proposes to implement a long-term groundwater and surface water monitoring plan (Tintina 2017a). Impacts on groundwater and surface water resources are not predicted. To confirm this prediction, the Proposed Action and AMA require the Proponent to conduct groundwater and surface water monitoring.
HC_043_Jim Steitz_U	3	Jim Steitz		Hard Copy Letter	Both Sandfire and Montana DEQ have grossly understated the volume of groundwater associated with the Smith River headwaters would be divetied into the mine cavity, absorbing heavy metal and acids. The aboveground wastes will	The mine hydrogeological model was developed based on years of on-site research, including well drilling and aquifer testing, examination of drill core from exploration drilling, and geologic mapping; the model provides a reasonable

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					remain acutely hazardous to these high-elevation streams for decades to come, well after the management and shareholders of Sandfire have lost interest in the area. These watersheds are very weakly buffered and cannot absorb the acidity produced by colossal quantities of mine tailings, which are bound to eventually leak, no manner the promises made about this experimental cement containment system.	estimate of groundwater inflows. Importantly, there is no direct hydrogeologic connection between groundwater in the Project area and the Smith River or its alluvium. Refer to Consolidated Response WAT-1 and Consolidated Response CUM-3.
HC_044_William Adams_U	3	William Adams		Hard Copy Letter	2 The Black Butte Project presents a significant long-term risk to water quality because the mine waste must be isolated from air and water in perpetuity to prevent the formation of acid mine drainage. Yet, the proposed cement tailings facility is new technology that is entirely untested. The DEIS fails to take a hard look at the potential for operational failures. 3 The DEIS grossly underestimates how much groundwater connected to the Smith River headwaters could flow into the underground tunnels, resulting in impacts to the overlying streams and wetlands that rely on groundwater for a portion of their flows.	Refer to Consolidated Response PD-2 for additional discussion regarding examples of proposed technology for the Project as well as Consolidated Response PD-3 regarding failure scenarios and catastrophic events. A summary of the CTF Design Features and Seepage Analysis during Operations and Closure report produced by Geomin (Geomin 2018) provides that “Operationally, and in closure, the CTF has a Foundation Drain System that transports groundwater from beneath the excavated facility in in a drainage collection system consisting of gravel and perforated pipes in trenches excavated into bedrock beneath the facility. This water is transferred from the collection system to a foundation drain pond outside of the CTF and pumped from there to the WTP prior to discharge. By removing water from beneath the CTF, the foundation drain system prevents the build-up of any hydrostatic pressure or head beneath the CTF facility’s liner system and therefore eliminates the risk of upward migration of groundwater through the bottom HDPE liner of the CTF and any risk of floating the liner during construction.” That report also describes other CTF design features aimed at reducing risks of environmental impacts, and describes an investigation completed to evaluate groundwater below the proposed CTF. See Section 3.5.3.2 of the EIS for a description of the impacts from the CTF. Short of major failure of the proposed design features, it is highly unlikely that the CTF-impacted water would cause any significant groundwater contamination. Monitoring would continue on Sheep Creek downstream of the Project boundary and along Coon Creek as described in Section 3.5 of the Draft EIS. See Consolidated Response ALT-2. The mine hydrogeological model was developed based on years of on-site research, including well drilling and aquifer testing, examination of drill core from exploration drilling, and geologic mapping. The model does not substantially underestimate groundwater inflows, especially to such a degree that the Smith River would be affected. Importantly, there is no direct hydrogeologic connection between groundwater in the Project area and the Smith River or its alluvium. Refer to Consolidated Response WAT-1 and Consolidated Response CUM-3. No long-term impacts on water quality are expected, as evaluated by quantitative groundwater and surface water models developed for the Project and in light of planned mitigation measures. Impacts on groundwater and surface water resources are not predicted. To confirm this prediction, the Proposed Action and AMA require the Proponent to conduct groundwater and surface water monitoring.

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BBC00390	3	Glenn Elison		email	The DEIS does not sufficiently account for possible dewatering, pollutants moving through groundwater to surface waters and wetland disturbances. The Smith River Drainage should have a proper accounting and planning for the worst-case-scenario; a real possibility associated with mining.	See Section 3.4.1, Section 3.4.2, Section 3.5.1 and Section 3.5.2 of the EIS. Also refer to Consolidated Response CUM-3, which discusses why impacts on the Smith River are highly unlikely.
BBC00584	5	Brian McCurdy		email	The company and DEQ haven't properly considered how to keep contamination from mine waste out of groundwater and surface water that will flow into the Smith River system. They also have failed to evaluate the high likelihood that wastes from this mine will create acid mine drainage laden with arsenic and other mine contaminants. This must be evaluated in the DEIS.	See Section 3.4.1, Section 3.4.2, Section 3.5.1 and Section 3.5.2 of the EIS. Also refer to Consolidated Response CUM-3, which discusses why impacts on the Smith River are highly unlikely.
BBC00721	4	Rhonda Sellers	Fly Fishers International	email	Potential Pollutants- The DEIS does not sufficiently account for how pollutants might travel as water used in the mine operation is pumped back into the groundwater.	See Consolidated Response WAT-2 regarding impacts on surface water resources.
BBC00851	1	Colin Cooney	Trout Unlimited	email	I would again like to submit the attached resolutions and proclamations from the cities of Helena, Missoula and Bozeman from 2016 and 2017. These resolutions and proclamations support the Smith River and express concerns over proposed mining activities that may adversely impact the health of Sheep Creek, the Smith River and the economic benefits they provide to each city.	Comment noted.
BBC00854	1	Jerry Hanley		email	Proposed water usage, treatment, and disposal are well engineered and vetted and pose little, if any, impact to groundwater (3.4 - 3.4.64 or surface water (3.5 - 3.5.38). However, the 0.09 mg/L - non-degradation for total nitrogen in Sheep Creek (3.4-48) appears to be exceeding low and appears unnecessary. This should be revised to a more reasonable standard.	The non-degradation criteria for total nitrogen was calculated in the MPDES permit (Hydrometrics, Inc. 2018a; Tintina 2018a) as required by established rules and policy.
BBC00884	6	Scott Bosse	American Rivers	email	The DEIS should include a discussion on how the Black Butte Copper Project might adversely impact water quality and ORVs on these two Wild and Scenic eligible waterways, especially if acid mine drainage and other pollutants enter Sheep Creek.	Section 3.5, Surface Water, of the EIS explains that impacts on surface water quality in Sheep Creek are expected to be minor. Therefore, potential impacts on water quality in the Smith River would be negligible. See Consolidated Responses WAT-1, WAT-2, and CUM-3.
BBC01024	3	Jeannette Blank		email	The issue is that the majority of the streams, wetlands and waterbodies in Montana a season/intermittent, the proposed Black Butte Copper Mine area is no exception. There is a high likelihood that many, if not all of the intermittent streams and seasonal wetlands that are located within and downstream of the proposed project site will lose federal protection under the CWA as a result of this WOTUS Rule revision. This is a significant change to the assumptions that DEQ's evaluation was based on and was not considered in the Draft EIS.	While the wetlands may lose Federal protection, the Montana Water Quality Act would still protect intermittent streams. While the proposed Project would impact 0.8 acre of jurisdictional wetlands, the U.S. Army Corp of Engineers has approved a mitigation plan to address this loss of wetlands.
BBC01028	1	Jordan Lanini		email	In summary, it appears that the DEIS reached a conclusion of only minor water quality impacts based on the assumption of VVF impermeability. VVF impermeability was not established through testing, and the groundwater model was unsatisfactorily calibrated in the LCZ. Additional investigation must be done to examine water quality impacts in the lower mine works.	Several samples of VVF material were tested with permeameter tests in the laboratory. Site-specific data indicate that groundwater inflows to the Johnny Lee Deposit LCZ would be low. In case higher inflows occur, adaptive management strategies such as grouting and reserve water treatment capacities are proposed. Proposed adit plugs near the VVF would limit groundwater flow through this zone at closure, and the Agency Mitigated Alternative further minimizes the potential for post-closure flow from this area by completely filling all mine voids in the LCZ with paste tailings. Also see Consolidated Response WAT-1, which provides a discussion of the model calibration and its predictive capacity.
BBC01048	2	David and Nike Stevens		email	The current DEIS is inadequate and must be rewritten to honestly address full risks. Please remember this project threatens the Smith River the single most important recreation river in Montana.	Comment noted.

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HC_036	4	Shelley Liknes	Fopp Family Trust	Hard Copy Letter	The Draft EIS does not provide sufficient information for commenters to determine what the definition is for the estimated average baseflow for Sheep Creek; this needs to be disclosed in a supplemental analysis prior to further permitting actions by DEQ. Please provide mean daily or monthly flows and the range of flows for the period of record at Sheep Creek Site SW-1 for low flow periods furing the summer and early fall or at other downstream gage sites that would be affected by the proposed project.	As described in Section 3.5.1 of the EIS, surface water quantity data were collected from May 2011 through December 2017 and are continuing. Monthly flow measurements and automated gaging stations on Sheep Creek provide detailed seasonal baseline data. Average base flows for Sheep Creek (SW-1) were determined from the data collected between 2011 and 2017. Additional low flow statistics (7Q10 and 14Q5) for the proposed discharge point on Sheep Creek (less than 2 miles upstream of SW-1) were calculated (Section 3.5.2 of the EIS).
HC_036	5	Shelley Liknes	Fopp Family Trust	Hard Copy Letter	As a trustee for the Fopp Family Trust, I have observed that in recent years our surface water right on the Smith River has seen an increase in the frequency of senior water right holders making a call. This is likely affected by changes in irrigation methods and assoicated changes in water consumption rates and temporal early season/late season flows. The DEIS needs to address the proposed project effects along with the cumulative effects to the reach of the Smith River downstream of Sheep Creek and Tenderfoot Creek from past changes in the Upper Smith basin water uses on late season flows.	The contribution of flow from Sheep Creek to the Smith River ranges from approximately 30 percent during the base flow periods to 4 percent during high flow periods. The potential Project impacts on water quantity in Sheep Creek are expected to be minor (2 percent reduction in base flow). This does not account for flow augmentation from the NCWR that would be required under the water rights authorizations. Therefore, the reduction in base flow in Sheep Creek would be less than 2 percent. Therefore, the potential impact on water quantity in the Smith River would be insignificant. Also see Consolidated Responses WAT-1, WAT-2, and WAT-4, all providing a discussion of potential effects on groundwater and surface water flow.
HC_030	13	Curtis G. Thompson		Hard Copy Letter	The course of subsettanean water flow is not definitively known. At best, it is known that it flows downgrade. Accordingly, the locations where water emerges which is toxic or polluted are diverse and not precisely identified. Monitoring for seepage of toxins must be conducted at numerous locations along the adjacent and downgradient water ways. If not, impacted water may emerge below the monitoring sites and go undetected.	The EIS analysis indicates that any significant transport of contaminants to surface waters around the Project area is unlikely. Under the Proposed Action and AMA, the Proponent would be required to conduct monitoring of Sheep Creek downstream of the Project area and along Coon Creek, as described in Section 3.5 of the EIS.
HC_030	14	Curtis G. Thompson		Hard Copy Letter	Monitoring of downgradient water must be performed by an independent entity. Placing trust in the mining company or any of its affiliates or subcontractors is no assurance of accurate reporting. The company has a finanacial incentive to either fail to report or inaccurately report test results monitoring water quality. Moreover, the lack of relability of mining companies to perform necessary tasks to assure minimal environmental impacts is well established. The draft EIS is deficient in that it does not contain or require comprehensive and independent monitoring of water quality.	DEQ will conduct verification sampling at key monitoring locations to confirm that water chemistry is consistent with that reported.
HC_026	2	Mark Canfield		Hard Copy Letter	Associated, and very much a critical ‘indicator’ of insufficient data being developed and/or put forward within the EIS, is the *volume of water to be potentially used for the volumes of extractants and copper-rich concentratates estimated to be produced, daily. Much of this lead-in data is found within Section 5.2 proposed action, including the several formats of ‘water’ involvement else where noted, and from all of my experience - which includes my probably presence in Brisbane, AZ, by the time you receive these comments, having been asked to give a “second opinion” on a future water-volume issue developing in the large scale Copper mike there - it appears to me that the estimated volumes of water to be required for this project and its scope are not even half of what I would consider to be even a low-ball estimate.	Thank you for your comment.
HC_026	3	Mark Canfield		Hard Copy Letter	The sensitivity of Sheep Creek, merely unto itself, is somewhat misjudged on this issue, in my opinion, and the ever-diminishing quality of the Smith River system has no mention anywhere within this draft…which equates, long-term, to the increasing importance of the maintenance of a healthy Sheep Creek system, all the more. The Aquatic Biologist who has conducted the “study” on	See Consolidated Response AQ-2 for more information about the baseline surveys and characterization of aquatic life in Sheep Creek.

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					behalf of Tintina/Sandfire has missed this aspect, quite entirely. I know, because I have seen his report and I have witnessed, first hand, his evaluation methodologies.	
HC_026	4	Mark Canfield		Hard Copy Letter	Also related to the “groundwater hydrology” section, within 6.1 not noly is far too shallow and dismissive, but the UIG success rates - industry wide - are virtually “random” in their actual/functional success history and many long-time analysts no longer believe the practice is valud.	The proposed UIG design is based on on-site hydrologic testing, which indicates that the sizing of the infiltration galleries is more than sufficient to handle the anticipated quantity of water that would require discharge. The predictions and analyses as presented are considered appropriate and sufficient to support the EIS and associated mitigation and mine planning. As is standard practice, the EIS includes quantitative predictive surface water and groundwater modeling to generate predictions to support the assessment application and inform mitigation and management strategies (see Section 3.4.1, Section 3.4.2, Section 3.5.1, and Section 3.5.2 of the EIS).
HC_025	2	John Kowalski		Hard Copy Letter	Flows and thermal issues. How can this mine possibly convince the DEQ it won’t have an effect on water flows and temperatures given the amount of water that will be pumped out of the mine, treated, and then pumped back into Sheep Creek or back down the mine. Water sitting in a pond is obviously going to become much warmer than that in the stream that it is discharged back into. Also, how will this underground mine affect the groundwater in the Smith River basin? Many springs and tributaries flow into the Smith over the length of the river and most probably all are connected.	The groundwater model predicted that mine-caused water table drawdown would not extend beyond a few kilometers away from the mine. The area of the water table cone of depression would be far from the Smith River. See Consolidated Responses WAT-2 and WAT-4 regarding impacts on surface water resources. See Consolidated Response WAT-5 regarding potential thermal effects on water resources and ecosystems.
HC_012	1	Peter Aengst		Hard Copy Letter	The project risks reducing flows as the DEIS underestimates how much groundwater is connected to the Smith River headwaters, so there will be more toxic effluent to treat before being pumped back underground. The DEIS didn’t fully evaluate the likelihood and risk % of acid mine drainage over longer time frames. The whole approach of keeping waste/toxins in place for decades seems experimental and untested.	Hydrometrics developed a groundwater model using data accumulated during years of on-site research, including well drilling and aquifer testing, examination of drill core from exploration drilling, and geologic mapping. The predictions and analyses sufficiently account for mine dewatering rates as well as surface water/groundwater interactions. The hydrogeological model does not substantially underestimate groundwater inflows, especially to such a degree that the Smith River would be affected. Importantly, there is no direct hydrogeological connection between groundwater in the Project area and the Smith River or its alluvium. See Consolidated Response WAT-1, Concerns Regarding the Hydrogeological Model and Underestimation of Groundwater Inflows; Consolidated Response CUM-3, Concerns Regarding Cumulative Effects Beyond the Sheep Creek Watershed; and Consolidated Response PD-2, Concerns Regarding Examples of Proposed Technology. Consolidated Response PD-2also addresses concerns regarding acid rock drainage.
BBC00024	3	Tim and Miriam Barth		Email	As a very valid fly fisherman, unless the party is a professional guide, it is highly unlikely that anyone fishes the Smith more then I. And if I had any doubts whatsoever as to the possibility that the river would be damaged by the mining operation, I would be the first to protest it! As very avid outdoors folks, my wife and I spend many hours hiking and biking the Little Belts. One of our favorite picnic and relaxing spots in Meagher county is the small camp site on Sheep Creek, directly below the site of the mine. We expect absolutely NO change in the quality of the crystal clear water	Comment noted.

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					running by that site nor do we expect to see the flow reduced due to mine operations.	
BBC00049	2	Deborah Johnston		Email	Another example is the dismissal of the idea that the Cemented Tailings Facility be elevated above the water table (Section 2.4.1.7). The analysis presented in Technical Memorandum 2 shows that there would be no environmental benefit to water quality or flow by adopting this alternative and it was dismissed. I am thankful for this dismissal because, besides offering no additional environmental benefit, the Cemented Tailings Facility would be visible from Highway 89 if this alternative were chosen.	Comment noted.
BBC00054	1	Linda Lien		Email	After reviewing the document, specifically the entirety of Sections 3.4, 3.5, 3.6 and the reclamation planning in Section 2.2.8, it is easy to see how the DEQ reached the ‘no harm’ conclusion. Clearly, Tintina Montana, Inc. has listened to the public and proposed a world-class mining process that offers, as indicated in the DEQ statement to the press, “water quality protections above and beyond what we think is required to comply with state water quality laws.” It is also clear that the DEQ review of air quality, surface water, wetlands, wildlife, fisheries, aquatic resources, geochemistry, soil, vegetation, groundwater, cultural resources, transportation and of course, socioeconomics was thorough and complete.	Comment noted.
BBC00058	1	Marc McGill		Email	Possibly the most recited issue from those who expressed concern about the mine are the possible impacts to the Smith River watershed. Those concerns are valid - we all want to protect this important waterway - but should be put to rest by the plans for constructing and operating this mine as outlined in the EIS. In reading the proposed alternative Sections 2.2.1 through Section 2.3 it is clear that protection of the quality and quantity of water was the primary focus of the planning process. From the construction phase (Section 2.2.2) through the reclamation phase (Section 2.2.8) the plan seems rightfully driven by the need to capture, collect, and treat (if necessary), and replenish all surface water and groundwater that interfaces with the mine operations. The extraordinary care given to water handling in Tintina Montana, Inc.’s proposed project is not only appreciated but is what Montanans require of modern mining. The Black Butte Project will be a much-needed economic engine for the rural Meagher County region and with the proposed modern mining techniques that engine can operate without compromising our valued water systems.	Comment noted.
BBC00066	1	Carl Krob		Email	A review of the Draft EIS shows that Tintina Montana, Inc. and the DEQ listened to the concerns of the public that were shared during the scoping process and those concerns have been heard and answered. Possibly the most recited issue from those who expressed concern about the mine are the possible impacts to the Smith River watershed. Those concerns are valid - we all want to protect this important waterway - but should be put to rest by the plans for constructing and operating this mine as outlined in the EIS. In reading the proposed alternative Sections 2.2.1 through Section 2.3 it is clear that protection of the quality and quantity of water was the primary focus of the planning process. From the construction phase (Section 2.2.2) through the reclamation phase (Section 2.2.8) the plan seems rightfully driven by the need to capture, collect, and treat (if necessary), and replenish all surface water and groundwater that interfaces with the mine operations. The extraordinary care	Comment noted.

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					given to water handling in Tintina Montana, Inc.'s proposed project is not only appreciated but is what Montanans require of modern mining. The Black Butte Project will be a much-needed economic engine for the rural Meagher County region and with the proposed modern mining techniques that engine can operate without compromising our valued water systems.	
BBC00075	1	Janet Carlson		Email	After reviewing the document, specifically the entirety of Sections 3.4, 3.5, 3.6 and the reclamation planning in Section 2.2.8, it is easy to see how the DEQ reached the 'no harm' conclusion. Clearly, Tintina Montana, Inc. has listened to the public and proposed a world-class mining process that offers, as indicated in the DEQ statement to the press, "water quality protections above and beyond what we think is required to comply with state water quality laws." It is also clear that the DEQ review of air quality, surface water, wetlands, wildlife, fisheries, aquatic resources, geochemistry, soil, vegetation, groundwater, cultural resources, transportation and of course, socioeconomics was thorough and complete. One outstanding example of progressive mine planning is the proposed drift-and-fill process of filling tunnels and access openings with mine waste that has been thickened with cement into a paste (Executive Summary 5.2, page ES4). In the DEQ statement to the press, the Agency indicated that this process 'would cut off any new potential paths for groundwater to flow.' This is an excellent example of Tintina Montana, Inc. going above and beyond what is required to assure the people that enjoy recreating on the Smith River that they will continue to be able to do so without fear of the river being negatively impacted by the economic development of this mine.	Comment noted.
BBC00093	1	Jane Slyker		Email	I read through the Draft EIS with a specific focus on the potential impacts to water resources. After my review, I agree with the conclusion reached by the DEQ that the project construction and eventual operation will not harm the water resources of the area. The analysis of the interface of the project's operation with both groundwater and surface water is comprehensive, thorough and appreciated. All issues of concerns have been studied and any potential impacts mitigated below the level of significance. The care given to water quantity and quality is highlighted throughout the mine's plan of operations. For instance, the surface facilities for the collection, storage, and as-needed treatment of the water (Section 3.4, Page 52) will assure that the water returned to the environment from the project area will meet strict standards for quality. I was pleased to see that Tintina proposes to use double liners with leak detection for the Cement Tailings Facility, the Processed Water Pond, and the brine section of the Contact Water Pond (Section 3.4, Page 52). Some seemingly small but ultimately important examples of the attention given water in the proposed plan includes the installation of plugs in declines and shafts in order to segment the mine at certain locations. This will make pumping and rinsing more efficient during closure and have the environmental benefit of reducing the flow of contact water through open tunnels and shafts (Section 3.4, Pages 56,57).	Comment noted.
BBC00094	1	Marilyn Saunders		Email	I am so much against a mine of any sort that would interfere with the pristine nature of the Smith River: one that provides pleasure and/or a living for people	Comment noted.

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					of this state. The citizens of this state have allowed the poisoning of our land, water and people and allowed out of state interests to profit at our expense. I don't care what the EIS permits. Our people don't benefit enough from the resources extracted for the enrichment of corporate profits to allow this mine or any other ever to proceed in Montana. Name one corporation that has been a good neighbor and given the Montana general fund an excellent payout, left no poisons behind and cleaned up after itself. I'll expect an answer.	
BBC00128	1	Herb Jones		Email	Thank you for allowing me to submit my comment on the Draft EIS for the Black Butte Project proposed by Tintina Montana, Inc. near White Sulphur Springs, Montana. I read through the Draft EIS with a specific focus on the potential impacts to water resources. After my review, I agree with the conclusion reached by the DEQ that the project construction and eventual operation will not harm the water resources of the area. The analysis of the interface of the project's operation with both groundwater and surface water is comprehensive, thorough and appreciated. All issues of concerns have been studied and any potential impacts mitigated below the level of significance. The care given to water quantity and quality is highlighted throughout the mine's plan of operations. For instance, the surface facilities for the collection, storage, and as-needed treatment of the water (Section 3.4, Page 52) will assure that the water returned to the environment from the project area will meet strict standards for quality. I was pleased to see that Tintina proposes to use double liners with leak detection for the Cement Tailings Facility, the Processed Water Pond, and the brine section of the Contact Water Pond (Section 3.4, Page 52). Some seemingly small but ultimately important examples of the attention given water in the proposed plan includes the installation of plugs in declines and shafts in order to segment the mine at certain locations. This will make pumping and rinsing more efficient during closure and have the environmental benefit of reducing the flow of contact water through open tunnels and shafts (Section 3.4, Pages 56,57).	Comment noted.
BBC00164	2	Corey Pullman		Email	Possibly the most recited issue from those who expressed concern about the mine are the possible impacts to the Smith River watershed. Those concerns are valid - we all want to protect this important waterway - but should be put to rest by the plans for constructing and operating this mine as outlined in the EIS. In reading the proposed alternative Sections 2.2.1 through Section 2.3 it is clear that protection of the quality and quantity of water was the primary focus of the planning process. From the construction phase (Section 2.2.2) through the reclamation phase (Section 2.2.8) the plan seems rightfully driven by the need to capture, collect, and treat (if necessary), and replenish all surface water and groundwater that interfaces with the mine operations. The extraordinary care given to water handling in Tintina Montana, Inc.'s proposed project is not only appreciated but is what Montanans require of modern mining. The Black Butte Project will be a much-needed economic engine for the rural Meagher County region and with the proposed modern mining techniques that engine can operate without compromising our valued water systems.	Comment noted.

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BBC00225	2	Eric Schneider		Email	This EIS, especially Sections 3.4, 3.5 and 3.6 that deal with groundwater, surface water and geochemistry, outline an aggressive ARD prevention methodology that includes not only proven technologies but above and beyond measures such as paste backfill and hardcapping of the double lined cement tailings facility upon closure. While sulfide removal sounds good, in reality the processes presented in this EIS makes much more sense. I work with mines like this everyday to help them ensure there liquid needs are met and committed to keeping the environment and worker safety as our most important concerns.	Comment noted.
BBC00419	2	Patricia Simmons		Email	The Smith's ecosystem includes the most important fish in Montana – trout, revered by people all over the world. There is also much more aquatic life to consider. You aren't doing anything to protect the spawning tributary, Sheep Creek. You haven't considered enough that ground waters will probably flow into the underground tunnels and the impacts on the Smith River's water flows. Did you work with Montana Fish, Wildlife & Parks' experts?	Section 3.5 of the EIS provides a description of the potential groundwater impacts from the proposed Project. DEQ did consult with Montana FWP throughout this Project.
BBC00424	3	Patricia Ames		Email	Second, The DEIS does not sufficiently account for the potential for dewatering, pollutants moving from groundwater to surface water and wetland disturbances. The health of the Smith Rives habitat deserves proper accounting of and planning for the worst case scenario. The Smith River is a resource cherished by people across the state and beyond, generating close to $10 million annually in economic activity. This mine must be held to the highest possible standard. At minimum, I request that you address these deficiencies by allowing for an extended comment period and by producing a revised DEIS. However, because of the extreme risks posed by this project, ultimately the DEQ should deny the permit to allow Sandfire to begin mining.	The mine hydrogeological model was developed by Hydrometrics based on years of on-site research, including well drilling and aquifer testing, examination of drill core from exploration drilling, and geologic mapping. The predictions and analyses sufficiently account for mine dewatering rates as well as surface water/groundwater interactions. The hydrogeological model does not substantially underestimate groundwater inflows, especially to such a degree that the Smith River would be affected. Importantly, there is no direct hydrogeologic connection between groundwater in the Project area and the Smith River or its alluvium. See Consolidated Response WAT-1, Concerns Regarding the Hydrogeological Model and Underestimation of Groundwater Inflows and Consolidated Response, and CUM-3, Concerns Regarding Cumulative Effects Beyond the Sheep Creek Watershed.
BBC00428	1	Roger Furlong		Email	I am writing regarding the Black Butte Copper Project and it's threats to the Smith River in MT. I am a Montana resident and long-time user of the Smith river having floated several times. I do not believe that this project can be approved without substantial threat to the quality and integrity of the Smith River watershed. Despite assurances from the mine developers, all large projects of this type in the last century have all gone on to defy remediation and are now having to be treated "in perpetuity" to prevent contamination of waterways and downstream users. It is simply not believable that this project will not pollute the Smith River and that any attempt at remediation will again require treatment forever, especially long after the mining company has declared bankruptcy and left the state. This has played out many times before and is not acceptable to the environmental outcome as well as using taxpayer money to treat the mess left by private corporations. If this mine is approved, it can only be if the bonding is adequate to treat mine was IN PERPETUITY, which is the likely outcome. It would be better to prevent this disaster in the first place and deny the permit for this poorly placed mined.	The Project is proposed to be an underground mine, and the only significant amounts of Project contact water would be excess water sent from the WTP to the UIG. Section 3.5.3.1 and Section 3.5.3.2 of the EIS discuss why impacts on the Smith River are highly unlikely. Also refer to Consolidated Response CUM-3. The Proposed Action and AMA would require establishment of an adequate groundwater monitoring network, plans for remedial action, and triggers to initiate such action in the unlikely event of a contaminant release from such a facility. The Proposed Action and AMA require the Proponent to conduct groundwater and surface water monitoring. Monitoring would continue on Sheep Creek downstream of the Project area and along Coon Creek as described in Section 3.5 of the EIS. Bonds required under the MMRA must be based on reasonably foreseeable activities the applicant may conduct in order to comply with conditions of an operating permit. DEQ has not identified any impacts that would last into perpetuity. Therefore, DEQ cannot require the applicant to post a bond for long-term monitoring and/or treatment.

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BBC00429	1	Margaret Regan		Email	I have great concerns about the proposed Black Butte copper mine near the Smith. I have floated the river many times. It is a Montana jewel. I do not think that the draft EIS gives adequate weight to the cumulative impacts of the development, to the interconnectedness of the groundwater, and to the problems of ever-warming water and climate change. In recent years the algae bloom on the Smith has been amazingly bad. The proposed mine will warm the water additionally as it sends the water back into the tributaties. Any increase will stress aquatic species. Climate change is real and we are only starting to see its effects. The high and low model parameters and assumptions for water balance are based on historic figures that likely no longer accurate.	The Project is proposed to be an underground mine, and the only significant amounts of Project contact water would be excess water sent from the WTP to the UIG. Section 3.5.3.1 and Section 3.5.3.2 of the EIS discuss why impacts on the Smith River are highly unlikely. Also refer to Consolidated Response CUM-3, Concerns Regarding Cumulative Effects Beyond the Sheep Creek Watershed and Consolidated Response MEPA-2, Concerns Regarding Climate Change. Monitoring would continue on Sheep Creek downstream of the Project area and along Coon Creek as described in Section 3.5 of the EIS. The Proposed Action and AMA require the Proponent to monitor water temperature in the TWSP discharge and at the stream monitoring sites (MOP Section 6.3.1; Tintina 2017a). If water temperatures violate the Montana Water Quality Act, including non-degradation standards, the Proponent would be required to implement engineering controls sufficient to avoid any temperature-related adverse effects.
BBC00442	1	Ken Scalzone		Email	I may never float the Smith River again or ever fish its waters and I may never travel all the canyons that contribute to this special place, but I would hope that Montana has the good sense to protect the Smith and its tributaries for future generations. I have seen first hand the results of countless mining operations gone awry in Montana, Colorado, Idaho, and Kentucky. I have seen the miles of dead, fish-less steams; waters left forever so acidic that few lifeforms can exist. Is it worth taking the chance of turning Sheep Creek and possibly the Smith River into another Acid Mine Drainage? I can not support the Black Butte Mine even with all the safeguards proposed to protect the water from contamination. The short term (less than a generation) gains could leave Montana with another perpetual water pollution problem that will never (countless generations) end. Please remember we are only here for a short time but our actions can have very long term affects. Thank you for the chance to express my concerns.	Comment noted.
BBC00490	1	Matt Moskal		Email	I am a capitalist, a former oil man and a Wall Street banker. I want to encourage you to reconsider the Smith Mine. I know we need minerals, metals, energy. But we cannot sacrifice our few remaining wild, natural places. I believe we can do better. If any decision-makers at Tintina/Sandfire would like to float the Smith to experience it for themselves. Please let me know. Give them my information. I would be happy to host free of charge.	Comment noted.
BBC00497	2	Sarah Clark		Email	Here are significant reasons that this is the wrong mine in the wrong place: 1. This mine seriously risks reducing flows and increasing pollution of the Smith River's most important trout spawning tributary. The company and the DEIS grossly underestimate how much groundwater connected to the Smith River headwaters will flow into the mine and have to be treated to remove contamination. 2. The water the company plans to pump back into Smith River tributaries so they don't dry up due to mining activities is highly likely to contain more acidity, nitrate, and toxic metals than the DEIS admits. In addition, that replacement water will be warmer than natural stream water. All of those changes in water quality are harmful to aquatic life, fish, and stream habitat.	The mine hydrogeological model was developed by Hydrometrics based on years of on-site research (including well drilling and aquifer testing), examination of drill core from exploration drilling, and geologic mapping; importantly, these studies indicate that there is no direct hydrogeologic connection between groundwater in the Project area and downstream of the Sheep Creek watershed and its tributaries, including the Smith River or its alluvium. The predictions and analyses sufficiently account for mine dewatering rates as well as surface water/groundwater interactions as presented in the EIS and are considered appropriate and sufficient to support the impact assessment (see Section 3.4.1, Section 3.4.2, Section 3.5.1, and Section 3.5.2 of the EIS).

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						No long-term effects on water quality are expected, as evaluated by quantitative groundwater and surface water models developed for the Project and in light of planned mitigation measures. Section 3.5.3.1 and Section 3.5.3.2 of the EIS explain why impacts on the Smith River are highly unlikely. Also refer to Consolidated Response CUM-3 and Consolidated Response WAT-5.
BBC00550	2	Steve Gilbert		Email	The Tintina mine proposes experimental techniques (such as backfilling the mine with cement-tailings paste) as well as a giant pond full of toxic water that sits on a theoretically impermeable liner. Liners of this nature have been known to fail at hard rock mines all over the west. The DEIS basically says trust us, it won't happen here. We are expected to believe that underground blasting won't send contaminants into ground water or negatively affect the volume of water entering Sheep Creek and Smith River. We are also assured there will be no significant or long term negative impacts to fish and wildlife resources. Baloney. Given the history of mining in Montana and other western states, I am not inclined to believe this mine will somehow prove to be the one with no monumental failings. The Smith River drainage is not a place that we can afford to experiment with in spite of guarantees and claims that this mine will be different.	Paste backfill in underground voids is an industry standard technique that is used by underground mines throughout the world and is a proven technology. Specific case studies for the use of cemented tailings for surface and underground tailings placement are provided in Consolidated Response PD-2. The Proponent has used hydrogeochemical monitoring, hydrogeological modeling, surface water modeling, and geochemical testing data to design its underground workings and related surface facilities (including the WTP and water storage ponds) to minimize potential impacts on water quality. Apart from groundwater in the underground workings at the end of the closure phase, water from all facilities would be collected and treated to meet non-degradation criteria prior to discharge (Hydrometrics, Inc. 2016b). No long-term effects on water quality are expected, as evaluated by quantitative groundwater and surface water models developed for the Project and in light of planned mitigation measures. Section 3.5.3.1 and Section 3.5.3.2 of the EIS predict that impacts on groundwater and surface water, including the Smith River, are highly unlikely. To confirm this prediction, the Proposed Action and AMA require the Proponent to conduct groundwater and surface water monitoring.
BBC00515	1	Scott Krueger		Email	Once again the lure of profit and the hollow promises of safety measures and potential jobs puts our environment at major risk. The lessons of the past long-term impacts and clean up costs of mining in Montana and elsewhere seem to have been forgotten. The Smith River as currently a treasure for the State of Montana and for all of us who love wild places and the outdoors. The Sith River provides clean water, good stream flows and wild trout. Generations of family farms and ranches have depended on the Smith. Acid mine drainage would change everything. Contamination of the water and millions of tons of dangerous sediment are the potential most obvious impacts that could easily happen, and most often have with mining. Groundwater contamination with arsenic would be an additional long-term impact. High concentrations of mercury, a neurotoxin that can accumulate in the tissues of fish and other aquatic organisms, can harm all the critters that feed on them, including people.	The Proponent has used hydrogeochemical monitoring, hydrogeological modeling, surface water modeling, and geochemical testing data to design its underground workings and relates surface facilities (including the WTP and water storage ponds) to minimize potential impacts of the Project on surface water and groundwater. Apart from groundwater in the underground workings at the end of the closure phase, water from all facilities would be collected and treated to meet non-degradation criteria prior to discharge (Hydrometrics, Inc. 2016b). This includes arsenic concentrations. No long-term effects on water quality are expected, as evaluated by quantitative groundwater and surface water models developed for the Project and in light of planned mitigation measures; refer to Consolidated Response WAT-2. Section 3.5.3.1 and Section 3.5.3.2 of the EIS predict that impacts on the Smith River are highly unlikely; also refer to Consolidated Response WAT-1. Mercury is not used in the mining process for the Project. Mercury has historically been used to facilitate the recovery of gold in hard rock and placer mining. The proposed Project is not a gold mine and would not use mercury.
BBC00539	3	Evan Youngblood		Email	Perhaps more important than the economic and cultural value of the Smith River is the significant impact the mine will have on the water flow and water quality in the Smith's main tributary, Sheep Creek. Tintina's plans include taking a significant amount of groundwater that is connected to Sheep Creek.	Note that there is no direct hydrogeologic connection between groundwater in the Project area and the Smith River or its alluvium. Sections 3.5.3.1 and 3.5.3.2 of the EIS discuss why impacts on Smith River are highly unlikely. Also refer to Consolidated Response CUM-3.

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					The Smith already suffers from low flows in the summer months, and less water in the river will mean higher water temperatures and greater trout mortality. In addition, the plans include pumping treated water back into Sheep Creek. The draft EIS Tintina has provided does not adequately address how contaminants from this water will be treated, so there is a significant risk that this water will contain acid mine drainage and arsenic. This could be devastating for the fish downstream. Also, the water will be warmer after it is treated, which will negatively impact both fish and macro invertebrate populations. Water temperatures already routinely hit 75 degrees in the mid-summer months, which is lethal for trout. Therefore, any actions that increase an already warm river could also be devastating for the fish population.	The Proponent has used hydrogeochemical monitoring, hydrogeological modeling, surface water modeling, and geochemical testing data to design its underground workings and related surface facilities (including the WTP and water storage ponds) to minimize potential impacts of the Project on surface water and groundwater. The EIS describes the water treatment process in Section 2.2.4. RO treatment is used by cities worldwide to ensure clean drinking water. More details of the Proponent's proposed RO treatment system can be reviewed in Section 3.7.3 of the Proponent's MOP Application (Tintina 2017a), which is available through DEQ's website. Apart from groundwater in the underground at the end of the closure phase, water from all facilities would be collected and treated to meet non-degradation criteria prior to discharge (Hydrometrics, Inc. 2016b). No long-term effects on water quality are expected, as evaluated by quantitative groundwater and surface water models developed for the Project and in light of planned mitigation measures (see Sections 3.5.3.1 and Section 3.5.3.2 of the EIS). Also refer to Consolidated Response WAT-2. Thermal impacts on surface waters are addressed in Consolidated Response WAT-5.
BBC00543	2	Hallie Rugheimer		Email	Especially, please refer to the stenographic notes that were recorded on the evening of Monday, April 28th, 2019. Example: pertinent extensive testimony was given by a women who spoke about needing to identify the "down stream" considerations: how the construction phase and long term operation of the mine into the future affects directly White Sulphur Springs infrastructure and community needs, housing and schools, the Boom and Bust cycle of past industrial impacts within our state; transportation corridor roads from site to railheads (Livingston or Townsend) and how heavy haul trucks create impacts to small towns who have 35 mph (school zones at 25 mph) on the Highway 89 route. According to MT Highway Patrol officials, right now the areas north of Livingston clear up to W.S.S. lacks adequate MHP patrolmen. Industrial trucking speeding through the small communities and farm accesses is a hazard to the local users and especially to wildlife. A section of Highway 89 has the name of suicide alley for the hoofed and flying animals that cross there and lay as road kill during all seasons of the year. The EIS path was definitively and substantially addressed at this 4/28/19 meeting with podium speakers representing thousands of citizens in concert with the expressed statements. Importantly was the need for more more time to address the environmental, human and community impacts. The numerous exgencies that were brought to the podium by representatives of organizations with probably more, like myself being written to DEQ during May, need to be addressed as important environmental impacts. These are the details which the project seems to be missing, indicating more time is needed to better review not only the technological and engineering considerations but environmental and cultural impacts of this particular project.	See Consolidated Response MEPA-1. The EIS has been revised to include additional analysis, where warranted, on socioeconomic and transportation issues.
BBC00607	1	Mike Socolofsky		Email	Montana has a lot of wonderful river systems, a lot of incredible fishing and a lot of unique wilderness. Of all that, there is only one permit-lottery wilderness river in Montana: The Smith.	Thank you for your comment.

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					And so it's very apparent there must be something unique and special about that place, wouldn't you agree? I know it to be so. And knowing there was recently an immense/detailed EIS produced, I ask you to delay implementation until all of our Montana Citizens and The Public have had more time to sufficiently digest this document. PLEASE DELAY! I will be on The Smith River June 25-29th with my family and friends. In addition to my Request to Delay, I would be honored for you to join us. Please advise at your earliest convenience.	
BBC00628	1	Susan Thomas		Email	I have two concerns on the Black Butte Mine Project. I would like to see the DEQ look further into and research more examples of this new way of disposing of the 55% mine tailings that will be stored above ground. I've done some research on this new procedure and have found no examples of it being used to plug defunct mine shafts. I feel this CTF is too new of a procedure to make it safe enough to use so close to Sheep Creek, one of the tributaries of our prized, Smith River. Are there any case studies where this method of long term storage has been used successfully? I worry about the lifecycle and degredation rate of these highly toxic tailings mixed with cement and how this whole unit would behave under it's own pressure, the affects it would have on the barrier underneath it and the ground water too.	Cemented paste tailings disposal in surface facilities and underground mines is not a new technology. Case studies for previous use of cemented tailings for surface and underground tailings disposal are included in Consolidated Response PD-2. The effect of adding cement and binder materials to tailings on oxidation of sulfide minerals is also discussed in Consolidated Response PD-2.
BBC00629	1	Cheryl C. Mitchell		Email	I am absolutely opposed to the proposed copper mine because the State of Montana is putting corporate profits ahead of the public welfare and the welfare of the environment. The Smith River is an extremely important trout spawning tributary and a major contributor to its flows. It is abundantly clear that the DEQ's draft Environmental Impact Statement (DEIS contained the following serious flaws that must be addressed: • The Black Butte copper mine seriously risks polluting and reducing flows in Sheep Creek, the Smith River's most important trout spawning tributary. Both Sandfire and the Montana DEQ grossly underestimated how much groundwater connected to the Smith River headwaters will flow into the mine and have to be treated for toxic contamination before being pumped back into the ground. These kinds of miscalculations are frequently made at the beginning of such projects and have to be amended after the mining is underway--when it is too late to take any meaningful action.	No adverse effects are predicted to occur on surface water and groundwater as a result of Project development based on results of the quantitative predictive models developed for the Project and in light of planned mitigation measures. The mine hydrogeological model was developed by Hydrometrics based on years of on-site research, including well drilling and aquifer testing, examination of drill core from exploration drilling, and geologic mapping. The predictions and analyses sufficiently account for mine dewatering rates as well as surface water/groundwater interactions; the modeling efforts as presented are considered appropriate and sufficient to support the EIS and associated mitigation and mine planning (see Section 3.4.1, Section 3.4.2, Section 3.5.1, and Section 3.5.2 of the EIS). Refer to Consolidated Response WAT-1, which discusses the reliability of the groundwater model predictions and estimation of groundwater inflows. Section 3.5.3.1 and Section 3.5.3.2 of the EIS discuss why impacts on the Smith River are highly unlikely. Also refer to Consolidated Response CUM-3.
BBC00633	2	Linda Foy		Email	Here are my environmental concerns: from the Save our Smith website 1. The Smith River generates $10 million in annual economic activity to the State of Montana. The Outdoor Recreation Industry generates $7 billion in state revenue. 2. Outfitters will launch 73 of 1,361 total Smith River permits in 2019. Outfitters create Montana jobs, are responsible stewards, and the money they generate stays in the state and has a substantial ripple effect on the economy—airfare, hotels, travel, etc. 3. Sandfire is an Australian-owned mining company that will pocket the lionshare of profits and cut-and-run when profitability ceases.	DEQ acknowledges the outstanding recreational opportunities afforded by the Smith River and recognizes its economic contribution. Recreation and use of the Smith River is addressed in Sections 3.7 and 3.8 of the EIS. Socioeconomic resources are addressed in Section 3.9 of the EIS. The EIS has been updated to include publicly available information on the economic contribution of the outdoor recreation industry, particularly the contribution attributable to the Smith River. See Consolidated Response FIN-1 for information about bonding and protection for taxpayers.

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					4. $50 million in Montana tax dollars already goes to mine clean-up. Do we want to add a failed mining experiment on the Smith River to the list, at the cost of existing, perpetual Montana jobs? 5. Sandfire has been clear about expanding and growing the operation into a 50-year mining district. The DEIS should evaluate the entirety of the project and its potential impacts, and not allow Sandfire to segment the analysis. 6. The DEIS does not accurately project how much water the mine will remove from the watershed. Further, the modeling used in the DEIS does not account for how much the surface temperature will change when they replace the water they are proposing to withdraw. 7. Explosives used in the mine will create fractures in the bedrock. These fractures will create pathways for nitrates (explosives waste) and other contaminants to flow into groundwater. 8. Nitrates, along with an increased temperature, promotes the growth of algae. Algal growth decreases the amount of available habitat for macroinvertebrates (fish food), and gravel beds available for spawning. 9. The cement-tailings paste that Tintina proposes backfilling the mine with will break down over time. As the cement decomposes, tailings will oxidize, which has the potential to produce acid drainage. Acid drainage could flow through fractures in the bedrock, into the groundwater, and ultimately into the Smith River. 10. Fish population analyses are incomplete, and existing data was misrepresented. Brook and brown trout were lumped together in some reports, and sculpin populations were presented in the same graphs as trout. 11. Size and frequency-of-length were not considered in evaluating the impact on fish populations—will a certain size class be harmed more substantially than another? This could significantly decrease reproductive success.	See Consolidated Response CUM-1 for information about Project segmentation. See Consolidated Responses WAT-1, WAT-3, and WAT-5 for information about the groundwater model, fractures, and temperature/thermal effects. See Consolidated Responses AQ-1 and AQ-2 for information about algal growth and aquatic species analyses. See Consolidated Response PD-5 for information about the breakdown of cement paste tailings.
BBC00652	1	Ruth Swenson		Email	The Smith River is an incredibly important resource for Montana. The draft EIS is deficient and does not provide a full accounting of the potential impacts. 1. The proposed mine would drop below the water table and Sandfire would have to pump water out of the mine. This water would contain arsenic and other toxins and the sulfur content would be turned into sulfuric acid on contact with the atmosphere. 2. The DEIS doesn't accurately project how much water the mine will remove from the watershed thereby impacting the 2 major employment sectors in Montana, tourism and agriculture. 3. Explosives used in the mining process will fracture bedrock thereby altering ground water flows with unknown consequences. 4. Nitrates which promote algae growth will affect spawning and fish habitat thereby impacting the people who rely on fishing and tourism. Tourism being the number two economic staple of Montana. 5. The cement tailing paste proposed will decompose, crack and leak over time producing contamination of both ground and surface waters. Poisoning	1. Geochemical analyses were conducted to characterize the oxidation products of sulfide minerals brought to the surface and exposed to air in the underground mine, and these analyses are discussed in Section 3.6, Geology and Geochemistry, of the EIS. The geochemical source terms generated by these analyses were incorporated into water quality modeling. Several aspects of the Project include mitigation to minimize loading of sulfide mineral oxidation products into surface water and groundwater, such as the RO WTP, seepage mitigation in the surface facilities, and flushing the underground mine with RO permeate during closure. These aspects of planning and design are discussed in Sections 3.4, Groundwater Hydrology, and 3.5, Surface Water Hydrology, of the EIS, and led to the determinations that oxidation of sulfide minerals is unlikely to affect groundwater and surface water quality. 2. See Consolidated Responses WAT-1 for information about the groundwater model and the estimated mine dewatering rate. 3. See Consolidated Response WAT-3 for information about fractures resulting from blasting in the underground mine. Section 3.4.3, Environmental Consequences, and Section 3.5.3, Environmental Consequences, discuss the impact of the Project on groundwater flows and effects on surface water resources, respectively.

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					people's wells, destroying irrigation systems and contaminating the Smith River. 6. The Smith River generates $10 million/year while tourism and outdoor recreation generates $7billion/year. Is it wise to sacrifice this revenue and people's jobs? 7. Sandfire is an Australian owned mining company. Do you think any of their assurances of cleanup or safe operating procedures are possible? 8. After Sandfire realizes their profits guess who will be left holding the bag for cleanup? 9. What about the expansion that Sandfire has been projecting? Shouldn't that be evaluated with the original proposal? 10. Do you really want to be remembered for assisting in the destruction of the ground and surface waters of the Smith River? Do you want to be remembered for assisting in the destruction of a fishery, ranches and farms in the Smith River valley and beyond?	4. See Consolidated Responses AQ-1 and AQ-2 for information about algal growth and aquatic species analyses. 5. See Consolidated Response PD-5 for information about the breakdown of cement paste tailings. 6., 7., 8., and 9. DEQ acknowledges the outstanding recreational opportunities afforded by the Smith River and recognizes its economic contribution. Recreation and use of the Smith River is addressed in Sections 3.7, Land Use and Recreation, and 3.8, Visuals and Aesthetics, of the EIS. Socioeconomic resources are addressed in Section 3.9, Socioeconomics, of the EIS. The Final EIS was amended to include publicly available information on the economic contribution of the outdoor recreation industry, particularly the contribution attributable to the Smith River. See Consolidated Response FIN-1 for information about bonding and protection for taxpayers. See Consolidated Response CUM-1 for information about Project segmentation. 10. As discussed in Section 3.4, Groundwater Hydrology, and Section 3.5, Surface Water Hydrology, of the EIS, significant impacts are not expected on surface water quantity or quality in Sheep Creek, or the receiving waters of the Smith River due to the Proposed Action. See Consolidated Response AQ-1 for additional discussion of Sheep Creek and Smith River water quality and quantity.
BBC00664	1	Mark Juranek	Madison River Ranches - Flying J Ranch	Email	I wanted to provide comment on the proposed Smith River Mine. I am home land owner in Montana. I will have a full time residence in Montana starting this year. I have traveled to Montana for over 40 years to enjoy the incredible outdoors, and in particular the river and lake systems, while living in the Pacific Northwest. What I have come to know is that water systems are incredibly fragile, and we don't really get a chance to make things the way they were once we head down paths of change. The Smith River is not a place to take this risk. It deserves to be left alone. I am adamantly opposed to mining activity on the Smith. It simply is not worth the risk. I particular I am concerned with the following: 1. The company and DEQ haven't properly considered how to keep contamination from mine waste out of groundwater and surface water that will flow into the Smith River system. They also have failed to evaluate the high likelihood that wastes from this mine will create acid mine drainage laden with arsenic and other mine contaminants.	No adverse effects are predicted to occur to surface water and groundwater as a result of Project development based on results of the quantitative predictive models developed for the Project and in light of planned mitigation measures. As is standard practice, the EIS includes quantitative predictive surface water and groundwater modeling to generate predictions to support the assessment application and inform mitigation and management strategies (see Section 3.4.1, Section 3.4.2, Section 3.5.1, and Section 3.5.2). Sections 3.5.3.1 and 3.5.3.2 of the EIS discuss why impacts on the Smith River are highly unlikely. Several aspects of the Project include mitigation to minimize loading of sulfide mineral oxidation products into surface water and groundwater, such as the RO WTP, seepage mitigation in the surface facilities, and flushing the underground mine with RO permeate during closure. These aspects of planning and design are discussed in Sections 3.4 and 3.5 of the EIS, and led to the determinations that oxidation of sulfide minerals is unlikely to affect groundwater and surface water quality. Also refer to Consolidated Response CUM-3. Monitoring would continue on Sheep Creek downstream of the Project boundary and along Coon Creek as described in Section 3.5 of the EIS.
BBC00740	1	Claire Baiz		Email	As a native Montana ex-pat, I spend thousands of dollars every year to show off Montana's natural bounty to friends, extended family, and the next generation, I am deeply concerned of the effect of Tintina's planned mining operation on the Smith River drainage. The proposed Black Butte Copper Mine is likely to have a large, ongoing	Refer to Consolidated Response WAT-2, which addresses concerns regarding impacts on surface water resources in the Project area. Refer to Consolidated Response AQ-1, which addresses concerns regarding impacts on aquatic life (including algal growth) in Sheep Creek.

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					impact on the Smith — and would be a constant source of local, environmental, and taxpayer concern long beyond the viability of the mine itself. The Smith River is not only is a source of pride, inspiration and solace — and one of the best streams in the lower 48 — it generates $10 million in annual economic activity: with so many things that can go wrong, in the pursuit of so little, it's simply not worth it to let our Smith River become the site of a foreign-owned mining experiment. The DEIS does not accurately project how much water the mine will remove from the watershed. Research that's been done on the impact of this mine on fish populations is incomplete and inaccurate. The potential effect on algal growth, the breakdown of cement tailings, water temperature changes, and the impact of explosives make this project too dangerous a bet for The Last Best Place, and for the taxpayers who are at risk of having to pay (yet again) for what's left, when the profit of a mining company no longer justifies the expense to clean up their own mess.	Refer to Consolidated Response PD-5, which addresses concerns regarding cement breakdown due to acid formation. Refer to Consolidated Response WAT-3, which addresses concerns regarding the impact of explosives. Refer to Consolidated Response WAT-5, which addresses concerns regarding potential thermal effects on water resources and ecosystems.
BBC00759	1	Jim and Janice Cooperstein	Business and Real Estate Consulting	Email	The Draft EIS for the Proposed Tintina Black Butte Copper Mine project does not sufficiently address the irreparable, long-term - forever harm this mine would cause to the Smith River, Sheep Cr. and all it's tributaries. At a crucial time when Montana waterways are suffering from gradually, but continually warming temperatures, earlier, drier and hotter summers that are seriously pressuring all waters and their aquatic habitat, this proposed mine is an untimely idea and will significantly add to this heavy burden that the Smith would have to bear. The river's flows in the last 20 or so years have frequently been limited as a result of this warming trend - and river aquatic quality and fishing have suffered as a consequence while tensions between recreational users/fishermen and irrigation/agricultural interests have increased. In this new, challenging weather environment where we should be making every effort to conserve and protect, this proposed mine risks losing everything we still have in the Smith waterway. 1. The amount and quality of water in Sheep Cr., the Smith's most important trout spawning tributary, will be significantly diminished by this proposed mine, far more than the Draft EIS is projecting, especially when the longer term effects of warmer and drier weather conditions are factored in. The ground water flows required by the proposed mine will be far more than estimated by the DEIS and will need to be treated to reduce contaminants. 2. Furthermore, water pumped back into the Smith will have higher concentrations of all contaminants, regardless of treatment and will be warmer than it was when removed from the river - which will have drastic effects upon stream habitat - the insect life so dependent on natural stream water conditions and particularly the fish and animal life which rely upon that step in the food chain. Fishing quality in the Smith has struggled against the warming conditions we have all been experiencing - imagine how this will play out over	1. Refer to Consolidated Response WAT-2, which addresses concerns regarding impacts on surface water resources in the Project Area. 2. In addition to Consolidated Response WAT-2, refer to Consolidated Response WAT-5, which addresses concerns regarding potential thermal effects on water resources and ecosystems. In addition, refer to Consolidated Response MEPA-2, which addresses concerns regarding climate change. 3. Refer to Consolidated Response WAT-2, which addresses concerns regarding impacts on surface water resources in the Project area.

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					the longer term! 3. DEQ and Tintina have failed to show that all proposed mine waste contamination can be eliminated from water pumped back into the Smith - which should be an absolute necessity for this project. And, they have not shown that these wastes will not create acid mine drainage or negatively impact the river environment in the short - and certainly not the long term. Why would we rishk this when we don't have to? Why would we risk this for someone else's copper mine? Makes no sense!	
BBC00761	1	LaVerne Sultz	Trout Unlimited	Email	The Smith River is one of the most precious jewels of the Treasure State and our only permitted recreational river. Any rush to allow underground mining in its headwaters could have serious implications that Montanans will have to deal with, and pay for, for generations. In its haste to complete this draft EIS, the DEQ claims that the proposed mine will not harm the Smith River. A closer look at the draft EIS and the history of mining in our state proves this statement to be false. There are significant reasons that this is the wrong mine in the wrong place: 1. The Black Butte mine runs a serious risk of reducing flows and increasing pollution of the most important spawning tributary of the Smith River. The company and the DEIS grossly underestimate how much groundwater connected to the Smith River headwaters will flow into the mine and must be treated for toxic contamination before being pumped back into the ground. 2. History shows that the water the company plans to pump back into Smith River tributaries, so they don't dry up due to mining activities, is highly likely to contain more acidity, nitrates and toxic metals than the DEIS admits. Additionally, the replacement water will be much higher temperature than natural stream flow that will cause increased algal growth and be detrimental to our coldwater fish populations. All of those changes in water quality are harmful to aquatic life, fish, and stream habitat. 3. The DEIS hasn't properly considered how to keep toxic waste from this mine out of groundwater and surface water connected to the Smith River system. It also has failed to evaluate the high likelihood that waste from this mine will create acid mine drainage laden with heavy metals like arsenic as has occurred from mining across Montana for more than 100 years. 4. The company's plans to keep waste and toxins in place for decades or generations is very experimental. They provide no good evidence that it will work. The Smith River is their guinea pig. 5. The DEIS has not properly or sufficiently assessed the abundant aquatic life in the Smith and its tributaries that this mine will threaten.	DEQ has been reviewing aspects of this Project for approximately 7 years. See Consolidated Response WAT-1 and WAT-2 for information about the hydrogeological model, groundwater flow assumptions, and impacts on surface water resources. See Consolidated Responses AQ-1, AQ-2, and AQ-4 for information about algal growth, aquatic life assessments, and temperature effects on aquatic ecosystems. The Proposed Action and AMA require the Proponent to monitor water temperature in the discharge and at the stream monitoring sites (MOP Section 6.3.1; Tintina 2017a). If water temperatures violate the Montana Water Quality Act, including non-degradation standards, the Proponent would be required to implement engineering controls sufficient to avoid any temperature-related adverse effects. See Consolidated Response WAT-5, which discusses concerns regarding potential thermal effects on water resources and ecosystems. See Consolidated Response PD-2 for information about the proposed technology and facilities. Other mines in Montana historically have not treated their wastewater using RO, which is a highly effective water treatment method. Impacts on groundwater and surface water resources are not predicted. To confirm this prediction, the Proposed Action and AMA require the Proponent to conduct groundwater and surface water monitoring.
BBC00817	1	Bradley Hansen	Trout Unlimited	Email	I write this letter on behalf of the Pat Barnes Chapter of Trout Unlimited in Helena. Our chapter has just over 500 members who are advocates for cold, clean, and unpolluted waters in Montana. We focus a large amount of our time to our local Helena area watersheds including the waters of the Smith River.	See response to Submittal ID BBC00761, Comment Number 1.

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					In its haste to complete this draft EIS, the DEQ claims that the proposed mine will not harm the Smith River. A closer look at the draft EIS proves this statement to be false. Here are significant reasons that this is the wrong mine in the wrong place: 1. This mine seriously risks reducing flows and increasing pollution of the Smith River's most important trout spawning tributary. The company and the dEIS grossly underestimate how much groundwater connected to the Smith River headwaters will flow into the mine and must be treated for toxic contamination before being pumped back into the ground. 2. The water the company plans to pump back into Smith River tributaries, so they don't dry up due to mining activities, is highly likely to contain more acidity, nitrates or toxic metals than the dEIS admits. Additionally, the replacement water will be much higher temperature than natural stream flow. All of those changes in water quality are harmful to aquatic life, fish, and stream habitat. 3. The dEIS hasn't properly considered how to keep toxic waste from this mine out of groundwater and surface water connected to the Smith River system. It also has failed to evaluate the high likelihood that waste from this mine will create acid mine drainage laden with heavy metals like arsenic.	
BBC00915	2	Megan Chaisson		Email	I believe the Smith River is too precious to risk so a foreign-owned mining company can turn a quick profit and leave Montana taxpayers to clean up its mess. The Black Butte copper mine would be in operation for only 13 years, but the damage to the Smith River and its tributaries would be permanent. For these reasons, I support the No-Action Alternative in the DEIS. Considerations: • The Smith River, specifically Sheep Creek is incredible trout spawning habitat. • The double-lining proposal for the tailing pond is experimental and may not work. • Baseline data on aquatic species populations must be collected prior to launching any major development. More generally, I encourage the State of Montana DEQ to recognize and support our strong connection to the natural world. Through your regulatory measures please enforce forward-thinking decisions that favor conservation and sustainability. Thank you for your consideration and for the opportunity to comment.	Comment noted.
BBC00918	1	Warren and Lezlie Hopper		Email	The mine will be located on Sheep Creek, the major upstream tributary of the Smith River. One obvious exposure is to decreased water availability for the river. The EIS describes a process that relies upon the use of ground water and yet assumes minimum impact on stream flow. That is inherently flawed logic; that the DEQ appears to accept without concern. In a late revision to the EIS, Tintina admitted that they would need to store treated water for release during higher stream flows. That can reliably be	No adverse effects are predicted to occur on surface water and groundwater as a result of Project development based on results of the quantitative predictive models developed for the Project and in light of planned mitigation measures. As is standard practice, the EIS includes quantitative predictive surface water and groundwater modeling to generate predictions to support the assessment application and inform mitigation and management strategies (see Section 3.4.1, Section 3.4.2, Section 3.5.1, and Section 3.5.2). Section 3.5.3.1 and Section

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					translated to saying that the stored water will be warmer than mainstream flow AND will require higher flows for dilution of added contaminants in the stored water. Dilution has never been the solution to pollution! This action cannot possibly do anything except degrade the water quality in Sheep Creek and ultimately the Smith River-and yet the proposal met NO objection from the DEQ.	3.5.3.2 discuss why impacts on Smith River are highly unlikely. The water pumped from the mine would be returned to the stream (via the UIG), minus about 210 gpm needed for processing. This return would limit impacts on stream flow. Reservoir storage and controlled release are proposed to offset these losses during lower flow conditions. Treated water would be stored during July through September, then released during the subsequent lower flow months. The only reason for storage is a very restrictive nutrient standard that is only in effect during July through September. The Proposed Action and AMA require the Proponent to monitor water temperature in the discharge and at the stream monitoring sites (MOP Section 6.3.1; Tintina 2017a). If water temperatures violate the Montana Water Quality Act, including non-degradation standards, the Proponent would be required to implement engineering controls sufficient to avoid any temperature-related adverse effects. See Consolidated Response WAT-5, which discusses concerns regarding potential thermal effects on water resources and ecosystems.
BBC00932	1	Andy Johnson	Geological Engineer/Mineral Consultant	Email	I have met with Tintina Montana personnel and reviewed their mine plans. I have also reviewed DEQ's draft EIS for this project. In my view Tintina has "gone the extra mile" to ensure minimal impact to the land and the downstream Smith River from this proposed copper project. Especially significant is the generous use of cement for physically and chemically stabilizing waste products both underground and on the surface. Much concern has been placed on possible pollution "ruining" the Smith River downstream from the proposed mine. I see little probability of that. For one thing, the meandering Sheep Creek tributary will sequester any pollutants that may reach Sheep Creek. For another the mine area is underlain by carbonate bearing sediments. In my view, any potential leakage of metals from the site will quickly be sequestered via natural attenuation in the carbonate bearing soils and fractured underlying sediments. Nevertheless, Tintina Montana's goal of 100% capture and 100% containment will most probably render these points moot.	Comment noted.
BBC00945	1	Michael Scott		Email	A. The environmental document under-represents the contribution Sheep Creek makes to fish recruitment in the Smith and Missouri Rivers The analysis in the document states that recruitment in Sheep Creek contributes locally to the Smith. Recent field work done by FWP, TU and others has documented that salmonids from as far away as the Missouri and lower Smith use Sheep Creek for spawning. The environmental review should be revised to reflect this new information and should be considered, especially in regard to potential heavy metal contamination in Sheep Creek. Heavy metals, as well as acid mine drainage can significantly affect recruitment and, thus, potentially fish numbers in the Smith, an economically important river.	No adverse effects are predicted to occur on surface water and groundwater as a result of Project development based on results of the quantitative predictive models developed for the Project and in light of planned mitigation measures. As is standard practice, the EIS includes quantitative predictive surface water and groundwater modeling to generate predictions that support the assessment application and inform mitigation and management strategies (see Section 3.4.1, Section 3.4.2, Section 3.5.1, and Section 3.5.2). Section 3.5.3.1 and Section 3.5.3.2 predict that impacts on Sheep Creek and the Smith River are highly unlikely. The Project is proposed to be an underground mine, and the only significant amounts of Project contact water would be excess water sent from the WTP to the UIG. Impacts on groundwater and surface water resources are not predicted. To confirm this prediction, the Proposed Action and AMA require the Proponent to conduct groundwater and surface water monitoring.

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						Additional relevant data on fish movement and stream redd counts near the Project area has been included in the Final EIS. Also, see Consolidated Responses AQ-1, AQ-2, AQ-3, and AQ-4.
BBC00945	3	Michael Scott		Email	C. There needs to be a better analysis of the potential heavy metal and acid mine drainage impacts to Sheep Creek. The proposed mine is below the groundwater level in the area where it would be built meaning that there will need to be pumping during its operation. The company proposes to dispose of the water, which will be laden with heavy metals by injecting it into deeper aquifers, relying on aquifer separation as the principal means for keeping contamination out of Sheep Creek. This is a deficient assumption for two reasons. First, opening the adit exposes sulfite bearing rock to the air allowing it oxidize and to be dissolved by water. Not all the water in the mine will be able to be pumped out. Some amount, not documented, will flow into the surrounding aquifer with the potential for polluting Sheep Creek affecting water quality for fish and downstream use by the ranching community. Second, there is little to no documentation of what a full development scenario, with potential open pits would mean for water quality. Finally, the company relies on back-filling the adit to seal it off from further air circulation as its mitigation strategy. There is no analysis of what would happen if that back-fill strategy fails, something that has happened frequently at other mine adits including the New World Mining District. Nor is there any estimate of the costs associated with additional mitigation requirements should that happen.	The Proponent has used hydrogeochemical monitoring, hydrogeological modeling, surface water modeling, and geochemical testing data to design its underground workings and associated surface facilities, including the WTP, and to minimize potential impacts on surface water and groundwater. Apart from groundwater in the underground workings at the end of the closure phase, water from all facilities would be collected and treated to meet non-degradation criteria prior to discharge (Hydrometrics, Inc. 2016b). The Project would be an underground mine, and the only significant amounts of Project contact water released to the environment would be excess water sent from the WTP to the UIG. The water would be released to the alluvial aquifer via the UIG during the mine construction and production phases. Prior to a release, that water would be treated to assure compliance with surface water and groundwater standards and non-degradation criteria per the MPDES permit (Hydrometrics, Inc. 2018a; Tintina 2018a). No Project contact water laden with heavy metals would be released to the environment. The RO-treated water would be injected to the alluvial aquifer, not deeper aquifers (there are no deeper aquifers around the Project site—the deep bedrock was found to be of low permeability and cannot be characterized as an aquifer). All the groundwater flowing into the mine would be pumped out. No groundwater migrating toward the mine would flow away from the mine during mine operation, as long as the mine is dewatered and a cone of depression is in place. See Consolidated Response WAT-3. During the post-mine period, the post-mine contact groundwater would be slowly migrating toward the surficial environment mainly through shallow bedrock. The geochemical model predicts low concentrations of analytes in that contact water below non-degradation levels after completion of washing the mine workings during mine closure. See responses to Submittal ID HC-003, Comment Numbers 52 and 68. The Proposed Action would not create any open pits. No expansion of mining would happen beyond what the Proponent has proposed. Any expansion would require a new application for mining followed by a new EIS. See Consolidated Response CUM-1. It is not clear what the commenter means by using a phrase “if the backfill strategy fails.” See Consolidated Response PD-5. Completely filling the open spaces underground with a cement-like material, followed by flooding them, has no potential to fail to prevent air circulation. There is no record of such a strategy to have failed. One example of a successful implementation of an approach similar to what was proposed by the Proponent is the New World Mining District,

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						where an old draining adit was reopened, with backfill and plugs installed over a century after completion of the mining, which resulted in significant improvements to water quality. The EIS provides a summary of the results of the quantitative predictive surface water and groundwater modeling. The model predictions support the environmental assessment and serve as tools to inform mitigation and management strategies (see Section 3.4.1, Section 3.4.2, Section 3.5.1, and Section 3.5.2 of the EIS). Section 3.5.3.1 and Section 3.5.3.2 explain why impacts on Sheep Creek and the Smith River are highly unlikely. Impacts on groundwater and surface water resources are not predicted. To confirm this prediction, the Proposed Action and AMA require the Proponent to conduct groundwater and surface water monitoring. Monitoring would continue on Sheep Creek downstream of the Project boundary and along Coon Creek as described in Section 3.5 of the EIS.
BBC00931	2	Stuart Lewin		Email	An adequate monitoring plan has not been required under the DRAFT EIS to determine Sheep Creek down stream from the proposed mine, Smith River where Sheep Creek empties into the Smith River and where the Smith River Flows into the Missouri River and just above the City of Great Falls water intake and the Missouri river below where Belt Creek flows into the Missouri river showing water quality which measures acid waste and arsenic levels and water quantity at each of these location should be established as part of the permitting process. Baseline measurements over several years should be determined and then after the mine begins operations there should be continuous monitoring as part of the monitoring plan. The goal is to measure the impact of the mining operation on water quality and quantity. C. An analysis of the impact to the Smith and Missouri Rivers of the mine after its bonding runs out and if and when the mitigation measures of the mine fail has not been included in the DRAFT EIS. Severa1 ·100 years is not a very long time to consider in the life of the City of Great Falls especially in light of the failure of the residents of Great Falls to address significant industrial pollution of the MR in the last 130 years of city's existence.	Baseline water quality monitoring has been conducted on Sheep Creek since 2011 and is continuing. Monitoring sites on Sheep Creek are sufficiently far downstream of the Project area that any possible water quality impacts from the mine would be detected there. If impacts could not be detected in Sheep Creek, then there would neither be any impacts on the Smith River or on the Missouri River. If impacts were detected in Sheep Creek, then remedial actions would correct the problem long before effects progressed farther downstream. Section 3.5.3.1 and Section 3.5.3.2 of the EIS present specific discussion on why impacts on the Smith River are highly unlikely. See also Consolidated Response CUM-3 for additional discussion regarding potential impacts beyond Sheep Creek. Bonds required under the MMRA must be based on reasonably foreseeable activities the applicant may conduct in order to comply with conditions of an operating permit. DEQ has not identified any impacts that would last into perpetuity. Therefore, DEQ cannot require the applicant to post a bond for long-term monitoring and/or treatment. See Consolidated Response FIN-1 for information about bonding and protection for taxpayers.
BBC00952	1	Will Trimbath	Trout Unlimited	Email	Unlike many of the comments you will read, this one will not start by telling you how many generations of a Montanan I am. I am not from Montana. I was born and raised in Pittsburgh, Pennsylvania. I grew up obsessed with fishing. My father, who would have rather wished I loved sports, met me where I was, and picked up fishing himself to spend time with me. Every other Saturday we would go fishing. Every other Saturday we would have to drive 90+ minutes to get to trout streams that weren't permanently polluted from mining. I can remember as an antsy kid just wanting to get out of the car and fish, asking Dad why we couldn't just fish the countless streams and rivers we were driving over to get to the mountains. Sometimes the answer was obvious, the streams were as orange as my Charles Barkley Phoenix Suns jersey. Others though, ran clear. When I'd ask my Dad, a civil engineer who specialized in mine reclamation, he'd inform me that those streams too, while not rust orange, were also biological deserts. Polluted by aluminum, selenium, and other heavy metals, the water running with conductivity levels orders of magnitude higher than they	Comment noted.

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					should be. The Smith River is in trouble. Your department is well aware of this and has admirably looked into the algae bloom problems on the river. We've all heard about the schools of fish that congregate at the mouths of Tenderfoot Creek and other Smith River tributaries in August when the river is hot and low, and fish are searching for higher levels of dissolved oxygen. With a river already imperiled, stacking unnecessary risks on top of it are irresponsible. I don't have anything against Tintina/Sandfire/whatever foreign mining company they'll be next year. I believe they think they truly are doing things right from the beginning. The problem is stepping out and looking at the mining industry as a whole, which you must do. Don't analyze this application in a vacuum, ignoring the failed mines across our great state. The mining industry has lost the benefit of the doubt. Plenty of comments will highlight the economics that the Smith River provides in recreation and tourism income, so I won't repeat those here. That is secure, stable income coming into Meagher, Lewis & Clark, and Cascade Counties. Permitting this mine will result in higher incomes to White Sulphur Springs, temporarily. But looking at the statistics of Montana mines, this one is going to fail. It will fail like the vast majority of the others, and we will have traded a stable recreational income for a get rich quick mine. I'm sending you this email from a devise that uses copper, I get it. We need copper. But this is the wrong location for this mine. There are plenty of other rich ore bodies in the arid west that don't sit immediately on top of a world-class fishery. Permitting this mine is placing a vastly irresponsible risk upon one of our state's most cherished treasures. Do not permit this mine. Do the right thing.	
Tintina Mine	1	Nancy Traner		Email	I am a landowner on the Smith River and am strongly opposed to the Tintina Mine because of the potential disastrous effects on the river should any mishap occur during the mining process.	The Proponent has used hydrogeochemical monitoring, hydrogeological modeling, surface water modeling, and geochemical testing data to design its underground workings and associated surface facilities, including the WTP, to minimize potential impacts on surface water and groundwater. The Project is proposed to be an underground mine and a primary planned mitigation measure is that the only significant amounts of Project contact water would be excess water sent from the WTP to the UIG; the water released to the alluvial aquifer via the UIG during the construction and operations phases would be treated to assure compliance with groundwater standards and non-degradation criteria per the MPDES permit (Hydrometrics, Inc. 2018a; Tintina 2018a). Impacts on groundwater and surface water resources are not predicted. To confirm this prediction, the Proposed Action and AMA require the Proponent to conduct groundwater and surface water monitoring. Monitoring would continue on Sheep Creek downstream of the Project area and along Coon Creek as described in Section 3.5 of the EIS.

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BBC00960	2	Max Hjortsberg	Park County Environmental Council	Email	Perpetual Water Treatment The extraction in a sulfide based ore body, such as the proposed BBC mine will be excavating, no matter the degree of “21 st Century” mining technology employed, poses serious threats to Montana’s environmental quality and health, not only for the life of the mine, but in perpetuity. Mining technology has consistently shown itself incapable solving the issue of acid mine drainage across the state of Montana. The course of mining history over the last 150 years–from the Berkeley Pit to the Zortman Landusky complex--demonstrates that even with better and better technology, Montana taxpayers bare the burden of toxic remediation. Zortman Landusky offers the cautionary tale of a mining corporation declaring bankruptcy, walking away from all responsibilities and leaving the State of Montana with insufficient bonding to deal with cleanup and reclamation, including perpetual treatment of the acid mine drainage at the site. On their website Sandfire claims their “mining operation will be completely different than nearly any mine operation seen in Montana.” (http://blackbuttecopper.com/faqs/why-will-we-not-repeat-the-mistakes-of-the-past/). While this may be true, based on their proposal, this hail-mary of a statement inspires little confidence when Sandfire proposes employing a technology like Cemented Tailings Backfill, which has not been tested or proven effective at the proposed mine site. Rigorous quality control measures must be required by DEQ, and added to the DEIS, to ensure that there are safeguards and mechanisms in place, as well as sufficient bonding, to address the potential for the need to perpetually treat contaminated water that the mine site may discharge to the surface long after the mine had ceased operations. Especially concerning is the assumption in the DEIS that the proposed, unproven reclamation technology will go according to plan and work out perfectly. The DEIS states in Section 3.5.3.2 that “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.” While we all agree that thorough analysis and modeling shows the effectiveness of the closure procedures working as planned, we can also agree that the “best-laid plans of mice and men often go awry,” especially in the mining industry. We think the DEQ and BBC should plan for the worst, and hope for the best. The worst in this case being the need for perpetual water treatment; the hope being the mine will be “unlikely to affect surface water quality.” We highly recommend DEQ add to the DEIS and proactively address this issue in its DEIS, and plan for the unfortunate possibility that this mine could permanently impact the surface waters of the Sheep Creek watershed, and consequently the Smith River watershed, and ultimately the Missouri River watershed.	It is standard practice to develop quantitative, predictive models to evaluate potential water quality and quantity effects associated with proposed development projects; the EIS includes quantitative predictive surface water and groundwater modeling to generate predictions to support the assessment application and inform mitigation and management strategies (see Section 3.4.1, Section 3.4.2, Section 3.5.1, and Section 3.5.2). Note, these predictive surface water and groundwater models and assessments completed to support the EIS do not indicate that perpetual water treatment would be required or likely. The Proponent has used hydrogeochemical monitoring, hydrogeological modeling, and geochemical testing data to design its underground workings and TWSP to minimize potential impacts on water quality. Apart from groundwater in the underground workings at the end of the closure phase, water from all facilities would be collected and treated to meet non-degradation criteria prior to discharge (Hydrometrics, Inc. 2016b). Cemented tailings backfill is a common approach used in underground mines. Enviromin (2018) noted that many laboratory studies and case studies exist to document the implementation of cemented paste tailings as backfill material. They stated that, “Cemented-paste tailings backfill technology was used as early as 1957 (Tariq and Yanful, 2013) and revolutionized mining. Today, it is a common method for underground tailings placement: as of 2010, at least 100 facilities were reported to employ paste or cemented-paste backfill techniques (Yumlu, 2010), and that number has undoubtedly risen. A range of materials can be placed as fill, including waste rock, paste tailings, and cemented-paste tailings, using a variety of binders.” Other mines that have used cemented paste tailings as backfill include: BHP Cannington mine in Australia, Stratoni Operations (Madem Lakkos and Macres Petres) in Greece, Zinkgruvan mine in Sweden, Langlois mine in Quebec, and the Barrick Goldstrike mine in Nevada (Moran et al. 2013). Using cemented paste tailings as backfill improves the stability of the underground workings (which reduces the risk of subsidence) and reduces the oxidative weathering of rock surfaces (Alakangas et al. 2013; Enviromin 2018). It has been successfully applied to underground mine openings in Canada, Australia, China, Turkey, South Africa, and the United States. See also Consolidated Response PD-2, which addresses concerns regarding examples of proposed technologies.
BBC00976	2	Amanda Stephenson		Email	The proximity of the project to the Smith River and some of its tributaries has caused some to oppose the project even though the Smith River is located 19 miles from project site. These concerns are appropriately addressed in the mine’s proposed plan. While the analysis shows that it is “highly unlikely that the Proposed Action in and of itself would have any measurable impact on water quality in the Smith River” (Section 3.4.3.2.1, page 57), implementation of the Agency Modified Alternative (AMA) would offer one more level of protection of water resources (Section 3.4.3.3.1, page 60). That additional level	Comment noted.

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					of protection is a good example of going 'above and beyond' when addressing possible environmental impacts since, in that same discussion (Section 3.4.3.3.1, page 60), the DEQ states that "implementing the AMA would not be required to ensure that Smith River water quality is not impacted". After reviewing the EIS and the DEQ's proposed alternative, I have to conclude that this project can safely be operated while protecting the environment of Meagher County - including the Smith River. The jobs and tax base that will be generated by the proposed action will assist Meagher County in correcting the decades long decreases in wages, increases in unemployment, and assist in reversing a trend toward young-family migration out of the area.	
BBC00978	4	Bruce Farling		Email	It is probable that because of the limited pump tests that occurred that the modeling for at least the deep aquifer is inaccurate. DEQ received many comments like this in scoping and from public reviews of the mine permit application. As such, there is a high probability that more groundwater will be encountered than anticipated. This is the conclusion of at least one groundwater expert who has reviewed the mine permit application, completeness review and DEIS (Myers 2016; Myers 2019). The groundwater model and the data supporting it should be reviewed by an objective third party expert panel and the findings reported to DEQ for inclusion in a supplemental DEIS. • The 3,000-foot underground infiltration gallery located in the alluvium next to Sheep Creek was not included in the mine permit application and not subject to a completeness review. Therefore data for the DEIS are insufficient to determine whether groundwater mounding will be problematic or not for Sheep Creek, whether the alluvium will adequately adsorb or "dilute" pollutants (doubtful and exactly what will be the effects of the discharges to the infiltration gallery on natural groundwater and surface water exchange. It appears that the nearest surface water quality station proposed in Sheep Creek will be at least a mile downstream, which is insufficient to determine the near effect of discharge to the infiltration gallery to surface water. The DEIS is deficient in its disclosure of the impacts of the newly located infiltration gallery. • It is important to note that Tintina does not have an approved new water use permit nor approved change of use for its proposal to divert surface water and store groundwater to supplement flows in Coon Creek and Sheep Creek. Approval of this stream supplementation plan could be complicated by DNRC's determination on water availability as well as objections from other downstream water right owners, including Montana FWP and the U.S. Forest Service, both which hold valid state-based instream flow reservations downstream in Sheep Creek and the Smith River. The DEIS should be clear that Tintina might have to modify its plans should it not clear hurdles posed by the Montana Water Use Act.	The mine hydrogeological model was developed by Hydrometrics based on years of on-site research, including well drilling and aquifer testing, examination of drill cores from exploration drilling, and geologic mapping. The predictions and analyses as presented are considered appropriate and sufficient to support the EIS and the proposed mitigation measures are sufficient for handling water during operations and closure. See Consolidated Response WAT-1 for additional data and discussion regarding the concern underestimating the rates of groundwater inflow into the mine workings, and Consolidated Response WAT-1, Concerns Regarding Hydrogeological Model and Underestimation of Groundwater Inflows. An alluvial UIG proposed for installation near Sheep Creek was included in the MOP Application, and therefore was subject to completeness reviews. Subsequently, the Proponent proposed an expanded alluvial UIG at that location as part of the MPDES permit application to DEQ. The revised UIG design was also reviewed by DEQ. The reviewed data included the results of substantial field testing and groundwater modeling. Monitoring in Sheep Creek is proposed to occur at a point about 1 mile downstream. Since the UIG would consist of several parts installed at different locations, the discharges of infiltrated water to the alluvium (mixed with ambient groundwater) would not completely enter surface water nearer the UIG sites.
BBC00984	1	Holly English		Email	I am writing to object to the construction of the proposed Copper mine at the Headwaters of the Smith River. I had the pleasure of floating the Smith River with my Montana friends last summer, and was struck by the sheer beauty and health of this pristine river and productive trout fishery. I was amazed by the number of wildlife encounters I had on the river and the diversity of bird species. I also understand, through my own studies, the legacy of pollution left by mining of decades past, that has left Montana residents with 2,500 miles of	With regard to acid drainage formation and generation of polluted water, see Consolidated Response PD-5, Concerns Regarding Cement Breakdown Due to Acid Formation; Consolidated Response PD-2, Concerns Regarding Examples of Proposed Technology; and Consolidated Response ALT-4, Concerns Regarding De-Pyritization of Tailings. The Smith River is included in DEQ's 303(d) list of impaired streams, covering

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					polluted rivers, due to poorly or unmanaged acid mine drainage and heavy metal contamination. Why on earth would the State of Montana approve a new mine that threatens a healthy trout stream, when they have failed to get a handle on the legacy mine pollution that exists today? The Smith River is a highly sought-after float trip for anglers, river runners, bird watchers, hunters, and tourists. The sheer number of permit applications received each year, along side the user days clocked by the commercial river outfitters attests to the value of the Smith River as a recreational gem. The State of Montana should reject this project outright by selecting the No Action Alternative based on the proposed impacts the project poses to the Smith River and its ecosystem. The company has failed to demonstrate that existing technology to surface and groundwater, fish and wildlife, and their habitat can be successfully mitigated, particularly in the areas of surface and groundwater contamination. 1. The company and DEQ haven't properly considered how to keep contamination from mine waste out of groundwater and surface water that will flow into the Smith River system. They also have failed to evaluate the high likelihood that wastes from this mine will create acid mine drainage laden with arsenic and other mine contaminants. 2. This mine seriously risks reducing flows and increasing pollution of the Smith River's most important trout spawning tributary. The company and the DEIS grossly underestimate how much groundwater connected to the Smith River headwaters will flow into the mine and have to be treated to remove contamination. Technology does not exist today that can successfully clean up groundwater contamination.	all stream reaches from the confluence of the North and South Forks to the mouth at the Missouri River (see Section 3.5.3 of the EIS). The impairments include flow regime modification, temperature, *E. coli*, total phosphorous, alteration in stream-side or littoral vegetative cover, physical substrate habitat alteration, and other human-caused substrate alteration. Algae growth reaching nuisance levels is another problem. The factors possibly contributing to that problem include increased nitrogen and phosphorus concentrations, increased water temperature, high pH, and other factors (Bell 2018). Regarding the issue of reducing flows in the nearby creeks and Smith River, see Consolidated Response CUM-3, Concerns Regarding Cumulative Effects Beyond the Sheep Creek Watershed; Consolidated Response WAT-1, Concerns Regarding Hydrogeological Model and Underestimation of Groundwater Inflows; Consolidated Response WAT-2, Concerns Regarding Impacts on Surface Water Resources in the Project Area; and Consolidated Response WAT-4, Concerns Regarding Sheep Creek Dewatering. See Consolidated Response PD-2 for information about the proposed technology and facilities.
BBC00991	2	Hayley Couture		Email	Even with the positive economic benefits of this project, I could not support it if I did not believe in the Tintina Montana's ability to reclaim the site when mining is complete. But I believe Tintina Montana will be a good steward of this land. Already, they've made it a point to reseed and recontour all of its exploratory drill sites. Plus, the proposed Black Butte Plan outlined in the Draft Environmental Impact Statement clearly meets or exceeds the strict environmental requirements we demand from mining projects. As a geologist who works in the mining industry, I can safely say, our country has some of the strictest environmental laws in the world. These regulations guide every element of the Black Butte Project and I have no doubt, when they finish mining the more than 1 billion pounds of copper, they will be able to return the land to agricultural use. As I've personally reviewed the project, I have been most impressed with Tintina Montana's commitment to water quality. The company will have a closed system in order to eliminate any direct discharge. Tintina Montana will collect all of the water pumped out of the mine during construction and operations and store it in appropriately lined and monitored ponds. If the ponds exceed any water quality standards, it would be treated to meet stringent requirements before being reintroduced to the groundwater. This proposed water treatment, including reverse osmosis, has successfully been used at other	Comment noted.

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					operations. As I said earlier in my letter, I believe the Black Butte Project is a win for Montana and its citizens. I hope the Department of Environmental Quality will approve the project as outlined in the Draft Environmental Impact Statement, so its benefits can be fully realized. Thank you for considering my comments.	
BBC00997	3	Jennifer Swearingen		Email	2 The DEIS significantly underestimates the amount of groundwater that will flow into the underground tunnels and then be removed for treatment, robbing the headwaters of the Smith River of its natural water flows. Replacement water will significantly raise the surface temperature of the river and will have devastating impacts on all the lifeforms in the Smith River. This failure to accurately gauge water flows and water removal significantly skews the analysis of impacts. 3 The DEIS failed to analyze the impacts of pollution from explosives wastes, which will be drawn into streamwater via the newly created fractures in the bedrock. Nitrates, a by-product of explosives, promote the growth of algae, which has very negative impacts on fish habitat. Algae is also expected to increase due to the rise in surface water temperature. These combined changes would have serious negative impacts on fish populations, none of which were considered in the DEIS. Ignoring these impacts is unacceptable.	Regarding reducing flows in the nearby creeks and the Smith River, see Consolidated Response CUM-3, Concerns Regarding Cumulative Effects Beyond the Sheep Creek Watershed; Consolidated Response WAT-1, Concerns Regarding Hydrogeological Model and Underestimation of Groundwater Inflows; Consolidated Response WAT-2, Concerns Regarding Impacts on Surface Water Resources in the Project Area; and Consolidated Response WAT-4, Concerns Regarding Sheep Creek Dewatering. Regarding acid drainage formation and generation of polluted water, see Consolidated Response PD-5, Concerns Regarding Cement Breakdown Due to Acid Formation; Consolidated Response PD-2, Concerns Regarding Examples of Proposed Technology; and Consolidated Response ALT-4, Concerns Regarding De-Pyritization of Tailings. Regarding pollution impacts from explosives wastes and created fractures, see Consolidated Response WAT-3, Concerns Regarding Fracturing Resulting from Blasting. Regarding rising surface water temperatures and causing algal growth and impacts on fish populations, see Consolidated Response WAT-5, Concerns Regarding Potential Thermal Effects on Water Resources and Ecosystems.
BBC01013	2	Marlena Lanini		Email	Secondly, a full fate and transport model extending a significant time post-closure is necessary to claim that groundwater discharging to surface water would not affect its water quality. I do not believe the current model shows the impacts after closure from the paste backfill interacting with groundwater flow.	See Consolidated Response WAT-1 for more information about the hydrogeological model and underestimation of groundwater flow. Groundwater modeling indicates that the deep bedrock zones that include the Johnny Lee Deposit contribute very little flow to shallow bedrock and surface water. Geochemical modeling indicates that post-closure, after the backfilled underground workings are flooded, groundwater quality in the area of the mine workings would be similar to baseline water quality conditions. Complete backfilling of these areas with cemented paste would also limit groundwater flux through these areas to rates comparable to pre-mining conditions. If groundwater quality and flow rates remain similar to baseline conditions, then fate and transport modeling would not predict changes from baseline conditions.
BBC01013	3	Marlena Lanini		Email	Additionally, I have the following comments on the groundwater models: To predict any long term water quality issues from groundwater flow through the former mine area, the permeability at the lower bound of the mine must be establish through data collection from drilling. However, Appendix M states “No test wells penetrate the VVF below the ore zone where it contacts the deeper Chamberlain shale or Neihart quartzite and therefore it cannot be established whether there is a damage zone in these deeper units associated with the VVF.”	The number and type of tests conducted to characterize the hydrogeologic properties of the geological materials for the Project are consistent with standard practice for this type of project. While it is possible that fractured zones are at depths that were not captured in the site data, it is unlikely that these zones are continuous to surface such that they behave as preferential flow pathways for groundwater. The likelihood of such flow pathways existing is regarded as low because:

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					Appendix N "placement of the synthetic cover which is expected to eliminate all subsequent seepage" Synthetic covers will not eliminate seepage to 0, nor eliminate seepage forever. The cover will crack over time and there will be seepage at some future date unless the cover is monitored and repaired/replaced in perpetuity. Appendix N, Section 6.2 "Precipitation water is assumed to be distilled water, and the wet paste seepage is estimated from water quality measured in process water from metallurgical tests (Appendix J, from Austin, 2015). The metallurgical data did not report alkalinity; therefore we estimated total alkalinity values of in the mass-load model of 400 ppm (as CaCO3)." Precipitation will not have the same properties as distilled water. Local precipitation could be sampled and used. Alkalinity values in the model are crucial to making any predictions in pH as part of the model and would impact sorption predictions. Data must be collected that would accurately represent this value as this is crucial to the model.	• The testing along fault zones (discrete zones of high permeability) most likely to occur in close proximity to the deformation occurring along faults, consistently indicated low hydraulic conductivity. • The hydrogeological modeling conducted for the Project (Hydrometrics, Inc. 2016a) was calibrated to observed groundwater level measurements (incorporating low hydraulic conductivity for deeper units and faults), indicating the hydraulic conductivity values used in the model provide a good fit to the site scale groundwater flow conditions. See Consolidated Response PD-4 for a discussion regarding liner failures and seepage mitigation. Routine inspection of all facilities would be a requirement for the site after closure. Additional seepage mitigation features are included in facility designs, including foundation liners and seepage collection systems. The approach of embedding multiple seepage mitigation features into facility designs reduces the likelihood of significant seepage discharging to the environment to negligible levels. Distilled (or deionized) water lacks the buffering capacity of carbonate/bicarbonate species found in rain water. As such, it acts as an aggressive solvent and provides a conservative estimate of constituents that might leach from test materials. The alkalinity of 400 ppm was estimated for the water that could seep from the cemented paste tailings as they solidify within the CTF, which would be expected to have elevated alkalinity due to the addition of cement/binder components. This estimate was close to the calculated alkalinity input from other dissolved species that were measured. Appendix N (Enviromin 2017a) of the MOP Application also states: "In addition to these solutions, run-on and direct precipitation (assumed to be deionized water) are added and water is removed as evaporation. These three fluxes of deionized water add up to a net influx of 10,000 m^3/yr of water, which dilutes the system by only a small amount. The final mixed solution is equilibrated in PHREEQC to predict the PWP chemistry that will report to the WTP."
BBC01014	4	Guido and Lee Rahr		Email	We are very concerned about the almost certain increase in water temperatures in Sheep Creek and the Smith River itself. There is no way the Smith can sustain its quality trout fishery with a reduction of cold summer flows from Sheep Creek, especially with the possible impacts of climate change. The Smith River is already temperature flow limited and suffers periodic summer algae blooms and fish kills. This will likely tip the system out of the range that can support salmonid fish. This element of the EIS needs to be re-evaluated. 4. Pollution of in-stream water. Large scale copper and gold mines create permanent source of acid mine drainage and other forms of pollution to downstream water quality. These impacts can be devastating to aquatic life and persist for centuries. Long after Tintina and its investors have collected their profit and moved on to another project, Montana citizens and Smith River landowners will be left with the toxic mess. My family and our neighbors--downstream from the mine --	No adverse or long-term effects are predicted to occur on surface water and groundwater as a result of Project development based on results of the quantitative predictive models developed for the Project and in light of planned mitigation measures, including RO treatment of mine dewatering flows. As is standard practice, the EIS includes quantitative predictive surface water and groundwater modeling to generate predictions to support the assessment application and to inform mitigation and management strategies (See Section 3.4.1, Analysis Methods; Section 3.4.2, Affected Environment; Section 3.5.1, Analysis Methods; and Section 3.5.2, Affected Environment, of the EIS). Section 3.5.3.1, Surface Water Quantity, and Section 3.5.3.2, Surface Water Quality and Temperature, of the EIS present specific discussion on why impacts on the Smith River are highly unlikely. Also refer to Consolidated Response WAT-2. Regarding rising surface water temperatures causing algal growth and impacts on fish populations, see the Consolidated Response WAT-5, Concerns Regarding Potential Thermal Effects on Water Resources and Ecosystems.

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					will all suffer the effects. There are many sources of copper in the world today but there is only one Smith River. It is the pride and joy of Montana, and as the world changes it will be seen as one of the most beautiful places on earth -- unless you permit this dangerous project. Lets prevent the permanent degradation of the remaining in-stream water in the Smith River. We are asking the DEQ to select the No Action alternative and not permit this mine based on this poorly developed Environmental Impact Statement and long term environmental impacts.	
BBC01019	3	Faye Bergan		Email	Second is addressing the uniqueness and fragility of the Smith River resources and the cultural value the Smith River system has to Montana citizens. ARM 17.4.608(d). I am sure many commenters will raise this issue, but the Smith River system is fragile as evidenced by being the only river in Montana that requires a permit to float and one of a few rivers that the Montana Legislature created a "Murphy" water right for in 1969. The unique nature of this resource cannot be overstated. People travel from all over the world to experience its' wonders. This river is a cultural treasure that goes beyond dollars earned from recreation. This alone must support a no action alternative. Third, there are so few areas like the Smith River left, the importance to the State and to each Montanan (and to society as a whole) from this environmental resource has to be carefully examined and specifically addressed. ARM 17.4.608(e). The Draft EIS fails to adequately address this. The company's plans to keep mine waste and the contaminants it produces from adversely affecting the environment for decades or generations is very experimental. They provide no good evidence that it will work. How many clean-ups do we have to pay for before we demand proof (not theory) of long-term safety?	DEQ acknowledges the outstanding recreational opportunities afforded by the Smith River and recognizes its economic contribution. Recreation and use of the Smith River is addressed in Sections 3.7 and 3.8 of the EIS. Socioeconomic resources are addressed in Section 3.9 of the EIS. The EIS includes quantitative predictive surface water and groundwater modeling to generate predictions to support the assessment application and inform mitigation and management strategies (see EIS Section 3.4.1, Section 3.4.2, Section 3.5.1, and Section 3.5.2). Section 3.5.3.1 and Section 3.5.3.2 explain why impacts on Sheep Creek and the Smith River are highly unlikely.
BBC01021	2	Sam Eidson		Email	3) A plan is only as good as the investment, intent and capabilities of the people in charge. And given the fact that DEQ is understaffed and has its hands tied by industry-favorable limitations to its authority, the management and monitoring of this mine would come down to Tintina. Please ask yourself whether you are ready to trust these people with the health of Montana's crown jewel fishery and Meagher County's residents. To assume they will stick to their word and keep their attention and investment focused on environmental safety is just not credible. Here is the data: • In July of 2015 I toured the mine and spoke with several of the mine executives. Perfectly pleasant people. But the unbridled confidence they showed – in the face of not a lot of data at that point – made it obvious that they would ignore any risks, bury any data, and create any spin to get this project through. Here are just a few examples: • "We won't dewater the Sheep Creek drainage. In fact, we'll probably net add clean water to it." • "We won't expand beyond this ore body." Even at the time of this tour, the company was telling investors a very different story – and since then, Sandfire has been clear about expanding the operation and making it a 50-year mining district.	See Consolidated Responses WAT-1 and WAT-4 for discussion about the accuracy and robustness of the groundwater model and anticipated dewatering. The Section 3.4.1.4 of the EIS discusses a series of aquifer tests that were conducted at the site that included both slug tests and short-term and long-term pumping tests to characterize the hydrogeologic characteristics of the principal stratigraphic units and the fault systems that bound the ore bodies (Hydrometrics, Inc. 2017a). The number and scope of the completed tests represent a standard practice for this type of project. In the EIS, development of the numerical groundwater model was informed by the results of those tests as well as other data (groundwater levels, discharge to streams, estimates of recharge), and the model was calibrated to measured values of various parameters. The reliability of the model predictions was assessed considering data limitations and results of a model sensitivity analysis (Hydrometrics, Inc. 2016a); the predictions and analyses as presented are considered appropriate and sufficient to support the EIS. DEQ would conduct regular inspections, if the Project is approved, and would be the entity regulating mining at the site.

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					• "The sulfides are already there. If anything, the paste we add will neutralize the acid already seeping into Sheep Creek." Yes, they actually said this. • The recent independent hydrology report shows that Tintina's hydrology analysis grossly underestimated the amount of groundwater they would be dealing with. • More than one of the executives touting modern mining techniques have been involved in mines that failed to the detriment of their watersheds – mines that were promoted with the same "modern mining" language. • All of that said, we really don't know who we would be entrusting with our environment and public health. Since I toured the site, the company has become a wholly owned subsidiary of its Australian financial backer, and half of the executives have turned over. The players can change overnight.	
BBC01054	5	Scott Bischke and Katie Gibson		Email	4. The DEIS does not accurately project how much water the mine will remove from the watershed. Further, the modeling used in the DEIS does not account for how much the surface temperature will change when they replace the water they are proposing to withdraw. 5. Explosives used in the mine will create fractures in the bedrock. These fractures will create pathways for nitrates (explosives waste and other contaminants to flow into groundwater. 6. Nitrates, along with an increased temperature, promotes the growth of algae. Algal growth decreases the amount of oxygen and available habitat for macro-invertebrates (fish food), and gravel beds available for spawning.	The mine hydrogeological model was developed based on years of on-site research, including well drilling and aquifer testing, examination of drill core from exploration drilling, and geologic mapping, and has not underestimated groundwater inflows, or the effect of dewatering activities in the Project area, including the Smith River and associated tributaries. See Consolidated Response WAT-1 for additional discussion about the accuracy and robustness of the groundwater model, and Consolidated Response WAT-2, which addresses potential fracturing resulting from blasting activities. The EIS includes quantitative predictive surface water and groundwater modeling (see Section 3.4.1, Analysis Methods; Section 3.4.2, Affected Environment; Section 3.5.1, Analysis Methods; and Section 3.5.2, Affected Environment, of the EIS). See Consolidated Response WAT-5 regarding concerns of potential thermal effects on water resources.
BBC01061	1	Ronald C. McGlennen		Email	I am a landowner on the Smith River, a first generation Montanan with the experience of another place, the unfolding catastrophe of hard rock mining for copper in northern Minnesota. The chemistry of that specific type of mining is rife for disaster, with the production of highly concentrated sulfuric acid there are untoward changes in the rivers and streams and the water table which are a source of drinking water for communities there. The mistakes and lack of vision of that community, and the regulators charged with protecting the environment there does not need to be our experience for the Smith River and surrounding area. For that reasons and others described below, my family and I are compelling your department and the dedicated researchers that work with you, to consider the following concerns with the current Smith River Environmental Impact Statement and to deny the approval for the mine to be developed. The Smith River is Already Under Threat Another DEQ sponsored study underway seeks to better understand the mounting threat of toxic algal blooms on the Smith River. We have experienced this first hand near our home, where the data of such blooms is occurring earlier each season. Part of the problem is agricultural runoff, part is the warming climate and part is the recurrent problem of low water flow. The proposed Black Butte mine cannot accurately project how much water the mine will remove from the local watershed. Further, the modeling used in the	See Section 3.4.1, Analysis Methods; Section 3.4.2, Affected Environment; Section 3.5.1, Analysis Methods; and Section 3.5.2, Affected Environment, of the EIS. Section 3.5.3.1, Surface Water Quantity, and Section 3.5.3.2, Surface Water Quality and Temperature, of the EIS present specific discussion on why impacts on the Smith River are highly unlikely. See also Consolidated Response WAT-2. See Consolidated Response WAT-1 for additional discussion about the accuracy and robustness of the groundwater model. See Consolidated Response WAT-3, which addresses concerns regarding fracturing resulting from blasting activities. The fracturing resulting from blasting was included in the hydrogeological modeling, as discussed in the MOP Application, Appendix N, Section 4.3.2 (Enviromin 2017a). The extent of fracturing is predicted to be limited to the area immediately around the mine openings and not extend into the formation in a manner that could result in high-permeability flow pathways with the potential to connect the mine to surface water. See Consolidated Response WAT-5, Concerns Regarding Potential Thermal Effects on Water Resources and Ecosystems, which addresses the commenter's concern that "the modeling used in the EIS does not account for how much the

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					EIS does not account for how much the surface temperature will change when they replace the water they are proposing to withdraw. The evidence of worsening algal blooms and their toxic effect on aquatic habitat will most certainly be compounded by the impact of the toxic water released from the mining process. Explosives used in the mine will create fractures in the bedrock. Rock fracturing, part of the mining process cannot be accurately modeled, and the result will be pollution of "other types" to the water table that underlies the area and downstream, the Smith River. These other types of pollution include contamination by materials from the explosives such as nitrates. The resulting fractures, fissures and channels will create unpredicted passageways for the acid-laced water to leach into the ground water and ultimately into the various surface waterways. And when the concrete used to "seal" of the fractured rocks degrades, all matter of the remnants of mining processes will be released into the surrounding environment.	surface temperature will change when they replace the water they are proposing to withdraw."
BBC01063	1	Zach Meyers		Email	I am writing to strongly oppose the proposed mine in the Smith River headwaters area. Did we not learn our lesson with Butte. The lasting effects of Copper mining, the water damage, the toxic metals, the tailings, these things not only damage our pristine waters, they damage the views, they lead to decreased tourist money. While the proposal states they will not be pit mining the practices of copper retrieval are waste heavy and toxic. This is a no brainer and we should not support such a proposal. The 'downstream' effects will last generations. The days of Copper Kings and Butte America have left us with the current toxic superfund site. Why would we risk this in one of the most scenic and natural areas left in the lower 48. Please do not allow this proposal to go forward.	Comment noted.
BBC01067	1	John W. Herrin		Email	1. It is my overall professional opinion that the DRAFT EIS and supporting background documentation accurately define the baseline and mine-life impacts to the surrounding groundwater and surface water state waters. I will briefly state what I believe are the major take-ways from the Draft EIS (please correct in responses any misstatements of facts or conclusions presented in the Draft EIS); a. all major aspects of the existing environment, and most importantly carefully and accurately defined the flow, quality, and interaction between the deep bedrock (confined) aquifer systems, shallower more fractured bedrock overlying the mine deposits, shallow bedrock sourced spring flows (10 nearby springs), and the upper-most Sheep Creek Alluvial and the Surface flows of Sheep Creek. b. then assessed the impacts on ground and surface water using industry and regulatory accepted water quality and quantity modeling tools to define groundwater movement during the various stages of deep underground mining, and post mining recoveries. c. plus assessed the mine milling metal extraction processes, water recycling and conservation and the plans to discharge highly treated & polished water to a 7 deep long trenches along Sheep Creek during the non-summer months (3 months a year) to supplement groundwater losses into the mine groundwater working. d. Plans to supplement groundwater mine working withdrawals by constructing	Regarding the questions raised in "f." of the comment: The groundwater modeling (Hydrometrics, Inc. 2016a) indicated that the maximum base flow reduction in Sheep Creek resulting from mine dewatering will be 157 gpm upstream of monitoring station SW-1. As indicated Section 3.5.3.1, subsection, Dewatering Associated with Underground Mine Operations, in the EIS, "The predicted decrease in flow (157 gpm) does not account for additions to base flow from seepage from the NCWR." As such, contributions of seepage from the NCWR are expected to partially compensate for the estimated reduction in flow in Sheep Creek resulting from mine dewatering included in the EIS. See also Consolidated Response WAT-4 for additional discussion regarding the base flow reduction in Sheep Creek. A discussion regarding flow reductions in small seeps is included in EIS Section 3.4.3.2, Dewatering Associated with Underground Mine Operations - Spring and Seep Flows. Flow reductions in small seeps were not quantified as part of the hydrogeological modeling, and reduction in flows in some seeps is expected. As specified in the EIS, "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)." The effect of cumulative reductions in seep flows on surface water flows in streams is captured in the base flow reductions quantified by the hydrogeological model.

Submittal ID	Comment Number	Name of Sender	Organization	Source	Comment	Response
					large unlined reservoir to be filling with Sheep Creek surface water during high spring flow periods, then slowly release through pumping to Coon Creek and infiltration to recharge the Sheep Creek alluvial aquifers, and finally e. Treating tailing with cementing compounds – 44-46% backfilled into the underground workings and 55-54% placed in the large lined surface permanent tailing impoundment. f. The groundwater declines during mining in the near-surface groundwater system would lower or eliminate flows in some area springs and reduce alluvial groundwater flow in Sheep Creek alluvial deposits (How Much? I did not find?), which in turn would reduce the surface water flow in Sheep Creek by 157 gallons per minute. Under worst case low flow in Sheep Creek conditions (rare 7Q10) the projected mine induced flow in Sheep Creek would reach a maximum of 6% reduction in flow on a very dry an hot summer day. MDEQ Non-degradation MPDES permits regulations allow for a change of 255 gallons per minute (10%) maximum reduction in flow in Sheep Creek. ?Does this reduction include the increased baseline flow (est. 50gpm) into Sheep Creek from the proposed non-contact reservoir storage structure?? g. Other than the slight and non-impactful reduction in low-surface water flow in Sheep Creek and tributary Coon Creek, the mine will not in anyway measurably degrade the water quality of any state waters – a condition of all MPDES water discharge permits.	Responses to the following submissions provide a discussion of, and responses to, questions regarding the potential Project-caused reductions in base flows of the nearby streams: • Submittal ID PC-01, Comment Number 1 • Submittal ID PM5-01, Comment Number 7 • Submittal ID HC-003, Comment Number 55 • Submittal ID HC-003, Comment Number 63 • Submittal ID BBC00745, Comment Number 2 • Submittal ID BBC00589, Comment Number 18 • Submittal ID BBC00589, Comment Number 19 • Submittal ID BBC00589, Comment Number 21 • Form Letter 30, Comment Number 2-G
BBC01067	4	John W. Herrin		Email	d. The state has classified Sheep Creek as being impaired for E-coli bacteria and for aluminum, but I did not really understand if that was just the fact that these two parameters were above the State/Federal water quality guideline/limits or if there were real aquatic life impacts being observed? e. I kind of put together the fact that the source of the elevated aluminum in Sheep Creek is leaching of it from upstream and surrounding bedrock, and which is supported by the water quality samples taken from 10 nearby springs – that had 31 of 237 samples above the standards. But do these springs trigger exceedances in aluminum in Sheep Creek itself and therefore impair aquatic life.	The impairment listing is based on measured exceedance of numeric standards of pollutants known to have adverse effects on human health and aquatic life, but it does not necessarily mean that impacts on human health or aquatic life have been observed. The springs that occasionally have aluminum concentrations above the acute aquatic life standard (0.75 mg/L) are identified as DS-3, DS-4, and SP-3. Developed spring DS-3 is located in the Butte Creek drainage, so it flows away from Sheep Creek and would not be considered a potential source of aluminum to the stream. Developed spring DS-4 and spring SP-3 have average measured flows less than 5 gpm, which are unlikely to measurably affect the concentrations in Sheep Creek, assuming there is even a direct flow connection. Water quality parameters like pH and other metal concentrations in the spring samples are not indicative of bedrock leaching. The list of impaired streams, which is included as Appendix A to the 2018 Integrated Report and 303(d) List (DEQ 2018d), indicates that aluminum in Sheep Creek is caused by grazing in riparian or shoreline zones, and it is reasonable to assume that the developed spring sites may also be affected by nearby grazing. Note that Moose Creek, located north of the Project area, is also listed as impaired for aluminum exceedances. However, Moose Creek occurs in a different geologic setting (Appendix M of MOP Application; Hydrometrics, Inc. 2016a) outside the Project area, indicating that aluminum in the Sheep Creek drainage may not be sourced primarily from underlying geology in the Project area. For further information on how the Proposed Action or AMA would affect water quality in Sheep Creek, see Consolidated Response WAT-2.
34_Combined	1	Doretta Reisenweber		Spreadsheet	Reverse osmosis treatment, if it worked on a large scale, would require safe disposal of the contaminants from the filters. Has that area's hydrology been studied?	See Consolidated Response PD-5, WAT-1, and WAT-2.

8.2.2.2. Form Letter Comment Submittals

Table 8.2-3 presents the substantive comments from the various form letters received by DEQ. Substantive comments from each form letter are presented along with the DEQ responses to those substantive comments. Many individuals personalized the form letters by adding comments to the base form letter, and any of these comments that were substantive were treated as unique comments (Section 8.2.2.1, Individual [Unique] Comment Submittals). **Table 8.2-4** list the names of the individuals who submitted the respective form letters. In some cases, individuals submitted the same form letter multiple times; however, duplicate names have been removed in this table.

Table 8.2-3
Form Letter Comments on the Draft EIS

Form Letter ID	Comment Number	Organization	Source	Comment	Response
1	1		Email	I would like to go on record in support of the Black Butte Copper Project as outlined in the Draft Black Butte Copper Project Environmental Impact Statement. The Socioeconomic Section 3.9 does a good job of underscoring the need for this project in Meagher County. The area has seen out-migration of young families due to the lack of jobs that can pay a family sustaining wage and include full benefit packages providing good family insurance, ample vacation and personal days, contributions to retirement plans, wellness programs, etc. The population of Meagher County has decreased over the last decade and those that have remained in the area are faced with a per-capita income that is 30% less than the Montana average (Section 3.9, page 5, table 3).	Thank you for your comment.
1	3		Email	The average income of miners in Montana, $60,190, is nearly double the income of the average job in Meagher County (Section 3.9, page 4) and would be a huge game-changer for the individuals and the families that call the area home. The Black Butte Project will directly employ 235 individuals and another 151 would find employment with contractors or other employers servicing the mine (Section 3.9, page 13, Table 9). Goods and services purchased by the miners themselves throughout the local area and state will create additional jobs for montanans. In addition, taxes that will be paid by the mining company while in production will add millions to local government coffers. For instance, the metal mines tax is estimated to be $4 million per year to the State of Montana (Section 3.9, page 17) with over $1.4 million of that amount to be distributed to Meagher County each year during the projected 11 years of production. Thankfully, the unique-to-Montana Hard Rock Mining Impact Act, the local area will be able to prepare for the influx of workers. The provisions of this act, as spelled out in Section 3.9, page 17, are intended to mitigate fiscal impacts of a hard rock mineral evelopment and assist affected local governments in preparing for, and mitigating, area fiscal and economic impacts.	Thank you for your comment.
2	1		Email	I would like to provide comments regarding the incredible economic boost the Black Butte Copper Project will bring to Meagher County. In reviewing the socioeconomic portion of the DEIS (3.9) it is abundantly clear that Meagher County is in dire need of the economic stimulus that the BBCP could provide. Meagher County ranks in the bottom categories of nearly every measurement in the socioeconomic analysis area. In looking at the five measures used in the analysis, unemployment, average earnings per job, per capita personal income, and families with income below the poverty level, it is clear that the DEQ made the right conclusion. The data indicates a "less healthy economy" in Meagher than that of the surrounding counties (3.9-5). With the median wage in MT being $32,750 in 2016 (Montana DLI 2016), any new mining jobs anywhere in our state will raise that very poor number. This is due to the average median wage of a mining sector job being nearly double the state's median wage at $60,190 (3.9-4). These are just the kinds of jobs that a county like Meagher needs. With an aging demographic that is ten years higher than the states' median age (3.9-3), the skilled labor positions making family wages will lower that number and significantly contribute to the goals of the White Sulphur Springs Growth Policy articulated on page (3.9-9). While there are certainly going to be some front-end strains on public	Thank you for your comment.

Form Letter ID	Comment Number	Organization	Source	Comment	Response
				infrastructure and services with the influx of these skilled workers (3.9-17), the Hard Rock Impact Plan will help prepare Meagher County for these stresses through the prepayment of Metal Mine License Taxes. Once up and running, the county is estimated to receive 1.4 million a year in these taxes on top of an additional 8 million in taxable valuation at peak copper production (3.9-17). This project will be an incredible stimulus for Meagher County. My hope is the DEQ gets through the public review process as quickly as possible to give Sandfire a permit and get this project into construction.	
3	3		Email	A good example of this is the suggestion in Section 2.4.1.5 - “Use Wetlands as Part of the Water Treatment System.” The suggestion that this is a better alternative than the treatment plant proposed by Tintina was studied by the DEQ for environmental benefit. In Section 2.4.1.5, Page 20, the DEQ rightfully maintains that there is no reason to assume that the treatment plant cannot be ‘maintained in operating order’ for as long as it is needed. The DEQ also pointed out that wetlands are often only effective for ‘polishing’ waters primarily treated in an active system and that the effluent standards required by law would not be able to be met using this alternative.	As described in Section 2.3.2.5, Use Wetlands as Part of the Water Treatment System, of the EIS, this alternative (use of wetlands as part of the water treatment system) was not considered due to concern for wetlands not being able to remove all contaminants and due to the discharge to wetlands potentially exceeding MPDES discharge permit standards.
6	2		Email	One of my concerns with the project is the acid generating rock at the site and it is important to me that this issue be addressed carefully. I was pleased to see, in the 64-page Section 3.4, an in-depth look at the methods used to determine the existing and future water quality along with the measures proposed by the mining company and required by your agency to mitigate the potential for acid generating rock to impact our water systems. It is clear the mining operation as proposed will aggressively and successfully deal with this issue. Of particular importance to me, the surface water handling (Section 3.4, pages 52, 53) that includes double lining and constant leak detection systems for the Process Water Pond, the Contact Water Pond brine holding section, and the Cemented Tailings Facility are examples of the steps being taken to alleviate concerns about contaminated runoff. In summary, the first-class approach to mining this ore body as outlined in the proposed plan directs the Black Butte Copper Project to handle the rock specifically to avoid problems that can occur with acid generation. Further, the requirements for additional and stringent testing throughout the life of the project gives me the comfort I need to support moving forward with the proposed mine.	Comment noted.
7	2		Email	The analysis of the interface of the project’s operation with both groundwater and surface water is comprehensive, thorough and appreciated. All issues of concerns have been studied and any potential impacts mitigated below the level of significance. The care given to water quantity and quality is highlighted throughout the mine’s plan of operations. For instance, the surface facilities for the collection, storage, and as-needed treatment of the water (Section 3.4, Page 52) will assure that the water returned to the environment from the project area will meet strict standards for quality. I was pleased to see that Tintina proposes to use double liners with leak detection for the Cement Tailings Facility, the Processed Water Pond, and the brine section of the Contact Water Pond (Section 3.4, Page 52). Some seemingly small but ultimately important examples of the attention given water in the proposed plan includes the installation of plugs in declines and shafts in order to segment the mine at certain locations. This will make pumping and rinsing more efficient during closure and have the environmental benefit of reducing the flow of contact water through open tunnels and shafts (Section 3.4, Pages 56,57). Another small but important example is the as-needed grouting of faults and fissures during construction of the access declines and	Comment noted.

Form Letter ID	Comment Number	Organization	Source	Comment	Response
				tunnels to inhibit groundwater inflow in the mine (Section 3.4, Page 55, 56). I am hopeful that the DEQ, when this comment period is complete, will move quickly to allow the Black Butte Project to move forward as planned. The proposed plan shows that responsible development of our natural resources in this state can occur without compromising the environmental values we hold dear.	
8	1		Email	Please accept my comment in support of the Black Butte Copper Project. A review of the Draft EIS shows that Tintina Montana, Inc. and the DEQ listened to the concerns of the public that were shared during the scoping process and those concerns have been heard and answered. Possibly the most recited issue from those who expressed concern about the mine are the possible impacts to the Smith River watershed. Those concerns are valid - we all want to protect this important waterway - but should be put to rest by the plans for constructing and operating this mine as outlined in the EIS. In reading the proposed alternative Sections 2.2.1 through Section 2.3 it is clear that protection of the quality and quantity of water was the primary focus of the planning process. From the construction phase (Section 2.2.2) through the reclamation phase (Section 2.2.8) the plan seems rightfully driven by the need to capture, collect, and treat (if necessary), and replenish all surface water and groundwater that interfaces with the mine operations. The extraordinary care given to water handling in Tintina Montana, Inc.'s proposed project is not only appreciated but is what Montanans require of modern mining. The Black Butte Project will be a much-needed economic engine for the rural Meagher County region and with the proposed modern mining techniques that engine can operate without compromising our valued water systems. Again, thank you for listening to the public's concerns and for answering those concerns with this plan. I look forward to your approval of the Black Butte Project.	Comment noted.
9	1		Email	I appreciate the opportunity to submit my comments on the Black Butte Copper Project Draft Environmental Impact Statement. I would like to go on record as being very supportive of the proposed mining project. Good, family-wage jobs are in short supply in the Meagher County area. This mine, done right, will be a real boon to the region's social and economic well-being. Section 3.9 page 13 reflects the 235 direct jobs that will be created by the mine and Section 3.9, page 18 states that "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." This will be good for the local schools and local businesses. Just one of the taxes that will be paid by the mining company while in production, the metal mines tax, is estimated to generate $4 million to the State of Montana (Section 3.9, page 17) with over $1.4 million of that amount to be distributed annually to Meagher County during the projected 11 years of production. Further, the median wage for a mining sector job in Montana was $60,190 in 2016, substantially higher than the overall median wage in Montana of $32,750 (Section 3.9, page 4) and a great deal higher than the current wage averages for Meagher County (Section 3.9, table 3). Thankfully, this economic foundation can be accomplished with minimal disturbance of the land and without compromising the wildlife and fisheries of the area. Upon conclusion of the mining, the Draft EIS states that the area would be reclaimed and returned to premining agricultural use (Executive Summary, page 5).	Thank you for your comment.
10	1		Email	Please enter my comment into the public record on the Black Butte Copper Project in Meagher County. The Draft EIS is very complete and includes an analysis of the potential impact the	Thank you for your comment.

Form Letter ID	Comment Number	Organization	Source	Comment	Response
				project might have on the transportation systems in the area. For those who live in the area, studying the increase in traffic that will come with constructing and operating of the Black Butte Mine is important. In Section 3.12, Pages 1 through 12, accomplishes this task in a responsible manner. Thank you. As the study revealed, when the mine is operating, the road system in the area that would receive the most incremental increase in traffic compared to 2016 is US Route 89. Table 3.12-2 shows that average traffic on this road, except for a few areas just north of I-90 near Livingston, has remained fairly static since 2005. Section 3.12.3, Page 8, explains that: “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.” In other words, even with the increase in traffic from the badly needed economic development the area would enjoy during the mine’s operation, the existing road system is more than capable of handling the increase in use. I was pleased to see that Tintina Montana proposes to encourage carpooling and would provide a shuttle service out of White Sulphur Springs as mitigation for these small increases in traffic. I was also pleased to see that the company intends to work with the Montana Department of Transportation in addressing possible safety concerns at the intersection of U.S. Highway 89 and Sheep Creek Road; U.S. Route 12 (Milepost 28.0 to 29.9); will review school bus schedules and project truck traffic to limit the risk of interactions with school bus traffic; and will use on-board systems to monitor and limit concentrate truck speeds on their routes (Section 3.12, Page 11).	
10	2		Email	In an area that has suffered through years of economic malaise, the socioeconomic impact of over 200 family-wage jobs is a huge positive compared to the small increase in road traffic the project will bring to road systems that are being utilized far below carrying capacities. This is especially true when Tintina Montana’s plan is to be pro-active in mitigating for the increase. Please approve this project so that the citizens of the Meagher County region have a job to drive to on the roads of the area.	Thank you for your comment.
11	2		Email	This EIS, especially Sections 3.4, 3.5 and 3.6 that deal with groundwater, surface water and geochemistry, outline an aggressive ARD prevention methodology that includes not only proven technologies but above and beyond measures such as paste backfill and hardcapping of the double lined cement tailings facility upon closure. While sulfide removal sounds good, in reality the processes presented in this EIS makes much more sense.	Comment noted.
12	1		Email	I appreciate the opportunity to comment on the Black Butte Mine Project proposed by Tintina Montana, Inc. When I read that the Draft EIS had been released and that the DEQ had determined that the mine construction and operation proposed along a tributary of the Smith River would cause the river no harm, I was very interested in reading how you came to that conclusion. After reviewing the document, specifically the entirety of Sections 3.4, 3.5, 3.6 and the reclamation planning in Section 2.2.8, it is easy to see how the DEQ reached the ‘no harm’ conclusion. Clearly, Tintina Montana, Inc. has listened to the public and proposed a world-class mining process that offers, as indicated in the DEQ statement to the press, “water quality protections above and beyond what we think is required to comply with state water quality laws.” It is also clear that the DEQ review of air quality, surface water, wetlands, wildlife, fisheries, aquatic resources, geochemistry, soil, vegetation, groundwater, cultural resources,	Comment noted.

Form Letter ID	Comment Number	Organization	Source	Comment	Response
				transportation and of course, socioeconomics was thorough and complete. One outstanding example of progressive mine planning is the proposed drift-and-fill process of filling tunnels and access openings with mine waste that has been thickened with cement into a paste (Executive Summary 5.2, page ES4). In the DEQ statement to the press, the Agency indicated that this process ‘would cut off any new potential paths for groundwater to flow.’ This is an excellent example of Tintina Montana, Inc. going above and beyond what is required to assure the people that enjoy recreating on the Smith River that they will continue to be able to do so without fear of the river being negatively impacted by the economic development of this mine. The reclamation plan, assured to take place since it will be backed by statutorily required bonding by Tintina Montana, Inc., will include removal of the mine infrastructure and exposed liner systems, covering exposed tailings so that waste rock will be left on the surface and monitoring of water quality after closure until DEQ determines that closure objectives have been met (Executive Summary, page ES-5).	
13	2		Email	The area certainly needs the jobs. Sawmill closures and logging job losses have contributed to a prolonged contraction of economic vitality in the White Sulphur Springs area. Meagher County has, sadly, some 18.3% of the population base living below the poverty level (Section 3.9, Table 3) and a median household income that is $11,000 less than Montana’s average. Wage earners with families have been forced to look elsewhere for family-wage jobs and K-12 school enrollment has decreased by over 20% between 2010 and 2016 (Section 3.9, Page 8). This project would substantially change the economic well-being of Meagher County. Section 3.9, Table 10 shows that as many as 165 of the 235 projected mine employees would move into the area during the years of mine operations. Those in-migrating employees are projected to have an average of 2.46 people per household (Section 3.9, Page 14) and I assume that some of the 1.46 non-employees in those households will be school children. In 2016, the average wages earned by Montana mine workers was $60,190 (Section 3.9, Page 4) or over 300% of the current per-capita personal income of the area (Section 3.9, Table 3). When these individuals and families spend their earnings and pay their taxes the entire area will benefit. Thankfully, this economic development can and will be able to occur without significantly impacting the local environment (Sections 3.1 through 3.16), including the locally cherished and nationally renowned Smith River.	Thank you for your comment.
15	1		Email	I would like to provide comment on the Draft Environmental Impact Statement (EIS) that has been completed for the proposed Black Butte Copper Project located near White Sulphur Springs. More specifically, I would like to comment on Section 3.3, which discloses potential impacts to Cultural, Tribal, and Historic Resources. As an individual that takes an interest in Montana’s history and archeological sites, I found it quite refreshing that the Proponent of this mining project took proactive steps to fully analyze the project area for potential sites that could contain important archeological artifacts. As illustrated in the DEIS (Figure 3.3-1), over three years of extensive cultural resource inventories were conducted. The result of these surveys has produced two sites located within the project area (24ME1104, 24ME0163) that are eligible for listing in the National Register of Historic Places. Both the DEQ and the project Proponents deserve praise for using the MEPA process to better evaluate previously documented sites like 24ME936 and 24ME925 (3.3.1) and for identifying other potential sites that will be further evaluated before any disturbance of them would occur (3.3.3.2). As clearly stated in the Draft EIS, there is no federal or state nexus that required the additional work that has been conducted. The fact that it was done	Comment noted.

Form Letter ID	Comment Number	Organization	Source	Comment	Response
				anyway is testament to the thoroughness of both the DEQ and the project Proponent in looking at all aspects of disturbance. This commitment is further underscored by the proposed actions to eliminate the possibility of losing these special places for future generations to learn about and enjoy.	
16	1		Email	Thank you for accepting my comment on the Draft Environmental Impact Statement for the proposed Black Butte Copper Project located near White Sulphur Springs. I am most interested in the balance between needed jobs and necessary environmental protections. I have looked at the document and would like to applaud both Tintina Montana and the DEQ in finding that balance for this project. The sensitivity given environmental issues found in the proposed construction and operating plans are abundant (Section 2, Pages 1 through 16). Critical to ensuring longterm protection the area's environment, the reclamation processes planned when the mining is complete are outstanding. The post-closure plans that include top sealing of the double lined Cemented Tailings Pond with a high density polyethylene cover before covering it with sloped soils and revegetating it will help to eliminate the possibility of acid generation from the stored materials (Section 3.5, Page 26). Steps such as these give credence to the DEQ statement that the project will not, during operations and after, affect the Smith River or its tributaries. Tintina Montana has offered a complete plan that balances the socioeconomic needs of the Meagher County region with the environmental protections we expect and demand of modern mining.	Thank you for your comment.
21	2		Email	First, the DEIS draft is 900 pages. Allowing only 60 days of review for a document of that size strikes me as disrespectful for those wishing to go through it thoroughly and one could argue that a rushed review only serves the mining company, not the public interest. The DEQ person I talked to stated that the life of the mine, from beginning to completed reclamation was 20 years. Recent descriptions of the life of the mine are now at 50 years. Why the error when I asked? What is scheduled to happen after/instead of the 20-year plan. Along those lines, more land has been leased from the landowner and Forest Service than the currently reviewed mine would need. I understand that during mineral leasing, the entity mining customarily leases as much land as it can obtain. However I am concerned that should Sandfire change their plans during mining, this acquisition of additional land would have been the tip off that the companies had further mining plans for the area. If so, there will be no public review process, just a DEQ review. If the DEQ is tolerant of a 60-day review for the current mine, how quickly will they act to review any additional mining plans? If the company decides to enlarge the mine at some future date, I could argue that with the additional land leased from the beginning, it could be done to circumvent full review and public comment. Is there any way to guarantee that is not the case?	To date, only the Black Butte Copper Project has been proposed for mining. Any future proposed mines or expansions would need a separate MEPA environmental review and permitting, which would include public disclosure and input. See Consolidated Response MEPA-1 and CUM-1.
21	6		Email	The Smith River generates $10 million in annual economic activity. The outdoor recreation industry generates $7 billion in revenue for the state. Outfitters will launch 73 of 1361 total Smith River permits in 2019. Outfitters create Montana jobs, are responsible land stewards, and the money they generate stays in the state, having a substantial ripple effect on the economy - airfare, hotels, travel, meals, supplies, etc. The draft EIS should evaluate any potential impacts to this burgeoning and sustainable industry. Sandfire is an Australian-owned mining company that will pocket the lion's share of profits and cut and run when profitability ceases. Montana already spends $50 million annually in tax dollars on mine clean-up. I do not want toadd a failed mining experiment on the Smith River to the list, at the cost of existing perpetual Montana jobs.	DEQ acknowledges the outstanding recreational opportunities afforded by the Smith River and recognizes its economic contribution. Recreation and use of the Smith River is addressed in Section 3.7, Land Use and Recreation, and Section 3.8, Visuals and Aesthetics, of the Draft EIS. Socioeconomic resources are addressed in Section 3.9, Socioeconomics. The Final EIS has been amended to include publicly available information on the economic contribution of the outdoor recreation industry, particularly the contribution attributable to the Smith River. DEQ does not predict contamination/pollution of Sheep Creek or any other surface water. See Section 3.4.3.2, Proposed Action, Section 3.5.3.1, Surface Water Quantity, and Section 3.5.3.2, Surface Water Quality and Temperature, of the EIS. Process water discharged to

Form Letter ID	Comment Number	Organization	Source	Comment	Response
					surface waters via the UIG would be treated to avoid impacts. Although contamination/pollution is not predicted, DEQ is requiring operational monitoring to verify that surface waters are protected. See Section 6 of the MOP Application (Tintina 2017a).
21	7		Email	Sandfire apparently has been clear about expanding and growing the operation into a 50-year mining district. The DEIS should evaluate the ENTIRETY of the project and its potential impacts, and not allow Sandfire to segment the analysis.	See Consolidated Response CUM-1.
22	2		Email	The Smith River depends on clean, cold and abundant water from its tributaries to sustain the fisheries and the recreational facilities we all love. When a mine such as Black Butte digs into ore containing sulfide, the sulfide when exposed to air and water produces high levels of acid and toxic metals. I understand that the additional water permitting for this mine is needed because the nitrate content of the water predicted to come from the mine was too high for the water quality standards. The mine has created a very experimental system to deal with the amount of nitrates in the outflow of the mine. I doubt it will work. Even with careful mining practices and careful tailing storage, mines have nearly always contaminated nearby surface water. Many require perpetual treatment of the outflow. I have discovered that 11 out of 12 mines permitted since 1980 have water quality problems, the most notable among them being Zortman-Landusky and the Beal Mine. If you think the public will stand behind using the Smith River as an experiment so that Sandfire can remove millions in profit from this state to a foreign country, you are wrong. I feel that they are asking to mine here, in Montana, because we have no laws to avoid the perpetual contamination of groundwater. They don't have to prove that perpetual contamination will not occur. They simply have to put on a dog and pony show all about state-of –the-art technology. There is absolutely no guarantee that this new technology will work, as it has never been tried before. And if it does fail, there is no real consequence to Sandfire. But there is a very real and horrorific consequence for the Smith River, its tributaries, fisheries and wildlife, and its wetlands.	The tailings produced by mine ore processing would be mixed with cemented paste, serving to reduce seepage contact with sulfide minerals, thereby reducing the leaching potential of oxidation products. Refer to Consolidated Response PD-2, Concerns Regarding Examples of Proposed Technology, for a discussion of previous use of the proposed cemented paste tailings approach at other mines. Refer to Section 3.5.3.1 of the EIS for details pertaining to water handling; Section 3.5.3.2 of the EIS for details pertaining to water quality including treatment. Also refer to Consolidated Response WAT-2, which discusses concerns regarding impacts on surface water resources in the Project area.
22	3		Email	I read that the new cemented tailings facility will sit on a hill overlooking Sheep Creek. The method of cementing the tailings is unproven. If the dam or the cement in the tailings fails, Sheep Creek is where the tailings will end up. Have you analyzed the effectiveness of the liner for up to 50 years? Have you analyzed the effects of a very probable earthquake on the dam? The liner and the dam are essential to protecting Sheep Creek, and ultimately the Smith. Strict, exacting analysis is required.	See Consolidated Responses PD-1, PD-2, PD-3, PD-4, and PD-5.
22	4		Email	I read that there will be a definite drawdown on the local water table. Coon Creek will be the most affected stream (70%), however Sheep Creek will also be affected. The plan is to pump water from Sheep Creek during high flow, store it, and pump it back into Coon Creek as needed during low flow. The flow quantity in Sheep Creek is already too low to totally protect the fishery during summer. This additional stress on Sheep Creek can cause a higher water temperature. This would allow algae to grow, which depletes oxygen in the water. Obviously, this would have an effect on wildlife and fish. Also, it appears that the water pumped out of the mine during the mining process will need to be treated at a special reverse osmosis plant and then released. This water will hold too many nitrates to meet the stricter water quality standards during the summer months. So it will be held back until the stricter standards are not in effect. This water would be released through underground tunnels below Sheep Creek, and would eventually end up in Sheep Creek itself. The current surface water monitoring site on Sheep Creek is not where the water exits the tunnels at the mine. It is two miles from	See Consolidated Responses WAT-2 and WAT-4 regarding impacts on surface water resources. See Consolidated Response WAT-5 regarding potential thermal effects on water resources and ecosystems. See Consolidated Response AQ-1, Nuisance Algae, for information about algal growth. Sampling of mine effluent before it is released to the environment via the UIGs would be required. Additionally, the MPDES permit would require monitoring for metals, nitrates, temperature, and flow near the proposed discharge points. Finally, monitoring sites upstream and downstream of the UIG discharge point would be used to detect any thermal impacts on groundwater.

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				the discharge point. If there is ever a problem at the reverse osmosis plant, the pollution will be over 2 miles gone before it is detected. At the very least, there should be a required surface water monitoring system at the exit from the mine. Nitrates and metals should be monitored as well as flow and temperature.	
24	2		Email	I would like to provide comment on the Draft Environmental Impact Statement (EIS) that has been completed for the proposed Black Butte Copper Project located near White Sulphur Springs. More specifically, I would like to comment on Section 3.3, which discloses potential impacts to Cultural, Tribal, and Historic Resources. As an individual that takes an interest in Montana's history and archeological sites, I found it quite refreshing that the Proponent of this mining project took proactive steps to fully analyze the project area for potential sites that could contain important archeological artifacts. As illustrated in the DEIS (Figure 3.3-1), over three years of extensive cultural resource inventories were conducted. The result of these surveys has produced two sites located within the project area (24ME1104, 24ME0163) that are eligible for listing in the National Register of Historic Places. Both the DEQ and the project Proponents deserve praise for using the MEPA process to better evaluate previously documented sites like 24ME936 and 24ME925 (3.3.1) and for identifying other potential sites that will be further evaluated before any disturbance of them would occur (3.3.3.2). As clearly stated in the Draft EIS, there is no federal or state nexus that required the additional work that has been conducted. The fact that it was done anyway is testament to the thoroughness of both the DEQ and the project Proponent in looking at all aspects of disturbance. This commitment is further underscored by the proposed actions to eliminate the possibility of losing these special places for future generations to learn about and enjoy.	Comment noted.
25	3		Email	The Draft EIS also correctly states that, "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)." The average income of miners in Montana, $60,190, is nearly double the income of the average job in Meagher County (Section 3.9, page 4) and would be a huge game-changer for the individuals and the families that call the area home. The Black Butte Project will directly employ 235 individuals and another 151 would find employment with contractors or other employers servicing the mine (Section 3.9, page 13, Table 9). Goods and services purchased by the miners themselves throughout the local area and state will create additional jobs for Montanans. In addition, taxes that will be paid by the mining company while in production will add millions to local government coffers. For instance, the metal mines tax is estimated to be $4 million per year to the State of Montana (Section 3.9, page 17) with over $1.4 million of that amount to be distributed to Meagher County each year during the projected 11 years of production. Thankfully, the unique-to-Montana Hard Rock Mining Impact Act, the local area will be able to prepare for the influx of workers. The provisions of this act, as spelled out in Section 3.9, page 17, 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.	Thank you for your comment.
26	3		Email	The Draft EIS also correctly states that, "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)."	Thank you for your comment.

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				The average income of miners in Montana, $60,190, is nearly double the income of the average job in Meagher County (Section 3.9, page 4) and would be a huge game-changer for the individuals and the families that call the area home. The Black Butte Project will directly employ 235 individuals and another 151 would find employment with contractors or other employers servicing the mine (Section 3.9, page 13, Table 9). Goods and services purchased by the miners themselves throughout the local area and state will create additional jobs for Montanans. In addition, taxes that will be paid by the mining company while in production will add millions to local government coffers. For instance, the metal mines tax is estimated to be $4 million per year to the State of Montana (Section 3.9, page 17) with over $1.4 million of that amount to be distributed to Meagher County each year during the projected 11 years of production. Thankfully, the unique-to-Montana Hard Rock Mining Impact Act, the local area will be able to prepare for the influx of workers. The provisions of this act, as spelled out in Section 3.9, page 17, 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.	
27	1		Email	I would like to provide comment on the Draft Environmental Impact Statement (EIS) that has been completed for the proposed Black Butte Copper Project located near White Sulphur Springs. More specifically, I would like to comment on Section 3.3, which discloses potential impacts to Cultural, Tribal, and Historic Resources. I grew up in White Sulphur Springs on the South Fork of the Smith River, and it is vitally important that this project be done the right way. As an individual that takes an interest in Montana’s history and archeological sites, I found it quite refreshing that the Proponent of this mining project took proactive steps to fully analyze the project area for potential sites that could contain important archeological artifacts. As illustrated in the DEIS (Figure 3.3-1), over three years of extensive cultural resource inventories were conducted. The result of these surveys has produced two sites located within the project area (24ME1104, 24ME0163) that are eligible for listing in the National Register of Historic Places. Both the DEQ and the project Proponents deserve praise for using the MEPA process to better evaluate previously documented sites like 24ME936 and 24ME925 (3.3.1) and for identifying other potential sites that will be further evaluated before any disturbance of them would occur (3.3.3.2). As clearly stated in the Draft EIS, there is no federal or state nexus that required the additional work that has been conducted. The fact that it was done anyway is testament to the thoroughness of both the DEQ and the project Proponent in looking at all aspects of disturbance. This commitment is further underscored by the proposed actions to eliminate the possibility of losing these special places for future generations to learn about and enjoy.	Comment noted.
28	1		Email	I would like to provide comments regarding the incredible economic boost the Black Butte Copper Project will bring to Meagher County. In reviewing the socioeconomic portion of the DEIS (3.9) it is abundantly clear that Meagher County is in dire need of the economic stimulus that the BBCP could provide. Meagher County ranks in the bottom categories of nearly every measurement in the socioeconomic analysis area. In looking at the five measures used in the analysis, unemployment, average earnings per job, per capita personal income, and families with income below the poverty level, it is clear that the DEQ made the right conclusion. The data indicates a “less healthy economy” in Meagher than that of the surrounding counties (3.9-5). With the median wage in MT being $32,750 in 2016 (Montana DLI 2016), any new mining jobs anywhere in our state will raise that very poor number. This is due to the average	Thank you for your comment.

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				median wage of a mining sector job being nearly double the state's median wage at $60,190 (3.9-4). Being from a county that relies heavily on tourism and provides only low paying jobs, nothing makes me happier for my friends, and neighbors than to see some of them find an opportunity to make a decent wage that will allow them to not only survive but prosper in Montana. These are just the kinds of jobs that a county like Meagher needs. With an aging demographic that is ten years higher than the states' median age (3.9-3), the skilled labor positions making family wages will lower that number and significantly contribute to the goals of the White Sulphur Springs Growth Policy articulated on page (3.9-9). While there are certainly going to be some front-end strains on public infrastructure and services with the influx of these skilled workers (3.9-17), the Hard Rock Impact Plan will help prepare Meagher County for these stresses through the prepayment of Metal Mine License Taxes. Once up and running, the county is estimated to receive 1.4 million a year in these taxes on top of an additional 8 million in taxable valuation at peak copper production (3.9-17). This project will be an incredible stimulus for Meagher County and surrounding counties. My hope is the DEQ gets through the public review process as quickly as possible to give Sandfire a permit and get this project into construction.	
29	1		Email	I would like to provide comments regarding the incredible economic boost the Black Butte Copper Project will bring to Meagher County. In reviewing the socioeconomic portion of the DEIS (3.9) it is abundantly clear that Meagher County is in dire need of the economic stimulus that the BBCP could provide. Meagher County ranks in the bottom categories of nearly every measurement in the socioeconomic analysis area. In looking at the five measures used in the analysis, unemployment, average earnings per job, per capita personal income, and families with income below the poverty level, it is clear that the DEQ made the right conclusion. The data indicates a "less healthy economy" in Meagher than that of the surrounding counties (3.9-5). With the median wage in MT being $32,750 in 2016 (Montana DLI 2016), any new mining jobs anywhere in our state will raise that very poor number. This is due to the average median wage of a mining sector job being nearly double the state's median wage at $60,190 (3.9-4). I entered the legislature in 2007 with the goal preserving and adding good paying jobs in Natural resources industry. These jobs not only keep our young people from leaving Montana but provide a much needed revenue source. Local, county and at the state level. Natural resources has long been the backbone of Montana's economy. Six sessions on either appropriations or Finance and Claims I can tell you that if Montana is to keep our young people in the state, then well vetted projects such as this must move forward.	Thank you for your comment.
30	2		Email	Our comments apply equally to the Proposed Action and the Agency Modified Alternative, as there appears to be no appreciable difference to hydrogeological andw ater resource risks between the two. Throughout our comments we refer to the groundwater model used by Sandfire to estimate mine dewatering (Hydrometrics 2016 and the groundwater model (Hydrometrics 2018 used to assess the discharge and return of effluent to the alluvium near Sheep Creek via the recently modified plans for Underground Injection Gallery (UIG), as well as an independentg undwater model we contracted to test the Hydrometrics 2016 model (Myers 2018. Big picture, the DEIS begins with a flawed definition of the regional study area (RSA by limiting the RSA to the portion of the basin that would "experience groundwater drawdown of more than 2 feet due to mine dewatering (3.4-1." This ignores the standard definition of an RSA as being inscribed by natural, no-flow boundaries. A	The RSA has been delineated at the 2-foot drawdown contour predicted by the Hydrometrics (2016a) model on the basis that a determination was made that no "secondary effects" (e.g., effects on groundwater quantity in turn resulting in effects on surface water resources) would occur outside this boundary. This approach is consistent with the definition of RSA included in Section 3.4.1.2 of the EIS, which also describes the LSA and watershed-scale Conceptual Model Domain. Potential effects outside the RSA were considered in the evaluation conducted to assess an appropriate RSA boundary, and are thereby captured in the EIS, with the implication that no effects are expected outside the RSA as delineated. This determination considered the methods and results of the Hydrometrics hydrogeological model, as well as potential receptors outside the 2-foot drawdown contour. The watershed-scale Conceptual Model Domain is inscribed by natural hydrologic boundaries, extending beyond the drawdown cone resulting from dewatering,

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				true RSA for this mine proposal would likely include a large area that could experience groundwater drawdown of up to 2 feet due to mine dewatering, which could entail a significant amount of water and, hence, dewatering. By arbitrarily limiting the RSA, the DEIS fails to provide a realistic prediction of mine dewatering.	capturing potential effects further afield. The predicted drawdown across the complete hydrogeological model domain were considered in delineating the RSA. See response to Submittal ID HC-003, Comment Number 58.
30	2-A		Email	The DEIS ignores linear defects in the mine workings, which means that it assumes almost no seepage and little or no possibility of groundwater quality being impacted within the mine workings. The assumption that the mine workings and engineering will operate flawlessly, without defects that lead to leakage, is highly unrealistic and grossly underestimates the risks of groundwater and surface water contamination.	Groundwater would inflow into the mine workings, and would be pumped and treated by the WTP before release to the environment. This groundwater inflow is analyzed by the groundwater model constructed based on the results of extensive field investigation and hydraulic testing of boreholes. Any fractures created by blasting in the proposed underground mine are predicted to be limited in extent. This topic is discussed further in Consolidated Response WAT-3. This comment is addressed in the responses to many other comments. Some of the responses are enumerated below: • The issues of groundwater inflow into the mine and its effect on the environment are discussed in response to Submittal IDs: HC-003, Comment Number 54; and BBC01028, Comment Number 1. • The issue of the adequacy of the completed hydraulic testing programs and groundwater modeling representing flow through rock discontinuities is discussed in responses to Submittal IDs: HC-003, Comment Number 54; BBC00589, Comment Number 4; BBC00589, Comment Number 30; BBC00589, Comment Number 36; HC_043_Jim Steitz_U, Comment Number 3: HC_044_William Adams_U, Comment Number 3; HC_012, Comment Number 1; BBC00424, Comment Number 3; BBC00629, Comment Number 1. • Quality of groundwater in contact with the mine workings during the post-closure period is discussed in responses to Submittal IDs: HC-003, Comment Number 52; and BBC00933, Comment Number 14. Additional information and extensive discussions of the groundwater inflows into the mine, and groundwater quality are provided by the following responses: • The Proponent's Second Supplemental Response to Public Comments (Sandfire 2019b) • The Proponent's Third Supplemental Response to Public Comments (Sandfire 2019a) • The Proponent's Fourth Supplemental Response to Public Comments (Sandfire 2019c) • Technical Memorandum – Initial Review Comments on the Tom Myers Black Butte Modeling Report, Section "Geologic Formation Zones" (Hydrometrics, Inc. 2019a). • Technical Memorandum – Supplemental Comments on Myers' Modeling Report of Black Butte Copper Project – DRAFT, Section "Geologic Formation Zones" (Hydrometrics, Inc. 2019c). DEQ concurs with the information and conclusions submitted by the Proponent as listed above.
30	2-B		Email	The 25 pump or slug tests used to understand hydraulics and flow within the underground area of the mine site do not provide enough information to understand the overall formation or even small portions within it (Hydrometrics 2016). In short,	See Consolidated Response WAT-1.

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				how water is and will move underground in the mine area remains mostly a proverbial black box. The DEIS assumption that there will be little or no seepage or possibility of groundwater quality impacts is, thus, based on paltry information. The DEIS also relies on small-scale flow tests, rather than large-scale tests, even though the operating mine would have impacts at the regional (largescale hydrologic level (Myers review of DEIS, pg. 3-5.	
30	2-C		Email	The Myers 2018 hydrologic modeling (provided to DEQ with Myers DEIS review, estimates that mine dewatering could be as high as two to three times greater than what is being predicted by the current DEIS. Given the impacts this amount of mine dewatering could have on pumping, water treatment, water storage, and return of effluent to the UIG, the possible large underestimation of dewatering in the DEIS alone should be reason to consider selecting the “No Action” alternative. (Also see, Myers DEIS review, pg 21), for analysis of the inability of the water treatment facility to handle the chemistry associated with the higher-than-anticipated amount of water that is likely to occur from mine dewatering. As per the Myers DEIS review, MTU recommends additional test for large-scale data sets to be collected. Borehole data used in the DEIS also is flawed because it includes sampling from mineralized zones that have very low permeability, which fails to predict the ways and amounts of water that could flow into mine workings once mining begins in those mineralized zones. The DEIS should include more thorough sampling of shale surrounding mineralized zones. Similarly, the DEIS uses average permeability from too few samples of the four major faults in the mine site area to estimate the permeability across the entirety of all these faults. This completely ignores the reality that faults are not homogeneous and contain areas of high permeability mixed with zones of very low or zero permeability. Using an average value across a fault is virtually meaningless. Additionally, the DEIS dismisses tests that Tintina did conduct in 2017, which showed a large range of high permeability in some of the faults (Myers DEIS review, pg. 6). Ignoring these permeability results and averaging fault permeability allows the DEIS to report much lower mine dewatering results than are, in reality, likely to occur (Myers, 2018). The faults should not be considered a flow barrier and the Myers 2018 alternative modeling, which estimated dewatering rates as high as 2000gpm should be considering in all other mine operations that involve dealing with water in the mine workings – pumping, storing, treating and injecting plans/infrastructure. Commenting on the necessity of a map of leakage within the bedrock aquifer, Myers provides the sobering consideration that “if there is insufficient data to complete a map, there is insufficient information to form an accurate conceptual flow model and to predict the impacts of the project (Myers DEIS review, pg. 6).” DEQ should not permit a mine that lacks such information, model, and map. Flaws in the DEIS prediction about permeability have significant surface water quantity and quality impacts. The problems with the way the DEIS estimates permeability (small-scale tests instead of large-scale ones translates into inaccurate estimations of groundwater flow rates. Permeability is a factor in the Darcy’s Law method of calculating flow rates used in the DEIS (3.4-21). So, the low permeability (mis calculated in the DEIS) translates into low flow rates from groundwater to the surface water of Sheep Creek. If there are areas of high permeability that contribute much higher flow from groundwater to Sheep Creek surface water, then the amount of the creek’s baseflow dependent on groundwater will be higher than accounted for in the DEIS. This means that mine dewatering will equate to larger impacts on Sheep Creek baseflow than anticipated. This could also risk contamination of Sheep Creek water by the known exceedances	See Consolidated Response WAT-1.

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				of elements in the alluvial and shallow bedrock for antimony, arsenic, iron, lead, manganese, strontium, and thallium (Myers DEIS review, pg. 7-8). Compounding the problems with how the DEIS estimates the amount groundwater contributes to Sheep Creek stream flow, the DEIS also relies on Sandfire's highly flawed method of calculating baseflow as a function of recharge from precipitation. Baseflow should be calculated using a regression analyses of sufficient surface water flow data from multiple gauges and a true hydrograph (Myers DEIS review, pg. 9-10). Mine plans regularly underestimate dewatering and geochemical reactivity. That common flaw appears to hold true for this DEIS and the Black Butte mine plan. MTU's uncertainty about mine dewatering as presented in Hydrometrics (2016 prompted us to engage an independent expert to review that model and to run an alternate, more thorough one. Myers hydrologic model (2018 demonstrates numerous flawed assumptions in the Hydrometrics model and, therefore, provides much higher estimates of mine dewatering throughout the expected life the the mine. We strongly recommend that DEQ address the discrepancy in these hydrologic models and re-evaluate the full host of possible environmental impacts if mine dewatering were to reflect the Myers 2018 predictions. DEQ should also reevaluate how mine infrastructure and plans for pumping, storing, treating and injecting the additional water would need to be changed (Myers 2018 and Myers DEIS review, page. 10-12).	
30	2-D		Email	Suggestions in the DEIS that grouting could solve any potential occurrences of increased dewatering are not supported by appropriate evidence (DEIS, 3.4-56). We echo the recommendation made by Myers (DEIS review, pg. 12-13) that if grouting is the proposed solution for unexpected dewatering rates, then it should be evaluated as a separate alternative within the DEIS.	See Consolidated Response WAT-1.
30	2-E		Email	We fully support the use of hydraulic plugs to prevent upward flow into the shallow aquifer. Unfortunately, the DEIS leaves latitude for Sandfire not to install these plugs based on its operational decisions, rather than on protecting the shallow aquifer and surface water from contamination. In the fractured and partially open environment of the shafts, for which these plugs are intended, oxidation of surrounding materials is increased such that there's high likelihood of long-term creation of acidic water that would be likely to leach heavy metals. Therefore, even the seemingly small difference in flow that the DEIS predicts between plugged and unplugged shafts, over long periods of time, constitutes significant quantities of highly contaminated water potentially entering the shallow aquifer and then the surrounding surface water of the Sheep Creek drainage (Myers DEIS review, pg. 13; DEIS Appendix D). Hydraulic plugs should be required throughout the mine site to prevent or decrease the upward flow of water post-closure.	Comment noted. The hydraulic plugs are required in both the Proposed Action and the AMA.
30	2-F		Email	This is especially true because the DEIS provides no analysis or evidence to substantiate the plan to flood the mine workings between six and ten times before backfilling them with cemented tailings to rinse soluble minerals from mine surfaces. How has it been determined rinsing underground surfaces six to ten will adequately reduce oxidizing minerals (see Myers DEIS review, pg. 21-22)? In situ evidence of this being an effective method of significantly reducing acid and contaminant generation should be required in the DEIS. More importantly, we recommend that the plan to rinse mine working surfaces be abandoned because it presents the risk of failing to capture the highly contaminated rinse water, for which the DEIS provides very few specifics. Instead, the DEIS should reconsider the alternative of shotcreting	At mine closure, much of the underground workings 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. Non-degradation criteria within the underground workings openings are expected to be achieved after repeated flooding/rinsing, which is conservatively estimated to take between 6 to 10 cycles. Until that time (estimated to take 7 to 13 months), water from the underground workings would continue to be captured and treated. Treatment of water from the underground mine would likely occur late in the closure phase. Importantly, only upon confirmation that the quality of contact groundwater meets the proposed groundwater non-degradation criteria, the contact water would no longer

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				all mineralized surfaces to better reduce the formation of metal-sulfide compounds that would likely create acid mine drainage (Maest, DEIS review, pg. 1, 11).	be pumped and treated, and the WTP would shut down as part of the post-closure phase (Hydrometrics, Inc. 2016b). Regardless of whether or not residual nitrate in the mine workings would be consumed by naturally occurring bacteria, the proposed rinsing of mine workings would effectively remove most nitrate from exposed surfaces underground. It is also reasonable to assume that the proposed rinsing with unbuffered RO permeate (essentially, distilled water) would dissolve most soluble oxidation products from exposed surfaces underground, and that these minerals would be the primary sources of dissolved metals in the initially flooded mine workings. Once the rinsing is complete, paste backfilling of the remaining mine openings within the zones of sulfide bedrock would greatly limit the volumes of groundwater that could occupy these areas, and also the ability of that groundwater to migrate into nearby aquifers. Also see response to Submittal ID HC-003, Comment Number 53. The closure rinsing would occur while there is still a groundwater cone of depression surrounding the mine workings, maintaining groundwater flow directions radially inward to the mine voids rather than out of them. Temporary flooding during rinsing would not be allowed to raise the water table to the point where outflow would occur. Draining the workings after flooding would result in stronger gradients from the surrounding bedrock into the mine voids, ensuring that the rinse water is recaptured.
30	2-G		Email	As for mitigation measures to re-water Coon Creek, Black Butte Creek, Moose Creek and Sheep Creek using the Non-Contact Water Pond or as-of-yet unsecured water rights, the DEIS fails to provide adequate information both about the degree mine dewatering will lead to drawdown of flows in these surface waters, as well as the method of determining when reduced flows are due to mining activities versus dry period, irrigation, or diversion of water. It appears that all of the above-mentioned surface waters, plus surrounding wetlands, are highly likely to experience much higher rates of drawdown than predicted in the DEIS (Myers 2018 and Myers DEIS review, pg. 13-16). The DEIS, nor the mine operating plan (MOP provide any clear mitigation plans for stream drawdowns that include a method of knowing when or how much that drawdown is due to the mine workings. Such determinations and the specific plans for recharging these surface waters with water that meets all water quality standards is essential to this DEIS. The DEIS also fails to include any mitigation needs of wetlands, even though the wetlands are, according to the DEIS, fed by groundwater and, therefore, susceptible to drawdown due to mine dewatering. Given the risks we have presented herein that mine dewatering could be much greater than predicted in the DEIS and that that could lead to correspondingly higher rates of surface water drawdown in the creeks within or adjacent to the project area, it is critical that the DEIS include a proper water balance – an accurate and realistic account of how the mine operators will mitigate for decreases in surface water. Where will they obtain sufficient water?	Stream drawdowns resulting from mine dewatering were quantified in the hydrogeological modeling conducted by Hydrometrics (2016a) and are discussed in Section 3.5.3.1, Surface Water Quantity, of the EIS. Refer to Consolidated Response WAT-4 for details regarding the estimated drawdown in Sheep Creek, and Consolidated Response WAT-1 for discussion of the validity of the mine dewatering estimates. The hydrogeological model estimates a maximum reduction in flow in Black Butte Creek of 0.1 cfs (4 percent of base flow), 0.12 cfs in Coon Creek (70 percent of base flow), and no reduction in base flow in Moose Creek. The Proponent has committed to mitigate the base flow reduction in Coon Creek by pumping water from the non-contact water reservoir into the headwaters of the creek to maintain flows within 15 percent of average monthly preconstruction flows. See response to Submittal ID HC-003, Comment Number 61 for more information about drawdown effects on wetlands.
30	2-H		Email	How will they ensure the quality of that mitigation water does not impair surface water into which it is being added or the aquatic life therein? This second question specifically could pertain to using NCWR as the source of water to mitigation flows in Coon Creek. The NCWR water will be drawn from Sheep Creek during high flows. The DEIS recognizes that that water exceeds standards for iron and aluminum (DEIS, 3.5-9). Putting that water in Coon Creek means that it will likely exceed nondegradation standards (see Myers DEIS review, pg. 22-25 for detailed analysis of shortcomings in the DEIS on this issue).	The elevated iron and aluminum concentrations in Sheep Creek are largely related to elevated suspended sediment concentrations in the creek occurring during periods of snowmelt, with increased flow and turbidity (Section 3.5.2.2 of the EIS). Retention of water in the NCWR would allow time for suspended sediment to settle out of the water column prior to transfer of the water from the NCWR for flow augmentation. The expected result of settling time would be reduced aluminum and iron concentrations. Some occurrences of elevated aluminum in Sheep Creek were observed when suspended solids concentrations were low. In these cases, it is likely that the aluminum is dissolved from soils during

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					snowmelt (which tends to be slightly acidic and may more aggressively dissolve aluminum from soils). In cases where elevated aluminum in Sheep Creek is not associated with elevated levels of suspended sediment that would settle out in the NCWR, it is expected that cold and slightly more acidic water diverted from Sheep Creek would equilibrate with water already stored in the NCWR, reducing solubility of aluminum and also causing precipitation of the aluminum within the reservoir. Also see the response to Submittal ID BBC00589, Comment Number 33 for a discussion of water quality effects, including for Coon Creek. Refer to Consolidated Response AQ-1 for discussion of impacts on aquatic life in Sheep Creek.
30	2-I		Email	In addition, the DEIS does not confirm that the company has numerous water right changes or new water rights secured that are necessary to operations and mitigation. We believe it is essential that the water balance, especially mitigation water, be legally secured before considering permitting this mine. Permitting and attaining necessary water right changes for this mine should be parallel processes. The DEQ should not allow one to be completed without the other.	See Consolidated Response WAT-2 regarding water rights and impacts on surface water resources.
30	2-J		Email	There are numerous risks to water quantity and quality associated with the Underground Injection Galleries and the modeling performed to evaluate them (Hydrometrics 2018 presented in the DEIS). First, the UIGs have been moved in the mine plan since the scoping process. The new location of the UIG, basically running from near the cemented tailings facility (CTF toward, and then along the edge of Sheep Creek, means that the UIG crosses ephemeral stream channels and both surveyed wetlands and wetland functional assessment areas (DEIS Figures 2.2-1 and 3.14-6). These changes in the UIG siting and the possible impacts to surface waters should, we believe, compel Sandfire to consult with the US Army Corps of Engineers on an updated or new 404 permit application. There is no indication in the DEIS that that has or is being done. The 404 permitting, including revisions due to the changes in the UIG, should be completed before DEQ considers the DEIS complete.	An alluvial UIG was proposed in the MOP Application by the Proponent before starting the scoping process. Subsequent proposed changes included enlargement of that UIG system and the elimination of the previously proposed “Upland UIGs.” Locations of alluvial UIGs are presented on Figure 3.4-12c in the EIS. Proposed UIG locations were selected such that disturbance of wetlands would be avoided (see MPDES application, Figure 3.2; Hydrometrics, Inc. 2018a). See Consolidated Response MEPA-3 regarding changes to the Project since the scoping period. See Consolidated Response WAT-4 for information about impacts on surface waters due to dewatering. For information about wetlands, dewatering effects, and the Section 404 permit, see responses to Submittal IDs: HC-003, Comment Number 61; and HC-003, Comment Number 62.
30	2-K		Email	A similar omission in the DEIS is any evidence of the Montana Department of Natural Resources and Conservation authorizing Sandfire to mine under Sheep Creek. During scoping MTU commented on the need for DNRC to make that determination (please refer to MTU’s scoping comments, submitted to DEQ 2017-11-15). Ore bodies the company has identified as viable for future mining, as well as possible mining outlined in the current DEIS pass beneath Sheep Creek, a navigable waterway that we believe falls under DNRC authority in respect to accessing mineral resources under the streambed. In a letter from Tintina Resources to DNRC, the company stated that the footprint of the Black Butte Copper Project includes a stretch under Sheep Creek, yet tried to persuade the department that discussion of the need for state (DNRC authority to mine that stretch would be “unproductive” until after the permit process is finished (Letter from Jerry Zieg to DNRC, Re: Black Butte Copper project, Sheep Creek mineral interest, January, 23, 2017). We strongly disagree and urge DEQ to make sure that DNRC determination on mining beneath Sheep Creek is completed before there is further consideration of this mine plan.	See response to Submittal ID HC-003, Comment Number 16 for more information about mineral rights beneath Sheep Creek and the DNRC.
30	2-L		Email	A second concern with the UIG is the poor modeling of the ability of this system to handle the full discharge that is likely to be put into it. The model (Hydrometrics 2018 overestimates the drawdown of the alluvium into which treated water would be	The hydrogeological modeling for the UIG (Hydrometrics, Inc. 2018a) indicated maximum steady state water table mounding of 3.9 feet when the maximum design discharge rate of 575 gpm was applied. This maximum does not include superposition (subtraction of

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				discharged. If drawdown of the alluvium is less than the model predicts (Myers DEIS review, pg. 16-17 then even the predicted discharge to the UIG will mean water levels will be well above ground, hence running directly into surface water. That would constitute an essential failure of the UIG. Compounding that potential risk is the likelihood (already described above that dewatering will be much greater than predicted in the DEIS, so the amount of water being discharged into the UIG would need to be much greater. In short, the UIG is likely not capable of handling the amount of water this mine will need to discharge back into the alluvium, nor will the alluvium be drawn down to a degree that it has the capacity for the discharge water that can reasonably be expected.	drawdown from dewatering). The modeling indicated that mounding is expected to result in effluent entering the ground and eventually discharging to Coon and Sheep Creeks after seepage through the sediments. The Hydrometrics (2018a) modeling is regarded as adequate to demonstrate the capacity of the UIG. The adoption of steady-state mounding using the maximum design discharge rate provides a layer of conservatism. The modeling is supported by field data and calibration to the observed water levels. In contrast, the Myers (2019a) model includes a lower hydraulic conductivity in the alluvial sediments that is not supported by field data. See Consolidated Response WAT-1 for discussion regarding the groundwater modeling methods used by Hydrometrics (2016a and 2018a) and Myers (2019a). Routine groundwater monitoring would be conducted in the alluvial sediments around the UIG during mine operations. This monitoring would detect the magnitude of water table mounding, and would provide a trigger for UIG system modifications should mounding be greater than predicted.
30	2-M		Email	Overburdening the UIG and alluvium into which it injects water risks degrading surface water quality. As stated by Myers on this issue: "Dewatering would remove ambient groundwater with low total N concentrations which would result in mixed groundwater with higher total N (Myers DEIS review, pg. 17). The DEIS has incorrectly dismissed concerns about increased nitrogen levels in surface or groundwater due to this potential mine operation. An inadequate UIG located near or within known wetlands and adjacent to Sheep Creek, as well as being directly connected to the shallow alluvium, presents one specific example of the DEIS failing to recognize nutrient pollution risks.	See response to Submittal ID BBC00589, Comment Number 36. Myers' comments were based on the incorrect assumption that mixing and dilution would be allowed in order to achieve compliance with in-stream nutrient standards. Therefore, the comment is not pertinent to the Proposed Action. The Proponent has included provisions in the mine plan specifically to address elevated nitrogen concentrations sourced in the underground contact water. In addition to RO water treatment upstream of the UIG, the mine plan includes diversion of treated water to storage in the TWSP if nitrogen concentrations exceed the effluent limit from July 1 to September 30. Starting October 1, the stored water would be blended with the WTP effluent prior to discharge, and the blended water sampled/monitored as required in the MPDES permit. As the MPDES permit does not authorize a mixing zone, it does not depend on mixing/dilution with either groundwater or surface water having low nitrogen concentrations in order to achieve nutrient standards in Sheep Creek.
30	2-N		Email	Discharging from a reservoir to the UIG or directly to Coon Creek risks significantly raising the temperature of shallow groundwater and the receiving surface waters. The DEIS does not calculate or take into account the likely high rise in temperature of water stored in a reservoir before being discharged to mitigation surface water drawdown. The temperature and volume of stored water need to be closely estimated then used to determine the amount it would raise surface and shallow groundwater temperatures based on injection or discharge rates (see Myers, DEIS review, pg. 26).	See Consolidated Response WAT-5 for a discussion of potential effects of the Project on receiving water temperature.
30	2-O		Email	Leakage from any of the lined ponds or impoundments in this mine plan proposal also constitute risks to groundwater and surface water that have been ignored or downplayed in the DEIS. Except for with the non-contact water reservoir (NCWR, the DEIS assumes that liners will work perfectly. This assumption runs in contrast to the literature on lined water reservoirs and impoundments at hardrock and other eventuality with all of the lined facilities in this mine plan, not just the NCWR. Which raises the question: why does the DEIS accept eventual leakage of the NCWR but not the process water pond (PWP) nor the cemented tailings facility nor recently added, 20-acre treated water storage pond? A leak or seepage from the PWP could lead to contamination of shallow groundwater and surface water with any or all of the contaminants the DEIS acknowledges will be present in high concentrations in this facility – nitrates, copper, nickel, lead, antimony, strontium, and thallium (DEIS, Table 3.5-9). The DEIS presents a particularly inaccurate assessment of seepage	See Consolidated Response PD-4 for the discussion regarding seepage from lined surface facilities. Designs for these facilities have been engineered with multiple layers of seepage mitigation. The approach of embedding multiple layers of mitigation into facility design reduces the likelihood of failure in the overall seepage interception/collection systems. The NCWR is designed to recharge the groundwater system via seepage through the pond bottom, and hence a liner is intentionally excluded from the design. The analyses have not assumed that all liners would work perfectly. Analyses of liner seepage considered laboratory and field studies of liner performance and typical frequency and size of liner defects as documented in available literature (refer to Section 3.5.7 of the MOP Application; Tintina 2017a). Assuming literature values for liner defect frequency, it was calculated that the proposed CTF liner system would leak at a rate of approximately 4

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				through the temporary waste rock dump. It appears that the seepage rate is based on an erroneous assumption that seepage will only occur in seven months during the two years that waste rock will be stored in this facility before being moved to the CTF. It also assumes that the waste rock will be moved to the CTF all at one time, rather than the reality that it will be moved over the course of months, hence more seepage will continue to occur. This is a concern because, as the DEIS identifies through testing, the waste rock has the potential to generate acid, as well as the potential to release metals in exceedance of groundwater standards, including nickel, thallium, copper, lead, uranium and arsenic (DEIS 3.6-11). As Maest describes in reviewing the DEIS: “The total metals results are presented in Enviromin (2017), Table 4-1. The copper content of the tailings is approximately 3,000 ppm, and the arsenic content is nearly as high (2,160 ppm in the raw tailings. The cobalt concentration is also impressive: 1,580 ppm in the raw tailings. The high concentrations suggest that the tailings contain toxic constituents that could leach under acidic (metals and non-acidic (arsenic, selenium, uranium, etc conditions (Maest, DEIS review, pg. 5).” As in the Maest review, the DEIS needs much more extensive testing of the potential for metals leaching both in acidic and non-acidic conditions. The risk of contaminating ground and surface water with toxic metals appears much higher than the current DEIS acknowledges.	gallons per day, and the PWP liner system would leak at a rate between 7 and 23 gallons per day. For both the CTF and PWP, the seepage predicted to pass through the liner systems would enter a foundation drain system designed to route the intercepted seepage into seepage collection ponds, from which this water would be routed to the WTP or to the PWP. Monitoring wells would also be located downgradient of the lined facilities, to confirm that seepage, if any, is intercepted by the foundation drain systems and does not affect groundwater quality. The estimated rate of percolation through the waste rock (0.9 gpm) in the temporary WRS facility is based on storage on the pad for up to 2 years (Section 3.6.5.4 of the MOP Application). This 0.9 gpm is the rate at which seepage would accumulate in the collection system beneath the waste rock. The collection system includes a network of drains underlain by a 100 mil HDPE liner, with the collected water routed to a sump and then via pipeline to the CWP. The seepage analysis for the temporary WRS facility indicates the volume of precipitation infiltrating into the waste rock over the planned 2 years of use would not be sufficient to saturate the waste rock material or accumulate on the liner. Rather, much of the water would either run off (reporting to the sump and directed to the CWP), be removed as snow, evaporate, or be absorbed by the rock. Given that saturated conditions are not expected to develop above the liner, seepage through the liner, even in the event of a defect, is predicted to be negligible. Although the rate of seepage through the temporary waste rock dump is projected to be a small volume, all precipitation that contacts this waste rock pile (whether it seeps through the waste rock pile or runs off it) would be collected on the lined surface beneath the waste rock and would then drain to the CWP for storage and treatment. Also refer to the response to Submittal ID BBC00933, Comment Number 5.
30	2-P		Email	Perhaps our biggest concern in regards to long-term water contamination risks posed by the Black Butte mine, as proposed, is with the cemented tailings facility. The DEIS section on “Tailings Geochemistry” is unequivocal that “tests indicate that the tailings would have a strong potential to generate acid regardless of cement addition (DEIS, 3.6-12).” It goes on to state that the addition of cement at 2% to 4% “is not sufficient to neutralize the sulfide in the tailings.” This high, undeniable potential for the tailings to go acidic underlie many of the following sections of our comments and constitute both a real potential for the creation of long-lasting, if not permanent source of water pollution necessitating permanent water treatment for this mine, which warrants the DEQ’s consideration (and our strong recommendation of a “No Action” alternative.	The addition of cement paste to the tailings is not intended to serve to neutralize the acid-generation potential of the sulfide minerals, and the ABA and NAG tests conducted with cement paste tailings confirm that the acid generation potential is not mitigated by the cement paste. However, the cement paste does serve to reduce the permeability of the tailings, thereby reducing the seepage rate and minimizing contact with water (the influence of cement paste addition on sulfide oxidation is discussed further in Submittal ID PM2-06, Comment Number 6). The CTF design for operations and closure includes other features serving to minimize seepage and prevent it from leaving the facility. The various forms of mitigation are discussed in the responses to Submittal ID HC-003, Comment Number 80 and Section 3.6.3.2 of the EIS. The mixing of cement paste with tailings is an established approach as demonstrated by its use at other mines (refer to Consolidated Response PD-2). The potential for liner failures is discussed in Consolidated Response PD-4. With consideration for the various forms of mitigation that have been embedded in the facility design, there are no expected significant effects on surface water or groundwater quality resulting from the CTF.

30	3a		Email	The DEIS does not fully recognize the risks of mining this particularly volatile sulfide ore body. The high sulfide content of the deposits targeted by the Black Butte project are comparable to other mines in the western United States that have and are producing extremely contaminated, acid water. The Iron Mountain Mine in California, which has mined a deposit very similar to what is present at Black Butte,"has the most acidic water ever measured," according to literature on the correlation of this kind of sulfide-bearing ore and severe water contamination (Maest, DEIS review, pg. 2). The exact same kind of rock and sulfide-bearing deposits that are at Black Butte have led to "extensive contamination" in the Coeur d'Alene mining district of Idaho, including the designation of a Superfund site complex (Maest, DEIS review, pg. 2). MTU also strongly recommends the "No Action" alternative in the DEIS because it lacks engineering and/or operations analyses of additional, appropriate alternatives.	Regarding the comment that the Draft EIS "lacks engineering and/or operations analysis of additional, appropriate alternatives," see Consolidated Response ALT-1. Regarding the comparison of the proposed Project to other western mines: Sulfide mineralization across the western United States clearly cannot be grouped into one category, and the site-specific geology and mineralogy must be considered when predicting geochemical conditions. The copper deposit at the proposed Project site is located within the carbonate-rich Newland Formation (Lower Belt Supergroup), which does not extend to western Montana or Idaho. The Belt Supergroup is an extensive group of meta-sedimentary units found across Idaho and western Montana. The geologic setting of the copper-rich deposits at Black Butte are described in Section 1.4.1 of the MOP Application (Tintina 2017a). The geochemical implications are described in Section 2.4.2.2 of the MOP Application, in addition to Appendices D and N of the same application: "Results of all kinetic tests of waste rock are summarized in Figure 2.13a and 2.13b. Sulfide oxidation was observed in HCT for the four volumetrically significant waste rock units. However, consistent with static test results, and the presence of abundant carbonate minerals, oxidation in the Ynl B, Ynl A, and LZ FW tests did not produced sufficient acidity to deplete alkalinity, nor did these tests produced acidic pH values." Below is a comparison of each of the formations named in the comment, with the proposed Project site: IRON MOUNTAIN: The massive sulfide deposits at the Iron Mountain Mine (Cu-Zn-Fe-Pt-Ti-Cd-Au-Ag) formed within altered/metamorphosed volcanics (rhyolite), which contain very little neutralizing/buffering capacity, and are susceptible to fracture-controlled flow. As described in Nordstrom and Alpers (1999), "The mineral deposits are primarily massive sulfide lenses as much as 60 m thick containing up to 95% pyrite, variable amounts of chalcopyrite and sphalerite, and averaging about 1% Cu and about 2% Zn... The mineral composition of the rhyolite is albite, sericite, quartz, kaolinite, epidote, chlorite, and minor calcite; consequently it has little buffering capacity." COEUR D'ALENE: The deposits in northern Idaho (Ag-Pb-Zn) are found within the Belt Supergroup, but within different formations (quartzite and argillite) and different stratigraphic timeframes than the formation at Black Butte. The silver-lead-zinc deposits of northern Idaho (Coeur d'Alene District) are also hosted within rocks in the Belt Supergroup, but the depositional environment and local mineralogy at the west end of the Belt Supergroup are quite different from the copper-rich deposits at Black Butte, on the eastern end of the Belt Supergroup. The extent of the Newland formation at Black Butte (carbonates and shale) is limited to the Helena embayment, and does not occur in western Montana or Idaho. The host rocks in the Coeur d'Alene District are primarily quartzite and argillite. Furthermore, comparison of the proposed Project with historic mines such as Iron Mountain are not appropriate because the historic mines were often developed with drainage tunnels that resulted in permanent lowering of groundwater elevations, resulting in continued oxidation of the sulfide bedrock in desaturated areas. Also, these historic mines typically have not been backfilled with low permeability material; thus, they allow rapid flow of both

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					air and water through their tunnels, which facilitates the continued rapid oxidation of sulfide rock and resultant production of acid drainage. Other comments contained in this form letter are addressed through Consolidated Responses and unique comment responses. See the following: • Response to Submittal ID BBC00830 (Comment Number 5): Concerns regarding long-term field testing • Response to Submittal ID BBC00933 (Comment Number 11): Concerns regarding cemented tailings tests • Consolidated Response ALT-1: Concerns Regarding Alternatives Screening Process and Dismissal Rationale • Consolidated Response ALT-2: Concerns Regarding Elevating the CTF Above the Water Table • Consolidated Response ALT-3: Concerns Regarding Alternative CTF Locations • Consolidated Response ALT-4: Concerns Regarding De-Pyritization of Tailings • Consolidated Response FIN-1: Concerns Regarding Bonding and Protection for Taxpayers • Consolidated Response PD-1: Concerns Regarding Tailings Storage Facility Design Documents • Consolidated Response PD-2: Concerns Regarding Examples of Proposed Technology • Consolidated Response PD-3: Concerns Regarding Failure Scenarios and Catastrophic Events • Consolidated Response PD-4: Concerns Regarding Liner and Pipeline Performance; • Consolidated Response PD-5: Concerns Regarding Cement Breakdown Due to Acid Formation • Consolidated Response WAT-1: Concerns Regarding Hydrogeological Model and Underestimation of Groundwater Inflows • Consolidated Response WAT-2: Concerns Regarding Impacts on Surface Water Resources in The Project Area
30	3b		Email	The DEIS fails to consider removing pyritized material from tailings and storing this highly reactive material off-site or somewhere that is truly out of the water table (see Chambers, DEIS review). According to the DEIS, there is already a point in the process of concentrating ore on-site when pyrite is removed from tailings, but it is then recombined with tailings for placement in the CTF. The DEIS fails to justify why this highly acidic, or acid-generating material is mixed back into otherwise less reactive material (Chambers review of DEIS, pg 1-2). Barring depyritizing the tailings, the long-term analysis of the CTF is gravely insufficient. Similarly, it appears that other options to reduce the potential reactivity of the CTF were eliminated for cost savings reasons, such as using 4% cement and 10% waste rock alternative (DEIS, 3.6-17).	See Consolidated Response ALT-4.

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30	3c		Email	The DEIS contains no evidence or extensive literature review on the long-term neutralizing or stabilizing nature of cemented tailings. Our research shows that world-wide there are no large-scale examples of above-ground cemented tailings facilities with high-sulfide material, which have been in place long-enough to draw conclusions about how effective they are at maintaining stability or preventing oxidation. In contrast, Chambers (DEIS review) concludes that the acid in the tailings for this proposed project will "neutralize/dissolve the cement" in a short amount of time. Therefore, the DEIS should analyze plans to manage the CTF after the cement degrades and it becomes a wet-closure facility. As such the DEIS must recognize and evaluate plans for long-term, if not permanent draining and treatment of highly acidic effluent from the CTF. A separate, independent analysis of the cemented tailings and their use in both underground backfill, as well as the CTF, makes even stronger claims about the risks of these tails to become acid, leach metals, and enter ground or surface water (Zamzow, CSP2, DEIS review, 5/2019). The DEIS provides the estimate that the tails will have a very high, 26% sulfide content, which is considered "extremely acidic (Zamzow, pg2; Tintina 2017, Appendix D, Table 4-2)." The addition of cement (actually a combination of Portland cement and slag) in a concentration of up to 4% for the backfill and 2% for the CTF only provides a slight delay in the generation of acid and the leaching of metals from the tailings. The addition of cement is largely to provide structural stability. But, the DEIS fails to include proper, longer-term testing of both the stability and the acid neutralizing property of the proposed cement tails. The tests conducted to assess the neutralizing character of the backfill only lasted 11 days, whereas the DEIS acknowledges that the cement could take more than twice that long to harden. Even after 11 days, the pH of the materials was beginning to drop precipitously. According to Zamzow, lab tests "indicates pH of tailings with 2% binder began dropping within 2 weeks, and was at pH 3.6 by week 4 (Zamzow, DEIS review, pg. 8; Tintina 2017, Appendix D, Subappendix D, Table D-2; also see Maest, DEIS review, pg. 10-12)." That means that tests ended before the cement will likely be solid and already the formation of acid was rapidly beginning (Tintina 2017, Appendix D, Sec 4.1.2 and Table 4-3; Fig 4-1). The cemented tailings for the CTF will have less binder (cement) and, hence, become acidic much quicker, plus they will cure or harden slower, leaving a much longer window of time for acid generation (Zamzow, DEIS review, pg. 8-10). The geochemical testing included in the DEIS clearly show that the tailings, as well as ore and some waste rock from the mine, will contaminate water such that the use of cementation will only very temporarily forestall the production of acid mine drainage. The tests presented in the DEIS also "underestimate potential concentrations for most constituents in the underground mine" that could lead to ground- and, eventually, surface water contamination (Maest, DEIS review, pg. 2-3, 10-12). Once acid is generated it both risks leaching toxic metals from the material and quickly breaking down the structural integrity of the cement. The DEIS even agrees that "the rates of Al, Cu, Cd, Ni, and Tl release from the 2% cement paste HCT (humidity cell tests) approached those of the unsaturated raw tailings after 4 weeks (Tintina 2017, Appendix D, Section 5.2)." The DEIS also states that "all of the the cemented tailings samples had potential to oxidize and to release at least some sulfate, acidity, and metals if left exposed to air and water…Increasing surface area and exposure to air/water drives the sample reactivity (DEIS, 3.6-13)." In short, the 2% cement tailings will break down quickly, become acidic and leach toxic metals. Once	See Consolidated Response PD-1, PD-2 and PD-5. For more information regarding testing procedures and characteristics of cemented tailings, see responses to Submittal IDs: BBC00933, Comment Number 11; and BBC00830, Comment Numbers 4, 14, 15, 16, and 24. See Consolidated Response WAT-2, Concerns Regarding Impacts on Surface Water Resources in the Project Area.

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				that happens, the CTF will essentially be a wet tailings facility. The DEIS should evaluate it as such.	
30	3d		Email	As MTU has stated at numerous opportunities, the CTF would constitute a completely experimental undertaking. There are NO real-world examples of cemented paste tailings being stored in an above-ground CTF as being proposed at Black Butte, much less one that is sited below the water table (Zamzon, DEIS review, pg. 3). The literature on the few above-ground CTF are mostly void of acid generating material or they have built in much more robust safeguards than what is being proposed at Black Butte. Plus, all of those (three) examples in the literature did much more extensive pilot project testing that has or will happen for Black Butte. Even so, these CTFs documented in the literature have experienced numerous problems. The unknowns and high-risk of the currently-planned CTF at Black Butte alone should warrant DEQ selecting the “No Action” alternative for this proposed project. The CTF is fraught with unknowns. This is especially concerning since the Failure Modes and Effects Analysis (FMEA) presented in Appendix R (Tintina, 2017) rates the consequences of failures for the CTF (and the PWP) due to overtoping or discharge as “Catastrophic,” which would lead to severe contamination of Coon or Brush Creek and, hence, Sheep Creek (Maest, DEIS review, pg. 12-13).	See Consolidated Response PD-1, PD-2, PD-3, and PD-5.
30	3e		Email	The DEIS lacks an analysis of the many complexities in processing tailings with cement, slag and water, such as mixing to achieve a homogenous paste of the very high thickness (79% tailings) that is being proposed. The DEIS lacks proper analysis of the risks of pumping this extremely dense paste to both the mine workings for backfill and the CTF. Pump pressure, corrosion, freeze-thaw integrity, and flushing with water are some of the as-of-yet poorly analyzed and untested elements of delivering the tail paste via a pump system and pipelines. Specifically, the DEIS does not require the project to invest in a positive displacement (PD) pump, even though it acknowledges that pumping a paste of high density, such as 79% tails, “often required” a PD pump. Instead of requiring a PD pump the DEIS states that doing so would “significantly impact capital and operating costs (Tintina 2017, Appendix K, Sections 3.2 and 3.2.4).” The risks of rupture or complete malfunction posed by an inadequate pump system meant to handle highly acid-generating tails far outweighs cost-cutting measures for Sandfire (also see: Zamzow, DEIS review, pg 4-6).	See Consolidated Response PD-4.
30	3f		Email	Even if the plan includes proper infrastructure to deliver paste tails to the CTF, that facility has design flaws. The CTF is designed so that the paste is pumped into the site and disperses evenly at a gentle, consistent slope (tailings beach slope of 1-2 degrees). The placement of the reclaimed water from a sump, which would be pumped to the process water pond for use in milling, as well as the size and layout of the top and bottom liner systems for the CTF are based on this oversimplified design. Literature shows that paste tailings, especially of the density proposed for Black Butte, will vary in their beach slope (possibly higher than 6%) and the surface of the tailings will not be even, rather it will have mounds and depressions. All of these asymmetries will be greatly exaggerated as the cement degrades naturally or, more likely, from the acid within the tails. As cement degrades the CTF will have fractures, become more porous throughout, and collapse or slump in places. All of these fluctuations in the stored tails will affect the flow of water within the CTF and, of perhaps greater concern, will risk tearing or compromising the liner systems above and below the tailings. None of this has been addressed in the DEIS (Zamzow, DEIS review, pg. 6-8, 11; Tintina 2017, Figure 3.33).	See Consolidated Response PD-4 and PD-5.

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30	3g		Email	Another flaw in the CTF design is in the timing of pumping fresh cemented paste tails. According to the DEIS the plan would be to add a new top-layer of paste tails about every week or so. By layering, the lower level of paste will have time to cure or harden, while limiting exposure to air and moisture. The flaw in this is that one or two weeks is not likely enough time for the 2% cement paste tails to harden. Thus adding new paste atop an unhardened layer will further extend the drying time of the underlayers. In that scenario, acid generation will likely outpace cement hardening, thus there will be even less buffering of acid by cured cement. The DEIS fails to analyze how these dynamics could be exacerbated by any delays or temporary shutdowns. Any interruption in the process would likely leave tailings exposed to air and precipitation or, in the underground workings, to air and dewatering (Zamzow, DEIS review, pg. 8-10).	See Consolidated Response PD-4. Regarding the time required to harden the CTF layers, Section 4.2.2.3 of the MOP Application (Tintina 2017a) states that, "Cemented paste will be spigotted into the facility in thin lifts with the upper surface of these lifts being exposed 7 to as many as 30 days (average range 7 to 15 days) before a new lift is deposited over the top. The upper surface of each lift will weather sub-aerially until covered by a fresh lift of tailings." Regarding temporary shutdowns, procedures for temporary closure are described in Section 7.1.2 of the MOP Application, which states, "Short-term temporary closure reclamation and site protection will include: continued underground mine dewatering, continued treatment of water through the WTP (and properly disposing of the brine), stabilizing site-wide drainage facilities, prevention of unnecessary erosion by stabilization and revegetation of any existing disturbances, maintaining site access, maintaining water quality sampling and monitoring / reporting, maintaining the site weather station, providing site security by maintenance of fencing for all of facilities (including the ponds, ventilation raises, and the mill area), protection of equipment, and preparation and implementation of a facility inspection programs."
30	3h		Email	The DEIS erroneously dismisses the alternative of raising the CTF above the water table. The justifications for not doing so are that a raised CTF would mean that the reclaimed impoundment would be visible as a mound, rather than replicate the original contour of the site. Having a mounded hill after mine closure and reclamation of the CTF is an insignificant impact compared to placing tailings with a high risk of generating acid mine drainage below the local water table. In fact, the entire CTF could be relocated to avoid having it sited within the water table or causing any deleterious visual impacts. The other, equally unsupportable justification for not bringing the CTF above the water table is that the liner system is intended to prevent groundwater flow into the tailings. As we have previously insisted, no matter how well-planned or effectively-installed these liner systems are, the literature confirms that they eventually fail. As Zamzow states: “If groundwater entered the CTF through tears, abrasion, or degradation of the bottom liner over time, the tailings and waste rock material would be exposed to the fluctuations of a water table rising and falling seasonally. These are conditions that are similar to laboratory HCT conditions, and could result in metal release within a matter of weeks (Zamzow, DEIS review, pg. 10).” Long-term prevention of shallow groundwater and surface water contamination by potentially permanent acid mine drainage generated in the CTF demands that this facility be placed above the water table. Furthermore, we highly recommend controls, such as fencing and a no-entry easement, be placed on the CTF so that they remain undisturbed forever (also see Chambers, DEIS review).	See Consolidated Response ALT-2 and PD-4.

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30	3i		Email	The plans for the water treatment plant (WTP) present another major weakness of the DEIS. The WTP has been designed to handle 588gpm. While that might accommodate the annual average flow of water into the WTP, it grossly fails to account for the high likelihood that the facility will have to handle up to 3,000gpm due to the predictable periods of high dewatering rates (Myers, 2018; amzow, DEIS review, pg. 12). Ignoring the predictions for extremely high dewatering rates allows for a dangerously inadequate WTP and the associated risk of large volumes of untreated water backing up in the mine workings or overflowing storage facilities. The DEIS also fails to provide an adequate post-closure and post-reclamation plan for long-term monitoring and maintenance, costs associated with these activities, and the real likelihood that these activities could include long-term water treatment.	The Project is proposed to use RO to treat water. RO treatment is known to scale well by simply adding more units, and the Proponent would have a back up unit available to treat up to 750 gpm (Section 1 of the MOP Application [Tintina 2017a]). If there is a need to treat additional water, it should be evident with enough time to secure additional units given the monitoring protocols proposed. DEQ would require the Proponent to adhere to a Reclamation Plan, pursuant to § 82-4-336, MCA, which states that all, “disturbed lands must be reclaimed consistent with the requirements and standard set forth in this section.” Monitoring would be required during construction, operation, closure, and post-closure to confirm all parameters are within the appropriate range with regards to water quality and geotechnical stability. Also see Consolidated Response WAT-1.
30	3j		Email	Another concern we have with the lack of post-reclamation plans is the absence of a bond calculation for reclamation and long-term activities. How much it could cost the mine operator, the state of Montana, Meagher County, or landowners due to long-term or perpetual activities, especially water treatment is a critical element that should be included in the economic impacts section of the DEIS.	See Consolidated Response FIN-1.
30	4a		Email	Because MTU’s mission is to protect, conserve and restore coldwater fisheries and their habitats in Montana, all of the water quality and water quantity impacts that we have identified associated with the Black Butte mine are of greatest concern to our organization relative to how they might affect trout and aquatic biota. Understanding the impacts a project like the one being proposed could have on aquatic organisms demands accurate baseline data. This DEIS generally lacks such data. According to our review of the sections of the DEIS (especially Aquatic Biology, chapter 3.16) dealing with fisheries and aquatic organisms, as well as the review provided to MTU by Ken Knudson (“A Critique of the Aquatic Biology Section of the Draft Environmental Impact Statement for the Proposed Black Butte Coper Project in Meagher County, Montana,” May 1, 2019, submitted to DEQ) “the existing conditions for the aquatic communities of Sheep Creek and the Smith River are incomplete, poorly presented and, in some cases, inaccurate.” We base this general assessment of the DEIS on the fact that it lacks critical fish length-frequency or biomass information throughout, both of which are essential for determining the actual health of the fishery. There are large data gaps, such as a complete lack of information on aquatic macroinvertebrates in the 2017 sampling period. And there is no data for Smith River aquatic macroinvertebrates. Chlorophyll-a data is also completely absent, except from the year 2015. During the Completeness and Compliance review period of the Black Butte mine permitting process, MTU submitted comments and suggestions for improving fish population sampling. We appreciate that some of our suggestions are reflected in the DEIS, such as increasing the length of electrofishing sections, using block nets in the sampling sections, and basing calculations on an iterative process to better reflect population counts. The DEIS also now includes expanded redd counts (into October) and fish tissue sampling for metals, among other improvements in calculating baseline data. But, the DEIS fails to provide a clear baseline condition because the presentation of the information is poor and incomplete (Knudson pages 3-4). Lack of information and poor presentation of redd count data – survey date, length of survey section, number of redds by species, and redd density - will be especially important to address. Section 3.16 mentions that each fish surveyed was weighed and measured for length	See Consolidated Responses AQ-2 and Submittal ID BBC00574, Comment Numbers 3 through 9, 12, and 13. Appendix K of the Final EIS includes seasonal fish size frequency data. Section 3.16.2.5 of the EIS includes a discussion of the 2017 macroinvertebrate data, as well as some data for the Smith River. Additional data was added to Section 3.16.2.5 of the Final EIS in response to comments.

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				but the DEIS does not present any information about the number of fish in each age/size class. This information is essential to determining how a species population is changing or being affected at different sizes and, hence, age classes. Fluctuations in size class can also be an indicator of fish health and reproductive success. Changes in reproduction or recruitment of young age classes is an especially important early indicator of impacts to a stream, such as environmental contamination from a mine.	
30	4b		Email	Knudson's review of the DEIS provides a thorough evaluation of the problems with the monitoring of macroinvertebrates in Sheep Creek and the Smith River. While the addition of monitoring sites is helpful, there remain significant data gaps to establish a true macroinvertebrate baseline. The poor presentation of the existing data in the DEIS compounds the lack of a proper baseline. Similarly, data gaps and presentation problems are prevalent in the DEIS for periphyton communities, which are indicators of nutrient loading and potentially harmful algae blooms. The DEIS dismisses any concern that the Black Butte mine could contribute to algae bloom issues, which the DEQ is well aware already plague the Smith River. Poor baseline data in the DEIS on periphyton communities, especially chlorophyll-A, mean that it would be very difficult to properly assess whether the mine, if permitted and operating, began impacting algae growth. Specifically, mine operations would include the use of thousands of pounds of explosives that contain high levels of nitrogen compounds. It is well-known that these compounds are present in mine waste water. The Black Butte project plan recently added a 20-acre Treated Water Storage Pond to impound nitrogen-rich water for subsequent treatment. The TWSP has possible surface and groundwater connections to Sheep Creek. The DEIS has not properly addressed the risk of water from the TWSP entering Sheep Creek and the poor baseline for chlorophyll-A and the periphyton community will make it nearly impossible to determine if surface waters are being impacted by nitrogen compounds associated with mining.	See Consolidated Responses AQ-1, AQ-2, and Submittal ID BBC00574, Comment Numbers 3 through 9, 12, and 13. Section 3.16.2.5 of the EIS includes a discussion of the 2017 macroinvertebrate data, as well as some data for the Smith River. Additional data was added to Section 3.16.2.5 of the Final EIS in response to comments.
30	4c		Email	Assessing the fishery baseline data and monitoring of fisheries should include fish tissue samples of sculpin, not just trout species. Because sculpin are more abundant and less migratory, their tissue samples provide more precise and timely information on fish health and any changes in a host of potential mine contaminants (metals).	See Consolidated Response AQ-3.
30	4d		Email	MTU largely agrees with the DEIS's assessment that sediment loading during mine and road construction would not affect Sheep Creek beyond some small, localized impacts IF Montana's Fish, Wildlife and Parks staff is, as planned, directly involved with overseeing best management practices (via the 310 process of the MT Stream Protection Act) for preventing sediment from entering surface water. However, MTU has serious concerns about the DEIS predictions that Sheep Creek base flows will only be reduced by 2% and no more than 7cfs during flows greater than 84cfs. If both of these parameters are not exceeded, Sheep Creek's wetted perimeter and, hence, aquatic habitat would not be significantly impacted. But we maintain that the DEIS fails to accurately predict possible flow impairments to Sheep Creek that could result from much higher levels of mine dewatering than the DEIS (see our comments herein related to Tom Myers's model, which predicts up to 2-3 times the amount of mine dewatering documented in the DEIS).	See Consolidated Responses AQ-1 and WAT-1.
30	4e		Email	Similarly, water quality impacts as per our comments above are gravely underestimated in the DEIS and therefore fail to account for the risks this project holds for aquatic life in Sheep Creek and the Smith River. To reiterate, all the water that passes through the project area would be altered in terms of chemistry and	See Consolidated Responses AQ-1, AQ-4, and WAT-1.

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				temperature. Geochemistry, hydrology, and engineering-related reviews of the DEIS submitted to DEQ by Chambers, Zamzow, Myers, and Maest all offer ample evidence that the DEIS is erroneous in stating that "The quality of groundwater reporting to Sheep Creek would be the same if not better than baseline conditions (3.16-31)."	
30	4f		Email	The DEIS acknowledges, although downplays, the high levels of nitrogen compounds from blasting and the high sulfide ores that will be exposed to and impact water quality within the mine site. As Knudson states in his review of the DEIS, the acid produced by mining this high sulfide ore "would dissolve heavy metals from the exposed ore (i.e., cadmium, copper, lead and zinc), which are toxic to aquatic life (Knudson, page 8)." The DEIS accepts the prediction that ALL of the nitrogen-, acid and heavy metal-laden water produced in the mining process will be fully treated on site before being returned to ground and surface water. This prediction ignores the long and recent history, as well as a wealth of scientific literature confirming Knudson's conclusion that "underground workings are rarely, if ever, closed and impervious systems (Knudson, page 8)." Potential and likely pathways for highly acidic water containing heavy metals, nutrients or other elements that are toxic to aquatic life are numerous and common at active and closed mines. Underground fractures, both natural and those created or exacerbated by blasting, provide ready pathways for contaminated water to enter groundwater and move to adjacent surface waters, especially Sheep Creek. Similarly, surface water runoff and precipitation will, at times, overburden or undermine the mine infrastructure meant to contain all contaminated surface water. As with groundwater, contaminated surface water entering Sheep Creek and moving down into the Smith River is a matter of when, not if. The DEIS fails to account for all the likely ways this will happen. As discussed previously in our comments, overburdening the water treatment facility and UIGs due to much higher rates of dewatering than the DEIS predicts is of special concern, especially combined with the highly reactive geochemistry of the ore, contact water, and tailings. (Also see, Myers DEIS review, pg 21, for analysis of the inability of the water treatment facility to handle the chemistry associated with the higher-than-anticipated amount of water that is likely to occur from mine dewatering).	See Consolidated Responses AQ-1, AQ-3, WAT-1, and Submittal ID BBC00574, Comment Numbers 3 through 9, 12, and 13. The alternative groundwater model presented by Tom Myers (Myers 2019a) does not prove that the Proponent or DEQ have underestimated how much groundwater could flow into the proposed mine; rather it only shows that a model that includes different assumptions (which are not supported by the site-specific tests that have been completed to document bedrock hydraulic properties) would produce different predictions; see Consolidated Response WAT-1. The tailings produced by mine ore processing would be mixed with cemented paste, serving to reduce seepage contact with sulfide minerals and thus reduce leaching of oxidation products. The Proponent has used hydrogeochemical monitoring, hydrogeological modeling, surface water modeling, and geochemical testing data to design its underground workings and associated surface facilities to minimize potential impacts on surface and groundwater, in line with industry best practices. No adverse or long-term effects are predicted to occur on surface water and groundwater as a result of Project development based on results of the quantitative predictive models developed for the Project and in light of planned mitigation measures, including RO treatment of mine dewatering flows. The water released from RO treatment to the alluvial aquifer via the UIG during the mine construction and production phases would be treated to assure compliance with surface water and groundwater standards and non-degradation criteria per the MPDES permit (Hydrometrics Inc. 2018a; Tintina 2018a). Impacts on groundwater and surface water resources are not predicted. To confirm this prediction, the Proposed Action and AMA require the Proponent to conduct groundwater and surface water monitoring.
30	4g		Email	The risks of water quality degradation post-closure are also poorly and inaccurately addressed in the DEIS. To reiterate our comments above, there is very little scientific evidence in the DEIS, nor in the literature on above-ground tailings, about how quickly the cemented tailings will break down, which will leave the surface tailings less stable and highly reactive. In fact, there is no good evidence that the addition of cement to these tailings will abate the creation of acid in the first place. Meanwhile, there is ample evidence of lined, surface tailings facilities leaking over time. Because the DEIS contains no plans for treating water post-closure, when leakage from the tailings impoundment or surface breaching of it does occur, it is highly likely that contaminated water will enter Sheep Creek and the Smith River perpetually. This risks serious impacts to the watershed's fishery and aquatic community and downstream irrigation. It also would lead to the state of Montana being responsible for the costs and responsibility of treating contaminated water for generations. In summary, the DEIS incorrectly predicts that aquatic impacts would be short-term, local, and minor; whereas solid scientific evidence shows just the opposite. As	See Consolidated Responses AQ-1, WAT-1, and Submittal ID BBC00574, Comment Numbers 3 through 9, 12, and 13. See response to Submittal ID HC-003 Comment Number 80 (water resources). See Consolidated Response PD-2 and Consolidated Response PD-5 for additional discussion of surface storage of tailings in the CTF and potential for weathering and oxidation/acid formation. No adverse or long-term effects are predicted to occur on surface water and groundwater as a result of Project development based on results of the quantitative predictive models developed for the Project. To confirm this prediction, the Proposed Action and AMA require the Proponent to conduct groundwater and surface water monitoring.

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				currently planned, the Black Butte mine poses serious risk of long-term, basin-wide, significant negative impacts to water quantity and water quality, which could result in comparable damage to the system's fishery and aquatic life.	
30	5		Email	Chapter 4 of the DEIS begins: "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 (DEIS, 4-1).'" In identifying the geographic extent within which cumulative impacts should be considered, the DEIS includes "reasonable and rational spatial boundaries (e.g., hydrologic unit codes, wildlife management units, sub-basins, areas of unique recreational opportunity, viewshed) (DEIS, 4-1). Yet, the DEIS has completely dismissed evaluating the impacts of mine expansion, especially on to adjacent public lands. As MTU has repeatedly urged the DEQ, including in the scoping process, the department should thoroughly evaluate environmental impacts of a future mine expansion encompassing the hundreds of mining claims the company has filed and maintained on more than 10,000 acres of public land, which crosses numerous Sheep Creek tributaries. These mining claims are hard evidence of potential "future actions related to the proposed action." Furthermore, Sandfire (previously Tintina) has informed potential investors of the opportunity and intent to build a large mining complex through expansion that could last upwards of 50 years. The Black Butte mine proposal and investment in it will likely be the proverbial tip of the spear. It is unreasonable that the DEIS includes the Gordon Butte Pumped Storage Project, the Castle Mountains Restoration Project, and the Portable aggregate crushing and screening operation in Great Falls as projects that warrant consideration for cumulative impacts but ignores the nearly inevitable expansion of the Black Butte mine itself (DEIS, Sec. 4.2.2, pg. 4-7). Early exploration for the Black Butte Copper Project have already identified additional ore bodies, such as the Lowry deposit. The DEIS allows for either Townsend or Livingston (or both) to be used as railheads for the shipping of ore from containerized trucks to trains. The decision about which location to use (or both) will, ostensibly, be left to the mine operator. The DEIS provides little information about how or when the operator will make shipping route determinations. The DEIS estimates that 18 round-trip per day will be made by trucks transporting mine concentrate in sealed containers to the MRL rail yards in one of those locations. It assumes that shipping containers used for the ore concentrate would not result in spills or leakage except, in the case of an accident severe enough to compromise the integrity of the container. Yet there is no good analysis of the likelihood, severity and impacts of an accident along the Deep Creek canyon of US 12 from White Sulfur Springs to Townsend. This is a water quality and fisheries risk that deserves a more thorough Failure Modes and Effects Analysis. That is especially true considering that the DEIS includes the following information on the Deep Creek route: "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	Regarding the mine expansion comment, see Consolidated Response CUM-1. Regarding the comment about accidents along the Deep Creek canyon of U.S. Route 12 from White Sulphur Springs to Townsend, reasonably foreseeable and/or potential environmental consequences and effects due to the Project have been analyzed in Section 3.12.3.2, Proposed Action, of the EIS. The Final EIS includes any new analyses dependent on new information (e.g., accidents along U.S. Route 12). Regarding the comment about impacts on wildlife, Section 3.15, Wildlife, of the EIS discusses effects on wildlife, including direct, indirect, and cumulative effects on big game species (e.g., elk, deer, etc.) and grizzly bears. Montana FWP reviewed the preliminary Draft EIS as part of the process, and the Draft EIS was revised according to edits from FWP staff. Regarding the climate change comment, see Consolidated Response MEPA-2.

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				road segment (DEIS, 3.12-8).” Anyone familiar with the road in question understands the risk of a severe truck accident, as well as the many places along this road where such an accident could lead to the rupture or failure of a sealed container and, hence, the contamination of Deep Creek with ore concentrate. The DEIS fails to properly assess and acknowledge this risk and to evaluate the consequences therein to Deep Creek water quality, habitat and aquatic life. A similar evaluation of risk and consequences is also lacking in the DEIS for the Livingston transportation route and the adjacent Shields River. Although it falls outside the MTU mission, reading the Cumulative Impacts section of the DEIS compels us to highly recommend that DEQ consult with Montana Fish, Wildlife and Parks on a re-evaluation of impacts of the current proposed mine, as well as future expansion, in regard to wildlife. The DEIS curtails consideration of wildlife impacts to the mine site proper, which disregards how that mine site might interrupt wildlife migration. DEQ’s consultation with FWP should emphasize movement patterns and data for species of concern such as grizzly bears, as well as highly valued game such as elk and mule deer. Finally, the DEIS needs to address the potential cumulative impacts of climate change. In regards to water issues, this means considering changes in flow, water availability, timing of seasonal high and low flows and water temperature. Mine facilities or infrastructure could also be impacted by changes in climate. For example, the vulnerability of the CTF to increasingly frequent and intense wildfires deserves close consideration. In July of 2017 a wildfire threatened the Zortman-Landusky mine site, including its water treatment system. The impact of such events, exacerbated by climate change, should be part of the mine plan analysis for Black Butte. There is a growing literature on the risks that climate change poses to the mining industry. For example, the Bureau of Land Management has recently determined that designing a stormwater facility that can accommodate a 24-hour/100-year storm event at Zortman-Landusky is inadequate due to the increased likelihood and severity of large runoff or rain on snow events that climate change modeling predicts (Williams, BLM, “Climate Change: Extreme Conditions: Do Plans of Operations Need to Include an Ark?” Presented at the 20th Annual Mine Design, Operations & Closure Conference, April 29-May 3, 2012. https://www.mtech.edu/mwtp/2012_presentations/Dave%20Williams.pdf). Currently the Black Butte mine plan estimates peak outfall flows based on a 10-year storm event and the stormwater drainage structures have been designed for a 24-hour/100-year event, which should no longer be considered best practices. Climate change prediction demand a re-evaluation of all site facilities that include water management, especially the CTF and stormwater systems. On the low flow side of the spectrum, the DEIS fails to consider the impacts of extreme low flows due to higher summer temperatures and drought on Sheep Creek and its tributaries, as well as the main Smith River. Climate impacted low flows will increase the risks posed by the mine’s reduction of stream flows in tributaries such as Black Butte Creek, Coon Creek, and Sheep Creek.	
31	1		Email	Please enter my comment into the public record on the Black Butte Copper Project in Meagher County. The Draft EIS is very complete and includes an analysis of the potential impact the project might have on the transportation systems in the area. For those who live in the area, studying the increase in traffic that will come with constructing and operating of the Black Butte Mine is important. In Section 3.12, Pages 1 through 12, accomplishes	Thank you for your comment.

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				this task in a responsible manner. Thank you. As the study revealed, when the mine is operating, the road system in the area that would receive the most incremental increase in traffic compared to 2016 is US Route 89. Table 3.12-2 shows that average traffic on this road, except for a few areas just north of I-90 near Livingston, has remained fairly static since 2005. Section 3.12.3, Page 8, explains that: "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." In other words, even with the increase in traffic from the badly needed economic development the area would enjoy during the mine's operation, the existing road system is more than capable of handling the increase in use. I was pleased to see that Tintina Montana proposes to encourage carpooling and would provide a shuttle service out of White Sulphur Springs as mitigation for these small increases in traffic. I was also pleased to see that the company intends to work with the Montana Department of Transportation in addressing possible safety concerns at the intersection of U.S. Highway 89 and Sheep Creek Road; U.S. Route 12 (Milepost 28.0 to 29.9); will review school bus schedules and project truck traffic to limit the risk of interactions with school bus traffic; and will use on-board systems to monitor and limit concentrate truck speeds on their routes (Section 3.12, Page 11). In an area that has suffered through years of economic malaise, the socioeconomic impact of over 200 family-wage jobs is a huge positive compared to the small increase in road traffic the project will bring to road systems that are being utilized far below carrying capacities. This is especially true when Tintina Montana's plan is to be pro-active in mitigating for the increase.	
32	1		Email	Please enter my comment into the public record on the Black Butte Copper Project in Meagher County. The Draft EIS is very complete and includes an analysis of the potential impact the project might have on the transportation systems in the area. For those who live in the area, studying the increase in traffic that will come with constructing and operating of the Black Butte Mine is important. In Section 3.12, Pages 1 through 12, accomplishes this task in a responsible manner. Thank you. As the study revealed, when the mine is operating, the road system in the area that would receive the most incremental increase in traffic compared to 2016 is US Route 89. Table 3.12-2 shows that average traffic on this road, except for a few areas just north of I-90 near Livingston, has remained fairly static since 2005. Section 3.12.3, Page 8, explains that: "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." In other words, even with the increase in traffic from the badly needed economic development the area would enjoy during the mine's operation, the existing road system is more than capable of handling the increase in use. I was pleased to see that Tintina Montana proposes to encourage carpooling and would provide a shuttle service out of White Sulphur Springs as mitigation for these small increases in traffic. I was also pleased to see that the company intends to work with the Montana Department of Transportation in addressing possible safety concerns at the intersection of U.S. Highway 89 and Sheep Creek Road; U.S. Route 12 (Milepost 28.0 to 29.9); will review school bus schedules and project truck traffic	Thank you for your comment.

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				to limit the risk of interactions with school bus traffic; and will use on-board systems to monitor and limit concentrate truck speeds on their routes (Section 3.12, Page 11). In an area that has suffered through years of economic malaise, the socioeconomic impact of over 200 family-wage jobs is a huge positive compared to the small increase in road traffic the project will bring to road systems that are being utilized far below carrying capacities. This is especially true when Tintina Montana's plan is to be pro-active inmitigating for the increase.	
33	2		Email	1. Despite assurances the Department of Environmental Quality offered years ago about the Zortmund Landusky mine, Montanans got stuck with the toxic aftermath of this mine and we inherited millions of dollars worth of perpetual cleanup costs. A. How much have the taxpayers paid in reclamation costs since this company declared bankruptcy and passed its cleanup responsibilities to Montana taxpayers? B. How much will the Montana annual reclamation expenses cost Montana taxpayers to pay for these broken corporate promises? C. How long will Montana taxpayers continue to bear these expenses? D. How much did the Pegasus Mining Company contribute to cleanup after the mines closed? E. What assurances can you give Montana taxpayers BEFORE the company has an opportunity to mine this will not happen again? F. Will bonding be sufficient to cover the perpetual water treatment that may be necessary?	See Consolidated Response FIN-1.
33	3		Email	2. History with mining in Montana is bad enough that DEQ should automatically vet all applicants, owners, and management teams. Sandfire has gone through leadership and company name changes during the application process that are significant. A. How much research has DEQ conducted in to the upper management of Sandfire? B. Have any of them been involved in mining activities in places other than Montana that have left behind unacceptable levels of contamination and liability? C. If the answer to B. above is yes, does DEQ intend to invoke the "Bad Actor" rule against them? D. How does DEQ enforce anything on a company that declares bankruptcy, and-or, changes its identity multiple times and continues to do business as usual?	See Consolidated Response FIN-1. DEQ has reviewed the MOP Application (Tintina 2017a) and does not intend to invoke the Bad Actor Rule against Tintina or its employees.
33	4		Email	3. Blasting activity used in the mining process could create major cracks in bedrock that potentially becomes new pathways for contaminants to flow into groundwater. A. How can you assure us that nitrates from the blasts and other mining waste by-products will not affect the water quality and all living things that depend upon the pristine waters of the Smith River and its tributaries?	See Consolidated Response WAT-3 for more information about the concern of blasting creating fractures. Section 3.4, Groundwater Hydrology, of the Draft EIS discusses faults. It is well known that faults can act as either groundwater flow conduits or groundwater flow barriers. However, based on the extensive modeling and other references, the blasting proposed in the MOP Application (Tintina 2017a) is not expected to create faults or long distance flow conduits. Rather, the fracture depth of the rock is expected to be on the scale of meters, which cannot act as groundwater conduits to the Smith River or its tributaries. Appendix N, Section 4.3.2 of the MOP Application states: • "In the base case model, we assume an F_D[1] of 10% in the upper zone, extending 1 meter from the wall surface, meaning that the fractures induced by the blasts have a reactive surface area that is 10% of the surface area of HCT material. A 10% F_D is conservative because it is on the high end of previously reported studies of pit walls fracture densities, which would be under less lithostatic pressure than subsurface workings and would be expected to have higher fracture density (Siskind and Fumanti, 1974; Kelsall et al. 1984)."

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					• "The base case model assumes that T_{RZ}[2] has a maximum of 1 meter, i.e., the limit of the fractured zone. Early reports (Kelsall 1984, and Siskind and Fumanti, 1974) indicate that blast fracturing in granite and basalt walls is generally limited to a depth of 1 meter, beyond which rock porosity was unchanged by blasting. Kelsall et al. (1984) also show that typical values range from 0.3 m to 1.0 m, so our estimate is conservative. We evaluate model sensitivity to this assumption by using a 2-meter maximum fractured zone in a sensitivity scenario. In another sensitivity scenario, we assume a 1-meter fractured zone and a reactive zone up to 15 meters." Further, the Proponent collected data indicating that some faults intercepted by the drilling are filled with gouge,[3] which limits transmissive capacity of the fault. Also, faults, even if hydraulically active, are often not fully expressed in zones of shallow and weathered bedrock close to ground surface, such that their capacity for providing hydraulic connection of the groundwater system with surficial waters is limited. Lastly, Appendix T, Pressure Grouting Plan, of the MOP Application also describes where and when mine access decline and tunnels would be grouted. Any remaining water in the mine workings would report either to the CWP, then to the WTP, or directly to the WTP, as described in Section 2.2, Proposed Action, of the Draft EIS. This contact water would be treated to non-degradation standards prior to discharge. Notes: [1] F_D = fracture density [2] T_{RZ} = thickness of the reactive zone [3] Putty-like material composed of ground-up rock found along a fault
33	5		Email	4. Tintina has proposed entombing tailing waste. A. Is the cement paste used to do this going to last forever? B. Will the acidic wastes corrode the cement paste, and if so, how long will this take and what contingency steps is the DEQ requiring of the company? C. What guarantees can you offer us that the acidic waters from the mine wastes will not enter groundwater in our lifetime or that of our decedents?	See Consolidated Responses PD-1, PD-3, and PD-5.
33	6		Email	5. The public review process for such a major proposal is extremely short. A. Why does a private foreign-owned company like Sandfire get to dictate how long Montana citizens get to review the environmental impact of their enormous mining proposal? B. What assurances can you give us that with these important decisions made by people who will profit from it, are fairly made, when it appears the company is making many of the process decisions regarding this permit? Isn't that a conflict of interest?	A. See Consolidated Response MEPA-1. B. DEQ has the ultimate decision-making authority over whether or not to grant the Proponent 1) an operating permit in compliance with the MMRA, 2) an integrated MPDES permit, and 3) a Montana Air Quality permit. Other permits are the authority of the respective federal, state, and local government agencies. The Proponent does not have any permit-granting authority.
34	1		Email	The Black Butte copper mine seriously risks polluting and reducing flows in Sheep Creek, the Smith River's most important trout spawning tributary. Both Sandfire and the Montana DEQ grossly underestimated how much groundwater connected to the Smith River headwaters will flow into the mine and have to be treated for toxic contamination before being pumped back into the ground.	See Consolidated Responses WAT-1 and AQ-1.
34	2		Email	Sandfire's plans to keep mine tailings and toxic waste in place for decades is very experimental. Neither the mining company nor the DEQ provided evidence guaranteeing that it will work. The reality is, there is no such thing as a leak-proof tailings pond, even if the pond has a double-lined bottom and the tailings are rendered non-flowable.	See Consolidated Responses PD-2 and PD-4.

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34	3		Email	The DEIS did not adequately characterize the fish populations and other aquatic life in Sheep Creek, other local tributary streams, and the Smith River that will be impacted if the Black Butte copper mine is built. Without this baseline information, it will be impossible to accurately gauge whether and to what extent the mine is adversely impacting aquatic life.	See Consolidated Response AQ-2.
34	4		Email	The cumulative effects section of the DEIS evaluated impacts of the Black Butte mine only until the year 2037, but Sandfire holds 525 mining claims on nearly 10,000 acres of adjacent federal lands and the former CEO told potential investors that the company plans to create a 50-year industrial mining district in the vicinity. Both the timescale and geographic scope of the cumulative effects analysis need to be broadened.	See Consolidated Responses CUM-1, CUM-2, and CUM-3.
34	5		Email	In conclusion, I believe the Smith River is too precious to risk just so a foreign-owned mining company can turn a quick profit and leave Montana taxpayers to clean up its mess. The Black Butte copper mine would be in operation for only 13 years, but the damage to the Smith River and its tributaries would be permanent.	See Consolidated Response FIN-1.
FL1	1		PDF	I believe the mine proposed by Tintina on the Sheep Creek drainage will cause an unacceptable risk to a Montana treasure, the Smith River State Park. The Smith River State Park has legendary status among Montanans as the only river in this amazing State to require a lottery, permit, and strict usage regulation for those very few lucky enough to win the opportunity to float its waters. Ask any trout enthusiast if they would rather fish- Yellowstone National Park, Glacier National Park, or the Smith River State Park, and they would likely be as excited about the Smith as the federally protected lands that have national protected status. A float down the Smith River is an extremely high quality environmental experience. It’s a rare place, unique in the continental United States. Among outdoors people it is legendary, deserving of protections offered by National Parks. We are asking the review of the Tintina EIS to reflect the importance of this extremely valuable Montana resource, which is a legendary Montana Treasure. Standards should be established to ensure that no temporary, private company can endanger this environmentally pristine resource. As Montana citizens, we are charging you, the Department of Environmental Quality, to value Smith River State Park as we do. It is far more valuable than temporary copper grab by a foreign corporation.	Comment noted. The EIS does discuss the uniqueness of the Smith River and the permit requirements for floating the river. As discussed in Section 3.7.3, Environmental Consequences, of the EIS, DEQ does not anticipate any direct, secondary, or cumulative impacts on recreational opportunities on the Smith River.
FL1	2		PDF	1. Despite assurances the Department of Environmental Quality offered years ago about the Zortmund Landusky mine, Montanans got stuck with the toxic aftermath of this mine and we inherited millions of dollars worth of perpetual cleanup costs. A. How much have the taxpayers paid in reclamation costs since this company declared bankruptcy and passed its cleanup responsibilities to Montana taxpayers? B. How much will the Montana annual reclamation expenses cost Montana taxpayers to pay for these broken corporate promises? C. How long will Montana taxpayers continue to bear these expenses? D. How much did the Pegasus Mining Company contribute to cleanup after the mines closed? E. What assurances can you give Montana taxpayers BEFORE the company has an opportunity to mine this will not happen again? F. Will bonding be sufficient to cover the perpetual water treatment that may be necessary?	See Consolidated Response FIN-1.

Form Letter ID	Comment Number	Organization	Source	Comment	Response
FL1	3		PDF	2. History with mining in Montana is bad enough that DEQ should automatically vet all applicants, owners, and management teams. Sandfire has gone through leadership and company name changes during the application process that are significant. A. How much research has DEQ conducted in to the upper management of Sandfire? B. Have any of them been involved in mining activities in places other than Montana that have left behind unacceptable levels of contamination and liability? C. If the answer to B. above is yes, does DEQ intend to invoke the "Bad Actor" rule against them? D. How does DEQ enforce anything on a company that declares bankruptcy, and-or, changes its identity multiple times and continues to do business as usual?	See Consolidated Response FIN-1. DEQ has reviewed the MOP Application (Tintina 2017a) and does not intend to invoke the Bad Actor Rule against Tintina or its employees.
FL1	4		PDF	3. Blasting activity used in the mining process could create major cracks in bedrock that potentially becomes new pathways for contaminants to flow into groundwater. A. How can you assure us that nitrates from the blasts and other mining waste by-products will not affect the water quality and all living things that depend upon the pristine waters of the Smith River and its tributaries?	Any fractures created by blasting in the proposed underground mine are predicted to be limited in extent. This topic is discussed further in Consolidated Response WAT-3. RO with pretreatment would be used to treat mine dewatering flow during operations and closure to assure compliance with surface water and groundwater standards and non-degradation criteria per the MPDES permit (Hydrometrics Inc. 2018a; Tintina 2018a). RO is a highly efficient treatment process that targets dissolved metals and nutrients, including nitrate. Also refer to Consolidated Response AQ-1, Nuisance Algae, for additional details on mitigating seasonal nutrient exceedances.
FL1	5		PDF	4. Tintina has proposed entombing tailing waste. A. Is the cement paste used to do this going to last forever? B. Will the acidic wastes corrode the cement paste, and if so, how long will this take and what contingency steps is the DEQ requiring of the company? C. What guarantees can you offer us that the acidic waters from the mine wastes will not enter groundwater in our lifetime or that of our decedents?	See Consolidated Responses PD-1, PD-3, and PD-5.
FL1	6		PDF	5. The public review process for such a major proposal is extremely short. A. Why does a private foreign-owned company like Sandfire get to dictate how long Montana citizens get to review the environmental impact of their enormous mining proposal? B. What assurances can you give us that with these important decisions made by people who will profit from it, are fairly made, when it appears the company is making many of the process decisions regarding this permit? Isn't that a cont1ict of interest?	A. See Consolidated Response MEPA-1. B. DEQ has the ultimate decision-making authority over whether or not to grant the Proponent 1) an operating permit in compliance with the MMRA, 2) an integrated MPDES permit, and 3) a Montana Air Quality permit. Other permits are the authority of the respective federal, state, and local government agencies. The Proponent does not have any permit-granting authority.
FL2	2		PDF	4. The company's plans to keep waste and toxins in place for decades or generations is very experimental. They provide no good evidence that it will work. The Smith River is their guinea pig.	See Consolidated Response PD-2.
FL2	3		PDF	5. The dEIS has not properly or sufficiently looked at the aquatic life in the Smith and its tributaries that this mine will threaten.	See Consolidated Responses AQ-1 and AQ-2.
FL3	2		PDF	I am concerned and mystified why the Montana Department of Environmental Quality (DEQ} has only provided a 60-day comment period on a highly technical document over 800 pages in length. It is vital that the public have an adequate period of time to review, research and comment on this document, especially since the proposed mining activity will impact our environment into perpetuity. I request that the DEQ and Sandfire extend the deadline to receive public comments.	The Draft EIS analysis does not predict that significant perpetual environmental impacts would occur. See Consolidated Response MEPA-1.

Form Letter ID	Comment Number	Organization	Source	Comment	Response
FL3	3		PDF	The DEIS does not sufficiently address the potential for dewatering, potential groundwater contamination and the possibility that this could impact surface waters, and the disturbance of critical wetland areas.	See Consolidated Responses WAT-1, WAT-2, and WAT-4. Also see Submittal ID HC-003, Comment Number 61.
FL4	2		PDF	1) The DEIS for this project was unacceptably rushed and it was based on an incomplete mine plan. Major changes were made to the mine plan after the public scoping process.	See Consolidated Responses MEPA-1 and MEPA-3.
FL4	3		PDF	2) The Black Butte Project presents a significant long-term risk to water quality because the mine waste must be isolated from air and water in perpetuity to prevent acid mine drainage. The proposed cement tailings facility is new technology that is untested over time, and the DEIS does not consider the potential for liner system failures – a common occurrence at mines.	See Consolidated Responses PD-2, PD-4, and PD-5.
FL4	4		PDF	3) The mine seriously risks reducing flows in the Smith River's most important trout spawning tributary. The company and the DEIS grossly underestimate how much groundwater connected to the Smith River headwaters will flow into the underground tunnels.	See Consolidated Responses WAT-1 and AQ-1.
FL4	5		PDF	4) The DEIS evaluates an artificially small mine footprint because it fails to consider the cumulative effects of mining the Lowry Deposit that is immediately adjacent to the existing ore deposit even though the company is telling its investors that it is part of its mining plans for the area.	See Consolidated Response CUM-1.
FL4	6		PDF	5) The DEIS has not properly or sufficiently looked at the aquatic life in the Smith and its tributaries that this mine will threaten.	See Consolidated Response AQ-2.
Postcard	2		Postcard	It is troubling that you have only allowed the public 60 days for review of a technical document containing over 800 pages. An adequate comment period is essential to guarantee that the public can adequately review the document and comment on it. I request that DEQ and Sandfire extend the comment deadline.	See Consolidated Response MEPA-1.
Postcard	3		Postcard	Second, the DEIS does not sufficiently account for the potential for dewatering, pollutants moving from groundwater to surface water, and wetland disturbances. The health of Smith River habitat deserves a proper accounting of and planning for the worst-case scenario.	See Consolidated Responses WAT-1, WAT-2, and WAT-4. Also see Submittal ID HC-003, Comment Number 61.

**Table 8.2-4
Individuals Submitting Form Letters**

Form Letter 01									
Lacie Farmer	Eric Boysen	Karen Long	George Everett	Faith Dewaay	Bob Doxey	Gordon Stewart	Foster Wilson	Justin Blake	Justin Brown
James Loomis	Carole Piazzola	Casey Erickson	Susan Hoskins	Eric Obrigewtich	Nancy Kenny	Barbara Ranta	Bill Nelson	Steve Petroni	Timothy Smith
Ed Moeglein	Harold Johnson	Jim Black	Walter Shaw	Tyler Kump	Christian Rohloff	Rich Johnson	Mary Mcguire	Johanna Defoort	Stuart Dallas
Andrew Cameron	Loren Hanni	Mykenzie Maupin	Craig Savage						
Form Letter 02									
Thomas Dalton	Sam Ziegler	Frank Sholey	Dawn Mikesell	Bryan Mikesell	Jim Olsen	Brian Lee	Shane Parrow	Jake Verlanic	Steven Vaala
Laura O'connor	Craig Espeland	Nickolas Vose	Jay Raymond	Dennis Morelock	Sharon Bennett	Susy Johnson	Michael & Lorna Emineth	Scott Mendenhall	June Voldseth
Josie Carlson	Charles Mcleod	Kevin Kovacich	Holly Wells	Dave Stratton	Kendall Ratcliff	Dan Flynn	David Armstrong	Corey Warner	Michael Wenskunas
Roger Zikmund	Ray Harrison	Dana Dugan	Scott Manhart	Pete Hallquist	Rena Wetherelt				
Form Letter 03									
Barbara Bartell	David Seder	Burt Thomas	Sally Stewart	Alysha Wilson	Brad Bartlett	Jill Dove	Doug Stiles	Robert Vince	Kip Knapstad
Richard Tatarka	Ethan Schlepp	David Gendrow	Devin Mccarthy	Kerry Weightman	Phil Garcia	Stephen Swan	Ashley Kent	Amy Breider	Seth Brown
Shawn Zahn	Shane Mellott	Stephen Walks	Shane Jacobsen	Theresa Taylor	Cathy Stone-Carlson	Trenton Streeter	Clint Sundt	Walter Mcnutt	Charlene Sholey
Ross Evig	Steve Enriquez								
Form Letter 04									
Bruce Vincent	Michael Maack	Helen Joyce	Paula K Pacente	Gary Marks	Carl Orth	Caroline Caudill	Dave Cole	Bob York	Calvin Johnson
Levi Sanders	Tom Smith	William Welsh	Mesa Williams	Chris Crosby	Jonathan Youngers				
Form Letter 05									
Nancy Duel	Alex Broili	Daniel Jones	Patricia Vincent	Shawn Erickson	Austin Timmons	Kelly Stolp	Randy And Cathy Nordhagen	Daniel Snyder	Terry Tincknell
Craig Carlson	David Lee	Carl Orth	Earl Andrus	Richard Fish	Mark Briggs	William Fitzpatrick	Brent Doig	Kristie Brenden	Jack Murray
Austin Davis	Jeromy Riggin								
Form Letter 06									
Patti Vincent	Kevin Test	Clint Moore	Echo Venn	Dick Roma	Petersen Petersen	Evan Crook	Phyllis Holm	Chris Nelson	Alan Jensen
Debbie Thomas	Guy Rasmussen	Sean Hill							
Form Letter 07									
Collin King	Justin Venn	Jason Dinius	Dale Malyevac	Brenda Funke	Kip Knapstad	Aaron Norby	Daniel Scheitlin	Amelinda Olson	Jake Doherty
Helen Paris	Joe Merrick	Lacey Hill	Rylee Smith	Kraig Pester	Guy Riggin				
Form Letter 08									
Randy Mikesell	Brian Lee	Keith Barkell	Sarah Schlepp	John Kafka	Brittany Caudill	Mark Pesa	Monty Streeter	Mike Merrick	Jaylynn Chiotti
Emily Burk	Sarah Herold	Judy Kolman	Shane Delzer	Helen Jensen	Tyler Yuhas				
Form Letter 09									
Tammie Quinby	Carlee Prough	James Hesketh	Russ Currie	Paul Babcock	Amanda Griffith	Teresa Platt	Brandon Kent	Bill Hahn	John Eddy
Donald Delauder	Richard Buti	Hilary Stermitz							
Form Letter 10									
Kevin Davis	Jerry Cummings	Jake Verlanic	Thomas Kloker	Al Bodle	Randy Sholey	William Dobb	William Young	Jerry Frohreich	Cory Chadwick
Thomas Chadwick	Patrick Hansen	Terry Tincknell							

Form Letter 11									
Jaime Tesky-Gendrow	Edward Regan	Michelle Davis	Travis Chiotti	Jeff Salmonsen	Roger Zikmund	Vickie Zikmund	Bill Brosam	Michelle Johnson	Scott Jennings
Christopher Condon	Ken Holkan	William Arnold	Chris George						
Form Letter 12									
John Kafka	Craig Staley	Tom Needs	Mike Krokosz	Scott Mccue	Colleen Snyder	Rick Jordan	Dave Wellman	Dallas Rasmussen	Ken Hugulet
Michael English									
Form Letter 13									
Clint Mortensen	Dena Hamry	Joe Perry	Keanen Fitzpatrick	Guy Rasmussen	Ronald Caudill	Tod Simon	Darlene Slusher	Cynthia Young	James Carlson
Tim Antonioli									
Form Letter 14									
Philip Mulholland	Harold Johnson	Vicki Moore	Michael Burk	James Liebetrau	Theresa Taylor	Brett Seitz	Charles Hill	Bob Hall	Stephanie Yuhas
Form Letter 15									
David Smith	Joshua Wiley	Buck Sullivan	Steven Mccullough	Terry Thompson	Ed O’neill	Paul Tash	Lynda Dewitt	Michael Teter	Tom Hohn
Form Letter 16									
Charles Slyker	James Rossiter	Frank Kieser	Linda Lien	Ronald Hanson	Fess Foster	Robin Sterrett			
Form Letter 17									
David Melius									
Form Letter 18									
Ted Antonioli									
Form Letter 19									
Carol Peterson									
Form Letter 20									
Morris Kaufman									
Form Letter 21									
Linda Healow									
Form Letter 22									
Linda Semones									
Form Letter 23									
Steven Lloyd	Steve Larson								
Form Letter 24									
Karl Jacobson									
Form Letter 25									
Eugene Graf									
Form Letter 26									
Jim Morton									
Form Letter 27									
Brad Mathis									
Form Letter 28									
Dana Riley									

Form Letter 29							
Duane Ankney							
Form Letter 30							
David Brooks							
Form Letter 31							
Aaron Whipperman							
Form Letter 32							
Kelly D Holmes							
Form Letter 33							
Mandi Standley	Jim Bryan	Maura Wright	Sherry Wells	Rachel Aagenes	Krisy And Scott Hammond	Kellan Anfinson	Mark And Ann Feldhauser

Form Letter 34									
Alex Cairns	Catherine Tyler	Anthony Pavkovich	Lisa H	Drew Macalady	Thomas Caldwell	Bill Bradt	Rebecca Knudsen	Josh Olsen	Linda Blair
Ann King	Phyllis Phillips-Clower	Vicki Wiepking	Cathe Lowden	Charles Hawkins	Margie Radtke	Spencer Lawley	Chrissy Pepino	Marilyn Mueller	Dori Bailey
Nicolas Duon	Erin Corsi	Jacob Sweezy	Mary Troland	P Perron	Virginia Sullivan	Rae Stevenson	Tessa Park	Gregory Madson	Michael Winebrenner
Donna Stoddard	J H	Kristin Green	Karen Orner	Carol Metzger	Stephen Mudrick	Thomas Libbey	Shirley Johannsen	Christopher Williams	Michael R. Watson
Thomas Fawell	Ian Ferguson	David Lamiquiz	Doug Roaten	Susan Babbitt	Antoinette Gonzales	John Palenik	Betty Pappas	Sam Weidenbach	Susan Mccarthy
Annie Mcmahon	Lollie Ragana	Annette Nelson	Judith King	Michael Blazewicz	Jonathan Slaughter	Miguel Ramos	Mary Fedullo	Peter Harwood	James Henriksen
Don Pew	Stephen La Serra	Dora Magovern	Myles Hunt	Tiffany Haverfield	Tower Snow	Ilene Beninson	Yvonne Irvin	Richard Desantis	Victoria Hall
Joyce Johnson	Brett Taylor	Julio Andujar	Ludmila Dmitriev-Odier	Kelsey Taylor	Gary Herwig	Suzanne Scollon	Terri Knauber	Dale Carpenter	Evelyn Malone
Richard Mclane	Tom Klein	Carol Lake	Elke Hoppenbrouwers	Brett Kengor	Kathleen Mclane	Stevie Sugarman	Nikki Doyle	Jamie Shultz	Bobbie Hensley
Christine Viscuso	Miranda Mendoza	John Comella	Nancy Fomenko	Marylyn Stroup	Michael Casey	Brenda Eckberg	Steven Korson	Steve Rajeff	Sandra Cobb
Wayne Wilkinson	Robert Gibb	Richard Mccrary	Ronald Brown	Fran Cox	Peggy England	Dan Horton	Arlene Aughey	Pierre Meilhac	Meryl Rogers
Timothy Dunn	John Deddy	Bruce Ross	Roger Williams	Gloriamarie Amalfitano	Jessica Burlew	Dan Brown	Joel Destefano	Carol Shelton	Pamela Shuman
Fern Stearney	Charles Roth	Thomas Carroll	Jacquelyn Barnes	Marie D’anna	Steve Brown	Deborah Baker	Shari Riffe	V.l. Brandt	Warren Allely
Carolyn Bartholomew	April Jacob	Richard Swain	Eileen Fonferko	Deanna Horton	Michael Wichman	Maureen North	Janna Piper	Tonda Bailey	Barbara Deur
Timothy Mullen	Steve Vicuna	Diane Kadomoto	William Bartley	Priscilla Drake	Robert Palmer	Edna Mullen	Gina Obrien	Beth Ross	Kathleen Williams
Taen Scherer	Eleanor Dowson	George Buehler	Michael Haskell	Kathy Semic	Robert Gendron	Richard Robinson	Rocio Luparello	Gordon Macmartin	Kristy Howe
Carolyn Marion	Scott Emsley	Kelly Saunders	Michael Maher	Donna Lewis	Kari Castillo	Lori Lester	Martha Vest	Elaine Larson	Sean Sellers
Glenn Barclift	Elizabeth Hegeman	Anne Kreis	Anne Fitzgerald	Bruce Coons	Arden Green	Sharon Balzano	Robert Pennell	Karen Lundvall	Dawn Kosec
Michael Stocker	Molly Mysliwiec	Micki Bailes	Pilar Quintana	James Sliger	Douglas Gunderson	Jeffrey Linden	Christopher Lawrence	David Kizer	Sherry Mccullough
Elizabeth Owens	Ann Sullivan	Franzelle Carmon	Brenda Michaels	Emmet Ryan	Regina Leeds	Diane Sullivan	Carol Jagiello	Nadine Duckworth	Therese Mcrae
Stephen D Cotterill	Ariella Ingraffia	Tina Bailey	Tia Triplett	David Rosenquist	Christopher Kowalski	Stephen Mead	Susan Goldstein	Carmon Steven	Ron Macarthur
Pat Lastrapes	Kacie Shelton	Jim Wingate	Doug Gemmell	Eric Hirshik	Linda Banta	Michelle Mouton	Chris Jones	Raymond Ings	Lydia Kendall
Marsha Schaub	Dean Peter	Nick Szumlas	Judith Lienhard	Amy Fisher	Ben Ganon	William Ridgeway	Steve Green	Patrik Pierce	Nancy O
Lori Erbs	Jl Angell	Heidi Ludwick	Sharon Porter	John Butterworth	Brian Baltin	Patrick Callaghan	Nancy Morgan	Cody Kenyon	Peter Chllds
Lauren Maclise	Patricia Duran	Elaine Dearden	William Barton	Cindy Loomis	Gwendolyn Karan	Eric West	Jan Fortini	Leonid Volovnik	Jennifer Downing
Ricki Stephens	Stacy Jensen	Ria Tanz Kubota	Jude Lotz	Mark Feldman	Deborah Mathiowetz	Mary Allen	Linda Ogren	Sheila Ganz	Paula Long
Linda Araujo	Kenneth Gillette	Joie Budington	Pamela Winberry	Stan Fitzgerald	Shannon Agee-Jones	Kevin Bourke	Hank Ramirez	Russ Wagner	Shari Grounds

Form Letter 34

Dan Perdios	Ina Pillar	Johnp Davis	Harriet Mccleary	Gloria Shen	John Thomas	Robert Wagner	Beverly Simone	Lynne Glaeske	Ben Rall
Mia Heavyrunner	Paula Neville	Katherin Balles	Ferris Lyle	Judith Sloane	Brian Gottejman	Brian Buhman	Orville Mckinney	Lois Heaston	Cathy Brandt
Michael Bennett	Ying Cooper	Cat Marron	Nancy Richard	Todd Goddard	Janet Neihart	Kermit Cuff	Elizabeth L. Anderson	Kathleen Oldham	Laura Combs
Deborah Williams	Michael Salzmann	Elaine Eudy	Joshua Aevum	Gerald Kretmar	James Bell	Denise Sicotte	Susan Ambler	Lonnie Patterson	Jessica Cresseveur
Kathleen Mallory	Blake Wu	Joyce Robinson	Les Lord	Cathy Brownlee	Dean Knauer	Jana Perinchief	Dustin Eldridge	Roslynn Budoff	Kathleen Grossman
T Bell	Benjamin Welborn	Lawrie Macmillan	Summer Devlin	Mark Soenksen	Charles B.	Lisa Koehl	Alison Taylor	Quentin Fischer	Pat Simons
Susan Thompson	Shaleigh Holland	Michael Brandes	Janis Gummel	Marcia Kellam	Gerald Hassett	Elizabeth Mackelvie	Steven Gilson	Sally Phelps	Paul Potts
Pat Halderman	Sheri Staley	Daken Vanderburg	Anna Simle	Robert Schuessler	Barbara King	David Hermanns	Linda Auld	Kathleen King	Peter Thompson
Duncan Cottrell	Rebecca Kimsey	Laura Collins	Robert Brown	Sara Shaw	Kevin Reynolds	Norm Wakerley	A. Todd	Susan F. Fleming	Mark Van Valkenburgh
Loretta Aja	Rhonda Carter	Ron Young	Marie Travis	Cecilia Nevel	Robert Helm	Jeffrey Luther	Shelly Kepler	Elaine Winter	John Seamon
Devin Dotson	Marian Cruz	Blair Kangley	Patricia Wynn	Ellen Halbert	Gregory Pais	Keith Hamilton	Jonathan Loeffler	Erik Schreiner	Ellen Homsey
Quida Jacobs	Susan Worden	Bart Spedden	Michael Kavanaugh	Joseph Stasey	Roanne Lebrun	Andrew Erwin	Meg Gilman	Curt Sholar	Melissa Fleming
Suzanne Hamer	George Simmons	Jeffery Biss	Bill Brabson	David Brockett	Michael Tucker	Robert Keiser	Ariana Saraha	Jasha Stanberry	Susan Wayne
Felicity Hohenshelt	Dan De Yo	Kirk Phillips	Ingrid Claus-Noto	Dorinda Kelley	Maryse Vrambout	Rebecca Muzychka	Chip Lyon	Martin Zahn	Matt Kroner
Debra Heatherly	Linda Smathers	Jan Weisel	Mimi Masse	Karine Aguilar	Edward Hall	Sandra La Mont	Brett Wedeking	Richard Siegel	John Kallestad
Garrick Campbell	Paul Richards	Lloyd Hedger	Karen Matthews	Juliet Pearson	Ellen Wasfi	Ashley Yonker	Julie Ogier	Paul Rubin	Ellen Ribolla
Leno Sislin	Sharma Gaponoff	Carolyn D Pruitt	Kathi Lyons	Sharon Mueller	Brendalee Lennick	Jared Howe	Sandra Perkins	Chris Tyran	Dennis Demarinis
Danielle Murphy	Rita Meuer	Marci Robinson	Michael Hague	George Alexander	Deirdre Morris	Laura M. Ohanian	Charlene Knop	Andy Tomsky	Rebecca Rabinowitz
Juli Van Brown	Stephen Auerbach	Susan Cox	Susan Peirce	Annetta Smith	Nathan Hall	Jean Publieee	Haydee Felsovanyi	Bettina Kirby	Nora Coyle
Debbie Friesen	Edward Kush	Maria Caturay	Bridgette Bracker	Joe Roy	Amy Roberts	Nathan Fisher	Steven Zserai	Art And Carol Stroede	Mike Macguire
Sherry Olson	Wesley G. Finkbeiner	Robert Fingerman	Lynn Merle	Tony Menechella	Lucas Gajewski	Judith S Anderson	Dolores Guarino	Rosemary Foster	Roger King
Hilarie Ericson	Janis Prifti	Walter Schultz	Jim Lieberman	Harold Watson	Julaine Roberson	Ryan Swanson	Cynthia Arneson	Vicky Hoagland	Christopher Devine
Brian Dalton	Michael Stauthamer	Jonathan Boyne	Rosemarie Di Giovanni-Norton`	Ashley Lewis	John Lesea	Tim Fleischer	Marilyn Fuller	Francois De La Giroday	Julie Roedel
Steve Iverson	Robert Keller	Blanca Luz Ross	Deb Sparrow	Michele May	Sally Morrow	Kelly Byrnes	Paula Lepore	Patricia Savage	Robert Moore
Susan Betourne	Belinda Sellari	Carol Book	Gail Noon	Mary Dinino	Michael Geci	Allison Wright	Kendra Knight	Karen Shockley	Lenore Sivulich
Laurie Conroy	Teri Matthews	Robert Lombardi	Peter Gunther	Barry Saltzman	Karla Devine	Mark Fullmer	Rayline Dean	James Kawamura	Suzan Mcglinch
Philip Dematteis	Stacy Cornelius	Andrea Chisari	Julie Spencer	Elizabeth Cross	Anita Smith	Scott Hodge	Emil Borruso	Steve Keena	Donna Wagoner
Thomas Hayes	Lindsay Johnson	Joe Calder	Sylvia Cardella	Maria Rua	Christopher Fetta	Karen Sewick	Ken Windrum	Jordan Longever	Ashley Baillargeon
Dean Smarjesse	Tina Yao	Jeanne Pollet	Patsy Shafchuk	John And Robbie Wertin	William Guthrie	William Mattson	Sherry Irvin	Florence Morris	Debbie Schlinger
Breeana Laughlin	Ben Ruwe	Elissa Mericle-Gray	Grace Ramirez	Tim Goode	Brad St.clair	Michael Garrity	Jane Chischilly	Elaine Cuttler	Mike West
Elizabeth Seltzer	Christina Ciesla	Deborah Hall	Martin Perlmutter	Robert Cobb	Michele Villeneuve	Sarah Bauman	Geraldine Fogarty	Gloria Morrison	Bret Polish
Lonnie Kaczmarsky	Robert Woodbury	Julie Martin	Yvette Frank	Sandra Middour	Rick Canning	Jennie Gosche	Chad Nason	Nancy Ellingham	Connor Hansell
Roger Godfrey	R David Wicker	Ron Tergesen	Sue Ellen Lupien	Isaac Ocansey	Harry Stuckey	David Cottrell	Denise Brennan	David Elfin	Mika Menasco
Virginia Dwyer	Kc Biehn	Donna Leavitt	Charles Happel	Elena Busani	Torren Valdez	Alexis Lamere	S. Jordan	Lindsey Mcneny	Thea Necker
Kate Crowley	Celine Blando	Lorenz Steininger	Mark Davis	Kerry C. Kelso	Rosanne Anderson	Melinda Weisser-Lee	Linley Fray	Robin Lorentzen	Beverly Gilyeart
Deborah Carroll	Walt Levitus	Gregory Esteve	Cindy Shoaf	Jill Kellogg	Douglas Smith	Kate Warner	Hylin Mcneeley	Shelley Hartz	Vicki Matheny
Terri Chappell	Joseph Lesniewski	James Montoya	Christie Vaughn	Marc And Alice - Imlay	Joseph Shulman	Sarah Apfel	Tuan Nguyen	Rebecca Savage	Al Good

Form Letter 34									
Deanna Doull	Mrs. P. D. Waterworth	Harold Robinson	Gordon Hills	Jane Butler	Sam Rushforth	Jay Caplan	Earl Lippold	Steve Uyenishi	Becky Breeding
Susan Hittel	Setsuko Maruki-Fox	Elissa Mcalear	William Kunkel	Jean Bride	Laurence Buckingham	Bob Rosenberg	Jo Johnson	Patricia Baker	Suzanne Barns
Rebecca Leas	Mark Bradley	Deborah And Johnny Alderson	Joan Scott	Stephen Strauss	Bruce Troutman	Barbara Ocskai	Claire Mckay	Pauline Bedford	Marcia Lisi
Bronwen Evans	Jeanine Dimmick	David Gregersen	Kai Marquis	Cheryl Watters	Michael And Barbara Hill	Terri Rose	Irene Snavely	Maria Gilardin	Sandi Covell
Edna Anderson	Donna O'berry	Irene Burt	Tricia Williamson	Marie Curtis	Delnita Davis	Dorinda Scott	Adam Pastula	George Sutherland	William Pfeiffer
Jeannie Pollak	Siegrid Berman	Joshua Krasnoff	Edward Zubko	Larry Walker	Jessica Adams	John Markham	Kimberly Mcdonald	Richard Payne	Valerie Brown
Deborah Lipman	Carol Farina	Greg Pelham	Barry Medlin	Rhonda D. Wright Md	Michelle Schramm	Kevin O'shea	Paul Moss	Sylvia Mitchell	John Limbach
Charles Riddle	Janet Maker	Adrian Smith	Debbie Mick	Carole Mcauliffe	Barbara Poland	Stacy Wagner	Thor Siegfried	Paul Schubert	Jessica Card
Matthew Franck	George Craciun	Julija Merljak	Joy Strasser	Pamela Jiranek	Maria Prokopowycz	Alison Bermant	Christopher Benjamin	Marlena Lovewell	Samuel Morningstar
Karen Mcguinness	Derek Meyer	David Lunde	Jean Ames	Sharon Fetter	Jerry Belter	Sarah Hammond	Kevin Chiu	Katherine Collins	Anthony Gervais
Carl Zimmerman	Robert Bean	Marjorie Xavier	Alan Lhommedieu	Carole Mehl	Arthur L Hanson Jr	Lillian Anderson	Leotien Parlevliet	Audie Paulus	Niels Loechell
Susan Callaway	Marilyn Bair	Karen Berger	Tess Husbands	Shelley Coss	Jeff Omans	Cara Schmidt	Teri Hammer	Alan Wojtalik	Jan Jasper
Virginia Knapp	Brian Lilla	Kathy Vadnais	Candace Christensen	Charles Olmsted	Adaria Armstrong	Dawson Pan	Steve Mcneill	Angelia Coleman	Natalie Mannering
Patricia Deluca	Laura Herndon	Anthony Owen	Tasha Chenoweth	Kenneth Bowman	James & Leslea Kunz	Henry Sanchez	Theresa Digiannantoni	Patricia Pippin-Emanuel	Ralph Sanders
Peggy Fugate	Tina Brenza	Jana Austin	Tamara Hulsey	Jessica Sands	Laurel Hughes	Charmaine Henriques	Karen Spradlin	Mark Leiner	Melinda Themm
Lindalee Mceachrontaylor	Carol Dearborn	Therese Debing	Robert Rhodes	Charles Wirth	Alan Friedman	Lisa Kunsch	Elizabeth Darovic	Arliene Oey	Shannon Jacobs
Jim Loveland	Charles Looney	Angela Chabot	Glenn Eklund	Joann Mcintosh	Mary Stone	Vicky Matsui	Quinn Mckee	Efrem Thomas	John Langevin
Robert Boyer	Alex Brockman	Sharon Rothe	Marion Friedl	Harold Veeder	Ulrich Ganz	Christine Gasco	James Zalba	Peter Gradoni	Ron Richter
Julia Gillett	Karen Peterson	Dean Webb	Laura Deming	Norman Sandel	Pierre Del Prato	Coleman Lynch	Sandy Reese	Gary Vesperman	Robert Burk
Marin Quezada	Vincent Elliott	Pauline Thomas-Brown	Sandy Thompson	Donald Di Russo	Barbara Schwartz	Victoria Brandon	Linda Wasserman	James Mulcare	Steve Valladares
Wendy And Dan Fischer	Gabriel Bobek	Jennifer Brandon	Veronica Schweyen	Melvin Bautista	Tamara Ashley	Heather Walker	Bill Maunders	Anne Proudfire	Cheryl Weiss
Patti Miller	Erma Lewis	John S. Sonin	Kevin Hadley	Fred Lavy	Peter Roche	Stacy Lang	Mark Parker	Ken Martin	Kim Hall
Virginia White	Patricia Wilburn	Margi Mulligan	Jimmie Smith	Jeralynn Cox	Ann Coz	Ellen Atkinson	Susanna Purucker	Susan Delles	Jonathan Zupkus
Lisa French	Amy Henry	Deb Lincoln	Dean Wilson	Frank Adamick	Christopher Lord	Emily Greer	Gordon Cox	Angela Leventis	Kiandra Waggoner
Sandra Smith	Donna Pemberton	Ilene Kazak	Cindy Risvold	Karen Steele	Susan Schuchard	Matt Shoener	Candan Soykan	Mari Dominguez	Susan Brandes
Rosemary Caolo	Walter Kuciej	Deborah Barber	Cindy Blue	Ryan Persad	Darlene Daniels	James Strickler	Susan Brown	Melissa Dorval	Sammy Low
June Vassallo	Karen Stimson	Michelle Gorton	Roger Easson	Paul Ghenoiu	Margaret Keene	Guadalupe Yanez	James Sullivan	Dara Murray	Mark Blandford
David Stetler	Thomas Moore	Gordon Macalpine	Sandra Poetzl	Rob Williams	Gordon Fellman	Melissa Harlan	Tracey Bonner	Warwick Hansell	Richard Johnson
Nathan Van Velson	Diana Williams	Anthony Buch	Bianca Molgora	Robert Martin	John Banks	Roth Woods	Ryan Curtis	Jeff Bloomgarden	Harvey Neese
Katelyn Scott	Mary Juneau	Gary Rejsek	Phoenix Giffen	Arthur Webb	Jill Alibrandi	Jeanne Held-Warmkessel	Abigaile Wolak	Nancy Hayden	Dan Hornaday
Lynne Teplin	Paul And Katherine Malchiodi	Vicki Rinehart	Barb Fitzgerald	Katherine Mouzourakis	John Wells	Sandy Kavoyianni	Steven Carpenter	Alan Papscun	Maria Aragon
Carolyn Chris	Tom Peace	Sandra Cais	Laurie Marshall	Ruth O'dell	Piper Burch	Linda Bolduan	Shelley Deshotel	Stephen Durbin	Logan Miller
Susan Damato	Shanna Brandow	K.kay Bircher	Maureen Sheahan	Sara Nason	Sheila Kelley	David Rogers	Ron Blidar	Heather Hundt	Kristina Harper
Steve Fedorow	John Kuhfahl	Dana Barela	Ralph Lopez	Regina Brooks	Stephen Parks	Jerry Fitzgerald	Joan Murray	Jean Sweetman	Tara Hottenstein

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Jason Kemple	David Osterhoudt	Leslie Spoon	Danielle Charney	Gordon Reed	Deborah Voves	Jeff Levicke	Patricia Lauer	Dirk Rogers	Marie Weis
Carolyn Dickson	Vikki Hallen	Sara Miller	Elizabeth Lengel	Karen Kindel	Angie Mackey	Jerry Napombhejara	Tanya Wenrich	Robert Slomer	Ken Ward
Jane Edsall	Diane Williams	Christopher Dill	Joan Hutton	Janet Moser	Harry Knapp	Patricia Schon	James Thomas	Gloria Skouge	Carmen Cocores
Laura Hackler	Sabrina Wojnaroski	Barry Cutler	Audra Serrian	Veronica Stein	Dan Streeter Jr	Zachary Totz	Mal Gaff	Gloria Uribe	Steve Clough
Daryl Teittinen	Nona Ganz	Jennifer Hill	Joan Sitnick	Charlene Henley	Tatiana Arguello	Marcus Straub	Barb Powell	Earlene Benefield	Marguery Lee Zucker
Brian Wade	Heidi Johnson	Michael Schumm	Roberta Bishop	Leah Olson	Kyle Brent	Anne Ackley	Walt Mercincavage	Julie Roberts	Whitney Watters
Catherine Higgins-Bisnett	Frank Fredenburg	Gail Linnerson	Jean Ross	Denise Ward	Lynn Wilbur	Janet Dietrich	L Lee	Carla Dummerauf	Colleen K
Paula Wanzer	Donna Morang	Janet Ginepro	William Chandler	Karen Horton	Teresa Logan	Anne Veraldi	David Bohn	Dennis Robinson	Brad Webb
Joan Farber	Mike Cluster	Querido Galdo	Karen Toyohara	Deborah Allison	S Lowe	Barbara Mcmahan	Karen Krause	Toby Ann Reese	Linda Mckillip
Jeff Komisarof	Chris Worcester	Wylie Cox	Dominic Melita	Joann Hess	Marianne Tornatore	Chris Smith	Jennifer Schally	Katherine Robertson	Croitiene Ganmoryn
David Randall	April Doyle	Maxine Clark	Amanda Sue Rudisill	George Stavnes	Stephen Rosenblum	Nancy Petersen	Richard Pasichnyk	Amber Murphy	Chris Loo
Kathlene Rohm	Sophia Mcaskill	Hillary Ostrow	Peter Sayre	Carole Osborn	George Rodgers	Juli Kring	Timothy Tait	Michele Johnson	Chris Berlet
Jeff Schwersinske	Kathleen Keske	Lilyana Srnoguy	Ruthann Mcdermott	William S.t. Holcomb	Dharma Best	Jeff Root	Christine Payden-Travers	Joyce Dixon	Bill Maharan
M Mooney	Dianna Wells	Palmeta Baier	Timothy Omalley	Robert Handelsman	Lori Kegler	Patricia Minor	Marion Lakatos	Pamela Vouroscallahan	John Fliessbach
Catherine Jurgensen	Ann Craig	Debra L. Reuter	Margaret Lohr	Becky Oldenburg	Roberta Thompson	Megan Baker	Karole Moyed	Kirsten Lear	Ellen Davis
Sally Abrams	David Amrod	Kathleen Mireault	Melissa Eddy	Richard Harrington	Margarita Perez	Henry Parker	Colette Wilson	Cathy Elizabeth Levin	Patricia Fleetwood
Edward Butler	Kathy Colletti	Marilynn Harper	Shirley Coelho	Delwin R Holland	Lorraine Brabham	Nilah M. Macdonald	Elaine Parker	Bernard Rafferty	Derinda Nilsson
Nadine Wallace	Jacky Canton	Rickey Westbrooks	Illana Naylor	Ed Fiedler	Ted Adams	Nancy Rausch	Bill Wood	Tammy Bullock	Mathew Vipond
Cori Bishop	Ron Verdonk	Victoria Holzendorf	Donna Ferguson	Tonya Rose	G Claycomb	Donna Wagner	Alice Naegele	Chris Guillory	Alexandra Tumarkin
Ellen Jahos	Hollie Hollon	Robin Van Tassell	Irene Mills	Emily Dickinson-Adams	Victor Ponce-Juarez	Duane Patrick	Nancy Mclaughlin	Kiley Brown	Chuck Donegan
Jim Melton	Joseph Rice	Linda Ferland	Anne Easterling	Lina Poskiene	Georgia Shankel	Pat Monacella	Mary Mcmahon	Cathy Barton	Angela Hughes
Robert Russo	Toni Freeman	Pamela Kjono	Joe Salazar	Michele Nihipali	Donna Hreha	Henry Coleman	Paul Moser	Paul Russo	Robert Tweten
Gary Whelan	Donna Ehret	Lynn Hafter	Erik Larue	Robert O'brien	Maya Moiseyev	Scott Species	Marie Garescher	Mark Cahill	Douglas Sedon
Chris Baillio	Linda Randel	Bill Michel	Michele Paxson	Ann Powlas	Eric Firchow	Tina Brown	Billy Weitzel	Sarah Raite	David Wolfson
Ruth Cook	Kent Grigg	Stephen Oder	Emily Van Alyne	Barbara Graper	Donna Austin	Bernadette Belcastro	Janice Banks	Cheri Riznyk	L Nelson
Coleen Garrity	Anna Clavin	Linda Howie	Sue Peters	Patricia Greiss	Cheryl Hughes	Linda Martinez	Catherine Williams	Lisa Hopkins	Adelheid Koepfer
Marty Crowley	Sarah Cripe	Rebecca Robinson	Uta Cortimilia	K Danowski	James Hoehn Jr	Michael Lombardi	Claire Chambers	James H. Fitch	George Dietz
Kathy Bradley	John Golding	Elizabeth Garratt	Terri Robb	Bitsa Burger	Elizabeth Carol Edwards	Nandita Shah	Deborah Lane	Andrew Syrios	Hannah Harris
Sharon Chakoian	Gertrude Battaly	Alice Polesky	Lisa Dunphy	Michelle Lee	Justin Boucher	Alice Henneberg	Laura Smith	Amanda Mayhack	Alice Shields
Martha Barrett	David Walker	Kirsten Fulgham	Linda Groetzinger	Eric Edwards	Susan Langston	Lila Wolan-Jedziniak	Joy Zadaca	Dorothy Segelson	Christine Carlson
Marian Liza Mientus	Carol Taggart	Jackie Demarais	Steven Waldrip	Karen Kawszan	Trisha Ten Broeke	Katherine Leahy	Stephanie Mory	Trigg Wright Iii	Colonel Meyer
Patricia Mcdonald	Christopher Wheeling	Brenda Psaras	Liz Murphy	William Buchan	Vaughan Kendall	Carolyn Massey	Kayla Cardenas	Elizabeth Leitao	Jennifer Greenidge
Yvonne White	Don Hon	Barbara Mckee	Alicia Kern	Jonathan Gottlieb	Jeffrey Myers	Bob Findlay	Allie Tennant	Kimberly Rigano	Shari Kelts
Mary Belle Kral	Mary Seegott	Amy Limyao	Tabitha Maya	Peter O'grady	Brian Resh	Susan Galante	John Klima	Natalie Deboer	Diana Maxell
Robin Mayerat	Sandra Joos	Pamela Goodman	Jeannie Roberts	Michelle Buerger	Ted Pasieniuk	Kathy Law	Elena Perez	Frank Belcastro	Namanand Henderson
Jan Modjeski	Bill Holt	Ruta Brazis	Kathleen Furness	Thomas Edmonds	Stephanie Fairchild	Carla Morin	Ron Rathnow	Barbara Morales	Robert Reed

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Jennifer Waters	Michael Cunningham	Christine Mc. Money	Gary Falxa	Kevin Hughes	Ana Mallett	Lee James	Candace Hollis-Franklyn	Andrew Kaplan	Shari Silverman
Thomas Sheets	Henry M.	Linda Pink	Judy Moore	Willie Hinze	Gerald Eller	Shari Sharp	Dennis Kreiner	Diane Black	Debra Moore
Laura Williams	Anna Shaughnessy	Maureen Wheeler	Tracy Brophy	Bruce Dobson	Deborah Boomhower	Dorothy Brooks	Ruth Curiale	Toni Siegrist	Mark Grenard
Barbara Byrd	Joseph Sebastian	Darlene Falk	Margaret Kibbee	Janie Sarason	Scott Coahran	Jeffrey Shuben	Christie Sanders	Randy Raspotnik	Caroline Themm
Susan Chandler	Gary Thaler	Kellee Anderson	Peggy Yeargain	Dennis Pennell	Carole H	Mihajlo Donovski	Jerry Lee	Nancy Strong	Marianne Flanagan
Lisa Cubeiro	William Towne	Julie Griffith	Charles Wilmoth	Mary Hard	Shannon Markley	Helen Stuehler	Jane Nicolai	Brett Kieslich	Sarah Hafer
L. Fielder	Michele Lauren	Alan Levine	Amy Cervene	Kenneth Waggoner	Jim Wilson	Michael Weaver	Eleanor Smithwick	Michael Amescua	John Noland
Annette Kastner	Estelle Voeller	Carlos Echevarria	Michelle Hoff	Barbara Benzwi	Crystal Hart	Joanne Mack	Antoinette Ambrosio	Hashi Hanta	Elaine Becker
Jon U-Ren	Joyce S	Teresa Fleener	Jennifer Abernathy	K Lyle	Jock Timmons	Eric Stiff	Rolf Best	C. C.	Elli Kimbauer
Catherine Malin	Chris Pratt	Lauren Bryant	Judith A Baxter	Brad Van Scriver	Connie Murphy	Lisa Whipple	Don B. Meriwether	Cheryl Tobin	Timmie Smith
Karen Reid	Diane Falk	Pamela Vasquez	Brian Larson	Sharon Hansen	Helena Winston	Maia De Raat	Mccree Williams	Barbara Aronowitz	Phillip Leija
Deborah Vandamme	Robert Senko	John Newman	Rabia Shah	Brent Ross	Gigi Vento	Tracy Ouellette	Randolph Willoby	Linda Thompson	Clarence Bolin
Hilary Danehy	Freddy Pixtun	Maureen Mcgregor Palmer	Ken Lavacca	David Brodnax	David Wilson	Joanne Mainiero	Mary -Margaret O'connell	Kris Head	Ann Wasgatt
Theodore King	William Gibson	Ann Thompson	Malcolm Elgut	Nancy White	Jeffery Clifford	Melissa Mazias	Lynne Chimiklis	Judy Allen	Candice Schellenger
Judy Dufficy	Suzanne Zook	Jonathan Mitchell	Jim Hemmingsen	Diane Soddy	Mark Russell	Ji-Young Kim	Marla Myles	Maria Cardenas	Hilarey Benda
Travis Garner	Virginia Baksa	Beverly Olney	Patti Fink	Douglas Wagoner	Sandra Reynolds	Randy Gerlach	Laura Overmann	Eleanor Rae	Adam Levine
Bernardo Alayza Mujica	Dona Laschiava	Judy Carlson	A R	Jean Bails	Steve Crase	Joann Butkus	Gary Hamel	Michael Shores	Steve S
Leon Epperly	Sarah Pierre-Louis	Carol Hewitt	James Roberts	Nancy Stocker	Betty Lininger	Forest Frasieur	Eva Cantu	Thi Ton-Olshaskie	Debra Marge
Lesley Mortimer	Kathleen Medina	Cornelia Shearer	Mona Chatterji	Gusty Catherin	Vittorio Ricci	Margaret Spak	Jennifer Smith	Sue Perry	Kirk Bails
Norman Koerner	Danny King	Pat Wolff	Karen Laakaniemi	William Lee Kohler	Susan Clark	A.l. Steiner	Ken Canty	Ursula Neal	Andy Hughes
Joseph Dimaggio	Susan Carey	Mary Theresa Cotter	Bk Young	Richard Boyce	Barbara Delgado	Andrew Berkson	Sarah Richey	Karen Neubauer	Katherine Macdonald
Amy Holt	Tina Short	Tom Jackman	P Wright	Lorraine Dumas	Buckie Jones	Sarah Meyers	Elaine Hughes	Jennifer Wetzel	Donald Barker
Dogan Ozkan	Shiki Bennington	Steve Prince	Noelle Nocera	Kristina Heiks	Animae Chi	Gary Wolf Ardito	Wojciech Rowinski	Lisa Phillips	Margo Wyse
Walter Goodman	Katharine Tussing	Richard Ruscitto	Timothy Pine	Stacy Schrader	Lynn Snyder	Allen Olson	Lori Mulvey	Cody Walters	Kelli Dendler
Frances Kelly	Bonnie Hernandez	Shirley Hale	Leslie Herron-Huff	Laura Prohaska	Marianne Lazarus	James Hutchison	Karen Hohe	Dorothy Anderson	Priscilla Wright
Laurie Cline	Patterson Leeth	George Erceg	Michael Norden	Jennifer Luna-Repose	Denise Lytle	Mike Stoakes	Tonya Lantz	Maria Hernandez	Renee Duncan
Dreena Delevieleuse	Michael Cecil	Alexandra D. Pappano	Susan Frankel	Katrina Freire	Dustin Kearns	Charles Alexander	Brian Minnick	John Papandrea	Martin Streett
Matthew Kapsner	Gregory Rouse	Kerri Piazza	Lara Miller	Brooke Prim	Joe Vincent	Max Salt	Annick Richardson	Margaret Reiter	Jim Simmons
Victor Escobar	Robert Uecker	Ann D Quota	Bonnie Hamilton	Virginia Jones	Obie Hunt	Ned Stitt	Mary Hertrich	Nm Porter	Cecelia Samp
Laura Grove	John Hafer	Karen Rubino	Jane Timmerman	Susan Porter	Scott Rail	Sandra Materi	Patricia Kortjohn	Robert Van Kolken	Karen Fischer
Richard Weiss	David Fischer	Sherrie Smith	Donna Tanner	Jean Power	David Frauenfeld	Anna Marie Wieder	Kathleen Sumida	Amy Curnutt	Shelley Coldiron
Roberta Munger	Owen Tesson	John Bradshaw	Alan Barnard	Lynne Scheve	Nancy Acopine	Michael Schmaus	Katy Whitehouse	David Green	Ryan Skeel
Patricia Law	Steven Morris	Richard+E Cooley	Irene Dovas	Terry Rice	Andrew Robbins	Heather Burke	Gary Kinson	Carol Bryant	Eric Lane
Christian Dollahon	Konrad Binder	Emerson Tjart	James Keats	Tom Lohaus	Gale Mangini	Ad Koch	Barbara Burghart	Mark Rynearson	Lynn Mendez
Martha Krein	John Poteraske	Irini Dieringer	Sherry Massaro	Bart Gulshen	Marcella Crane	Judy Wood	Jeffrey Cody	Lindsay Mugglestone	Larry Mccowan
Janet Marineau	Rosemary Graham-Gardner	Karen Collins	Shannon Daniels	James Schoppet	Jameson Mcdonnell	Matthew Noel	Yasemin Tulu	Mark Steudel	Jeff Walters
Thomas Swoffer	Richard Meier	Sarah Epstein	Joanne Robrahn	Barbaraa Kwasnik	Robert Chirpin	Michael Krall	Norman Baker	Shemayim Elohim	Kathleen Turnbull

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Susan Parlier	Jody Richards	Jannis Conselyea	Edward G Heidel	Barbara Hegedus	Alicia Ricketts	Bruce Blackwell	Linda Sorenson-Kapica	Elizabeth Kelson	Tina Mizhir
Leslie Smith	Teresa Hildenbrand	Sandy Crooms	Sandy Zelasko	Ruth Braithwaite	Emma Jennings	Travis Jennings	Marsha Stanek	Robert Abbott	June Elliott-Cattell
David Davis	N Kaluza	Becky Andrews	Paul Smith	Richard Peterson	Jim Landua	Margaret Shermock	Deborah Exum	Doris Potter	Michael Martin
Jocelyn Stowell	Andrew Frishman	Kristina Fukuda	Tom Grazier	Catherine Morris	Mark Wirth	Shamus N	Susan Willard-Killen	Michelle Oroz	Gerald Christiansen
Robert Blanchard	Darlene Wolf	Eli Ren	Leslie Mclean	Rhonda Mandato	Leslie Brown	Anna Tangi	Laila Nabulsi	Judy Pizarro	Irene Dobrzanski
Raeann Scott	Carol Whitehurst	Scott Shepherd	Alice Gard	Marian Scena	Tony Segura	Michele Balfour	Tessa Peters	Ed Dobson	Sharon Dunn
Lisa Salazar	Jonathan Rettmann	Freddie Williams	Michael Scholz	Jill Hawtrey	Laura Pitt Taylor	Sacha De Nijs	Ann Bein	Steve V.	Grace Neff
Joseph Leonhard	Jerry Sullivan	Sharon Lacy	Barbara Rosenkotter	Sharon Jones	John Harris	Melissa Friedman	Gina Read	Nicole Shaffer	Vicki Machanic
Elissa Engelbourg	Lorraine Minto	Tiffany Snyder	Bart Hughes	Cay White	Amanda Tomasik	Adam Schaffer	Kitty Savage	Debbra Gill	Aurora Insurriaga
Ann Koppelman	Fred Kahn	Dolores Cohenour4	Christopher Loch	Joan Falkenstein	Bernadette Webster	Gena Anderson	Karen Christian	Joseph Silva	Jennifer Moix
Donna Pope	Debra Espinoza	Lisa Ribons	Krista Guardino	Lenie Molendijk-Schipper	Patricia Parsley	Gosia Mitros	Jamie Charles	Sharon Crane	Karen Sanchez
Pamela Johnston	Anne Elkins	Kevin Oldham	Carole Pooler	Marianne Larkins-Strawn	Nancy Hline	Nicole Zanetakos	Water Dragon	Laura Priest	Aiice West
Amy Spicka	Gay Fawcett	Ben Badger	David Kent	As Er	Brian Pike	Louise Mcgannon	Sarah Foster	David Hopkins	C S
Sheila Cowden	Christina Little	Pat Shore	Ann Knott	Deborah Reeves	Loretta Lehman	Mcgregor Wells Hayslip	Carol Bentley	Lauren S	Deanna Knickerbocker
James Bronson	Shawn O'grady	Denise Vandermeer	Dylan Nguyen	Chuck Dinkel	Angela Bellacosa	Raquel Sosnowski	Danielle Rowland	Todd Johnson	Tammy King
Linda Reilly	Michael Trepkowski	Frances Averitt	Debbie Mccarthy	Mara Isbell	Claudia Greco	Ana Rodriguez	Virgene Link-New	Ladene Mayville	Danny Aiuto
Wendy Noon	Susan Ortega	Diane Huffine	Emily Rothman	Nick Barcott	Paul Huddy	Laura Utrecht	David Moore	Taylor Surratt	Jennifer Gitschier
Desiree Nagyfy	Hristina Boncheva	Kim Scott	Sandra Borrini	Shelly Shivers	Kris Aaron	Silvia Bertano	Glen Mensinger	Florinda Tudose	Jamie Perron
Claudia Correia	Oza Bell	Donald C Beck	Arlene Forwand	Laurie Newman	Donna Russell	Annette Bailey	Matthew Hassler	Nichole Diederiks	Dena Garcia
Rhonda Lawford	Carol Hammond	Jessica Ramirez	Matt Rosett	Uphoria Blackham	Wendy Balder	Wanda Mabe	Bonnye Reed Fry	Albert Honican	Kimberly Jones
Diana Keyser	Samuel Brugger	Virginia Toomey	Melania Padilla	Margaret Babcock	Michelle Rice	Kristen Lightbody	Cathy Rupp	Sally Hodson	Sandra Rice
Casey Jo Remy	Margaret Heydon	Lisa Douglass	Donna Roddvik	Paul Eberhart	Mayank Bhandare	Peter Kahigian	Jl Burns	Paula Shafransky	Maria Lang
Michael Raymond	Shawnee Mclemore	Steven Cozzi	Angeline Zalben	Leslie Just	Mary Delger	Steven Piku	Mike And Susan Raymond	Zachariah Hinman	Denise Pedersen
Ann Tagawa	Torunn Sivesind	Carolyn Burns	Gregg Johnson	Jorge De Cecco	Laura Kaberngel	James Wilkinson	Misha Carr	Mark Caso	Rosemary Luzum
Ky Osguthorpe	Cynthia Edwards	Carol Hill	James Alexander	Karina Pavlova	Basey Klopp	Dawn Clayton	Peter Jones	Donna Lenhart	Ian Garman
Anthony Donnici	Maryellen Todd	Nicole Monforti	Linda Ferguson	Harriet Grose	Cara Stanley	Rama K Paruchuri	Kimberly Swenson-Zakula	Marlena Lange	Malcolm Simpson
Sue Bassett	Joe Rogers	William Leavenworth	Carol Collins	Christine Canning	Nina Utigaard	Cathy Nieman	Karl Koessel	Maryanna Foskett	Chris Evans
Linda Mclain	C Grimes	Ashley Carter	Karen Wolf	Leslie Richardson	Andrea Snyder	Tina Patrick	Tom Wardell	Martin Riley	Megan Spatchek
Donna Lagomarsino	Marcello Franciamore	Catherine Mcnamara	J. Beverly	Geralyn Leannah	Karla Frandson	Crystal Wolf	James Lieb	Cristen Mcconville	Dipali N
Rich Moser	Berklee Robins	Dennis Rogers	Susan Butterfass	Susan Myers	Kristina Younger	Barbara Scott	Robert Ayers	Frank Graves	Kathy Durrum
Gloria Aguirre	Dacia Murphy	Anthony Palumbo	Ken Pflugrad	Pete Lesinski	Will Blount	Janice Phelps	David Rawlings	David Smith	Susan Berzac
Robert Fischoff	Michael Halloran	Michelle Collar	Erica Johanson	Gilda Fusilier	Greg Romero	Alison Zyla	Lasha Wells	Larry Burback	Paula Simmons
Tracey Katsouros	James Campbell	Margaret Goettelmann	Zach Mcclellan	Carol Baier	Jeffrey White	John Hutchens, Jr.	Brent Rocks	John Van Straalen	Frank Margowski
Patty Duffy	Luke Furman	Roberta E. Newman	Beth Goode	Juan Calvillo	Garrett Becker	Esther Garvett	Daniel O'brien	Emily Roth	Jc Sarmiento
Bridget Koch-Timothy	Laura Dickey	Ronald Drahos	Gretchen Hafner	Dallas Windham	Renee Sharp	Virginia Jastromb	Anita Nowell	Phyllis Stanbury	Joshua Seff
Marylou Ogle	Donald Turken	Tyler Komarnycky	Urmila Padmanabhan	Lisa Mazzola	Aleks Kosowicz	Twyla Bacon	Lascinda Goetschius	Anne Barker	Grace Padelford

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Ford Barr	Merrill Boone	Diana Bowen	Linda Pflugrad	Georgia Labey	Gary T Pederson	Jim Jordan	Jane Schnee	Lauren Rapp	Katrin Rosinski
Jill And Gary Ballard	Michael Lagassey	Christine Oda	Nicola Nicolai	Teresa Daylight	Doug Cecere	Eric Stordahl	Ian Shelley	Nick Evans	Lynn Matarelli
Michelle Mackenzie	Rhodie Jorgenson	Vicky Brandt	Bob Brucker	Paul Brooks	Jim Bennett	Dennis Feichtinger	Virginia Douglas	Valerie Lukas	Barbara Fain
Marge Barry	William Dolly	Beverly Boynton	Julia Bottom	Nancy Currah	Claudia Richner	Stephanie Hulett	Jim Forbes	Lonna Richmond	Joe Worthy
Donald Harland	Judith Peter	Larry Bader	Margery Race	Diane Klock	Laurie Storm	Meredith Needham	Anthony Mehle	Ann Blanchard	Theresa Thornbug
Marcel Liberge	K R	Ann Spearing	Dennis Mcgee	Blake O’quinn	Lacey Hicks	Stephanie C. Fox	Brock Roberts	Jami Shaver	Greg Everett
Hank Chilton	Cate Griffin	Brenda Bailey	Celia Tkach	Michael Gan	Judi Poulson	Barbara Harper	Guy Perkins	Steven Pruitt	Larry Bogolub
Shea Allen	Melissa Norman	Michael Bordenave	Clare Shomer	Abigail Howes	Tania Malven	Kari Sue King	Natalie Fahmy	Elizabeth Smyth	Sally Brown
Felix Dowsley	Carla Newberry	William Carmen	Sharon Strong	Katherine O’sullivan	Delbert Myers	Elaine Benjamin	Lynda Barry	Jared Brenner	Marilyn Logan
Anna Louise Fontaine	Dana Sklar	Irwin Hoenig	Holly Hall	Mary Lou Petitjean	Mary Palmer	Maya Rainey	Wayne Laubscher	Diane Luck	Carol Devoss
Gary Binderim	Scott Pace	Jamie Le	Kerry Dowdell	Chris Riesch	Ed Young	Dara Rider	Ellen Domke	Brian Yanke	Helgaleena Healingline
Kate Solisti	Steve Mazur	Nina Black Reid	Carol Coons	Gloria Wade	Jeff Mcnair	Donald Davis	Nan Warshaw	Fred Granlund	Frank Hartig
Michael Eisenberg	Gabriel Lautaro	Rodney Rice	Julie Bush	Roy Fuller	Diane Hoefnagel	Tim Chambo	Bobby Belknap	Michael Richardson	Stephen Pazdziorko
Merikay Garrett	Shirley Bensetler	Victor Kit	Linda Luke	Samuel Socolar	Paula Connelley	Barbara Leicht	Erika Wanenmacher	Rod Snyder	Michael Lewandowski
Tina Rogers	Armando A. Garcia	Todd Elliott	Namita Dalal	Nezka Pfeifer	George Mackison	Deborah Hirsh	Rita T Lynch	Julia Cranmer	Deborah Ebersold
Marianne Corona	Molly Swabb	Gerritt And Elizabeth Baker-Smith	Annie D’lima	Judith Smith	Victoria Villagran	Beverly Villinger	D. Rex Miller	Erick Burres	Donald Taylor
Lee Robinson	Jeff Reynolds	Shannon Leitner	Mary Hanley	Loretta Rogers	Dan Roman	Josi Gebhardt	Jadene Fourman	Gary Camarro	Toni Eisenhart
Constance Betz	Ron Mendelblat	Carol Curtis	Raymond Nuesch	Russ Ziegler	Mark Koritz	Mark Mark.scheunemann@Yahoo.com	Sheryl Becker	Jaremy Lynch	Wendy Weldon
Susan Hanlon	Michael Macklin	Gael Irvine	Eric Lewis	Mijanou Bauchau	Chester Gustafson	Rosina Cespedes	Sil Reynolds	Julie Slater-Giglioli	Jason Long
Jill Johnson	Richard Falls	Lisa Annecone	Evelyn Marencik	Marie Napolitano	Vincent Geiger	Daniel Henling	Sue Mcnally	Patricia Packer	Ronald Christ
Rick Mutzabaugh	Gwen Hadland	Darius Semmens	Margaret Maiorano	Gary Lewis	Jean Eunson	Anne Mclaughlin	George Latta	Diana Greenhalgh	P. W.
J C	Richard Pecha	Paul Lima	Heather Aka Heth Drees	David Doty	Candie Glisson	Mary Gutierrez	Uriah Solomon	Rita Collins	Robert Demuth
Vito Degrigoli	Mark Enser	Eric Britton	Dean Shrock	Shel Grove	Luis Lozano	Matthew Schaut	Jody Gibson	Dean Weiss M.d.	Paul Thiel
Kathe Garbrick	Tom Butch	Joyce Overtin	Clifford Phillips	Alyssa Henry	Debra Nichols	Janet Rutigliano	Joy Kroeger-Mappes	Brian Reitz	Steven Karges
Edith Root	Nicholas And Joanne Cartabona	Kevin Walker	Chuck Rocco	Cave Man	Jacqui Skill	Margaret Mogg	Anne Young	Millicent Sims	Ellen Cohen
Jesse Gore	Evelyn Verrill	Thomas Brenner	Glenn Outon	Rich Bornfreund	James Mockaitis	Mary Lebert	Jeffrey Jones	Don Hamilton	Wayne Lensu
Teresa Zamalloa	Alex Delehanty	Barbara Brockway	Larry Bloom	Susan Mulcahy	Darryl A. San Souci	Mary Trujillo	Catherine Corwin	David Konigsberg	Curt Cunningham
R.a.l. West	Jessica Rocheleau	Anne Lebas	Betty Peterson-Wheeler	Neil Ferguson	Judy Shively	Dave Mills	Gretchen Randolph	Joe Glaston	Donny Seals
Lee White	Jenifer Gold	David Goldsmith	Susan Harmon	William Witt	Daniel Bayley	Thomas Ray	Bob Quail	Meya Law	Paul Borcherding
Denise Martini	Michael Aldridge	Lindsey Caudill	Robert Booth	Hans Kleinknecht	Tina Colafranceschi	James Tucker	James Vogt	Anne Haflich	Kathy Ralph
Cliff Nigh	Beth Braun	Ken Schefter	Lance Kammerud	Florinda Sanchez	Jackie Pomies	Carlo Popolizio	Pam Kmiec	William Shelton	Rita Fahrner
Angela Buffo	Michael Rynes	Pam Zimmerman	David Billups	E. Neal	Daniel Soulas	Dennis Branse	Elizabeth Adan	Michael Eckhardt Sr	Linda Marshall
Kevin Reisenbichler	Jewell Batway	Gail Tanner	Lauren Bond	Paul Runion	Maryellen Redish	Marc Conrad	Sarah Dean	Pamela Kane	Susan Laube
Betty Winholtz	Tirzah Sandoval-Labadie	Kate Harder	Gail Yborra	Jon Spar	Robert Spaccarotelli	Philip Rampi	Denise Romesburg	Judith Wecker	S. Almskaar

Form Letter 34									
Jenna Fallaw	Linda Bescript	Karen Raccio	Karen Bonnell	Anthony Tsang Yee	Charlotte Serazio	S Silvia Rennie	Tami Schreurs	Helmut Mueller	Vasu Murti
Anne Reich	Carrie Mullen	John Feeney	Barbara Lafaver	Regina Barakat	Lincoln Boykin	Yvonne Oelkers	Michael Mattox	Richard Gerber	David Fura
Jim Rice	Amy Ganahl	Edward Dwyer	Joe Buhowsky	Peter Schumacher	Wayne Wathen	Ingrid Eichenbaum	Joseph Balsamo	Chuck Graver	Johnny Hall
Bob Struble	Joelle Porter	Rahul Subramanian	Charles Carroux	Joseph Pluta	Steven Cantner	Jeffrey Parker	John Blaustein	Charles Hensel	Gm Whiting
Marjorie Short	Peter Wood	Ron Cavin	Chey Richmond	Victoria Miller	Donna Parente	Stewart Chumbley	Trudy Dittmar	Pamela Miller	Elaine Donovan
Erika Boka	Gavin Bornholtz	Patricia Koehler	Dawn Hendry	Rachel Cox	Lois Nottingham	Pamela Nowell	Joann Koch	Mary Peterson	Gabriel Cohen-Glinick
Edward Allard	Karl Lohrmann	Sheryl Post	Martha Izzo	Joan Roberts	Mark Betti	Charles Massey	Michael Iltis	Lisa Howell	Graham Mitchell
Susan Uyeda	Alan Citron	Dorothy Hornby	Evan Jane Kriss	John Doucette	L. Adams	Judith Poxon	Dave & Ada Dorn	Fay Forman	Marcia Hoodwin
G. Paxton	Kathi Ridgway	Bruce Hlodnicki	Marce Walsh	Paula Orbaugh	Peter Fairley	Mary Riley	Sharon Nicodemus	James Van Nada	Susan Davenport
Timothy And Angela Mitchell	Mary Wolney	Edith Goren	Jeanne Davenport	Soretta Rodack	Cathy Thornburn	Erika Reilley	Tom Brown	John Massman	Louise Mcclure
Mary Beauchemin	Craig Mackie	Leann Turley	Bob Roach	Eileen Robinson	Marion Marsh	Jacqueline Zimmerman	Jacob Cronin	Nancy Nelson	Tamara Mccready
Ana Herrero	Ronald Bogin	Charlotte Holley	Kathy Dabanian	Danville Sweeton	Elizabeth Gann	Patricia Stock	Don Simms	Beverly Conway	Kathleen Cross
Stacy Lupori	Jason Kelley	Kate Belknap	Maureen Mccarthy	Marge Dakouzlian	Kay Reinfried	Shelley Driskell	Pamela Rogers	Ann Kuter	Wendy Dew
Midori Furutate	Dave Frank	Melissa Suarez	Mary Firnrohr	Katherine Dander	Robert Ricewasser	Patricia Jensen	Katherine Kelling	Betina Mattesen	Philip Simon
Donna D Varcoe	Karen Chinn	Michael Vance	Kevin Bickers	Mark Volans	Donna Capalbo	Eric Fox	Elizabeth Ryan	Cynthia Hicks	Kenneth Althiser
Charlotte Smith	Brian Fink	A Samuel Chiodo	Stefon Lira	Barry Maloney	Jerald Olsen	John Varga	G. Countryman-Mills	Paul Eisenberg	Candice Lowery
Stephanie Reynolds	Kelly Timon	Scott Meyer	Nancy Heck	Susan Ross	Colleen Rodger	Tony Merrill	Karla Vogt	Dennis Robison	Steve Keim
Carmen Blakely	Peter Townsend	Ron Parsons	Avtar Khalsa	Annie Davidson	Edward Kern	Jon Nicholson	Richard Smith	Corey Schade	Janice Brown
Doris Applebaum	Juliann Pinto	Ray Wolanzyk	Kathleen Brannon	Bob Steininger	Marianne Frusteri	Frederique Joly	John Leinen	Frank Ayers	Justin Wesche
Martin Horwitz	Fran Malsheimer	Drew Pelton	Lyn Berling	William Stanley	Kelly Hibbert	Nancy Pearson	Louis Palazzini	Barbara Hauck	Sara Barsel
Karen Brian	Kathy Heaton	Lee Jenkinson	Keith D’alessandro	Paula Adams	Oscar Bird	James Cooper	Deb Walker	Virginia Winter	Robert Mayton
Carol Doty	Jim Leske	Forrest Rode	Kevin Powers	Reed Fenton	Gwendolyn Sky	Fredric Griffin	Susan Dorchin	Tim Oswald	Kathy Martinez
Rodney Martin	River Steenson	Ragen Serra	Joseph Mitton Jr	Charlie Burns	Ralph Oberg	Oliver Stubbs	John Paladin	James Lansing	Ann George Shaffer
Takako Ishii-Keifer	Jennifer Barbara	Duskey Mallory	Susan Miller	Scott Kennedy	Stephanie Clark	Jennifer Cunningham	Roy Gamse	Steve Schildwachter	Lloyd Chapin
David Copper	Vivian Yost	Ainsley Donaldson	Michael Morgan	Lisa Daloia	Joey Henson	Maureen O’neal	Neil Courtis	Dennis Adkins	Vii Wee
Michael Denton	Jolynn Jarboe	Marliese Bonk	Richard Pross	Janet Flinkstrom	David Lauder	Sally Marshall	Douglas Paprocki	Renee Woodman	Paul Hunrichs
R. Zierikzee	Charles Phillips	Redlion York	Cheryl Siegelman	Jen Eiffert	Marketa Anderson	Nicole Hilkovitch	Amy Wolfe	Mina Loomis	Ce Gac
Kelly Pasholk	Virginia Watson	Richard Fasano	Virginia Lee	Nogah & Bruce Revesz	Greg Steuck	Janet Walley	Sharon Johnson	Mr. Ford	Jill Robison
Kathy Collins	Joel Perkins	Yvonne Westbrook	Toni Hamilton	Katharine Wallerstein	Shyama Orum	Jackie Tryggeseth	Jl Titelman	Tami Phelps	David Crawford
Lisa Hughes	Kathleen Robinson	Linda Bridges	Crystal Walter	Susan Campanini	Kay Lowe	Matthew Tarpley	Patrick De La Garza Und Senkel	Robert Callahan	Rick Schoenfield
David Eisbach	Whitney Metz	Kurt Cruger	Justin Lee	William Welkowitz	Lynn Mattson	John Fargnoli Jr	Donna Hemingway	Deb Dearing	Marilyn Starr
Juliana Benner	Thomas Ecker	Julann Carney	Kelley Coleman-Slack	Barbara Cabana	Robert Wohlberg	William Mccullough	Lois Denaut	Ronald Perkins	Richard Spotts
Harold Meyer Jr	George Burnash	Raymond Reines	Jim Dugan	Becky Monger	Constance Contreras	Julian Ward	Cynthia Merriman	Adele Kapp	Kathleen Shabi
Purnima Barve	Daniel Turner	Robert Hensman	Robert & Cheryl Miller	Gerald Ney	Gloria Picchetti	Ellen Fleishman	Dolores Arndt	Sarah Clark	Richard Carr
Robin Lim	Jeanne Unz	Karen Naiman	Scott Moorman	Brenda Haig	David Hammack	Philip J. Hyun	Elaine Sloan	Adam Savett	Jon Zychowski
Matt Yanchek	Donald Garlit	Greg Rosas	Gabrielle Peak	Kate Sherwood	George Melendrez	Roger Krause	Robert Craig	Bruce Jackson	Elise Margulis
Brian Girard	Steve Robey	Eva Z	Calvin Crole	Karen Erickson	Charlotte Sines	Tasha Nagle	Kathryn Hopkins	Pamela Lanagan	Marie Manhardt
Marjorie Angelo	Gene Polito	C. Martinez	Sandra Varvel	Sally Maish	Martin Lecholat	Gail Columbia	Patricia Dishman	Barbara Jaramillo	Betti Jones

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Eileen Reznicek	Ana Chou	Debora Brown	Sarah Stimely	Kathleen Gates	Anita Scheunemann	Bari Bowles	Terry Tedesco	Kathy English	Sally Rings
Roberta Ortiz	Cheryl Walker	Maggie Lefford	Mary Keithler	Isaac Schrock	Hersha Evans	Patricia Pruitt	Kathy Grieves	Robert Beverly	Mary Shallenberger
Fletcher Chouinard	Geralyn Farwell	Jean Allgood	Michael Wallace	Linda Mansfield	Madison Hoover	Keith Betterton	Donna Pedroza	James H Jorgensen	Steve Tullar
Shoshana Serxner-Merchant	Eric Duggan	Rebecca Hoskins	Jamila Garrecht	Geri De	Richard Tidd	Ronald Hammersley	Douglas Lovell	Ann Schwab	Mark Kassal
Thomas Pauley	Erik Hvoslef	Deborah Santone	Aaeron Robb	Gerald Kelly	Alex Keir	Marisol Maddox	Tina Wilson	Thomas Esposito	June Esposito
David Mitchell	Carol Fly	Darrel Bruck	Margaret Niemack	Wendy Denby-Pascale	Susan Nienstedt	Susan Danford	Patricia Nazzaro	Astrid Berkson	Nancy Blastos
Nancy Dollard	Carol Ruth	Jeff Achey	Jordan Burton	Red Mendoza	Gwen Mehring	Robert Burnett	Jl Charrier	Trevor Downie	T Mullarkey
Geraldine May	Carol Wiley	Dixie Nihsen	James Henrickson	Bob Wandle	Nichola Napora	Kim Tran	Denis Dellaloggia	Judith Collas	Nancy Hauer
Alyssa Winkelman	Ed Perry	Braxton Worth	Stella Godbey	Joan Smith	Sharon Mylott	Arleen Ferrell	Leah Santone	Tim Ray	Kevin Davis
John Kraemer	Anita Mcmurtrey	John And Jean Fleming	Ken Mundy	Suzanne Cerniglia	Marie Michl	Marilyn Berkon	Cherine Bauer	Brant Kotch	John Weber
Victor Rini	Jennifer Hayes	Diana Saxon	Gregory Amour	Donald Watson	James Mullins	Matt Freedman	M Langelan	K Steasser	Chelsea Colwyn
Susan Thurairatnam	David Guleke	Jean Naples	Susanna Sikorski	Kathy Spera	Diane Nowak	Erin Garcia	Todd Monson	David Katz	Debra Gleason
E. James Nedeau	David Harris	Leslie Calambro	Beatrice Battier	Raymond Bissonnette	Billy Halgat	Barbara T	Susan P. Walp	Maryanne Pilgram	Philip Ritter
Bob Hagele	Bonnie Lynn Mackinnon	Kathy Abby	Marybeth Rice	Mari Roth	Ester Deel	Michael Sherburne	Jennifer Harris	Chad Johnson	Alva Pingel
William Rohan	Elisabeth Brackney	Justine King	Barry Spielvogel	Gary Mccuen	Kenneth Nahigian	Margaret Schultz	Donna Gensler	Robert Johansson	Beti Webb Trauth
Linda Chase	J.c. Williamson	Carolyn Minert	Brian Gingras	Barbara Diederichs	Nick Dickens	Lynn Benson	Kenneth Stewart	Lisa Mcdaniel	Kathy Hinson
Edward Hubbard	Howard Cohen	Jo K	Tracy Cole	Bruce Brown	Jody Lewis	Peggy File	Ruth Siekevitz	Robert Digiovanni Jr.	Joyce Stoffers
Jessica Mitchell-Shihabi	Margaret Blakley	Robert Ortiz	Karen Suit	Mercedes Benet	Elizabeth Enright	Martin Marcus	Carolyn Riddle	Kathryn Lemoine	Samuel Case
Jared Cornelia	Julie Kramer	Shelly Hudson	Denia Tsiriba	Carolyn Treadway	Suzanne Kent	Glenn Koehrsen	Jo Ferneau	John Holland	Sandra & Victor Colvard
Judy Rees	Cathy Revis	Tia Shoemaker	Mark Wagner	John Everett	Sallie Robbins-Druian	Marie Maciel	Gina Capra	Juan Hernandez	Richard Mcnutt
Anne Roberts	Teresa Sem	Betty Beaver	Elaine Genasci	Edwin Quigley	Tory Ewing	Wendy Barker	Arnold Johnson	Sasha Jackson	Spyros Braoudakis
Elliot Daniels	Douglas Rohn	John Essman	Timothy Knapp	Virginia Feldman	Cynthia Tant	Duncan Brown	Philip Gormley	Linda Myers	Danika Esden-Tempski
Scott Lombardo	Philip Ratcliff	James Murphy	Ellen Quinn	Dianne Croft	Brett Dennison	Barbara Bugess	J. Barry Gurdin	Lauren Richie	Ellen Franzen
Camille Gilbert	Daniela Bosenius	Roger Dietz	Saran K.	Raleigh Koritz	Josie Lopez	Angela Skosky	Jason Hladik	Beverly Harris	Letitia Noel
Martin Landa	Daniela Rossi	Aldana Santto	Nicholas Lenchner	Beatriz Pallanes	Jeanine Greene	Mary Anne Joyce	Gary Markham	Derek Gendvil	Annie P
Patricia Baley	Pat Petro	Patsy Mclaughlin	Mauricio Carvajal	Tom Gerald	James Mulhern	Camilla Smith	Jay Humphrey	Ludger Wilp	Allen Aronson
Jose Figueroa Jr	Beth Carr	Lois Cline	Michael Jones	Dennis Williams	James Cunningham	Monica Gilman	Jen Manders	Jessica Goody	Mary Twombly
Marlen Hdz	Elizabeth Manske	Christine Finch	Chanda Farley	Andreas Vlasiadis	Barbara Bonfield	Eric Garrison	Monica Padilla	Naomi Lidicker	Sorangel Margulies
James Hatchett	J K	Brenda Hartman	Neville Bruce	Chandra Stephens	Geoff Long	Daniel Reinhold	Jeffrey Sanders	Dan Morgan	Diane Kossman
Chris Howard	Sam Butler	Jason Fish	P. Sturm	Suzanne Gordon	Natalie Aharonian	Barbara Mesney	Christopher Panayi	Kathleen Jones	Lee Hutchings
Steve Berman	Tess Kramer	Kathy Oppenhuizen	Maria Bon	James Thrailkill	Sara Fogan	Pat Blackwell-Marchant	Don Abing	Leslie Burpo	Carla Marshall
Evelyn Parker	Nicole Soos	Jill Paulus	David Holloway	Sofia Karvouna	Jennifer Pritchard	Eric Voorhies	William Conger	Shelley Wehberg	Jean Goetinck
Ron Melsha	Probyn Gregory	Elsy Shallman	Sharon Longyear	Daren Brady	Marcina Motter	Camelia Mitu	Rob Jursa	Mary Nesham	Joshua Dubansky
William Grannell	Linda Prostko	Katia Scaglia	Scott Davis	Nate Peterson	Lauryn Slotnick Weisberg	Virginia Bennett	Aaron Libson	Peggy Andersen	Kathy Michaelson
Tia Pearson	Janet Lee Beatty	Pietro Poggi	Steve Owens	Susang-Talamo Family	Nicole Terry	Joanne Grossi	Alexandre Kaluzhski	Joseph Quirk	Michael Hall

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Andrea Cain	Russell Novkov	Linda Fighera	Francine Dolins	Timothy Bruck	Cristina Russo	Susan Lefler	Alan Morgenstein	Lucinda Reinas	Sylvia Forte
Ronit Corry	Elizabeth Roberts	Marion Kraus	Len Jacobs	Robert Moeller	Sandi Cornez	Linda Graae	Marjorie Faust	Marie Elaina Rago	Patricia Wolongevicz
Frances Bell	Andrea Frankel	Lea Morgan	Stephen Bailey	Patti Johnson	Nate Carpenter	Caryn Cowin	Marilou Jung	Christine King	Ray Gehring
Richard Puaoi	John Magee	Marc Draper	Marty Gooch	Samantha Ladd	Chuck Rhoades	Sandra Bissett	Yvette Fernandez	Chris Williams	Sheila Miller
Christine Moreno	Steven Nelson	Miguel Angel Machuca Sanchez	Robert Towns	Corinna Hasbach	Jacqui Lipschitz	Marilyn Koff	Doris Verkamp	Jeff Alonzo	Rachel Porter
Chris Chiquoine	Susan Kalan	Rankin Smith	Sara Ogden	Paula Beall	Vanessa Aguiar	Melissa Wales	Eliot Brown	Frank Avagliano	Rick Elliott
Ronald Bader	Dorothy Dunlap	Lisa Westervelt	Richard Martin	Elizabeth Cherubin	Linda Shirey	Robert Belknap	Robert Rutkowski	Hailey Moore	James Dowd
Nancy Rupp	James Peloquen	Pat Pike-Dimel	James Groton	Jessica Foster	James Burge	Jane Doherty	Steve Troyanovich	Nancy Meute	Hannah Osborne
Deborah Marchand	Kevin Carroll	Lynn Gazik	Jackie Critser	Cynthia Warren	Liz Davis	Christine R	Melissa Dodson	Dmitry Landa	Les Roberts
Deborah Heron	Kyra Kester	Robert Jehn	Angie Copen	Becky Daiss	Kerry Heck	Jean Saja	Joe Muscara	Deborah Barolsky	Philip D’jernes
Marie Simmons	Elena Jurgela	Jane Gulley	Joyce Heyn	Carole Smudin	Mary Tuma	Laurel Colton	Pippa Pearthree	Margaret Handley	Colleen Mcglone
Barbara Miller	Amanda Gordon	Scott Nichols	John Gambriel	Susan Palma	Eric Mclearon	Jan Ebersole	Michael Seager	Linda Iannuzzi	Freya Harris
Jamie Greer	Jon Krueger	Randy Diner	Ann Sandritter	Marco Mannino	Janie Hinson	Mary Nausadis	Elizabeth Cronin	Ellen Phillips	Diana Duffy
Katherine Barrett Zywan	Tracy Darby	Zoe Schumaker	Sylvia Weaver	Kimberly Seger	David Spruance	Ammen Jordan	Benjamin Allen	Chad Plumly	Diane Pease
Kristine Moy	Aline Rosenzweig	Eileen Metress	Weslie Phillips	John Saccardi	Zola Packman	Lisa Burton	Margaret C Mchugh	Mariana Morse	Miriah Reynolds
Marie Rossachacj	Roxanne Bohana	Lora Losi	Dennis Luna	Susan Alexander	Barbara Abraham	Lorraine Manon	Roel Cantu	Dorothy Jordan	Ed Demers
Paul Bigelow	Bob Moyer	David Cook	Andi Shotwell	Lisa Ricci	John Pope	Diane Mcjunkin	Brenda Carmichael	Kyle Embler	Bobbie Flowers
Tom Watkins	Judith Murphy	Louise Wallace	Patricia Vineski	Carol Thompson	Matt Stedman	George Bourlotos	Steven Brockmeyer	Walter R. Hoeh	Claudia Chaffin
Heidi Jarratt	Lillie Lee	V. Euripides	Copley Smoak	Cliff Long	Lorraine Barrie	Mo Kafka	Adam D’onofrio	Robert Reece	Blaise Brockman
Joanna Taylor	Bonnie Mccune	Margaret Biase	Rita Rogers	Kyle Quandt	Louise Friedenson	Joyce Coogan	Duncan Storlie	Dawn Silver	Carolyn La Berta
Dorothy Riddle	Charmaine Michaels	Julie Watkins	Lori Stenger	William Knudson	Steve Loe	Vic Burton	Amanda Smock	Lee Lemos	Tara Verbridge
Carol Blaney	Julie Viergutz	Diane Moschetta	Carol Herdman	B Sitkin	Jamila Hadjsalem	Wanda Gaspich	Marta Calleja	Jamie Silva	Sue Velez
Mary Grimaldo	Michael Klausing	Briana Sabia	Marya Zanders	Marilyn Waltasti	Dan Sernick	Jane Davidson	Karen Deckel	Liz Lacy	Michael Chase
Jill Nicholas	Dan Nelson	Arthur Alfreds	Sharon Newman	Don Gilbert	Karol Bryan	Debra Skup	Tracy F.	Janet Hendrick	Sandra Boylston
Linda Cox	Jo Jones	Robert Johnston	Steven Besser	Tris Palmgren	Kevin Silvey	Elisa Townshend	John Dalla	Lucy Norman Spencer	Stephen Hirsch
Sharon Sauro	Carol Hanson	Smita Skrivanek	Richard Ley	Heather Schlichter	Dan Esposito	Tom Simmons	Cathy Ramsey	Frank B. Anderson	Bridget Irons
Kathy Winterburn	Sammia Panciocco	Richard Nell	Laura Gamsby	Al Bedard	Amelia Fusaro	Joel Jones	Charlene Cooper	Martha Thomae	Sheila Tran
Barb Morrison	Christine Harshman	Kathy Mason	Jean Marie Vanwinkle	Moselle Milner	Susan Fishman	Lark Svenson	Cami Leonard	Dave Allison	John Desmond
Aaron Allen	William Skirbunt-Kozabo	Dawn Albanese	Gregory Dudley	Jp Little	Carole Klumb	Matt Carson	Paul Schwarzkopf	Cathy Marczyk	Janine Kondreck
Janet Leung	Joseph Kelsey	Seb Villani	Barbara Tetro	Judy Childers	Vic Bostock	Robert Gore	Ted Proske	Mike Peale	C Davis
Dianna Suarez	Pamela Green	Kristi Dolch	Melinda Clausing	Marie Snavely	Michael Perkins	Megan Decker	Dorien Zaricor	Linda Pridgeon	Jane Herschlag
Michele B.	Julia Deasley	Dennis Schaef	Rich Ladenberger	Lynn Bengstonlynnb@Psych.umass.edu	Jen Brown	D. ‘Margo’ Salone	Kelly Riley	Greg Gehsmann	Gayle Doukas
Luci Howard	Vicki Jaynes	Brett Kelly	Maureen Swiss	David Frank	Valerie Hildebrand	William Rose	William Trimble	Ginger Ikeda	Ben Goodin
Paul Rindfleisch	Raphael Ponce	Frank Lorch	Joanne Sieck	Beverly Shea Schurr	Greg Brown	Charles Hammerstad	Janis Todd	Jon-Erik Zappala	Fred Coppotelli
Heide Coppotelli	Natalie Quiet	Vernon Batty	Kirk Rhoads	Susan Mamich	Douglas Drew	Shannon Taylor	Robert Ertner	Jeff Schwefel	Debbie Koundry
Phoebe Robinson	Suze Gingery	Kathleen Schalk	Kim English	Terrie Williams	Rick Mcanulty	Pamela Hamilton	Crickett Miller	Stacey Francis	Lisa Simms

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James A Clark Jr	Lazarus Boutis	A G Hansen	Carol Carne	Brian Ainsley	Douglas Mcmillan	Betsey Porter	Gail Wing	David Abalos	Lana La Fata
William Ryerson	Anna Engdahl	Meghan Maloney	Brooks Barnes	James Crutchfield	Michael Langlais	Rachel Cilley	Ronald Woolford	Robert Swab	Erline Towner
Carol Hyndman	Matt Mozier	Nancy Neumann	Eileen Sonnenberg	Reb Babcock	Pete Lyford	Warren Plunkett	Mark Kieran	Dana Sanchez	Karen Olden
Steve Lucas	Ashley Bean	Rachael Pappano	Hannelore Debus	Bonnie Blitzstein	Gisela Schloss-Birkholz	Ted Bernhard	Sid Jennings	Ross Wright	Kristin Campbell
Carolyn Trindle	Gail Battaglia	Joe Baggett	L M	Elizabeth Milliken	Todd Smarr	Jim Bosanny	Jeffrey Hemenez	Deborah Stowe	Chris Roche
John Beamer	Mary Jean Cunningham	Marianne Bentley	Teresa Iovino	Naomi Klass	Christy Molenkamp	Jen Backer	Kathleen Rice	Art Meeder	Maria Kalousi
Jen Matthews	Rebecca Marshall	Joe Brazie	Timothy Devine	Alfred Mancini	Laura J. Peskin	Milva Deluca	Albert Marra	Jim And Carol Watkins	Samuel Rametta Jr
Doris Miller	Glenn Hufnagel	Elizabeth Ketz-Robinson	Raina Broadstone	John Teevan	Nancy Stamm	Morgan Shimabuku	Joseph Naidnur	Rodney Hemmila	Gloria J Howard
Gary Kelzenberg	Amy Leigh Garland	Donna Sawyer	Matthew Humphrey	Christopher Stimson	Charlie Speno	Dianne Maughan	Joseph Madigan	Dina Belmir	Kyle Montgomery
Dede Christopher	Tim Romano	Clyde George	Karen And Edward Osgood	Carolyn Clark	Heidi Lynn Ahlstrand	Richard Stockton	Joanne Meister	Betty Stewart	Stephanie Lovell
Scott Reese	Paul Elliott	Leigh Begalske	Larry Smith	Jonathan Nash	Micaela Fierro	Daniel L. Harris	Helen Low	Cameron Huffman	Cindy Sheaks
Vance Blackburn	Sa Higgins	Dennis Landi	Chris Watson	B Levy	Marybeth Arago	Diana Soleil	Barbara Snell	Stephen Owen	Hollie Torrence
Richard Zimmermann	James Staszewski	Kyle Gardner	Susan Preston	Larry Brown	Darren Strain	John Christopher	Cynthia Johnson	Norman Howe	Melissa K
Jeane Harrison	Dani Bigley	Louise B Angelis	Louis C Harris Jr	Dyke Williams	Kathy Britt	Kristen Renton	Howard Lambert	Jennifer Scott	Yanisa Anaya
Christine Fluor	Randy Hawker	Pete Gibson	Thomas Dorsey	Martha Larsen	Josette Deschambeault	Marilyn Costamagna	Pat Vermillion	Peter Lefebvre	Sally Sprague
Debra Guel	Cheri Koehler	Heather Cross	Michael Hegemeyer	Michael Zuber	Leonard Elliott	Geoffrey Pruitt	Aggie Shapiro	Mildred Mcdermott	Wilfredo Morales
Doug Landau	Jeff Metzger	Bryan Coggins	Deborah Willette	John Kirk	Michael Ranger	Chris Saia	Wilmalyn Puryear	Gordon Cook	Wayne Gafford
Rohana Mclaughlin	Duane Gustafson	Lou Paller	Dylan Coates	Hannah Specht	Carol Banever	Cara Ammon	Jerry Horner	Pat Foster	Karen Odonnell
Douglas Cooke	Ellyn Sutton	Sr Hinrichs	Colleen Mcmullen	Kay Hudson	Ken Gibb	Wentworth Clarke	Gary Lett	Jill Herbers	Jamie Brozovich
Flagg Miller	Dale Patterson	Chris Washington	Miriam K.	Karen Levins	L.l. Wilkinson	Matthew Reid	Theresa Morris	Lorraine Heagy	Joyce Shiffrin
Carla L	Mel Wilson	Mindy Newby	Crystal Walter	Calli Madrone	Paul Riconscente	Katherine Babiak	John Walker	Jeff Laflamme	Barbara Murray
Chris Abery	Terry Kleid	Lela Perkins	A. W.	Patricia George	Roberta Kessler	Joe Cundari	Mike Dawes	Mary Thorpe	Deloris Lenas
Steve Aydelott	Douglas Meikle	Britt Clemm	Vicki Wheeler	Noele Aabye	Karen Taylor	Horst Hoetzer	Judi Naue	Alan Brown	Jenifer Johnson
James Gysler	Miriam Baum	Bryce Morris	Laura Sanders	Barbara Sandford	Richard Bouton	Peter Sweeny	Brenda Tobin	John Fox	Pat And Gary Gover
Eugene Jones	Laura Long	Rhonda Bast	Chris Talbot-Heindl	Lori Ugolik	Tommy Parran	Adam Mills	Ernie Walters	Daviann Mcclurg	Merrie Thornburg
Tom Dinicola	Anna Drummond	Gloria Fischer	Steve Carr	Warren Totten	Douglas Gammell	Wayne Steffes	Anthony Mansell	Stephen Dutschke	Richard Labudie
Martin Henderson	Dale Wood	Tim Harden	Christine Becker	James Mcbride	Sandy Draus	Lucy Tyndall	Rex Mixon	Vicki Hughes	Patrick Gallagher
Shirl Atwell	Roberta Wagner	H. Guh	Travis Miller	Margaret Hostetter	Ed Benner	Janet Rafferty	Kirsten Cayabyab	Adam Johnson	William Rivers
Donna Koechner	Mary Able	Jeffery Garcia	Ann Mcpadden	Sonia Immasche	Ron S.	Laura Adams	Aurelie Ward	Lucinda Murphy	Wayne Mortimer
Michele Langston	Laura Prestridge	Agnew Wilson	L Krausz	I. Engle	Frances Goff	Richard Han	Diane Basile	Dan Murchison	James Dawson
Reeta Roo	Ashley Hunsberger	Stephen Gliva	S. Kaehn	David Schneider	Joseph Porporino	William Tickell Iii	Jessi Harris	Lisa Klepek	Jamie Trask
Jerry Golay	Mike Anderson	Covi Lopez	Walter Moore	Frances Rogovin	Steve Dennis	Catherine Macan	Jason Rapacilo	Preston Larimer	Sara Wallick
Jared Borba	Aixa Fielder	Eric Polczynski	Carrie West	Mary Johannsen	John Swiencicki	Ronald Kestler	John Kane	Richard Stern	Marian Carter
Sam Asseff	Noah Youngelson	Corita Forster	Bradley Mefford	Mark Foster	Ramsay Kieffer	Susan Termini	Patricia Broda	Helen Webb	Michael Gill
Mary Loomba	Terri Pigford	John Schmittauer	Jesse Williams	Martha Burton	Alison Wasielewski	Alexa Jenkins	Bobbi Chapman	Rita Kain	Ken Maurice
Sandra Costa	Carmel Ammon-Mulloli	Mike Souza	Michael Montgomery	Steve Babb	Elisabeth Bechmann	Donna Bookheimer	Jessica Matelsky	James Robertson	Pamela Nelson

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Kimberly Bonnell	Kirsten Wuerdeman	Megan Williams	Paulette Zimmerman	Josiah Howison	Scott Parson	David Koser	Gina Johansen	Mary F Platter-Rieger	Betty Funkhouser
Dianne Alpern	Patty Linder	Alex Schoen	Dan Hubbard	Mary Zack	Martha Stopa	Paul Kalka	Debbie Brawner	Bridgett Heinly	Celia Scott
Ian Peisner	Christine Rohde	Carol Rahbari	Michael Gaul	Rochelle Lazio	Jim Bearden	Holly Marczak	Kristen Swanson	Rio Valencia	Pattie Meade
Kyle Schaefer	Robert Carroll	Allison Alberts	Greg Zyzanski	Karen Lampke	Billy Von Raven	Diane Miller	James Thoman	Stacey Skole	Tina Herzog
Kyle Alhart	Angela Negri	Katy Neusteter	Noreen Conort	Julie Clayman	Jennifer Valentine	Bryan Gregson	Richard James	Dave Freed	Sara Pandolfi
Donald Cook	George Carlino	Jan Leath	Sharon Budde	Laurel Eckert	Jessica Stabler	Patti Eckert	Christina Viljoen	Barbara Brockell	Garry Taroli
Monica Raymond	S. Nam	Richard Rheder	Don Clapp	Sofie Forsberg	Thelma Matlin	Helen Palmer	Wil Sloan	Larry Neasloney	Rose Aranita
Ms Zentura	Kathleen Burke	Eric Mocko	Michele Vaillancourt	Amelia Linder	Tracy Wells	Rob Carter	Barbara Mathes	Kelsea Love	Edward Rengers
James Donahue	Darcy Bergh	Ryan Stander	Robert Swift	Edwin Colberg	Jason Steadmon	Chris Dacus	Cortney Zaret	Rick Crawford	Alan Wolff
Jan Lowrey	Stephen And Robin Newberg	Irena Franchi	Laura Guttridge	Liam Donohoe	Earl Dodds	Sherilyn Coldwell	Kathleen Eaton	Rj Zaczyk	Albert Fecko
Jennifer Brennan	Camie Rodgers	Beth Angel	Jill Bohr Jacob	April West	Rick Miller	Richard Jaramillo	Karlene Gunter	Ruth Leventhal	Carl Stapler
Pauline Rosenberg	Pilar Barranco	Frank Elder	Kathleen Kiely	Manfred Zanger	Andrea Smith	Matt Steinwurtzel	Johnnie Allen	Jerusalem Wise	Paul Kripli
Vanessa Mcclinchy	Michael Swanson	Cammy Colton	Bob Leppo	Shelley Frazier	Linda Waine	Amanda Jungkuntz	Katherine Wright	Michele Laporte	Kate Nyne
Sabrina Eckles	Abigail Montgomery	Ann Marie Sardineer	Cory Monty	Ed Jocz	Wanda Graff	J.t. Smith	Harriet Shalat	Bev Hagen	Deborah King
Nick Hall-Skank	Ada Rippberger	Gloria-Jean Berberich	Wil Polesnak	Alex Maccollom	Keith Runion	Terry Friedman	Amy Biggs	Joseph Ponisciak	Beverly Antonio
Brittany Carlino Marburger	Kirsten White	John Ruhl	Stephanie Nunez	Randall Nord	Bruce And Maureen Denunzio	Loretta Kerns	Tony And Cindy Guarnieri	Barbara Sickles	Nathaniel Brodsky
Josh Mills	Morris Applebaum	Wm Briggs	Kala Mckinley	Tawnee Livingston	Hitomi K	Rob Weinberg	Valerie Sotere	Darleen Moranobrown	Helen Kite
Heloisa Henriques	Claudio Henriques	Debra Elder	Claudio Mattos	Jacob Nolan	Gerald Thompson	Jolie Jacobus	Heloisa Mattos	Vince L	Sandy Goncarovs
Susan Nierenberg	Chrisann Guinta	Mary Jeffrey	Lynn Spees	Priscilla Trudeau	Barry Wolfe	Leila Goldmark	Michael Caputo	Yazmin Gonzalez	Heath Post
Daniel Swink	Melissa Bishop	Claire Trauth	Michael Pecora	Janet Rupp	Donna Smith	Mark Giese	Christopher Lish	Bellamy Oughton	Kathrina Spyridakis
Inara Powers	Sharon Paltin	Gabriel Kirkpatrick	Tait Rocksund	Graham Ellis	Thomas Ballew	Marcia Carter	Leroy Damian	Tim Ryan	Paula Beers
Tom Barry	Katherine Murdock	Ruth Potts	Ed Christy	Matthew Ferrell	Suzanne Hansen	Mary Barchman	Elise Van Valkenburg	Pam Miller	Ricki Newman
Gwen Gay	Sophie Parker	Steve Ollove	Nancy Leech	Helen Smylie	J Lasahn	Nic Torrence	Steven Kranowski	Jamie Harris	Andrea Sreiber
Mary Lou Soscia	Genevieve Deppong	Allan Campbell	Perla Gonzalez	Nora Sotomayor	Patricia Marinaccio	Holly Smallwood	Sherrie Mcintyre	Marsha Adams	Justin Pistore
Katharine Walker	Nikki Wojtalik	Charles J Whittle Jr	J Bocchino	Ricky Sloan	Damian Estrada	Daigham Bowers	Marcela Proctor	Mary Barhydt	Bob Yancey
Susan Helmer	Vince Bauerlein	Norma Morgan	Christina Adkins	Norma Itule	Dameta Robinson	Amanda Wheelock	Teresa Woods	Paige Mcglaughlin	Colin Siracuse
Sandra Breakfield	David Timby	Gary Clarke	Nolan Hudson Jr	Todd Spangler	Maryanne Jerome	Ben Dotson	Lois Linn	Robert Gibson	Donna Shinkawa
Marc Van De Waarsenburg	Justin Hotovy	Robert Hallas	Juanita Romero	Matt Mccormick	Michael Strange	Robert Burch	Scott Macdougall	Deborah Kreuser	Mark Molloy
Tom Greiner	David Burns	Cecily Anne	Thomas Nowacki	Traci Pellar	Diane Shifrin	Matthew Myerson	Mary Sue Baker	Diane Kent	Snow Morgan
Patricia Borri	Valerie Rice	Lisa Goldman	Peter Arrant	Maria Gritsch	Heather Mullee	F Fitz	Mary Lannon	Sherrill Gary	Larry Trout
Megan Warren	Michael Yarnall	Margaret Mcginnis	Bonnie Tanner	Stephen Heliker	Martina Hainke	Mark Fuller	Saul Schreier	Jeffery Olson	Christine Parus
Doug Franklin	Antal Kalik	Crystal Howell	Alexander Alimanestianu	Kent Forbes	Douglas Koffler	Eric Steele	Greg Hime	Britt Tinkle	David Schlendorf
Peter Beves	Harold Zimmer Jr	Peggy Moody	William Fast	Linda Kehew	Amy Wolff	Bill Macartney	Logan Paul	Clayton Jones	Jeff Parsons
Anne Stray Gundersen	Cem Ozkok	Stacey Bishop	Kristin Gardner	Mark Zall	April Narcisse	Tonya Stiffler	Deborah Coviello	Marilyn Snyder	Sally Wise
Robert Giusti	Theodore Mertig	Janet Forman	Edward Bernas	Natalie Van Leekwijck	Donna Bing	Susan Goldberg	Heather Turbush	Elizabeth Watts	Susan Burns
Lawrence Hilf	Joyce Kelly	Karen Brant	Oleg Varanitsa	Diane Berliner	Aaron Teets	Danny Davenport	Kate Ryan	Lyn Du Mont	Fran Merker
Jan Tullis	Fritzi Cohen	Chloe Frooninckx	Tlaloc Tokuda	Tom Raedeke	Kevin Dean	Mike Rolbeck	Ken Visger	Annick Baud	Thomas Wasmund

Form Letter 34

Lorraine Forte	Mike Casper	Charles Ellis	Karen Estok	Kay Warren	Wayne Teel	Angelika Braxton	Marie Brown	Angela Lambert	Joellen Arnold
Ruth Boice	Judy Brewer	Maiya Greenwood	Steven Tichenor	Cliff Davis	Kim Lawler	Cheli Bremmer	Thom Peters	Joan Jacobs	John Andes
Jaime Becker	Lee Karkruff	Ross Lockridge	David Edwards	John Poffenberger	Amy Harlib	Diane Bristol	Kyenne Williams	Charles Walbridge	Jean Raby
Jean Farris	Patricia Tursi	Roxanne Dolak	Steve Andrews	Paul West	James Shelton	Roseann Blacher	Kenny Lerner	Mha Atma S Khalsa	R Palm
Thomas Nieland	Frank Ackerman	Sharon Tkacz	Anne O'brien	Daniel Graham	Julia Natvig	Theodore Weber	Pat Foley	Cynthia Mcnamara	Joseph Boone
Margret Mccleeary	Jack Stansfield	Sharon Parshall	Eric Nylen	James Keil	Priscilla Martinez	Greg Hamby	Jordan Hashemi-Briskin	Susan Gottfried	Julie Holtzman
Anne Jackson	Barb Arana	Lea Tolley	Maurine Canarsky	Werner Bergman	H Dennis Shumaker	Patty Williams	Judy Fairless	James Schupsky	Jeanine Center
Tracy Hendershott	Bob Miller	Cecilia Nakamura	Barry Bennett	Gertrude Crowley	Allen Bohnert	Charlene Woodcock	Eileen Hennessy	Charles Chaffe	Dechenne Cecil
Russ Manning	Orysia Dagney	Claire Egtvedt	William Maynard	Michael Letendre	Frank Pilholski	Deidre Burnstine	Kathleen Mckeehen	Joanne Zabik	Sharon Morris
Kathy Shimata	Karen Naifeh	Gayle Janzen	Alison Massa	Michael Conrey	David Adams	C. Sullivan	Rachel Krucoff	Ruth Feldman	Patrick Reyna
Mike Mccool	Kimberly Schmidt	Elisa Greco	Jean Blackwood	Karen Kalavity	Marsha Lowry	Kristen Ringham	Larry And Elaine Larimer	Rita Harrington	Stephanie Johnson
Steve Foley	Milan Vigil	John Chadwick	Ran Pigman	Barbara Graham	Nicholas Travers	Allison Ostrer	Virginia Davis	William Schoene	Janet Delaney
Thomas Mader	Abigail Ann Fanestil	Lyndsay Dawkins	Ole Raadam	Catherine Oleksiw	Joan Hobbs	Martha Martin	Geri Cummings	Karsten Mueller	Charles Andrews
Don Mc Gowan	Jim Hajek	James Heckel	Leonard And Ellen Zablow	Barbara Sallee	Barbara Lamb	Robert Fritsch	Mara Scallon	Mark Huddleston	Alan Lambert
Tammy Lettieri	David Roberts	David Collins	Maia Maia	Jane Nachazel	Eloise Swenson	Beverly Rae	Linda Rossin	Wendy Raymond	Deborah Smith
James Salkas	James Abendroth	Randy Juras	Gail Caswell	David Worley	Dick Dragiewicz	Dacelle Peckler	Richard Lyon	Joann Francis	James Johnson
Cathy Geist	Russ Taylor	William Sharfman	Aloysius Wald	Mimi Hodsoll	Susan Donaldson	Susie Cassens	Marc Mccord	Jennifer Nitz	Avi Okin
Gina Bates	M W	Deb Nelson	Ms Lilith	N Houghton	Jamie Mackintosh	Nancy Gutierrez	Randall Foreman	Sara Lang	Joyce Weir
Hugh Lentz	Ronald Fritz	Emily Willoughby	Nina Wouk	Donna Fine	Diane Griffeath	Janet Strothman	Jason Himick	Stephen Greenberg	Michael Guest
Richard Rutherford	Richard Booth	Thomas Carlino	Susan Sanocki	Jim Blugerman	James Klein	Jeff Somers	Melissa Bauer	Jeremy Winick	Alexandra Sale
Elliott Bailiff	Perri Gaffney	Barbara Anders	Sandra Oliver-Poore	Art Hanson	Mary Jo Masters	Maureen Knutsen	Stephen Schmidt	Eugenia Larson	Tim Duda
Thomas Heinrich	Valissa Taggart	Linda Mintun	Peter Giffin	J Weil	Barbara Johns	Parker Corbin	Jesse Reyes	Peggy Gilges	Kathy Bosler
Roxanne Ciatti	Kate Skolnick	Tina Kramer	Michael Beech	Dori Cifelli	Riley Canada Ii	Denise Deslauriers	Nancy Ruffing	Beth Thebaud	Carol Hatfield
Bonita Staas	Jamie Upham	Kathleen Doyle	David Yoder	Jo Anna Hebberger	William Anderson	David Miller	Linda Covington	Abigail Gindele	Christopher Betts
Jacqueline Birnbaum	Larry Lambeth	Juliann Rule	Dan Mccurdy	Royal Graves	Brian Gibbons	Henry Westmoreland	Serenity Montano	Alexis Morris	Carol Sills
Jo Niemann	Lisha Mejan	Sara Casey	Julia Stevenson	Kristel Buck	Randall Woodford	Tanya Piker	Margaret Murray	Chris Cavaliere	Whitney Eure
Jerry Mcgaba	Roger Risley	Emily Peppers	Cinda Johansen	Dorothy Buchholz	Emery Rheam	Paula Defelice	James Stone	James Mcvey	David Palladini
Rebecca Howe	Robert Anderson	Rachael Denny	Thomas Winner	Maureen Startin	Juanita Hull	Val Marjoricastle	Gary Hull	Steven Gross	Carole Farrar
Diana Cowans	David Keddell	Gardner Dee	Robert Hiekkanen	Amy Quate	Laura Horowitz	Bernard Lizak	Duncan Duchov	David Dee	Michael Powell
Jake Hodie	Dorothea Herman	Yvonne Smith	Cathy Brunick	Stephen Burns	Jon Baum	Catherine Gumtow-Farrior	Jim Steitz	Richard Packman	Gretchen Zeiger-May
Tim Glover	Ruth Stewart	Fran Field	Janice M Stocker	Matthew Perkins	Wayne Goin	Brendan Shumway	Melissa Early	Laura Ferguson	Jeff Welsch
Sarah Segal	Will Duff	Carol Hay	Leigh Fredrickson	Helen Meeker	Eugene Brusin	Douglas Kretzmann	Elery Keene	Sarah Roberts	Nadine Nadow
Matthew Genaze	Karen Jacques	Doretta Reisenweber	Bruce Thompson						

Form Letter FL1									
Aaron Parnett	Charles Aydlett	Michael Blakely	Matthew R. Wilson	Emily Free Wilson	Theresa Cardiello	Daniel Struthers	Skyler Angone	Rhiannon Weaver	Mary Ann Dunwell
Ryan Cosne	John Patrick	Bruce Anfinson	Mark A. Squires	Cathy Wabu	Timothy Speyer	Marc Moss	Jonathan Read	Dustin Burdick	Mitch Carroll
Nicholas Danielson	David Kruk	[Illegible] Haaslva	Todd Pentico	Jeff Nash	Kelsey Duncan	Brad Robinson	Teresa Amsbugh		
Form Letter FL2									
Ellie O.	Kristine Bell	Sawyer Delumann	Violette Jandt-Padgham						
Form Letter FL3									
Charles D. Buskirk	Rebecca C. Guay								

Form Letter FL4									
Alan Septoff	Marlene Miller	Tarn Ream	Clarann Weinert	Tom Wilde	J Foster	Jillian Fiedor	Vonnie Donahue	Phyllis Faulkner	Anita Mcnamara
Jim Davis	Gene Moore	Billy Angus	Pete Rorvik	Catherine Ream	Ryan Hunter	Jenna Fallaw	Bill Boggs	Dylan Flather	Joan Daniels
Krystal Weilage	Gail And John Richardson	Heidi Handsaker	Frank Sennett	Shari Sutherland	Jennifer Lundberg Deneut	Rocio Muhs	Steve Mcarthur	Peter Newbern	Claudia Wornum
Jennifer Nelson	Stephen Mead	Ann Khambholja	Karen Jones	Alex Stavis	Cave Man	Judi Poulson	Arthur Connor	David Elfin	John Lopez
Michele Laporte	Kristin Green	Laurel Eckert	Lisa Witham	Sally Karste	Ambrey Nichols	Mostyn Thayer	Sandra Geyer	Chad Fuqua	Lawrence Bojarski
Carol Laurencell	Raymond Nuesch	Debra Evon	Marcella Hammond	John M Schaus	Gregory Fite	Warren Allely	Anne Lebas	Brooks Obr	Don Waller
Sue Hanlin	B Sitkin	Cristen Mcconville	Diana Saxon	Dina Belmir	Laura De La Garza Blanca	Stevie Sugarman	Ned Cavasian	Mary Trujillo	V Smith
Tina Pirazzi	David J. Lafond	Patricia Fleetwood	Marianna Bunn	Eury Ramos	Denise Kastner	Greg Hartley-Brewer	Leticia Garcia	Carmen Chacon	Clyde Williams Ii
Dacia Murphy	Marjorie Nothern	Karen Guarino Spanton	Linda Townill	Arthur Kemish	Dennis Feichtinger	Donna Bubb	Leena Maristo	Victoria Groshong	Debbie Schlinger
Lindsey Caudill	Thomas Pintagro	Ruth Steger	Jeffery Morgenthaler	Vesna Glavina	Mary Burrell	Susan Anderson	Frances Blythe	Thomas Klein	Michael Keough
Catherine Williams	Janet Heinle	James Adams	Jessica Motta	Elisabeth Armendarez	Claudia Fischer	James Ploger	Vidya Dunki Jacobs	Krista Dana	Kj Casey
Katia Scaglia	Georgeanne Samuelson	Lois White	Barbara Heil	Stephen La Serra	Joyce Robinson	Janice Robertson	Elizabeth Guldan	Lyssa Mercier	Cindy Blue
Alan Williams	Lois Harris	Thomas Campanini	Dorothy Li Calzi	M. Cecilia Correia	Kristina Lozon	Brittany Barringer	Alfred Staab	Sylvia Vairo	Frank Fredenburg
Stephen Rosasco	Pamela Miller	Jana Perinchief	Charles Gould	Kyle W.	Dallas Williams	Jennifer Sumiyoshi	Diane Kuc	Louis Levi	Querido Galdo
Charles Massey	Randy Thomas	Susan Vogt	Bruce Hlodnicki	Sarah Murdoch	Jane Marquet	Valerie Leonard	Stephanie Erev	Frances Hoenigswald	Susan Hathaway
Charlotte Sines	Deborah Voves	Karen Hellwig	Patricia Wynn	Ellen Waller	Nell Nieves	David Ringle	Steve Vogel	Stephen Greenberg	Charles Looney
R Wells	Richard Twillman	Noah Youngelson	Sarah Foster	Terri Camara	Marilyn Waltasti	Angela Stuebben	Susan Kutz	Jennifer Barbara	Ruth Fatur
Victor Paglia	Frank Gonzales Jr.	Jo Dolittle	Ruth Ann Wiesenthal-Gold	Mary Meehan	Jeffrey Bains	Mary Foley	Linda Williams	James R Monroe	Timothy Larkin
Joyce Overton	John Rybicki	Robert Shippee	Merry Harsh	Maryrose Cimino	Fritzi Cohen	Jean-Michel Leblond	Jean Cheesman	Laura Ramon	Stacey Bradley
Phyllis Park	Eleanor Navarro	Marina Barry	Michael Iltis	Edmund Weisberg	Leah Jacobs	Joseph Breazeale	Kim Perry	Bonnie Faith-Smith	Francois Bezuidenhout
Linda Byrne	Pat Lastrapes	Bonnie Williams	Paula Rock	Mary Seegott	Kellie Martindale	John Mora	Frances Sullivan	Valerie Romero	Suzanne Rogers
Ted Rubin	Cate Schroeder	Thomas Swoffer	Raffaela Kane	Mary Workman	Guy Perkins	Mike Laporte	Gregory Penchoen	Sandy J.	Linda Rushoe
Eileen Poroszok	Amber Simmons	Suong Huynh	Andy Munoz	Brenda Psaras	Janet Grossman	Dawn Silver	Carol Thompson	Delfina Fernandez	Diana Baker
Mark S. Weinberger	Bob Ottosen	Mark Goodman	Richard Langis	Karen Deckel	William Mcgoldrick	Lee Finnegan	Kenneth Barkin	Carrie Breen	Nancy Philips
Alice Clark	Patty Hopkinson	Denise Pedersen	Cecily Colloby	N. Diamond	Martha Rowen	Richard Stern	Joseph Dimaggio	Robert Wesley	Rosalind Herbert
Jan Golick	Kathryn Johanessen	Cheri Moore	Sabrina Fiodorow	Rob Gallinger	Steve Iverson	Mark Latiker	Dunja Gasser	John Krumrein	Barry Saltzman
Mariana Varela	Carrie Swank	Joellen Rudolph	Mike Parsons	Francine Tolf	Christopher Cassa	Linda Harris	James Clark Jr	Jace Mande	Kaaren Klingel
Paul Shabazian	Glenn Eklund	Craig Cline	Marcia Hoodwin	James Roberts	Kathy Stack	Joan Martorano	Erik Larue	Eric Polczynski	William Leavenworth

Form Letter FL4									
Linda Boyd	Anne Barker	Donna Goodnight	Edythe Ann Quinn	Joann Konski	Linda H	J Rodriguez	Jim Wingate	Corinne Jordan	Harold Wakefield
David Lawrence	Alva Pingel	Susan Esposito	Sammy Almaita	Karen Wolf	Carol Devoss	Karen Bryant	Amy Henry	Sue And John Morris	Patricia Taylor
Tony Segura	Linda Banta	Ellen Bardo	Dan Pepin	Toni Freeman	Kay Lowe	Marianne Orr	Donald Sage Mackay	S. Jordan	Stan Partin
Richard Kite	Edward Hall	Elisabeth Ritter	Sue Biederman	Steve Radcliffe	Laurie Storm	C Keating	John Daly	Laura Ray	Irene Snavely
Diana Townsend	Robert Wallen	Marlena Lange	K L Paul	George Craciun	Donna Bonetti	Christine Etapa	George Fairfax Md	Michael Hegemeyer	Jl Angell
Stanley Hix	Bill Gardner	Darren Jacobs	Naomi Klass	Steve Mattan	Veronica Schweyen	Silvia Hall	Erika Agnew	Frank Bures	Kay Randall
Jaye Screamingeagle	Takako Ishii-Kiefer	Barbara Boros	Daniel Wilkinson	Michael Tucker	Merlin Hay	Ken Wagner	Gene Fox	Jennifer Bellano	Ruth Cook
Dave Ogilvie	Diana Lemus	Chris Wrinn	Stephanie C. Fox	Lynette Ridder	Evelyn Coltman	Edna Mullen	Polly Pitsker	Sandra Lynn	Patricia Montague
Maureen Oliver Borquez	Pamela Brocious	Laurence Topliffe	Rosa Baeza	Paul Russell	Chris Lima	Robert Rector	Elizabeth Freer	Lisa Barrett	Robin Nadel
John Deddy	Tammy King	Shawnda Drennen-Schwartz	Bob Farrell	Sheldon Rosenblum	Laura Kaufman	James Heermans	Patricia Jean Young	Thomas Turek	Jan Emerson
T Mo	Debra Wollesen	Donald Shaw	Lisa Gordon	Libby Sosa	K. Smith	Kathy Haverkamp	K. Paro	Kim Seger	Patricia Rogers
Linda Ogren	Sally J Hills	Avis Deck	Teseo Staffilani	Blake O’quinn	John Lippiello	Ann Sandritter	Bob Gendron	Daniela Hermida	Martin Penkwitz
Lauretta Gordon	Nancy Bush	Heidi Parvela	Douglas Cooke	Efrain Sanchez	Bree Pugh	Diane Huber	Joseph G Lawson	Jessica Mitchell-Shihabi	Jamie Rosenblood
Alisn Yates	Yvette Fallandy	Gale Espinosa	Rk	Traci Cain	Nancy Walsh	Michael Lane	Drew Cucuzza	Gail Roberts	Jamie Trask
W Blair	Nic Duon	Jan Salas	Linda Walters	Andrea Hall	Michael Dutton	Derinda Nilsson	Myriam Bois	Tony Menechella	Brenda Smith
Sylvain-Paul Côté	Lori Korioth	Carey Million	Laura Koulish	Marianne Corona	Dean F. Amel	William Crist	Nancy Fleming	Ileana Lopez	Jane Hayward
Ariel Heron	John Dervin	Kenneth Miller	M Mattell	Mellisa Elrick	Douglas Klein	Laurelyn Baily	Meredith Kent-Berman	Susan Sullivan	Harold And Georgi Mortensen
Eric Johnson	Judy Kinsman	Janine Comrack	Lasha Wells	William Mittig	Randy Gerlach	Christine Arroyo	Raeann Scott	Leah Berman	Marjorie Angelo
Shawn Hall	Lawrie Macmillan	Kathleen Mireault	Anthony Mehle	Bob Steininger	Marlena Tzakis	Brooks Barnes	Betty Scholten	William M. Musser Iv	Joel Maguire
Karen Kirschling	Karen And Will Lozow Cleary	Gabriel Lautaro	Laura Grossman	Natalie Smith	G. Countryman-Mills	Carol Wagner	Tom Rummel	Renee Klein	Donna Campbell
Oscar Bird	Stuart Hall	Judy Devault	Michel Collin	Roberta Bishop	Eleanor Decker	John Everett	Lori Triggs	Diane Clark	Michael Richardson
Abriete Medore	Daniel Corbin	Patrick Reilly	Sherry Monie	Jan Ackerman	Janice Jones	Jody Goldstein	Tiffany Snyder	Michael Eisenberg	Larry Branson
Hanne Naegler	Robert Rogan	Jan Voorhees	Loretta Aja	Kristo C	Mark Sayers	Pamela Winberry-Thompson	Darynne Jessler	Zoe Bird	Carol Garber
Reese Forbes	Mattie Haack	Amitav Dash	Yazmin Gonzalez	Robert Gilman	Kenneth Althiser	Lorna Holmes	Chris Kliveland	Anavai Harish	Debra Miller
Jamie Shultz	Gregg Fletcher	Bonnie Kenny	Harold Adolph Meyer, Jr	James Hoots	Whitney Watters	Mark Reback	Jeffrey Hemenez	Diane Nowak	Brooke Prim
Fawn King	Felicity Devlin	Diane Kokowski	Gertrude Battaly	Maria Miller	Maureen Lynch	Kimberly Mcconkey	Emmet Ryan	Kathleen Williams	Paula Propst
Sandi Covell	Nikki Nafziger	Ernie Walters	Dan Perdios	Lisha Doucet	Janet Tice	Patricia Moguel	Kellie Miller	Tim Stein	Nina Black Reid
Jackie Demarais	Tracy Brophy	Terry Bulla	Wayne Kelly	Julia Cranmer	Mary Hares Franklin	Peggy Morris Reed	Aaron Ucko	Joe Azzarello	Ali Morse
Jack Stansfield	Deborah Long	Teresa Iovino	Jeane Harrison	Nathalie Quesnel	Wendy Fossa	Vince Bjork	Conrad Schaub	Lisa Howell	Judy Shively
George Hite	Fritzi Redgrave	Gerald Hallam	Eileen Massey	Nancy Moore	Keith Everton	Glenn Welsh	Jaymie Arnold	Ana Mallett	Jo Wiest
Brenda Lewis	Donna Lewis	Anca Vlasopolos	Kerry Burkhardt	Linda Smith	Sara Frothingham	Martha Spencer	Jane Drews	Judi Oswald	Ken Arconti
Robert Ayers	Jesse Calderon	Renata Bartoli	Jean Roberts	Susan Hittel	Christopher Devine	Jeff Reagan	Cortney Zaret	Rob Jursa	Ana-Paula Martins-Fernandes
Patricia Archuleta	Nina Van Overbeek	James Bess	Gidon Eshel	Jason Schulman	Suzanne Johnson	Peggy S. Collins	James Hansler	George Mufdi	Harla Hill
Cheryl Kallenbach	Michael Mccartin	Karen Stimson	Neil Stafford	Amy Schumacher	Kimberly Jones	Ken Martin	John Harrington	Mark Cosgriff	Fred Kahn

Form Letter FL4

Sarah Epstein	Robert Robinson	Etta Robin	Kathy Keating	Eleanor Yasgur	Anna Brewer	Chris Hazynski	Michelle Mackenzie	Linda Ulvaeus	Martin Horwitz
Debra Temple	Carolyn Pettis	Robert Janusko	Debra Berlan	Michele Mcferran	Saliane Anderssen	Judy Genandt	Massimiliano Urso	W. Andrew Stover	Darlene Baker
Michael Stauber	Adam Jackaway	Doyle Adkins	Josef Wagner	Allan Rubin	Sandra Henning	Mark Egger	Yvonne White	Sarah Dean	Joseph Erdeljac
Judith Burch	Marjorie Faust	Mary Ann Cernak Mary Ann Cernak	Jeanne Fletcher	Patrick Keene	Jane Schnee	Mary Eide	Deanna Horton	Max Sampson	Karin Wagner
William Skirbunt-Kozabo	Irene Stewart	Sheila Tran	Ellen Segal	David Tvedt	Dan Horton	Dimitar Dolnooryahov	Candace Russell	Fran Terry	Jeremy Spencer
Dale Sloat	Angelika Blochwitz	Gisele Sampson	Gayle Solomon	Al Gedicks	Margaret Rangnow	Connor Hansell	Elizabeth Chitto	Jennifer Cunningham	Joie Budington
Jan Sloat	Dinorah Hall	Scott Cottrill	Tracey Kleber	Claire Chambers	Carol Metzger	Jennifer Miller	Beverly Hoff	Gayle B. B. Rosenberry	Frances Rove
Timothy Post	The Gideon Animal Foundation	Eugene Jones	Jennifer Gaffney	Rosario Cosimo	Ronald Russo	Merlin Levan Wilkins	Ron S.	Karen Matulina	Jane Sawcer
Jessica Mitchell	Mike Butkiewicz	Robert R. Waddell	Heidi Johnson	Barbara Fletcher	Soretta Rodack	Jim Rice	Lindalee Mceachrontaylor	Kim Beeler	Marcel Liberge
Kathy Watson	Carol Dodson	Laurette Culbert	Joyce Moscowitz	Jeanne Sumner	Jackie Dow	Rebecca Muzychka	Jim Melton	Ernst Mecke	Anne Streeter
Terry Flowers	Jack David Marcus	Mary Ann Barrett	Shirley Harris	Harriet Cohen	P Scoville	Gary Baxel	Fran Field	Christine Wordlaw	Rob Carter
Fleming Markel	John Merriman	James Rendek	Elizabeth Hunter	Heather Buchanan	Bruce Patterson	Jesse Reyes	Nancy Schuhrke	Joanne Linden	Carole Smudin
Marco Pardi	Heide Coppotelli	Mike Conlan	Ann Bennett	Thomas Struhsaker	Charles Hendriks	Will Ritter	Dennis Underwood	Kimberly Jordan	Catherine Clifton
Mark Soenksen	Abigail Gindele	Donna Dearborn	Miriam Neff	Ann Loera	Roxanne Rothafel	Mary Shabbott	Kathy Yeomans	Ken Ross	Elizabeth Mostov
Susan Lindell	Teri Teed	Gary Reese	Karen Renne	Eva-Maria Von Bronk	Jon Singleton	Lisa Annecone	Nan Stevenson	Bobbiejo Winfrey	Marilyn Kaggen
Vic Bostock	Sarah Townsend	Patty Rustad	Leslie Danielle Brown	Barb Kuchno	Caroline Mislove	Susan Goldberg	Christine Gasco	Robert Kennedy	Howard Young
Elizabeth Mccullough	Judy Fairless	Mindy Abraham	Kyle Bracken	Terri Schneider	Eilene Janke	Peter Sayre	Stan Tamulevich	Nancy Rupp	Michael Keene
Maryrose Hollie	Charles Dineen	Carol Masuda	Christopher Laforge	Shawn Anderson	Fred Coppotelli	Diane Krell-Bates	Matthew Schaut	Judith Smith	Alexandra Richards
John Schmittauer	Grant Sorrell	Cathy Brownlee	Neil Hansen	Wendy Monterrosa	Amy Haines	Ann Thompson	Gary Herwig	Cay White	Dorothy Chamberlin
Alysia Gayw	A. Cohen	Les Rees	Marjorie Xavier	R Peirce	Karen Peterson	Bianca Molgora	Kris B	Jonathan Brinning!	Pela Tomasello
Christopher Panayi	Lorraine Gray	Melodie Huffman	Judith Ackerman	Brien Comerford	Gail Ryall	Darla Kravetz	Caroline Deegan	Judy Childers	Alisa Battaglia
Charlotte Maier	Elsa Petersen	Michael Kolassa	Mark Grotzke	Lynn Shoemaker	Joan Agro	Alan Harper	Marie D’anna	Karen Chinn	Karen Bond
Diane Eisenhower	Claire Berkwitt	Gary Harris	Jamie Harrison	Donald Rumph	Gerry Finazzo	Ronald Woolford	Michael Gamble	Michael Halloran	Silvana Borrelli
Annabelle Herbert	Stephen A Johnson	Marilee Nagy	Celine Blando	Stephen And Robin Newberg	Alessandro Zabini	Melek Korel	Wayne Stalsworth	Jasmin Koenig	Bert Greenberg
Beth Darlington	Melvin Bautista	Julie Smith	Linda Butler	Paulo Monteiro	Vr	Nancy O	Greg Goodman	Wendy Fast	Roberta E. Newman
Holly Wells	Ellen Mccann	Stephen Wilson	Matthew A. Weaver	Ann Ellen	Lisa Hammermeister	Annmarie Wilson	Alan Goga	David Cottrell	Dean Peter
Elizabeth Jasicki	Jeffrey Miller	Carol Goslant	Danny Norvell	Toni Arnold	Garth Ehrlich	Ronald Hubert	Richard Tregidgo	Tami Palacky	Sandra Franz
Shakayla Thomas	Carol Dearborn	Gy	Scott Emsley	Mary Gathman	Dennis Adkins	Douglas Rives	Caroline Miller	Gabriel Bobek	Emily Rugel
Pilar Quintana	Linda Howie	Julia Ortiz	William Ridgeway	William Kooi	Terri Knauber	Christiane Schneebeli	Noreen Stevenson	Sherry Luke	Maureen Knutsen
Richard Guier	Maureen Mcdonald	Angelika Altum	Holly Kukkonen	Zola Packman	Meryle A. Korn	C. Mendel	Michael Tomczyszyn	Jerry Persky	Anthony Ricciardi
Georgia Labey	Gregory Coyle	Jeff Mcnair	Kathy Canada	Analisa Crandall	Pam Zimmerman	Dan Meier	Katherine Robertson	Cecelia Samp	Catherine Nettesheim
Anita Shanker	Mike Bushaw	Peter Kuhn	John Leonard	Dorinda Kelley	Eloy Santos	Jacqui Foster	Therese Mcrae	David Brayfield	Beverly Villinger
Barb Gelman	Katherine Barrett Zywan	Wendy Scherer	Deborah Childers	Lw	Kenneth Gillette	Kim Strickland	Robert Reece	Haven Knight	Michael Ott
Laura Manges	Judy Bernhang	Paula Neville	Frank Cassianna	Ron Fritz	Janie Horowitz	Daniel Uiterwyk	Paul Kalka	Manfred Holm	Joan Glasser

Form Letter FL4									
Georgia Locker	Cindra Broenner	Herb Evert	Jennifer Gitschier	Darren Frale	Pete Wilson	Vincent Villers	Linda Wasserman	Derek Gendvil	Gl
Kerstin Murr	Bobbi Segal	Elizabeth Porter	Lisa-May Reynolds	Barbara Demars	Susan Harman	Christopher Roy	Richard Khanlian	Henry Schlinger	Laurie Millette
Nancy Hiestand	Earl Roberts	Peter Fontaine	Susan Mccarthy	Jamie Le	Jo Kusie	David Miller	Susan King	Josh Wainwright	Richard Schwarze
Jessica Fielden	Carolin Schellhorn	Erna Beerheide	Theresa Winterling	Tom Tripp	Michael Abler	Cynthia Marrs	Mark Youd	Rhonda Bradley	Tom Richardson
Joseph Naidnur	Mark Hollinrake	Robert Cobb	Judy Tervalon Eugene	Jennifer Gindt	Casee Maxfield	Eric Naji	Barbara Carr	Blaze Bhence	Mark Levin
Samuel Sautaux	Rhea Moss	Joan Farber	Willie Hinze	Robert Wohlberg	Corey Schade	Roberta Stern	Alex A. Bobroff	Rainer Gast	Linda Fighera
Micki Bailes	Mary A Leitch	Kersti Evans	Paul Cole	Candace Bassat	Patty Bonney	Ellis Woodward	Marc David	Tracey Katsouros	Robert March
Lucy Downton	Lisa Waege	Garry J. Still	Sharon Gooding	Megan Robbins	Kelly Brannigan	Mark Leiner	Lisa Knight	Steve Black	Arlene Aughey
Lynne Stokes	Jan Kampa	Margaret Sherer	Jonathan Yellick	Jodi Rodar	Mike K Butche	G. Phipps	Romi Elnagar	Jay Wolff	Kimberly Rigano
Tony Moore	Elizabeth Tuminski	Judy Hollingsworth	Greg Stawinoga	Shana Smith	Donlon Mcgovern	Don Thompson	Leslie Burpo	Pippa Pearthree	Shelly Peddicord
Linda Mccrosky	Sheila Miller	Illana Naylor	Marian Carter	Suzy Sayle	Jennifer Lanham	Edith Molocher	A Lai	Cassandra Lewis	Kate Anderson
Sue Andrews	Coleman Lynch	Ann Stratten	Gail Lengel	Marya Zanders	Paul Riley	Timothy Gilmore	Linda Bridges	Edward Thornton	Melissa Cleaver
Linda Paleias	Suzanne Conner	Celine Villax	Gregg Johnson	Julie Hansen	Ana Herold	Michele Villeneuve	Nancy Stamm	Nicky Shane	Louise Sellon
Tim Hayes	Avis Ogilvy	Maureen Burke	Richard Rheder	Rik Masterson	Mike Rolbeck	Renee Arnett	Bruce Roe	Robert Burns	Tamara Lesser
Jason Steadmon	Alan Lopez	Betty Walters	Irene Dobrzanski	Elisabeth Bechmann	Cathy Rowan	Francine Ungaro	Michelle Jung Janus	Trina Hawkins	Kathy Gynane
Ciry Null	John Hill	Thomas Fawell	Nora Nelle	Wanda Plucinski	Kathy Kane	Tamara Miller	William Ryerson	Allan Johnston	Vincent Petta
Charles Happel	Gene Ulmer	Karl Clarke	Gillian Miller	Daniel Morneau	A Callan	Ina Pillar	Richita Anderson	Robert Lombardi	Heather R
Bruce Krawisz	Kevin Klenner	Karen Orner	Tanya Wenrich	Brenda Haig	Deborah Gibbs	Lauri Desmarais	Judy Savard	Katrin Winterer	Don Hon
Cornelia Teed	Virginia Watson	Sharon Longyear	Pamela Richard	Donna Blue	Jane Klinedinst	Elaine Costolo	Lawrence Crowley	Lyn Younger	T Iverson
George Bickel Iii	Anna Jasiukiewicz	Jeffery Biss	Sarah Bacon	Jamie Thomas	Diane Norris	Sally Maish	L.l. Wilkinson	Dawn Florio	Ep
Susan Ellis	Michelle Lord	Kenneth Ruby	Holly Burgin	Mark Aziz	Martha Gorak	Julie Harris	Dennis Kreiner	Liz D.	Linda Kane
Joyce Niksic	Robert Nichols	Elizabeth Garratt	Stacy Niemeyer	Garry Taroli	Wil Sloan	Tom Miller	Gina Johansen	Al Good	Nancy Fomenko
Jean Hopkins	Liz Moore	Karen Rubino	Vicki Hughes	Greg Singleton	James Nelson	Patricia Spencer	Rob Seltzer	Don Barth	Bret Klotz
Julie Parisi	Leonard Heether	June Hurst	Susan Dorchin	Daniel Rarback	Kathy Carroll	Peter Gradoni	Charles R Shelly	Carol Becker	Steve Troyanovich
Pamela Williams	John Colgan-Davis	Robert H. Feuchter	Lisa Hughes	Marta Styczynska	John Delgado	Sgt. Alexander Palloc	Adrienne Bermingham	Baker Smith	Joan Balfour
Linda Shirey	Gene Moy	Andrew Serafin	Tina Scherr	Carl Pflug	Mary Hard	Michael Langlais	Jean Eunson	Jodi Bell	John Watt
Sara Barsel	Terry Terzuolo	Jean Cameron	Ann Wiseman	Lumina Greenway	Ann Dorsey	Janna Piper	Margaret Handley	Gerald Mcnellis	Rachel Imholte
Carolyn Dickson	John Lemanski	John Comella	Ann Watters	Sherlene Evans	Julie Dudley	Frank Bodine	Tony Regusis	Ron Bottorff	Linda Fowler
Tamara Hulsey	Melody L Mead	Bob Miller	Judith Embry	Jacqui Skill	Danny Gregg	Elizabeth Gann	Clauida Abderhhalden	Gale Rullmann	Heidi Hartman
Audrey Huzenis	Denise Lenardson	Debbie Mick	John Reckling	Chris Manley	Hilarey Benda	Laraine Muller	Ina Cantrell	Russ Ziegler	Dave Searles
Sonia Romero Villanueva	Harriet Mccleary	Hilarie Ericson	Shirley Sutter	J Lofton	Lynda Aubrey	Donald Barker	Elisabeth N.	Judith Carter	Eric Martinez
George Plummer	Frank Hartig	Lynne Preston	Karen Anderson	Rebecca Tilden	Douglas Mccormick	George Stradtman	Susan Spencer	Jennifer Keys	Catherine Mills
Peter Burval	Anne Karlsson	Uc Burton	Annie Davidson	Jill Davine	Re Marlow	Yolani Moratz	Sandra Smith	Julie Clayman	Carol Tredo
Javier Rivera	Anne Dahle	Katie Werther	Johan Van Landeghem	Steven Esposito	Bob Lichtenbert	Linda Reilly	Max Denise	Diane Janicki	Karl Koessel
Claudia Montero	Lorna Wallach	J. Beverly	Pat Lang	Marsha Jarvis	Margaret Cathey	Kathy Bradley	M. C. Corvalan	Laura Silverman	Barbara Bonfield
Bindi Binkley	Christina Babst	Anthony Albert	Anthony Owen	Matilde Damian	Carla Harris	Cheryl Watters	Susan Thompson	Karla Devine	Barbara Levenson
Susan Enzinna	Probyn Gregory	Julieta Nagy-Navarro	Lodiza Lepore	James Huffendick	Brandon Kozak	Ros Giliam	Henry Sak	Vance Arquilla	Michele Cornelius
Sharon Saunders	Henry Holtzman	Wolfgang Lippel	Elena Perez	Christopher Marcille	Robb Mottl	Jeffery Olson	Betty Trentlyon	Phyllis Schmidt	Marisa Landsberg
Chris Scholl	Robert Dentan	Tc	Gwendolyn East	Julie Kennie	Joe Ratley	Liz Nedeff	Sharyn Barson	Sharon Dietrich	Nataliya Yakovleva

Form Letter FL4

Paula Baldissard	Richard Smith	Pamela Kjono	Jud Woodard	Bruce Ross	Robert Szymanski	Noel Crim	Michael Motta	Sybil Schlesinger	Shirley Crenshaw
Gavin Dillard	Sherri Wright	Pam Ward	Marilynn Mcgraw	Juliet Pearson	Leslie Limberg	Louis Palazzini	Jennifer Hall	Jacqueline (Jackie) T. Rabbitskin	Fran Schmidt
Terry King	Tom Hougham	Harold Watson	Richard Holloway	Andrew Higgs	Mike Pasner	Norman Kindig	C. Demaris	Rich Panter	Sandra Cope
Sandy Beck	Allen Salyer	Martha Atkinson	Mark Klugiewicz	Anthony Barron	Gloria Shen Shen	Raymond Crannell	Terrie Amerson	Belinda Colley	Richard Hieber
Patricia Sheely	Carol Boschert	Beth Painter	Jessie Vosti	Betsey Porter	Ben Ruwe	Maria Borremans	Pat Hanbury	Donny Seals	Kimberly Musselman
Lee Winslow	Tom Soden	Carole Williams	Bert Giskes	Ken Windrum	Dana Wrich	Mark Blandford	Robert Posch	Charlotte Serazio	Amy Mower
Demetrios Lekkas	Diane Sullivan	D Robinson	Sharon Porter	Sandra Serazio	Fay Forman	Scott Gibson	Ben Goodin	Debra Espinoza	Shawn Liddick
Kathleen Moraski	Marce Walsh	Sandy Loney	Dorothy Davies	Mark Irving	Mari Vink	Michelle Hayward	Ronald Drahos	Chris Casper	Carole Maclure
Robert Hicks	Donald Mackey	Elizabeth Darovic	Tami Hillman	Jack West	Theresa Obrien	M Rangne	Marilyn Rose	Amy Riddle	Amy Mueller
Sandy Lynn	Joan Smith	Pamela Bayless	Carol Lloyd	A Puza	Richard Johnson	Anne Ritchings	Madeline Labriola	Kenneth Large	Jill Wettersten
Steven Korson	Diane Miller	Sarah Amberge	Maureen Mccarthy	Michael Rosa	Walter Schultz	Kate Sherwood	Blake Wu	Mickey White	Nancy Robison
Janet Witzeman	Hashi Hanta	Peter Zurfluh	Mark Wheeler	Doug Krause	Lindsey Mcneny	Nikisha Ross	Betty Kowall	Tim Duda	Paula Rufener
Rebecca Marshall	James Fairley	Laura Rose-Fortmueller	Lisa Krausz	Stefan Zeiner	Bernadette Andaloro	Cecily Mcneil	Beverly Simone	Michelle Mondragon	Robert Jonas
Lisa Patton	Phil Fitzgerald	Maria Sagarzazu	Kathy Hinson	Reed Fenton	Shearle Furnish	Juli Van Brown	William Crosby	M.e. Scullard	Robert Gunther
Billy Trice	Dave Mills	Dawn Pesicka	Chris Drumright	James Hartley	Sandra Sobanski	Andrea Nutley	Patricia Patteson	John Lewis	Anthony Jammal
W Kent Wilson	Peggy Fugate	Claire Perricelli	Barbara Harper	Wayne Straight	Johnny Armstrong	Doreen Tignanelli	Julia West	Jan Oldham	Elizabeth Mackelvie
Bill Wiener	Alan Jasper	Peter Gunther	Janell Smith	Bob Schildgen	Robert Haslag	James Thoman	Dawn Mason	Leah Boyd	Allie Tennant
Monique Edwards	Richard Berger	Caroline Satterfield	Craig Hanson	Patricia Huberty	Sandra Cobb	Ingar Forsmark	Crickett Miller	Elaine Donovan	Breanna Strain
Susan Purcell	Leone Olson	Micaela Fierro	Charlie Urns	Linda Greene	Sara Simon	Brenda Eckberg	Mike Fegan	Cornelia Shearer	Kirsten E
Alix Keast	Jarrett Cloud	Yvonne Fast	Brandie Deal	Dan Esposito	Deb Hirt	Christine Payden-Travers	Jayni Chase	Richard Shannahan	Kathi Ridgway
Anne Cawood	Anna Surban	Kenneth Winer	Pamylle Greinke	Leonard Cordova	Jean Toles	Geraldine May	Cindy Crawford	Teresa Wall	Dennis Mcgee
Susan Maderer	Julie Brickell	Joyce Johnson	Miriam Sexton	Marie Nikas	Sabine Buergermeister	Hynda Rome	Carlos Castro	Cindy Yates	Carol Collins
Lollie Ragana	Dennis Vieira	A Lynn Raiser	Michael Halm	Maria Johnson	Rick Auman	Jean Adams	Karen Gray	Nicole Fountain	Margarita Mclarty
Patrick L Hudson	Patti Johnson	Andrelene Babbitt	Wayne Steffes	Maria Millar	Norm Schiffman	Karen Kindel	Robbi Courtaway	Maxine Clark	Karl Wirtenberger
Sandra Perkins	Gloria Picchetti	Greg Zyzanski	Cynthia Von Hendricks	Jonathan Boyne	Michele Johnson	Elaine Johnson	Sheena Lonecke	Pilar Barranco	Jo Ann Mcgreevy
Sharon Fetter	Theophilus Ojonimi	Solo Greene	Thomas Libbey	Grendel Guinn	Phyllis Erwin	Mary Wellington Wellington	Jane Church	David Parker	Duane Gustafson
Richard Perkowski Perkowski	Julia Rapp	William Guthrie	Gary Binderim	Linda Ferland	Suzanne Hall	Gloria Diggle	Lee Margulies	Mark Grzegorzewski	Sam Asseff
Judy Scriptunas	Lana Henson	Tanja Rieger	Jen Messina	Mal Gaff	Jean Publieee	Cathy Johnson	Denise Bright	Jennie Sabato	Karl Hamann
William Grosh	Susan Getzschman	Janet Neihart	Elizabeth Pentacoff	Carmen Miranda	Kristin Campbell	Paul Rubin	Deb Fritzler	Emily Haggeryy	Melissa Michaels
Brian Field	Beatrice Simmonds	Lena Tabori	Tanya Arguello	Rina Rubenstein	Myrna Britton	Jana Pruse	Pierre Del Prato	Helgaleena Healingline	Bonnie Denhaan
Lynn Schneider	Connie Kirkham	Barbara Mathes	Lori Mulvey	Wayne Ott	Donna Pfeffer	Karen Landrum	Laura Herndon	Marilynn Harper	Leslie Sutliff
Stephan Donovan	Barbara Thomas-Kruse	Peter Cummins	Nancy Cushwa	Charlotte Alexandre	Caroline Sévilla	Gp	Parrie Henderson-O’keefe	Elizabeth Paxson	Gro Standal
Russell James	Richard D D Mccrary	Tova Cohen	Jens Hansen	Martie Enfield	C Emerson	Justin Wesche	Karvin Spurgeon	Rebecca Vesper	Michael Peterson
Willis Gray	Michele Temple	Derek Kelsey	Robert Rauh	Robin Lorentzen	Gabriele Lauscher-Dreess	Lori Lyles	Jean Mont-Eton	Kathy Hart	Linda Hendrix

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Jacqui Jacoby	Kathryn Heniff	Cathy Loewenstein	Ellen Dryer	James Mosley	Fay Hicks	Xavier Petit	Michelle Davis	Kristina Fukuda	Justin Small
Susanne Groenendaal	James Donahue	Maggie Kalabakas	Dana Bleckinger	James Smith	Larry Bogolub	Dolores Guarino	Leslie Bullo	Ginny Jackson	Harold Robinson
Jason Klinkel	Lorraine Minto	Beth Reimel	Rachel Scott	Susan Corner	Victoria Mathew	Janice Flood	Dorothy Anderson	Ronald Hobbs	Dale Wood
Helen Strader	Anthony Thackston	Melissa Fleming	Christopher Dowling	Jonathan Rayson	Bill Wypler	Sarah Rose	Marilyn Shup	Leslie Valentine	John D’hondt
Cindy Koch	Dayana Avila	Susan Porter	Teresa Woods	Sammy Low	Stephen Diamond	Lucinda Tucker	Robert Keller	Michael Coleman	Jim Stoner
Bob Druwing	Kathryne Cassis	Usha Honeyman	Joseph & Lynn Diblanca	Gloria Fischer	Daphne Llewellyn	Diane Tessari	Jan Horwitz	Forest Shomer	Julie Wade
Michael Mcdonald	Stephen Woof	Helen Rynaski	Elizabeth Werner	Kimberly Crane	Ann Tung	Eileen Dailey	Anne Haflich	Deborah Williams	Daniel Chrest
Julie Martin	Lynn Morris	Marilyn King	Christie Vaughn	Dagmar L. Anders	Nathaniel Doherty	Thomas Goodrich	Doris Pappenheim	Shinann Earnshaw	Jeannie Evans
Ste Ho	Paula Wanzer	Janet Moser	Jean Marie Vanwinkle	Linda Prostko	Lynn Costa	Mary Able	Diane Shaffer	Rosena Baumli	Mariko Wheeler
Donna Deese	Kathryn Choudhury	Sue E. Dean	Alyssa Lunghi	Dale Janssen	Stefan Petersen	Pat Baker	Larissa Matthews	Apostle Kontos	Linda Kronholm
Katherine Mouzourakis	Sandra Breakfield	Susan Wechsler	Albert Lepage	Ron And Maria De Stefano	Jill Simon	Gisela Zechmeister	Suzanne Hamer	Sherry Marsh	Todd Snyder
Deneice Oroszvary	Candace Rocha	Barbara Schatt	Jessica Ehmke	Laraine Lebron	Phyllis Corcacas	Michael Helwig	Matthew Shapiro	Dee Randolph	Ken Odenheim
Pam Clark	Jan Phillips	Ann Sullivan	Sherri Hodges	Marta Anguiano	Jose Leroux	Wim Cossement	Peter And Marilyn Miess	Rhonda D. Wright	Omar Siddique
Ann Titelman	Nancy Burger	Jocelyn Sharp-Henning	Ellen Demarco	Evan Mehrman	Perry Harris	Donna Smith	Walter Ramsey	Craig Clark	Elizabeth Bnryant
Susan Dettweiler	Tracy Foster	Richard Rothstein	Marina Morrone	Mel Cup Choy	Diane Tabbott	David Wallace	Jennifer Schally	Jr	Katherine Leahy
Aida Brenneis	Sasha Jackson	Sara Sexton	Lori Conley	Carol Storthz	Patricia Pippin-Emanuel	Priscilla Shade	Adriana Guzmán	Mark Koritz	Kelley Slack
Leslie Bradford	Susan Delles	Dorothy Neff	Anthony Buch	Ken Bowman	Larry Scudder	Michael Deangelis	Lindsey Howarth	Jamila Garrecht	Stephanie Silva
Thaddeus Kozlowski	Robin Soletzky	Emma Henderson	Daniel Rosenfeld	Phillip Mitchell	Daniel Juroff	Elaine Eudy	Eric Fosburgh	Wolfgang Burger	Marliese Bonk
Larisa Long	Nancy Paskowitz	Julia Mastrototaro	G. Paxton	B Walker	Claudia Mcnulty	Laura Aldridge	Michael Pan	Stewart Baron	Eileen Reznicek
James Mulcare	Frances Bell	Lisa Stone	Beatriz Pallanes	Jana Lynne Webb Muhar	Linda Ross	Frederique Joly	Zeki Gunay	Ray Clanderman	Keith Kleber
Jim Littlefield	K Krupinski	Brenda Hill	Theresa Deery	Scott Bishop	Graciela Manjarres	Mary Dilles	Cathy Wootan	Mary Eldredge	Steve S
Louis Gauci	Alexander Honigsblum	Denise Bivona	Virginia Douglas	Paris Zarikos	Hilary Brown	Ana Medins	Meg Carter	Elyette Weinstein	John Carroll
Deborah Balasko	Jim Marsden	Jean Langford	James Pfitzner	Jeb Pronto	Karen Spradlin	James Mcclure	Jacqueline Hud	Melody Williamson	Kimberly Ross
Anna Louise E. Fontaine	Keith D’alessandro	Antonio García-Palao	Sylvia Boris	Robert Fritsch	Richard Waldmann	Daniel L. Harris	Caroline Hair	June Smith	Heather Hundt
Darleen Moranobrown	Glory Adams	Desiree Nagyfy	Carole Bergstraesser	Christine Stewart	Dianne Douglas	Hunter Klapperich	Ronald Hammersley	Gosia Mitros	Jennifer Hayes
Susie Cassens	Michele Rule	Kyle Schmierer	Darrel Easter	Sandra Stofan	Connie Tate	David Maclean	Jennifer Rials	Barbara Miller	April Eversole
Gail Hubbs	Joanne Snyder	Tracy Ouellette	Felena Puentes	Andrea Snyder	Laurie Izzo	Angela Leventis	Debi Bergsma	Louise Zimmer	Gerald Brookman
Irene Quilliam	Anja Stadelmann	Darren Spurr	Eileen Fonferko	Akankha Perkins	Martin Jordan	Jeffrey Courter	Robert Oberdorf	Ann Kuter	Grace Neff
William Ryder	Dori Cole	Greg Smith	Pamela Meyer	Victoria Miller	Pam Evans	Todd Atkins	Jan Clare	Doug Morse	Marcia Kellam
Greg Gentry	Lily Mejia	Darlene Jakusz	Lawrence Hager	Jeanne Myers	Herschel Flowers	Maureen Sheahan	Gordon Grant	Kathy Gruber	Donna-Lee Phillips
Mallory Sanford	Lily Knuth	Bonita Dillard	Roger Williams	Jane Grove	Marcos Elenildo Ferreira	Nadine Duckworth	Patricia Marlatt	Maureen Mahoney	Hans-Peter Heinrich
Rich Moser	Bob Keller	Diane Bloom	Cate Clark	Sam Butler	Rochelle Lazio	Miriam Baum	Lonna Richmond	Ruth Griffiths	Douglas Langenau
Shirley Constas	Frank Pilholski	Joy Zadaca	Lisa Vaughan	Jeanette Mcdonald	Niels Henrik Hooge	Laurence Margolis	Maria Reis	James Cooper	M. Arveson
Barb Crumpacker	Joanne Dixon	Ct Bross	Sheila Kelley	Kevin Vaught	Jackie Pomies	Maria Asteinza	Michael Lombardi	Margaret Gantz	Irena Franchi

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Julie Skelton	Christopher Tobias	Wewe Fer	Guadalupe Yanez	Mary Cray	Lynda Haemig	Mary Keithler	Donna Pope	Robert Ricewasser	Alice Polesky
Pamela Bendix	Andi Gibson	Elizabeth Dahmus	Gregory Whynott	Ann Ryan	Patricia Copenhaver	Debz Jones	Anthony Donnici	Doug Bender	M Langelan
Kris Joslin	Gigi Vento	Janet Robinson	Lesa Diiorio	Andrea Neal	Shawn Johnson	Margi Mulligan	Roslynn Budoff	Randall Nerwick	Paul Eisenberg
Linda Iannuzzi	Johanna Ellison	Rachel Collins	Robert Reed	Walker Everette	Ms Zentura	Cheryl Mumaw	Kay Reinfried	Bonnie Karlsen	Michael Sarabia
Leti Vale	Jody Lewis	John And Jean Fleming	Yvonne Irvin	Kim Mcdonald	Linda Osburn	Tina Rhea	Gregory Holtzapple	Martha D. Perlmutter	Mary De Rosas
Carole Arbour	Kenneth Fisher	Celeste Howard	Al	Dw	Robert Okroi	Robert Slomer	Gavin Bornholtz	John Campbell	Sondra Boes
Cindy Shoaf	Leonidas Gucciardo	Heidi Ludwick	Kim Messmer	Percy Hicks-Severn	Cindi Dean	Janet H.	Diane Faircloth	Greg Houdkamp	Diane Rose
Cathy Marczyk	Rhonda Green	Thomas Smith	Paul Burks	Aixa Fielder	Frankie Seymour	Rob Weinberg	Kaylene Schultz	Pat Griffey	Caryl Pearson
Tina Wilson	Mark Caso	Lori Ricciardi	Candy Frantz-Crafton	Alexis Lamere	Charles Arnold	Ernst Bauer	Richard Keefer	Anthony Straka	John Wolford
Richard Beaulieu	Sharon Parshall	Brandon H	Sylvia Lambert	Joseph Pluta	Laraine Bowen	Claude Mcdonald	Janet Chafe	Katherine Wright	Karen Yarnell
Debi Holt	Sarah Sercombe	Lenore Reeves	Mike Huwe	Glen Popple	Eugene Rosinski	T Garmon	Dominique Renucci	Robert Davenport	Payal Sampat
Jane Herschlag	Mari Dominguez	David M. Dunn	Rick Simkin	Kristen Potter	Phoenix Giffen	Alvin Pudwill	Mary Junek	Chris Dacus	Julie Yost
Edgar Gehlert	Kathleen Parajecki	Rick Blanchett	Walter Loquet	Jeffrey Colledge	Diane Ethridge	Adina Parsley	Elisa Mcglinchey	James Katzen	James H. Fitch
Esther Johnson	Pamela Mccann	Laurence Buckingham	Ana Herrero	Lisa Weil	Pat Wolff	Graciela Huth	Robert Hall	Theresa Dee	Ed Pool
Carolyn Summers	Jody Gibson	Peter Belmont	Matthew Franck	Carolin Radcliff	Lazarus Boutis	Donna Thelander	Regine Ruelle	April Doyle	Ellen Atkinson
Christopher Toye	Dolores Parra	Carla Shuford	Daniel Weinberger	Astrid Suchanek	Sonja Tilbury	Chrissie Mitchell	John Butterworth	Samuel Durkin	Marjorie Streeter
Barry Medlin	Annie Belt	Gabriel Colombo	Allie Secor	Beverly Ann Conroy	Linda Day	Barney Bryson	Shannon Markley	Cheryl Carney	Eric Haskins
Jennifer Anderson	Ruthie Bernaert	Ashley Farreny	Pat Dosky	R David Jones	Charlie Graham	Ronald Warren	Wanda Graff	Paul Runion	George Erceg
Elizabeth Milliken	Martin Rosenberger	Valerie Clark	Steven Carpenter	Becki Fulmer	Stephen Boletchek	Brian Girard	Corinne Greenberg	J. Barry Gurdin	Renee Rizzo
Sylvia Laver	Lois Lommel	Bernardo Alayza Mujica	Eric Nylen	Joann Hunter	Crystal Wolf	Ross Christianson	Mary Grace Manning	Aviva Shliselberg	Alfred Mancini
Steve Garrett	Brant Kotch	Hersha Evans	Catherine Jubb	Catherine Milovina	Michelle Collar	Pamela Shuman	Laura Matturro	Rosemary Graham-Gardner	Leslie Calambro
Helena Hernandez	Ann Debolt	Rosina Van Strien	Claire Joaquin	Joanna Welch	Michelle Kaufman	Cheryl Fontaine	Maureen Oneill	Linda Mckillip	Michael Gorr
C Day	Cammy Colton	Maria Emmetti	James Sliger	Mark Frydenborg	Fran Malsheimer	Kay Brainerd	Theresa Murphy	Virginia Dwyer	Kathy Ruopp
Lois W. Duvall	John Tovar	Marcia Flannery	Donna Davis	Hilda Williams	Ellen Fallon	Elissa Mericle-Gray	Paula Simmons	Tania Cardoso	Myrna Fisher
John Nelson	Gary Wolf Ardito	Beverly Bradshaw	Jacqueline Tessman	David Meade	Jim Black	Kimberly Swenson-Zakula	Sarah Hafer	Eve Fitzgibbon	Robert Ferrara
Bonnie Duman	Sandra Schomberg	Stacia Haley	Barbara Blackwood	F Sylvester	Andrea Cain	Raquel Buxton	Gail Yborra	Laurel Temple	Margie Egan
Steven Steele	Carroll Arkema	Lynn Lovell	Cathy Wallace	Martin Judd	John Kerby	Charlene Cooper	Lynne Campbell	Lois Dunn	Ian Garman
Leslie Spoon	Becky Monger	Linda Melski	Natalie Van Leekwijck	Sean O'dell	Susan Hamann	Lars Jefferson	Rena P	Tina Bailey	Barbara Burgess
Joseph Dadgari	Cameron Vail	Steve Vicuna	Sharon Newman	Chuck Hammerstad	Peg Herlihy	Dennis Hebert	Alexander B Vollmer	Joan Murray	Peter Soule
Karen Vayda	Knud Thirup	Van Knox	Camie Rodgers	Barbara Ginsberg	Joel Perkins	Jeff Komisarof	Sally Nelson	Jo Ann Baughman	Elizabeth Hodges
Fran Maroney	Patricia Rossi	Matt Loper	Jackie Tryggeseth	Jennifer Hill	P Souza	Karl Kernehan	Robin Kory	Carolyn Church	Martha Carrington
Carol Crawford	Linda Jeffries	Dwight Fellman	Sandi Makynen	Edward Rengers	Pamela Shaw	Sharon Stork	Judy Krach	Carolyn Hawk	Darlene Jenkins
J.t. Smith	M C Kubiak	Maria White	Timothy Targett	Steven Christian	Vladimir Plisko	Mary Sennewald	Arkady Vyatchanin	L. Fielder	A. W.
Robert Thornhill	John Weston	Alice Jena	Jeanne Held-Warmkessel	Ronald Bogin	Charlene Ferguson	Jeri Altman Altman	Alena Jorgensen	Paula Shafransky	Amanda Gordon
Maryanna Foskett	Paul-Denis Clermont	Kevin Walsh	Bruce Morrison	Juliann Rule	Becky Sayler	Anne Labouy	Linda Shabot	Rita Leone	Marla Maleski
Rex Franklyn	Heidi Buech	Jeff Kiralis	Cindy Risvold	Nina Utigaard	Melissa Dorval	Carla L	Brooke Kane	Barbara Frances	Gina Caracci
Carl Arnold	Lisa Jack	Ed And Jan Jang	Barbara Klinger	Laura Collins	Heidi Palmer	Susan Tucker	Carrie West	Christina Dickson	John Doucette

Form Letter FL4									
Katherine Kautz	Helen Greer	Michelle Hughes	Holly Marczak	Janice Bernard	T Bell	Ken Ward	Christi Dillon	Linda Mazer	Janelle George
Sharon Ketcherside	Dana Sklar	Carol M Neumann	Meya Law	Boel Stridbeck	Ann Craig	Wayne Westfall	Mary Townsend	Gwendolyn Karan	R. E.
John Brown	Erma Lewis	Anjelina Galbadores	John Bush	S Cook	Nannette Taylor	Kathie E Takush	Sharron Stewart	Kelly Larkin	Louise Stark
Ricki Newman	Vickie Wagner	Claudia Richner	Barbara Bradshaw	Ann Bicking	Stacy Grossman	Thuha Tran	Debra Gleason	Connie Lindgren	Laurie Jensen
Jennifer Valentine	Barbara Warren	Bradley Budnik	Elana Katz Rose	Jessica Miracola	Reb Babcock	David Leroy	Brent Richards	Linda Buckingham	Heather Cross
Mary Sebek	Kathleen Collins	Michelle Waters	Stephanie Trudeau	Carol Dimer	Scott C. Walker	Maureen Saval	Susan Harmon	Robert Wagner	Peggy Oba
Cheryl Shushan	Patricia Savage	Lisanne Panter	Janet Sleeth	Ruth Boice	Pamela Mcdonald	Laura Jones	Michael Lynch	Sophia Mcaskill	Christine King
Cheryl Peppel	Harry Hochheiser	Chris Watson	Laura Lambert	Karl Lohrmann	Martha R Vest	Rocio Luparello	Gloria Uribe	Mark Johnsen	Joan Sitnick
Helene Steinhardt	Petra Jenkins	K. Gorman	Helen Stuehler	Andy Lupenko	Mike Murphy	Rich Speer	Michele Smith	Susan Miller	Sally Small
Roger E. Sherman	Denise Hosta	P Pierce	Allison Castle	Mayumi Knox	Lisa Lester	Anna Stein	Linda Thompson	Anna Shaughnessy	Mitchell Gershten Md
William Hutchings	Katlyn Stranger	Cindy Borske	Lynne Hughes	Edna Anderson	Marilyn Gockowski	Palmeta Baier	Nancy Pope	Jerry Curow	Rachel Krucoff
Phil Tompetrini	Susan Linden	Erica Johanson	Charles Wieland	Jerry Mazzolini	Robert Gordon	Carole Osborn	Kathleen Kuczynski	Bertha Civeira	Susan Wigfield
Angela Negri	Steven Vogel	Jaremy Lynch	Bruce Cutts	Donna Denise	Jessica Card	Francy Elkins	Ace Hull	Kat Thomas	John Kirchner
Storm Morgan	Holly Dowling	Toni Mayer	Jordan Lipka	Jc	Geri Collecchia	Kathy Durrum	Rosanne Anderson	Alicia Baker	Sandra Joos
Dan O’keefe	Gloria Aguirre	Lisa Piner	Tim Gundlach	June Curley	Susan Lozoraitis	Esther Garvett	Linda Ay	Denise Tratolatis	Veronica Bourassa
Linda Jennings	Judith Peter	Carol Baier	Sanda Logan	Beth Goode	Frank Longo	Suzanne Miller	Jim Robertson	Joann Koch	Rodolfo Sanchez
Bob Brucker	Mike Adamson	Destiny Orantes	Roger Gilmore	Valerie Lukas	Edward Temple	Eleanor Dubois	Caryl Sawyer	Gertrude Crowley	Suzanne Kirby
Gene E	Mary Ann Doll	James & April Thompson	Jennifer Hole	Pamela Jiranek	Leslie Richardson	Dana L Thompson	James Thorpe	Peter Jays	Espree Bonterre
Kris Cordova	Sarah B Stewart	Deborah Spencer	James Walton	Joann Ramos	Sherry Weiland	Roxie Piatigorski	Thomas Ray	Jelica Roland	Melvin Siegel
Cathy Elizabeth Levin	Kirk Krebs	Meredith Needham	Joanne Gates	Richard Bartolomeo	Gary Rejsek	Deanna Knickerbocker	Robert Semanske	Christy Giesick	Susan Mcmullen
Christian Dollahon	Bob Hollon	Hollie Hollon	Philomena Easley	S Kaehn	Arthur And Lois Finstein	Erika Wanenmacher	Ronda Reynolds	Andrea Bonnett	Randall Baird
Bill And Fran Stenberg	Barbara Costigan	Trigg Wright Iii	Carole Duckworth	Karen Berger	Felicia Bander	Elizabeth Fowler	Karen Kawszan	Mark Seis	Maria Esparza
Mary Mcmahon	Robert Belknap	Namita Dalal	Tina Rogers	Ellen Mcneirney	Natalie Kovacs	Laura Sipes	Christine M.c. Money	Mary Lou Ferralli	S Smith
Gerritt And Elizabeth Baker-Smith	Janice Hallman	Jessica Denis	Meredith Green	Sarosh Patel	Dana Landis	Randy Harrison	Kiley Newton	Craig Michler	Angela Hughes
Kimberly Allen	Peter Schultz	Sabrina Wojnaroski	Mike Lanka	Ruth Cassilly	Michele Paxson	Steve Sheehy	Michael G G Ballin	Jean Buck	Joan Walker
Christie Sanders	Evelyn Verrill	Neil Miller	Garrine Petersen	Michael Garitty	Tracy Cheek Cannell	Victoria Mcfadyen	Krista Carson Shankara	Beth Braun	Karla Frandson
David Trask	Robert Goos	Julie Bush	Vera Cousins	Laura Blanchette	Martin Stradling	Jana Menard	Richard Acosta	Devin Anctil	Donald Taylor
Elizabeth Adan	William Jastromb	Viola Hernandez	Harriet Grose	Delores Stachura	Kim Diment	Wendy Weldon	Carrie Mullen	Joelle Porter	S Foley
Devon Seltzer	D. Hubenthal	Cindy Lance	Eileen Levin	Katie And Bill Dresbach	Pamela Raup-Kounovsky	Herbert C. Ziegler	Beverly Smalley	Alistair Kanaan	Daniel Slade
Matthew Lipschik	Alan Wojtalik	Warren Albright	Tania Malven	Ron Mendelblat	Adi S	Betty Winholtz	Dale Carpenter	Janell Copello	Kate Harder
Robert Jacobson	Audrey Simpson	Edward J Allard	Mary Riley	Jill Meier	Dobi Dobroslawa	Nicole Trotta	Julie Wreford	Leo Sandy	Patricia Nazzaro
Judith Lang	Lois Nottingham	Terry S	Gary Wattles	Neal Steiner	Marc Conrad	Anita Cannata-Nowell	Mitra Shams	Elaine Becker	Edward Reichman
Clare Ann Litteken	Carol Rue	Melissa Jordan	Sharon Nicodemus	Robyn Matra	Felicia Chase	Lee Karkruff	Peter Fairley	Dawn Hendry	Nancy Pichiotino
Elliot Comunale	Carol Whitehurst	Brenda Parada	Shelley Driskell	Kimberly Campbell	Judy Bryan	Marion Skidmore	Mary Anne Kornbau	Bruce Fleming	Charlotte Smith
Rhoda Levine	Pamela Rogers	Kimberly Mcguire	Jon Levin	Jan Mitchell	Clinton Nagel	Daniel Brooks	Joana Kirchhoff	Traci Turner	Birgit Hermann
Cindy Graham	Howard Petlack	Tom Cate	Lisa Hopkins	Candace Smith	David Halsall	Laurie Ferhani	Jana Kitzinger	D’arcy Goodrich	Janette Jorgensen
Annette Spanhel	Constance Glenn	Mike Seyfried	Pamela Vouroscallahan	Kathleen Kitchen	Nina Gondos	Laura Dalton	Virginia Krutilek	Alan Canfield	Bree M

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Sandra Denbraber	David Burtis	Deborah Krupp	Paula Adams	Hugh Harwell	Joan Squires	Jonathan Weinstock	John Mortensen	Sand Ship	Lauren Thompson
Jayen Pitchford	Heather Aka Heth Drees	Lynn Glielmi	Ira Gerard	Robert Luke	Mary Peterson	Patricia Williams	William Kelley	Christopher Calvert	Ed Fiedler
John Dunn	Sarah Lincoln	Dale Haussner	Helen Moissant	Philip A Kunzler	D R Spencer	Margaret M. Davison	Peter Townsend	Alethia Bustamante	Andrew Jackson
Cheryl Hewitt	Frank Belcastro	Maureen O'neal	David Copper	Aloysius Wald	Anje Waters	John Wienert	Lisa Daloia	Rebecca Baker	Peter Kahigian
Douglas Meyer	Rebecca Burmester	Debbie Sequichie-Kerchee	Gerald Bukosky	Kathrine Jones	Wanda Ballentine	Carol Poleno	Kathy Mallory	Shauna Sparlin	Elaine Alfaro
Lydia Peters	Richard Camp	John Miskelly	Dennis Trembly	Jerry Swarzman	Ilene Kazak	Philip J. Hyun	Arlene Baker	Ct	Len Messina
Amy Hile	Barbara Hegarty	Linda Mattusch	Cindy Jefferys	Jim Cronin	Henry Newhouse	Virginia Lee	Tim Zemba	Sheilagh Bergeron	Adrien De Ruyck
A Patterson	Marianne Frusteri	Mark Hayduke Grenard	Thomas Guaraldi	Donna Burrows	Ann & Steven Glenn	Benjamin Allen	Carolyn Massey	Joanne Skelton	Karen Reid
Sarah Stimely	Frank Wilsey	Amanda Pinson	Erika Boka	Doug Roaten	Cara Schmidt	Diane And Syd Marcus	Jaime Skizas	Marketa Anderson	Lisa Goldwyn
Michele Null	Robert And Ginny Bonometti	Jim Gergat	Richard Diran	Julie Roedel	David Wilen	Ken Morrison	Mary Fox	Janette Shablow	Mike Krouse
Emily Van Alyne	Susan Brandes	Rhonda Marrone	Denise Mcgrew	Elise Phillips Margulis	Kellie Smith	Chessa Rae Johnson	Susan Selbin	Laura Watchempino	Vonnie Iams
Dirk Kortz	Barbara Wight	Celeste Andersen	Andre Meaux	Terry Tedesco-Kerrick	Diane Berliner	Donna Knipp	Carolyn Poinelli	Patricia Wiley	Gary Jones
Lisa Gee	Dale Beasley	Suzann Mcalister	Molly Hauck	Juli Kring	Patricia Dishman	Kathleen Wheeler	Melissa K	Joyce S	Elke Hoppenbrouwers
Kelly Lyon	Jon Hager	Sheryll Punneo	Susan Hanson	Denys Cope	Tom Schwartz	Lis Farrell	Antoinette Ambrosio	Scott Coahran	Marianne Flanagan
Croitiene Ganmoryn	Cheryl Robison	Bevan Early	Cynthia Mcmath	Jl Charrier	Thomas Avery	Debbi Pratt	Robert Beverly	Jan Mcmichael	Edythe Cox
Peg Carrothers	Judy Rhee	Margaret Goodman	Barbara Kiernan	Kathleen Angotti	Ken Mundy	Jorge Belloso-Curiel	Carol Yerden	Michael Phillips	Willy Aenlle
Sandra Zwemke	Deborah Boomhower	Susan Thurairatnam	Theodore Beloin	Emily Rothman	Winston Huang	Kenneth Nahigian	V Mangum	Georgann Falotico	Jen Bentzel
Rod Repp	Marion Tidwell	Nancy Hauer	Tanja Schacht	Nikki Appavoo	Ettore Pilato	Linda Hilf	Scott Bruins	Amy Spencer	Gina Anson
Tracy Fleming	Barbara Bolin	Annie Ryan	Pierre Schlemel	H. Dennis Shumaker	Suzanne Cerniglia	Jan Modjeski	Jeanne Musgrove	Marie L. Michl	Joan Diggs
Arleen Ferrell	Susan Davenport	Melissa Sanford	E James Nedeau	George Burnash	Ricki Stephens	Michael Zeller	Wendi Cohen	K Danowski	Arlene Hansen
Shirley Rivas	Marion Walls	Marilynn Russell	Joanne Mack	Letitia Noel	Virginia Bennett	Sharinne Lercara	Crystal Hart	Jo K	Shellie Vann-Volk
Sandy Zelasko	Lara Derasary	Marie Grenu	Petra Stang	Frank Stroupe	William Bader	Emily O'hare	Lynn Welch	Brian Gingras	Alexia Jandourek
Karen Winnubst	Jean Naples	Connie Hodges	Ronald Ratner	Mercedes Benet	Jared Cornelia	Maureen Quinn	Dale Shero	Sandra Klueger	Joyce Stoffers
Cindy Meyers	Leah Franqui	Julie Kramer	Joyce Mcdonald	Nancy White	Iris Rochkind	Dale Mckenna	Ren Evanoff	Rhys Atkinson	Alice Tobias
Konsta Bala	Joe Salazar	Christine Sinclair	Tracy Cole	Gulshan Oomerjee	Ellen Desruisseaux	Tory Ewing	Edwin Quigley	Ana Torres	Joseph Moore Jr
Jon Anderholm	Twila Friberg	Karen Kravcov Malcolm	Judy Rees	Lyn Franks	Kathryn Lemoine	Yvette Frank	Anne Parzick	Cynthia Brooks-Fetty	Chris Guillory
Cecilia Gagnefjord	Danielle Schaeffer	Joshua Morgan	Timmie Smith	Dianne Croft	Ruth Milas	Cs	Debra Wolfley	Shirley C	Giorgio Redigolo
Monica Gilman	Jay Humphrey	Linda Laddin	Patty Erwin	Bambi Magie	Judith Salkin	Françoise Bolot	Timothy Storer	Daniela Bosenius	Cara Gubrud
Miranda Parkinson	Lorraine Hersey	Kathleen Lee	Lou Baxter	Camille Gilbert	Nancy Chismar	Sheryl Benning	Maria Cardenas	Tami Linder	Emily Willoughby
Giulio Ugazzi	Michelle Daddy	Veronica Ambler	Monique Tonet	Guy Corvers	Bonnie Murphy	Lisa Watson	Annie Wei	Grace Padelford	Kristof Haavik
Michael Shores	Silvia Bertano	Cristina Tirelli	Helen Mcdaid	Mauricio Carvajal	Fabienne Oubrayrie	Thi Tonolshaskie	Vittorio Ricci	Monica Stamm	Eva Cantu
Robert Markham	Maria Steffen	Penny Hanton	Samantha Honowitz	Katrin Sippel	Marie Fitzsimmons	Robert Drop	Lopamudra Mohanty	Mari Nyyss	Patti Fink
Ravinder Singh	Laurence Skirvin	Tom Quinn	Douglas Wagoner	Dorothy Wilkinson	Michèle Haudebourg	Pat Flahart	Ananthanarayanan Ramakrishnan	Kim Lyons	James Hatchett
Stephanie Warnock	Neville Bruce	Celeste Anacker	Holly Graves	Geoff Long	John Gilberto Rodriguez	Robert Fingerman	Denise Tuttle	Carol Mcmahon	Nancy Barcellona

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Terrance Hyk	Beatrice Narbona	Josh Pelleg	Joshua Angelus	Miriam Feehily	Maria Schneider	Judy Carlson	Susan Zimmermann	Ellen Quinn	Thom Peters
Pam Ferman	Douglas Kinney	Sue Batte	Gayle Blakeslee	Brendan Lee	Dorothea Stephan	Patrick Maloney	Elaine Fischer	Cinzia Colombi	Betsy Maestro
George Ruiz	Monika Huber	Ainga Dobbelaere	Jessica Diekman	Jill Paulus	Paula Bonnell	Donna Adams	Carrie Darling	Carol Bostick	David N
David Allen Stringer	Daniela Rossi	Sophie Weiss	Devon Jones	Sophie Bonami	David Weinstein	Sofia Karvouna	Suzanne Gordon	Meryl Pinque	Lorraine Elletson
Brian Miller	Forest Frasieur	Marilyn Koff	Steve Crase	Joëlle Riche	Christopher Ecker	Diane Geary	Sylvie Ries	Deborah Giniewicz	Diana Sommerville
Matthias Reichl	Jeri Stokes	Alexandra Meyer	Greg Grieman	Satya Vayu	Kenneth Hyche	Suzanne Flanegan	Marianne Kohler-Maetz	Paola Catapano	Twyla Meyer
Robyn Phillips	Gail Noon	Raymond Ings	Joe Quirk	Susan Campbell	K Abate	Lieke Mur	Kirk Bails	Liane Mcfetridge	Robert Moeller
Michelle Hayes	Marion Kraus	Matthieu Brillet	Helga S.	Regina Brooks	Darlene Molina	Nandita Shah	Leo Deluca	Nancy L Cowger	John Woods
Rick Posten	Candace Laporte	Roger Aus	Diana Mcnair	Tammy Nogles	Ilya Turov	Ana Teresa Monteiro	Adrienne Hochberg	Diana Scott	Janis Todd
Michael Schwaabe	Daniel Cottin	Christina Williams	Giovanna Perini-Folesani	Paula Johnson	Gerrit Woudstra	Thomas Andreas Michel	Miro Krajnc	Massimo Savigni	Yvette Fernandez
Doris Verkamp	Joann Butkus	Marina Jirotka	Vanessa Aguiar	Cinzia Caporali	Jan-Paul Alon	Jennifer Gilbert	Lesley Jorgensen	Lisa Dunphy	Violet Houtzagers
Kacey Brown	Michael Waida	Dorothy Dunlap	Johnnie Prosperie	Catherine Johnson	Anne Rutten	Andrea Rohr	James Robertson	Les Roberts	Prescott Mccurdy
Lionel Burman	Jerily Robinson	Andrea Lewis	Nancy Beavers	Marina Mooney	Jean Saja	Fred Leiss	Jane Gulley	Tara De Veau	Martha Izzo
Linda Singletary	Robb Hoehlein	Patricia Mackinnon	Anne Gegg	Dan Morgan	Vanessa Kohlgrüber	Mireille Urbain	Eric Pash	Sigrid Acosta Ramos	Rose Dippel
Alexandra Pappano	Janet Petermann	Nancy Faust	Henk-J Land	Llewelyn Lavista	Angelika Eberl	Kerry Heck	Andre Walter	Isabelle Boisgard	David Wiley
Riley Canada Ii	Pat Bunte	Chuck Swackhammer	Jackie Critser	Brandon Schoonover	Peter- R4 Ch	Richard Coveny	Jeff Nadler	Sha Davies	Omar Boumali
Michelle Macy	Melissa Martin	Warren Johnsen	Chetna Pittea	Carl B. And Pamela S. Lechner	Matt Stedman	Doris Westerman	David R Wilcox	Clarisse Holman	Lara Whiting
Oleg Finodeyev	Lynne Weborg	Katalin Kónya-Jakus	Adam D’onofrio	D.e. Whitcomb	Constantina Hanse	Robin Spiegelman	George Bourlotos	Myles Hunt	Roel Cantu
Gretchen Messer	Natasja Torfs	Vic Burton	Andrew Joncus	Iwona Krzeminska	Ashley Fitzgerald	Michael Seager	Judith Lindsey	Margaret Muirhead	Johanna Stiller
William Cagle	Isabel Travesset	Annette Straubinger	Tara Verbridge	Judy Skole	Elizabeth Cocker	Addie Smock	Craig Figtree	Eden Guidroz	Michael Raymond
James Harrison	Grace Golata	Matt Geer	Michelle Sewald	Sonia Goldstein	Stephanie Fairchild	John Riordan	Catherine Farrell	Janet Hendrick	Eve Forde
Bruce O’brien	Karon Schmitt	Gayle Blue	Martha Herrero	Sandra Boylston	Lisa Wallser	Grace Strong	Carolyn Marion	Rebecca Oberlin	Michael Harrison
Leotien Parlevliet	Carolyn Turner	Mary Ann Calvert	Cynthia Raha	Lee Whitehall	D Gryk	Michael Norden	Sheila Ward	Adella Albiani	Louise Quigley
Gordon Scott	Ralph Collier	Jennifer Sweetland	Laurel Stein	Kathryn Christian	Gabriele Holland	Rhonda Mandato	Erica Runge	V Evan	Robert L. Blau
Maryann Linehan	Carole Klumb	Craig Drew	Robert Blanchard	Cheryl Biale	Nancy Neumann	Mark Lotito	Cristina Economides	William Rastetter	Jean Mcdonald
Mildred Bursler	Michael Barnes	Raphaël Ponce	Bobbie Hensley	Jud Schlacter	Linda Winchester	Crystal Wilson	Nicole Rosa	Donna Tanner	Kevin Chiu
Shirley G Schue	Phil Hembury	Rebecca Mcdonough	David Awtrey	David Luxem	Marianne Nelson	Marie Schlabach	Pamela Hamilton	Mike And Susan Raymond	Tim Baxter
Dawn Albanese	Douglas Sobey	A G Hansen	John Thomas	Sandra Bovy	Phillip Delaplaine	Georgia Libbares	Birgitta Martinez	Julia Broad	Brenda James
John T	Nancy Feuerbacher	Tine Holscher	Valérie Horne	Reba Reiser	Sheila Stevens	Ruth Gitto	Steve Lucas	Matt Freedman	Lorne Beatty
Kathy Coffman	Jordan Longever	Simon Martin	Tami Fleming	Irene Bussjaeger	Barbara Gautier	Mary Barbezat	Susan S. Mintzes	Amy Greer	William Blackman Iii
Erica Coco	Diane Marks	Carolyn Tolliver	Michael Mcmahan	Quentin Fischer	Alyson Shotz	K. Arnone	Michael Skidmore	Veerle Van De Velde	Stephen Black
Connie Curtis	Cathy Hope	Eva Luursema	Irene Miller	Daniel Brant	Ryan Bradley	Lynn Boulton	Frank Mastri	Heidi Lynn Ahlstrand	Bob Yarger
Melonie Milnes	Lloyd Hedger	Robert Sargent	Chiara Barbero	Gail Burns	Donna Duncan	Dagmar Rosenberger	Donald Ament	Karin Shea	Lorrie Ogren
Andrea Bounds	Michael Suchorsky	Vicky Lescody	Laura Long	David Rechs	Rodney Hemmila	Vicky Matsui	Dennis Scheck	Dennis Schaef	Michel Leboeuf
Marcia Storer	Callie Riley	Rita Lemkuil	Laura Riley	Darlene Davies-Sugerman	Valerie Bergeron	Judy Wood	Eric Brooker	Matt Klara	Kelly Hurlbut
Craig Cook	Judith Schmitz	Margo Wyse	James Mccarthy	Amanda Morrison	Diane Arnal	Virginia Robert	Jimmy Morrison	Annick Somerville	Mark Porter

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K Strasser	Demaris Hollembeak	Jennifer Scott	Colt Maule	Grant Werschkull	Owen Gustafson	Sheila Silan	Heidi Hartmann	Bk Young	Carl Skipworth
Nancy Frisbie	Karla Klueter	Jesse Gore	Carole Pooler	Jane Oldfield	Vicky Moraiti	John Wise	Cathy Zimmerman	Cara Ammon	Robert Fuchs
Ryan Bahnfleth	Jerry Horner	Richard Fairfield	Margaret Richardson	David Soares	Amy Holt	Donna Davenport	Mike Mccool	Kim Nero	Deanna Mousaw
Amy Dombek	Karen Bravo	Marie Weis	Mary Wier	Anthea George	Wendy Larson	Annette Soucy	Richard Streett	Karl Graff	Joyce Shiffrin
Mark Williams	Evelyn Griffin	Harriet Jernquist	Katarina Spelter	Christiane Westerburg	Eric Fournier	Sally Hodson	David Fiedler	Sandra Dieterich-Hughes	Elfie Elms
Ramsey Gregory	Wendy Balder	Dave Holt	Linda Nelson	Bill Bahnfleth	Shelley Ottenbrite	Carlotta Sailer	Warwick Hansell	Edda Hambrecht	T J Thompson
Susan Termini	Carol Berkeley	Victor Carmichael	Lisa Hensel	Piet Noppen	Douglas Gendron	Tamara Ashley	Jim Finn	Cathy King-Chuparkoff	Alana Willroth
Susan Eikenbary	Martin Diedrich	Marjorie Quon	Donna Panza	Rhonda Carter	Jeff Curtis	Michael Martin	Mark Wirth	Jean Farris	Stephanie Clark
Stephen Dutschke	Larry Orzechowski	James Mcbride	Beverly Mardis	Barbara Hamacjek	Erasmo Joseph	Bob M	Christine Becker	Barbara Mcgrath	Bonnie Hill
Pauline Berkeley	Birthe Henriksen	Dana Knutson	H. Guh	Sandra Hazzard	Rich Elam	Jeffery Garcia	Dara Murray	Ricardo Hernandez	June Cattell
Stephen Gliva	Greg Strauss	Jc Honeycutt	Daniel Smith	Denise Lytle	Myra Dewhurst	Debbie Koundry	Sally Garfield	Nancy Polito	Susan Wayne
Diane Basile	Susan Nowicki	Barbara Smith	Luis Mon	Katherine Olmstead	Mary Reed	Lori Murray	Josh Heffron	Alisha Begell	Marc Ruffolo
Rosemary Kluepfel	Arlene Butters	Patricia Mccoy	Richard Han	Robert B	Mc	Carolina Varga	Kristina Harper	Sally Daubert	Janna Sumner
Georges Raymond	Darlene Wolf	Jennifer Romans	Francisco Dacosta	Maryanne Preli	Chrissie Flintoff	Maria Falconer	Kathleen Grossman	John Swiencicki	Babette Bruton
Jessica Likens	Jocelyn Stowell	Christeen Anderson	Joseph Braun	Robert Wolf	Art Hehn	Leslie Harper	Laurie And Dave King	Bonnie Mcgill	William Swinney
Christine Josselin	Sandra Costa	Kate Nyne	Christopher Benjamin	Barbara Laxon	Marianella Torres	Anthony Siciiano	Sue Sutton	Donna Bookheimer	Robert Levin
Steve Overton	Halcyone Hurst	Mindy Maxwell	Donald Anderson	Patrick Sweeney	Stanley Sayer	Lorenz Steininger	Janet Nugent	Sue Hustead	Mark Gall
Lotte Larsson	Mary Zack	Robert Aguirre	Linda Sperber	Martina Hainke	Sarah Bloomgren	Joyce Nelson	Marcia Ward	Brad Nelson	Lyn Capurro
William G Gonzalez	Nancy Campbell	Daniel And Karen Erlander	Andreas Rossing Angeltveit	Deborah Lipman	Nicole Shaffer	John Liss	Rose Wolny	Peggy Powell	Richard Freeman
Christine Norman	Steve Uyenishi	Florian Maitre	Catherine Macan	Tote Reli Vasilica	Kate Gualtieri	Holly Quick	Mari Vanantwerp	Natasha Saravanja	Linda King
Linda Kram	Christine Lojko	Amanda Busch	Sylvia Dwyer	Paul Verzosa	Herbert Elwell	Pamela Unger	Judith Wilson	Dolores Cohenour	Annie Spear
Nora Dyster	Virginia Boehne	Sara Sang	Nicholas Diamond	Kim Crawford	Jill Vaniman	Mayelly Moreno	Richard Mackin	Jim Traweek	Bellinda Rolf-Jansen
Carolyn Stark	Jeffrey Christo	Tiffany Hardy	Dora Oldham	Margaret Gallagher	Becky Andrews	James Herther	Peggy Moody	Stephen Appell	Robert Swift
Mary Tarallo	Terry Friedman	Benjamin Wagner	Sudeshna Ghosh	Gillian Wilkerson	Kate Skolnick	Shelley Frazier	Robert Cook	John Femmer	Ilona Braune
Sammy Ehrnman	Sharon Janson	Margarita Latimer	Jennifer R	Chris Worcester	Linda Davis	Jackie Stewart	Carol Patton	Tom Peace	Melanie Jones
Feather Jones	Fire Pruitt	Stephanie Nunez	Jesus Montealegre	Sarie Bryson	Marjorie Wing	Heath Post	S. Urton	C. Kasey	Julie Ford
Rachel Wolf	Jamie Dos Santos	Tina Dasilva	Michael And Barbarahill Hill	Russell Weisz	Gary Dowling	Jerry Druch	Donna Frye	Cem Ozkok	Amanda Collins
Vince L	Jane Mcgraw	Charlene Rush	J Stufflebeam	Annie Caton	Michael Gan	Sheldon & Shirl Pitesky	Kevin Warren	Pat Ridenour	Justin Cline
David Smith	Allen Kelly	Janine Vinton	Wendy Raymond	Kevin Rolfes	Mary Madeco-Smith	M. Lopez	William Carmen	Michele Morris	Danny Chan
Marilee Murray	Rick Rogers	Sharron Rogers	Sandra Tucker	Chris Rice	Christopher Lish	Juanita Dawson-Rhodes	Eleanor Smithwick	Anna Rincon	Janet Larson
Jerry Morrisey	Mary Combs	Scott Dulas	Steve Claas	Sylvia Cooper	Emily Onello	A. Mcleod	Angela Saracen	Mariana Lukacova	Mark Rowlatt
Kathleen Oconnell	Bob Petermann	Bethany Witthuhn	Tom Konesky	Steven Schafer	Abby Todd	Nancy Spittler	Ellen P Ayalin	David Czarnecki	Meg Dugan
Ken Gunther	Mark Canright	Rebecca Canright	Amy Hansen	Taunja Beck	Gwen Gay	Don Faia	Cherine Bauer	Robert Bates	Helen Smylie
Sibrina Russell	Carol Gordon	Jamie Harris	C. Martinez	James Field	Edeltraut Renk	Danielle Curcio	Maria Papastamatiou	Paula Fougere	Angela Bellacosa
Heyward Nash	Ali Van Zee	Karla Mcnamara	Alex Rappaport	Adrian Fried	Gabriella Turek	Lisa Salazar	Isabel Tamayo	Alexandre Kaluzhski	Monika Seegler

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Mike Deiotte	Ken Wenzer	Ann Marie Ross	Donald Williams	Joyce Murray	Issaqueena Sparks	Gerald Walsh	Logan Johnson	Marla Bottesch	Suzanna Hägglöf
Carol Hay	Kris Wegerson	Dennis Ledden	Julia Dugan	Christine Lomaka	Esther Juhl	John And Brigitte Wallace	Larry Goodman	Laura Fake	David Ross
Yael Shimshon	Lynn Carey	Lorie Schoen	Wendy Curtis	Gregory Rouse	Karen Haynam	Ashton Fell	Rdsfd Dfs	Chris P. Mooney	Suzanne Lipkin
Mark Ritari	Dameta Robinson	George Jackson	Luis Fuentes	Debi Combs	Kathryn Grady	Julianne Martinson	Dawn Oehlerich	Shaun Opp	Hana Correa
Max Demars	Darcia Hurst	Erin Osswald	Whitney Milhoan	Tessa Ramsey	Lori Park	Bruce Park	Ellaine Janicki	Richard Ulstad	Christiane Bruch
Melissa Owens	Marni Edmiston	Scott Macdougall	Chie Dunford	Sharon Brodie	Mark Molloy	Boylan Lisa	Will Fortna	Erika Berglund	Leeanne Watkins
Eugene Mariani	John Boyd	Scott Swanson	William Hoard	Barbara Arko Hargrove	Charles Lee	Charles Brumleve	Nick Robinson	Lisa Zales	Tibor Gacs
Anna Wagner	Brian Ratliff	Pat Hinz	Joan Morris	Linc Conard	Patricia Callaghan	Marsha Lowry	Jaime Belcourt	John Ameslberg	Lisa Meeker
Stephanie Deveau	Julian Madison	Robert Krueger	Tonya Lantz	Anita Fortin	Tatiana Medina	Chelsea Emery	Sylvia Lewis Gunning	Amber Conger	Madeline Gnauck
Meredith Mohr	Mary Levitt	Sherry Howard	Gloria Rosenkrantz	Sandra Lannon	Kendra Cousineau	Patricia Borri	Hannah Nikonow	Eileen Gillespie	K. Jane Duncan
Theresa Hebron	Holly Staples	Kristin Freeman	Edward Craig	Sondra Daly	Leigh Perkins Jr	Lance Sapp	Kimberly Wade	Andrew Pierce	Karla Mills
Benjamin Etgen	Doug Franklin	Chris Callahan	Judith Bird	Nancy Lewis	Chantal Van Beveren	Judson Curry	Lora Steiner	Dita Škali-	Gail Gray
Justin Stricker	Ann Hughes Devereaux	Chad Nelson	Ericeu Steele	Ed Gittines	Amy Kelley Hoitsma	Elizabeth Abrantes	Sandy Dumke	Anusch Ricaud	Bantwal Rao
Lindsay Hopkins-Weld	Peter Zemlock	Zachary Golightly	Florette Henner	Nancy Ojala	Gardner Smith	Brian Regnier	Jordan Costello	Lilli Ross	Eileen Ewan
Kyle Roberts	Kirk Liponis	Mike Chimenti	Ian Hanobeck	Logan Paul	Terrie Phenicie	Maria Ford	Robert Longo	Rohana Wolf	Lina Poskiene
Drew Mills	Anne Butterfield	Steven Kline	Nerrida Mcintosh	June Jarka	Graham Reinhard	Janet Falcone	Jan Peele	David Westberg	Erik Alvarado
Charles Perkins	Doreen Kowalski-Anhorn	Carolyn Stallard	Susan Lantow	Deborah Coviello	Joseph Urbani	Jill Fogg	Jon Barlow Hudson	Maria Gotta	Colleen Cleary
Patrick Finnegan	Marsha Krauter	Janet Forman	Gary Timm	Jenna Obrien	Maryann Gregory	Daniel Bailey	Philip Kritzman	Patti Ashmore	Anne Veraldi
Lee Miller	Elizabeth Watts	Wiley Kendle	Hannah Holst	Shawn Rodriguez	Tyson Wilke	Oleg Varanitsa	Adrienne Ross	Sandra Frohling	Marie Garescher
Carla Mettling	Helen W Dickey	Callie Stolz	Adrienne Graf	Sara Green	Lauren Richie	Naomi Solomon	Katherin Balles	Deborah Fexis	Chris Thompson
George Gaydos	Randall And Luanne Mierow	Zach Montano	Dan Grove	Dale Miller	Miranda Vorhees	Tara Cleveland	Debbie Thorn	Peggy Detmers	Elizabeth Klarich
Rachel Violett	Stacie Wooley	David Allen	Mary Kay Alexander	Dana Monroe	Angelique Delattre	Kacey Donston	Jim Mccue	Susan Chapman	Jacki Crossblade
Shirley Mills	Richard Gould	John Zamos	Canan Tzelil	Els Denhoed	Heather Ohm-Fisher	Christann Schmid	Nancy Ward	Nicoletta Buttignon	Suzanne Kim
Darlene Schmid	Roger Wild	Priscilla Newcomer	Franca Marchese	Karen Nadow	Roberta Young	Jeremiah Greco	Denie English	Kilby Rech	Rickey Buttery
Sandra Materi	Charles Fitze	Kiarra Mcgee	Kj Linarez	Mildred Huttenmaier	Roderick Jude	Jan Anderson	Amanda Melrood	Roswell Hahn	Karen Welles
Beti Webb Trauth	Gayle Gordon	Bp	George Pate	John Rudolph	Sue Stoeckel	Lawrence Joe	Fran Teresi	Ermanno De Gregorio	Therese Hernoe
Mallory Mcgill	Veronica Koch	Terry Forrest	Barbara & Vincent Smolinski	Jo.com Garrett	Kem Himelright	Carol Hewitt	Pierluigi Iacono	Dorothy Lynn Brooks	Pamela Nelson
Christine B.	Emily Moran	Aimee Devlin	Laura Hanks	Kim Wells	Thomasin Kellermann	Kim Forrest	Hilary Morrison	Donald Munn	Brianna Onken
Joana Durán	Marcia States	Elisa Leflore	Susan Edelstein	Rhonda Lawford	Shannon Taylor	Rita Meuer	William Lewis	Deb Hahn	Maria Parthe
Bonnie Hamilton	Theodora Boura	Abby Foran	Geraldine Fogarty	Erik Renna	Elsa Borges	Amber Gilchrist	Randi Saslow	Annette Pieniazek	Carol Johnson
William Schoene	Stavros Sofokleous	Martina Martens	Patricia Burton	Frances Ashforth	Sandrine Bernard	Abigail Rome	Lisa Zalenski	Sarai Aveleira	Kathy Finkenstaedt
Kevin Leys	Norene Bailey	Laura Pitt Taylor	Tony Osusky	Melanie Smith	Theresa Owens	Casey Jo Remy	Timothy Fridsma	Laurie Puca	Susanna Randall
Linda Kourtis	Edmund Dornheim	Daniel Mink	James Feichtl	Margaret Lohr	Aimee Charbonneau	Wayne Langley	Richard Peterson	James Balder	Sonia Zainko
Sara Orbe	Susan Stewart	Peter Hammond	George Warco	Jane Finkenstaedt	Ed Jocz	Linda Cummings	Hayley Buchbinder	Sue Parker	Patricia Haworth
Valerie Hildebrand	Waundra Blizzeard	Barry Lebeau	Bernie Zelazny	Stewart Lewis	Tyler Anfinson	Marcelo Vazquez	Jeff Wells	Lynn Skillman	Pamela Gibberman
Eldert Koenderman	Thomas Talbot	Dasha Xaytseva	Franziska Hanke	Isabel Cervera	Steven Poeckes	Jennifer Hagens	Pat Bryan	Rax Green	Doretta Miller

Form Letter FL4

Burton Mchugh	Kelsy Steiner	Sudhir Pandit	Joseph Hoess	Donna Ennis	Kelli Lewis	Steven Smith	Mary Wooldridge	Niels Loechell	Lyle Brandt
Andrew Mcdonnell	James Schoppet	James Lohman	Paul Desjardins	Brenda Michaels	Warren Vogt	Elizabeth Butler	Elizabeth Hemzacek	Bente Petersen	Mirabai Nagle
Livia Vertova	Mary Alice Carlson	Shawnee Mclemore	Lisa Madzin	Lara Schulz	Tim Rose	Larry Stoodt	Marie Goewert	Tera Ginnaty	Joan Scott
Nancy Gault	O.c. Oliveira	M. Starr	Evelyn Parker	Wim Van Caelenbergh	Charlotte Mullen	P Harde	Harley Doss	Nikki Wojtalik	Theresa Maloughney
Nanette Oggiono	Emilia Novo	Michael Lawrence	Tyler Harrington	Karen Sewick	Paul Thompson	Craig Conn	Hipolito Arriaga	Laura Staples	Ryan Delaney
Ulf Remahl	Carrie Phyliky Rimes	Stacie Charlebois	Christina Martin	Janet Ruggiero	Savannah Horwood	Carl Tyndall	Paulette Fay	Taylor Surratt	Kim Smith
Paula Cano	Mary Camardo	Susan Alice Mufson	Raymond Arent	Nancy Bellers	Alessandra Paolini	Donye Sacco	Lisa Klein	Carolw Wiley	Denise Romesburg
Cara Stanley	April Kohles	Donald Garlit	Matt Sheridan	Alex Silverio	Karen Keating-Secular	Josie Lopez	Melissa Elder	David And Laura Smith	Carol Mcinerny
Jen Scibetta	Paul Logue	Susan Heath	Darlene Warner	Polly O’malley	D Bello	A.l. Steiner	Stephen Marshall	Ashleigh Ranft	Kian Daniel
Tiffany Witmer	Lorraine Brabham	Lenie Molendijk-Schipper	Sonja Nielsen	Evan Kroeker	Neil Bleifeld	Rosemary Ward	Shannon Milhaupt	Wilder Kingsley	Marty Bostic
Susan Burns	Mindy Newby	Siochai Oconnor	Ellen Singer	Miranda Everett	Heather Ruckman	Andrea Pernick	Carol Joan Patterson	Sharon Frank	Isabelle O’sullivan
Kevin Kriescher	Hal Trufan	Hannah Lange	Ron Melsha	Rachelle Aisen	Ann Marie Sardineer	Andrew Luckhardt	Peter Farris	Todd Hildebrandt	Eric Speed
Elizabeth Ketz-Robinson	Colleen Mcglone	Laura Taylor	Wendy Forster	Eileen Chieco	Lori Bates	David Kagan	Gisele Souza	Laetitia Petit	Penelope Prochazka
Andrea Cimino	Lauri Moon	Tara Warfield	Mary Jo Nagy	G. G. Johnson	Michael Olenjack	Evelyn Fraser	Linda Freeman	Donna Jay	Jim Ewing
Richard Gockel	Melanie Fisher	Norman Bishop	Jennifer Nitz	Joel Vignere	Gina Bates	Jon Krueger	Tracy Bonner	Caroline Kane	Bo Breda
Harriet Mullaney	Jackie Wolf	Faith Kirk	Tess Husbands	Teresa Seamster	Carol Jurczewski	Maria Celia Hernandez	Rebecca Howe	Jean King	Tenorio Robie
Don Pew	Dave And Rita Cross	Greg Garbulinski	Peter Ayres	Louise Usechak	John Van Straalen	Cheriel Jensen	Kathryn Burns	Gary Albright	David Jaffe
Kermit Cuff	Siegrid Berman	Terry Jess	Ellen Halbert	Thomas Nieland	Fred Jakobcic	Mary N. Swersey	James Vander Poel	Eric Meyer	Maren Kentfield
David Fiske	Karen Kalavity	Raymond Litzsinger	Miki Laws	Hubert Kimball	Eileen Coffee	Paul Palla	Linda Louise Carroll	Bill Vom Weg	J. Scott
Nancy Ostlie	Nicole Weber	Judi Gooding	Mark Feldman	Amy Niles	Mary Hahn	Cheryl Rigby	Priscilla Martinez	Joseph Boone	Henry Berkowitz
Betsy Webster	David Henning	Karen Jacques	Beth Jane Freeman	Julie Takatsch	Lisa Koehl	Susan Peterson	Peter Harrell	Harry Knapp	Colleen Pearson
Elaine Livesey-Fassel	William Steele	Roger Vaughan	Eve Duplissis	David Abalos	Christine Rosen	Bruce Wade	Adam Matar	Mary Rojeski	Sheri Kuticka
Marianne Hunter	Sherrie Raymond	Susan Haywood	Jordan Hashemi-Briskin	Emma Shook	Felicia Dale	Glen Anderson	Danielle J	Eric Griffith	Sherri Kalman
Richard Van Aken	Laura Waterworth	Mary Loughlin	Neilia Pierson	Clint Rech	Mary Ann And Mr. Frank Graffagnino	Riley Pearson	Debra Engdahl	Andrew Stuart	Dan Mccurdy
Janene Caywood	Tanya Piker	Lou Orr	Theresa Kardos	Carter Thompson	Karlene Gunter	Gloria Mcclintock	Marilyn Martin	Richard Mcdonald	Juanita Hull
Miriam K.	O Jerry Waters	Justin Grover	Stephen Cardwell	William Butler	Carla Orr	John Livingston	Catherine Lambeth	Margaret Wood	Belinda Berkemeijer
Ronald Clayton	Pamala Mcdonald	Michelle Smith	Rodger E. Sherman	Mitchell Gershten	Kari Gunderson	Denise Halbe	Holly Mcdonald	James Klein	Libbey White
Mark Lundholm	Vivienne Lenk	Derek Gaasch	Maggie Secrest	Metthew Jewett	Charlene Woodcock	Eric Franzon	John Ochs	Eric Heidle	Bryan Wyberg
Kim Young	Deborah Kmon	Dianne Ensign	John Falconer	Charles Wolfe	Michael Wortham	Jeffery Schimpff	Rita Gentry	Stephen Scott	Joan Hobbs

MEIC Contact the DEQ									
Barbara Boley	Chris Nelson	Brett Pfautz	John Dillon	Deborah Hanson	Carla Young	Jaimee Turley	Marion Gerrish	Kathleen Gessaman	Melinda Farrington
Milla Cummins	James Kleine	Kathryn Posten	Katie Ballard	Julir Elliott	Mary Ann Kelly	David Saslav	Kyle Turner	Stephen Mcevoy	Todd Gage
Lorraine Rowe-Conlan	Richard Dykstra	Robert Freistadt	Raso Hultgren	Robert Griffin	Bruce Cohen	Anthony Farrington	Gail Mclean	Pamela Kloote	Chris Daum
Nancy Schultz	Timothy Stevens	Anita Ho	Kristin Freeman	Jack Ferriter	Rick Whitman	Madeleine Padon	Kathie Daviau	Monica Perez-Watkins	Claire Trauth
Jo Nielsen	Sara Pierson	Walter Barry	Rebecca Briber	Becky Grey	Wendy Oneil	Rindi Mcdonald	Camille Broadbent	William Stuart Broadbent	Charlynn Escobar
Slater Crosby	Tessa Wohl	Erin Sharaf	Tammy Taylor	Morgan Burkholder	Steve Guettermann	Michael Alvernaz	Rozanne Smith	Jamie Burkholder	David Harmon
Anthony Sciolino	Jerry Fahrenthold	Cheryl Ross	Ken Grossman	Rodolfo Miguel	Friedrich Wurm	Jamie Gaskins	Ross Chaney	Catharine Bunnell	Trish Christofferson
Janet Neville	Ann King	David Johnson	Shari Alick	Eileen Morris	Erik Hansen	Therese Wurm	Sophie Wurm	Cecil Bell	Preston Walls
Linda Campbell	Will Shull	Jessica Lahr	Tom Olson	Mark Stutrud	John Jensen	Mary Hall-Salina	Harrison Selle	G.b. Carson	Calla Rose Ostrander
Mark Hamachek	Nick Wolf	Harold Sloane	Tricia Payer	Helena Gorka	Bruce Bender	Caitlin Selle	Marty Ruffner	Debra Louttit	Janet Selle
Nicholas Voss	Virginia Holt	Heather Mullins	Jane Bernstein	Grant Barnard	Eric Eggen	Wayne Tomicich	Lydia Blanchet	Dianne Morriosn	Joseph Selle
Michael Chapman	David Hamlin	Deborah Coburn	Bill Shull	Chris Shields	Sabine Weyermann	Lore Adams	Ben Reoux	Stuart Kutchins	Renae Munson
Patrick Cirillo	Valerie Jordan	Marie Kerpan	Rae Rodgers	Heather Gray	Pr Stevens	Catherine Morrison	Elizabeth Jennings	Addison Piper	Laurie Trow
Edward Cruz	Loretta Byrd	Littlebird Parks	Gabi Smith	Martha Archer	Lauren Worona	Sarah Merrill	Nancy Smalley	Mark Stonacek	Gustavo Acerenza
Becky Brucker	Carlee Schnase	Katie Fernands	Sheila Roberts	Al Beavis	The Real	Greg Page	Catherine Ream	Chad Hess	Donna Worona
Paul Kramer	Elizabeth Haffenreffer	John Lee	Marcene Swingley	Mike Berry	Barbara Rosenkotter	Toby Bent	Laura Hutchinson	Carol Edwards	Scott Rosenbaum
Katie Bogart	Blake Singer	Dameon Hansen	Gretchen Piper	Bruno Stumpf	John Murray	John Haffenreffer	Gary Lee	John Herbert	Marc Worona
Diana Hammer	Clara Goldberger	Larry Hart	Daniel Mcguire	Devin Downes	Ron Johnson	Andrew Reich	Grace Callahan	Nancy Ostlie	Andrew Sledd
John Hanrahan	Shelby Sly	Paul Schutt	Amy Sheppard	Donovan Fernandes	Mitchell Carroll	Jackson Harris	Ryan Cruz	Matthew Larson	Coby Gibson
John Willoughby	Ronald Volpi	Claire Callahan	Alana Mcclements	Joshua Payne	Jake Schilling	Margaret Pickett	Michael Baicker	Michael Schedin	Lesley Crosby
Hannah Rubin	Thomas Eby	Leonard Dayton	Catharine And Robin Carey	Johann Hartl	Jim Crosby	Berit Degrandpre	Jake Spano	Lisa Sammons	Karen O’brien
John Gueringer	Mikey Moore	Liberty Degrandpre	Roxanne Dolak	Doug Power	John Cavo	Daniel Huvet	John Winton	Jennifer Lavalley	Stewart Crosby
Marna Fullerton	Robert Sutton	Lucinda Glock	Dan Kearney	Dave Gorton	Sara Hamilton	Tad Quill	Jon Kennedy	Scott Wales	Greg Daniel
Christopher Haffenreffer	John Dunnigan	Ella Robson	Mike O’connell	Stephen Wells	Helen Coleman	Frank Sennett	Stephenie Ambrose	Gregory Pertile	Kathleen Mcmahon
Alan Hilden	Jerome Kalur	William Rahr	Anne Lacroix	Peggy Ratcheson	Dane Bailey	Katherine Matic	Christina Lane	K Kim Potts	Chris Skinner
Leo Tracy	Carissa Beckwith	Nadine Nadow	John Dunkum	Bernie Kneefe	Michael Scott	Gil Jordan	Mark Maynard	Isaac Mawhinney	David Rockwell
Robert Villers	Mark Johnstad	Aven Satre-Meloy	Barb Wool	Douglas Rohn	Al Smith	Joan Hinds	Samuel Gates	Donald J. Burgard	Billy Angus
Jonathan Matthews	Gayle Gregovich	Susan Gallagher	Chet Morris	Julie Holzer	Judy Moore	John Hesselgesser	Jenna Fallaw	Bartley Deason	Robin Vogler
Michelle Nieset	Margaret Schuberg	Dana Smego	Jim Banks	O. Alan Weltzien	Scott Zerba	John Helvey	Carl Clark	Jacob Johnson	Joan Mckeown
Jeremy Stubbs	Charlene Woodcock	Craig Lacasse	Randi Hove	Dennis Underwood	Deborah Cerny	Paul Martin	Lowell Chandler	William Rolls	Carol Collins
Joe Brennan	Bolars Matson	Dorothy Starshine	Brenda Frey	Margie Reck	Rachel Burk	Rebecca Durham	Marlene Miller	Zack Winestine	Pamela Green
Constance Kromarek	Jessica Rubino								

MEIC Postcard

Thomas Blue	Blakely	Joanne Fisher	Tim Wagner	B. Geise	Roxan Holbrock	No Name	Campbell	Meidnger	Garback
Chet Rock	Mike Diangelis	Bertelsen	Claire Carren	Robert Donner	Kelly Wooley	Linda Semones	Emma White	Toddy Perryman	Kappel
Fred Paoli, Jr.	Bruce Mickelsen	Mary Brutger	Andrew Mitchell	Dehaan	Jack Benson	Monforton	Sharon Renfro	Henry White	Stephen Wallace
Martin Onishuk	Jack And Barbara Kligerman	Eisele	Meyer	Claudia Narcisco	Jerry Lawdewig	Kathy Powell	Grimm	Bob & Sara Lou Springer	Bouman
Brieger	Mary Erickson	Schroeter							

Postcard

David James	Ann M. Smith	Mike Feuersinger	C. Dudley	Tyler A. Mack	Kathryn Hiestand	L. Colbert	Cole	John B. Wheeler	John Thornton
Phillips	Schneider	Chester Morris	Linda L. Parker	James D. Bell	Maureen Montague	Noreen Sheahan	David Ward	Paul Zitzer	Laura Mitchie-Zitzer
Randi Hood	Linda Tawney	Habien	Dane Bailey	John R. Turmell	Mary Ellen Turmell	Barbara Van Arsdell	Jean Thorntenseon	John Garrity	Keelie O'brien
Goldmanyarbrough	William Mclaughlin	Molly Cottrell	Karen Roholt	Thompson	Robert Rich	Edwards	Fleming	John Walker	R. Rivers
Mary Jo Olson	Duane Catlett	Steven D. Mcarthur	Johnson	Denice Elison	Sheila Roberts	Susen	T. A. Cox	S. T. Johnson	Peter Susen
Bruce Brown	M. Ascher	Spring	M. Simpson	Thomas	Bill Story	Matthew Hoalcraft	Johnna L. Williams	Richard Lloyd Jones	Jay Leach
Claire O'connell	Katherine Ps Johnson	Paulette Hall	Holmes	Vanbrunt	Kathlen Johnson	B. Johnson	William	C. L. Thomas	Tim Holmes
James Hartung	Andrew Conlin	Stephen Desnoyer	William Green	Rick Henry	J. Hays	Barnhart	G. Hedman	Steven L. Harbin	Holly S. Schwind
Simard	Matthew N. Paine	B. Swartz	Gh Purcell	Steve Diekman	Sean O'lallaghen	Jesse Devoe	Tom Welsch	Casey Folley	Addison Sessions
J. Hickman	Doreen Weber	Cheryl A. Fisher	Ed Stalling	Molly Schiltz	Daryl Dodd	Beau Freund	Joseph Chalupa	James Screnar	Yu Jin Cho
Brandon Demars	Nunlist	Judy Tsiang	Mike Harris	Rachel L. Burk	M. Peterson	Harbour	Gregory Clement	Nick Domitrovich	Michael Stebbins
Frank Carpenter	Bj Hoven	Emily Geery	Andrew Funk	Daniel Anderson	Troy Burrows	Kayla Broughton	Stan Frasier	Drew Stuart	D. Rodwell
James C. Wallace	Loren Graham	Richard Fertterer	Tim W. Croft	R. Forde	Robert N. Lane	Annie King	Olsen	Meloy	Michael Kowalski
M. Poortenga	John Hoeglund	Daniel M. Kelly	Cole Brilz	Denise Gianoulias	Landes	Kasey Delahunt	Edward Starkel	Kim Schleicher	D. Corcoran
Steve Meloy	Darrell Ehlert	Mike K. Enderes	Mike Schreiner	Ganno	Jeff Nash	Terry Mede	Eric Moon	Zeb Breuckman	Dennis R. Bauer
Verl L. Clark	Jacob Brown	Aaron Brock	David Linford	Jeff Kinderman	Grant Nakamura	S. Mcintosh	Aubrie Lorona	Cole Jensen	David Anderson
Christy Eisinger	B. Memahon	Miles Curtis	Ron Brock	Paul Thurston	Mike Alvernaz	Edgell	Pat Ortmeyer	James Brown	T. Bauer
Patrick Neary	Cheney Raymond	Brad Miles	Janet Parker	Steve Ongerth	Rayna Eyster	Brent Brye	Spedden	Mary V. Peet	Jennifer Swearingen
Audrey Jean Haight	Peter J. Wilczynskilane	Eric Szemes	John Parker	Dorothy Durdon	Kathleen Spritzer	Karen Renne	S. Merrell	Annick Smith	Martha Bisharat
Pattie Fialcowitz	James Mohr	Richard F. Zander	M. Wikstrom	M. Sharon Wolfe	L. Weber	David Webb	Dean Webb	Robin Tyner	Bradford Dickson
Debra Bullington	D.a. Baumeister	Brenda And Douglas Allington	Maureen Redfield	Steve Demers	Coons	Todd R. Hillier	Lesley Conning	Azure	Whittle
David L. Reid	M. Booth	Andrea Vannatta	Fredrick Dauber	Robert Gates	Craig Hatch	Edward Zitt	Robert M. Woehrle	Jon Wyrzykowski	S. Vajdic
J. Vail	Jim Thomas	Laura Timby	Ken Bennett	Chelsea Baum	Roz Badger	S. Barrett	Peter Bell	Bob Buhr	Daniel R. Bullock
Charline And Ronald S. Alexander	Ann Mcgeehan	Langston	Dustin Allen	David L. Best	David Buchler	Nolan Brilz	Raymond Ciolkosz	Egan	Samuel H. Gane
Kelsey Bush	Alan Zackheim	N. Vallincourt	Steck	Pius Schenker	Deborah R. Roudebush	Timothy B. Patrick	Paul Means	Ostby	R. Pauli
James Perry	Ellen Bishop	Doris Bishop	Smith	Deann Cavanaugh	Paty S. Mastin	Jessica C. Graybill	Robert G. Arrington	Jaime Johnson	Marlyn Atkins
David Templeton	Marian J. Setter	Melanie Ruby	Frank R. Sennett	Linda Sentz	B. Shirley	Joel Franjevic	Vicki Freyholtz	Douglas Williams	Steve Eller
Carrie L. Vollrath	Anne Feighner	Robyn Butler-Hall	Beth Ward	Anna K. Daley	Frideres	R. Breen	Michael B. Agee	Dennis Hanson	Daniel Gillespie
John Cornett	John A. Middleton	J.a. Wunderlich	Christa Groeschel	William Rolls	Mary Beth Cottrell	Chris Carver	Ralph Stephens	Concetta V. Ross	Mary Peele-Masek
Jean Jenks	N. Tirrell	Mary Quint	Richard N. Espenscheid	H. Longmire	Stephanie Eubanks	Peter And Audrey Hadfield	Anderson	E. Kane	Quentin Hays

Postcard

Ken Vesely	Valerie E. Oakland	Kevin Orth	Rod Legg	P. Joyce	Craig A. Geary	Matthew Cronin	Randall S. Carlson	Sarah C. Brosier	P. Alberda
Stephen M. Carey	O. M. Meek	Mike Buckley	Michael Mccreanor	Lawrence	M. Kmon	Denise Kampf	William Glass	Kerry Erickson	James B. Cross
William F. Collins	Edward Wisman	Molly Whitesell	Jessianne Yulga	Molly And Joshua Netburn	Molly Sternke	Matthew Salava	Robert Sain	Roberson	Philip J. Naro
A. Norick	Maki Nakagawa	Tromly	Schweizer	Vincent A. Scales	Joseph C. Purkett	Mark Arana	Tom Harned	Heidi Marcum	Burr
Marc Burkhart	A. Wise	Laurie Willett	C. Householder	Meghan Hanson	Lyn Gallik	Michael S. Flynn	Fedyschyn	M. D. Moody	Greg A. Lazerte
Chris Kelly	Jack Jennelle	Jerry L. Jackson	Laura M. Jackson	Scott Kuhr	Marc Miller	Cameron Myers	Troutman	Thomas Martini	Alissa Mcgonigal
Vince Grillo	Leblanc	Michael Chadek	Robin Billau	David Baumbauer	Scott Baines	Carlson	Laurence Carr	K. Eisenstadt	Jack E. Hunnell
Tom Greene	William Whyard	Theard	Ryan Sparks	D. Robbins	Sandra Pisauro	Frank B. Newmack	Gail And David Mcglothlin	D. Mcfarland	Zach Heser
Cynthia Ford	Russell Sherry	T. Susen	Jackson Rowsell	Daniel Tenenbaum	Cotter	Marvin And Louise M. Parker	Rosalyn F. Rohfleisch	Hampton G. Baxter	Kosaka
Carol Werner	Morse	Woodson	Adan Cooney	Matt Jones	Anna L. Lane	Markle	Sue Toth	Eric D. Smith	Glen Faechner
Justin Gerard	R. Gayler	Neil Fleming	Renee Faltings	Christoffer Dye	Donaghy	Diane Derosier	John A. Burke	Bock	Chris Bertoldi
K. Jonsson	Carla Jones	Donald Johnson	Dan Jamieson	Humphrey	Haley Harkema	Tony Herbert	Shanna Green	David Gonzalez	Golden
Alex Pyle	Petersen	Victor Otley	A. Moretti	Mooney	Eric Merkt	Cynthia A. Lee	Neil Larson	Nicki T. Karst	John Sucher
D. Steinert	Julia Smith	Sam Sharpe	Patrick G. Shannon	Russell Saxon	Curtis L. Rowsey	Romney	Erich Riehl	Carol Quintano	Clawson
Chris Daum	Carol Evans	Christian Frazza	Gilleon	Margaret C. Good	Nancy Gibson	Friedman	Dorothea Fallat-Kupesky	Crowley	Prather
Deborah Hanson	Charles And Bonnie Hash	Jane Borish	Julie Burrows	Billie Brown	Wendell And Barbara Beardsley	Janet Carter	Patricia Coulter	Sharon Christensen	Douglas Ezell
Sidney Mehlschmidt	Marcia Lauzon	Robert Lassila	Paul Kent	Merlyn And Linda Huso	Mark Kuipers	Gerry Jennings	Cindy Holder	Hans Haumberger	Hattenburg
Julie Reeser	Sandra Rachlis	Marcia Pedersen	S. Paverman	Dan Payne	Mary E. Owens	Nancy Oesau	Susan And Greg Mccormick	Jim Mocabee	Minich
Bueling	Jim Bowker	Craig Watts	Dan Pierson	James Schulz	Schieffelbeinwood	Ottocar Samson	Larry And Betty Salois	Saul Roubik	Judith Rogers
Jean Zankner	Jeannine Willison	Raymond D. Whitehead	Jodi Weisz	Erich Weber	Sullivan	Roger Sullivan	Strachan	V. Stevens	A. Silverman
E. E. Erp	Marilyn Hayes	Terri Corrigan	Jeff Claassen	Harper & Lansing	Bob Ringler	Shannon Walden	Begler	Donna Loving	Connie O’connor
Patricia Pierson	Starshine	Dennis Tighe	Michael Roskilly	Grandstaff & Mcintyre	Teresa J. Jasmin	S. Wayne Chamberlin	Patricia Sicotte	Lori Henderson	Schulz
Suzanna Mcdougal	Sara Buley	John A. Cleveland	Jennie Dixon	Geroge Widener	Robert Osterholt	Gail Galloway	Bj Finlayson-Pitts	Randall P Biang	Jeselle M. Hicks
Shelley A. Rahl	Jeremy Catrondrake	Jennifer Gustafson	Ann Fagre	Dan M. Brandborg	J. Baker	Jj Smith	Glenda L. Ransom	Marta Meengs	Joyce M. Spolar
R. Krawiec	John And Gail Richardson	Rick Arnold	Linda S. Bell	Christine Vickers	Sandi And Dave Ashley	R. F. Macdonald	Jill S. Van Alstyne	Rob Clemons	Phyllis White
A. Pittendrish	Charles N. Ketterman	Ruth Kopec	David Reynolds	Fred D. Opperman	Sara Scott	Carl Davis	Jerome S. Kalur	Kathleen Hayden	Bernice Wigen
Teri Colbert	Jojan And Don Bishop	Cheryl Lynn Tatum	Boston/Daley	Robert G. Byron	Jessica Scheer	Sandra Daly	Louis And Barbara Bonini	Kim L. Latterell	John Heminway
Catherine Alger	Collette Brooks-Hops	Jay Mennenga	Lewis	Gary J. Doll	Rich And Holly Furber	William D. Phillips	William M. Witt	Sara Murray	Jon Larson
Weaver	Stephanie Mcdaniel-Gilman	Janet Sproull	Ligas	Marla C. Hennequin	David Thomas	Al Beavis	Kris Spanjian	Gary Splittberger	C. David Gorton
Doxey Hatch	Frank Kondelik	Vincent Conrad	Mihailovich	Melinda Vaughn	Kristi G. Dobyns	Brown	Clayton Wilson	Ida J. Meyers	Diana Hammer

Postcard									
Blackfoot River Brewing Co.	Charles Ringer	Aaron Selig	Nina Corelli	J Lord	Jessica Sauls	Kristine Proudfoot	Laura Thomson	Mike Becker	Adam Mclane
Pamela Poulsen	Rosemary Neilsen	Roberta Uecker	Ingrid Estell	Alex Clark	Bob Morgan	Cheryl M. Reichert	Robert Lishman	A. Lindstrand	Bill And Polly Cunningham
William Pratt	Darlene Grove	Bob Stabio	Lindy Miller	Wilbur Rehmann	Susan Miles	Josey Linskey	Julia Cougall	John Kelley	Brian Shovers
Jo Lace	Kerry Krebill	Peggy Mahle	K Davidson	Richard Bucsis	Laura E. Cunningham	Richard Torkildson	Robert Filipovich	Carole And Thomas Angland	Lindsay Peace Rumberger-Leffel
Irene Erdie	Chris Ralph	M. Ozog	Carolyn S. Meyer	Michael Howard Lee	Thomas M. Hayes	Levi Long	Rebecca Snider	Debra Tillo	John L. Wilson
Vance Morrison	Sharron Mashburn	P. Heckel	Patricia Sharp	Carl Clark	Helen Comer	Charles Sampsel	Krista Partridge	Gretchen Grayum	Fisher-Haladay
Russell B. Hill	Janet Kenter	Ellyn Murphy	J. Goetz	Debra Debode	Lance Sears	Paoli	Mari L. Von Hoffmann	David Mcewen	Rodney C. Schaefer
Bruce Baxter	Haller	Roy Loman	Douglas C. Rhodes	Stephanie Morsett	Gerard And Loretta Byrd	Irene E. Johnson	Bj Carlson	Joanne Berghold	Crazy Creek Products
John Freetly	Brent Noel	Ella Robson	Cooperstein	Kath Feeley	Thompson Smith	Gary Rillema	Rudy And Beverly Gideon	Jl Dahlman	Willy And Mimi Van Straaten
Michael R. King	Maryann Gingerich	John Oetinger	Kathryn Dunham	Mike Wagner	Gary W. Mendenhall	Cody Kenyon	Mcmichael	Andrew Buchanan	Dana Chavez
Kory Abercrombie	Miskulin	Mark Rachlitz	John Ewy	Tholl	Travis J. Garner	Robert Kunkler	John M. Marshall	Aaron Lamont	Paul Berry
J. Davis	Ana Ruiz	Matthew Bozek	Ken P. Foust	Charles Feders	Todd Helmer	James Reiss	Bob Embree	Tillman Law, Llc	Michael L. Jourdan
Timothy Rutty	Kelly Gill	Jacob Wright	Tim Engleson	Denton J. Erickson	Brooke Berg	James Mackay	Renna	J. Livingston	Clinton Pike
K. Burger	Jay Colombo	Jeffrey A. Ford	Stephen Merriam	Harley Demarois	G. Swica	Julia Gwinn	Joe Kristof	C. Hubert	Sg Bennink
Gricus	Robert E. Johnston	Mark Madson	J. Lauman	Jeff Johnson	Matt Jewett	Laura Selby	Libby Mckinney	Laura Brickell	Marsha Exley
Jim Blugerman	Lexie Solanik	E. Brown	Brian Bagley	B. Stevens	David Levine	Timothy Krawczel	E. Crum	H. Culbreth	Erwin
Mundruczo	Michael Nania	Gary Vert	Jonathan Kath	Erin Geiges	Shane Wood	Dana Lund	Bonnie Rountree	Jason Fleege	Hunt
Greg Myers	Paul Lang	Pc Hurley	Jan Anderson	George Schneider	Cory Mccaffrey	Robert D. Brown	Gayler	Marshall Metcalf	Christian E. Appel
Ken Switzer	Sayer Wickham	Gina Knudson	J. Goduti	Ken Anderson	Warren Kays	Jared Mcfarland	Bergdolt	M. Stender	Joe R. Wee
Alan C. Kakovich	Don Starkin	John Michael Socolofsky	Edward R. Stotka	Boyce	C.d. Henry	John Hotovy	Brian L. Follis	Jennifer Thoman	Abrams
Mark J. Salisz	Christipher L. Thomas	Martin Daniel	Christy Bertani	Marcus S. Anderson	Mark S. Connell	Ronald Cullin	Virginia Duke	Carter Bermingham	Signe Leirfallon
Jodi Bishop	Logan Jackson	David Ensner	R. Manniello	Richard T. Daniels	Eric Johnson	Britton West	D. Lanning	Timothy R. Bartholomew	Joseph Steinhauer
Mark Delorenzo	Mullowney	Erika Lovelien	Charles Fritz	George W. Johnson Jr.	Steven Sennewald	Karen Stoltzfus	Valerie Evans	Patrick Diekemper	Daniel L. Porter
Bryce Love	Brad Bringgold	Jeffrey Allen	Justin Sackman	Dean Tribble	Cain	Jeff Welch	Cha Hart	Alex Russell	Robert Hayes
Cyndi Crayton	Kenny Tietz	Steve Hample	Cassandra Brownlow	Justus Thorgramson	David Uberuaga	Mark E. Lawson	Adam Wright	James Jensen	Michael L. Palmer
Jason Hoff	David Wood	Abby Mccash	Scott St Germain	Boersma	Garrett W. Burke	Don Petersen	P.a. Puckett	James King	Margaret Tuttle
Jon Muir	J. Whaley	Catherine Merritt	Annie Schick	Jeff D. Edmunds	Daryl Gustafson	Rich Day	Julia Marsik	Sarah Crouch	Scott
Karen Feldner	Abbie J. Chermack	Christopher H. Buslee	Jensen	Lacy Benkley	Davis	Jill Mcknight	Terry L. Rosin	John Sherve	Cary Griffin
S. Stevens	Dawne Smith	Robert J. Bushmaker	Jeffrey Fain	Mike Williams	George Nobil	May	John S. Shafer	Mike Clancey	Wlf Felstiner
Luther J. Carter	Brenda Kay Frey	Robert Mcquade	Kirk Price	Michael W. Scott	Sara And Howard Melnick	Stephen Potts	Terry Beaver	Mary Van Swearingen	Robert Fort
Mardell O. Moore	Bradley Dyksterhouse	Douglas H. Sphar	W. Ben Johnson	Tony Schoonen	Rick Hainsworth	Margaret Ten Eyck	Guzman-Aspevig	Colleen Mcneilly	William G. Hudson
Lucille Olds	Heather Schmidt	Doreen Granbois	Paul Gilbertson	Cornelius Kelly	N. Michelson	Melissa Lafontaine	David T. Goodhart	Amy Harvey	Jeffrey B. Nord
Anne M. Robertson	Mike Morawski	Andy Whelchel	Kent Schlosser	Randolph Rottenbiller	John Grant	R. Boley	Laverdiere	Will Snider	William D. Bermingham

Postcard									
Jennifer Dewey	Jeff Bartos	Errol Rick Schlenker	Orpha R. Montgomery	John Chaffee	Hamblock, Schmenchel	James Kobasziar	Mike Rieger	Dan Mclean	Scott Moss
James R. Walsh	Kathryn Van Tighem	David L. Shute	John Anthony	Seta Berg	Gary Whisenant	Spencer T. Macdonald	Michael Iten	Michael Stevenson	Brock Selig
Gary And Judy Matson	Catherine H. Ream	Heidle	Mark Van Tassell	Elizabeth Brann	Jennifer Elden	T. Gilfillan	Rick Yates	T. John Finsaas	Susan Cahill And Steve Martinez
Jane Timmerman	Michael Fraser	Mark Long	Ronald And Judith Pearce	Whetzel	N. Allan	Carolanne Wright	Janet H. Downey	Roxanne Brothers	Ray O’connor
Janet R. Allison	John E. Dunkham	Marilyn Wolff	Craig Menteer And Laura Millin	Leo W. Tracy	M. Werner	Eric Nelson And Gay Allison	David Rockwell	Jack Brown	Earl Lory
Gene Bernofsky	Christa Brick	Larry And Mary Chinn	Andrea Bjornlie	Leon Berzins	Mark Dehmer	Jim Parker	Anne Van Doren	Grit Boring	Winifred Hepler
Michael A. Abell	John Mcewen And Mary Musil	Tracy Mayer	Hannah Specht	Kockler	Patricia B. Helvey	Karen Reinhart	William E. Grey	Paul Burns	Teri S. Ball
Wendy Visscher	Joseph Azure	Laurie Talcott	Bryce Ross	William Collins	Kathryn Britton	Richard S. Hildner	Susan B. Carpenter	Roland	Dana Smego
Dennis Haverlandt	Raso Hultgren	Richard Belgrad	Marian Mckenna	T. C. Mcsloy	Bruce Bender	Glory Blood Artis	Brian Holdorf	Timothy Riley	Stephen F. Whitlatch
Brian Ciesielczyk	Gary Huschle	D. Belanger	William S. And Camille N. Broadbent	Wayne Tomicich	Robert Judd	E. Hosking	Lorna Nelson	Marshall White	Dewitt Ward
Martha G. Eng	Matthew Grobe	Scott Henning	Ivy Fredrickson	Wilma And William Immonen	C. B. Gubler And Danielle Fogarty	Rick Whitman	Lavonne Anderson	Alan D. Hilden	Drew Marsh
Tucker J. Torok	Edis Kittrell	J. Goodwin	Neal Artz	Anthony Petrillo	Craig R. Mcintyre	David Pontrelli	Scott Brunk	Christopher Lebato	Juedeman
Karen Johnson	Peter Hanson	Bill Hudson	Tricia Henneberg Loucks	Donald Reed And Risa Grenedlinger	Mark Good	Peggy Fujita	Brad Fuller	Andrew Freestone	Samuel Cathey
Campofranco	Lynn Tennefoss	James Smith	Davis B. Ward	Emily Cleveland	Fitzgerald	A. Gardes	David Wickens	Murry Graham Iii	Jackie Ladner
Douglas Stange	A. Brown	Seth Swan	Annette M. Mcdowell	Boland	Katherine Dayton	Erika Cannon	Richard Newman	Jessica Jacobson	Paul Jacquay
D. Reichard	Roger Sherman	William Lunger	Charles D. Doering	Marie Ann Toldness	William F. Service	Thomas K. Harding	Mckenna	Gail V. Hewitt	Barb Belt And James Emerson
Larry G. Peterman	William And Marsha Davis	Theodore Scherf	Henry And Sharon Lang	K. M. Bramer	Clyde And Sally Angove	Mildred Beard-Morgan	Pamela M. Harris	Gregory L. Rider	Wendy Kamm
Richard Tuber	Sandra Dunham	Tom Chandler	K. Horn	Judith And George Oberst	Jon Salmonson	Gary Grzebielski And Lois Menzies	Kathy Lloyd	Gail Carter	Michaelle Grimaud
Gregg Wheeler	Juanita Polston	Bonnie E. Warren	D. Corzine	Ashley I. Sherburne	Daniel And Linda Donovan	D. Hart	James W. Jensen	Mary And Sarumi And Ruby Fritschen	Vicky Johnson
J. R. Ferriter	O. Neudecker	Don Harris	Van Lieshout	Stuart F. Lewin	K. Colussi	Susan Wall	Jenny Van Swearingen	Burke Townsend	Jacob Smith
P. Schutt	Donna Paulsen	Shirley Oswald	Mark K. Mrgudic	Alexia Moran	Mauer	D. Kallestad	Sue Janssen	Linda Helding	Michael Helling
Patricia Grabow	Dick Forehand	Mary Edelman	Kristin Snyder Douglass	Albert Canaris	Barrell	Sally Davis And Margaret Benes	L. Casey	Lowell Chandler	D’orazio
Linda Eichwald	Julie Epperson	Eleanor J. Hall	John Hammond	Martha Larsen	Victoria Crampton	Claire Martineau	Joel Masser	Vicky Mclane	Judy Tucker
Hallie Rugheimer	Duane Moe	Margarita And Don Mclarty	Judy Hutchins	Jennifer Hinds	Paulette Hardy	Caroline Grabner	Julie Brantley	Patricia Bradley	Lisa Anderson
Lenore Adams	Palmer Moe	R. H. Carrothers	Josh Hill	C. B. Fulton	Ken C. Ryan	Ron Pust	Penny Friend	Tom Mutchler	Kate Ferguson
Mutchler	Gregory J. Smith	J. Brown	Herrin	Tom Kelly	Steven Schwab	April A. Adams	Kim Potts	Alan Pawlick	M. Morgan
O. Alan Weltzien	M. Cole	Harvey Bjornlie	Cathy Fleming	N. Green	Arnold Mccormick	Jim Froland	Marcia Rider	Linda Elkhind	Norma B. Hamilton
Gary Zimmer	Janet E. Kempff	Margaret M. Jerrett	Sydney Rick	Geoff York	Michael B. O’connell	Robert A. Haddock	G. Etchart	Matt Walker	Jennifer C. Kelsh

Postcard

Mark Patten	P. Vignere	Melva Morlene Plouzek	E. R. Smith	Lindsey Hromadka	Kim Sands	Bonita Reishus	Julie G. Wulf And Frank J. Dinenna	K. E. Datko	Judi Stauffer
James Mezzetta	Joseph Caveney	Wendy S. Heckles	Cynthia Logan	Eileen Carpenter	Matt Risley	Jeffrey N. Sekavec	Marilyn Guggenheim	Molly Cross	Kyle Hertenstein
Mark Mcelroy	David Bishop	Weyshawn Koons	Karli Houle	Orr	Robert P. Metzger	J. Fitzgerald	David L. Martin	Fay Homan	J. L. Kujawa
Judith A. Hinz	Keenan Brame	Don Tietz	Terry Rhoades	George Gaines	B. Hunner	Hans Zuuring	R.l. Dill	Coralee Smith	Marvin K. Smith
Beth Beringer	Bartley Deason	Patrice And Ken Loucks	Pamela Erickson	Bevin Feutrier	Hamm	Ron Sawdey	Adam Hudson	O’conner	R. E. Gilleran
K. Richardson	Chelsea Colwyn	J. Lamson	David Lowery	E. Peterman	A. Ponti	Betty Ann Violette	Dawn Rutherford	Randy Kenyon And Donna Harrison	David L. Schaub
Amy Werner	Aly Johnston	Greiner	Gulan	Hunter	Eldon Drain	Penny Weymouth	Jean L. Demarco	Schofield	Terry Burnes
Carson	Holly N. Bancroft	D. Lucas	Hanna	R. Kassel	Nelson	Gerard Keck	R. Shaw	Diane Deyo	W. Gary Shaw
Chad Searle	Brent Patel	Shelby Lower	Hahn	Diane Bastian	Bernard Baker	Nick Norton	C. Jones	Rolanda Bjornson	D. Brown
Steve J. Summers	Larry Roberts	Charles A. Clough	B. C. Fortna	Knox	Mark Mueller	Thomas Grissom	C. Simpson	Robert Mccormack	Corley
Brian Steinert	Bill Sodetz	Scott Schreiner	Helen Hopson	Betty Steffens	Christine Sampley	Darrin Huth	Dave Taylor	Patrick Johnson	R. Scott Garland
Aaron G. Banks	Todd M. Smith	Dirk Plumlee	Rick Friez	Mark Debonville	Sam Hickok	C. Henehan	Moore	V. Riverso	Gretchen Brunworth
John P. Stoltenberg	D. Bell	Esther Klady	Steve Garnaas-Holmes	Sheila Bowley	Brenda Weber	George G. Ryffel	Bob Gue	Gary Gorder	Jill Johns
Conner	Karen Williamson	C. Higman	Craig Ritland	John W Howard	Rebecca Himsl	Charles C. Stearns	Dowling	Carol Murray	Mary Jo Gardner
Ronda L. Gagnon	Sherry Culp	Richard H. Fretheim	Gary R. Powell	Tam Grinsteiner	Linda Smith	Dale R. Johnson	Sally K. Nee Broste	Stephen J. Schombel	Beth Underwood And J. Hogg
James T. Roach	April Armstrong Kreis	Kimberly Lugthart	Joan Schumacher	Thomas P. Hagan	Kevin Gordon	Lenard Lande	Robert E. Benson	Lisa Fleischer	Martin D. Mclellan
B. T. Smith	Fanwood Foundation And Sara Solaimanian	James Dyer	Dan H. Davis	Prudence A. Smith	Howard Reinhardt	Robert F. Hensler	Gary Teggeman	Harold Young	Anita P. Hunter
Claire E. Trauth	Brian Parks	J. Leirfallom	Mary Anich	Brenda And Steve Oreskovich	Roger Norgaard	Janet Lyon	J.g. And Carol Hansen	Drury	Kelly Weingardt
Craig Mohr	Rita E. Cheek	V. Douglas Grimm	D.l. Blank	D. Eisenberg	Christopher J. Ruffatto	C. Metzgar And C.a. Campbell	Meredith Stewart	David Swanson	Cameron Blake
Paula Ford	Graydon D. Moll	Citizens For A Better Flathead	Megan L. Heil	Stephen Rickard And Vicky Angyus	Dan And Sheri Burden	Loren S. Vranish	Marion And Gordon Gerrish	Jan Bertelsen-James	Judith M. Gobert
Debra G. Aldrich	Monty C. Brekke	F.w. Huson	Harry W. Largay	Mark Lagerstrom	Tracy Christensen	R. R. Saunders	Kevin M. Calnan	K. Ireland	Pamche Erekson
Theresa Cox	Dennis L. Workman	Robert O. Raffety	J. Langstaff	Gordon J. And Eileen Burgess Watson	Kathy J. Heffernan	Evan M. Phillippe	Jared Larson	Claudia S. Brown	Layne Rolston
Nancy L. Pickhardt	Mitch Strang	Carolyn M. Metcalf	John Crull	Ayers	Rebecca Durham	Christian Sawicki	Conrad	Jill Reiman	Sharon Lamar
Harold And Jan Hoem	Patrice A. Manget	Robert F. Hitchens	Michelle Levitus Barnum	Thomas S. Greiner	Kathleen F. Roubik	Don Burgard	Ryan Hunter	Noice Studio & Gallery	Helen Pilling And David Moore
Ricky Norman And Lynn Fergus	Paul Rice	Doug Foster	Jane Tapp Barnes	Penelope Wilson	E. Conrey	Paula Albers	Bruce Johnke	Thomas F. Haensly	James Kristof
Larry P. Jolivette	Paulette Briese	Tuchscherer	Robin And Jane Walsh	John Everette	David Martin	Irmeli I. Smith	James S. Lane	Cantwell	Howard Bethel
Ilen E. Stoll	A. Young	Diane Bergstein And Steve Mccoy	Mike Penfold	Keith Mcglothlin	Chris Rangel	Orville Bach	T. R. Kenney	James Thompson	Milla L. Cummins
Wayne Paffhausen	Tara Kramer	Labrel	Christopher Fox	John R. Jones	Lee Lykins	Epstein	Eric Saalborn	Theurer	Helen M. Waller
Glenn Cottone	John Burns	Gandulla	L. Holenstein	M. Wheeler	Jason Coligan	H.g. Longobardi	Mike Dawes	W. Wurtsbaugh	Wallwork
R. W. Barry	K. Irwin And R. Landini	Yzaguirre	Chris Cluff	Jim Stutzman	Tristen R. Wood	Jan Carlson	Capozzelli	William F. Rivers	Emily Swaim

Postcard									
R.t. Ojala	Paula A. Myers	Dawn Wellman	M. Harding	Richard Tourangeau	James S. Levi	Walter Busch	Michael Turner	Devrin Weiss	Peter A. Stedman
Nancy Webster	Kevin C. Brockbank	Navone	Andrew E. Sledd	Janet Sperry	Patrick Mcmullen	Mary Mueller	Davidson	R. Duncan	M. Buckley
Stanley	Marshall N. Weakley	Cox	Robert Elgee	Jessica J. Flammang	Leslie A. Shaw	F. B. Rose	Jodi And Kevin Daily	Elizabeth T. Brooking	Brook Parker
Simpson	Claire Navidomskis	Jesse Johnson	James Kleyman	O'donnell	Anaka Broste	Eister-Hargrave	Kem Mcmaster	Adam Fedock	Feaster
Rick Batchelor	J. Knight	John O'bannon	Donald C. Wright	Kurt Schaff	Darla Shreffler	Laurence Weinberg	Kathryn Posten Lance	S. Meredith	Logan Norris
Hopper	Mary Costello For Rock Creek Alliance	Robert Voorhees	Alice E. Foster	N. Jinings	Anna-Lisa Kingsley	Kate Hasterlik	Carrie Cubbage	L. A. Adams	Annie Hull
Douglas Baty	Trina Starker	F. Hale	R. Hanson	Stephens Gullings	Laura Dodd	Charles C. Scaief	M. Mcintosh	Tracy Blount	Kyle E. Clark
J. Ng	M. & J. Johnson	H. W. Gabriel	Chris Schoenen	Callari	O. Reiser	Sarah Brown	Jim Taylor	Janis L. Strout	W. Lekan
Rita T. Rozier	J. Erwin	M. Cox	Norm Doebel	Nancy Jochem	Ott	Jason Roudebush	Craig Craayer	Eric Stollar	Kagan And Genevieve Kaszuba
Mike Petersen	K. Northrop	Rick Barlow	Gordon C. Anderson	James Boyle	Sean Corley	J. P. Mcgee	Morgan	Teasdale	S. Riparetti
Thomas H. And Jeannette S. Davis	Tom Grazier	Fred Karlson	E.a. Schick	R. Honeycutt	K. Cook	Joe Randall	James T. Mcdonnell	Casey Jacoby	C. Callanan
J. Sherman	Joseph Galeazzi	J. C. Henderson	Benjamin R. Brown	Scott Smith	Jerry J. Smith	J. D. Proops	Susan Sheldon	Wuertz	Matt Evans
Tim O'connor	T. Martin	Maryan J. Alderson	C.m. Hinds	Steve Olson	Colin Browne	Gretchen Rupp	Scott Hamburg	Jennifer Prigge	D. Gregerson
Polebridge Mercantile	Marilyn Siess	Tosdal	Rhiannon S. Wood	Jeannie Williams	C. Wrinkle	Charters	Geraldine Curry	Jon Schumaker	John And Pamela Kloote
Taylor Orr	Steve Moore	S. Tynes	Bloetscher	Na	David Knickerbocker	Debra Crawford	Robert Groves	Scott Peterson	John Winkley
Dan Bigelow	Daniel C. Shively	F. T. Osgood	Henry M. Yaple	Megan Collins	Cliff F.	Bobby Heiney	Dale Zulauf	Nancy Schultz And G. Monahan	Nancy Porter
Ken And Gwen Jonas	A. Johnson	Steinthal	George Staab	Donald And Marcia Rasmussen	Robert Handelsman	Nathaniel M. Cerf	Guy R. Bingham	Joe Loney	Brian Fadie
K. Norane Freistadt	Susan Mattson	Bonnie R. Ambuehl	Anne M. Murphy	Pamela Aldridge	Timm Schwarz	Barrett	Jeanne And Dan Olson	Ray Shackleton	James Sladek
Elain Snyder	Heather K. Walsh	Stephen Gerdes	Hank Fuller	William Freese	James Eidson	Mike And Jo Devris	Rich Byron	Wendy Williams	Vicki Brester
Lyn Benedict	Constance G. Barton	Mike Frederick	Julie Flammang	Ryan Eisfeldt	Crawford	John Coston	Jerry P. Clark	Janice Carlson	Margaret Ann Butcher
W. A. Blood And J. Pressmar	John R. Bradley	Don Bachman And C. Cripps	Kari Gunderson	Goldberg	Will Halpin	Sharon Sutherland	John And Eleanor Mest	Jennifer Mahan	Deborah A. Martinez
Livingston	Robert Landis	Marilyn R. Hill	Anne S. Holub	Keith J. Hammer And Pamela Willison	Peter Kendig	Patty Laughlin	Abigail Huseth	Catherine A. Carey	Nina Alexander
Molly Nelson	Cecily Johnson	Dean Littlepage	Mollie Kieran	Mayre Flowers	Thomas Graff	John And Lynne Putsche	Diane Bianchi	Mary Dostal	Larry Blackwood
Angela Culver	William C. Guenther	Sherri L. Taylor	M. Kleinhaus	Mary And Tom Steenberg	Randy Norley	Jeannette Barnes	Overman And Strizich	Leigh Mintz	Holly Heinzmann
Kurt Meyerpeter	Ken Decker	Henry Lischer	Taryn Naylor	John Webster	Cross	Fletcher	Nellie Israel	Terry Meinershagen	John D. Mulcare
Guyin P. Kratina	J. Castillo	Dorothy Anders	Churchman	Dennis Braun	Schenck	Charles K. Skinner	J. Wallace	Kie Kirol	K. Stacy Kiser
Robert Gilbreath	Robert Blackmon	William And Ellen Flanery	Dean Kile	J. Scaramella	Claire Svejkovsky	Brian M. Icenogle	Joan Schmidt	Sally F. Moskol	Cameron Frieh
Wes Sperry	Rahr	A. Barber	C. Foster	Mary Lake	Courtney Giles	David A. Finegan	Sandi Nichols	Bonnie C. Hefty	Dana Williams
Tom Nelson	William Huhn	Christine Mckay	Bruce Juhl	Shari Dayton	K. P. Mclaughlin	Zach Lindor	Mouch/Hagemeier	Jeffrey Padgett	Katrina Mikiah And Steve Nelson
Bev Glueckert	Dennis J. Croxton	Cara Nichols	Marilyn Gogas	Gayle M. Crane	Wayne A. Kruse	Beth Hickok	Christine Nilsson	William H. Fagan	Louis Bruno

Postcard									
C.m. Amundson	Robert And Judith Bartram	Charles Gestring	C. H. Rydell	Alexandra Amonette	J. Breault	Eva Patten	Roger L. Bidwell	Clare Witcomb	Harvey
Manfred Zanger	Thomas Nyquist	Thomas Dills	R. Craig Martin	Scott Dissel	Erslev	Jolin Mohar	Sally Lydon	Dee Anna	G. Mccauley
Connelly	Susan L. Colvin	Emily Free Wilson	Shirley Hautzinger	Richard D. Ecklund	Kalanick	Julia M. Saylor	Kimball-Moody	Mark Macleod	Nancy Filbin
Brandon Hobbs	Kent And Marcy Watson	Mcleod	Mike Donovan	Gary L. Sullivan	Janice E. Miller	Raymond D. Brown	Dennis Petrak	Bateman	James E. Ruth
S. L. Delzer	C. Larson	Deborah Marjanen	Sarah Muller	R. Gregg	C. Walker	Wendy H. Berthold	J.l. Lekander	Ross Prosperi	Kephart
William Knotek	Graham Hubner	Debbie Hinde	Lynne Oulman	David F. Steinhoff	S. Sand	Erin Johnshoy	Richard Frazier	Danahy	Lucy S. Edwards
Michael Distefano	L. Millar	Bernie Kois	Kauffman	Mclean Gunderson	Alan C. Hays	Michael Ober	J. Roberts	Russ	Linda Wagner
Elizabeth Schenck	Ruth Swenson	John Stover	Ada Stapleton	Gabrielle Roesch-Mcnally	Catherine And Robert Billie	Doug Anderson And Mary Miester	William Kunkel	Gerry Milliken	Manchel
Anne And Joe Biby	J. Le Tellier	Diana Burfield	Brit Farthing	Mary O. Mckay	Mack Battaglia	S. Kudalsky	Blake Nicolazzo	Sheila Murray	Teresa Turnbull
Kenneth Mclean	Carol Mcgeehan	Laurenda S. Messer	John Moffatt	David R. Montague	Arlene Montgomery	Sharon Morris	Whisque Parr	Sally Porter	Linda J. Regnier
Jonathan S. Roe	A. Rohn	Nancy Mcdonald	Kay E. Macneil	R. S. Leenhouts	William Jones	Martyn Hitchcock	Mark M. Giese	Lauren Mcmullen	L. Hinkins
Anne Tews And W. Gardner	R. Mccord	Herbert York	Charles And Margaret Teague	Steve Muth	Warren Boling	Dan Glynn	Ken Zafren	Griffiths	Tracey Vivar
D. Johnson	Leigh Dicks	Robert Shook	Haley Alexa Court	K. Kirkley	Jamie Robertson	Larry Evans	George Mattson	Bobbie Murray	J. Kreidler
Donald L. Lodmell	John Ohrmann And Myrlin Rasmussan	Lori Armstrong	Tami Degrosky	Brian Foster	Judith E. Dammel	Edward Platt	Duane Claypool	Margie Reck	Robert O. Hughes
Charlotte Trolinger	Jane Ellison	Scott J. Hall	Dillon Downs	Janet M. Wynne	Tom Weas	Edward Burnett	Tracy O’reilly	Bradley White	Stacy Rogge
Mary O. Randall	Patrick F. Mcmurray	Arthur Hayes	Doug Weber	Jim Schwalbe	Fisher G. Martin	Richard Carosone	John Wells	Luke Bever	Margaret Leverton
Bishop	Tarn Ream	Harvey Kramis	Bonnie Ellis And J. Stanford	T. Dokken	Anne Hamilton Stirli	Ycas	Peter Guynn	Tracey Welch	Scott Zerba
Nancy Pitblado	Vd Singer	Jeff Mccauley	Eugene Jurovich	David Rockafellow	David Steinmuller	Curtis Kruer	Joseph Gutkoski	Thomas Brady	Robert Brown
Wermers	D. Barnard	Marianne Schappek	Joann S. Nelson	Bernell Jay	Beverly Mchugh	Pamela Morris	Deborah S. Massett	Jennifer Ferguson	Ronald L. Mueller
Janet Metcalf	Richard Ellis	Jackie Mathews	Karen C. Stevenson	Bob And Sue Dickenson	Middagh	C. Phelps	Ewan	Arlyne Reichert	Paula Evitts
Gordon Whirry	Lonnie Adkins	Mary Papoulis	Gayle Gregovich	James Driggers	Eckel	Karole Lee	Christopher Mast	Deborah And David Cooper	Augusta Clarke
Kelly W. Elder	Beverly Fox	Durley	Zane Zell	Howard Kilmer	Wendy C. Fox	Terry Copenhaver	Mary Ann Dunwell	Shirley J. Hudson	Rachel Carroll
Peltomaa	Speyer	Barbara Phinney	Carolyn Roche	Travis J. Mcadam	Vander Weit	Mark Salo	Annie H. Thomas	A. Killsnight	Van Slyke
Anders Harrison	Linda K. Healow	Richard Van Aken	D. W. Corcoran	Y. L. Pfister	Sirois	Emily Clark	Lissa Sather	M.j. Ryshavy	Mcgeehan
R. Walters	Sean Slattery	Theresa Moore	Emily Jensen	Kirsten Lee	Paul B. Smith	Lillard	Jessica Marsh	Cwikiel	Peterson
Harvey H. Black	Lindsay R. Olsen	Scott Mainwaring	David J. Ryan	Joyce Schaub	Karen Kaufmann	Luista Loveridge	J.f. Gore	D. Ristau	Paul R. Muehlhausen
Virginia Arensberg	Gary B. Jones	Ray And Juanita Hart	Mark Gilmore	Spenner	Makenna Sellers	A. Budke	Catherine Haug	Jo Ann Ridder	Iree Wheeler
William H. Clarke	Kathryn Ballard	Nicholas Roberts	Kathryn Jane Duncan	Kizer	Heather Budd	Paul Gazzo	Ethel Macdonald	Holly And Josh Wulf	M. Welander
C. Buffington	Schlepp	Randal Rake	P. Mavrolas	Christopher G. Bruch	Gordon L. Cox	Brad Volbrecht	Sieg	Sarah Sentz	Glenda Barnes
Kent Brodie	B. King	Yanker	Sarah Clark	Sara Maccalman	Walter Honan	Susanne M. O’connor	Les Jones	David Stone	Prescott
Kenneth Cochrane	C. Powell	Jared Elm	Kelly L. Love	Joe A. Marino	Joseph F. Wieners	Janet Sedlack	Peace Valley Hot Springs	Janice Frisch	Susan Hillstrom
Emil Smith	Coleen K. Browning	Craven	A. Skari	Bob Adams	David Antos	Jane E. O’driscoll	Thomas J. Altmaier	Robert A. Bushnell And Olga Lincoln	Michelle Proper

Postcard									
Maureen Gary	Briana Kottke	Scott Johnson	Robert J. Rice	Shieila M. Devitt	Williams	Leslie A. Hayes	Torrey Holmquist	Vicki Watson	J. Klingbeil
Day	Janet Elizabeth Sperry	Peter Lesica	Robert Oswald	James Keller	Andrew R. Forauer	May Bermann	Korth	C. Wilson	C. Tuchschmidt
Molly J. Morrison	Lynne M. Vanhorn	Michael R. Yelinek	Randell Hansen	C. D. Wenzek	Ken Yachechak	Raymond L. And Shirley Jacobs	Brynne, Dustin, And Parker Leftridge	Jean Carlson	Jean Weiskotten
E. Fields	C. Armstrong	Tannes Babcock	Louis Schmidt	Elizabeth Parris	Tamara King And Alex Rodriguez	D. Twilley	P.a. Ratcheson	Kara Campbell	Babette Eustance
Craig Cook	Matt Wimett	J. Esper	Cathy Burda	Marsh	Matt Steffens	Patricia A. Rosenleaf	Dean Bennett	Tim Vonada	John Rincker
Terry J. Hanson	Elise Strong	Peter Aengst	T. Schmidt	Christine K. Greve	Kris Ellingsen	A. Weber	C. Dickson	Meagan Hash Gilmore	Barbara L. Aas
Molly Carrico	Nancy Nehs	H. Davenport	Janine Baker	Tuberty	Maryann Eikens	Lara Hillis	Beth Taylor Wilson	Dickinson	Heather Mcadams
Dan Enseleti	M. Ford	Emily K. Mason	Anthony Jennings	Scott Lowry	Sandra B. Roe	Gordon N. Johnson	Debra J. Ruggiero	Anne Garde	Kelli Whithorn
Katherine Bacon	S. Greer	A. Davis	Janine M. And C. Mccleod	D. Young	R. Inouye	Erica Rosenberg	Wyatt Edsel	O'connell	David Shelly
Jason E. Reichel	Nancy Stetter	Mike W. Bunch	Kathi Jenkins	Samples	Morie Mullenax	Judith Frey And Russ Read	Cynthia S. Pott	Lynda Caine	Jenny B. Younger
Dennis Slonaker	Scott T. Mcculloch	Holly Sienkie	Gail Holmes	Joan Reysa	Shaye Ewing	Samantha Travis	K. Franke	Susan And Dan Stone	Nathan J. Beckwith
Liz Ametsbichler	Lana Shura	William Bruzek	Neilsen	Scheinz	Allison Linhart	Judy Staigmiller	Michelle Uberuaga And Bill Zanoni	Gregoire	Dori Gilels And Beltz
Lindsey Hagmaier	Carol Weaver	Kathleen Cok	Patricia Ann Simpson	Robert Bates	Tom Crane	Irene Cannon-Geary	Lucy Lee Grimes Evans	John F. Green	Jason Long
Z. Winestine And Joanne Pawlowski	Josh Mcbain	James C. Parham	Paul R. Eisner	Jill Norvell	William Wilt	Joseph T. Maier	F.s. Dail	Merentino	Clay Welshofer
Travis Erny	C.m. Woodcock	Nicole Lee Thompson	Charles Paniszyn	Kathy L. Lundquist	Kara L. Mcwilliams	Lawrence P. Wayne	Spence Kircher	T. Smith	Carl Anderson
J.f. Royall	Tim Crawford	Ed Verry	Kent Madin	Kay Proops					

Questionnaire 1									
Alice Kern	Andrew C. Lind	Ardell C. Herr	Brian Burroughs	Christina Fister	David Brewer	Gary Voldseth	Gordon Stewart	James Stubblefield	Jay Paulsen
Joseph Lester	John Coy	John Murphy	Judy Geordge	June Bergan	Laura Thomas	Marlene Richeson	Mary Lou Wetterling	Michael And Richard Mord	Nancy Heggen
Naomi Lester	Patrick Mccoy	Ray Johnson	Robert Gardiner	Ron Lester	Ron Prevost	Ronald E. Teig Sr.	Ronald Sigafas	Steven Lukenbill	Terral A. Mcdermott
Wendy R. Johnson	William H. Simmons	Ardith Lester	Arnold And Barbara Blair	Arnold Michael Blair	Barry Bergan	Bert Williams	Carl W. Hunt	Christina Andes	Christina R. Pomeroy
Daniel H. Fuller	Dawn Blair	Debra Giffin	Don Doig	Donald Lester	Edwin Celander	Garry W. Bears	Gene M. Gudmundson	George J. King	Georgina Jordan
Geraldine K. Ogle	Gordon Doig	Gregory Ogden	Howard Dixon	James Drew	Jessica Ketola	Jodi L. Zehntner	John R. Zawada	Justin Massti	Kathy Sulser
Ken Bossert	Kevin T. Brewer	K.g.h. Nicholes	Leigha Minnick	Martha Lukenbill	Melissa Bacon	Mike Bears	Mike Greener	Mike A. Hald	[No Name]
Pamela Johnson	Ramesh Kumar Sapru	Randy Porter	Ronald L. Burns	Roxanne Lester	Sandra Harris	Steve Hicks	Tim Allen	Tim Barth	Tim Rock
V.m. Towery	Vera A. Sickich	William B. Cummins							

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APPENDIX A

Technical Memorandum 1

Technical Memorandum 1

To: Montana Department of Environmental Quality

From: Environmental Resources Management

Date: December 29, 2017

Subject: Black Butte Copper Project - Whether there is an advantage to increasing the cement content in tailings placed in the impoundment and underground workings

INTRODUCTION

The basis for this technical memorandum is the Mine Operating Permit Application (Tintina Montana, Inc. 2017) submitted to the Montana Department of Environment Quality on July 14, 2017. That document is referenced in the body of this memo as "MOP", with the particular section and page numbers as appropriate.

BACKGROUND

Production Mine Workings

During mine operations, the production workings (stopes) would be backfilled with cemented tailings, pumped and piped as a paste to final placement. Over the life of the mine, it is expected that the process would place 5.8 million tons (MT) (45percent of total tailings). The stopes would be extracted and then backfilled. The backfill would be pumped in two or more blocks as shown in the MOP (Figures 3-4, 3-5, pp. 145, 146), allowing reasonable handling and complete placement along the horizontal length of each stope. The backfill is pumped to refusal, with complete contact across the sill (floor) and the ribs (walls).

Adjacent stopes are taken only after the fill has set and reached its projected 28-day strength. Typically, this entails a multiple-pass sequence where primary stopes are bounded by virgin ground on both ribs (sides), and secondary stopes have either one or both ribs comprised of previously placed backfill.

In the designed overhand scheme, the stopes are taken from the bottom up. An entire sublevel, or significant amount thereof, is mined and backfilled before mining proceeds in the overlying stopes. The overhand stopes are mined with the working sill (floor) being the previously placed and hardened cemented backfill. When backfilled, the new fill is placed across that subjacent fill, assuring intimate contact and support with no air gap between fill levels.

Cemented Tailings Facility

During mill operations, the cemented tailings facility (CTF) would be filled with both waste rock from the mine development phase and with cemented tailings. The waste rock would be used in the construction of a drain blanket and sump before the tailings are placed. Waste rock also would be used in constructing a vehicle access ramp within the lined basin. In total, approximately 770,000 tons of waste rock would be placed in these areas. Across the life of the mill, a total of 7.1MT of cemented tailings (55 percent of total tailings) would be placed in the CTF.

The CTF composite underliner would include foundation drains, engineered fill subgrade bedding protective layer, double underliner (geotextile-high density polyethylene (HDPE)-geotextile-geonet-geotextile-HDPE-geotextile), engineered fill protective layer, and waste rock drainage layer (MOP Figure 3.33, p. 248).

Following placement of the cemented tailings within this lined basin and upon initiation of closure construction, the composite overliner would be installed directly on the cemented and hardened tailings. That closure system would include the primary overliner (geotextile-HDPE-geotextile), engineered fill protective layer, excess construction or fill material, subsoil, and topsoil (MOP Figure 7.3, p. 418).

CURRENT MOP

The proponent proposes to mix thickened tailings with cementitious binder(s) to create cemented tailings paste. The underground paste will be mixed to a 4-percent cement content and pumped to final placement in mined-out stopes. That would entail approximately 232,000 tons of binder across the life of mine. The tailings scheduled for surface placement would be mixed to 0.5 to 2 percent cement content and pumped to final placement in the CTF. That would entail up to another 142,000 tons, for a total of 374,000 tons of binder across the life of the mine.

The variability in cement content is projected to comport to operational requirements at the time, as well as with tailings properties, which may vary depending on ore characteristics. Operational flexibility in cement content is recommended to allow optimizing performance in pumping and final behavior.

The selected cement content ranges are based on the distinct requirements for each final placement area. The cement contents have been developed through extensive bench tests run on exploration samples (MOP, Section 3.3.2.5, pp. 166-168; Section 3.5.9, pp. 205-211). The proposal to continue further testing follows prudent practice for all long-term engineering and construction. That allows changes to accommodate varying ore and tailings characteristics, as well as changes in binder and admixture sources and requirements.

CONSTRUCTION ISSUES

Overall, both paste backfill and paste surface deposition are readily constructible. Tailings in cemented paste systems are common in the mining industry.

Pumpability of the cement paste is critical for the success of this method. A long set or flash time can be critical in maintaining pumpable flow. Low to moderate cement contents are a primary means to achieve pumpability and avoid system upsets. Rheology and strength testing has been conducted to support the selected cement contents.

These investigations include consideration of admixtures of fly ash and/or slag. Typically, these are used to reduce cement requirements, but they also can provide benefits such as improved pumpability and sulfate resistance. Tests of specific materials establish their utility, and the proponent is investigating their suitability and availability. Type C and F fly ash and a suite of possible slag sources are under review.

Chemical retarders can be added during mixing as means of achieving and maintaining pumpability with high cement content. These do lead to process complications, which must function to maintain operability. In addition to increasing costs, the added complexity elevates risks of system upsets.

Normal mine and mill operating practice is to assay and evaluate the tailings for varying chemical characteristics. That will allow adjusting binder, admixtures, and chemical agents to optimize the mix and assure consistent and desirable properties. One aspect is to monitor pyrite to avoid excessive exothermic reactions whether underground or in the CTF (Landriault 2001; Beamish & Theiler 2016).

EIS ENVIRONMENTAL ISSUES

CEMENTED BACKFILL COMMON USAGE

Cemented backfill is a common and proven concept for a wide range of mining methods and applications (CIM 1978; Crandall 1992). It has been used underground in coal, industrial minerals and metal mining for decades, domestically and internationally (Hassani et al. 1989; Stone 2001).

Hydraulic backfill has a long history and is common and proven across a number of commodities and mining methods. The first hydraulic backfill documented was at a coal mine in Shenandoah, Pennsylvania in 1864 (Crandall 1992) with the goal of controlling subsidence beneath a church foundation. The paste fill now common in underground mining is an evolution using modern pump characteristics and material science, with a primary intent to minimize the amount of water required to transport the cemented media.

There are challenges in handling high-sulfur materials, but many base-metal mines are so characterized and have been using mill tailings as the basis or major components of their fill systems (Landriault 2001, Palkovits 2010). It is not expected that the addition of cement to tailings would completely buffer the acid-generating potential of the tailings (Bertrand et al. 2000). That said, the physical contributions of cementing the material minimize infiltration and the release of contained water, contributing overall to positive environmental performance of cemented backfill.

Black Butte Copper tested paste backfill with 2 and 4 percent cement. These are reasonable take-off levels and fit with Carlin-type geologies, where host rocks are characteristically pyrite-rich silty limestone or limey siltstone (Cline et al. 2005). Those tailings are characteristically pyrite-rich, and the backfill mix ranges are reasonably applicable to the Black Butte Copper Project.

In paste, the 20-micron particle size seems to be more critical to performance than binder content, in that an envelope of fines is necessary to assure consistent paste flow (Landriault 2001). That said, binder is important as if it sets too soon – paste does not move rapidly – the entire process halts. Generally, an overhand design does not require the strength of an underhand, and the cut and fill geometry requires only a 16-foot-tall rib rather than the 50- to 150-foot-tall ribs common in long hole open stopping. Suitable rheology – maintaining Bingham or pseudoplastic flow behavior – is a driving goal in paste fill methods. The 30-micron grind of the Black Butte ore would assure sufficient percentage of 20-micron particle size fraction to maintain desired paste flow conditions.

UNDERGROUND-PLACED CEMENTED BACKFILL

Historically, backfill has been primarily a ground control technique to allow safe mining and avoid surface subsidence. Uncemented and cemented fill has been used with the aggregate or ground ranging from mine waste rock, quarried rock, or sand and mill tailings. Coarse-grained fill typically is transported by haul trucks and worked to final placement with construction or mining equipment. Fine-grained fill typically is transported either by transit mixers or through pipelines, using boreholes where applicable.

In recent decades, the use of mill tailings has become more common as a full-circle means for disposing them underground rather than in typically large surface tailing impoundments. A given volume of rock or soil expands when fragmented through excavation. Due to the increase in void ratio, commonly termed “swell” (USBM 1968), not all the tailings can be returned to the original underground space, and a third or more of the mass will require storage elsewhere.

The proposed Black Butte Copper Project appears to combine the best of both these proven techniques. The ore, now processed to cemented tailings, would be returned underground. The balance of tailings that would not fit underground would be cemented and placed in a modern environmental containment facility. Like the underground fraction, the solidification would render the mass relatively inert chemically as compared to uncemented tailings. Being cemented, the tailings would behave mechanically as a rock formation rather than a substantially saturated soil mass.

SURFACE-PLACED CEMENTED TAILINGS

Though some mineral assemblages in some tailings are cementitious, mixing cement into tailings prior to surface storage is a relatively new and still-innovative technique. It follows logically from the mechanical and environmental benefits of dry-stacked and subaerially-deposited tailings. Those techniques use dewatering and densification to increase the mechanical qualities of tailings while reclaiming significant amounts of tailwater for recycling into the milling process.

The mechanical quality improvements essentially include increasing cohesion and friction angle with a commensurate increase in resistance to seismicity, with or without impounding embankments.

With the adoption of common concrete mixing equipment to the tailings handling process, the proposed CTF would further extend the reliability and robust nature of both operational placement and long-term storage of the tailings. Rather than storing a mass that may be subject to liquefaction, the CTF would hold a solid cement mass.

During operation, the susceptibility of the placed and set cement to both water infiltration and release of contained moisture would be lower than uncemented tailings. Since the contained moisture potentially would carry metals and salts, the cementation provides a desirable environmental benefit in chemical as well as mechanical terms.

The CTF would have a composite underliner during operation. During the closure phase, a composite overliner would be added and welded to the underliner where the liners meet along the perimeter of the facility. These robust containment systems further protect the environment from a solid mass of concrete, which would have minimal water available for release.

POTENTIAL DEGRADATION OF CEMENTED MATERIAL – WATER QUALITY CONSEQUENCES

Sulfate Attack

Sulfate attack is an expected form of degradation given the tailings mineralogy. Sulfate attack generally presents as either external or internal (DePuy 1994). External is when sulfates originate from groundwater or are leached from soils. Internal is when sulfates are present in the aggregate (i.e. tailings), or sulfates dissolve in the mix water, additives, and admixtures. The predominant form of sulfate attack on the tailings is internal.

The cemented backfill is not expected to deteriorate hydrologically or structurally under anoxic conditions. The fill would not be exposed to cyclical wetting and drying, which induce repeated sulfate attacks progressing to significant deterioration. Those cycles typically are associated with conventional construction of infrastructure and buildings, with surface and meteoric phenomenon being the principal setting.

Further, due to the sequential construction (local geometry) and overall geometry, the cemented backfill would be physically constrained from expansion, thus minimizing cracking.

The cemented tailings deposited in the CTF are not expected to deteriorate significantly. Due to the essentially continuous layered flow of cemented paste into the CTF, repeated wetting and drying cycles would be localized in the area and few in number. Due to its own mass and confinement of the lower portion, significant crack propagation from deterioration is not expected within the CTF mass. Coupled with its operational liner and closure encapsulation, groundwater degradation is not expected.

Whether potential sulfate attack is external or internal in each setting (i.e., underground fill or surface CTF), there are established tests and procedures for estimating and evaluating performance (DePuy 1994; MOP Section 3.5.9.3, p. 206). Not all cracking is deleterious, as some reaction products simply fill the cracks, retaining hydrologic and even structural integrity. By the same token, in both settings potential reduction of structural strength from sulfate attack is not a system failure. The underground cemented tailings would remain substantially incompressible and a strength reduction would not induce failure of surrounding rock into the backfill mass. The surface cemented tailings would be fully contained within the CTF basin and require little structural integrity. The embankment stability analyses are acceptable during construction, operation, and closure, considering a full floodwater pool during the final two phases (MOP, Section 3.5.5.4, pp. 192-194).

The waste rock (MOP, Section 2.4.2.2, pp. 80-81) will be encapsulated within cemented tailings in the CTF to remove that material from potential degradation of water quality.

Arsenic Mobilization versus Cement Content

The underground cement content of 4 percent is not expected to significantly offset the pyrite contents, which are expected to be consistently much higher in the tailings. Thus, it is not expected that the cement content would drive the pH into ranges where arsenic mobilization is significantly increased (Zaman 1985). If local (small quantity) underground construction-grade concrete or grout – both requiring high cement content – is planned using tailings as the aggregate, numerous analyses provide guidance in treatment of arsenic (Reddy and Ramachandran 2005).

CONCLUSIONS AND RECOMMENDATIONS

PROPONENT PROPOSES APPLICATION OF PROVEN TECHNOLOGY

Cemented backfill is a proven and common technology in underground mining. The extension to a CTF on the surface is practical, logical, and combines positive elements of underground and surface tailings management practices. To date, the testing regimen supports the selected cement content levels and does not indicate a need for or benefit from increased cement contents.

CONFIRM BMPS

The proponent presented best management practices (BMPs) throughout the MOP as benchmarks for design and operation. BMPs proposed for the use of cemented backfill include geological engineering analyses, hydrologic modeling, ongoing material property testing, and diligent monitoring to confirm closure with design assumptions, compliance standards, and goals.

REVIEW SYSTEM OPTIMIZATION POTENTIALS

Varying Ore Characteristics

The ore, and subsequently tailings, are expected to vary between and within the Upper and Lower Zones. Diligent sampling and process controls optimize copper recovery. These include tailings analyses, which can then be used to optimize cemented tailings preparation and handling. Rapid sample turnaround can inform mix arrangements and fill scheduling. Treating backfill and tailings management as fundamental aspects of mine and mill management, which they are, go a long way toward optimizing both short- and long-term mining and milling processes.

Available Binder Media

The proponent has identified a number of sources for available binder media. With standard tests and comparisons, the possible sources can be characterized, ranked, and selected with confidence. Both short- and long-term behavior can be incorporated in the selection process, with possible distinctions between underground and surface applications. It is prudent to initiate selection based on drill hole samples, but contingent (6 months) or conventional (1 year) selections can be developed with actual milling experience.

In these discussions, admixes such as fly ash and slag must be considered. In addition to potential cost reductions, these materials may improve performance under short- and/or long-term sulfate attack and other phenomenon characteristic to mine backfill and tailings storage applications.

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APPENDIX B

Technical Memorandum 2

Technical Memorandum 2

To:	Montana Department of Environmental Quality
From:	Environmental Resources Management
Date:	December 29, 2017
Subject:	Black Butte Copper Project - Whether there is an advantage to constructing the CTF so that the entire facility is above the water table

INTRODUCTION

The basis for this technical memorandum is the Mine Operating Permit Application (Tintina Montana, Inc. 2017) submitted to the Montana Department of Environment Quality on July 14, 2017. That document is referenced in the body of this memo as “MOP”, with the particular section and page numbers as appropriate.

BACKGROUND

CEMENTED TAILINGS FACILITY

During mill operations, the cemented tailings facility (CTF) would be filled with both waste rock from the mine development phase and with cemented tailings. The waste rock would be used in the construction of a drain blanket and sump before the tailings are placed. Waste rock also would be used in constructing a vehicle access ramp within the lined basin. In total, approximately 770,000 tons of waste rock would be placed in these areas. Across the life of the mill, a total of 7.1 million tons of cemented tailings (55 percent of total tailings) would be placed in the CTF.

The CTF composite underliner would include foundation drains, engineered fill subgrade bedding protective layer, double underliner (geotextile-high density polyethylene (HDPE)-geotextile-geonet-geotextile-HDPE-geotextile), engineered fill protective layer, and waste rock drainage layer (MOP Figure 3.33, p. 248).

Following placement of the cemented tailings within this lined basin and upon initiation of closure construction, the composite overliner would be installed directly on the cemented and hardened tailings. That closure system would include the primary overliner (geotextile-HDPE-geotextile), engineered fill protective layer, excess construction or fill material, subsoil, and topsoil (MOP Figure 7.3, p. 418).

PRE-CONSTRUCTION GROUNDWATER TABLE

The pre-construction groundwater table ranges from 31 feet (9.5 meters) above the CTF base elevation on the west side of the impoundment to 6 feet (2 meters) below on the east side (MOP Figure 2.8, p. 50; Figure 3.36, p. 254).

CURRENT MOP

COMPOSITE-LINED FACILITY (EARTHEN AND SYNTHETIC COMPONENTS)

The CTF composite underliner would include foundation drains, engineered fill subgrade bedding protective layer, double underliner (geotextile-HDPE-geotextile-geonet-geotextile-HDPE-geotextile), engineered fill protective layer, and waste rock drainage layer (MOP Figure 3.33, p. 248). All of these components, foundation drains through drainage layer are best available technology (BAT) and best management practice (BMP) features with proven success in mining, municipal waste handling, and other industrial applications.

COMPOSITE-CAPPED FACILITY (EARTHEN AND SYNTHETIC COMPONENTS)

Following placement of the cemented tailings within this lined basin and upon initiation of closure construction, the composite overliner would be installed directly on the cemented and hardened tailings. That closure system would include the primary overliner (geotextile-HDPE-geotextile), engineered fill protective layer, excess construction or fill material, subsoil, and topsoil (MOP Figure 7.3, p. 418). The excess fill, subsoil, and topsoil would provide long-term freeze-thaw protection, limit infiltration to the HPDE liner, and provide natural growth media for vegetation, reducing erosion.

CONSTRUCTION ISSUES

CONVENTIONAL CONSTRUCTION METHODS

The proposed foundation drains and overall CTF entail conventional contemporary construction methods in a canyon-fill setting. There is essentially one embankment (east side) and minimal footprint. The cut and fill balance and overall siting have been selected to provide construction materials for the CTF and other surface facilities throughout the Project.

CONSTRUCTION-PHASE PROTECTION OF SYNTHETIC LINERS

The engineered fill protective layers are intended to avoid synthetic liner penetration due to construction and early stage filling operations. The fill suitability (angularity, gradation) must be confirmed to avoid damaging the synthetic media. Also, application must consider low-ground-pressure (LGP) equipment (wide-track small dozers or telescoping stacking conveyors on LGP crawlers) for placement of the protective layers (MOP Section 3.6.8.7; Section 3.6.8.8, p. 255; Section 3.6.8.10, p. 259). The bottom protective layer must not be rutted prior to receiving the synthetic liners. The upper protective layer must be thick enough to minimize stress transmittal by vehicles and machinery to the upper synthetic liners.

In the upper closure cap, care must be taken that potential liner bridges or penetrations are properly handled. Ruts, gullies, or ledges in the hardened cemented tailings must be reduced to smooth non-bridging or non-penetrating features. Alternatively, they can be covered with select fill to prevent either bridging or penetration.

The detailed construction specifications and steps must be clear and well-monitored to assure the synthetic liners would not be compromised during construction (Peggs 2003).

ELEVATING THE CTF ABOVE THE WATER TABLE THROUGHOUT

This construction issue:

- Enlarges CTF footprint;
- Increases CTF material import requirements (alters cut/fill material balance); and
- Triples (or more) the number of embankments, with concomitant seismic risk.

These three items are intertwined and addressed together in the following discussion.

Footprint enlargement is direct and indirect. Direct is in the footprint expansion of the CTF itself. Essentially, with a 2.5:1 slope, for every foot of elevation increase, the footprint extends outward 2.5 feet. To retain the same basin take-off point, the embankment centerline also moves outward so the downstream or out slope enlargement becomes 5 feet per vertical foot.

Indirect is the footprint expansion by relocating the associated structures to accommodate an enlarged or even relocated CTF. The associated structures would include but not be limited to the Process Water Pond (PWP), the reclamation materials stockpile, and the subsoil stockpile and their access roads.

By inspection (MOP Figure 3.34, p. 249), elevating the CTF as little as ten feet would dramatically enlarge the eastern embankment and entail sufficient fill along the north and south to form distinct embankment faces in those areas. In addition to presenting additional faces, that enlargement requires two out slope convex corners, which are not recommended geological engineering features (slope stability) for earthwork embankments.

Increasing the embankment size to raise the CTF above the water table would dramatically alter the cut/fill balance, requiring the import of engineered fill from offsite.

Alternatively, the eastern embankment could be constructed in a continuous or near-continuous out slope convex arc, but that shape simply extends the non-recommended convex feature.

If a 30-foot elevation increase is considered, the required embankments would be considerably larger than the selected siting. That embankment size could be somewhat reduced by sloping the basin floor to more closely follow the existing topography. Even with that, placing a solid cemented mass in a canyon mimics a wedge shape, which is a classic geological engineering failure analysis. Any tendency to slide would have to be analyzed, with conceptual potential remedies entailing keys (footings), which might in turn intercept the water table.

EIS ENVIRONMENTAL ISSUES

PERCHED OR REGIONAL GROUNDWATER

It reasonably could be expected that the water table intercept would be of a small perched aquifer, which may drain during the construction phase. Whether perched or part of the local regional aquifers, the intercept would direct remaining water (upgradient of the intercept) into the foundation drains or otherwise downgradient beneath the CTF. In either case, the ultimate disposition would remain in the regional groundwater system, analogous to surface runoff diversions.

Groundwater Mounding

Prior to insisting on an elevated CTF, it is appropriate to investigate whether groundwater mounding would occur. If so, elevating may have no benefit, as the result of mounding might simply replicate the interception now expected.

Wetland Impacts

On inspection, elevating the CTF would expand its footprint. A rigorous evaluation would be necessary to gauge the extent of impact into wetlands below the CTF, but the facilities site plan (MOP Figure 1.3, p. 9) shows that any increase in downstream footprint immediately impacts wetlands. If the nearby facilities (especially the PWP, but potentially the reclamation materials stockpile and subsoil stockpile) must be moved, there is a much greater chance of impacting wetlands beyond the selected siting.

It bears stressing that a part of the selection process for the current siting was to minimize the impact on drainages and wetlands (MOP Section 3.6.8.14, p. 261; Section 3.6.13, pp. 275-276).

Visual Impact

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 ten feet would be marginally more visible from Sheep Creek Road. A lift of 30 feet would be visible from portions of US 89.

Granodiorite Sourcing

In design and construction, the quality of the engineered fill is as important as the quantity. A principal focus of the CTF excavation is to access the chemically inert granodiorite, which is a critical component in the construction of the drainage blankets for the CTF and the PWP, as well as other structures of the surface facilities (MOP Section 3.6.8.10, p. 259).

A similar mechanically robust and chemically inert rock could be located, quarried, transported, stockpiled, and used in constructing the larger facility associated with elevating the CTF. That would increase the environmental impact far offsite (quarrying) and between sites (transportation) in addition to the local footprint increase.

Single versus Two-Phase Construction and Filling

With or without an expanded footprint, the query has been raised as to whether there is a benefit to constructing the CTF in one layer or phase. In a broadened facility, that conceivably could be done in one layer.

The phased CTF construction conforms to the mill schedule while minimizing liner exposure across the mine life (MOP Section 3.6.8.9, pp. 256-258). Among other construction efficiencies, it allows handling the tailings pipe spigots with close access during the early years of guiding and forming the cemented tailings deposition. Staging embankment construction also is a common technique to minimize the exposure time of both embankment faces (internal/external) to possible seismic activity.

A common driving practicality is that phased construction of these large earthwork structures is less disruptive in all aspects of heavy construction – workforce, equipment, construction materials, transportation, and support services (lodging, fuel, etc.).

TECHNICAL APPROACH

CONFIRM/PREPARE A TRADE-OFF STUDY OF PROPOSED AND ELEVATED IMPOUNDMENTS

A rigorous part of the selection process for the current siting was to minimize the impact on drainages and wetlands (MOP Section 3.6.8.14, p. 261; Section 3.6.13, pp. 275-276; MOP Appendix Q). There is no need to replicate those efforts, which in any event cannot be done within the scope of this memo.

The primary object of considering elevating the CTF is to avoid impacting the local water table. Evaluating the water table impact would likely address the detailed nature (perched or regional) of the water table, and whether mounding would occur. The evaluations would likely address if either the original intercept or interception of a mounded water table would be deleterious.

If a groundwater analysis indicates a deleterious condition, a cursory trade-off could be initiated based on the following investigations:

- Constructability
- Operability
- Long-term performance

The environmental issues presented above also could be folded into this trade-off analysis. Conventional weighting and ranking methods could be a relatively simple way to organize and evaluate the options, whether rigorous financial costs and benefits are included.

CONCLUSIONS AND RECOMMENDATIONS

Cemented tailings have become common for underground backfill, and the surface deposition of cemented tailings within a lined basin is a combination of the best of underground and surface tailings storage techniques.

Essentially, the groundwater intercepted by the CTF would be diverted beneath the composite liner system and/or captured by the foundation drains. In both cases, these are diversions, not removals from or degradations to the overall water system. In that regard, the groundwater diversion should be considered in the same regard as surface water diversions – spatial and temporal handling of water to the overall benefit of the system and environment. Any negative effects would be *de minimus* and significantly outweighed by the conservation and protection aspects of diversion. As such, there is no conceptual benefit to elevating the CTF above the groundwater table. Given the items addressed in this technical memo, it reasonably is expected that any ranking of current proposal versus elevated configurations would not favor the elevated configurations.

PROPONENT PROPOSES APPLICATION OF PROVEN TECHNOLOGY

From the alternate site analyses through the specifics of foundation drain and liner design, the proponent has achieved BAT and BMP goals. The liner construction details noted above should be incorporated into the design and construction of the facility(ies). With that, there would be a reasonable expectation that execution of the construction and operating phases would bring those goals to safe and productive reality.

DETERMINE WHETHER RE-SITING IMPROVES OR WORSENS ANY ENVIRONMENTAL IMPACT

Three of the four analyzed CTF sites were less favorable than the selected location and configuration. The selection is a culmination of direct and indirect aspects relating to impoundment size through wetlands and visual impacts. The presented configuration is optimal and re-siting would worsen the environmental impact.

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Tintina Montana, Inc. 2017. Mine Operating Permit Application. Black Butte Copper Project, Meagher County, Montana, Revision 3. PO Box 431, White Sulphur Springs, MT 59645.

APPENDIX C

Technical Memorandum 3

Technical Memorandum 3

To: Montana Department of Environmental Quality

From: Environmental Resources Management

Date: December 21, 2017

Subject: Black Butte Copper Project - Full Sulfide Separation Prior to Tailings Disposal

BACKGROUND

Tintina Resources, Inc. is the owner of the Black Butte Copper Project (the Project), a proposed underground copper mine located approximately 15 miles north of White Sulfur Springs in Meagher County, Montana. The project is currently in the permitting phase and a Mine Operating Permit Application was submitted to the Montana DEQ's Hard Rock Bureau in July 14, 2017 (Tintina Montana, Inc. 2017). A number of tailings management alternatives were evaluated by a large working group of scientists and engineers to decide on the best approach (Geomin Resources 2016). Further assessment of the depyritized tailings approach is specifically warranted.

Montana DEQ has requested that Environmental Resources Management (ERM) assess the feasibility of using the flotation/separation process to remove all sulfide minerals from the tailings prior to disposal. Both raw and cemented paste tailings were assessed under subaqueous and subaerial weathering conditions in laboratory tests as part of a baseline geochemical evaluation for the Project. Static and kinetic testing indicated the potential for acid generation in both the raw and the cemented paste tailings. Kinetic testing indicated elevated sulfate and metals concentrations in leachate, including exceedances of groundwater standards for arsenic (As), nickel (Ni), and thallium (Tl).

Sulfide-S composition was 17.7 to 29.9 percent in raw tailings and 21.6 to 21.9 percent in paste tailings. Pyrite was a primary mineral constituent in tailings. Stripping out sufficient pyrite to render the rest of the tailings mass non-acid-generating would be technically challenging and yield large volumes of pyrite concentrate. Stripping out sulfide minerals creates a more hazardous waste than tailings; while being smaller than the original tailings, the volume of the depyritized tailings is substantive and poses a challenge for disposal and long-term storage. In addition, the use of acid is required for depyritizing of tailings, which comes with associated costs (Benzaazoua and Kongolo 2003; Bois et al. 2004).

CURRENT MOP

Feasible alternatives for tailings management and storage were evaluated (Appendix Q to the MOP; Geomin Resources 2016). Cemented paste tailings using 0.5 to 2 percent cement was selected as the preferred management method in an impoundment (cemented tailings facility [CTF]) located just south of the mill site. The current MOP does not propose to remove non-ore sulfide materials from the tailings prior to disposal.

In the Tailings Management Alternatives Evaluation (Appendix Q to the MOP), two alternatives involving depyritized tailings were considered:

1. Depyritized ultra-thickened subaqueous tailings deposition; and
2. Two-cell ultra-thickened depyritized tailings and pyrite concentrate.

These two alternatives received the lowest score in the Tailings Management Method Alternatives Working Group Rankings.

Key challenges associated with depyritization included the following:

- The need to adjust the pH of the process downward for pyrite flotation, followed by further pH adjustment for copper flotation, increasing lime consumption and issues in the pyrite circuit operation.
- Higher chemical consumption, which also increases:
  - Cost and complexity of flotation;
  - Tracking materials held onsite;
  - Transportation logistics; and
  - Potential for spills/leaks/errors in handling.
- The requirement for an additional circuit in the mill.
- The need for additional mining to provide sufficient space for underground disposal of the pyrite concentrate. More waste rock would result from this additional mining.

EIS ENVIRONMENTAL ISSUES

IMPACT OF NOT REMOVING SULFIDE MINERALS FROM TAILINGS PRIOR TO DISPOSAL

Potential for Acid Generation

Tailings that have not been stripped of their sulfide minerals have a higher acid potential (AP) compared to depyritized tailings. As a result, the requirement for capture and treatment of tailings seepage becomes necessary at the surface. Underground backfill has a lower potential to impact groundwater if it is adequately sealed and less permeable to groundwater flow as saturated conditions develop.

Higher Source of Acid Potential

Sulfide minerals typically represent the largest source of acid generated at mine sites. The oxidation of sulfide minerals in the presence of water is responsible for the generation of sulfuric acid. A simplified reaction for the oxidation of pyrite is as follows:

$$4FeS_2 + 15O_2 + 14H_2O \rightarrow 4Fe(OH)_3 + 16H^+ + 8SO_4^{2-}$$

Where: Fe = iron; S = sulfur; O = oxygen; H = hydrogen

It is assumed that two moles of acid will be produced for each mole of sulfur. The AP is calculated by multiplying the percent of total sulfur or sulfide sulfur in a sample by a conversion factor (AP = 31.25 * %S). Units for AP are kilograms (kg) $CaCO_3$ /t (EPA 1994; INAP 2009; Price 2009; Sobek et al. 1978), where Ca = calcium and C = carbon.

AP in rock or tailings samples are potentially offset by minerals providing neutralization potential (NP). Units for NP are kg $CaCO_3$ /t. The acid rock drainage (ARD) potential of a sample is determined by acid-base accounting (ABA), where NP/AP less than or equal to 1 is considered potentially acid generating (PAG), NP/AP greater than 1 and less than or equal to 2 has an uncertain acid-generating potential, and NP/AP greater than 2 is not PAG (nPAG) (INAP 2009; Price 2009). The ratio of NP/AP is often referred to as the net potential ratio. Clearly, not removing pyrite from a sample renders it with a higher AP compared to a sample that has been depyritized.

Environmental Management

Management practices considered at the Project if pyrite was not removed from the tailings are described in Appendix Q of the MOP and include:

1. Conventional tailings slurry deposition;
2. Dry stack tailings;
3. Paste tailings with underground paste cement content (approximately 4 percent); and
4. Paste tailings with underground reduced paste cement content (approximately 2 percent).

The pros and cons of each option are summarized in Appendix A of this memo and represent the results of the tailings management alternatives evaluation (Geomin Resources 2016).

The preferred management option selected by the working group was the cemented paste tailings using 0.5 to 2 percent cement in an impoundment (CTF). This method was preferred since the potential environmental impacts would be minimized (e.g., facility stability, environmental risk, and impacts to wetlands). The paste tailings method using reduced 0.5 to 2 percent cement was recognized to have the lowest impact to nearby designated wetlands in terms of total disturbed area. The impact to the wetlands is described in Appendix K of the MOP application. Furthermore, the CTF location alternative is associated with the smallest catchment area footprint. Despite the markedly higher total cost of paste tailings disposal relative to other evaluated methods, the cemented tailings paste and CTF site location were selected as the preferred alternatives.

IMPACT OF DEPYRITIZATION PROCESS AND DISPOSAL OF SULFIDIC BYPRODUCT

The removal of the sulfide minerals from a PAG tailings sample yields two products: (1) refined nPAG tailings, and (2) PAG tailings with much higher sulfide content compared to the original tailings sample. The amount of sulfidic byproduct is less than the total amount of the original tailings material; therefore, the required capacity for disposal is lower (Bois et al. 2004). An added benefit of removing sulfide minerals from tailings is that the depyritized tailings product is nPAG and fine grained with a high surface area to volume ratio. This makes for useful cover material overtop of PAG waste rock/tailings because the depyritized tailings do not generate acid, and will limit the ingress of water and oxygen to the material underneath; this is particularly true if applied as a cover with capillary barrier effects (CCBE) (Bussiere and Aubertin 1999).

Environmental Management

Management practices considered at the Project if pyrite was removed from the tailings are described in Appendix Q of the MOP and include:

1. De-pyritized and ultra-thickened subaqueous tailings deposition; and
2. Two-cell ultra-thickened depyritized tailings and pyrite concentrate.

The pros and cons of each option including those not removing pyrite from the tailings are summarized in Appendix A of this memo and represent the results of the tailings management alternatives evaluation (Geomin Resources 2016). Despite there being some clear environmental advantages to removing pyrite from tailings, these two tailings management options were ranked lowest by the working group in the alternatives evaluation. The associated costs of pyrite removal with current technology and additional costs related to handling and disposal for long-term storage weighed in heavily on the working group's rankings, although practical limitations were also considered.

TECHNICAL APPROACH

DE-PYRITIZED TAILINGS

The technical approach under investigation is the use of a flotation/separation process to remove all sulfide minerals from the tailings prior to disposal. While the de-pyritized tailings represent a relatively benign waste product from an ARD perspective, the concentrated pyrite product has a much higher potential for acid generation compared to the original tailings material. Therefore, disposal options have to be considered for this technical approach.

Case Histories

Several cases exist where sulfide removal was applied as a tailings management practice. Six are listed below and are summarized briefly in the following subsections for context:

- Strathcona Mine, Ontario, Canada
- Musselwhite Mine, Ontario, Canada
- Detour Lake Mine, Ontario, Canada
- Kemess Mine, British Columbia, Canada
- KSM, British Columbia, Canada
- Thompson Creek Mine, Idaho, USA
- Aitik Copper Mine, Sweden

Strathcona Mine, Ontario, Canada

Low-sulfur (less than 1 percent) scavenger tailings combined with lime kiln dust or reject material from lime production were used to cover the high-sulfur (30 percent) tailings at the Strathcona tailings facility near Sudbury, Ontario. The low-sulfur tailings cover was produced as the cyclone overflow from the scavenger flotation units that generate a sandy material for mine backfill. The overflow contains a fine-grained fraction and therefore has the value-added property of moisture retention capacity and reduction of oxygen ingress. The minimum thickness of the cover is 1.5 meters, which is considered sufficient for moisture retention in the lower zone of the cover layer. The area of high-sulfur tailings exposed to the atmosphere, and therefore oxidation, was reduced by at least 50 percent since the cover was applied.

Musselwhite Mine, Ontario, Canada

A pilot study was carried out to assess the suitability of froth flotation for desulfurization of reactive mine tailings at the Musselwhite Mine in Northern Ontario to prevent acid mine drainage (AMD). The effects of operating conditions such as froth depth, air flow rate, impeller speed, and pulp density on desulfurization of Musselwhite tailings were investigated. Results indicated that all of these parameters have effects on the flotation kinetics, recovery of sulfur, and concentrate grade. The most important operating parameters were identified as the air flow rate and froth depth. Environmental desulfurization was demonstrated to be technically feasible for Musselwhite tailings. Based on the data presented for the Musselwhite tailings, the maximum recovery of total sulfur was achieved when the operational parameters were set to the froth depth of 5 centimeters, air flow rate 125 liters per minute, impeller speed 1300 revolutions per minute, and pulp density 35 percent. Under these conditions, the froth flotation produced a satisfactory NP/AP ratio within 12 minutes.

Detour Lake Mine, Ontario, Canada

A single-layer desulfurized tailings cover 1 to 1.5 meters thick was installed over the Detour Lake mine tailings facility. The material was unlikely to produce acidity, and retained oxygen consumption potential. However, the cover materials were coarser grained than originally designed and were confirmed to desaturate in some locations. The cover material was intended to compose of finer material than the tailings, which would create a capillary barrier, high saturation, and low oxygen diffusion. Regardless, near-neutral pH conditions were recorded at the Detour Lake facility.

Kemess Mine, British Columbia, Canada

The Kemess gold mine in north-central British Columbia contains one of the largest earth filled dam structures for tailings storage. In order to meet engineering and regulatory requirements the original construction design called for a 1-kilometer-wide rock dam made with 30 million tons (MT) of non-acid generating waste rock. Instead, the dam was built from suitable quality tailings sand as a cost saving measure. The tailings sand was subjected to cycloning and flotation to reduce pyrite concentration and meet the neutralizing potential ratio specifications for dam construction. Grain size of the sand had to be consistent with less than 15 percent passing through 200 mesh sieve (75 micrometers). In addition to environmental benefits, the economic benefits of using cycloned sands for dam construction include lower dam height and reduced construction costs.

KSM, British Columbia, Canada

Depyritization of tailings is planned for the KSM project in British Columbia with Seabridge having already received permits (September 2014) authorizing early-stage construction activities at the Mine Site and Tailings Management Facility (TMF). The Treaty Process Plant will produce two tailing streams: the bulk rougher flotation tailing representing approximately 90 percent of the ore and a fine, sulfide-rich cleaner tailing comprising the remaining 10 percent. The sulfide stream will be cyanide leached using the carbon in leach (CIL) method followed by processing for gold recovery. A two-stage cyanide destruction circuit is proposed, using the Inco sulfur dioxide process followed by hydrogen peroxide treatment.

Cyclone sand produced from the KSM tailing was deemed suitable for construction material in the TMF. The flotation tailing is classified as nPAG and will be cycloned to produce sand fill for construction of the tailing dams during the summer months. The CIL residue tailing is classified as PAG. This material will be deposited under water in the CIL Residue Storage Cell in the center of the TMF and kept saturated to mitigate the onset of acid generation.

Thompson Creek Mine, Idaho, USA

Desulfurized tailings were produced at the Thompson Creek mine in Idaho for use as covers and in reclamation. ARD from these facilities is not an issue since the sulfide mineral content was removed and the pyrite concentrate was disposed in an offsite location.

Aitik Copper Mine, Sweden

The use of desulfurized tailings as a cover material was investigated at the Aitik Copper mine in Sweden. After desulfurization, the pyrite-depleted tailings can be used to cover water saturated tailings with higher pyrite content, and the pyrite enriched tailings have to be disposed of separately under an engineered dry cover or water cover. The thickness of the depyritized tailings cover is predicted to be 15 to 20 meters. Flotation pilot test results indicate that there is difficulty achieving the target limit less than 0.3 percent sulfides, if only flotation is used in depyritization. The problem is associated with the concurrent presence of both magnetite and pyrrhotite in the tailings, in addition to pyrite. A combination of flotation and magnetic separation has been suggested as a solution.

Environmental Impact

There is a potential for a reduced environmental impact by removing pyrite from tailings (i.e., depyritization) as a method to control AMD. In depyritization, the acid forming sulfide mineral fraction (i.e., pyrite) is either partly of fully separated from the tailings by froth flotation prior to final deposition into the tailings storage facility (Bois et al. 2004).

In complete desulfurization, all tailings are desulfurized by froth flotation. As a result of the separation, an acid generating high sulfur fraction with a reduced volume and a high volume of nPAG low sulfur fraction are formed. Low sulfur nPAG tailings do not represent a long-term liability, which is the most important advantage of the method (Bois et al. 2004).

Partial desulfurization represents the tailings fraction that is desulfurized only during a few years period prior to mine closure. nPAG tailings can be used as an inert dry cover material over top of acid generating tailings. The layer of 1 to 2 meters of desulfurized material acts as an elevated water table and keeps sulfide rich tailings saturated. The saturation of tailings is accompanied by the formation of an oxygen barrier, thus limiting oxygen diffusion to the underlying PAG tailings (Bois et al. 2004).

Storage or Disposal Options

Separation of sulfide minerals generates a small volume of sulfide-rich concentrate and a large stream of tailings with low sulfur content. The two streams can be handled differently. The low sulfur content tailings are relatively non-reactive and do not require as comprehensive decommissioning measures and can be deposited in large-volume repositories, or alternatively used for construction purposes (e.g., cover material, dams, roads, etc.). The sulfide-rich concentrate could be stored underwater in a tailings pond covered with depyritized tailings in a surface facility, or stored underground as paste backfill (Benzaazoua and Kongolo 2003; Sjoberg Dobchuck et al. 2003; Bois et al. 2004; INAP 2009). The most commonly used additive for paste backfill is a pozzolanic binder (e.g., cement, slag, fly ash). These provide significant strength underground at addition levels of 3 to 6 percent by weight. Cement addition also serves to increase the NP, raise the pH, and potentially immobilize metals by mineral precipitation. Other additives include specialty chemicals, resins, and surfactants that can enhance metal adsorption, as well as organic carbon and bacteria to aid biofixation (Newman et al. 2001). The pyrite concentrate would require more cement to raise NP compared to the currently proposed tailings disposal alternative. However, the risk of oxidation is typically limited to a thin upper layer.

Costs

The use of depyritization can reduce reclamation costs at a mine site due to the reduced transportation and material costs. Low sulfur tailings can potentially be used as cover material, which reduces transportation costs if the cover material has to be sourced from offsite. The costs of separating the sulfide minerals from the tailings can be high. The viability of the method depends on the amount of sulfide minerals that have to be removed because negative cost impacts are generated if the sulfide content is too high.

Site-specific conditions and scale of waste also influence how tailings are managed. Partial depyritization can generate cost savings if the tailings pond is located in a flat topography site with a soft base, as the costs for dam construction in these cases are typically high. The operational costs for partial depyritization are lower because only a fraction of the tailings is treated. Complete depyritization of tailings is economically viable if the construction of low permeability tailings dams becomes expensive (Bois et al. 2004).

CONCLUSIONS AND RECOMMENDATIONS

In spite of the environmental advantages associated with depyritized tailings, depyritization was not selected as the best tailings management strategy for the Project. Depyritization of tailings generates a larger volume of nPAG tailings and smaller fraction of PAG concentrated sulfides; however, the management costs of the PAG concentrated sulfides remain too high to be considered feasible compared to other alternatives. These alternatives also pose a number of technical challenges that includes the requirement for large amounts of acid in the processing (which increases lime consumption and potentially poses issues to the pyrite circuit operation due to scaling), and the need for an additional circuit in the mill, which presents a risk to copper recovery. It was also suggested that additional mining of host rock would be necessary to provide sufficient storage space for the underground pyrite disposal. Ultimately, the technical challenges and costs associated with these alternatives resulted in the working group's low ranking in the tailings management alternatives evaluation.

The preferred management option selected by the working group was the cemented paste tailings using 0.5 to 2 percent cement in an impoundment – a CTF located just south of the mill site. Approximately 45 percent of the total tailings or 5.8 MT would be returned back underground as paste backfill in the mine workings. The claim for selecting this option was that the potential environmental impacts would be minimized. Compared to the depyritized tailings alternatives, there would be less impact to wetlands in terms of total disturbed area. The impact to wetlands is described in Appendix K of the MOP application. The potential for oxidation on the surface of the impoundment materials during the time a deposit lift is laid down prior to depositing the next layer was identified as a risk. However, the group dismissed this concern using the rationale that acidification would be decelerated by the cement to the point of preventing acidic conditions from developing before the next lift is deposited.

It is recommended that more consideration be given to technical feasibility and the pros/cons of the various tailings management alternatives rather than cost feasibility. Based on the material presented in the MOP, it is not clear how much more underground volume would be needed to dispose of the concentrated pyrite fraction if the tailings were subject to pyrite removal. The requirement for a tailings disposal facility at the surface was not eliminated in any of the alternatives presented. The nPAG tailings fraction would provide a useful source of cover material for any of the surface facility designs considered for storage of PAG tailings. There appears to be an increasing number of success stories for the application of desulfurized/depyritized tailings material as a clean cover component of a CCBE.

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Technical Memorandum 3: Appendix A

Table 1. Method Alternative Matrix

Method Alternative	**Pros**	**Cons**
1 Whole Tailings Slurry Deposition (subaqueous disposal)	Proven method for controlling acid rock drainage (ARD)	Requires pond management
	Flexible to take paste when it is not needed	Does not provide for pyrite recovery
	Water storage capacity	Tailings could acidify if they dry
	Lower cost	Largest embankment
	Simplicity	Long-term monitoring
2 Dry Stack Tailings	Can be located on slopes/uplands away from wetlands	Air quality issues
	Reduced site footprint	Higher capital costs
	Reduced water treatment costs	Higher operating costs
	Provides for segmented closure/reclamation	Complex operating plan
	No additional access roads required	Requires 4 full-time equivalents
		Requires Process Water Pond (PWP)
		Requires storage of contaminated process water
3 De-pyritized and ultra-thickened subaqueous tailings	Placing pyrite back underground	Storing waste rock for closure
	Established tailings management methods for safety purposes and environmental risk	Cost of pyrite removal
		Uses more functional wetlands
		Requires road relocation
		Potential for tailings seepage

Method Alternative	**Pros**	**Cons**
4 Thickened de-pyritized tailings and pyrite concentrate in two cells	No large pond required	Complicated process
	Requires less make-up water	Depends on pyrite flotation and removal at closure
	Removes ARD potential following closure	Requires storage of contaminated process water
	Pyrite separation	Run-off management
5 Paste Tailings - Cement content 4% same as underground paste	Non-flowing tailings	Requires road relocation
	Reduced embankment construction costs	Higher construction costs
	Reduced dust potential	Higher operating costs
	Reduced water loss to evaporation	Higher process and storm water costs
	Limits short-term ARD potential	
	Facilitates placement of closure cover	
6 Paste Tailings - Reduced cement content (2%)	Non-flowing tailings	Requires road relocation
	Reduced embankment construction costs	Higher construction costs
	Reduced dust potential	Higher operating costs
	Reduced water loss to evaporation	Higher process and storm water costs
	Limits short-term ARD potential	
	Facilitates placement of closure cover	

Source: Geomin Resources 2016

APPENDIX D

Technical Memorandum 4

Technical Memorandum 4

To: Montana Department of Environmental Quality

From: Environmental Resources Management

Date: December 21, 2017

Subject: Black Butte Copper Project - Tunnel and Shaft Plugs for Controlling Groundwater Flow at Closure

BACKGROUND

The Mine Operating Permit (MOP) for the Black Butte Copper Project (the Project) indicates that during operations, production workings would be continuously backfilled with low-permeability cemented tailings, but access tunnels and ventilation shafts would not be backfilled. During closure, cement plugs would be placed at strategic locations in the decline and access ramps, but these openings would otherwise not be backfilled. A subsurface plug would be placed in each of the four ventilation shafts, and portions of the shafts would be backfilled with non-cemented reclamation fill. The non-cemented fill would have relatively high hydraulic conductivity and not provide a water seal. Except where plugs are placed, this memorandum treats the decline, access ramps, and all ventilation shafts as hydraulically "open."

Baseline data indicate the general presence of upward hydraulic gradients, which would provide the potential for upward groundwater flow after the hydrologic system recovers from the hydraulic stresses imposed by the dewatering operation. Upward flow, if not controlled, could cause mine-impacted groundwater in deeper geologic units to migrate upward and affect the water quality in shallower units, most notably the Lower Newland A Formation (Ynl-A) unit and alluvial units that discharge groundwater into streams. In the natural hydrogeologic system, upward migration is very slow because the geologic units generally have low vertical hydraulic conductivity. However, the presence of (hydraulically) open tunnels and shafts could provide conduits that convey upward flow in a way that by-passes the containment afforded by the natural undisturbed system. Thus, the sealing provided by plugs in otherwise open tunnels and shafts is an important closure issue for the Environmental Impact Statement (EIS).

CURRENT MOP

As discussed in the MOP, the Proponent proposes to install 14 cement plugs at strategic locations in the main decline, deeper access ramps, and four ventilation shafts to restrict upward groundwater flow after closure and prevent human access. The locations of the plugs are shown on MOP Figures 7.4 and 7.5. The purpose of the plugs is to provide the following hydraulic separations:

- Between the Volcano Valley Fault (VVF) and overlying geologic units
- Between the lower and upper mine stopes of the Lower Sulfide Zone (LSZ)

- Between the Lower Copper Zone (LCS) and Lower Newland B Formation (Ynl-B)
- Between the Upper Sulfide Zone (USZ)/Upper Copper Zone (UCZ) and the Ynl-A

A plug would be installed at the water table in the main decline. Five additional plugs would be installed where the decline and all four ventilation shafts intersect ground surface to prevent physical access and invasion of surface water.

CONSTRUCTION ISSUES

The plugs would be installed at the end of mining with the dewatering system still operating to maintain dry excavations. After plug installation, the dewatering system would be turned off (or operated at systematically decreasing flow rates) to allow the mine to flood with groundwater. The engineering design will assess and recommend the construction of plugs that have low hydraulic conductivity to provide adequate sealing and sufficient strength to remain stable when subjected to differential water pressures on opposite sides of the plugs. Construction options include cement-only plugs or cement layered with foam. It is reasonable to assume that the plug material would have an effective hydraulic conductivity less than or equal to 10^{-7} centimeters per second (cm/sec) (0.00028 feet per day [ft/day]).

Two important construction issues are (1) development of cracks in the plug material after placement and (2) incomplete sealing at the cement/rock interface. Historically, both problems have occurred in tunnel/shaft seals but are generally attributed to improper cement mixes or inadequate methods of cement placement. With good quality engineering and modern construction practices, it is expected that these problems could be prevented or minimized.

A less tangible issue is the development of a disturbed zone adjacent to the tunnel or shaft wall due to blasting when the rock is first excavated. The blasting process could create fractures that extend outward from the rock face, and stress release can cause these (and natural) fractures to open. The result could be a zone adjacent to the wall with hydraulic conductivity that is greater than the undisturbed rock further away from the wall. It is considered that the thickness of the disturbed zone could range from 4 to 12 feet; for analyses in this memorandum, a thickness of 8 feet is assumed. The poor sealing performance of some tunnel plugs has been attributed to by-pass in the disturbed zone adjacent to the plug. The MOP states that if a detrimental disturbed zone is suspected, a fracture-grouting program will be initiated to seal fractures prior to plug placement. To do this, boreholes would be drilled outward from the rock face and grout would be injected into fractures under pressure. Experience has shown this technique to have mixed success in reducing groundwater flows below dams or into underground tunnels.

EIS ENVIRONMENTAL ISSUES

An important EIS environmental issue revolves around the function of plugs to reduce upward flow and chemical migration of potentially impacted water from deeper to shallower geologic units. Compared to deeper bedrock units, the Ynl-A has higher hydraulic conductivity and could be used for the development of low-capacity water wells. Groundwater in the Ynl-A unit also tends to discharge into streams, either directly or via alluvium adjacent to the streams. There is concern that open tunnels and shafts extending downward for many hundreds of feet could provide conduits that convey chemically affected water upward at flow rates that are higher than the natural system and with reduced travel times. At a scoping level, this technical memorandum attempts to address the utility of plugs in reducing enhanced upward flow that could otherwise occur in open tunnels and ventilation shafts.

TECHNICAL APPROACH

This memorandum provides a scoping-level evaluation of plug performance using (1) historical documentation, (2) details of the plugging program presented in the MOP, and (3) analytical calculations. It is not meant to be a definitive evaluation of the plug issue; this memorandum is meant to provide evidence on the expected success of plug installation at the Project mine and the ability of plugs to reduce the upward flow and migration of potentially affected mine waters.

USE OF TUNNEL AND SHAFT PLUGS IN MINING

Many mining operations, particularly those in mountainous terrain, rely on tunnel plugs to permanently seal mine adits and to flood (at least in part) the mine workings upon closure. It is generally accepted that the design criteria for permanent mine closure plugs should be stricter than those used during mine operations, particularly if the plug is used to impound acid rock drainage. In most cases, it is the allowable seepage/gradient rather than the shear strength of the rock or concrete that controls the length of the plug (Lang 1999).

The Natural Resources Conservation Service Conservation Practice Standard for Mine Shaft and Adit Closing (Code 457) enumerates the closing of underground mine excavations by filling, plugging, capping, and installing barriers with the following objectives:

- Reduce hazards to humans and/or animals.
- Maintain or improve access and/or habitat for wildlife.
- Protect cultural resources.
- Reduce subsidence problems.
- Reduce the emission of hazardous gases.
- Reduce or prevent contamination of surface water and groundwater.

Kirjapaino Oy (2008) writes that, in addition to reducing subsidence risk, the use of adit plugs can prevent the physical migration of the mine backfill if it becomes saturated with water. Installation of plugs and rock fill is not generally recommended in access tunnels and shafts in case the mine is to reopen at some future date.

Among the plug purposes enumerated on Code 457, two appear to be applicable to the proposed Project upon its future closure: (1) reduce hazards to humans and/or animals; and (2) reduce or prevent contamination of surface water and groundwater.

PLUGGING PROGRAM PRESENTED IN THE MOP

MOP Figures 7.4 and 7.5 show the proposed locations of plugs. ERM's review of the MOP identified the following plug issues that merit additional consideration in the EIS:

- As shown on Figure 7.5, the lower portion of the lower intake ventilation shaft (IVL) is continuously open and connects to the lower decline. The lack of a plug in the lower IVL may negate the hydraulic function of the decline plugs labeled "Upper VVF" and "Below USZ" on Figures 7.4 and 7.5.
- As shown on Figure 7.5, the lower portion of the lower exhaust ventilation shaft (EVL) has no plugs, but connects the middle decline to a lower access ramp. The lack of a plug in this portion of the EVL may negate the hydraulic function of the plug labeled "Upper VVF" on Figure 7.5.
- It is not entirely clear in the MOP which portions of the ventilation shafts would be backfilled.
- The MOP indicates that a plug would be installed at the groundwater table in the decline, but the hydraulic utility of a plug at this location is unclear.

HYDRAULIC ANALYSIS OF PLUG PERFORMANCE

Figure A-1 in Appendix A of this memorandum shows conceptual flow paths for leakage that could occur through and past a tunnel plug. While the plug itself is generally of low permeability and entails minimal flow, significant leakage could occur in the disturbed zone adjacent to the tunnel wall that likely would have higher hydraulic conductivity than the undisturbed rock mass. In this section, scoping-level calculations are performed to evaluate leakage through the plug and in the disturbed zone. Flow in the undisturbed rock mass is not considered because it is expected to be relatively small. However, if the rock mass has appreciable hydraulic conductivity, this flow component might be significant and could be evaluated using numerical methods.

Flow By-Passing a Tunnel or Shaft Plug

The hydraulic performance of a tunnel plug at the Project site was evaluated based on the conceptualization shown on Figure A-2. The plug being considered is for the EVL raise and would be used to hydraulically separate the USZ/UCZ unit from the overlying Ynl-A unit. This location is of interest because the Ynl-A has relatively high hydraulic conductivity and there are nearby piezometers that provide reliable data on the vertical hydraulic gradient (MW-9, PW-9, and PW-10). The hydraulics of a shaft at this location without a plug was independently analyzed in the MOP (Section 4.1.7.2) and summarized on MOP Figure 4.15. At the EVL location, the static hydraulic head in the USZ/UCZ unit is higher than the head in the Ynl-A unit, providing the potential for upward flow, which would be enhanced by the presence of an open shaft. The intended purpose of the plug would be to reduce the upward flow between the two units.

The conceptualization on Figure A-2 considers radial horizontal flow converging into the shaft from the underlying USZ/UCZ unit, flow up the shaft with or without a plug, and radial flow away from the shaft into overlying Ynl-A unit. The system flow rate is affected by flow through a disturbed zone adjacent to the shaft wall that has higher hydraulic conductivity than the undisturbed rock mass. For this evaluation, the disturbed zone is assumed to be 8 feet thick and have a possible hydraulic conductivity (K_d) ranging from 0.1 ft/day (slightly less than undisturbed USZ/UCZ rock) to 100 ft/day for highly disturbed rock.

The following steady-state equation (Theim 1906; Kruseman and de Ridder 1990) is used to compute horizontal radial flow into the shaft from the USZ/UCZ unit (Q_2):

$$Q_2 = \frac{2\,\pi\,K_{h2}\,b_2\,(H_2 - H_{s2})}{F}$$

where:

- K_{h2} = horizontal hydraulic conductivity of geologic materials in USZ/UCZ (0.16 ft/day)
- b_2 = effective thickness of more permeable geologic materials within USZ/UCZ (46 feet)
- H_2 = static hydraulic head in the USZ/UCZ unit (5,703.4 feet mean sea level [msl])
- H_{s2} = Hydraulic head in the shaft below the plug (computed)
- F = steady-state shape factor (5.7)

Steady-state flow from the shaft into the Ynl-A (Q_1) is computed similarly:

$$Q_1 = \frac{2\,\pi\,K_{h1}\,b_1\,(H_{s1} - H_1)}{F}$$

where:

- K_{h1} = horizontal hydraulic conductivity of geologic materials in Ynl-A (1.3 ft/day)
- b_1 = effective thickness of more permeable geologic materials within Ynl-A (46 feet)
- H_1 = static hydraulic head in the Ynl-A unit (5,696.1 feet msl)
- H_{s1} = hydraulic head in shaft above the plug (computed)

The steady-state shape factor (F) for horizontal radial flow is typically given by:

$$F = ln\left(\frac{r_w}{r_o}\right)$$

where:

- r_w = well radius (in this case the shaft radius)
- r_o = radius of influence; distance to where the hydraulic head is near static

The typical value used for practical application is F = 5.7, which implies that the ratio (r_w/r_o) is equal to 300.

The combined vertical flow through the plug and disturbed zone (Q_3) is computed using the Darcy equation:

$$Q_3 = \left(K_p\,A_p + K_d\,A_d\right)\left(\frac{H_{s2} - H_{s1}}{L}\right)$$

where the cross-sectional area of the plug (A_p) is:

$$A_p = \frac{\pi}{4} D^2$$

the cross-sectional area of the disturbed zone (A_d) is:

$$A_d = \frac{\pi}{4} [(D + 2\,a)^2 - D^2]$$

and:

D = shaft diameter (16 feet)

a = thickness of disturbed zone (8 feet)

L = plug length (20 feet)

K_p = hydraulic conductivity of plug material (0.0003 ft/day = 10^{-7} cm/sec))

K_d = hydraulic conductivity of disturbed zone (range of 0.1 ft/day to 100 ft/day)

and other parameters are previously defined.

In the direction of flow, continuity requires that:

$$Q_2 = Q_3 = Q_1$$

Starting with the known static head in USZ/UCZ (H_2), algebraic manipulation of the above equations is used to *compute* a static head in Ynl-A. Then by an iterative process, the system flow rate (Q) is modified until this computed head is equal to the known static head in Ynl-A (H_1). The computations are programmed in the Mathcad worksheet provided in Figure A-3. As a sensitivity analysis, the flow rate (Q) was computed for different values of the disturbed zone hydraulic conductivity (K_d) to evaluate how the plug would perform with different amounts of by-pass leakage in the disturbed zone adjacent to the plug.

Calculations show that if the hydraulic conductivity of the plug material (cement and/or foam) is less than 0.003 ft/day (10^{-6} cm/sec), the flow through the plug can be neglected. However, the system flow rate is affected by the disturbed zone hydraulic conductivity (K_d). To evaluate how the plug might perform, a series of calculations were performed using K_d values ranging from 0.1 ft/day (slightly less than the undisturbed USZ/UCZ hydraulic conductivity of 0.16 ft/day) to a very high value of 100 ft/day. The inputs listed in Figure A-3 are for one realization where the disturbed zone hydraulic conductivity is taken to be 1.6 ft/day, or one order-of-magnitude greater than that of undisturbed USZ/UCZ rock. Other realizations use the same inputs except for the disturbed zone hydraulic conductivity (K_d).

Results of the analysis are shown graphically on Figure A-4. As the disturbed zone hydraulic conductivity (K_d) increases, the upward vertical flow by-passing the plug also increases, which makes logical sense. However, it is surprising that for a three order-of-magnitude increase in K_d, the by-pass flow rate only increases by a factor of three (from 0.08 gallon per minute [gpm] to 0.27 gpm). This is because the effect of higher K_d on flow is counteracted by a reduction in the hydraulic gradient through the disturbed zone. Note that for the K_d values greater than 10 ft/day, the by-pass flow rate is similar to the value computed in the MOP for the case of no plug (0.27 gpm). As K_d increases, the hydraulic head in the shaft below the plug (H_{s2}) becomes more similar to the head above the plug (H_{s1}). For K_d greater than 10 ft/day, the heads are nearly equalized and similar to the value of 5,697 feet msl computed in the MOP for the no-plug case. This analysis suggests that shaft plugs can reduce groundwater flow through a shaft or tunnel; however, for the rock properties considered in this example, the flow reduction (0.27 gpm to 0.08 gpm) is not very large.

At face value, one might interpret from Figure A-4 that the system flow rate can be greatly reduced by grouting fractures in the disturbed zone so that K_d is a very low value. However, the effect of this would be to shift the flow lines to outside the disturbed zone away from the shaft, so the reduction in flow rate may not be as great as envisioned. To properly analyze this type of situation would likely require an axisymmetric numerical flow model, which while doable, was outside the scope of this technical memorandum.

Assuming an effective porosity of 0.10, Figure A-5 shows the migration velocity and sharp-front travel time for unattenuated chemical migration through the disturbed zone. For K_d increasing from 0.1 ft/day to 100 ft/day, the sharp-front travel time decreases from about 77 days to 23 days, which is not a large change.

Natural Vertical Flow

Figure A-6 considers natural vertical groundwater flow in the same geologic units considered for the shaft analysis. Based on calibration of the site groundwater model, the vertical hydraulic conductivity of USZ/UCS unit is taken to be 0.011 ft/day and the vertical hydraulic conductivity of Ynl-A is 0.26 ft/day. The static hydraulic head in USZ/UCZ at PW-9 is 5,703.4 feet msl and the head in Ynl-A at MW-9 is 5,696.1 feet msl. Based on well completion data, the vertical distance between midpoints of the completion intervals for these wells is 110 feet. Because the vertical hydraulic conductivity of the USZ/UCZ unit is lower than that of the overlying Ynl-A, the vertical hydraulic gradient in the USZ/UCZ unit should be greater as shown by the conceptual head distribution graph on Figure A-6. For a given vertical flow rate, the Mathcad worksheet in Figure A-7 computes the map area associated with natural vertical flow for that flow rate. Figure A-7 considers a vertical flow rate of 0.27 gpm, which is the estimated flow rate for the shaft without a plug. The equivalent area of natural vertical flow for this flow rate is computed to be 1.24 acres. Thus, the vertical leakage for a shaft without a plug is equivalent to the natural vertical flow that takes place over a footprint area of 1.24 acres. For the case of a plug with a lower permeability disturbed zone, the estimated shaft leakage is estimated to be about 0.1 gpm, and this is equivalent to a natural flow area of about 0.5 acre. The implication here is that the total upward flow through four vent raises and one decline, with or without plugs, would be relatively small compared to the upward natural flow that occurs over the general area of the mine.

Vertical seepage velocity and travel time in the natural system is also assessed in the Mathcad worksheet. For an effective porosity of 0.10, the vertical seepage velocity is 3.5 feet per year (ft/yr). For the vertical distance of 110 feet between the mid-points of PW-9 and MW-9, the computed sharp-front travel time is on the order of 30 years. Calculations confirm that this travel time is independent of the flow rate considered in Figure A-7.

Discussion

This analysis provides evidence supporting the following statements:

- After closure and hydraulic recovery, the presence of four shafts and one decline, with or without plugs, would not substantially change the natural upward flow that would occur between lower geologic units and the Ynl-A unit. With or without plugs, the upward flow rate through the openings would be small compared to natural upward flow that would occur in areas where there are no mine openings.
- The placement of shaft and tunnel plugs just below the USZ/UCZ – Ynl-A contact would reduce flow in the openings, but the relative decrease would not be very large.
- The greatest effect of shafts and tunnels is reducing the chemical migration times from deeper units into the Ynl-A unit. In areas without openings, the travel time for upward flow in geologic materials would likely be many decades to perhaps centuries. However, where shafts and tunnels would be installed, the upward travel time, with or without plugs, could be less than several years.
- If an environmental priority is to increase the time it takes for chemicals in deeper units to reach the Ynl-A unit, the only practical engineering approach would be to completely backfill the shafts and declines with a granular porous material so that upward (Darcian) flow could occur in a medium with reasonably high effective porosity (which reduces migration velocity). If the backfill were to have low hydraulic conductivity (such as cemented tailings), this approach could eliminate the need for all subsurface plugs.

CONCLUSIONS AND RECOMMENDATIONS

The main conclusion of this technical evaluation is that the upward migration of potentially affected groundwater into shallower geologic units via shafts and tunnels would be relatively rapid regardless of whether or not plugs are installed. Mixing calculations might show that the flow rates are small enough to not significantly impact the Ynl-A water quality, but the time frame for chemicals to migrate up the tunnels and shafts is relatively rapid. Calculations show that placement of plugs would not greatly increase the travel times compared to shafts and tunnels that do not have plugs. If minimizing upward vertical chemical migration from deeper to shallower units is an EIS priority, the only engineering solution may be to completely backfill the decline, access ramps, and ventilation shafts with non-cemented or cemented granular material. It is recommended that this be established as an alternative in the EIS. The alternative might entail stockpiling an adequate volume of tailings or other granular material at the end of mining, which could be used to backfill all tunnels and shafts prior to turn-off of the dewatering system. If tailings are used for backfill, one consequence of this approach would be a smaller ultimate volume of tailings to be placed in the cemented tailings facility (CTF). Engineering options can consider the use of non-cemented or cemented backfill material.

For the closure approach currently described in the MOP, other EIS alternatives may consider the following:

- One additional plug in the lower portion of the IVL to hydraulically separate the VVF from shallower geologic units.
- One additional plug in the lower portion of the EVL to hydraulically separate the VVF from shallower geologic units.
- Elimination of the water-table plug in the decline (labeled “At GWT” on MOP Figures 7.4 and 7.5).

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Lang, B. 1999. “Permanent Sealing of Tunnels to Retain Tailings or Acid Rock Drainage.” In Proceedings of the Mine, Water & Environment - IMWA Congress, Sevilla, Spain.

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Technical Memorandum 4: Appendix A

Figure A-1: Flow Patterns Through and Around a Plug

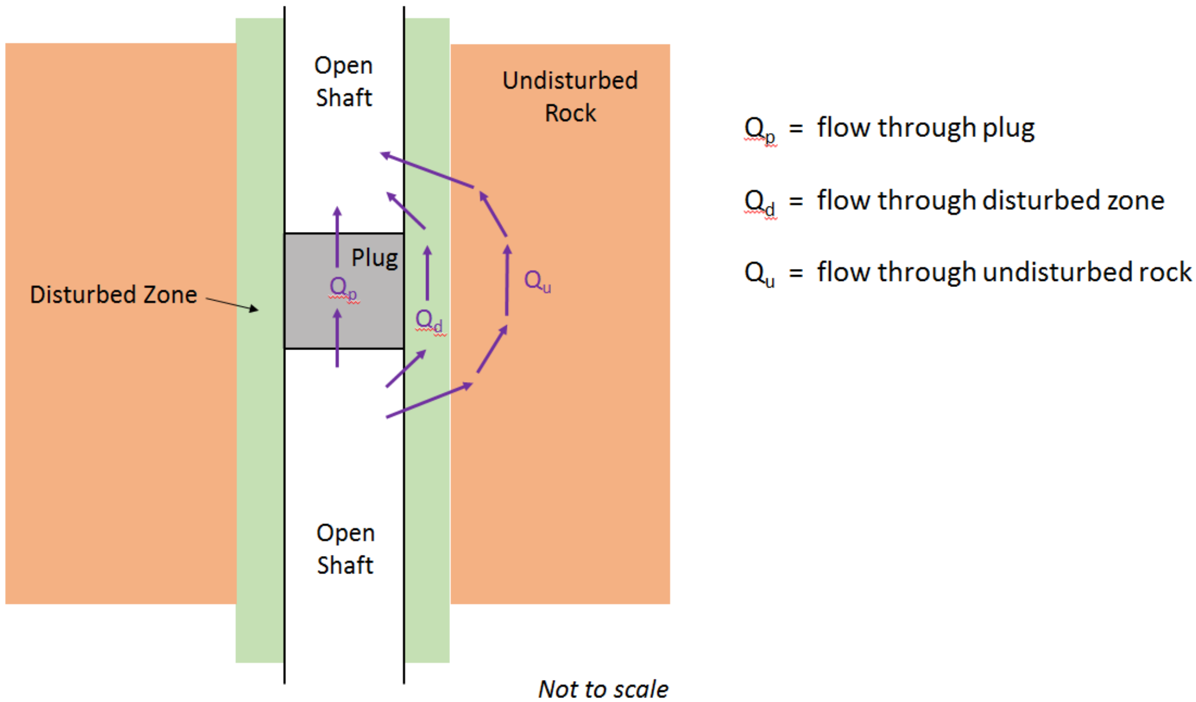


Figure A-2: Flow Analytical Model

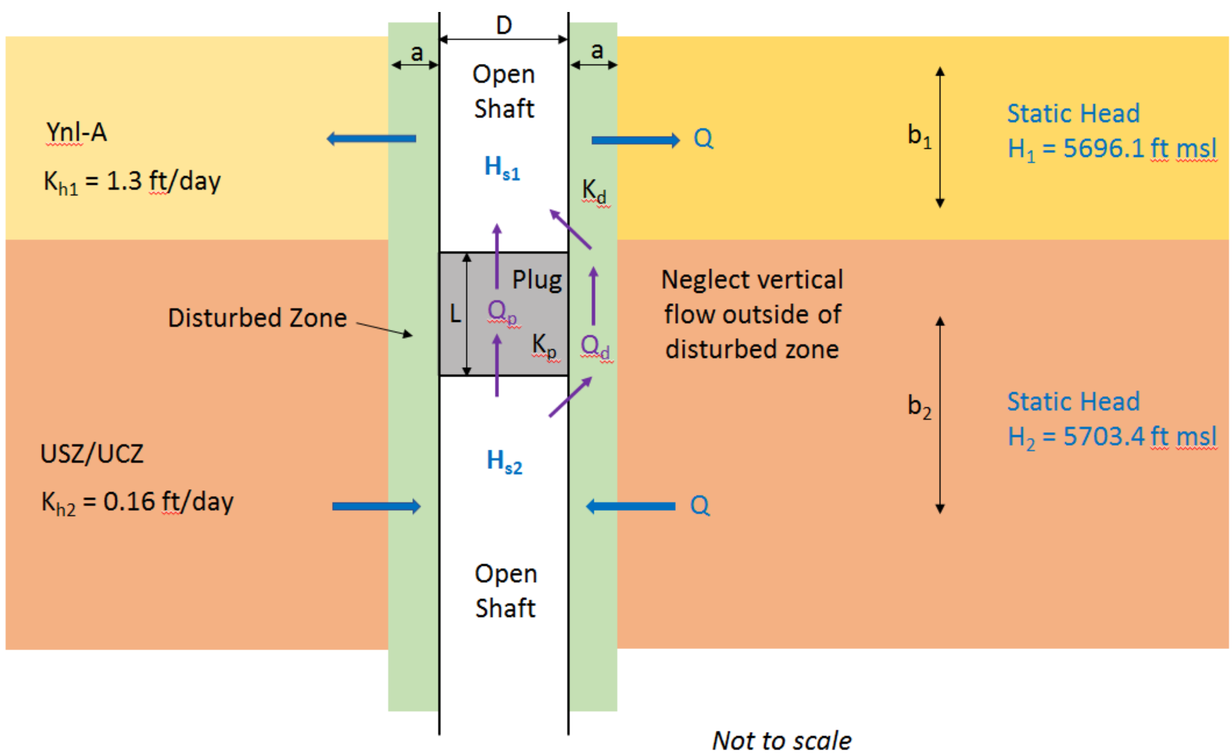


Figure A-3: Flow Through (and By-passing) a Plug

Inputs

$H_1 := 5696.1 \cdot ft$	Static hydraulic head in Ynl-A unit	
$K_{h1} := 1.3 \cdot \frac{ft}{day}$	Horizontal hydraulic conductivity of Ynl-A unit	
$b_1 := 46 \cdot ft$	Permeable thickness of Ynl-A unit	
$H_2 := 5703.4 \cdot ft$	Static hydraulic head in USZ unit	
$K_{h2} := 0.16 \cdot \frac{ft}{day}$	Horizontal hydraulic conductivity of USZ unit	
$b_2 := 46 \cdot ft$	Permeable thickness of USZ unit	
$L := 20 \cdot ft$	Length of plug	
$D := 16 \cdot ft$	Shaft diameter	
$a := 8 \cdot ft$	Thickness of disturbed zone	
$K_d := 1.6 \cdot \frac{ft}{day}$	Hydraulic conductivity of disturbed zone	
$F := 5.7$	Shape factor for radial flow to shaft	
$K_p := 0.000284 \cdot \frac{ft}{day}$	Hydraulic conductivity of plug	$K_p = 1.00 \times 10^{-7} \cdot \frac{cm}{sec}$
$\phi := 0.10$	Effective porosity of disturbed zone	

Calculations

$A_d := \frac{\pi}{4} \cdot \left[(D + 2 \cdot a)^2 - D^2\right]$	Cross-sectonal area of disturbed zone	$A_d = 603.186 \cdot ft^2$
$A_p := \frac{\pi}{4} D^2$	Cross-sectional area of plug	$A_p = 201.062 \cdot ft^2$
$H_{s2}(Q) := H_2 - \frac{Q \cdot F}{2 \cdot \pi \cdot K_{h2} \cdot b_2}$	Hydaulic head in shaft below plug	
$H_{s1}(Q) := H_{s2}(Q) - \frac{Q \cdot L}{K_d \cdot A_d + K_p \cdot A_p}$	Hydraulic head in shaft above plug	
$H(Q) := H_{s1}(Q) - \frac{Q \cdot F}{2 \cdot \pi \cdot K_{h1} \cdot b_1}$	Computed static head in Ynl-A	
$q := 0 \quad Q := root(H(q) - H_1, q)$	Find by-pass flow rate for H(Q) = H_1	$Q = 0.2383 \cdot gpm$
	Computed head in shaft below plug	$H_{s2}(Q) = 5697.75 \cdot f$
	Computed head in shaft above plug	$H_{s1}(Q) = 5696.80 \cdot f$
$Q_p := K_p \cdot A_p \cdot \left(\frac{H_{s2}(Q) - H_{s1}(Q)}{L}\right)$	Computed flow rate through plug	$Q_p = 0.000 \cdot gpm$
$Q_d := K_d \cdot A_d \cdot \left(\frac{H_{s2}(Q) - H_{s1}(Q)}{L}\right)$	Computed flow rate through disturbed zone	$Q_d = 0.238 \cdot gpm$
$v_d := \frac{Q_d}{A_d \cdot \phi}$	Seepage velocity in disturbed zone	$v_d = 0.76 \cdot \frac{ft}{day}$
$t_d := \frac{L}{v_d}$	Sharp-front travel time through disturbed zone	$t_d = 26.302 \cdot day$

Figure A-4: Results of Shaft Plug Analysis

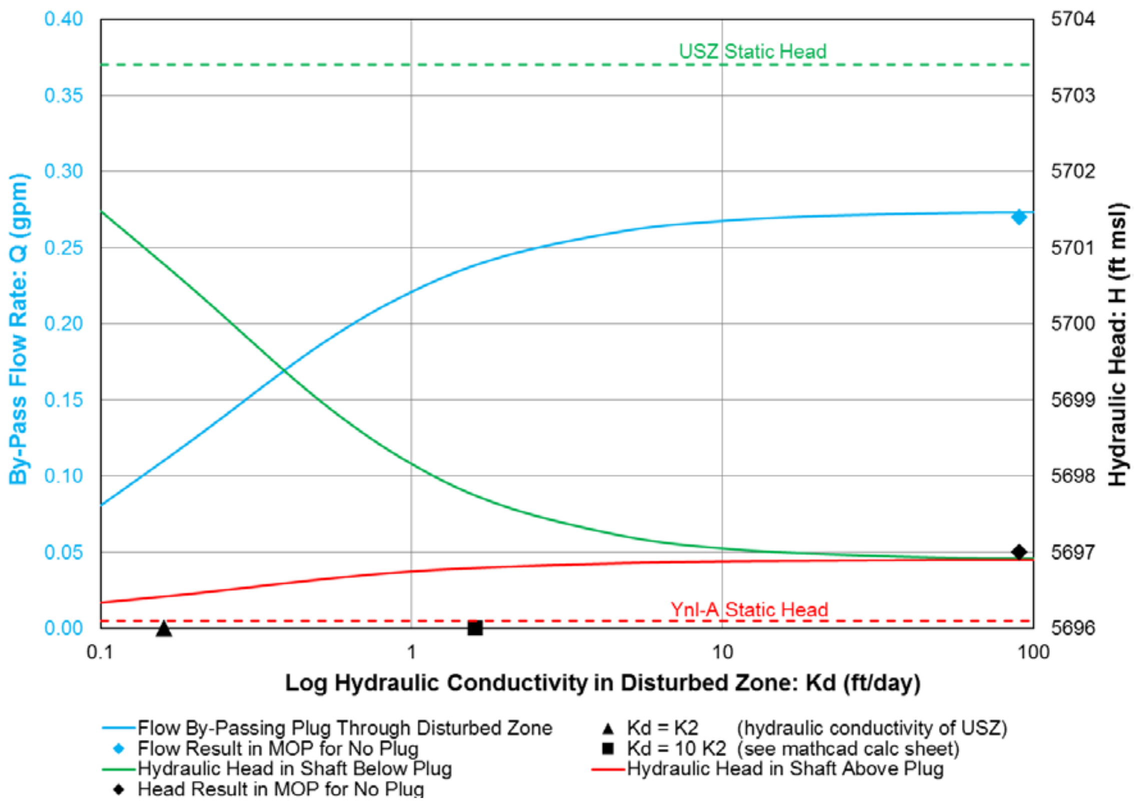


Figure A-5: Chemical Migration Past Plug

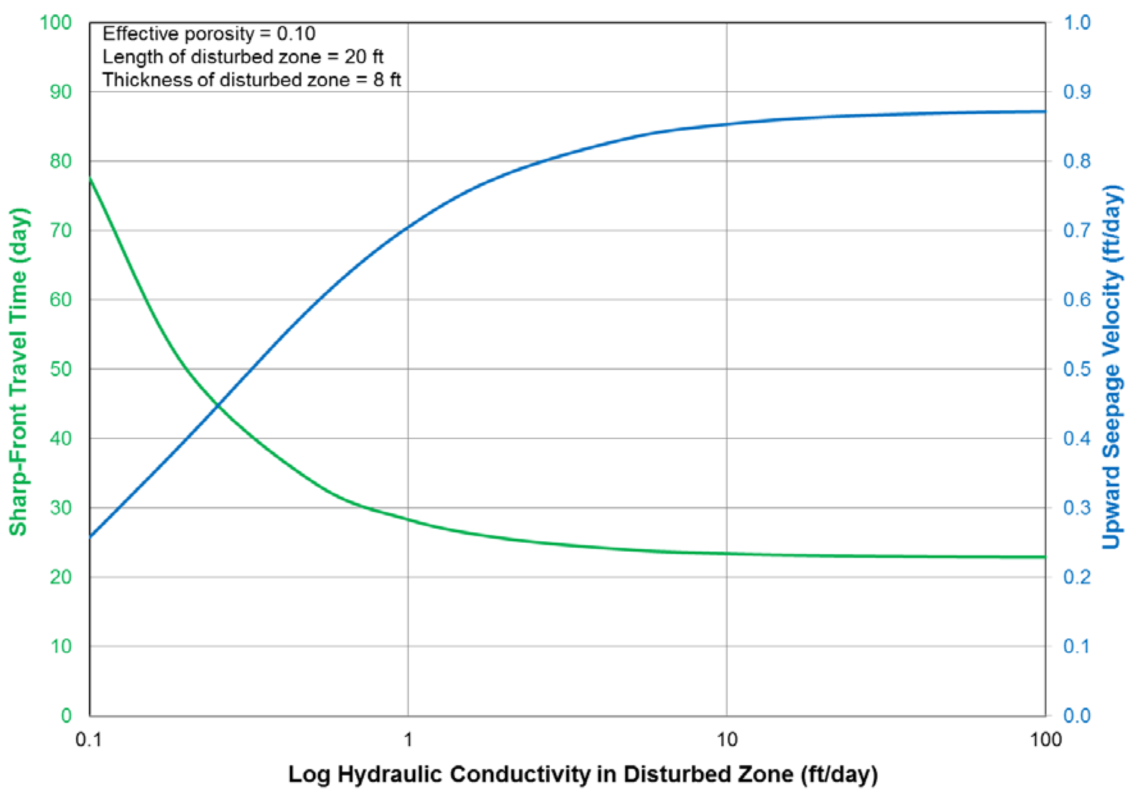
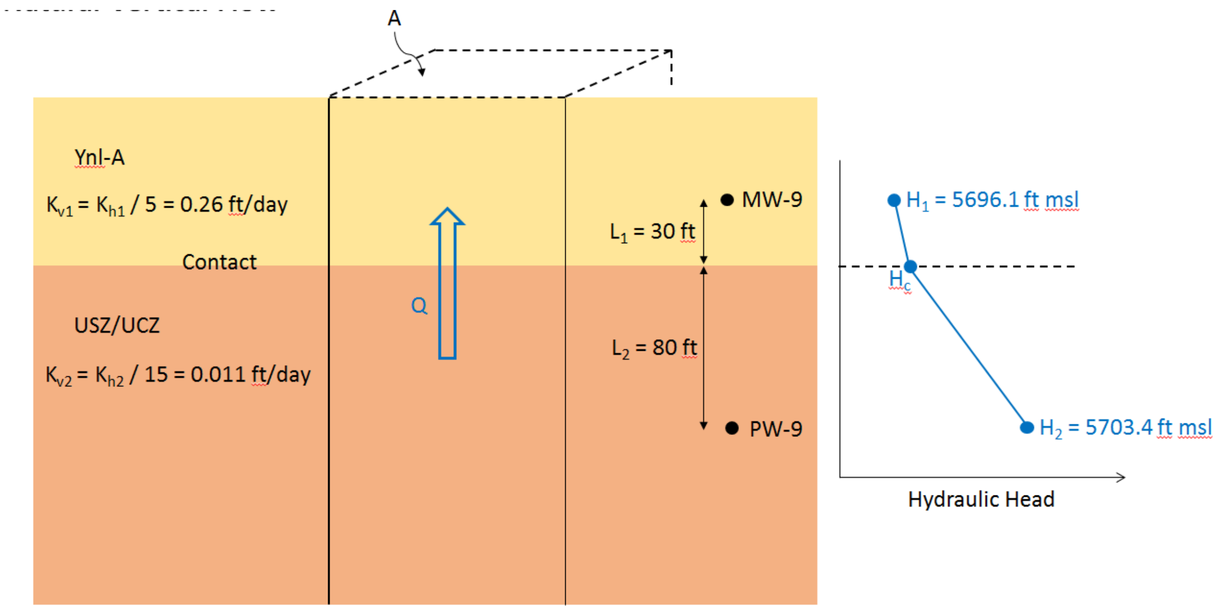


Figure A-6: Natural Vertical Flow



Not to scale

Figure A-7: Natural Vertical Flow (in Absence of Shaft)

Inputs

$H_1 := 5696.1 \cdot ft$	Static head in Ynl-A	
$K_{v1} := \frac{1.3}{5} \cdot \frac{ft}{day}$	Vertical hydraulic conductivity in Ynl-A based on numerical model calibration	$K_{v1} = 0.26 \cdot \frac{ft}{day}$
$L_1 := 30 \cdot ft$	Vertical distance from midpoint of MW-9 completion to the Ynl-A / USZ contact	
$H_2 := 5703.4 \cdot ft$	Static head in USZ (PW-9)	
$K_{v2} := \frac{0.16}{15} \cdot \frac{ft}{day}$	Vertical hydraulic conductivity in USZ based on numerical model calibration	$K_{v2} = 0.011 \cdot \frac{ft}{day}$
$L_2 := 80 \cdot ft$	Vertical distance from Ynl-A / USZ contact to midpoint of MW-9 completion	
$Q := 0.27 \cdot gpm$	Vertical flow rate considered	
$\phi := 0.10$	Effective porosity of undisturbed rock	

Calculations

$H_c(A) := H_2 - \frac{Q \cdot L_2}{K_{v2} \cdot A}$	Hydraulic head at Ynl-A / USZ contact	
$H(A) := H_c(A) - \frac{Q \cdot L_1}{K_{v1} \cdot A}$	Computed static head Ynl-A (MW-9)	
$a := 0.5 \cdot acre \quad A := root(H(a) - H_1, a)$	Find map area for which computed head in Ynl-A equals H_1 when vertical flow rate is Q	$A = 1.24 \cdot acre$
	Actual head head in Ynl-A (MW-9)	$H_1 = 5696.1 \cdot ft$
	Computed head in Ynl-A (MW-9)	$H(A) = 5696.1 \cdot ft$
	Conputed head at Ynl-A / USZ contact	$H_c(A) = 5696.2 \cdot ft$
	Head in USZ (PW-9)	$H_2 = 5703.4 \cdot ft$
$i_1 := \frac{H_1 - H_c(A)}{L_1}$	Vertical hydraulic gradient in Ynl-A (negative for upward flow)	$i_1 = -0.004$
$i_2 := \frac{H_c(A) - H_2}{L_2}$	Vertical hydraulic gradient in USZ (negative for upward flow)	$i_2 = -0.090$
$v := \frac{Q}{A \cdot \phi}$	Vertical seepage velocity	$v = 3.50 \cdot \frac{ft}{yr}$
$t := \frac{L_1 + L_2}{v}$	Sharp-front travel time over 110 vertical feet from PW-9 to MW-9	$t = 31.4 \cdot yr$

APPENDIX E

Technical Memorandum 5

Technical Memorandum 5

To: Montana Department of Environmental Quality

From: Environmental Resources Management

Date: December 29, 2017

Subject: Black Butte Copper Project - Whether there is an advantage to requiring in-situ treatment through placement of organics in the underground workings at closure to limit oxidation

BACKGROUND

In the drift and fill mining technique, cemented paste tailings would backfill the underground workings in operation and through closure. The cemented paste tailings would contain alkaline materials such as fly ash, lime, and other locally sourced materials that would partially neutralize acids. There are concerns that there is not sufficient alkalinity or neutralizing capacity in the cemented paste tailings to prevent acid mine drainage. At closure, the mine would be flooded and the paste tailings would reside below the groundwater table in an anoxic and, depending on depth, anaerobic environment. The hydraulic conductivity of the cemented paste tailings would limit interaction with groundwater. This Technical Memorandum examines the additional control measure of adding a carbon source to the underground workings to promote the growth of bacteria that would reduce sulfate and precipitate metal sulfides and increase the pH and alkalinity.

CURRENT MOP

To limit groundwater inflow and therefore oxidation and acid mine drainage, the Mine Operation Plan (MOP) (Tintina Montana, Inc. 2017) proposes the following: (1) installing hydraulic plugs to separate the lower mine workings from the upper groundwater, (2) shotcreting high sulfide zones, (3) high pressure rinsing of the mine walls with unbuffered Reverse Osmosis (RO) treated water to remove soluble sulfates and other oxidation products, and (4) collecting and treating this rinsate to non-degradation standards. At closure, buffered RO permeate would be injected into the underground workings followed by low-oxygen groundwater. The MOP also describes a “wait and see” approach to tailor the additional controls based on the resulting water quality versus the predicted (modeled) water quality at mine closure. Control measures would be tested during the operations phase, and the most successful measures would be adopted at closure.

The cemented paste tailings backfill (79 percent total solids by weight of the mixture) would be produced onsite by mixing fine-grained tailing from the milling process and 2-4 percent cement and proposed binders, such as locally available cement, slag, and fly ash. Over time, Humidity Cell Tests (HCT) results described in the MOP predict that the cemented paste tailings could potentially oxidize if exposed to air and water and release acid. In the drift and fill mining process, Tintina maintains that the backfilled material would not be exposed to air for an extended period of time; in addition, at closure the backfill would be immersed with groundwater. Since diffusion of oxygen through saturated material is considerably slower than direct contact with air, oxidation would be minimized at closure. The deeper the groundwater, the more likely anaerobic conditions would prevail. Interaction with groundwater should also be minimized due to the low hydraulic conductivity of the backfill placed during the operational phase.

EIS ENVIRONMENTAL ISSUES

The potential environmental impacts would result from the oxidation of the rock surfaces in the underground workings, producing acidic conditions and leaching metals and metalloids into groundwater. Anoxic conditions can promote the release of arsenic into groundwater by increasing its solubility.

TECHNICAL APPROACH

PASSIVE BIOLOGICAL TREATMENT

Sulfate can be reduced to sulfides in anoxic conditions with the addition of organic substrates due to the presence of naturally occurring anaerobic bacteria *Desulfovibrio* and *Desulfotomaculum*. During respiratory metabolism, sulfates, sulfites, and other reducible sulfur species act as electron acceptors. These anaerobic bacteria utilize an organic substrate of short chain lactic and pyruvic acid that can be generated from the fermentation by other anaerobic bacteria of other organic substrates. Anaerobic conditions must be created and complex organic materials (e.g., molasses, sewage sludge, manure, and substrates such as straw, newspaper, manure and sawdust) must be introduced. To precipitate specific metals, the pH needs to be in the proper range, with copper and iron precipitating at low pH levels (Bowell 2004).

Passive Treatment systems are typically used for biological treatment of mine wastes and are defined as systems that use naturally available energy sources such as microbial metabolism. These systems typically require some long-term, infrequent maintenance to operate over a designated design life. To cultivate sulfate reducing bacteria (SRB), certain conditions are required. SRBs require a pH around 6, a substrate, a carbon source, and anoxic conditions. SRBs may use a wide range of substrates as electron donors and carbon sources, which oxidize incompletely (to acetate) or thoroughly to carbon dioxide (CO_2). These substrates are generally organic compounds composed of activated sludge, wood chips, farm manure, sawdust, mushroom compost, and other agricultural wastes (Luptakova 2012).

Domestic animal waste contains sulfate reducers and has been used to seed anaerobic bioreactors. Sulfide precipitation of metals is possible in anaerobic bioreactors. For pH less than 5.5, hydrogen sulfide gas was produced that precipitated metals and formed bicarbonate, raising the alkalinity and pH of the water. This study found that SRBs function optimally at pH values greater than 5.0 with a source of sulfate and a carbon source (Gusek 2016).

A thick cover layer of organic material over piles of tailings and waste rock has been effective in reducing oxidation, as the oxygen is depleted by the microbial degradation of the organic material. Microbial degradation and oxygen consumption has been most effective at a near-neutral pH. In above ground conditions, cover materials need to be replaced when the carbon has been depleted (Butler 2014).

Types of passive biological treatment systems for mine wastes have included the following (Kaupilla 2012):

- Construction Wetlands – Organics with alkaline material promoting sulfate reduction, precipitation of metal sulfide, adsorption of metals to organic material, and neutralization of water.
- Organic filters – Addition of organic material such as peat, manure, or others along with alkaline materials to sorb the metal onto the solid surfaces through either physical or chemical adsorption and water neutralization.
- Reactive ditches – Ditches containing carbonate materials to neutralize water, precipitate iron, and retain precipitates in the cell.
- Reactive dams/walls/curtains – Organic material such as peat and manure combined with alkaline materials to promote the adsorption of metals onto the surface of the solids and neutralize water.

None of these passive treatment systems is applicable for the Black Butte Copper Project (the Project) unless underground organic filters or reactive dams/walls/curtains could be built and maintained underground at closure, which is not a practical long-term solution.

Literature Review has provided a number of examples of mostly experimental and pilot-scale passive biological treatment systems, as follows:

- Two anaerobic pilot cells were built at the closed Brewer open pit gold mine in South Carolina and treated pit and cyanide heap leach pad (Pad 5) flows of 1.0 and 0.75 gallons per minute (gpm) for 18 months. Cow manure was used as an inoculum of SRB onto a substrate of composted turkey manure, sawdust, and phosphate rock reject (limestone). The cell experienced fluctuating influent concentrations and a flourishing plant growth that removed iron through oxidation, but not copper. Once the plant growth was removed for the second time, metals removal and sulfate reductions were higher than predicted despite an increased metal loading. This was possibly due to the presence of a more available carbon source provided by the dead plant material (Gusek 2016).
- A pilot scale downflow anaerobic cell was constructed at an abandoned underground copper mine in Wyoming (Ferris Haggarty Mine/Osceola tunnel). Fed with 3 to 6 milligrams per liter (mg/L) of dissolved copper and less than 100 mg/L of sulfate, the 15-foot diameter by 4-foot deep cell was constructed of sawdust, hay, limestone, gypsum, and cow manure as a source of SRB. The cell was allowed to incubate at summer temperatures in 1996 prior to the addition of the mine flow, which appeared to help the SRB acclimate to the subfreezing conditions experienced during the winter months. Effluent copper concentrations from the cell were measured at 0.1 mg/L (Gusek 2016).
- Batch experiments in bioreactors were conducted using synthetic mine water and treatment with limestone, activated sludge, spent mushroom compost (SMC), and mixed substrates

under anoxic conditions. The removal of heavy metals such as iron, manganese, copper, lead, and zinc was evaluated. SMC had the best sulfate and heavy metal removal, with an overall efficiency of 89.98 percent with good alkalinity generation. Activated sludge reduced heavy metals by 97.98 percent but was not as efficient for sulfate removal (43.75 percent) (Muhammad et al. 2015).

- A pilot (research) passive treatment system was installed in 1994 at a closed tin mine in Cornwall, United Kingdom (Wheal Jane). Aerobic, anaerobic, and rock filter systems were tested in the pilot study. The anaerobic system was intended to promote sulfate reduction and increase alkalinity, pH, and precipitation of copper, zinc, cadmium, and iron sulfides. Two pretreatments to the anaerobic cells were tested, and lime was dosed to increase the pH and passage through an anoxic limestone drain. The anaerobic cells were essentially compost bioreactors that had been filled with manure as a source of organic carbon and straw and sawdust as substrate. The bioreactors were monitored regularly; after 2 years, they did not perform as expected, mainly due to the introduction of ferric solids from the aerobic cells. The anaerobic process did not bring the pH up to over 5.5, increase the alkalinity, or remove metals through sulfide precipitation (CL:AIRE 2004).
- A biotreatment system was constructed at an operating underground lead mine (Asarco Incorporated West Fork Unit, Missouri). Mine drainage contained 0.4 mg/L of lead and 0.18 mg/L of zinc with a flow rate of 1,200 gpm. The biotreatment system had multiple parts including a settling pond, two anaerobic cells, a rock filter, and an aeration pond. This system from the beginning of operation has been able to meet permitted discharge requirements with lead reduced to 0.027 to 0.050 mg/L from 0.4 mg/L and reduction in zinc, cadmium, and copper concentrations. From the conclusions to this study, SRB were responsible for the bulk of the lead removal (Gusek 2016).
- Acidophilic microbes responsible for sulfide dissolution and influence on leaching rates at the Iron Mountain mine in California included Eukarya, Bacteria, and Archea (prokaryotes). Subsurface, chemosynthetic prokaryotes utilized reduced iron and sulfur from pyrite for energy and fixed carbon monoxide for cell carbon. Heterotrophic microbes utilized organic carbon for energy in the environment (Edwards et al. 2000).
- The addition of natural phosphate rock has been shown to promote the biofilm growth of heterotrophic microbes that consume oxygen and promote reducing conditions. These heterotrophs are typically out-competed by the acidophilic microbes that are responsible for the acid generation. Fine-ground natural phosphate rock was slowly dissolved in water and applied to tailings. Natural phosphate rock contains calcium-carbonate and phosphate and has been used to neutralize acidic soils. It also contains inorganic and organic carbon and other microbial growth nutrients. In studies with a number of different types of mine tailings and rocks, the research has shown that a one-time application of natural phosphate rock to both tailings and waste rock will promote the development of heterotrophic microbial biofilms (Kalin 2015).

TOTAL ORGANIC CARBON CONTENT OF WASTE ROCK

In the MOP, Total Organic Carbon (TOC) was measured in a range of 0.13 to 0.39 percent for waste rock samples collected at the Project site. Under the right conditions, the rock TOC content could provide an electron donor to promote microbial activity – the type dependent on the pH and the oxygen content. For SRB, the conditions need to be anaerobic, growth substrate, near neutral pH, and a sufficient carbon and nutrient source. Additionally, the TOC would have to be at the exposed rock surfaces and available to a microbial population. It is unlikely that the native TOC would sustain the desired outcome of sulfate reduction, metal sulfide precipitation, and pH and alkalinity increase.

NEUTRALIZING CAPABILITIES OF THE WASTE ROCK

The neutralization potential of the rock can be indicated by the carbonate and silicate content, with carbonate being a stronger indicator. Carbonates and clays present effective acid neutralizing capabilities. The actual amount of acid produced would be determined by the overburden geochemistry, tailings management during reclamation, and the hydrology of the site after closure (Skousen 2002).

There is neutralization potential in the Lower Newland A Formation (Ynl-A) with a net neutralization potential of 164.9 (mean) and in the Lower Newland B Formation (Ynl-B) with a net neutralization of 174.7 (mean). However, to be the most effective, the availability of the oxides and carbonates would be improved if the material was finely ground into particles that would react and neutralize acids. There would be some neutralization with the exposed rock surfaces. Further study is needed to explore the costs/benefits of producing finely ground waste rock and filling the mine void. Per the MOP, locally sourced materials would be added primarily for structural support but as a secondary benefit to increase the neutralizing capabilities of the cemented pastes. Effective additives for neutralizing acidic rock include limestone with a neutralization potential of 75 to 100 percent or fluidized bed combustion ash at 20 to 40 percent (with cementing properties). Lime and cement kiln dust contain 50 to 70 percent unreacted limestone, absorb moisture and harden upon wetting, and are commonly used for stabilization and binder materials (Skousen 2002). Use of these materials would be more practical as they are available and abundant waste materials and are already finely ground with reactive surfaces for neutralizing acid mine waste.

MINE INERTING WITH NITROGEN PRIOR TO CLOSURE

Historically, the use of nitrogen gas in the mining industry has been for extinguishing coal mine fires. It has the potential to inert abandoned or worked-out mines that have not been adequately sealed (Parker Hannifan Corporation 2011). Mine sealing with nitrogen generated onsite was investigated in a study at the National Institute for Occupational Safety and Health (NIOSH) Safety Research Coal Mine (SRCM). The objective was to extinguish oxygen in the mine so that the atmosphere would not support combustion (Trevits et al. 2009). While the nitrogen generator was successful at inerting the SRCM, testing in an actual mine was still recommended.

Inerting by injecting nitrogen gas into the underground mine just prior to flooding could displace oxygen and reduce the oxidation potential of the mined surfaces. Some of the uncertainties center on the quantity of nitrogen needed, whether onsite production would be beneficial to the use of delivered cryogenic nitrogen, how well the mine is sealed to prevent the escape of the nitrogen and influx of other gases, and the timing of the inerting with flooding. Cost versus effectiveness compared to other more conventional methods should also be considered.

Mobilization of Metals in Anoxic/Anaerobic Conditions

Anoxic conditions are defined when dissolved oxygen levels fall to below 0.5 mg/L (Ohio EPA 2014). Other subcategories of anoxic conditions are defined by what inorganic compound acts as the main electron acceptor (i.e., nitrate reducing, iron/manganese reducing, sulfate reducing). Anaerobic conditions are the complete absence of oxygen. In reducing conditions, metals can be present as sulfide minerals either from the ore deposit or from bacterial reduction of sulfate in oxidized rock and tailings. Metal sulfides remain immobile as long as they remain in a reducing environment. Metal hydroxides have low solubilities in neutral pH ranges. Their solubility increases with decreased pH (John and Leventhal 2004). Arsenic exists in the groundwater near the Black Butte Copper ore deposit. The additional release of arsenic into the groundwater as a result of mining activities is a complex interaction of the solid phase arsenic and other metal (such as iron) content and the dissolution/ desorption processes that may occur. Although arsenite (AsIII) is thermodynamically favored in anoxic water, both forms have been observed (Shankar 2014).

CONCLUSIONS AND RECOMMENDATIONS

The conclusions from this technical memorandum are listed as follows:

- SRB metabolic reactions consume energy sources and reduce sulfates to sulfides that precipitate metal sulfides and increase the pH and alkalinity of the water.
- The conditions proposed in the MOP at closure involve the creation of anoxic and anaerobic conditions (at depth) by flooding the underground workings. SRBs require more than just anoxic/anaerobic conditions. They require:
  - Inoculation of SRBs (if not present) by adding a source such as manure;
  - pH around 6;
  - Carbon source and nutrients; and
  - Growth substrate.
- While SRBs can be cultured under the conditions listed above, the establishment of a viable bioculture, growth substrate, and replenished carbon source needed to promote ongoing sulfate reducing conditions is questionable.

- Passive systems have typically been constructed bioreactors or a thick cover of organics over the top of a tailings pile, which need long-term, infrequent maintenance to operate effectively.
- The TOC of the native rock may be used by naturally occurring SRBs at depths in the right conditions, and may provide some sulfate reduction depending on the availability of the TOC within the rock.
- There is not enough experience with nitrogen inerting in full-scale mines to predict success in this application.
- Addition of a carbon source in the underground workings at closure by itself is unlikely to be effective in creating a bioreactor capable of sulfate reduction.

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APPENDIX F

Technical Memorandum 6

Technical Memorandum 6

To: Montana Department of Environmental Quality

From: Environmental Resources Management

Date: December 29, 2017

Subject: Black Butte Copper Project - Whether there is an advantage to requiring additional source controls (prevention of water inflow or application of treatment to rock faces) to limit oxidation during operation

BACKGROUND

During operation, Tintina plans to backfill production workings with a paste of tailings, cement, and binders. The backfill would provide structure to prevent subsidence; it would minimize groundwater contact with exposed rock both during operation and through closure and provide some neutralizing capability. The estimated surface area of the underground mine exposed to both air and groundwater inflow water would thereby be reduced at any given time. The Mine Operation Plan (MOP) also describes the grouting of fractures to limit intrusion of groundwater and collection and treatment of groundwater inflow (Tintina Montana, Inc. 2017). Water inflow would supply all of the water for the mine operation, although only 40 percent of the predicted inflow would actually be needed. All groundwater inflow would be collected and treated to non-degradation standards.

If inflow could be reduced, less water would have to be collected and treated. This Technical Memorandum explores the advantages of additional control measures to limit inflow and oxidation during operation.

CURRENT MOP

The groundwater inflow is estimated to be in the 420 to 500 gallons per minute (gpm) range during active mining, with occasional spikes of up to 1,000 gpm. Inflow and exposure to sulfates and metal oxide in the mined areas would need to be reduced as much as practical during operation. To limit inflow and groundwater contamination, planned procedures in the MOP include:

- Grouting – Tintina plans to grout major water bearing fractures or faults as they are encountered using pressure grouting techniques (sealing fractures by injecting a cement-based grout or a solution-based chemical mixture and diverting water around openings). One of the areas where grouting is anticipated to eliminate significant inflow due to fractures is underlying Coon Creek. According to the MOP, grouting the near-surface portion of the decline would substantially reduce mine inflow, with a ten-fold reduction in the first year according to model predictions.
- Use of Pilot Holes – Pilot holes ahead of the advancing mined face would be drilled to locate water-bearing geological structures. When or if large amounts of water are encountered in a

pilot hole, a packer would be installed to seal the hole. Following installation of the packer, directional grouting would be done prior to advancing.

- Collection and Treatment of Inflow – Groundwater inflow would provide the water needed for mine operation; however, only 40 percent of the estimated groundwater inflow would be needed. The remaining 60 percent would be treated to non-degradation standards and discharged to the upland underground infiltration galleries (UIGs) or to the alluvial UIGs if necessary.
- Cemented Tailings Backfill – During operation, a plant would be constructed to produce a paste (79 percent total solids by weight of mixture) comprised of fine-grained tailing from the milling process and 2-4 percent cement with proposed binders such as locally available cement, slag, and fly ash. The cement binder used to make the cemented tailings paste would also contain hydrated lime and should have neutralizing abilities. The low hydraulic conductivity of the backfilled tailings would reduce contact with groundwater.

ENVIRONMENTAL IMPACTS

The environmental impact of inflow would be the contamination of groundwater by exposure to oxidized surfaces and the dissolution of sulfates and heavy metals. Control of groundwater contamination would substantially reduce the amount of treatment needed and promote the ability of the planned treatment system to meet non-degradation standards.

TECHNICAL APPROACH

Methods of controlling groundwater inflow and contamination during operations are summarized in the following table (Kauppila 2011):

Method	Description	Applicability to Tintina BBC Mine
Paste Cover	Mixing fine-grained millings, cementitious materials, and water into pastes and covering tailings and exposed rock provides a barrier to oxidation	Planned use
Blending and backfilling mined areas	Blending waste rock and/or tailings with paste or neutralizing rock and returning to the excavated areas that are either filled with water or sealed from groundwater intrusion	Planned use
Sealed waste handling structures/dams	Sealing/liners/dam structures to prevent water intrusion and pickup of acid forming materials and heavy metals	Planned use

Method	Description	Applicability to Tintina BBC Mine
Depyritizing	Full or partial removal of iron sulfide from the waste to remove the acid-forming material prior to backfilling or placement in waste ponds	Evaluated in another Technical Memorandum
Water Cover	Owing to the significantly lower concentration and diffusion of oxygen in water, oxidation and acid production on tailings, waste rock and exposed rock surfaces can be limited through a water cover	Planned for by Tintina at closure (i.e., saturation of backfill with ambient groundwater), not practical during operation
Separation of acid and alkaline wastes	Acid forming tailings are separated to reduce the amount of material needing treatments to reduce oxidation	Applicable to tailings treatment, does not apply to underground mine surfaces
Encasing acid wastes within alkaline wastes	Carbonate/neutralizing tailing or waste rock coats or cover acid-forming material for either aboveground disposal or backfilling	Applicable to tailings treatment, does not apply to underground mine surfaces
Reactive Surface Coating	Coating tailings and/or waste rock with reactive materials such as organics to neutralize acid and bind or precipitate heavy metals	Use of organics to promote biofilms evaluated in another Technical Memorandum
Chemical Addition	Adding lime or other chemicals to neutralize acids	Lime and other alkaline materials would be a component of the cemented tailings backfill

Traditional and non-traditional surface coatings for sealing mined surfaces were evaluated in literature studies and are summarized in the following table (Haug and Pauls 2001):

Method	Description	Applicability to Tintina BBC Mine
Asphalt	Production of asphalt in a batch plant and application to mined surfaces	Can be used to limit oxidation, is subject to degradation over time, not practical for underground mine applications
Cementitious cover	Polypropylene fiber reinforced shotcrete	Planned use
Cement-stabilized coal fly ash grout	Fly ash mixtures and geopolymers	Planned use

Method	Description	Applicability to Tintina BBC Mine
Synthetic liners and covers	Geomembranes, spray-on membranes barriers, and geosynthetic clay liners	Spray on membrane barriers can be effective in limiting oxidation
Bentonite modified soil barriers	Soil-bentonite mixtures, polymer modified soil, and polymer surfactants	Can be used to limit oxidation, more appropriate for tailings piles and ponds
Mine Waste Tailings	Tailings and waste rock covers	Planned use
Wax barriers	Wax application to mined surfaces	Can be used to limit oxidation, are subject to degradation over time, not practical for underground mine applications

Some of these materials are only appropriate for covers or containment and not appropriate for surface treatments designed to mitigate acid formation. Prevention of acid formation requires the coating to be impermeable to oxygen transfer and resistant to acid degradation. The results of the evaluations showed that asphalt, wax, and spray-on membrane could be somewhat successful to limit oxygen transfer and liners such as geosynthetic clay liners and soil; modified soil barriers are only effective if they are maintained in a saturated state. Asphalts and waxes are subject to degradation if exposed for extended periods of time. None of these would be appropriate for sealing underground workings during operation to limit oxidation. The modification of fine grained and waste rock with bentonite, fly ash, or other materials could provide a surface cover that would limit oxygen transfer, be resistant to degradation, and provide structural support (Haug and Pauls 2001). This is similar to the Tintina MOP planned use of cemented tailings.

Butler (2014) describes using waste rock/tailings and grouting to seal cracks and fractures, and grout curtains to intercept groundwater flow paths. Additionally, flooding the mine workings before oxidation occurs can help to establish an anaerobic environment (Butler 2014). A large zinc-copper mine near Crandon, Wisconsin proposes to use grouting of underground mine working and active treatment of contaminated groundwater (Leopold et al. 2001). All of these methods except the grout curtains are in the Tintina MOP. Shotcrete could be produced that exhibits characteristics of high strength, low permeability, and good homogeneity. If shotcrete were to be applied over the top of rock surfaces, it would need to occur shortly after exposure. If the rock surfaces have already oxidized, the sulfate could attack the shotcrete and deteriorate the lining. Sulfate resistant cement could be used where sulfate attack is likely (Ma 2011).

CONCLUSIONS AND RECOMMENDATIONS

A technical review of the available sources compared to the MOP finds that most of the commonly used methods to control inflow are planned for use by Tintina. Other methods may have potential application but should only be considered if the control measures tested during the operations phase are unsuccessful.

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APPENDIX G

Technical Memorandum 7

Technical Memorandum 7

To: Montana Department of Environmental Quality

From: Environmental Resources Management

Date: December 29, 2017

Subject: Black Butte Copper Project - Whether there is an advantage to requiring alternative water treatment technologies rather than the proposed reverse osmosis treatment

BACKGROUND

Groundwater collected during the dewatering of the underground workings starting in year 2 of construction through closure would be collected and treated in a water treatment system that includes a dual pass Reverse Osmosis (RO) system. Approximately 60 percent of the groundwater would be treated to non-degradation standards and discharged under the conditions of a Montana Pollutant Discharge Elimination System (MPDES) permit through upland underground infiltration galleries (UIGs) to shallow bedrock, or into an infiltration gallery located in the Sheep Creek alluvial aquifer system. There are concerns with the ability of the water treatment system to effectively treat the water in all phases of mine operation to non-degradation standards, particularly for nitrates, and the disposition of the large volume of waste brine generated from the RO system.

CURRENT MOP

There are three phases of water management: Construction, Operation, and Closure. During construction, no water would be treated in the first year, and an estimated 250 gallons per minute (gpm) is anticipated in the second year. RO with pretreatment would be used to treat dewatering flow. Pretreatment prior to RO for all three phases includes ferric chloride precipitation/ coagulation of metals and solids and settling, followed by multimedia and cartridge filtration. The pretreatment and RO system treats the water to non-degradation standards. Following the RO system, treated water would be discharged primarily to the alluvial UIG (if needed) under the conditions of the MPDES permit. Treatment residuals would be stored in the Contact Water Pond (CWP). RO blowdown (brine) would be further treated in a Vibratory Shear Enhanced Process (VSEP) system to reduce its volume prior to storage in the brine cell or the CWP. The VSEP is a membrane system that uses vibrational shear forces to reduce membrane fouling, resulting in the ability to treat brine streams and recover water while reducing the brine volume (Johnson 2002). Constituents of concern for treatment during the Construction phase include arsenic, lead, strontium, thallium, total suspended solids (TSS), and nitrogen (nitrate, nitrite, etc.) species. Nitrogen species that originate from blasting operations are predicted to be removed in the RO system. An estimated 48.1 million gallons of RO blowdown would be generated during the 2-year Mine Construction Phase and stored in the CWP brine cell or hauled offsite, if necessary.

In the Operations phase, the treatment capacity would be increased to 588 gpm, with only 497 gpm treated with RO. The remaining water would be used in the Mill. During Operations, water would be a mixture of underground, process, and contact water. Constituents of concern would include pH, dissolved metals (antimony, arsenic, copper, lead, nickel, strontium, and thallium), nitrogen species (nitrate, nitrite, and precursors), and TSS.

The VSEP would not be used during the Operations phase as there are multiple onsite disposal options for the brine, and volume reduction is not needed. One brine disposal option is to pump the brine to the Process Water Pond (PWP). A second option is to pump the brine to the mill thickener. Both options would involve the incorporation of the brine into the cemented tailings paste for permanent disposal.

In the Closure phase, the RO system would be used at full capacity (500 gpm) to produce water to rinse the underground workings. RO blowdown would be volume reduced with the VSEP and shipped offsite. Water treatment would have the same effluent goals of not exceeding the Estimated Maximum Allowable Effluent Concentrations (EMAEC) throughout the three phases; however, the influent quality would vary.

Tintina maintains that the anticipated nitrate concentration from the water treatment facility would be below the groundwater non-degradation level. For the surface water alluvium (Little Sheep Creek), the non-degradation criteria for Nitrate + Nitrite (as N) is 11.29 milligrams per liter (mg/L), and Total Nitrogen at 0.61 mg/L. The predicted quality from the water treatment facility is estimated for Nitrate + Nitrite (as N) at 0.22 mg/L and Total Nitrogen at 0.32 mg/L. If these systems function as predicted, there should be no issues with meeting the non-degradation standards.

EIS ENVIRONMENTAL ISSUES

The potential environmental impacts would be with the water treatment system not consistently meeting non-degradation standards, particularly for nitrates and the disposition of the brine from water treatment from Construction through the Closure phases.

TECHNICAL APPROACH

RO membranes have a pore size of less than 0.002 micron and are susceptible to fouling by particulates, gas bubbles, and other fouling contaminants, requiring pretreatment of the influent beforehand. Constituents found in mine dewatering than could cause problems with RO membrane are iron salts, silica, calcium sulfate, and calcium carbonate (Chambers 2014). These constituents can reach saturation and cause scaling due to precipitate solids on the membrane. This causes reduced permeate flux and downtime of the treatment system to de-scale the membranes. Removal of cations through softening is a common RO pretreatment to increase the permeate recovery and reduce maintenance. Calcium, magnesium, and iron can be removed through hydroxide or sulfide precipitation, softening, or ion exchange. Precipitation produces a metal sludge that has to be disposed. Softeners and ion exchange processes require regeneration, which also produces a brine or concentrated waste that needs disposal. RO systems produce a significant amount of concentrated blowdown or brine for disposal. The permeate recovery and success of mine water treatment would depend on how well the pretreatment removes the scaling (calcium, iron) constituents in the water (USEPA 2003).

RO is a technically feasible treatment to remove nitrates. Rejection rates for sodium chloride and sodium nitrate can be as high as 98 percent and 93 percent, respectively (Jensen et al. 2012). RO membranes theoretically can reject as much as 99.5 percent of all dissolved ions including sodium, nitrate, and chloride (Dahm 2014).

While the most common application for RO is drinking and high-purity water treatment, RO has been considered in mining operations. In a report on water management in mines across the globe, RO was mostly used to desalinate sea water for mine operations. Only one mine – the closed Homestake gold mine in South Dakota – used RO to treat mine seepage (ICMM 2012). A large zinc-copper ore body near Crandon, Wisconsin, proposed to use RO and Evaporation for treatment of contaminated groundwater from the mine before reusing the water in the mine (Leopold et al. 2001).

ALTERNATIVE TECHNOLOGY

Other technologies considered for mining operations include ion exchange, electrodialysis, and mechanical (vapor compression) evaporators.

Ion Exchange has been used in mining applications to remove heavy metals and other divalent metal cations. Ion exchange resins for nitrate removal depend on the quality of the incoming water. There are three types of ion exchange systems: anionic, cationic, and chelating ion. Potable water influent can be treated for nitrate removal with strong base anion exchange and weak base anion exchange (Jensen 2012). Anions or cations are removed with the resins, producing treated water removed from the resin bed by regeneration with either acid or caustic. Regeneration of ion exchange beds produces a waste stream that has to be disposed of. Regeneration requires the storage of concentrated acids and bases and knowledgeable operators (Chambers 2014). Ion Exchange is generally not feasible or cost effective for treating large volumes of water as would be encountered in the Black Butte Copper Mine Project.

Electrodialysis uses direct electrical current across a stack of alternating cation and anion selective membranes to collect either anions or cations. Electrodialysis Reversal (EDR) units operate under lower pressures and are more tolerant of temperature and pH than RO. However, like RO, EDR units are susceptible to calcium sulfate scaling if pretreatment is inadequate. EDR treatment efficiency in removing dissolved ions does not compare favorably with RO. The amount of water recovered is lower, and a waste brine solution is also produced for disposal (Bowell 2004).

Mechanical vapor recompression evaporators can significantly reduce the waste brine volume; however, they have high maintenance requirements and high capital and operating costs. Mechanical and solar evaporation was considered by Tintina, but rejected based on inefficiency and costs.

The VSEP is a viable technology for volume reduction of the brine. It is not susceptible to calcium sulfate scaling and is more cost effective than mechanical evaporation.

CONCLUSIONS AND RECOMMENDATIONS

In theory, RO can remove 90+ percent of dissolved ions, including nitrate. In reality, the influent water quality and pretreatment determine the actual water recovery. The quality of the treated water modeled by the membrane manufacturer predicts that the proposed RO treatment system would produce water quality for injection below the non-degradation standards. However, the presence of calcium sulfate in the mine water is expected to play a significant role in reducing the water recovery rates and treatment efficiency. Selection and use of a calcium sulfate specific antiscalant would mitigate the impact of calcium sulfate and improve water recovery. The ability of the pretreatment would be critical to achieving the predicted quality of the RO treated water. There are not many technically feasible and non-cost prohibitive methods to reduce water treatment residuals. The VSEP system has been used for treatment of acid mine drainage and appears to be an appropriate method of reducing brine. In conclusion, there are no better alternatives to those proposed in the MOP for treating groundwater inflow and reducing brine volumes.

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APPENDIX H

Technical Memorandum 8

Technical Memorandum 8

To:	Montana Department of Environmental Quality
From:	Environmental Resources Management
Date:	December 29, 2017
Subject:	Black Butte Copper Project - Analysis of the effectiveness of the proposed end of mine flushing of the underground workings to remove oxidation products, including an evaluation of the length of time needed to accomplish this procedure

INTRODUCTION

The basis for this technical memorandum is the Mine Operating Permit Application (Tintina Montana, Inc. 2017) submitted to the Montana Department of Environment Quality on July 14, 2017. That document is referenced in the body of this memo as "MOP", with the particular section and page numbers as appropriate.

BACKGROUND

MINERAL SALT ACCUMULATION

Mineral salt accumulation is expected locally on access drift sills, backs, and ribs during the life of mine. Some of the salts would be highly soluble and susceptible to migration into groundwater upon inundation following mine closure.

FLUSH PROGRAM EXTENT

Humidity cell testing indicates that a three- to six-cycle flush program would be needed to wash down salts (MOP Section 7.3.3.6, pp. 428-433). Locally, that could extend to ten cycles. Conservatively, the duration of each cycle across the various zones would lead to a total program length on the order of 1 year.

CURRENT MOP

PHASED RO PERMEATE FLUSHING

The Proponent proposes to flush underground access workings initially with unbuffered RO permeate and subsequently with buffered RO permeate. The unbuffered RO permeate would have a relatively elevated capacity to scavenge solutes, whereas the buffered RO permeate would have a reduced capacity to scavenge solutes from bedrock (MOP Section 7.3.3.6, p. 428; Section 3DEQ [Response to Comments], p. 481).

POST-RINSE GROUNDWATER INUNDATION

Following these rinse phases, groundwater inundation would occur, creating anoxic conditions that are expected to result in groundwater characteristics meeting background conditions.

MONITORING AND REMEDIATION

Groundwater monitoring throughout the closure process would guide the rinsing and any remediation procedures (MOP Section 4.3.2, pp. 381-383; Section 6, pp. 391-406; Section 7.3.3.5, pp. 421-428; Section 7.3.3.6, pp. 428-433; Section 7.3.3.9, p. 435). This has been queried (Smith 2017), and the proposed MOP entails diligent and thorough background, operational, and closure monitoring programs. It would be prudent to allow these state-of-the-art investigations to shape and guide the closure and post-closure plans.

CONSTRUCTION ISSUES

EQUIPMENT DEPLOYMENT AND RINSE PROVISION

The Proponent is considering high-pressure washing of oxidation products and possibly shotcreting exposed high sulfide zones to isolate and immobilize those oxidation products (MOP Section 7.3.3.9, p. 435).

Typical shotcrete is not recommended as a chemical barrier over high sulfide zones. It is relatively permeable and susceptible to sulfate attack.

SUMP STAGING TO RECOVER RINSATE

In addition to the proposed monitor wells (MOP Section 7.3.3.7, p. 434), staging sumps could be appropriate to handle rinsate. It is appropriate to include the concept in the Environmental Impact Statement (EIS), with specific details to be based on the developing conditions during operational and closure monitoring.

EIS ENVIRONMENTAL ISSUES

COMPLIANCE WITH DEQ NON-DEGRADATION CRITERIA

Though the Humidity Cell Test (HCT) program was rigorous, it is appropriate to investigate whether salt build-up on the access and development drift surfaces is an environmental liability with respect to volume, concentration, potential dissolution, precipitation, or reaction to inert compounds, travel times, and distances to potential beneficial use of impacted groundwater. Those investigations are or can be part of the operational and closure water monitoring programs.

ADDITIONAL QUERIES

Increased Solute Loading

The question has been raised as to whether the greater surface area of broken rock, tailing, and open drifts would result in greater solute loading (Jepson 2017). There would be a broken rind around the access drifts, but the extent would be remarkably minimized with controlled blasting techniques and in any event is expected to be no more than a drift radius. Blasting breaks preferentially follow pre-existing fractures, and energy outside the individual blast pattern perimeter would tend to open those rather than introduce new fractures. Pre-splitting or smoothing the shots could virtually eliminate fracturing outside the blast pattern (Langefors and Kihlström 1963). Those techniques or their corollaries – in common use since the 1950s – are typical for permanent drill and blast openings in mining as well as virtually all drill and blast civil infrastructure openings.

The cemented tailing would present little internal surface area. With the overhand mining method, the superjacent fill would be poured directly on the hardened subjacent fill, and there would be no significant gaps between levels. The only air gap would be approximately 1.5 feet on the final level, and that could be readily filled with expansive grout or other media suitable for that application. Thus, the pre-mining naturally fractured rock would be replaced by a relatively tight and massive cemented formation.

It is reasonable to expect that the presented drift surface area would be similar to the pre-mining fracture surface area in the same volume. It could be less, depending on original local fracture frequency.

With these tailings and geology properties and prudent mining, no significant increase in surface area is expected. The essential change would be in exposure to atmosphere, which is proposed to be handled by the multiple flushing cycles.

Flushing Effectiveness

Questions have been raised as to whether oxidation products in fractures, voids between paste backfill and stope backs, and/or within the paste backfill would be effectively flushed out by the proposed rinsing (Jepson 2017). Will they continue to dissolve and bleed out slowly into the groundwater flow paths after active mining ceases, resulting in greater loading rates to the groundwater system than under the pre-mining condition?

Means for field evaluation of flushing effectiveness could be conducted during development and mining, with reasonable time to consider modifications to the closure procedures if needed. The field testing, which can begin relatively early in the mine life, would confirm whether the HCT results of “no significant salt loading” remain valid guidelines.

The post-mining anoxic conditions would significantly reduce or halt the tendency for producing additional salts. The relatively lower permeability of the cemented tailings (MOP Section 2.2.5, pp. 56-61; Table 2-13, p. 60) and low-permeability construction concrete would result in groundwater flow diverting around these structures; therefore, they are not expected to significantly contribute to salt loading of the groundwater.

Non-Degradation Compliance

Questions have been raised as to whether groundwater or surface water non-degradation criteria would be exceeded at some point post-closure (Jepson 2017).

The operational monitoring programs (MOP Section 6.3.1, pp. 391-398; Section 6.3.2, pp. 398-399) would provide years of data, providing opportunities for understanding trends and predicting behavior. The mining and milling processes are designed to prevent exceedances, and the background and operational monitoring are designed to assist in predicting exceedances.

Though testing to date indicates there would be no exceedances post closure, the post-operational closure monitoring for water quality (MOP Section 6.4.2, p. 405)

> … will occur until such time as the mine is certified as fully reclaimed and all bonding release milestones are met, or as determined in the post-operational monitoring program to be developed in conjunction with DEQ.

Nitrogen Flooding

A question has been raised as to whether nitrogen flooding would be suitable control for oxidation on the surfaces of underground openings. The procedure presented (Brown 2017) is:

> At closure, after the plugs are in… starting at the lowest level, flood the workings with low pressure N2 gas to displace oxygen/air moisture and limit oxidation. As that is being done, control fill with polished water. Once the lowest area is full, move on to the next higher. N2/polished water injection and monitoring wells would have to be installed in each, but the wells could be used for water monitoring post closure.

At first pass, this procedure does not eliminate the rinsing or flushing but is an additional action to supplant or augment the eventual groundwater inundation. An initial consideration is the suitability of the rock for gas flooding. Would gas seepage into the rock occur simply due to concentration gradient? Would that reduce or increase gas flooding efficiency? Would pressurization be needed to maintain efficiency?

Some of the wells for N2 and polished water injection would be close to and perhaps east of Sheep Creek in order to reach the lower ore zone and its access drifts. In order to intercept mine openings (16 feet wide at approximate depths from 300 to 1,300 feet), directional drilling would be necessary for both the lower and upper workings, as well as the ramp between them and on toward the portal. Though technically feasible, that adds considerable cost and constraints to the drilling. As injection wells with the attendant tankers and pump rigs, the drill sites would be larger than typical mineral exploration or water monitoring pads.

Nitrogen gas is handled in many industrial settings, even in bulk quantities. Historically, the use of nitrogen gas in the mining industry has been for extinguishing coal mine fires. However, even the fire retarding potential of flooding coal mines with nitrogen gas has not advanced beyond the research phase (Trevits 2009). Safety, skill, and experience may not easily be found for nitrogen flooding. Some of the uncertainties center on the quantity of nitrogen needed, whether onsite production would be beneficial to the use of delivered cryogenic nitrogen, how well the mine is sealed to prevent the escape of the nitrogen and influx of other gases, and the timing.

Nitrogen flooding entails installing all plugs and then drilling/injecting. The Proponent proposed that flushing is done sequentially before the plug construction, with the plugs subsequently contributing to the desired and natural anoxic condition. If the nitrogen is applied following flushing, would it in fact contribute to resolving salt generation and infiltration into groundwater? If flushing is not done before the nitrogen and polished water addition, would those alone achieve salt removal? Since the nitrogen program would be monitored only by remote means (drill holes), could the salt removal be verified?

Would sequential flushing be significantly more efficient than nitrogen flooding simply based on the plug construction timeline? As a very effective asphyxiant, it is not prudent to plan on nitrogen flooding with personnel in the mine, even with plugs above the nitrogen and below the personnel. The use of nitrogen in this application would have to be very reliably engineered to supplant the proposed closure flushing program. The RO permeate closure flushing is comparatively very benign from the perspective of personnel safety.

TECHNICAL APPROACH

CONFIRMATION THAT RINSING IS EFFECTIVE

Rinsate Infiltration

The drifts are not impermeable vessels; they are openings excavated in naturally fractured rock. Whether high pressure washing or inundation is used, what amount of rinsate would infiltrate into the back, ribs, and sill, and escape recovery? With high pressure washing, the rinsate would run to and over the sill to final collection. With inundation, the rinsate would stand or pond on the sill, against the ribs, and then against the back. Would infiltration significantly diminish the effectiveness of rinsing by seeping into the surrounding rock? Could infiltration be monitored and evaluated during the operational testing and design of the rinse procedures?

Rinsate Volume versus Inundation/Groundwater Volume

The predicted duration of rinsing cycles (MOP Section 7.3.3.7, p. 434) is a state of the art hydrological analysis. As queried above, could infiltration be monitored and evaluated during the operational testing and design of the rinse procedures? This could refine the model analysis and provide field scale guidance in designing rinse procedures.

Local versus Extensive Flushing

There is a reasonable expectation that surface oxidation would be localized to high-sulfur zones within the rock formations. The investigations during mine operations should include evaluating local versus extensive flushing aspects of the proposed rinsing program.

Salt Generation Time versus Salt Dissolution Time

When operational field testing can begin, it would be appropriate to investigate the efficacy of pressure washing versus inundation. An aspect of that could be the salt generation rate, which may resume or continue between high pressure wash cycles. That phenomenon could indicate that inundation is the most appropriate rinsing technique, or a combination of local pressure washing followed by inundation for subsequent rinses.

Implementation Cost

The implementation cost of closure flushing has been questioned (Freshman 2017). The Proponent is asked to provide that support. If appropriate, costs can be developed by the technical memo author(s) or other third party in either cursory or detailed analysis based on heads, volumes, equipment, and personnel. Conceptually, flushing as proposed appears to be a relatively low-cost approach. Apart from the hydrologic plugs, the essential material handled is water, which already is part of the process stream.

Implementation Duration

The duration of closure flushing has been questioned (Jepson 2017). The most conservative estimate (MOP Section 7.3.3.7, p. 434) is between 12 and 13 months. Post-closure monitoring would continue after the flushing program (MOP Section 6.4.2, p. 405).

MINIMIZE/ELIMINATE SALT GENERATION

Since the generation of the mineral salts is expected to be related to oxidation, eliminating or minimizing exposure of susceptible high sulfur zones to the mine air flow should be considered.

An additional aspect of operational testing could be to investigate whether preventive fillings or coverings could effectively minimize or eliminate salt generation. In various mining, tunneling, and infrastructure settings, these have been used to good effect for controlling gas, vapor, and water inflow. Using them as a low-pressure airflow barrier can readily be investigated.

Below are common items in underground construction and can be used separately or in combination, dependent on the specific application.

Grout Injection

Grout rings have a long and successful history in control of water and weak ground. In a high-sulfur zone, they could be used to flood and encapsulate that rock within a distance of several meters from the opening surface – sill, ribs, and back. If done with or soon after initial excavation, grout rings might eliminate much of the potential salt generation. Injected grout typically is packed or staged to prevent blowouts to the collar (surface). In this application, it would be appropriate to follow the grouting with concrete or shotcrete to seal the opening surface.

Concrete

Alternatively, concrete lining could be formed and poured to a sufficient thickness to retard or eliminate salt generation. Admixes to reduce permeability are recommended for this application.

A concrete lining would entail sub-excavation of the entire drift perimeter to establish the lining without encroaching on the drift cross-section. The sill must be taken deep enough to form and armor a running surface, which would withstand the mine vehicular traffic.

Constructing a concrete lining over grout rings could provide substantial reduction in the potential to oxidize high sulfur ground.

Shotcrete

Shotcrete has a long history in underground mining and construction for mechanical support of soil and rock. If admixtures to minimize permeability are used and applied thickly enough (typically in multiple passes), it can retard passage of liquids and gases. Shotcrete is aerated in application and typically is not an effective barrier to liquid or gases.

Shotcrete typically is of lesser utility on the sill of active drifts, as most configurations are not designed for vehicle traffic.

Sprayable Membranes

Synthetic sprayable membranes have applications as atmospheric and liquid barriers. In a mine setting, they typically are protected with either shotcrete or concrete. Across the sill, concrete is more appropriate for protecting against vehicular traffic. Conceptually, these membranes are a spray application of moisture/vapor/gas barriers used in conventional construction.

Rock Dusting

Rock dusting with limestone and/or lime could be investigated as a preliminary control measure in neutralizing the sulfur reactions, which initiate on exposure to the air. Though mine water treatment is common in plant settings (Geldenhuys et al. 2003), the drift setting with dry application could warrant consideration as the mine development were to proceed.

Rock dust is envisioned as an immediate application upon exposure of a high sulfur zone. Even if repetitive applications would be needed, it is a field scale investigation that may diminish formation of deleterious compounds but which would not preclude or impede adoption of closure flushing.

CONCLUSIONS AND RECOMMENDATIONS

CLOSURE FLUSHING OF ACCESS AND ANCILLARY OPENINGS

The hydrologic and geochemical analyses to date indicate that flushing the salt out of access and ancillary openings is a feasible and appropriate method of reaching groundwater discharge compliance.

Salt-laden rinsate infiltration should be analyzed in detail prior to commitment to closure flushing as the primary control for achieving post-closure water quality.

SHOTCRETE ALONE IS NOT RECOMMENDED

Shotcrete alone is suggested by the proponent (MOP Section 7.3.3.9, p. 435). Shotcrete alone is not recommended as a chemical barrier over high sulfide zones. Even vulcanized shotcrete can be susceptible to sulfate attack, losing adhesion to the rock surface and subsequently cracking or spalling.

MINIMIZE/ELIMINATE SALT GENERATION

The Proponent is asked to evaluate whether isolating potential salt generation zones is feasible and would eliminate their impact on groundwater discharge. Those evaluations could commence during the development and proceed through the operational phases, with the object of determining whether salt generation could be minimized or prevented during the life of mine, thus eliminating the need for or reducing the extent of closure flushing.

Various techniques are discussed above.

CEMENTED TAILINGS BACKFILL OF ACCESS OPENINGS

The proponent is asked to evaluate or confirm evaluation of the suitability of flushing as opposed to select plugs of salt zones or complete cemented tailings fill of access and ancillary openings.

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APPENDIX I

Baseline Surface Water Quality

Table 1 Water Quality Summary Statistics, SW-1

Parameters	Units	Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017		No. Samples	No. Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
		Aquatic Life Standard, Chronic	Human Health Standard, Surface Water									
Field Parameters												
Staff Gauge	Feet			46	46	0.5	13.3	1.5	0.8	1.0	1.6	1.8
Flow	Cubic Ft Sec			55	55	8.8	613	72.2	19.8	40.3	103	92.6
pH - Field	s.u.			65	65	5.3	8.7	7.9	7.8	8.1	8.3	0.7
Field Specific Conductivity	umhos/cm			66	66	176	363	284	239	304	321	54.2
Water Temperature	Deg C			66	66	-1.0	15.5	5.0	0.1	4.1	9.1	4.9
Dissolved Oxygen	mg/L	6.5		66	66	3.9	15.0	11.1	10.1	10.8	12.3	1.9
Physical Parameters												
Total Dissolved Solids	mg/L			70	70	104	227	165	147	175	186	28.6
Total Suspended Solids	mg/L			64	26	<4	50.0	10.3	4.0	9.5	10.3	9.1
Major Constituents - Commons Ions												
Alkalinity as CaCO3	mg/L			70	70	87.0	200	150	130	160	170	32.4
Bicarbonate as HCO3	mg/L			7	7	110	220	167	125	190	200	46.1
Carbonate as CO3	mg/L			7	5	<1	11.0	6.1	2.5	8.0	9.0	4.1
Chloride	mg/L			70	69	<1	5.0	1.5	1.0	1.0	2.0	0.7
Fluoride	mg/L		4	70	20	<0.1	0.2	0.1	0.1	0.1	0.1	0.01
Sulfate	mg/L			70	70	2.0	18.0	5.2	4.0	5.0	6.3	2.2
Hardness as CaCO3	mg/L			69	68	<7	199	146	114	162	173	37.1
Calcium (DIS)	mg/L			70	70	22.0	55.0	41.3	34.3	45.5	48.0	9.1
Magnesium (DIS)	mg/L			70	70	6.0	15.0	10.9	9.0	12.0	13.0	2.5
Potassium (DIS)	mg/L			70	65	<1	3.0	1.1	1.0	1.0	1.0	0.5
Sodium (DIS)	mg/L			70	70	1.0	3.0	2.2	2.0	2.0	2.0	0.4
Nutrients												
Nitrate + Nitrite as N	mg/L	10		70	31	<0.01	0.2	0.03	0.01	0.01	0.03	0.04
Kjeldahl Nitrogen as N	mg/L			12	5	<0.5	4.5	1.5	0.5	0.5	2.5	1.4
Total Persulfate Nitrogen	mg/L			43	36	<0.003	1.1	0.2	0.08	0.1	0.2	0.2
Phosphorus (TOT)	mg/L			53	49	<0.003	0.09	0.02	0.01	0.01	0.02	0.02
Metals - Trace Constituents												
Aluminum (DIS)	mg/L	0.087		70	33	<0.009	0.3	0.06	0.009	0.01	0.06	0.09
Aluminum (TRC)	mg/L			8	8	0.06	2.1	0.6	0.10	0.1	0.9	0.9
Antimony (DIS)	mg/L		0.0056	4	0	<0.003	0.003	0.003	0.003	0.003	0.003	0
Antimony (TRC)	mg/L			70	0	<0.0005	0.005	0.0009	0.0005	0.0005	0.0005	0.0009
Arsenic (DIS)	mg/L	0.15	0.01	4	0	<0.003	0.003	0.003	0.003	0.003	0.003	0
Arsenic (TRC)	mg/L			70	11	<0.001	0.003	0.001	0.001	0.001	0.001	0.0006
Barium (DIS)	mg/L		1	4	4	0.08	0.1	0.1	0.09	0.09	0.1	0.01
Barium (TRC)	mg/L			70	70	0.08	0.1	0.1	0.1	0.1	0.1	0.010
Beryllium (DIS)	mg/L		0.004	4	0	<0.001	0.001	0.001	0.00	0.001	0.001	0
Beryllium (TRC)	mg/L			70	0	<0.0008	0.001	0.0008	0.0008	0.0008	0.0008	0.00006
Cadmium (DIS)	mg/L	0.00025	0.005	4	0	<0.00008	0.00008	0.00008	0.00008	0.00008	0.00008	0
Cadmium (TRC)	mg/L			70	5	<0.00003	0.0002	0.00004	0.00003	0.00003	0.00003	0.00003
Chromium (DIS)	mg/L		0.1	4	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Chromium (TRC)	mg/L			70	3	<0.001	0.01	0.009	0.01	0.010	0.010	0.003
Cobalt (DIS)	mg/L			4	0	<0.01	0.01	0.01	0.01	0.010	0.010	0
Cobalt (TRC)	mg/L			70	0	<0.005	0.01	0.01	0.01	0.010	0.010	0.001
Copper (DIS)	mg/L	0.00285	1.3	4	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Copper (TRC)	mg/L			70	10	<0.001	0.008	0.002	0.002	0.002	0.002	0.0008
Iron (DIS)	mg/L			4	1	<0.03	0.04	0.03	0.03	0.03	0.03	0.005
Iron (TRC)	mg/L	1		70	70	0.1	1.9	0.4	0.2	0.2	0.6	0.4
Lead (DIS)	mg/L	0.000545	0.015	4	0	<0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0
Lead (TRC)	mg/L			70	21	<0.0003	0.002	0.0004	0.0003	0.0003	0.0005	0.0002
Manganese (DIS)	mg/L			4	4	0.006	0.009	0.007	0.006	0.007	0.008	0.002
Manganese (TRC)	mg/L			70	70	0.009	0.08	0.02	0.01	0.02	0.02	0.01
Mercury (DIS)	mg/L	0.00091	0.00005	4	0	<0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0
Mercury (TRC)	mg/L			70	17	<0.000005	0.00002	0.000007	0.000005	0.000005	0.000006	0.000004
Molybdenum (DIS)	mg/L			4	0	<0.005	0.005	0.005	0.005	0.005	0.005	0
Molybdenum (TRC)	mg/L			70	0	<0.001	0.005	0.002	0.002	0.002	0.002	0.001
Nickel (DIS)	mg/L	0.0161	0.1	4	0	<0.01	0.01	0.01	0.01	0.01	0.01	0
Nickel (TRC)	mg/L			70	15	<0.001	0.01	0.002	0.001	0.001	0.002	0.003
Selenium (DIS)	mg/L	0.005	0.05	4	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Selenium (TRC)	mg/L			70	0	<0.0002	0.001	0.0003	0.0002	0.0002	0.0002	0.0003
Silver (DIS)	mg/L		0.1	4	0	<0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0
Silver (TRC)	mg/L			70	0	<0.0002	0.0005	0.0003	0.0002	0.0002	0.0002	0.0001
Strontium (DIS)	mg/L		4	4	3	<0.1	0.1	0.1	0.1	0.1	0.1	0
Strontium (TRC)	mg/L			70	65	<0.0779	0.1	0.1	0.1	0.1	0.1	0.02
Thallium (DIS)	mg/L		0.00024	4	0	<0.0002	0.00020	0.00020	0.00020	0.00020	0.00020	0
Thallium (TRC)	mg/L			70	0	<0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0
Uranium (DIS)	mg/L		0.03	4	3	<0.0003	0.0004	0.0003	0.0003	0.0003	0.0003	0.00005
Uranium (TRC)	mg/L			70	9	<0.0003	0.008	0.006	0.008	0.008	0.008	0.003
Zinc (DIS)	mg/L	0.037	7.4	4	0	<0.01	0.01	0.01	0.01	0.01	0.01	0
Zinc (TRC)	mg/L			70	27	<0.002	0.01	0.004	0.002	0.002	0.005	0.003

Reporting Period: May 2011 to December 2017

°C = degrees Celsius, DIS = dissolved concentration, N = nitrogen, SD = standard deviation, TRC = total recoverable concentration, PCTL = percentile, TOT = total

Grey shading indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 chronic aquatic life guideline.

Bold indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 human health surface water guideline.

Table 2 Water Quality Summary Statistics, SW-2

Parameters	Units	Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017		No. Samples	No. Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
		Aquatic Life Standard, Chronic	Human Health Standard, Surface Water									
Field Parameters												
Staff Gauge	Feet			38	38	0.2	1.7	0.8	0.5	0.8	1.2	0.4
Flow	Cubic Ft Sec			42	42	4.0	250	52.1	13.8	29.9	93.4	52.5
pH - Field	s.u.			64	64	6.5	8.7	7.9	7.7	8.1	8.3	0.5
Field Specific Conductivity	umhos/cm			66	66	156	388	279	236	295	322	55.0
Water Temperature	Deg C			66	66	-1.0	15.8	4.9	0.003	3.3	9.9	5.1
Dissolved Oxygen	mg/L	6.5		66	66	6.35	16.2	11.1	9.94	10.8	12.1	1.8
Physical Parameters												
Total Dissolved Solids	mg/L			72	72	112	225	168	160	175	186	26.7
Total Suspended Solids	mg/L			67	19	<4	105	10.6	4.0	10.0	10.0	13.6
Major Constituents - Commons Ions												
Alkalinity as CaCO3	mg/L			72	72	80.0	200	155	140	160	173	28.7
Bicarbonate as HCO3	mg/L			9	9	98.0	220	178	140	200	210	43.1
Carbonate as CO3	mg/L			9	8	<1	11.0	7.2	6.0	7.0	11.0	3.4
Chloride	mg/L			72	71	<1	5.0	1.4	1.0	1.0	2.0	0.7
Fluoride	mg/L		4	72	1	<0.1	0.4	0.1	0.1	0.1	0.1	0.04
Sulfate	mg/L			72	72	2.0	9.0	4.9	4.0	4.8	6.0	1.5
Hardness as CaCO3	mg/L			71	70	<7	202	151	131	159	173	34.7
Calcium (DIS)	mg/L			72	72	21.0	58.0	43.5	37.8	46.0	49.3	8.4
Magnesium (DIS)	mg/L			72	72	5.0	15.0	11.0	9.8	12.0	12.0	2.2
Potassium (DIS)	mg/L			72	67	<1	2.0	1.0	1.0	1.0	1.0	0.1
Sodium (DIS)	mg/L			72	72	1.0	3.0	2.0	2.0	2.0	2.0	0.3
Nutrients												
Nitrate + Nitrite as N	mg/L	10		72	34	<0.01	0.1	0.03	0.01	0.01	0.05	0.04
Kjeldahl Nitrogen as N	mg/L			14	5	<0.5	3.6	1.4	0.5	0.5	2.4	1.3
Total Persulfate Nitrogen	mg/L			41	35	<0.003	1.4	0.2	0.06	0.09	0.2	0.3
Phosphorus (TOT)	mg/L			54	46	<0.003	0.2	0.02	0.01	0.01	0.02	0.03
Metals - Trace Constituents												
Aluminum (DIS)	mg/L	0.087		72	32	<0.009	0.4	0.04	0.009	0.01	0.05	0.07
Aluminum (TRC)	mg/L			8	8	0.0500	2.7	0.5	0.07	0.1	0.4	0.9
Antimony (DIS)	mg/L		0.0056	6	0	<0.003	0.003	0.003	0.003	0.003	0.003	0.0
Antimony (TRC)	mg/L			72	0	<0.0005	0.005	0.0008	0.0005	0.0005	0.0005	0.0009
Arsenic (DIS)	mg/L	0.15	0.01	6	0	<0.003	0.003	0.003	0.003	0.003	0.003	0.0
Arsenic (TRC)	mg/L			72	1	<0.001	0.003	0.001	0.001	0.001	0.001	0.0006
Barium (DIS)	mg/L		1	6	6	0.0770	0.1	0.09	0.08	0.08	0.09	0.01
Barium (TRC)	mg/L			72	72	0.0700	0.1	0.09	0.09	0.09	0.1	0.01
Beryllium (DIS)	mg/L		0.004	6	0	<0.001	0.001	0.001	0.001	0.001	0.001	0.0
Beryllium (TRC)	mg/L			72	0	<0.0008	0.001	0.0008	0.0008	0.0008	0.0008	0.00006
Cadmium (DIS)	mg/L	0.00025	0.005	6	0	<0.00008	0.00008	0.00008	0.00008	0.00008	0.00008	0.0
Cadmium (TRC)	mg/L			72	5	<0.00003	0.00008	0.00004	0.00003	0.00003	0.00003	0.00002
Chromium (DIS)	mg/L		0.1	6	0	<0.001	0.001	0.001	0.001	0.001	0.001	0.0
Chromium (TRC)	mg/L			72	1	<0.001	0.01	0.008	0.01	0.01	0.01	0.003
Cobalt (DIS)	mg/L			6	0	<0.01	0.01	0.01	0.01	0.01	0.01	0.0
Cobalt (TRC)	mg/L			72	0	<0.005	0.01	0.010	0.01	0.01	0.01	0.001
Copper (DIS)	mg/L	0.00285	1.3	6	0	<0.001	0.001	0.001	0.001	0.001	0.001	0.0
Copper (TRC)	mg/L			72	6	<0.001	0.004	0.002	0.002	0.002	0.002	0.0004
Iron (DIS)	mg/L			6	3	<0.03	0.04	0.03	0.03	0.03	0.04	0.005
Iron (TRC)	mg/L	1		72	72	0.0900	2.5	0.3	0.1	0.2	0.3	0.4
Lead (DIS)	mg/L	0.000545	0.015	6	0	<0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0
Lead (TRC)	mg/L			72	16	<0.0003	0.002	0.0004	0.0003	0.0003	0.0004	0.0002
Manganese (DIS)	mg/L			6	4	<0.005	0.01	0.008	0.005	0.007	0.008	0.003
Manganese (TRC)	mg/L			72	72	0.00600	0.1	0.01	0.008	0.01	0.01	0.01
Mercury (DIS)	mg/L	0.00091	0.00005	6	0	<0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.0
Mercury (TRC)	mg/L			72	11	<0.000005	0.00006	0.000007	0.000005	0.000005	0.000005	0.000006
Molybdenum (DIS)	mg/L			6	0	<0.005	0.005	0.005	0.005	0.005	0.005	0.0
Molybdenum (TRC)	mg/L			72	0	<0.001	0.005	0.002	0.002	0.002	0.002	0.001
Nickel (DIS)	mg/L	0.0161	0.1	6	0	<0.01	0.01	0.01	0.01	0.01	0.01	0.0
Nickel (TRC)	mg/L			72	13	<0.001	0.01	0.002	0.001	0.001	0.001	0.003
Selenium (DIS)	mg/L	0.005	0.05	6	0	<0.001	0.001	0.001	0.001	0.001	0.001	0.0
Selenium (TRC)	mg/L			72	0	<0.0002	0.001	0.0003	0.0002	0.0002	0.0002	0.0003
Silver (DIS)	mg/L		0.1	6	0	<0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0
Silver (TRC)	mg/L			72	0	<0.0002	0.0005	0.0002	0.0002	0.0002	0.0002	0.0001
Strontium (DIS)	mg/L		4	6	4	<0.1	0.1	0.1	0.1	0.1	0.1	0.0
Strontium (TRC)	mg/L			72	69	<0.0818	0.2	0.1	0.1	0.1	0.1	0.02
Thallium (DIS)	mg/L		0.00024	6	0	<0.0002	0.00020	0.00020	0.00020	0.00020	0.00020	0.0
Thallium (TRC)	mg/L			72	0	<0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0
Uranium (DIS)	mg/L		0.03	6	3	<0.0003	0.0004	0.0003	0.0003	0.0003	0.0003	0.00004
Uranium (TRC)	mg/L			72	8	<0.0003	0.008	0.006	0.008	0.008	0.008	0.003
Zinc (DIS)	mg/L	0.037	7.4	6	0	<0.01	0.01	0.01	0.01	0.01	0.01	0.0
Zinc (TRC)	mg/L			72	22	<0.002	0.01	0.004	0.002	0.002	0.005	0.003

Reporting Period: May 2011 to December 2017

°C = degrees Celsius, DIS = dissolved concentration, N = nitrogen, SD = standard deviation, TRC = total recoverable concentration, PCTL = percentile, TOT = total

Grey shading indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 chronic aquatic life guideline.

Bold indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 human health surface water guideline.

Table 3 Water Quality Summary Statistics, SW-3

Parameters	Units	Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017		No. Samples	No. Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
		Aquatic Life Standard, Chronic	Human Health Standard, Surface Water									
Field Parameters												
Staff Gauge	Feet			15	15	0.1	1.0	0.5	0.4	0.5	0.6	0.2
Flow	Cubic Ft Sec			21	21	0.03	4.9	0.4	0.08	0.1	0.3	1.0
pH - Field	s.u.			25	25	7.9	8.7	8.3	8.2	8.3	8.4	0.2
Field Specific Conductivity	umhos/cm			25	25	269	408	373	363	383	393	35.7
Water Temperature	Deg C			24	24	0.01	14.5	7.8	2.2	9.4	12.1	5.0
Dissolved Oxygen	mg/L	6.5		25	25	6.0	13.4	10.2	9.4	10.0	11.0	1.7
Physical Parameters												
Total Dissolved Solids	mg/L			28	28	152	235	214	209	215	224	16.3
Total Suspended Solids	mg/L			25	10	<4	14	7.9	5.0	10.0	10.0	3.1
Major Constituents - Commons Ions												
Alkalinity as CaCO3	mg/L			28	28	150	210	197	190	200	200	12.5
Bicarbonate as HCO3	mg/L			7	7	180	240	224	225	230	235	20.7
Carbonate as CO3	mg/L			7	7	2.0	9.0	7.0	6.5	8.0	8.5	2.4
Chloride	mg/L			28	26	<1	2.0	1.4	1.0	1.0	2.0	0.5
Fluoride	mg/L		4	28	28	0.1	0.2	0.2	0.2	0.2	0.2	0.03
Sulfate	mg/L			28	28	5.0	24.0	15.3	12.0	15.0	18.3	5.0
Hardness as CaCO3	mg/L			27	27	139	225	206	201	213	219	19.5
Calcium (DIS)	mg/L			28	28	31.0	50.0	45.6	45.0	46.0	48.0	4.14
Magnesium (DIS)	mg/L			28	28	15.0	25.0	22.3	21.0	23.0	24.0	2.25
Potassium (DIS)	mg/L			28	25	<1	2.0	1.0	1.0	1.0	1.0	0.2
Sodium (DIS)	mg/L			28	28	2.00	2.0	2.0	2.0	2.0	2.0	0
Nutrients												
Nitrate + Nitrite as N	mg/L	10		28	25	<0.01	0.1	0.05	0.04	0.05	0.06	0.03
Kjeldahl Nitrogen as N	mg/L			4	1	<0.5	2.2	0.9	0.5	0.5	0.9	0.9
Total Persulfate Nitrogen	mg/L			12	11	<0.04	0.2	0.1	0.1	0.1	0.2	0.06
Phosphorus (TOT)	mg/L			16	15	<0.004	0.04	0.01	0.01	0.01	0.02	0.007
Metals - Trace Constituents												
Aluminum (DIS)	mg/L	0.087		28	3	<0.009	0.07	0.02	0.009	0.009	0.01	0.01
Aluminum (TRC)	mg/L			6	5	<0.03	0.7	0.3	0.1	0.2	0.6	0.3
Antimony (DIS)	mg/L		0.0056	5	0	<0.003	0.003	0.003	0.003	0.003	0.003	0
Antimony (TRC)	mg/L			28	0	<0.0005	0.005	0.001	0.0005	0.0005	0.003	0.001
Arsenic (DIS)	mg/L	0.15	0.01	5	0	<0.003	0.003	0.003	0.003	0.003	0.003	0
Arsenic (TRC)	mg/L			28	0	<0.001	0.003	0.001	0.001	0.001	0.001	0.0008
Barium (DIS)	mg/L		1	5	5	0.1	0.1	0.1	0.1	0.1	0.1	0.01
Barium (TRC)	mg/L			28	28	0.1	0.2	0.1	0.1	0.2	0.2	0.01
Beryllium (DIS)	mg/L		0.004	5	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Beryllium (TRC)	mg/L			28	0	<0.0008	0.001	0.0008	0.0008	0.0008	0.0008	0.00008
Cadmium (DIS)	mg/L	0.00025	0.005	5	0	<0.00008	0.00008	0.00008	0.00008	0.00008	0.00008	0
Cadmium (TRC)	mg/L			28	0	<0.00003	0.00008	0.00004	0.00003	0.00003	0.00003	0.00002
Chromium (DIS)	mg/L		0.1	5	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Chromium (TRC)	mg/L			28	0	<0.001	0.01	0.008	0.004	0.01	0.01	0.004
Cobalt (DIS)	mg/L			5	0	<0.01	0.01	0.01	0.01	0.01	0.01	0
Cobalt (TRC)	mg/L			28	0	<0.005	0.01	0.01	0.01	0.01	0.01	0.0009
Copper (DIS)	mg/L	0.00285	1.3	5	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Copper (TRC)	mg/L			28	5	<0.001	0.003	0.002	0.002	0.002	0.002	0.0004
Iron (DIS)	mg/L			5	0	<0.03	0.03	0.03	0.03	0.03	0.03	0
Iron (TRC)	mg/L	1		28	28	0.0400	1.1	0.2	0.09	0.2	0.2	0.2
Lead (DIS)	mg/L	0.000545	0.015	5	0	<0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0
Lead (TRC)	mg/L			28	16	<0.0003	0.003	0.0007	0.0003	0.0004	0.0006	0.0007
Manganese (DIS)	mg/L			5	0	<0.005	0.005	0.005	0.005	0.005	0.005	0
Manganese (TRC)	mg/L			28	11	<0.005	0.2	0.01	0.005	0.005	0.007	0.04
Mercury (DIS)	mg/L	0.00091	0.00005	5	1	<0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.0
Mercury (TRC)	mg/L			28	2	<0.000005	0.00001	0.000006	0.000005	0.000005	0.000005	0.000002
Molybdenum (DIS)	mg/L			5	0	<0.005	0.005	0.005	0.005	0.005	0.005	0
Molybdenum (TRC)	mg/L			28	0	<0.001	0.005	0.003	0.002	0.002	0.003	0.001
Nickel (DIS)	mg/L	0.0161	0.1	5	0	<0.01	0.01	0.01	0.01	0.01	0.01	0
Nickel (TRC)	mg/L			28	0	<0.001	0.01	0.003	0.001	0.001	0.001	0.004
Selenium (DIS)	mg/L	0.005	0.05	5	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Selenium (TRC)	mg/L			28	5	<0.0002	0.001	0.0004	0.0002	0.0002	0.0006	0.0003
Silver (DIS)	mg/L		0.1	5	0	<0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0
Silver (TRC)	mg/L			28	0	<0.0002	0.0005	0.0003	0.0002	0.0002	0.0005	0.0001
Strontium (DIS)	mg/L		4	5	0	<0.1	0.1	0.1	0.1	0.1	0.1	0
Strontium (TRC)	mg/L			28	25	<0.0838	0.1	0.1	0.1	0.1	0.1	0.00914
Thallium (DIS)	mg/L		0.00024	5	0	<0.0002	0.00020	0.00020	0.00020	0.00020	0.00020	0
Thallium (TRC)	mg/L			28	3	<0.0002	0.0004	0.0002	0.0002	0.0002	0.0002	0.00004
Uranium (DIS)	mg/L		0.03	5	5	0.00050	0.0006	0.0005	0.0005	0.0005	0.0006	0.00005
Uranium (TRC)	mg/L			28	9	<0.0005	0.008	0.006	0.00070	0.008	0.008	0.004
Zinc (DIS)	mg/L	0.037	7.4	5	0	<0.01	0.01	0.01	0.01	0.01	0.01	0
Zinc (TRC)	mg/L			28	15	<0.002	0.03	0.006	0.002	0.003	0.009	0.006

Reporting Period: May 2011 to December 2017

°C = degrees Celsius, DIS = dissolved concentration, N = nitrogen, SD = standard deviation, TRC = total recoverable concentration, PCTL = percentile, TOT = total

Grey shading indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 chronic aquatic life guideline.

Bold indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 human health surface water guideline.

Table 4 Water Quality Summary Statistics, SW-4

Parameters	Units	Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017		No. Samples	No. Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
		Aquatic Life Standard, Chronic	Human Health Standard, Surface Water									
Field Parameters												
Staff Gauge	Feet			4	4	0.3	2.0	1.5	1.4	1.9	2.0	0.8
Flow	Cubic Ft Sec			23	23	0.004	2.0	0.2	0.01	0.03	0.2	0.4
pH - Field	s.u.			26	26	7.5	8.7	8.0	7.9	8.0	8.2	0.3
Field Specific Conductivity	umhos/cm			26	26	237	390	351	343	359	374	33.5
Water Temperature	Deg C			26	26	0.08	15.0	7.4	1.5	9.0	12.5	5.3
Dissolved Oxygen	mg/L	6.5		26	26	5.4	13.7	9.6	8.5	9.6	10.7	1.9
Physical Parameters												
Total Dissolved Solids	mg/L											
Total Suspended Solids	mg/L											
Major Constituents - Commons Ions												
Alkalinity as CaCO3	mg/L											
Bicarbonate as HCO3	mg/L											
Carbonate as CO3	mg/L											
Chloride	mg/L											
Fluoride	mg/L		4									
Sulfate	mg/L											
Hardness as CaCO3	mg/L											
Calcium (DIS)	mg/L											
Magnesium (DIS)	mg/L											
Potassium (DIS)	mg/L											
Sodium (DIS)	mg/L											
Nutrients												
Nitrate + Nitrite as N	mg/L	10										
Kjeldahl Nitrogen as N	mg/L											
Total Persulfate Nitrogen	mg/L											
Phosphorus (TOT)	mg/L											
Metals - Trace Constituents												
Aluminum (DIS)	mg/L	0.087										
Aluminum (TRC)	mg/L											
Antimony (DIS)	mg/L		0.0056									
Antimony (TRC)	mg/L											
Arsenic (DIS)	mg/L	0.15	0.01									
Arsenic (TRC)	mg/L											
Barium (DIS)	mg/L		1									
Barium (TRC)	mg/L											
Beryllium (DIS)	mg/L		0.004									
Beryllium (TRC)	mg/L											
Cadmium (DIS)	mg/L	0.00025	0.005									
Cadmium (TRC)	mg/L											
Chromium (DIS)	mg/L		0.1									
Chromium (TRC)	mg/L											
Cobalt (DIS)	mg/L											
Cobalt (TRC)	mg/L											
Copper (DIS)	mg/L	0.00285	1.3									
Copper (TRC)	mg/L											
Iron (DIS)	mg/L											
Iron (TRC)	mg/L	1										
Lead (DIS)	mg/L	0.000545	0.015									
Lead (TRC)	mg/L											
Manganese (DIS)	mg/L											
Manganese (TRC)	mg/L											
Mercury (DIS)	mg/L	0.00091	0.00005									
Mercury (TRC)	mg/L											
Molybdenum (DIS)	mg/L											
Molybdenum (TRC)	mg/L											
Nickel (DIS)	mg/L	0.0161	0.1									
Nickel (TRC)	mg/L											
Selenium (DIS)	mg/L	0.005	0.05									
Selenium (TRC)	mg/L											
Silver (DIS)	mg/L		0.1									
Silver (TRC)	mg/L											
Strontium (DIS)	mg/L		4									
Strontium (TRC)	mg/L											
Thallium (DIS)	mg/L		0.00024									
Thallium (TRC)	mg/L											
Uranium (DIS)	mg/L		0.03									
Uranium (TRC)	mg/L											
Zinc (DIS)	mg/L	0.037	7.4									
Zinc (TRC)	mg/L											

Reporting Period: May 2011 to December 2017

°C = degrees Celsius, DIS = dissolved concentration, N = nitrogen, SD = standard deviation, TRC = total recoverable concentration, PCTL = percentile, TOT = total

Grey shading indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 chronic aquatic life guideline.

Bold indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 human health surface water guideline.

Table 5 Water Quality Summary Statistics, SW-5

Parameters	Units	Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017		No. Samples	No. Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
		Aquatic Life Standard, Chronic	Human Health Standard, Surface Water									
Field Parameters												
Staff Gauge	Feet			1	1	0.9	0.9	0.9	0.9	0.9	0.9	NA
Flow	Cubic Ft Sec			5	5	0.4	4.7	1.4	0.5	0.7	0.8	1.9
pH - Field	s.u.			5	5	7.3	8.2	7.6	7.5	7.5	7.6	0.3
Field Specific Conductivity	umhos/cm			5	5	49.0	60.0	52.8	50.0	50.0	55.0	4.7
Water Temperature	Deg C			5	5	0.29	12.1	6.0	2.9	6.9	7.8	4.6
Dissolved Oxygen	mg/L	6.5		5	5	8.5	14.0	10.6	9.4	9.7	11.4	2.2
Physical Parameters												
Total Dissolved Solids	mg/L			5	5	66.0	123	90.2	74.0	86.0	102	22.8
Total Suspended Solids	mg/L			4	2	<10	107	38.0	10.0	17.5	45.5	46.5
Major Constituents - Commons Ions												
Alkalinity as CaCO3	mg/L			5	5	24.0	27.0	25.8	25.0	26.0	27.0	1.3
Bicarbonate as HCO3	mg/L			2	2	32.0	33.0	32.5	32.3	32.5	32.8	0.7
Carbonate as CO3	mg/L			2	0	<1	1.0	1.0	1.0	1.0	1.0	0.0
Chloride	mg/L			5	0	<1	1.0	1.0	1.0	1.0	1.0	0.0
Fluoride	mg/L		4	5	0	<0.1	0.1	0.1	0.1	0.1	0.1	0.0
Sulfate	mg/L			5	3	<1	2.0	1.3	1.0	1.0	1.5	0.4
Hardness as CaCO3	mg/L			5	5	19.0	26.0	24.6	26.0	26.0	26.0	3.1
Calcium (DIS)	mg/L			5	5	6.0	7.0	6.8	7.0	7.0	7.0	0.4
Magnesium (DIS)	mg/L			5	5	1.0	2.0	1.8	2.0	2.0	2.0	0.4
Potassium (DIS)	mg/L			5	5	1.0	2.0	1.6	1.0	2.0	2.0	0.5
Sodium (DIS)	mg/L			5	5	1.0	1.0	1.0	1.0	1.0	1.0	0
Nutrients												
Nitrate + Nitrite as N	mg/L	10		5	4	<0.01	0.2	0.06	0.01	0.04	0.06	0.08
Kjeldahl Nitrogen as N	mg/L			1	1	0.7	0.7	0.7	0.7	0.7	0.7	NA
Total Persulfate Nitrogen	mg/L			1	1	1.20	1.2	1.2	1.2	1.2	1.2	NA
Phosphorus (TOT)	mg/L			2	2	0.04	0.2	0.1	0.1	0.1	0.1	0.1
Metals - Trace Constituents												
Aluminum (DIS)	mg/L	0.087		5	5	0.2	3.1	1.3	0.4	0.7	2.1	1.2
Aluminum (TRC)	mg/L			2	2	0.7	1.0	0.8	0.8	0.8	0.8	0.2
Antimony (DIS)	mg/L		0.0056	1	0	<0.003	0.003	0.003	0.003	0.003	0.003	NA
Antimony (TRC)	mg/L			5	0	<0.0005	0.003	0.002	0.001	0.001	0.003	0.001
Arsenic (DIS)	mg/L	0.15	0.01	1	0	<0.003	0.003	0.003	0.003	0.003	0.003	NA
Arsenic (TRC)	mg/L			5	3	0.001	0.004	0.003	0.002	0.003	0.003	0.001
Barium (DIS)	mg/L		1	1	1	0.2	0.2	0.2	0.2	0.2	0.2	NA
Barium (TRC)	mg/L			5	5	0.2	0.3	0.2	0.2	0.2	0.2	0.08
Beryllium (DIS)	mg/L		0.004	1	0	<0.001	0.001	0.001	0.001	0.001	0.001	NA
Beryllium (TRC)	mg/L			5	0	<0.0008	0.001	0.0009	0.0008	0.0008	0.001	0.0001
Cadmium (DIS)	mg/L	0.00025	0.005	1	0	<0.00008	0.00008	0.00008	0.00008	0.00008	0.00008	NA
Cadmium (TRC)	mg/L			5	1	<0.00003	0.0002	0.00008	0.00003	0.00008	0.00008	0.00007
Chromium (DIS)	mg/L		0.1	1	0	<0.001	0.001	0.001	0.001	0.001	0.001	NA
Chromium (TRC)	mg/L			5	1	<0.001	0.01	0.006	0.001	0.01	0.01	0.005
Cobalt (DIS)	mg/L			1	0	<0.01	0.01	0.01	0.01	0.01	0.01	NA
Cobalt (TRC)	mg/L			5	0	0.01	0.01	0.01	0.01	0.01	0.01	0.0
Copper (DIS)	mg/L	0.00285	1.3	1	1	0.002	0.002	0.002	0.002	0.002	0.002	NA
Copper (TRC)	mg/L			5	5	0.003	0.009	0.004	0.003	0.003	0.004	0.003
Iron (DIS)	mg/L			1	1	0.2	0.2	0.2	0.2	0.2	0.2	NA
Iron (TRC)	mg/L	1		5	5	0.5	6.0	2.1	0.7	1.4	1.9	2.257
Lead (DIS)	mg/L	0.000545	0.015	1	0	<0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	NA
Lead (TRC)	mg/L			5	3	<0.0005	0.005	0.001	0.0005	0.0005	0.0007	0.002
Manganese (DIS)	mg/L			1	1	0.019	0.02	0.02	0.02	0.02	0.02	NA
Manganese (TRC)	mg/L			5	5	0.011	0.2	0.05	0.01	0.01	0.037	0.066
Mercury (DIS)	mg/L	0.00091	0.00005	1	1	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	NA
Mercury (TRC)	mg/L			5	4	<0.0000062	0.00002	0.00001	0.00001	0.00001	0.00001	0.00001
Molybdenum (DIS)	mg/L			1	0	<0.005	0.005	0.005	0.005	0.005	0.005	NA
Molybdenum (TRC)	mg/L			5	0	<0.002	0.005	0.003	0.002	0.002	0.005	0.002
Nickel (DIS)	mg/L	0.0161	0.1	1	0	<0.01	0.01	0.01	0.01	0.01	0.01	NA
Nickel (TRC)	mg/L			5	3	<0.003	0.01	0.007	0.004	0.008	0.01	0.003
Selenium (DIS)	mg/L	0.005	0.05	1	0	<0.001	0.001	0.001	0.001	0.001	0.001	NA
Selenium (TRC)	mg/L			5	2	<0.0002	0.001	0.0006	0.0002	0.0004	0.001	0.0004
Silver (DIS)	mg/L		0.1	1	0	<0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	NA
Silver (TRC)	mg/L			5	0	<0.0002	0.0005	0.0003	0.0002	0.0002	0.0005	0.0002
Strontium (DIS)	mg/L		4	1	0	<0.1	0.1	0.1	0.1	0.1	0.1	NA
Strontium (TRC)	mg/L			5	3	<0.028	0.1	0.06	0.03	0.03	0.1	0.04
Thallium (DIS)	mg/L		0.00024	1	0	<0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	NA
Thallium (TRC)	mg/L			5	0	<0.0002	0.00020	0.00020	0.00020	0.00020	0.00020	0.0
Uranium (DIS)	mg/L		0.03	1	0	<0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	NA
Uranium (TRC)	mg/L			5	0	<0.0003	0.008	0.003	0.0003	0.0003	0.008	0.004
Zinc (DIS)	mg/L	0.037	7.4	1	0	<0.01	0.01	0.01	0.01	0.01	0.01	NA
Zinc (TRC)	mg/L			5	4	<0.007	0.03	0.01	0.01	0.01	0.02	0.010

Reporting Period: May 2011 to December 2017

°C = degrees Celsius, DIS = dissolved concentration, N = nitrogen, SD = standard deviation, TRC = total recoverable concentration, PCTL = percentile, TOT = total

Grey shading indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 chronic aquatic life guideline.

Bold indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 human health surface water guideline.

Table 6 Water Quality Summary Statistics, SW-6

Parameters	Units	Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017		No. Samples	No. Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
		Aquatic Life Standard, Chronic	Human Health Standard, Surface Water									
Field Parameters												
Staff Gauge	Feet			1	1	0.9	0.9	0.9	0.9	0.9	0.9	NA
Flow	Cubic Ft Sec			23	23	0.04	4.1	0.4	0.1	0.2	0.2	0.8
pH - Field	s.u.			27	27	6.7	8.7	8.0	8.0	8.1	8.2	0.4
Field Specific Conductivity	umhos/cm			27	27	249	433	387	371	393	411	36.1
Water Temperature	Deg C			27	27	-0.03	18.3	7.7	1.5	6.8	13.1	6.1
Dissolved Oxygen	mg/L	6.5		27	27	5.8	14.2	9.7	8.5	9.9	11.0	1.9
Physical Parameters												
Total Dissolved Solids	mg/L			28	28	162	254	222	216	221	233	18.4
Total Suspended Solids	mg/L			23	16	<4	107	20.0	10.0	10.0	19.0	26.7
Major Constituents - Commons Ions												
Alkalinity as CaCO3	mg/L			28	28	140	240	213	208	220	223	19.6
Bicarbonate as HCO3	mg/L			7	7	220	260	246	245	250	250	12.7
Carbonate as CO3	mg/L			7	7	4.0	13.0	9.1	7.0	9.0	12.0	3.3
Chloride	mg/L			28	8	<1	2.0	1.0	1.0	1.0	1.0	0.189
Fluoride	mg/L		4	28	26	<0.1	0.2	0.16	0.1	0.2	0.2	0.05
Sulfate	mg/L			28	28	6.0	34.0	11.5	8.8	9.5	13.0	5.4
Hardness as CaCO3	mg/L			28	28	119	239	212	211	216	227	24.3
Calcium (DIS)	mg/L			28	28	28.0	54.0	49.3	49.0	50.0	52.3	5.3
Magnesium (DIS)	mg/L			28	28	12.0	26.0	21.6	21.0	22.0	23.0	2.8
Potassium (DIS)	mg/L			28	14	<1	3.0	1.1	1.0	1.0	1.0	0.448
Sodium (DIS)	mg/L			28	28	2.0	3.0	2.9	3.0	3.0	3.0	0.315
Nutrients												
Nitrate + Nitrite as N	mg/L	10		28	25	<0.01	0.1	0.05	0.02	0.05	0.07	0.03
Kjeldahl Nitrogen as N	mg/L			5	1	<0.5	3.4	1.1	0.5	0.5	0.5	1.3
Total Persulfate Nitrogen	mg/L			11	11	0.1	0.4	0.2	0.1	0.2	0.2	0.09
Phosphorus (TOT)	mg/L			16	16	0.01	0.04	0.02	0.02	0.02	0.03	0.01
Metals - Trace Constituents												
Aluminum (DIS)	mg/L	0.087		28	1	<0.009	0.03	0.01	0.009	0.009	0.02	0.009
Aluminum (TRC)	mg/L			7	7	0.03	0.2	0.1	0.1	0.1	0.2	0.05
Antimony (DIS)	mg/L		0.0056	5	0	<0.003	0.003	0.003	0.003	0.003	0.003	0
Antimony (TRC)	mg/L			28	0	<0.0005	0.005	0.001	0.0005	0.0005	0.003	0.001
Arsenic (DIS)	mg/L	0.15	0.01	5	0	<0.003	0.003	0.003	0.003	0.003	0.003	0
Arsenic (TRC)	mg/L			28	0	<0.001	0.003	0.002	0.001	0.001	0.002	0.001
Barium (DIS)	mg/L		1	5	5	0.107	0.1	0.1	0.1	0.1	0.1	0.007
Barium (TRC)	mg/L			28	28	0.091	0.2	0.1	0.1	0.1	0.1	0.028
Beryllium (DIS)	mg/L		0.004	5	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Beryllium (TRC)	mg/L			28	0	<0.0008	0.001	0.0009	0.0008	0.0008	0.0009	0.00009
Cadmium (DIS)	mg/L	0.00025	0.005	5	0	<0.00008	0.00008	0.0001	0.00008	0.00008	0.00008	0
Cadmium (TRC)	mg/L			28	2	<0.00003	0.00008	0.00004	0.00003	0.00003	0.00006	0.00002
Chromium (DIS)	mg/L		0.1	5	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Chromium (TRC)	mg/L			28	0	<0.001	0.01	0.007	0.001	0.01	0.01	0.004
Cobalt (DIS)	mg/L			5	0	<0.01	0.01	0.01	0.01	0.01	0.01	0
Cobalt (TRC)	mg/L			28	0	<0.005	0.01	0.010	0.01	0.01	0.01	0.001
Copper (DIS)	mg/L	0.00285	1.3	5	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Copper (TRC)	mg/L			28	1	<0.001	0.002	0.002	0.002	0.002	0.002	0.0004
Iron (DIS)	mg/L			5	3	<0.03	0.05	0.04	0.03	0.04	0.04	0.008
Iron (TRC)	mg/L	1		28	28	0.05	1.9	0.4	0.2	0.4	0.5	0.4
Lead (DIS)	mg/L	0.000545	0.015	5	0	<0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0
Lead (TRC)	mg/L			28	10	<0.0003	0.002	0.0005	0.0003	0.0004	0.0005	0.0004
Manganese (DIS)	mg/L			5	5	0.005	0.01	0.008	0.005	0.007	0.01	0.003
Manganese (TRC)	mg/L			28	26	<0.005	0.07	0.02	0.01	0.02	0.02	0.01
Mercury (DIS)	mg/L	0.00091	0.00005	5	0	<0.00001	0.00001	0.0000	0.00001	0.00001	0.00001	0
Mercury (TRC)	mg/L			28	4	<0.000005	0.00002	0.00001	0.000005	0.000005	0.00001	0.000004
Molybdenum (DIS)	mg/L			5	0	<0.005	0.005	0.005	0.005	0.005	0.005	0
Molybdenum (TRC)	mg/L			28	0	<0.001	0.005	0.003	0.002	0.002	0.005	0.001
Nickel (DIS)	mg/L	0.0161	0.1	5	0	<0.01	0.01	0.01	0.01	0.01	0.01	0
Nickel (TRC)	mg/L			28	2	<0.001	0.01	0.003	0.001	0.001	0.004	0.004
Selenium (DIS)	mg/L	0.005	0.05	5	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Selenium (TRC)	mg/L			28	7	<0.0002	0.001	0.0005	0.0002	0.0002	0.001	0.0004
Silver (DIS)	mg/L		0.1	5	0	<0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0
Silver (TRC)	mg/L			28	0	<0.0002	0.0005	0.0003	0.0002	0.0002	0.0005	0.0001
Strontium (DIS)	mg/L		4	5	5	0.1	0.2	0.2	0.2	0.2	0.2	0.04
Strontium (TRC)	mg/L			28	28	0.1	0.3	0.2	0.2	0.2	0.2	0.04
Thallium (DIS)	mg/L		0.00024	5	0	<0.0002	0.00020	0.00020	0.00020	0.00020	0.00020	0
Thallium (TRC)	mg/L			28	0	<0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0
Uranium (DIS)	mg/L		0.03	5	5	0.0006	0.0007	0.0006	0.0006	0.0006	0.0007	0.00005
Uranium (TRC)	mg/L			28	10	<0.0005	0.008	0.0054	0.0007	0.008	0.008	0.004
Zinc (DIS)	mg/L	0.037	7.4	5	0	<0.01	0.01	0.01	0.01	0.01	0.01	0
Zinc (TRC)	mg/L			28	12	<0.002	0.03	0.006	0.002	0.003	0.01	0.006

Reporting Period: May 2011 to December 2017

°C = degrees Celsius, DIS = dissolved concentration, N = nitrogen, SD = standard deviation, TRC = total recoverable concentration, PCTL = percentile, TOT = total

Grey shading indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 chronic aquatic life guideline.

Bold indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 human health surface water guideline.

Table 7 Water Quality Summary Statistics, SW-8

Parameters	Units	Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017		No. Samples	No. Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
		Aquatic Life Standard, Chronic	Human Health Standard, Surface Water									
Field Parameters												
Staff Gauge	Feet			17	17	0.2	2.1	0.6	0.3	0.4	0.6	0.5
Flow	Cubic Ft Sec			20	20	0.09	9.1	1.4	0.2	0.5	1.1	2.2
pH - Field	s.u.			23	23	6.9	8.7	7.9	7.8	8	8.2	0.4
Field Specific Conductivity	umhos/cm			23	23	164	445	377	338	408	431	80.4
Water Temperature	Deg C			23	23	-0.2	16.1	6.5	0.04	6.9	11.0	5.8
Dissolved Oxygen	mg/L	6.5		23	23	5.6	13.5	10.3	9.4	10.1	11.1	1.8
Physical Parameters												
Total Dissolved Solids	mg/L											
Total Suspended Solids	mg/L											
Major Constituents - Commons Ions												
Alkalinity as CaCO3	mg/L											
Bicarbonate as HCO3	mg/L											
Carbonate as CO3	mg/L											
Chloride	mg/L											
Fluoride	mg/L		4									
Sulfate	mg/L											
Hardness as CaCO3	mg/L											
Calcium (DIS)	mg/L											
Magnesium (DIS)	mg/L											
Potassium (DIS)	mg/L											
Sodium (DIS)	mg/L											
Nutrients												
Nitrate + Nitrite as N	mg/L	10										
Kjeldahl Nitrogen as N	mg/L											
Total Persulfate Nitrogen	mg/L											
Phosphorus (TOT)	mg/L											
Metals - Trace Constituents												
Aluminum (DIS)	mg/L	0.087										
Aluminum (TRC)	mg/L											
Antimony (DIS)	mg/L		0.0056									
Antimony (TRC)	mg/L											
Arsenic (DIS)	mg/L	0.15	0.01									
Arsenic (TRC)	mg/L											
Barium (DIS)	mg/L		1									
Barium (TRC)	mg/L											
Beryllium (DIS)	mg/L		0.004									
Beryllium (TRC)	mg/L											
Cadmium (DIS)	mg/L	0.00025	0.005									
Cadmium (TRC)	mg/L											
Chromium (DIS)	mg/L		0.1									
Chromium (TRC)	mg/L											
Cobalt (DIS)	mg/L											
Cobalt (TRC)	mg/L											
Copper (DIS)	mg/L	0.00285	1.3									
Copper (TRC)	mg/L											
Iron (DIS)	mg/L											
Iron (TRC)	mg/L	1										
Lead (DIS)	mg/L	0.000545	0.015									
Lead (TRC)	mg/L											
Manganese (DIS)	mg/L											
Manganese (TRC)	mg/L											
Mercury (DIS)	mg/L	0.00091	0.00005									
Mercury (TRC)	mg/L											
Molybdenum (DIS)	mg/L											
Molybdenum (TRC)	mg/L											
Nickel (DIS)	mg/L	0.0161	0.1									
Nickel (TRC)	mg/L											
Selenium (DIS)	mg/L	0.005	0.05									
Selenium (TRC)	mg/L											
Silver (DIS)	mg/L		0.1									
Silver (TRC)	mg/L											
Strontium (DIS)	mg/L		4									
Strontium (TRC)	mg/L											
Thallium (DIS)	mg/L		0.00024									
Thallium (TRC)	mg/L											
Uranium (DIS)	mg/L		0.03									
Uranium (TRC)	mg/L											
Zinc (DIS)	mg/L	0.037	7.4									
Zinc (TRC)	mg/L											

Reporting Period: May 2011 to December 2017

°C = degrees Celsius, DIS = dissolved concentration, N = nitrogen, SD = standard deviation, TRC = total recoverable concentration, PCTL = percentile, TOT = total

Grey shading indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 chronic aquatic life guideline.

Bold indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 human health surface water guideline.

Table 8 Water Quality Summary Statistics, SW-9

Parameters	Units	Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017		No. Samples	No. Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
		Aquatic Life Standard, Chronic	Human Health Standard, Surface Water									
Field Parameters												
Staff Gauge	Feet			8	8	1.3	2.1	1.9	2.0	2.0	2.0	0.3
Flow	Cubic Ft Sec			25	25	0.3	12.7	1.4	0.4	0.7	1.7	2.5
pH - Field	s.u.			26	26	7.7	8.5	8.2	8.1	8.2	8.3	0.2
Field Specific Conductivity	umhos/cm			26	26	335	474	418	409	424	435	28.5
Water Temperature	Deg C			26	26	0.5	14.9	6.0	1.8	5.2	10.1	4.7
Dissolved Oxygen	mg/L	6.5		26	26	5.7	14.9	10.5	10.1	10.5	11.4	1.8
Physical Parameters												
Total Dissolved Solids	mg/L											
Total Suspended Solids	mg/L											
Major Constituents - Commons Ions												
Alkalinity as CaCO3	mg/L											
Bicarbonate as HCO3	mg/L											
Carbonate as CO3	mg/L											
Chloride	mg/L											
Fluoride	mg/L		4									
Sulfate	mg/L											
Hardness as CaCO3	mg/L											
Calcium (DIS)	mg/L											
Magnesium (DIS)	mg/L											
Potassium (DIS)	mg/L											
Sodium (DIS)	mg/L											
Nutrients												
Nitrate + Nitrite as N	mg/L	10										
Kjeldahl Nitrogen as N	mg/L											
Total Persulfate Nitrogen	mg/L											
Phosphorus (TOT)	mg/L											
Metals - Trace Constituents												
Aluminum (DIS)	mg/L	0.087										
Aluminum (TRC)	mg/L											
Antimony (DIS)	mg/L		0.0056									
Antimony (TRC)	mg/L											
Arsenic (DIS)	mg/L	0.15	0.01									
Arsenic (TRC)	mg/L											
Barium (DIS)	mg/L		1									
Barium (TRC)	mg/L											
Beryllium (DIS)	mg/L		0.004									
Beryllium (TRC)	mg/L											
Cadmium (DIS)	mg/L	0.00025	0.005									
Cadmium (TRC)	mg/L											
Chromium (DIS)	mg/L		0.1									
Chromium (TRC)	mg/L											
Cobalt (DIS)	mg/L											
Cobalt (TRC)	mg/L											
Copper (DIS)	mg/L	0.00285	1.3									
Copper (TRC)	mg/L											
Iron (DIS)	mg/L											
Iron (TRC)	mg/L	1										
Lead (DIS)	mg/L	0.000545	0.015									
Lead (TRC)	mg/L											
Manganese (DIS)	mg/L											
Manganese (TRC)	mg/L											
Mercury (DIS)	mg/L	0.00091	0.00005									
Mercury (TRC)	mg/L											
Molybdenum (DIS)	mg/L											
Molybdenum (TRC)	mg/L											
Nickel (DIS)	mg/L	0.0161	0.1									
Nickel (TRC)	mg/L											
Selenium (DIS)	mg/L	0.005	0.05									
Selenium (TRC)	mg/L											
Silver (DIS)	mg/L		0.1									
Silver (TRC)	mg/L											
Strontium (DIS)	mg/L		4									
Strontium (TRC)	mg/L											
Thallium (DIS)	mg/L		0.00024									
Thallium (TRC)	mg/L											
Uranium (DIS)	mg/L		0.03									
Uranium (TRC)	mg/L											
Zinc (DIS)	mg/L	0.037	7.4									
Zinc (TRC)	mg/L											

Reporting Period: May 2011 to December 2017

°C = degrees Celsius, DIS = dissolved concentration, N = nitrogen, SD = standard deviation, TRC = total recoverable concentration, PCTL = percentile, TOT = total

Grey shading indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 chronic aquatic life guideline.

Bold indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 human health surface water guideline.

Table 9 Water Quality Summary Statistics, SW-10

Parameters	Units	Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017		No. Samples	No. Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
		Aquatic Life Standard, Chronic	Human Health Standard, Surface Water									
Field Parameters												
Staff Gauge	Feet			16	16	0.7	1.2	0.9	0.8	0.9	1.0	0.2
Flow	Cubic Ft Sec			20	20	0.2	15.2	1.45	0.3	0.5	1.4	3.3
pH - Field	s.u.			22	22	7.8	8.8	8.3	8.2	8.3	8.5	0.2
Field Specific Conductivity	umhos/cm			22	22	353	438	413	410	417	425	20.1
Water Temperature	Deg C			21	21	0.02	18.6	8.5	4.7	6.4	13.9	6.5
Dissolved Oxygen	mg/L	6.5		22	22	6.6	13.0	10.4	9.9	10.7	11.1	1.6
Physical Parameters												
Total Dissolved Solids	mg/L			2	2	236	249	243	239	243	246	9.2
Total Suspended Solids	mg/L			2	2	6.0	38.0	22.0	14.0	22.0	30.0	22.6
Major Constituents - Commons Ions												
Alkalinity as CaCO3	mg/L			2	2	210	220	215	213	215	218	7.1
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			2	0	<1	1	1.0	1	1	1	0
Fluoride	mg/L		4	2	2	0.2	0.2	0.2	0.2	0.2	0.2	0
Sulfate	mg/L			2	2	15.0	19.0	17.0	16.0	17.0	18.0	2.8
Hardness as CaCO3	mg/L			2	2	220	220	220	220	220	220	0
Calcium (DIS)	mg/L			2	2	50.0	52.0	51.0	50.5	51.0	51.5	1.4
Magnesium (DIS)	mg/L			2	2	22.0	23.0	22.5	22.3	22.5	22.8	0.7
Potassium (DIS)	mg/L			2	1	<1	1.0	1.0	1.0	1.0	1.0	0
Sodium (DIS)	mg/L			2	2	2.0	2.0	2.0	2.0	2.0	2.0	0
Nutrients												
Nitrate + Nitrite as N	mg/L	10		2	2	0.1	0.1	0.1	0.1	0.1	0.1	0.01
Kjeldahl Nitrogen as N	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Total Persulfate Nitrogen	mg/L			2	2	0.2	0.4	0.3	0.3	0.3	0.4	0.1
Phosphorus (TOT)	mg/L			2	2	0.01	0.03	0.02	0.01	0.02	0.02	0.01
Metals - Trace Constituents												
Aluminum (DIS)	mg/L	0.087		2	0	<0.009	0.009	0.0090	0.0090	0.009	0.009	0
Aluminum (TRC)	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Antimony (DIS)	mg/L		0.0056	0	NA	NA	NA	NA	NA	NA	NA	NA
Antimony (TRC)	mg/L			2	0	<0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0
Arsenic (DIS)	mg/L	0.15	0.01	0	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic (TRC)	mg/L			2	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Barium (DIS)	mg/L		1	0	NA	NA	NA	NA	NA	NA	NA	NA
Barium (TRC)	mg/L			2	2	0.077	0.09	0.08	0.08	0.08	0.09	0.008
Beryllium (DIS)	mg/L		0.004	0	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium (TRC)	mg/L			2	0	<0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0
Cadmium (DIS)	mg/L	0.00025	0.005	0	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium (TRC)	mg/L			2	1	<0.00003	0.00004	0.00004	0.00003	0.00004	0.00004	0.000007
Chromium (DIS)	mg/L		0.1	0	NA	NA	NA	NA	NA	NA	NA	NA
Chromium (TRC)	mg/L			2	0	<0.01	0.01	0.01	0.01	0.01	0.01	0
Cobalt (DIS)	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt (TRC)	mg/L			2	0	<0.01	0.01	0.01	0.01	0.01	0.01	0
Copper (DIS)	mg/L	0.00285	1.3	0	NA	NA	NA	NA	NA	NA	NA	NA
Copper (TRC)	mg/L			2	0	<0.002	0.002	0.002	0.002	0.002	0.002	0
Iron (DIS)	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Iron (TRC)	mg/L	1		2	2	0.2	0.8	0.5	0.3	0.5	0.6	0.4
Lead (DIS)	mg/L	0.000545	0.015	0	NA	NA	NA	NA	NA	NA	NA	NA
Lead (TRC)	mg/L			2	1	<0.0003	0.001	0.0007	0.0005	0.0007	0.0009	0.001
Manganese (DIS)	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Manganese (TRC)	mg/L			2	2	0.01	0.02	0.02	0.01	0.02	0.02	0.008
Mercury (DIS)	mg/L	0.00091	0.00005	0	NA	NA	NA	NA	NA	NA	NA	NA
Mercury (TRC)	mg/L			2	0	<0.000005	0.000005	0.000005	0.000005	0.000005	0.000005	0
Molybdenum (DIS)	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Molybdenum (TRC)	mg/L			2	0	<0.002	0.002	0.0020	0.002	0.002	0.002	0
Nickel (DIS)	mg/L	0.0161	0.1	0	NA	NA	NA	NA	NA	NA	NA	NA
Nickel (TRC)	mg/L			2	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Selenium (DIS)	mg/L	0.005	0.05	0	NA	NA	NA	NA	NA	NA	NA	NA
Selenium (TRC)	mg/L			2	0	<0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0
Silver (DIS)	mg/L		0.1	0	NA	NA	NA	NA	NA	NA	NA	NA
Silver (TRC)	mg/L			2	0	<0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0
Strontium (DIS)	mg/L		4	0	NA	NA	NA	NA	NA	NA	NA	NA
Strontium (TRC)	mg/L			2	2	0.2	0.2	0.2	0.2	0.2	0.2	0.01
Thallium (DIS)	mg/L		0.00024	0	NA	NA	NA	NA	NA	NA	NA	NA
Thallium (TRC)	mg/L			2	0	<0.0002	0.00020	0.00020	0.00020	0.00020	0.00020	0
Uranium (DIS)	mg/L		0.03	0	NA	NA	NA	NA	NA	NA	NA	NA
Uranium (TRC)	mg/L			2	0	<0.008	0.008	0.008	0.008	0.008	0.008	0
Zinc (DIS)	mg/L	0.037	7.4	0	NA	NA	NA	NA	NA	NA	NA	NA
Zinc (TRC)	mg/L			2	2	0.003	0.008	0.006	0.004	0.006	0.007	0.004

Reporting Period: May 2011 to December 2017

°C = degrees Celsius, DIS = dissolved concentration, N = nitrogen, SD = standard deviation, TRC = total recoverable concentration, PCTL = percentile, TOT = total

Grey shading indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 chronic aquatic life guideline.

Bold indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 human health surface water guideline.

Table 10 Water Quality Summary Statistics, SW-11

Parameters	Units	Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017		No. Samples	No. Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
		Aquatic Life Standard, Chronic	Human Health Standard, Surface Water									
Field Parameters												
Staff Gauge	Feet			19	19	0.2	0.9	0.5	0.4	0.5	0.6	0.2
Flow	Cubic Ft Sec			20	20	0.2	21.4	2.3	0.4	1.0	2.6	4.6
pH - Field	s.u.			27	27	7.5	8.7	8.2	8.1	8.2	8.4	0.3
Field Specific Conductivity	umhos/cm			27	27	312	497	402	384	404	425	44.2
Water Temperature	Deg C			27	27	-0.02	16.3	6.0	0.1	6.2	10.5	5.7
Dissolved Oxygen	mg/L	6.5		27	27	7.0	15.4	11.1	9.8	11.6	12.0	2.0
Physical Parameters												
Total Dissolved Solids	mg/L			27	27	166	282	229	215	231	240	25.8
Total Suspended Solids	mg/L			23	9	<4	68.0	13.7	4.0	10.0	11.5	15.2
Major Constituents - Commons Ions												
Alkalinity as CaCO3	mg/L			27	27	160	250	204	195	210	220	21.2
Bicarbonate as HCO3	mg/L			6	6	210	260	238	225	245	250	19.4
Carbonate as CO3	mg/L			6	6	4.0	12.0	8.8	7.3	9.0	11.5	3.1
Chloride	mg/L			27	21	<1	2.0	1.3	1.0	1.0	1.6	0.4
Fluoride	mg/L		4	27	27	0.1	0.2	0.2	0.2	0.2	0.2	0.03
Sulfate	mg/L			27	27	9.0	46.0	20.1	14.0	18.0	23.5	8.0
Hardness as CaCO3	mg/L			27	27	156	267	217	194	225	236	28.7
Calcium (DIS)	mg/L			27	27	36.0	60.0	49.7	45.5	51.0	53.5	6.1
Magnesium (DIS)	mg/L			27	27	16.0	29.0	22.6	20.0	24.0	24.5	3.4
Potassium (DIS)	mg/L			27	26	<1	2.0	1.1	1.0	1.0	1.0	0.3
Sodium (DIS)	mg/L			27	27	2.0	3.0	2.6	2.0	3.0	3.0	0.5
Nutrients												
Nitrate + Nitrite as N	mg/L	10		27	24	<0.01	0.19	0.07	0.03	0.05	0.1	0.06
Kjeldahl Nitrogen as N	mg/L			4	1	<0.5	3.4	1.2	0.5	0.5	1.2	1.5
Total Persulfate Nitrogen	mg/L			12	12	0.09	0.5	0.2	0.1	0.2	0.3	0.1
Phosphorus (TOT)	mg/L			16	16	0.003	0.06	0.03	0.02	0.02	0.03	0.02
Metals - Trace Constituents												
Aluminum (DIS)	mg/L	0.087		27	6	<0.009	1.4	0.09	0.009	0.009	0.03	0.3
Aluminum (TRC)	mg/L			6	6	0.08	0.3	0.2	0.1	0.2	0.3	0.1
Antimony (DIS)	mg/L		0.0056	4	0	<0.003	0.003	0.003	0.003	0.003	0.003	0
Antimony (TRC)	mg/L			26	0	<0.0005	0.005	0.001	0.0005	0.0005	0.002	0.001
Arsenic (DIS)	mg/L	0.15	0.01	4	0	<0.003	0.003	0.003	0.003	0.003	0.003	0
Arsenic (TRC)	mg/L			26	2	<0.001	0.003	0.001	0.001	0.001	0.001	0.001
Barium (DIS)	mg/L		1	4	4	0.092	0.1	0.1	0.10	0.1	0.1	0.009
Barium (TRC)	mg/L			26	26	0.09	0.1	0.1	0.10	0.1	0.1	0.01
Beryllium (DIS)	mg/L		0.004	4	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Beryllium (TRC)	mg/L			26	0	<0.0008	0.001	0.0008	0.0008	0.0008	0.0008	0.00009
Cadmium (DIS)	mg/L	0.00025	0.005	4	0	<0.00008	0.00008	0.00008	0.00008	0.00008	0.00008	0
Cadmium (TRC)	mg/L			26	3	<0.00003	0.00008	0.0000	0.00003	0.00003	0.000055	0.00002
Chromium (DIS)	mg/L		0.1	4	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Chromium (TRC)	mg/L			26	0	<0.001	0.01	0.007	0.002	0.01	0.01	0.004
Cobalt (DIS)	mg/L			4	0	<0.01	0.01	0.01	0.01	0.01	0.01	0
Cobalt (TRC)	mg/L			26	0	<0.005	0.01	0.01	0.01	0.01	0.01	0.001
Copper (DIS)	mg/L	0.00285	1.3	4	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Copper (TRC)	mg/L			26	5	<0.001	0.003	0.0018	0.002	0.002	0.002	0.0005
Iron (DIS)	mg/L			4	3	<0.03	0.06	0.04	0.04	0.04	0.05	0.01
Iron (TRC)	mg/L	1		26	26	0.04	2.1	0.4	0.1	0.2	0.4	0.5
Lead (DIS)	mg/L	0.000545	0.015	4	0	<0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0
Lead (TRC)	mg/L			26	8	<0.0003	0.0031	0.0006	0.0003	0.0003	0.0005	0.001
Manganese (DIS)	mg/L			4	1	<0.005	0.007	0.006	0.005	0.005	0.006	0.001
Manganese (TRC)	mg/L			26	16	<0.005	0.08	0.01	0.005	0.007	0.02	0.02
Mercury (DIS)	mg/L	0.00091	0.00005	4	0	<0.00001	0.00001	0.0000	0.00001	0.00001	0.00001	0
Mercury (TRC)	mg/L			26	4	<0.000005	0.00002	0.0000	0.000005	0.000005	0.00001	0.000003
Molybdenum (DIS)	mg/L			4	0	<0.005	0.005	0.005	0.005	0.005	0.005	0
Molybdenum (TRC)	mg/L			26	0	<0.001	0.005	0.003	0.002	0.002	0.004	0.001
Nickel (DIS)	mg/L	0.0161	0.1	4	0	<0.01	0.01	0.0100	0.01	0.01	0.01	0
Nickel (TRC)	mg/L			26	3	<0.001	0.01	0.003	0.001	0.001	0.002	0.004
Selenium (DIS)	mg/L	0.005	0.05	4	0	<0.001	0.001	0.0010	0.001	0.001	0.001	0
Selenium (TRC)	mg/L			26	4	<0.0002	0.001	0.0004	0.0002	0.0002	0.0009	0.0004
Silver (DIS)	mg/L		0.1	4	0	<0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0
Silver (TRC)	mg/L			26	0	<0.0002	0.0005	0.0003	0.0002	0.0002	0.0005	0.0001
Strontium (DIS)	mg/L		4	4	4	0.1	0.2	0.2	0.2	0.2	0.2	0.050
Strontium (TRC)	mg/L			26	26	0.1	0.2	0.2	0.2	0.2	0.2	0.025
Thallium (DIS)	mg/L		0.00024	4	0	<0.0002	0.00020	0.00020	0.00020	0.00020	0.00020	0
Thallium (TRC)	mg/L			26	0	<0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0
Uranium (DIS)	mg/L		0.03	4	4	0.0007	0.0009	0.0008	0.0007	0.0008	0.0008	0.0001
Uranium (TRC)	mg/L			26	9	<0.0007	0.008	0.0055	0.0009	0.008	0.008	0.003
Zinc (DIS)	mg/L	0.037	7.4	4	0	<0.01	0.01	0.0100	0.01	0.01	0.01	0
Zinc (TRC)	mg/L			26	14	<0.002	0.016	0.006	0.002	0.004	0.01	0.004

Reporting Period: May 2011 to December 2017

°C = degrees Celsius, DIS = dissolved concentration, N = nitrogen, SD = standard deviation, TRC = total recoverable concentration, PCTL = percentile, TOT = total

Grey shading indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 chronic aquatic life guideline.

Bold indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 human health surface water guideline.

Table 11 Water Quality Summary Statistics, SW-12

Parameters	Units	Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017		No. Samples	No. Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
		Aquatic Life Standard, Chronic	Human Health Standard, Surface Water									
Field Parameters												
Staff Gauge	Feet			0	NA	NA	NA	NA	NA	NA	NA	NA
Flow	Cubic Ft Sec			2	2	8.8	24.2	16.5	12.7	16.5	20.4	10.9
pH - Field	s.u.			2	2	7.8	7.8	7.8	7.8	7.8	7.8	0.04
Field Specific Conductivity	umhos/cm			2	2	75.0	97.0	86.0	80.5	86.0	91.5	15.6
Water Temperature	Deg C			2	2	10.8	14.1	12.5	11.6	12.5	13.3	2.3
Dissolved Oxygen	mg/L	6.5		2	2	8.7	9.2	9.0	8.8	9.0	9.1	0.4
Physical Parameters												
Total Dissolved Solids	mg/L											
Total Suspended Solids	mg/L											
Major Constituents - Commons Ions												
Alkalinity as CaCO3	mg/L											
Bicarbonate as HCO3	mg/L											
Carbonate as CO3	mg/L											
Chloride	mg/L											
Fluoride	mg/L		4									
Sulfate	mg/L											
Hardness as CaCO3	mg/L											
Calcium (DIS)	mg/L											
Magnesium (DIS)	mg/L											
Potassium (DIS)	mg/L											
Sodium (DIS)	mg/L											
Nutrients												
Nitrate + Nitrite as N	mg/L	10										
Kjeldahl Nitrogen as N	mg/L											
Total Persulfate Nitrogen	mg/L											
Phosphorus (TOT)	mg/L											
Metals - Trace Constituents												
Aluminum (DIS)	mg/L	0.087										
Aluminum (TRC)	mg/L											
Antimony (DIS)	mg/L		0.0056									
Antimony (TRC)	mg/L											
Arsenic (DIS)	mg/L	0.15	0.01									
Arsenic (TRC)	mg/L											
Barium (DIS)	mg/L		1									
Barium (TRC)	mg/L											
Beryllium (DIS)	mg/L		0.004									
Beryllium (TRC)	mg/L											
Cadmium (DIS)	mg/L	0.00025	0.005									
Cadmium (TRC)	mg/L											
Chromium (DIS)	mg/L		0.1									
Chromium (TRC)	mg/L											
Cobalt (DIS)	mg/L											
Cobalt (TRC)	mg/L											
Copper (DIS)	mg/L	0.00285	1.3									
Copper (TRC)	mg/L											
Iron (DIS)	mg/L											
Iron (TRC)	mg/L	1										
Lead (DIS)	mg/L	0.000545	0.015									
Lead (TRC)	mg/L											
Manganese (DIS)	mg/L											
Manganese (TRC)	mg/L											
Mercury (DIS)	mg/L	0.00091	0.00005									
Mercury (TRC)	mg/L											
Molybdenum (DIS)	mg/L											
Molybdenum (TRC)	mg/L											
Nickel (DIS)	mg/L	0.0161	0.1									
Nickel (TRC)	mg/L											
Selenium (DIS)	mg/L	0.005	0.05									
Selenium (TRC)	mg/L											
Silver (DIS)	mg/L		0.1									
Silver (TRC)	mg/L											
Strontium (DIS)	mg/L		4									
Strontium (TRC)	mg/L											
Thallium (DIS)	mg/L		0.00024									
Thallium (TRC)	mg/L											
Uranium (DIS)	mg/L		0.03									
Uranium (TRC)	mg/L											
Zinc (DIS)	mg/L	0.037	7.4									
Zinc (TRC)	mg/L											

Reporting Period: May 2011 to December 2017

°C = degrees Celsius, DIS = dissolved concentration, N = nitrogen, SD = standard deviation, TRC = total recoverable concentration, PCTL = percentile, TOT = total

Grey shading indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 chronic aquatic life guideline.

Bold indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 human health surface water guideline.

Table 12 Water Quality Summary Statistics, SW-13

Parameters	Units	Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017		No. Samples	No. Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
		Aquatic Life Standard, Chronic	Human Health Standard, Surface Water									
Field Parameters												
Staff Gauge	Feet			0	NA	NA	NA	NA	NA	NA	NA	NA
Flow	Cubic Ft Sec			2	2	33.1	77.7	55.4	44.2	55.4	66.5	31.6
pH - Field	s.u.			2	2	7.7	8.7	8.2	8.0	8.2	8.4	0.7
Field Specific Conductivity	umhos/cm			2	2	216	251	234	225	234	242	24.7
Water Temperature	Deg C			2	2	16.5	17.5	17.0	16.8	17.0	17.3	0.7
Dissolved Oxygen	mg/L	6.5		2	2	8.6	8.9	8.8	8.7	8.8	8.8	0.2
Physical Parameters												
Total Dissolved Solids	mg/L											
Total Suspended Solids	mg/L											
Major Constituents - Commons Ions												
Alkalinity as CaCO3	mg/L											
Bicarbonate as HCO3	mg/L											
Carbonate as CO3	mg/L											
Chloride	mg/L											
Fluoride	mg/L		4									
Sulfate	mg/L											
Hardness as CaCO3	mg/L											
Calcium (DIS)	mg/L											
Magnesium (DIS)	mg/L											
Potassium (DIS)	mg/L											
Sodium (DIS)	mg/L											
Nutrients												
Nitrate + Nitrite as N	mg/L	10										
Kjeldahl Nitrogen as N	mg/L											
Total Persulfate Nitrogen	mg/L											
Phosphorus (TOT)	mg/L											
Metals - Trace Constituents												
Aluminum (DIS)	mg/L	0.087										
Aluminum (TRC)	mg/L											
Antimony (DIS)	mg/L		0.0056									
Antimony (TRC)	mg/L											
Arsenic (DIS)	mg/L	0.15	0.01									
Arsenic (TRC)	mg/L											
Barium (DIS)	mg/L		1									
Barium (TRC)	mg/L											
Beryllium (DIS)	mg/L		0.004									
Beryllium (TRC)	mg/L											
Cadmium (DIS)	mg/L	0.00025	0.005									
Cadmium (TRC)	mg/L											
Chromium (DIS)	mg/L		0.1									
Chromium (TRC)	mg/L											
Cobalt (DIS)	mg/L											
Cobalt (TRC)	mg/L											
Copper (DIS)	mg/L	0.00285	1.3									
Copper (TRC)	mg/L											
Iron (DIS)	mg/L											
Iron (TRC)	mg/L	1										
Lead (DIS)	mg/L	0.000545	0.015									
Lead (TRC)	mg/L											
Manganese (DIS)	mg/L											
Manganese (TRC)	mg/L											
Mercury (DIS)	mg/L	0.00091	0.00005									
Mercury (TRC)	mg/L											
Molybdenum (DIS)	mg/L											
Molybdenum (TRC)	mg/L											
Nickel (DIS)	mg/L	0.0161	0.1									
Nickel (TRC)	mg/L											
Selenium (DIS)	mg/L	0.005	0.05									
Selenium (TRC)	mg/L											
Silver (DIS)	mg/L		0.1									
Silver (TRC)	mg/L											
Strontium (DIS)	mg/L		4									
Strontium (TRC)	mg/L											
Thallium (DIS)	mg/L		0.00024									
Thallium (TRC)	mg/L											
Uranium (DIS)	mg/L		0.03									
Uranium (TRC)	mg/L											
Zinc (DIS)	mg/L	0.037	7.4									
Zinc (TRC)	mg/L											

Reporting Period: May 2011 to December 2017

°C = degrees Celsius, DIS = dissolved concentration, N = nitrogen, SD = standard deviation, TRC = total recoverable concentration, PCTL = percentile, TOT = total

Grey shading indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 chronic aquatic life guideline.

Bold indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 human health surface water guideline.

Table 13 Water Quality Summary Statistics, SW-14

Parameters	Units	Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017		No. Samples	No. Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
		Aquatic Life Standard, Chronic	Human Health Standard, Surface Water									
Field Parameters												
Staff Gauge	Feet			16	16	0.3	0.9	0.5	0.4	0.4	0.5	0.1
Flow	Cubic Ft Sec			19	19	0.3	11.8	2.7	0.7	1.5	3.0	3.2
pH - Field	s.u.			19	19	6.1	8.4	7.9	7.7	8.1	8.2	0.5
Field Specific Conductivity	umhos/cm			20	20	263	439	368	347	376	407	50.5
Water Temperature	Deg C			20	20	-0.9	13.7	6.9	3.1	7.1	11.5	4.6
Dissolved Oxygen	mg/L	6.5		20	20	7.6	15.0	10.9	9.8	10.3	11.8	1.8
Physical Parameters												
Total Dissolved Solids	mg/L			21	21	175	244	221	214	228	233	18.5
Total Suspended Solids	mg/L			21	3	<4	15.0	5.0	4.0	4.0	4.0	2.8
Major Constituents - Commons Ions												
Alkalinity as CaCO3	mg/L			21	21	160	220	203	190	210	220	21.3
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			21	21	1.0	2.5	1.9	1.8	2.0	2.0	0.3
Fluoride	mg/L		4	21	21	0.1	0.2	0.2	0.2	0.2	0.2	0.04
Sulfate	mg/L			21	21	6.5	19.0	9.2	7.0	8.1	9.3	3.2
Hardness as CaCO3	mg/L			21	21	153	232	209	198	213	225	22.0
Calcium (DIS)	mg/L			21	21	38.0	57.0	52.5	48.0	54.0	57.0	5.5
Magnesium (DIS)	mg/L			21	21	12.0	23.0	18.9	18.0	19.0	20.0	2.4
Potassium (DIS)	mg/L			21	19	<1	2.0	1.0	1.0	1.0	1.0	0.2
Sodium (DIS)	mg/L			21	21	2.0	3.0	2.6	2.0	3.0	3.0	0.5
Nutrients												
Nitrate + Nitrite as N	mg/L	10		21	20	<0.01	0.3	0.1	0.04	0.09	0.2	0.09
Kjeldahl Nitrogen as N	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Total Persulfate Nitrogen	mg/L			21	20	<0.003	1.3	0.3	0.1	0.2	0.3	0.3
Phosphorus (TOT)	mg/L			21	16	<0.003	0.2	0.02	0.004	0.008	0.01	0.04
Metals - Trace Constituents												
Aluminum (DIS)	mg/L	0.087		21	3	<0.009	0.05	0.01	0.009	0.009	0.009	0.009
Aluminum (TRC)	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Antimony (DIS)	mg/L		0.0056	0	NA	NA	NA	NA	NA	NA	NA	NA
Antimony (TRC)	mg/L			21	0	<0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0
Arsenic (DIS)	mg/L	0.15	0.01	0	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic (TRC)	mg/L			21	0	<0.001	0.001	0.001	0.001	0.001	0.001	0
Barium (DIS)	mg/L		1	0	NA	NA	NA	NA	NA	NA	NA	NA
Barium (TRC)	mg/L			21	21	0.08	0.1	0.1	0.1	0.1	0.1	0.01
Beryllium (DIS)	mg/L		0.004	0	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium (TRC)	mg/L			21	0	<0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0
Cadmium (DIS)	mg/L	0.00025	0.005	0	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium (TRC)	mg/L			21	2	<0.00003	0.00004	0.00003	0.00003	0.00003	0.00003	0.000002
Chromium (DIS)	mg/L		0.1	0	NA	NA	NA	NA	NA	NA	NA	NA
Chromium (TRC)	mg/L			21	0	<0.01	0.01	0.01	0.01	0.01	0.01	0
Cobalt (DIS)	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt (TRC)	mg/L			21	0	<0.01	0.01	0.01	0.01	0.01	0.01	0
Copper (DIS)	mg/L	0.00285	1.3	0	NA	NA	NA	NA	NA	NA	NA	NA
Copper (TRC)	mg/L			21	0	<0.002	0.002	0.002	0.002	0.002	0.002	0
Iron (DIS)	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Iron (TRC)	mg/L	1		21	20	<0.02	0.4	0.1	0.02	0.05	0.12	0.1
Lead (DIS)	mg/L	0.000545	0.015	0	NA	NA	NA	NA	NA	NA	NA	NA
Lead (TRC)	mg/L			21	1	<0.0003	0.0005	0.0003	0.0003	0.0003	0.0003	0.00004
Manganese (DIS)	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Manganese (TRC)	mg/L			21	2	<0.005	0.007	0.005	0.005	0.005	0.005	0.0005
Mercury (DIS)	mg/L	0.00091	0.00005	0	NA	NA	NA	NA	NA	NA	NA	NA
Mercury (TRC)	mg/L			21	0	<0.000005	0.00001	0.00001	0.00001	0.00001	0.00001	0
Molybdenum (DIS)	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Molybdenum (TRC)	mg/L			21	0	<0.002	0.002	0.002	0.002	0.002	0.002	0
Nickel (DIS)	mg/L	0.0161	0.1	0	NA	NA	NA	NA	NA	NA	NA	NA
Nickel (TRC)	mg/L			21	1	<0.001	0.002	0.001	0.001	0.001	0.001	0.0004
Selenium (DIS)	mg/L	0.005	0.05	0	NA	NA	NA	NA	NA	NA	NA	NA
Selenium (TRC)	mg/L			21	1	<0.0002	0.0004	0.0002	0.0002	0.0002	0.0002	0.00005
Silver (DIS)	mg/L		0.1	0	NA	NA	NA	NA	NA	NA	NA	NA
Silver (TRC)	mg/L			21	0	<0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0
Strontium (DIS)	mg/L		4	0	NA	NA	NA	NA	NA	NA	NA	NA
Strontium (TRC)	mg/L			21	21	0.08	0.1	0.1	0.1	0.1	0.1	0.02
Thallium (DIS)	mg/L		0.00024	0	NA	NA	NA	NA	NA	NA	NA	NA
Thallium (TRC)	mg/L			21	0	<0.0002	0.00020	0.00020	0.00020	0.00020	0.00020	0
Uranium (DIS)	mg/L		0.03	0	NA	NA	NA	NA	NA	NA	NA	NA
Uranium (TRC)	mg/L			21	0	<0.008	0.008	0.008	0.008	0.008	0.008	0
Zinc (DIS)	mg/L	0.037	7.4	0	NA	NA	NA	NA	NA	NA	NA	NA
Zinc (TRC)	mg/L			21	1	<0.002	0.003	0.002	0.002	0.002	0.002	0.0002

Reporting Period: May 2011 to December 2017

°C = degrees Celsius, DIS = dissolved concentration, N = nitrogen, SD = standard deviation, TRC = total recoverable concentration, PCTL = percentile, TOT = total

Grey shading indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 chronic aquatic life guideline.

Bold indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 human health surface water guideline.

Table 14 Water Quality Summary Statistics, USGS-SC1

Parameters	Units	Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017		No. Samples	No. Detects	Min.	Max.	Mean	25% PCLT	50% PCLT	75% PCLT	SD.
		Aquatic Life Standard, Chronic	Human Health Standard, Surface Water									
Field Parameters												
Staff Gauge	Feet			NA	NA	NA	NA	NA	NA	NA	NA	NA
Flow	Cubic Ft Sec			37	37	9.3	152	45.5	13.8	28.0	67.5	38.4
pH - Field	s.u.			54	54	6.8	8.7	8.0	7.8	8.2	8.3	0.4
Field Specific Conductivity	umhos/cm			55	55	234	408	326	292	340	364	46.2
Water Temperature	Deg C			55	55	-1.0	13.1	4.4	0.2	3.5	9.0	4.3
Dissolved Oxygen	mg/L	6.5		55	55	7.1	16.6	11.2	10.1	10.8	12.2	1.7
Physical Parameters												
Total Dissolved Solids	mg/L			53	53	134	230	190	183	193	204	20.1
Total Suspended Solids	mg/L			53	13	<4	38.0	7.8	4.0	4.0	10.0	6.4
Major Constituents - Commons Ions												
Alkalinity as CaCO3	mg/L			53	53	120	220	177	170	180	190	22.0
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			53	53	1.0	5.0	1.7	1.0	1.5	2.0	0.929
Fluoride	mg/L		4	53	1	<0.1	0.1	0.10	0.1	0.1	0.1	0
Sulfate	mg/L			53	53	3.0	8.0	5.6	4.8	5.4	7.0	1.4
Hardness as CaCO3	mg/L			53	52	<7	214	175	167	183	191	31.7
Calcium (DIS)	mg/L			53	53	35.0	61.0	50.6	47.5	52.0	55.0	6.0
Magnesium (DIS)	mg/L			53	53	8.0	15.0	12.6	12.0	13.0	14.0	1.6
Potassium (DIS)	mg/L			53	53	1.0	1.0	1.0	1.0	1.0	1.0	0
Sodium (DIS)	mg/L			53	53	2.0	3.0	2.1	2.0	2.0	2.0	0.2
Nutrients												
Nitrate + Nitrite as N	mg/L	10		53	32	<0.01	0.1	0.04	0.01	0.02	0.08	0.04
Kjeldahl Nitrogen as N	mg/L			11	6	<0.5	5.0	1.9	0.5	2.2	3.0	1.6
Total Persulfate Nitrogen	mg/L			39	29	<0.003	1.1	0.1	0.04	0.07	0.2	0.2
Phosphorus (TOT)	mg/L			49	35	<0.003	0.05	0.01	0.004	0.009	0.01	0.009
Metals - Trace Constituents												
Aluminum (DIS)	mg/L	0.087		53	17	<0.009	0.2	0.02	0.01	0.01	0.02	0.03
Aluminum (TRC)	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Antimony (DIS)	mg/L		0.0056	0	NA	NA	NA	NA	NA	NA	NA	NA
Antimony (TRC)	mg/L			53	0	<0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0
Arsenic (DIS)	mg/L	0.15	0.01	0	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic (TRC)	mg/L			53	1	<0.001	0.001	0.0010	0.001	0.001	0.001	0
Barium (DIS)	mg/L		1	0	NA	NA	NA	NA	NA	NA	NA	NA
Barium (TRC)	mg/L			53	53	0.06	0.09	0.07	0.07	0.07	0.07	0.006
Beryllium (DIS)	mg/L		0.004	0	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium (TRC)	mg/L			53	0	<0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0
Cadmium (DIS)	mg/L	0.00025	0.005	0	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium (TRC)	mg/L			53	2	<0.00003	0.00009	0.00003	0.00003	0.00003	0.00003	0.000008
Chromium (DIS)	mg/L		0.1	0	NA	NA	NA	NA	NA	NA	NA	NA
Chromium (TRC)	mg/L			53	0	<0.005	0.01	0.01	0.01	0.01	0.01	0.001
Cobalt (DIS)	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt (TRC)	mg/L			53	0	<0.005	0.01	0.01	0.01	0.01	0.01	0.001
Copper (DIS)	mg/L	0.00285	1.3	0	NA	NA	NA	NA	NA	NA	NA	NA
Copper (TRC)	mg/L			53	2	<0.002	0.003	0.0020	0.002	0.002	0.002	0.0001
Iron (DIS)	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Iron (TRC)	mg/L	1		53	53	0.07	1.7	0.3	0.1	0.1	0.3	0.3
Lead (DIS)	mg/L	0.000545	0.015	0	NA	NA	NA	NA	NA	NA	NA	NA
Lead (TRC)	mg/L			53	6	<0.0003	0.001	0.0003	0.0003	0.0003	0.0003	0.0001
Manganese (DIS)	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Manganese (TRC)	mg/L			53	53	0.005	0.08	0.01	0.007	0.008	0.01	0.01
Mercury (DIS)	mg/L	0.00091	0.00005	0	NA	NA	NA	NA	NA	NA	NA	NA
Mercury (TRC)	mg/L			53	2	<0.000005	0.00001	0.000005	0.000005	0.000005	0.000005	0.0000007
Molybdenum (DIS)	mg/L			0	NA	NA	NA	NA	NA	NA	NA	NA
Molybdenum (TRC)	mg/L			53	0	<0.001	0.002	0.002	0.002	0.002	0.002	0.0003
Nickel (DIS)	mg/L	0.0161	0.1	0	NA	NA	NA	NA	NA	NA	NA	NA
Nickel (TRC)	mg/L			53	6	<0.001	0.003	0.001	0.001	0.001	0.001	0.0004
Selenium (DIS)	mg/L	0.005	0.05	0	NA	NA	NA	NA	NA	NA	NA	NA
Selenium (TRC)	mg/L			53	0	<0.0002	0.0004	0.0002	0.0002	0.0002	0.0002	0.00004
Silver (DIS)	mg/L		0.1	0	NA	NA	NA	NA	NA	NA	NA	NA
Silver (TRC)	mg/L			53	1	<0.0002	0.0004	0.0002	0.0002	0.0002	0.0002	0.00003
Strontium (DIS)	mg/L		4	0	NA	NA	NA	NA	NA	NA	NA	NA
Strontium (TRC)	mg/L			53	53	0.1	0.2	0.1	0.1	0.1	0.1	0.009
Thallium (DIS)	mg/L		0.00024	0	NA	NA	NA	NA	NA	NA	NA	NA
Thallium (TRC)	mg/L			53	0	<0.0002	0.00020	0.00020	0.00020	0.00020	0.00020	0
Uranium (DIS)	mg/L		0.03	0	NA	NA	NA	NA	NA	NA	NA	NA
Uranium (TRC)	mg/L			53	4	<0.0003	0.008	0.007	0.008	0.008	0.008	0.002
Zinc (DIS)	mg/L	0.037	7.4	0	NA	NA	NA	NA	NA	NA	NA	NA
Zinc (TRC)	mg/L			53	15	<0.002	0.009	0.003	0.002	0.002	0.003	0.001

Reporting Period: May 2011 to December 2017

°C = degrees Celsius, DIS = dissolved concentration, N = nitrogen, SD = standard deviation, TRC = total recoverable concentration, PCTL = percentile, TOT = total

Grey shading indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 chronic aquatic life guideline.

Bold indicates the concentration exceeds the Montana Numeric Water Quality Standards, DEQ-7 Circular, May 2017 human health surface water guideline.

APPENDIX J

Preliminary Determination on Air Quality Permit Application

DEQ
Montana Department of Environmental Quality

Air, Energy & Mining Division

PRELIMINARY DETERMINATION
ON PERMIT APPLICATION

Date: March 11, 2019

Name of Applicant: Tintina Montana Inc.

Source: Underground Copper Mine and Mill Site

Proposed Action: The Department of Environmental Quality (Department) proposes to issue a permit, with conditions, to the above-named applicant. The application was assigned Permit Application Number 5200-00.

Proposed Conditions: See attached.

Public Comment: The original preliminary determination was issued on June 5, 2018, with a subsequent 30-day public comment period ending on July 5, 2018. Comments received during the 30-day comment period have been incorporated into this revised preliminary determination. The Department is taking additional comments on this revised preliminary determination and taking comments on any air quality items included in the Draft version of the Environmental Impact Statement (EIS) which will inform the air quality permit. Any comments on the revised preliminary determination are due the same date as the comments are due for the Draft EIS.

Departmental Action: The Department intends to make a decision on the application within 30-days after the Final EIS is released. The permit shall become final on the date stated in the Department's Decision on this permit, unless an appeal is filed with the Board of Environmental Review (Board).

Procedures for Appeal: Any person jointly or severally adversely affected by the final action may request a hearing before the Board. Any appeal must be filed by the date stated in the Department's Decision on this permit. The request for a hearing shall contain an affidavit setting forth the grounds for the request. Any hearing will be held under the provisions of the Montana Administrative Procedures Act. Submit requests for a hearing in triplicate to: Chairman, Board of Environmental Review, P.O. Box 200901, Helena, MT 59620.

For the Department,

Julie A. Merkel
Permitting Services Section Supervisor
Air Quality Bureau
(406) 444-3626

Craig Henrikson, P.E.
Environmental Engineer
Air Quality Bureau
(406) 444-6711

JM:CH
Enclosures

MONTANA AIR QUALITY PERMIT

Issued to: Tintina Montana Inc.
P.O. Box 431
White Sulphur Springs, MT 59645

MAQP: #5200-00
Application Complete: 05/11/2018
Preliminary Determination Issued: 06/5/2018
Revised Preliminary Determination: 03/11/2019
Department's Decision Issued:
Permit Final:

A Montana Air Quality Permit (MAQP), with conditions, is hereby granted to Tintina Montana Inc. (Tintina), pursuant to Sections 75-2-204 and 211 of the Montana Code Annotated (MCA), as amended, and Administrative Rules of Montana (ARM) 17.8.740, *et seq*., as amended, for the following:

Section I: Permitted Facilities

A. Permitted Equipment

Tintina is proposing to develop and operate a new underground copper mine and mill identified as the Black Butte Copper Project (BBCP). The BBCP proposes to produce and ship copper concentrate mined from both the upper and lower zones of the Johnny Lee copper deposit. The area of the planned permit boundary encompasses 1,888 acres of privately owned ranch land under lease to Tintina. Mine life is estimated at approximately 19 years including two years of construction/pre-production, 13 years of active production mining, followed by four years of reclamation and closure. A complete list of permitted equipment is contained in Section I.A of the permit analysis.

B. Plant Location

Tintina proposes to develop the BBCP approximately 15 miles north of White Sulphur Springs in Meagher County, Montana. Total surface disturbance required for construction and operation of all mine-related facilities and access roads comprises approximately 311 acres. The proposed mine permit area resides in Sections 24, 25, and 36 in Township 12N, Range 6E, and Sections 19, 29, 30, 31, and 32 in Township 12N, Range 7E, Meagher County, Montana

Section II: Conditions and Limitations

A. Emission Limitations

1. Tintina shall be limited to a maximum of 2.19 million tons of waste rock as measured by the total material processed by the Portal Crusher (P1) during any rolling 12-month period (ARM 17.8.749).

2. Tintina shall be limited to a maximum of 1.46 million tons of ore as measured by the material processed by the weight meter following the coarse ore bin and prior to entering the mill during any rolling 12-month period (ARM 17.8.749).

3. Tintina shall be limited to a maximum usage of 1,552 tons of ammonium nitrate fuel oil (ANFO) during any rolling 12-month period (ARM 17.8.749).

4. Tintina shall be limited to a maximum total usage of 4,180,000 gallons of propane for the Upper Copper Zone Propane Heater (P10A) and the Lower Copper Zone Heater (P10B) during any rolling 12-month period (ARM 17.8.749).

5. Tintina shall be limited to diesel-fired generator sets for surface mine equipment including P2, P4, P5, P6, P17, P18 and F26 of a maximum rated design capacity of the generator engine(s) not exceeding 2,735 brake-horsepower (bhp). This condition does not include the ratings from the four emergency diesel generators P7A, P7B, P8 and P9 (ARM 17.8.749).

6. Tintina shall be limited to a maximum total usage of 806,384 gallons of diesel fuel for mobile equipment, stationary and portable equipment for both surface and underground operations during any rolling 12-month period (ARM 17.8.749).

7. Tintina shall not cause or authorize to be discharged into the atmosphere any fugitive emissions from process equipment not covered under 40 CFR 60, Subpart LL that exhibit 20% opacity or greater averaged over 6 consecutive minutes (ARM 17.8.308).

8. Tintina shall limit process fugitive emissions for any affected facility as identified in 40 CFR 60, Subpart LL, from the date of the performance test (as required by Section II.C.1) forward, to a maximum opacity of 10%. Stack emissions from any affected facility are limited to a maximum of 7% opacity unless using a wet scrubber (40 CFR Part 60, Subpart LL, ARM 17.8.308 and ARM 17.8.340).

9. Tintina shall formalize a Fugitive Dust Control Plan from the elements approved in the BACT analysis to control fugitive dust and comply with ARM 17.8.308 - Airborne Particulate Matter (Reasonable Precautions). This plan shall include all mine areas including roads utilized within the mine permit boundary as defined by the Montana DEQ Hardrock Operating Permit. The plan should include four elements common with best management practices. 1) Staff titles responsible for carrying out the Fugitive Dust Control Plan. 2) Identification of dust control problems. 3) Recommended strategy or strategies for resolution. 4) Documentation of corrective action.

   Prior to the commencement of operation, Tintina shall submit the Fugitive Dust Control Plan to the Department for review and input. Tintina may develop separate plans based on the current phase of the mine; development, production and reclamation (ARM 17.8.749 and ARM 17.8.752).

10. Tintina shall not cause or authorize emissions to be discharged into the outdoor atmosphere from any sources installed after November 23, 1968, that exhibit an opacity of 20% or greater averaged over 6 consecutive minutes (ARM 17.8.304).

11. Tintina shall not cause or authorize the use of any street, road, or parking lot without taking reasonable precautions to control emissions of airborne particulate matter (ARM 17.8.308).

12. Tintina shall treat all unpaved portions of the haul roads, access roads, parking lots, or general plant area with water and/or chemical dust suppressant as necessary to maintain compliance with the reasonable precautions limitation in Section II.A.9 and Section II.A.11 (ARM 17.8.749 and ARM 17.8.752).

13. Tintina shall comply with all applicable standards and limitations, and the reporting, recordkeeping and notification requirements contained in 40 CFR 60, Subpart A and 40 CFR 60, Subpart LL (ARM 17.8.340, 40 CFR 60 Subpart A and 40 CFR 60 Subpart LL).

14. Emissions from the dust collectors controlling emitting points P12, P13A, P13B, P14 and P15 (Jaw Crusher Building, Mill Building Areas, Surge Bin Discharge, and Water Treatment Area) and shall be limited to a maximum of 0.01 grains per dry standard cubic foot (gr/dscf) (ARM 17.8.340, 40 CFR Part 60, Subpart LL and ARM 17.8.752).

15. Tintina shall comply with all applicable standards and limitations, and the reporting, recordkeeping and notification requirements contained in 40 CFR 60 Subpart IIII for the four units identified as emergency generators. These are identified as P7A, P7B, P8 and P9 (ARM 17.8.340 and 40 CFR 60 Subpart IIII).

16. Tintina shall comply with all applicable standards and limitations, and the reporting, recordkeeping and notification requirements contained in 40 CFR 63 Subpart ZZZZ for the four units identified as emergency generators. These are identified as P7A, P7B, P8 and P9 (ARM 17.8.342 and 40 CFR 63 Subpart ZZZZ).

17. The four emergency generators shall be used for emergency or back-up operations only and shall each be limited to 500 hours of operation during any rolling 12-month time period. Preventative maintenance activities shall be included in the 500 hours of operation during any rolling 12-month time period (ARM 17.8.749).

18. Tintina shall use diesel engine/generators which satisfy 40 CFR Part 89 and/or 1039 for non-road engines (ARM 17.8.752, ARM 17.8.340 and 40 CFR 60 Subpart IIII).

19. Diesel-fired engines P2, P4, P5, P6, P7A, P7B, P8, P9, P17, P18, and F26 shall be a minimum of EPA Tier 3-rated engines (ARM 17.8.749).

B. Emission Control Practice and Requirements

1. Underground Blasting – Industry Best Operating Practices (BOPs) shall be used for minimizing blasting emissions, including hole size optimization, placement optimization, optimizing the quantity of explosive, and mine planning to prevent overshooting (ARM 17.8.752).

2. Ore transferred from the jaw crusher to the mill building shall be done in an enclosed conveyor (ARM 17.8.752).

3. Portable Crusher (P1) and two Screens (P3) shall use reasonable precautions including water spray suppression for particulate control (ARM 17.8.752).

4. Diesel-fired engines P2, P4, P5, P6, P17, P18, and F26 meet 40 CFR 60, Subpart IIII (ARM 17.8.340, 40 CFR 60, Subpart IIII and ARM 17.8.752).

5. Propane Heaters P10A and P10B shall be rated for a maximum of 75 MMBtu/hr total and shall utilize clean burning fuel (propane or equivalent) and utilize good combustion practices (ARM 17.8.752).

6. Temporary Diesel-fired Portal Heaters (P11-Up to 3 diesel-fired engines with a 1.2 MMBtu/hr total)) shall use diesel fuel or equivalent and utilize good combustion practices (ARM 17.8.752).

7. Temporary Portable Propane-fired Heaters (F28-Up to 9 units with a 37.8 MMBtu/hr total) shall use propane or equivalent and utilize good combustion practices (ARM 17.8.752).

8. Emitting Units P12, P13A, P13B, P14, and P15 (Jaw Crusher Building, Mill Building Lime and Lime Silo Areas, Surge Bin Discharge, and Water Treatment) shall use dust collectors for particulate control (ARM 17.8.752).

9. Backfill Plant Cement Operations including Fly Ash Hopper and Fly Ash Silo (P16A and P16B) shall use dust filters/collectors for particulate control (ARM 17.8.752).

10. All road sections and all stockpiles (ore, waste rock, excavated bedrock, topsoil, subsoil and temporary construction material etc.) shall utilize reasonable precautions for particulate control. For stockpiles, this may include wind-fencing and/or treatment with water or chemical dust suppressant (ARM 17.8.752).

11. Soil and subsoil stockpiles saved for mine reclamation will be revegetated in place within two growing seasons following their completion (ARM 17.8.752).

12. If water and/or chemical dust suppressant are not effective for controlling fugitive dust, Tintina shall also require vehicle restrictions including the use of vehicle speed limits to further reduce fugitive dust (ARM 17.8.752).

C. Testing Requirements

1. The affected facilities under 40 CFR 60, Subpart LL shall be tested and demonstrate compliance with the emission limitations contained in Section II.A.8 within 60 days after achieving the maximum production rate at which the affected facility will be operated, but not later than 180 days after initial startup of the affected equipment (ARM 17.8.105, ARM 17.8.340, 40 CFR 60.8 and 40 CFR 60, Subpart LL).

2. All compliance source tests shall conform to the requirements of the Montana Source Test Protocol and Procedures Manual (ARM 17.8.106).

3. The Department of Environmental Quality (Department) may require further testing (ARM 17.8.105).

D. Operational Reporting Requirements

1. Tintina shall supply the Department with annual production information for all emission points, as required by the Department in the annual emission inventory request. The request will include, but is not limited to, all sources of emissions identified in the emission inventory contained in the permit analysis.

   Production information shall be gathered on a calendar-year basis and submitted to the Department by the date required in the emission inventory request. Information shall be in the units required by the Department. This information may be used to calculate operating fees, based on actual emissions from the facility, and/or to verify compliance with permit limitations (ARM 17.8.505). Tintina shall submit the following information annually to the Department by March 1 of each year; the information may be submitted along with the annual emission inventory (ARM 17.8.505).

   a. Amount of ore produced as measured by the weight meter downstream of the coarse ore bin.

   b. Total gallons of diesel fuel used by underground equipment and above-ground equipment.

   c. Gallons of propane used by P10A and P10B.

   d. Tons of ANFO explosive used.

   e. Hours of operation of each of the four emergency diesel-fired generators.

   f. An estimate of company vehicle miles traveled on the main mine roads.

   g. Amount of disturbed acreage by stockpile and material type.

2. Tintina shall notify the Department of any construction or improvement project conducted, pursuant to ARM 17.8.745, that would include ***the addition of a new emissions unit***, change in control equipment, stack

height, stack diameter, stack flow, stack gas temperature, source location, or fuel specifications, or would result in an increase in source capacity above its permitted operation. The notice must be submitted to the Department, in writing, 10 days prior to startup or use of the proposed de minimis change, or as soon as reasonably practicable in the event of an unanticipated circumstance causing the de minimis change, and must include the information requested in ARM 17.8.745(l)(d) (ARM 17.8.745).

3. All records compiled in accordance with this permit must be maintained by Tintina as a permanent business record for at least 5 years following the date of the measurement, must be available at the plant site for inspection by the Department, and must be submitted to the Department upon request. These records may be stored at a location other than the plant site upon approval by the Department (ARM 17.8.749).

4. Tintina shall document, by day, the waste rock production levels as measured by the number of trucks transported from the portal. An estimated density per truckload should be applied for the calculation either based on an expected density or actual determination. By the 25th day of each month, Tintina shall document the total tons of ore processed for the previous month. The monthly information will be used to verify compliance with the rolling 12-month limitation Section II.A.1. The information for each of the previous twelve months shall be submitted along with the annual emission inventory (ARM 17.8.749).

5. Tintina shall document, by month, the ore production levels as measured by the weight meter downstream of the coarse ore bin. By the 25th day of each month, Tintina shall document the total tons of ore processed for the previous month. The monthly information will be used to verify compliance with the rolling 12-month limitation in Section II.A.2. The information for each of the previous twelve months shall be submitted along with the annual emission inventory (ARM 17.8.749).

6. Tintina shall document, by month, the tons of ANFO explosive used at the site. By the 25th day of each month, Tintina shall document the total tons of ANFO explosive used for the previous month. The monthly information will be used to verify compliance with the rolling 12-month limitation in Section II.A.3. The information for each of the previous twelve months shall be submitted along with the annual emission inventory (ARM 17.8.749).

7. Tintina shall document, by month, the gallons of propane used by P10A and P10B. By the 25th day of each month, Tintina shall document the total gallons of propane used for the previous month. The monthly information will be used to verify compliance with the rolling 12-month limitation in Section II.A.4. The information for each of the previous twelve months shall be submitted along with the annual emission inventory (ARM 17.8.749).

8. Tintina shall document, by month, the diesel fuel consumption of all the underground equipment and above-ground equipment. By the 25th day of each month, Tintina shall calculate the total diesel fuel consumption for

diesel-fired equipment for the previous month. The monthly information will be used to verify compliance with the rolling 12-month limitation in Section II.A.6. The information for each of the previous twelve months shall be submitted along with the annual emission inventory (ARM 17.8.749).

9. Tintina shall document, by month, the hours of operation of each emergency diesel-fired generator (P7A, P7B, P8 and P9). By the 25th day of each month, Tintina shall document the total hours of operation of the diesel engine/generator for the previous month. The information for each of the previous twelve months shall be submitted along with the annual emission inventory (ARM 17.8.749).

10. Tintina shall provide documentation that the equipment installed at the site which relied on specific dispersion characteristics for ambient air quality modeling, is consistent with the modeled assumptions. These parameters are primarily exhaust flow, engine size (bhp), stack height and stack diameter. Alternatively, Tintina shall provide a demonstration that any significant differences in dispersion characteristics from those used in the modeling demonstration, do not result in increases in modeled concentrations and risk the determination that the project does not cause or contribute to a violation of an ambient air quality standard. Tintina shall provide this information within 90 days following start-up of the milling and flotation operation (ARM 17.8.749).

E. Notification

1. Tintina shall supply the Department the following notifications (ARM 17.8.749 and 40 CFR 60, Subpart A and 40 CFR 63, Subpart A):

    a. Date when Aboveground Ore Processing commences construction, postmarked no later than 30 days after such date.

    b. Date when Aboveground Ore Processing including milling and flotation begins operation, postmarked no later than 15 days after such date.

2. Tintina shall provide notification and any documentation, as necessary, from Section II.D.10 within 90 days of start-up of the milling and flotation operation (ARM 17.8.749).

SECTION III: General Conditions

A. Inspection – Tintina shall allow the Department's representatives access to the source at all reasonable times for the purpose of making inspections or surveys, collecting samples, obtaining data, auditing any monitoring equipment such as Continuous Emission Monitoring Systems (CEMS) or Continuous Emission Rate Monitoring Systems (CERMS), or observing any monitoring or testing, and otherwise conducting all necessary functions related to this permit.

B. Waiver – The permit and the terms, conditions, and matters stated herein shall be deemed accepted if Tintina fails to appeal as indicated below.

C. Compliance with Statutes and Regulations – Nothing in this permit shall be construed as relieving Tintina of the responsibility for complying with any applicable federal or Montana statute, rule, or standard, except as specifically provided in ARM 17.8.740, *et seq*. (ARM 17.8.756).

D. Enforcement – Violations of limitations, conditions and requirements contained herein may constitute grounds for permit revocation, penalties, or other enforcement action as specified in Section 75-2-401, *et seq*., MCA.

E. Appeals – Any person or persons jointly or severally adversely affected by the Department's decision may request, within 15 days after the Department renders its decision, upon affidavit setting forth the grounds therefor, a hearing before the Board of Environmental Review (Board). A hearing shall be held under the provisions of the Montana Administrative Procedures Act. The filing of a request for a hearing does not stay the Department's decision, unless the Board issues a stay upon receipt of a petition and a finding that a stay is appropriate under Section 75-2-211(11)(b), MCA. The issuance of a stay on a permit by the Board postpones the effective date of the Department's decision until conclusion of the hearing and issuance of a final decision by the Board. If a stay is not issued by the Board, the Department's decision on the application is final 16 days after the Department's decision is made.

F. Permit Inspection – As required by ARM 17.8.755, Inspection of Permit, a copy of the air quality permit shall be made available for inspection by the Department at the location of the source.

G. Permit Fee – Pursuant to Section 75-2-220, MCA, failure to pay the annual operation fee by Tintina may be grounds for revocation of this permit, as required by that section and rules adopted thereunder by the Board.

H. Duration of Permit – Construction or installation must begin or contractual obligations entered into that would constitute substantial loss within 3 years of permit issuance and proceed with due diligence until the project is complete or the permit shall expire (ARM 17.8.762).

Montana Air Quality Permit Analysis
Tintina Montana Inc.
MAQP #5200-00

I. Introduction/Process Description

Tintina Montana Inc. (Tintina) proposes to develop and operate an underground copper mine and mill facility. The facility is located approximately 15 miles north of White Sulphur Springs, in Meagher County. The facility is known as the Black Butte Copper Project (BBCP).

A. Permitted Equipment

Point Source Identification at Tintina

Point #	Emitting Unit Name
P1	250 ton per hour (TPH) Portable Conical Crusher
P2	325-horsepower (hp) Portable Diesel Engine/generator
P3	2 Portable Screens (400 TPH each)
P4	131-hp Portable Diesel Engine/generator
P5	545-kilowatt (kW) /914-hp Diesel Engine/generator
P6	320-kW /536-hp Diesel Engine/generator
P7A & P7B	1000-kW /1675-hp Diesel Engine/generators (2) - Emergency
P8	100-hp Diesel Engine/generator - Emergency evac hoists
P9	50-hp Diesel Fire Pump - Emergency
P10A	23 million British thermal unit per hour (MMBtu/hr) Propane-fired heater @ Intake Vent for Upper Copper Zone
P10B	52 MMBtu/hr Propane-fired heater @ Intake Vent for Lower Copper Zone
P11	3 Temporary diesel heaters at Portal - (1.2 MMBtu/hr total)
P12	Jaw Crusher (3640 TPD), Building/Dust Collector
P13A	Mill Building (mill, lime storage, etc.) Dust Collector
P13B	Mill Building (lime area/slurry mix tank) Dust Collector
P14	Surge Bin Discharge Dust Collector
P15	Water Treatment Plant Lime Area Dust Collector
P16A	Backfill Plant Cement/Fly Ash Hopper Dust Filter/Collector
P16B	Backfill Plant Cement/Fly Ash Silo Dust Filter/Collector
P17	Portable diesel engine/generators (total of 400 hp, 4 units)
P18	Air Compressor - Diesel Engine (275 hp)
F26	Diesel-powered Light plants - 11 - 14 hp each, 154 hp total
F27	Gasoline storage tank (double-walled 500 gallon (gal))
F28	9 Temporary portable propane heaters (37.8 MMBtu/hr total)
UG	ANFO

The Point Source table identifies each point source for which an emission inventory was developed and used within the air modeling analysis. Tintina identified the highest emitting rates which occur at each of the emitting units (point sources) over the course of the proposed mine life, and modeled those as if they were occurring at the same time. This approach over-estimated the actual emissions for nearly any given period but also ensures the highest possible rate was used in the modeling demonstration.

It was also necessary to model certain fugitive emissions such as those from haul roads. And while mobile sources are not regulated, underground emissions from blasting and engine emissions are modeled as point sources from the three planned exhaust portals. Fugitive emission sources are shown in the table below.

Fugitive Sources

F1	Road Dust, Mine Operating Year (MOY) 0 to 1
F2	Road Dust, MOY 1 to 2
F3	Road Dust, MOY 2 to 15, Annual Average
F4	Road Dust, MOY 16 and 17, Annual Average
F5	Road Dust, MOY 18
F6	Material Transfer to Temporary Stockpile, MOY 0 to 1.5
F7	Temporary Construction Stockpile
F8	Embankment Construction, MOY 0 to 1.5
F9	Backfill, (NCWR) Embankment Material to Facility CTF MOY 16 to 18
F10	Material Transfer to South Stockpile, MOY 0 to 1
F11	Excess Reclamation Stockpile (South)
F12	Material Transfer from South Stockpile, MOY 16 to 17
F13	Material Transfer to North Stockpile, MOY 0 to 1
F14	Excess Reclamation Stockpile (North)
F15	Material Transfer from North Stockpile, MOY 16 to 18
F16	Soil Removal and Stockpiling, MOY 0 to 1
F17	Topsoil Pile
F18	Subsoil Pile
F19	Soil Return, MOY 16 to 18
F20	Copper-enriched Rock Drop to Stockpile, MOY 2 to 3
F21	Copper-enriched Rock Stockpile (Mill Feed)
F22	Waste Rock Drop at WRS Pad, MOY 0 to 1.5, at CTF, MOY 1.5 to 4 and 8
F23	Temporary WRS
F24	Waste Rock Transfer from WRS to CTF, MOY 2 to 3
F25	Waste Rock Storage Pad Reclamation, MOY 3
F26	11 - 14-hp Portable Diesel-powered Light Plants (only 4 units will be used in Production Phase)
F27	500-gal Gasoline Storage Tank (double-walled)
F28	9 -Temporary Portable Propane-fired Heaters (37.8 MMBtu/hr total) (only 3 will be used in Production Phase)
F29	Road Dust, Construction Access Road, Year 0-2 Avg.
F30	Road Dust, Main Access Road, Year 2-15 Avg.
IEU1	Diesel Storage Tanks (250-gal, 500-gal, 10,000- gal)

B. Source Description

The proposed BBCP will mine approximately 15.3 million tons of copper-enriched rock (CER) and waste rock. This includes 14.5 million tons of CER with an average grade of 3.04% copper and 0.8 million tons of waste rock. Mining will occur at a rate of approximately 1.3 million tons/year or roughly 3,562 tons of CER per day. Ore production permit limits were set to match the highest predicted production level occurring in Year 11 of the mine life. The expected life of the mine is approximately 19 years including: a two-year development phase consisting of construction and pre-production mining, approximately 13 years of active mine production and milling, and four years of reclamation and closure.

Tintina plans to mine CER from the upper and lower Johnny Lee mining zones. The mine permit boundary area is divided into three main property areas near the Sheep Creek Road and Butte Creek Road intersections. The northwest sector contains the mine ventilation raises, while the northeast portion contains an access to a proposed public water supply water well utilized by Tintina. The southern property sector contains all mining operations including the mine portal, milling and material processing facilities, two emergency backup reciprocating internal combustion engine (RICE) gensets, a cemented paste tailings facility, material stockpiles, and various water containment ponds.

A drift and fill method will be used where finely ground mill tailings will be mixed with cement and binder to a form a paste used to backfill production workings. This will allow mining to proceed without the need to leave pillars for structural support. Mined rock will be brought to the surface via haul trucks and processed by vibrating screens and a Portal Crusher located within a crusher building. Material is then conveyed in an enclosed conveyor to the mill building for regrinding and flotation.

C. Response to Public Comments

The Department received a number of comments (17 total) received via the U.S. Mail and also received at the email address specifically set-up to receive electronic comments on the preliminary draft permit. The majority of comments did not address specific air quality permit items and were mostly comments either in favor of, or against the development of the mine. A summary of any substantive comments relative to the air quality concerns is included below along with the Department's response.

Person/Group Commenting	Permit Reference	Comment	Department Response
Trout Unlimited, Colin Cooney and David Brooks	Section II: Conditions and Limitations, subsection B: Emission Control Practice and Requirement	10. Backfill Plant Cement Operations including Fly Ash Hopper and Fly Ash Silo (P16A and P16B) shall use dust filters/collectors for particulate control (ARM 17.8.752). 11. All road sections and all stockpiles (ore, waste rock, excavated bedrock, topsoil, subsoil and temporary construction material	The largest source of particulate matter above-ground will be associated with the short haul road route from the portal to the crusher building. Tintina will also be required to formalize a Fugitive Dust Control Plan which includes all mine areas. Dust collectors will ensure particulate matter is controlled at the Fly Ash Hopper and Fly Ash Silo.

	s, #10 and #11	etc.) shall utilize reasonable precautions for particulate control. For stockpiles, this may include wind-fencing and/or treatment with water or chemical dust suppressant (ARM 17.8.752). Due to the vicinity of the mine, and all its workings including the tailings impoundment, waste rock, use of fly ash etc., in relation to Sheep creek and the surrounding watershed, we stress the highest precautions and strict inspections be taken to minimize impacts from particulate matter to the surrounding watershed. We fear in this case, due to the sensitive area of the proposed mine, reasonable precautions doesn't appropriately describe the measures that need to be taken to protect the surrounding watershed.	Reasonable Precautions through the use of water and/or chemical dust suppressant are required at all sources handing rock screening and crushing facilities. The Department has determined these permit requirements should be adequate to prevent dust events. If after operation begins, the Department determines additional controls are required due to violations; further mitigations would be incorporated through one or more Department mechanisms.
Christopher Policastro	General	This project creates an outsized risk to the environment and should not be approved. Please consider the quality of air, water, and other natural surroundings before the concerns of business. We only have one planet and every step we can take to preserve it is an important one.	This draft air quality permit has identified those conditions which Tintina will need to follow to be protective of ambient air quality. Water and other natural surroundings are addressed in the EIS.
Name Illegible	II.A (General)	The specifics (and broad extent) of the potentially harmful (if not judiciously utilized, monitored and controlled) chemical elements which are an integral part of this Project are, I would judge, well beyond the Public's current awareness or scope, at this juncture. For example, I seriously doubt that the use of "1,552 tons of Ammonium Nitrate Fuel Oil" per year, nearly half-a-million gallons of diesel fuel for just the Underground fueling segment (and the possibilities involved through any leaching of a spill) and the 4.2 Million gallons of propane ... all are merely 'operational Essentials' to the day-by-day duties of this Project. Not just such Volumes, but the potential toxicity of any mishaps in just this small portion of	The Department's Field Services staff would be responsible for site visits to determine compliance with the permit conditions. Secondly, as a stationary source, Tintina would be submitting annual emission inventory information for review by the Department. The Department believes the permit conditions, if followed, will be protective of ambient air quality.

		elements (and there are another eight – 8 - more of near equal concern) should require 'Pause'. Who will monitor these amounts and how they are stored /controlled/securely used and accounted for?	

D. Response to Tintina Comments

Permit Reference	Comment (Summarized by Department)	Department Response
II.A.1	The condition incorrectly applies the daily limit on copper enriched rock to P1 (referred to as the "portal crusher"), a portable crusher that is associated with the development phase at the mine. As described in Appendix A of the April 20, 2018, ·revision of the MAQP Application, P1 will process waste rock in the development phase of the mine, not copper-enriched rock throughout the production phase. In addition, P1 was permitted for up to 250 tons per hour (TPH) of that waste rock, which would equate to 6000 tons per day, not 3,700. The daily throughput capacity of mining operations can vary +/- 20% every day due a variety of circumstances from hard ore to equipment availability. This variability can also apply to the annual numbers. The annual production estimate of 1.35 million tons of copper-enriched rock (from which the 3,700 tons per day appears to have come from) is an annual anticipated average over the production life of the mine. Tintina needs the flexibility to increase throughput if the previous day, week, month or year has had issues that prevented it from operating at full capacity. BBCP will not cause or contribute to a violation of the ambient air quality standards given the existing analysis that is based on equipment operating at a full potential to emit, not on a specific production level.	The Department misunderstood that the portal crusher was only planned to be operational during the development phase of the mine. Therefore, the Department has revised the limit to reflect the 6000 tons per day and revised the limit to reflect a rolling 12-month limit of 2.19 million tons per year of waste rock.
II.A.2	Like Condition II.A.1, the condition incorrectly applies the annual limit on copper-enriched rock to P1 (referred to as the "portal crusher"). P1 is a portable crusher that is associated with the development phase at the mine. As described in Appendix A of the April 20, 2018, revision of the MAQP Application, P1 will process waste rock in the development phase of the mine, not copper-enriched rock throughout the production phase. In addition, P1 was permitted for up to 250 TPH of that waste rock, resulting in 2.19 million tons per year of waste rock processed, not the 1.35 million tons of copper-enriched rock described.	The Department has reviewed the need for a daily limit and determined that a rolling 12-month limit will be protective of ambient air quality standards for particulate matter. The Department has reviewed the information and determined a given year may have more production than the earlier estimate which was based on average annual production and determined 1.46 million tons per

	Also, like Condition II.A.1, the annual production estimate of 1.35 million tons of copper enriched is an anticipated annual average over the production life of the mine and was never intended. to limit the operations. The mine needs flexibility to improve the financial position of the company. Tintina also needs the flexibility to increase throughput if the previous day, week, month or year has had issues that prevented it from operating at full capacity. As discussed above, the daily throughput capacity of mining operations can vary +/- 20% due a variety of circumstances from hard ore to equipment availability. This variability also applies to the annual numbers. With respect to measurement of a potential production limit, Tintina requests this condition be updated to apply to the weight meter following the coarse ore bin (COB) instead of P1.	year as a 12-month rolling limit that will still be protective of ambient air quality. The location for measurement has been modified to reflect the weight meter following the coarse ore bin.
II.A.5	Tintina requests removal of unit P1 from the listing in the condition. The condition addresses diesel-fired generator sets. P1 is a portable crusher and while it is associated with a diesel-fired generator, that generator is listed separately as P2 and is already included in the condition. The corrected hp rating for the nonemergency engines should be "not to exceed" 2735 hp.	The Department has corrected the condition to remove P1 and revise the hp rating to 2,735 hp.
II.A.6	Tintina requests deletion of this limit. This issue is well covered in the overall facility diesel fuel limit in Condition II.A.7. As the Department is aware, the underground emissions are almost exclusively comprised of mobile source emissions.	The Department agrees that this limit is effectively already included within II.A.7, and opted not to incorporate a specific permit condition requiring testing on the exhaust portals. However, the Department could require source testing in the future, if determined to be necessary.
II.A.13	Tintina requests the reference to Section II.A.10 be changed to reflect the "reasonable precautions" condition of Section II.A.12.	Corrected as requested.
II.A.15	Tintina requests the term "baghouses" be replaced with "dust collectors" which is consistent with Condition II.B.9 and the BACT analysis for these units.	Revised as requested.
II.A.20	Tintina requests "P7" be replaced with "P7A and P7B" to be consistent with Conditions II.A.16 and 17.	Revised as requested.
II.B.3	Tintina assumes this condition was meant to address P1 - 250- TPH Portable Conical Crusher and P3 - Two Portable Screens (400 TPH each), and requests the condition language be changed to "Portable crusher and screens (P1 and P3) ... "	Revised as requested.
II.B.4	Tintina requests units P7, P8, and P9, the emergency engines, be removed from this condition. Those units are already identified as	Revised as requested.

	being subject to 40 60, Subpart LLLL in Condition II.A 16.	
II.B.8	This condition is unnecessary because it already exists in federal law. Ultra-low sulfur diesel (diesel limited to 15 parts per million sulfur by weight) is the only diesel fuel available for purchase for on-road and nonroad vehicles pursuant to EPA's diesel in fuel regulations that were fully in effect nationwide after 2014 (see EPA's diesel fuel· regulations at 40 CFR 80, Subpart I.	Revised as requested.
II.D.1.a	Tintina requests this be updated to reflect measurement at the weight meter following the COB.	Revised as requested.
II.D.1.b	On the basis of the comment on Condition II.A.6, Tintina requests this condition be removed.	Revised as requested.
II.D.1.c	There is no corresponding condition to track diesel fuel used by above-ground equipment. Tintina requests this condition be removed.	Condition II.D.1.c has been modified to reflect a site wide tracking of diesel fuel usage to address II.A.6.
II.D.5	See discussion on the corresponding Condition II.A 1.	Condition was modified to reflect an annual limit. See new II.A.1.
II.D.6	See discussion on the corresponding Condition II.A.2 with respect to location of measurement and the inapplicability of the limit to the Portal Crusher (P1).	Revised accordingly.
II.D.9	See discussion on the corresponding Condition II.A.6. Tintina requests deletion of this requirement.	Incorporated.
II.D.10	This condition references "underground equipment" and appears to be identical to Condition II.D.9. Tintina requests this condition be updated to reflect Condition II.D.7.	Revised.
Permit Analysis Section II.F	Tintina submitted· an affidavit of publication for the February 20, 2018, issue of the Helena Independent Record, a newspaper of general circulation in the area affected by the permit, in addition to those newspapers listed. Tintina requests this affidavit also be included in the notification list.	Revised.
Permit Analysis, Section IV	Tintina requests correction of the horsepower (hp) rating on unit P6 in the first table listing the emitting units. The correct hp rating is 536-hp, as listed in Section I.A of the permit analysis.	Revised.
Permit Analysis, Section IV	Tintina requests a clarifying comment associated with the total in the last table of that section listing the fugitive source PM totals. The total indicated covers emissions from multiple mine operating years that would not coincide; therefore, the "total" is not representative of actual mine operation in any one annual period.	The total was removed and the Department will let the individual fugitive IDs and the year of emissions represent the emissions for their respective periods.

II. Applicable Rules and Regulations

The following are partial explanations of some applicable rules and regulations that apply to the facility. The complete rules are stated in the Administrative Rules of Montana (ARM) and are available, upon request, from the Department of Environmental Quality (Department). Upon request, the Department will provide references for location of complete copies of all applicable rules and regulations or copies where appropriate.

A. ARM 17.8, Subchapter 1 – General Provisions, including but not limited to:

1. ARM 17.8.101 Definitions. This rule includes a list of applicable definitions used in this chapter, unless indicated otherwise in a specific subchapter.

2. ARM 17.8.105 Testing Requirements. Any person or persons responsible for the emission of any air contaminant into the outdoor atmosphere shall, upon written request of the Department, provide the facilities and necessary equipment (including instruments and sensing devices) and shall conduct tests, emission or ambient, for such periods of time as may be necessary using methods approved by the Department.

3. ARM 17.8.106 Source Testing Protocol. The requirements of this rule apply to any emission source testing conducted by the Department, any source or other entity as required by any rule in this chapter, or any permit or order issued pursuant to this chapter, or the provisions of the Clean Air Act of Montana, 75-2-101, *et seq*., Montana Code Annotated (MCA).

   Tintina shall comply with the requirements contained in the Montana Source Test Protocol and Procedures Manual, including, but not limited to, using the proper test methods and supplying the required reports. A copy of the Montana Source Test Protocol and Procedures Manual is available from the Department upon request.

4. ARM 17.8.110 Malfunctions. (2) The Department must be notified promptly by telephone whenever a malfunction occurs that can be expected to create emissions in excess of any applicable emission limitation or to continue for a period greater than 4 hours.

5. ARM 17.8.111 Circumvention. (1) No person shall cause or permit the installation or use of any device or any means that, without resulting in reduction of the total amount of air contaminant emitted, conceals or dilutes an emission of air contaminant that would otherwise violate an air pollution control regulation. (2) No equipment that may produce emissions shall be operated or maintained in such a manner as to create a public nuisance.

B. ARM 17.8, Subchapter 2 – Ambient Air Quality, including, but not limited to the following:

1. ARM 17.8.204 Ambient Air Monitoring
2. ARM 17.8.210 Ambient Air Quality Standards for Sulfur Dioxide
3. ARM 17.8.211 Ambient Air Quality Standards for Nitrogen Dioxide

4. ARM 17.8.212 Ambient Air Quality Standards for Carbon Monoxide
5. ARM 17.8.213 Ambient Air Quality Standard for Ozone
6. ARM 17.8.214 Ambient Air Quality Standard for Hydrogen Sulfide
7. ARM 17.8.220 Ambient Air Quality Standard for Settled Particulate Matter
8. ARM 17.8.221 Ambient Air Quality Standard for Visibility
9. ARM 17.8.222 Ambient Air Quality Standard for Lead
10. ARM 17.8.223 Ambient Air Quality Standard for PM_{10}
11. ARM 17.8.230 Fluoride in Forage

Tintina must maintain compliance with the applicable ambient air quality standards.

C. ARM 17.8, Subchapter 3 – Emission Standards, including, but not limited to:

1. ARM 17.8.304 Visible Air Contaminants. This rule requires that no person may cause or authorize emissions to be discharged into the outdoor atmosphere from any source installed after November 23, 1968, that exhibit an opacity of 20% or greater averaged over 6 consecutive minutes.

2. ARM 17.8.308 Particulate Matter, Airborne. (1) This rule requires an opacity limitation of less than 20% for all fugitive emission sources and that reasonable precautions be taken to control emissions of airborne particulate matter. (2) Under this rule, Tintina shall not cause or authorize the use of any street, road, or parking lot without taking reasonable precautions to control emissions of airborne particulate matter.

3. ARM 17.8.309 Particulate Matter, Fuel Burning Equipment. This rule requires that no person shall cause, allow, or permit to be discharged into the atmosphere particulate matter caused by the combustion of fuel in excess of the amount determined by this rule.

4. ARM 17.8.310 Particulate Matter, Industrial Process. This rule requires that no person shall cause, allow, or permit to be discharged into the atmosphere particulate matter in excess of the amount set forth in this rule.

5. ARM 17.8.322 Sulfur Oxide Emissions--Sulfur in Fuel. This rule requires that no person shall burn liquid, solid, or gaseous fuel in excess of the amount set forth in this rule.

6. ARM 17.8.324 Hydrocarbon Emissions--Petroleum Products. (3) No person shall load or permit the loading of gasoline into any stationary tank with a capacity of 250 gallons or more from any tank truck or trailer, except through a permanent submerged fill pipe, unless such tank is equipped with a vapor loss control device as described in (1) of this rule.

7. ARM 17.8.340 Standard of Performance for New Stationary Sources and Emission Guidelines for Existing Sources. This rule incorporates, by reference, 40 CFR Part 60, Standards of Performance for New Stationary Sources (NSPS). Tintina is considered an NSPS affected facility under 40 CFR Part 60 and is subject to the requirements of the following subparts.

a. 40 CFR 60, Subpart A – General Provisions apply to all equipment or facilities subject to an NSPS Subpart as listed below:

b. 40 CFR 60, Subpart LL – Standard of Performance for Metallic Mineral Processing Plants.

c. 40 CFR 60, Subpart IIII – Standard of Performance for Stationary Compression Ignition Internal Combustion Engines. Owners and operators of stationary CI ICE that commence construction after July 11, 2005, where the stationary CI ICE are manufactured after April 1, 2006, and are not fire pump engines, and owners and operators of stationary CI ICE that modify or reconstruct their stationary CI ICE after July 11, 2005, are subject to this subpart. Based on the information submitted by Tintina, the CI ICE equipment to be used under MAQP #5200-00 may be subject to this subpart because the proposed engines are manufactured after the applicable date.

10. ARM 17.8.342 Emission Standards for Hazardous Air Pollutants for Source Categories. The source, as defined and applied in 40 CFR Part 63, shall comply with the requirements of 40 CFR Part 63, as listed below:

a. 40 CFR 63, Subpart A – General Provisions apply to all equipment or facilities subject to an NESHAP Subpart as listed below:

b. 40 CFR 63, Subpart ZZZZ – National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines. An owner or operator of a stationary reciprocating internal combustion engine (RICE) at a major or area source of HAP emissions is subject to this rule except if the stationary RICE is being tested at a stationary RICE test cell/stand. An area source of HAP emissions is a source that is not a major source. Based on the information submitted by Tintina, the RICE equipment to be used under MAQP #5200-00 may be subject to this subpart if Tintina remains in the same location for more than 12 months.

c. 40 CFR 63, Subpart CCCCCC – National Emissions Standards for Hazardous Air Pollutants for Source Category: Gasoline Dispensing Facilities.

D. ARM 17.8, Subchapter 4 – Stack Height and Dispersion Techniques, including, but not limited to:

1. ARM 17.8.401 Definitions. This rule includes a list of definitions used in this chapter, unless indicated otherwise in a specific subchapter.

2. ARM 17.8.402 Requirements. Tintina must demonstrate compliance with the ambient air quality standards with a stack height that does not exceed Good Engineering Practices (GEP). The proposed height of all stacks for Tintina is below the allowable 65-meter GEP stack height.

E. ARM 17.8, Subchapter 5 – Air Quality Permit Application, Operation, and Open Burning Fees, including, but not limited to:

1. ARM 17.8.504 Air Quality Permit Application Fees. This rule requires that an applicant submit an air quality permit application fee concurrent with the submittal of an air quality permit application. A permit application is incomplete until the proper application fee is paid to the Department. Tintina submitted the appropriate permit application fee for the current permit action.

2. ARM 17.8.505 Air Quality Operation Fees. An annual air quality operation fee must, as a condition of continued operation, be submitted to the Department by each source of air contaminants holding an air quality permit (excluding an open burning permit) issued by the Department. The air quality operation fee is based on the actual or estimated actual amount of air pollutants emitted during the previous calendar year.

   An air quality operation fee is separate and distinct from an air quality permit application fee. The annual assessment and collection of the air quality operation fee, described above, shall take place on a calendar-year basis. The Department may insert into any final permit issued after the effective date of these rules, such conditions as may be necessary to require the payment of an air quality operation fee on a calendar-year basis, including provisions that prorate the required fee amount.

F. ARM 17.8, Subchapter 7 – Permit, Construction, and Operation of Air Contaminant Sources, including, but not limited to:

1. ARM 17.8.740 Definitions. This rule is a list of applicable definitions used in this chapter, unless indicated otherwise in a specific subchapter.

2. ARM 17.8.743 Montana Air Quality Permits--When Required. This rule requires a person to obtain an air quality permit or permit modification to construct, modify, or use any air contaminant sources that have the potential to emit (PTE) greater than 25 tons per year of any pollutant. Tintina has a PTE greater than 25 tons per year of particulate matter (PM), particulate matter with an aerodynamic diameter less than or equal to ten microns (PM10), oxides of nitrogen (NOx), carbon monoxide (CO) and volatile organic compounds (VOCs), and therefore, an air quality permit is required.

3. ARM 17.8.744 Montana Air Quality Permits--General Exclusions. This rule identifies the activities that are not subject to the Montana Air Quality Permit program.

4. ARM 17.8.745 Montana Air Quality Permits--Exclusion for De Minimis Changes. This rule identifies the de minimis changes at permitted facilities that do not require a permit under the Montana Air Quality Permit Program.

5. ARM 17.8.748 New or Modified Emitting Units--Permit Application Requirements. (1) This rule requires that a permit application be submitted

prior to installation, modification, or use of a source. Tintina submitted the required permit application for the current permit action. (7) This rule requires that the applicant notify the public by means of legal publication in a newspaper of general circulation in the area affected by the application for a permit. Tintina submitted an affidavit of publication of public notice for the February 20, 2018, issue of the *Bozeman Chronicle*, a newspaper of general circulation in the Town of Bozeman in Gallatin County, as proof of compliance with the public notice requirements. Tintina also submitted an affidavit of publication of public notice for the week of February 20, 2018, issue of the *Great Falls Tribune*, a newspaper of general circulation in the Town of Great Falls in Cascade County, as proof of compliance with the public notice requirements. Tintina also submitted an affidavit of publication of public notice for the week of February 22, 2018, issue of the *Meagher County News*, a newspaper of general circulation in the Town of White Sulphur Springs in Meagher County, as proof of compliance with the public notice requirements. Tintina also submitted an affidavit of publication of public notice for the week of February 20, 2018, issue of the *Helena Independent Record*, a newspaper of general circulation in the Town of Helena in Lewis and Clark Count, as proof of compliance with the public notice requirements.

6. ARM 17.8.749 Conditions for Issuance or Denial of Permit. This rule requires that the permits issued by the Department must authorize the construction and operation of the facility or emitting unit subject to the conditions in the permit and the requirements of this subchapter. This rule also requires that the permit must contain any conditions necessary to assure compliance with the Federal Clean Air Act (FCAA), the Clean Air Act of Montana, and rules adopted under those acts.

7. ARM 17.8.752 Emission Control Requirements. This rule requires a source to install the maximum air pollution control capability that is technically practicable and economically feasible, except that BACT shall be utilized. The required BACT analysis is included in Section III of this permit analysis.

8. ARM 17.8.755 Inspection of Permit. This rule requires that air quality permits shall be made available for inspection by the Department at the location of the source.

9. ARM 17.8.756 Compliance with Other Requirements. This rule states that nothing in the permit shall be construed as relieving Tintina of the responsibility for complying with any applicable federal or Montana statute, rule, or standard, except as specifically provided in ARM 17.8.740, *et seq*.

10. ARM 17.8.759 Review of Permit Applications. This rule describes the Department's responsibilities for processing permit applications and making permit decisions on those permit applications that do not require the preparation of an environmental impact statement.

11. ARM 17.8.760 Additional Review of Permit Applications. This rule describes the Department's responsibilities for processing permit applications

and making permit decisions on those applications that require an environmental impact statement.

12. <u>ARM 17.8.762 Duration of Permit</u>. An air quality permit shall be valid until revoked or modified, as provided in this subchapter, except that a permit issued prior to construction of a new or modified source may contain a condition providing that the permit will expire unless construction is commenced within the time specified in the permit, which in no event may be less than 1 year after the permit is issued.

13. <u>ARM 17.8.763 Revocation of Permit</u>. An air quality permit may be revoked upon written request of the permittee, or for violations of any requirement of the Clean Air Act of Montana, rules adopted under the Clean Air Act of Montana, the FCAA, rules adopted under the FCAA, or any applicable requirement contained in the Montana State Implementation Plan (SIP).

14. <u>ARM 17.8.764 Administrative Amendment to Permit</u>. An air quality permit may be amended for changes in any applicable rules and standards adopted by the Board of Environmental Review (Board) or changed conditions of operation at a source or stack that do not result in an increase of emissions as a result of those changed conditions. The owner or operator of a facility may not increase the facility's emissions beyond permit limits unless the increase meets the criteria in ARM 17.8.745 for a de minimis change not requiring a permit, or unless the owner or operator applies for and receives another permit in accordance with ARM 17.8.748, ARM 17.8.749, ARM 17.8.752, ARM 17.8.755, and ARM 17.8.756, and with all applicable requirements in ARM Title 17, Chapter 8, Subchapters 8, 9, and 10.

15. <u>ARM 17.8.765 Transfer of Permit</u>. This rule states that an air quality permit may be transferred from one person to another if written notice of intent to transfer, including the names of the transferor and the transferee, is sent to the Department.

G. ARM 17.8, Subchapter 8 – Prevention of Significant Deterioration of Air Quality, including, but not limited to:

1. <u>ARM 17.8.801 Definitions</u>. This rule is a list of applicable definitions used in this subchapter.

2. <u>ARM 17.8.818 Review of Major Stationary Sources and Major Modifications--Source Applicability and Exemptions</u>. The requirements contained in ARM 17.8.819 through ARM 17.8.827 shall apply to any major stationary source and any major modification, with respect to each pollutant subject to regulation under the FCAA that it would emit, except as this subchapter would otherwise allow.

This facility is not a major stationary source because this facility is not a listed source and the facility's PTE is below 250 tons per year of any pollutant (excluding fugitive emissions).

H. ARM 17.8, Subchapter 12 – Operating Permit Program Applicability, including, but not limited to:

1. ARM 17.8.1201 Definitions. (23) Major Source under Section 7412 of the FCAA is defined as any source having:

   a. PTE > 100 tons/year of any pollutant;

   b. PTE > 10 tons/year of any one hazardous air pollutant (HAP), PTE > 25 tons/year of a combination of all HAPs, or lesser quantity as the Department may establish by rule; or

   c. PTE > 70 tons/year of particulate matter with an aerodynamic diameter of 10 microns or less (PM_{10}) in a serious PM_{10} nonattainment area.

2. ARM 17.8.1204 Air Quality Operating Permit Program. (1) Title V of the FCAA amendments of 1990 requires that all sources, as defined in ARM 17.8.1204(1), obtain a Title V Operating Permit. In reviewing and issuing MAQP #5200-00 for Tintina, the following conclusions were made:

   a. The facility's PTE is greater 100 tons/year for CO and NO_x during the development phase when the use of temporary equipment would be needed.

   b. The facility's PTE is less than 10 tons/year for any one HAP and less than 25 tons/year for all HAPs.

   c. This source is not located in a serious PM_{10} nonattainment area.

   d. This facility is subject to NSPS 40 CFR 60, Subpart LL and Subpart IIII.

   e. This facility is subject to NESHAP 40 CFR 63, Subpart ZZZZ and Subpart CCCCCC.

   f. This source is not a Title IV affected source, or a solid waste combustion unit.

   g. This source is not an EPA designated Title V source.

   Based on these facts, the Department determined that Tintina is subject to the Title V operating permit program. Tintina has indicated they will apply for a Title V operating permit as required unless they prepare an updated MAQP application during the development phase to reduce their emissions below Title V thresholds.

III. BACT Determination

A BACT determination is required for each new or modified source. Tintina shall install on the new or modified source the maximum air pollution control capability which is technically practicable and economically feasible, except that BACT shall be utilized.

A BACT analysis was submitted by Tintina in permit application #5200-00, addressing available methods of controlling emissions from the proposed BBCP. The Department reviewed these methods, as well as previous BACT determinations. The following control options have been reviewed by the Department in order to make the following BACT determination.

BACT for Particulate Matter Emissions from Mineral Handling and Processing (jaw crusher, surge bin, mill building processes) and Auxiliary Processing and Handling (backfill plant, water treatment plant lime storage)

The mineral handling includes a jaw crusher, surge bin, and ore processing/milling. The auxiliary processing includes the backfill plant and the water treatment plant lime storage. These sources are individual emissions sources but are considered as a group with respect to particulate control technology evaluation.

Of the list of regulated criteria pollutants, these sources emit particulates (PM, PM_{10}, and $PM_{2.5}$). The analyses presented here are restricted to evaluation of BACT for the product processing and handling.
Note: Conveyors used in ore processing are enclosed and as a result do not require further analysis.

Step 1 - Identify All Control Options

The table below briefly describes available technologies for controlling particulate emissions from product processing and handling.

Available Particulate Control Technologies

Technology	Description
No Add-on Control	This is the base case for proposed new sources.
Enclosure	Enclosure technology employs structures, devices or underground placement to shelter material from wind entrainment. Enclosures can either fully or partially surround the source.
Wet Dust Suppression Including Retained or Inherent Moisture	Fogging water spray adds water, with or without surfactant, to material. Emissions are reduced through agglomerate formation by combining small dust particles with larger aggregate or with liquid droplets. Moisture retained from water sprays upstream in the process or moisture inherent in the material provides a similar emission reducing effect.
Electrostatic Precipitator (ESP)	An ESP uses electrical forces to move entrained particles onto a collection surface. To remove dust cake from the collection surface, the collection surface is periodically "rapped" by a variety of means to dislocate the particulate, which drops down into a hopper. Particulate-laden air must be able to be collected and ducted to the ESP.

Technology	Description
Wet Particulate Scrubber	Wet scrubbers typically use water to impact, intercept, or diffuse a particulate in a waste gas stream. Particulate matter is accelerated and impacted onto a solid surface or into a liquid droplet through devices such as a venturi and spray chamber. Wet slurry material is typically stored in an on-site waste impoundment.
Fabric Filter Dust Collector/Bin Vent/Baghouse	Fabric filter dust collectors/bin vents/baghouses direct particulate- laden exhaust through tightly woven or felted fabric that traps particulate by sieving and other mechanisms. Collection efficiency and pressure drop simultaneously increase as a particulate layer collects on the filter. Filters are intermittently cleaned by shaking the bag, pulsing air through the bag, or temporarily reversing the airflow direction.

Step 2 - Eliminate Technically Infeasible Options

Wet Scrubber

Wet scrubbers can be very effective for particulate control; however, wet scrubbers would create a waste stream for disposal and are very seldom used on processes of this small size due to their complex operation, large footprint, and heavy use of water resources. For these reasons, a wet particulate scrubber as a control technology would be considered technically infeasible and not available to control particulate emissions from the mineral handling and processing.

Electrostatic Precipitators

Although ESP units are theoretically capable of controlling particulate emissions at levels similar to baghouses, they are generally not feasible for the application considered here. The EPA Air Pollution Cost Manual states that, "ESPs are not typically viewed as cost effective control devices for smaller sources" (U.S. EPA, 2002, pp. 4-15). Further, EPA states in another technical report that, "Electrostatic precipitators are usually not suited for use on processes which are highly variable, since frequent changes in operating conditions are likely to degrade ESP performance" (U.S. EPA, 1998). Tintina indicated it is unaware of any application of an ESP to control fugitive particulate emitted during mineral processing/handling or auxiliary processing/handling. For these reasons, ESP technology is considered to be technically infeasible and not available to control particulate emissions from the product processing and handling.

Step 3 - Rank Remaining Options by Control Effectiveness

The remaining available alternatives according to their respective potential effectiveness values.

Technology	Control Efficiency	Ranking
Fabric Filter Bin Vent/Dust Collector/Baghouse	95-99.9+%	1
Enclosure	Up to 90% (varies with degree of enclosure)	2
Wet Dust Suppression	50%	3
No Add-on Control	Base case	4

Step 4 - Evaluate Most Effective Controls and Document Results

Tintina proposes to install the top ranked control technology, fabric filter dust collector, to control particulate emissions from the mineral and auxiliary processing and handling points. Additional control will be provided by building enclosures for the jaw crusher, milling processes, backfill plant, and water treatment lime silo.

Step 5 - Select BACT

Based upon the preceding analysis, Tintina proposes that fabric filter dust collectors with a grain loading limit of 0.01 gr PM (with respect to filterable emissions, the manufacturer uses the conservative approach of equating PM_{10} and $PM_{2.5}$ emissions with PM) as BACT. The grain loading value is consistent with recent MDEQ-permitted small dust collectors installed in Montana. Larger processes provide for smaller air-to-cloth ratio; i.e., more filtration available for a unit amount of exhaust flow. The Texas Commission on Environmental Quality publishes current guidelines for Bulk Material Handling which indicate that fabric filter baghouses with 0.01 gr/dscf grain loading specifications (approx. 99% reduction) constitute BACT for those types of sources.

BACT for Gaseous and Particulate Emissions from Diesel Engines/Generators

Tintina is proposing to use a variety of diesel engines/generators from light plants powered by 14-hp diesel engines to 1,000-kilowatt emergency backup generators. All of these are subject to EPA non-road engine standards, as described in 40 CFR Part 89 and/or 1039, as well as NSPS Subpart IIII for RICE. BACT for these engines is compliance with EPA nonroad standards and NSPS Subpart IIII. The proposed BACT conforms to previous BACT determinations made by MDEQ for similar-sized diesel engines. With respect to using the most recent (and lowest emitting) engines available, 40 CFR 60.4208 requires owners and operators to install recently manufactured engines that meet the NSPS standards.

BACT for Gaseous and Particulate Emissions from Propane Heaters (23 MMBtu/hr and 52 MMBtu/hr each)

Tintina is proposing to use two direct-fired propane heaters (one 23 MMBtu/hr and one 52 MMBtu/hr) at each intake vent to heat air entering the mine. Of the list of regulated criteria pollutants, these sources emit both gaseous and particulate emissions. The BACT analyses is broken down in two categories for add-on control: CO/VOC and NOx. Particulate matter emissions from cleaning burning fuels such as propane are quite small and would be best controlled by good combustion practices. SO_2 emissions are negligible and result solely from the sulfur content of propane.

Step 1 - Identify All Control Options – CO/VOC

CO and VOC are formed from the incomplete combustion of organic constituents in propane. Because CO and VOC are generated and controlled by the same mechanisms, they are addressed together. Two general and nonexclusive approaches were analyzed for controlling these emissions: improving combustion conditions to facilitate complete combustion in the heater burner and completing oxidation of the exhaust stream after it leaves the heater burner. Post-combustion CO/VOC control is accomplished via add-on equipment that creates an environment of high temperature and oxygen concentration to promote complete oxidation of the CO and VOC remaining in the exhaust. This can be facilitated at relatively low temperatures by the use of certain catalyst materials.

Technology	**Description**
Proper system design and operation	The base level of emissions for CO and VOC is proper design and operation of the proposed heater without additional add-on control. The CO and VOC emissions can be minimized by controlling the system temperatures through operation at maximum loads; increasing oxygen concentrations; maximizing combustion residence time; and improving mixing of the fuel, exhaust gases, and combustion air. Generally, a reduction in CO and VOC emissions will result in an increase in NOx emissions.
Thermal oxidation	Thermal oxidizers are essentially supplementary chambers that complete the fuel combustion of unburned organic constituents. They accomplish this by creating a high temperature environment with optimal oxygen concentration, mixing, and residence time. They require temperatures of approximately 1400 degrees Fahrenheit (°F) to 1500°F. This high temperature environment is produced by the combustion of supplemental fuel. Several design variations address different inlet concentrations, air flow rates, fuel efficiency requirements, and other operational variables. All of them function using the basic principles described above. One commonly used design is called a regenerative thermal oxidizer (RTO) which is evaluated for this BACT analysis. RTOs are capable of reducing CO and VOC emissions by 95 to 99 percent.
Catalytic oxidation	Catalytic oxidizers employ the same principles as thermal oxidizers, but they use catalysts to lower the temperature required to affect complete oxidation. One commonly used design is called a regenerative catalytic oxidizer (RCO) which is evaluated for this BACT analysis. The optimum temperature range for catalytic oxidizers is generally about 800°F. Catalytic oxidizers must be located downstream of a PM control device if the exhaust stream contains appreciable concentrations of PM because catalysts are prone to plugging and poisoning. For this application, the portal heater would be combusting a clean fuel (propane) and PM loading is not anticipated to be a problem. Like thermal oxidizers, catalytic oxidizer designs include many varieties to address specific operational conditions and requirements. They are generally capable of 90 to 99 percent destruction or removal efficiency at steady-state conditions.

Step 2 - Eliminate Technically Infeasible Options – CO/VOC

The proposed portal heaters are direct-fired burners where the combustion exhaust gases and the heated air are inseparable. This configuration makes the installation of the add-on pollution control equipment addressed here technically infeasible. The remaining option is proper system design and operation.

Step 3 - Rank Remaining Options by Control Effectiveness – CO/VOC

Proper design and operation was determined to be the only technically feasible control option for the portal heaters.

Step 4 - Evaluate Most Effective Controls and Document Results – CO/VOC

Proper design and operation was determined to be the only technically feasible control option for the portal heater.

Step 5 - Select BACT – CO/VOC

Tintina proposes that proper design and operation of the two propane-fired vent heaters are BACT for CO and VOC. The combustion of a clean fuel (propane) and following good combustion practices is proposed as BACT for the heaters associated with this project. The proposed BACT conforms to previous BACT determinations made by MDEQ.

BACT for NO_x for the Two Propane-Fired Heaters

Step 1 - Identify All Control Options – NO_x

NO_x is formed during propane combustion in the heater. NO_x comes from two sources in combustion, fuel NO_x and thermal NO_x. The fuel NO_x portion is relatively small and is based almost solely on the type of fuel combusted. The majority of NO_x formation is dominated by the process called thermal NO_x formation. Thermal NO_x results from the thermal fixation of atmospheric nitrogen and oxygen in the combustion air. The rate of formation is sensitive to local flame temperature and, to a lesser extent, local oxygen concentrations. Virtually all thermal NO_x is formed in the region of the flame at the highest temperature. Maximum thermal NO_x production occurs at a slightly lean fuel-to-air ratio due to the excess availability of oxygen for reaction with the nitrogen in the air and fuel. The following table contains NO_x control technologies for heaters.

Technology	Description
Proper system design and operation	The base level of emissions for NOx is proper design and operation of the proposed heater without additional add-on control.
Low NO_x Burners with Flue Gas Recirculation	Due to limited success of Low NO_x Burners (LNB) in lowering NO_x emissions as a stand-alone technology, it has been integrated with Flue Gas Recirculation (FGR). Together, LNB and FGR integrate staged combustion into the burner creating a fuel-rich primary combustion zone. Fuel NO_x formation is decreased by the reducing conditions in the primary combustion zone. Thermal NO_x is limited due to the lower flame temperature caused by the lower oxygen concentration. The secondary combustion zone is a fuel-lean zone where combustion is completed. The combined technology may result in increased CO and hydrocarbon emissions, decreased boiler efficiency and increased fuel costs.
Selective Non-Catalytic Reduction	Selective Non-Catalytic Reduction involves the noncatalytic decomposition of NO_x in the flue gas to nitrogen and water using a reducing agent (e.g., ammonia or urea). The reactions take place at much higher temperatures than in an SCR, typically between 1,650°F and 2100°F, because a catalyst is not used to drive the reaction. The efficiency of the conversion process diminishes quickly when operated outside the optimum temperature band and additional ammonia slip or excess NO_x emissions may result.

Technology	Description
Selective Catalytic Reduction	Selective Catalytic Reduction (SCR) is a post-combustion gas treatment technique for reduction of NO and NO_2 in an exhaust stream to molecular nitrogen, water, and oxygen. Ammonia (NH_3) or urea is used as the reducing agent. Ammonia or urea is injected into the flue gas upstream of a catalyst bed, and NO_X and NH_3 combine at the catalyst surface, forming an ammonium salt intermediate, which subsequently decomposes to produce elemental nitrogen and water. The control technology works best for flue gas temperatures between 575°F and 750°F. Excess air is injected at the heater exhaust to reduce temperatures to the optimum range, or the SCR is located in a section of the heater exhaust ducting where the exhaust temperature has cooled to this temperature range.

Step 2 - Eliminate Technically Infeasible Options – NO_x

The proposed portal heaters are direct-fired burners where the combustion exhaust gases and the heated air are inseparable. This configuration makes the practical installation of the FGR as well as add-on pollution control equipment addressed here technically infeasible. The remaining option is proper system design and operation.

Step 3 - Rank Remaining Options by Control Effectiveness – NO_x

Proper design and operation was determined to be the only technically feasible control option for the portal heaters.

Step 4 - Evaluate Most Effective Controls and Document Results – NO_x
Proper design and operation was determined to be the only technically feasible control option for the portal heater.

Step 5 - Select BACT - NO_x

Tintina proposes that proper design and operation of the two propane-fired vent heaters are BACT for NO_x. The combustion of a clean fuel (propane) and following good combustion practices is proposed as BACT for the heaters associated with this project. The proposed BACT conforms to previous BACT determinations made by MDEQ.

BACT for Gaseous and Particulate Emissions from Small, Temporary, Portable Propane (nine heaters, 37.8 MMBtu/hr total) and Diesel Heaters (three heaters, 1.2 MMBtu/hr total)

Tintina proposes to use temporary heaters during the development phase for worker safety and to heat mine intake air, as necessary. The BACT analysis regarding the temporary diesel heaters in use at the portal and the temporary portable propane heaters that will be moved site-wide has been combined to assess BACT for small clean-burning heaters. Based on the small size of the heaters and the minimal emissions generated, particularly as temporary units, no add-on control technology would be economically feasible. Emissions of all criteria pollutants will be minimized through the combustion of propane and diesel and by following good combustion practices for these units.

Good combustion practices are proposed as BACT for the small, portable, temporary heaters associated with this project which burn both propane and diesel. The proposed BACT conforms to previous BACT determinations made by MDEQ for similar-sized propane and diesel heaters.

BACT for Particulate Emissions from Small Crushers and Screens (250 TPH crusher and two 400-TPH screens)

PM emissions are created by crushing and screening equipment. The potential uncontrolled emissions of particulate matter emissions from these operations can be significant. The moisture content of the material processed can have a substantial effect on emissions. Surface wetness causes fine particles to agglomerate on or to adhere to the faces of larger stones, with a resulting dust suppression effect. However, as new fine particles are created by crushing and attrition and as the moisture content is reduced by evaporation, this suppressive effect diminishes. Operators that use wet suppression systems (spray nozzles) to maintain material moisture as needed can effectively control PM emissions throughout the process. Therefore, Tintina proposes wet suppression as BACT for the control of PM emissions on the small, portable crushing and screening units.

BACT for Gaseous and Particulate Emissions from Explosives Detonation/Blasting Ammonium Nitrate Fuel Oil (ANFO)

Explosives (primarily ANFO) will be used for underground mining and will 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% 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 cost. Gaseous emissions will result from the detonation of the chemical compounds with the explosives. Particulate emissions will result from the blasting and loosening of ore material. While blasting seemingly generates large amounts of dust, the operation occurs infrequently enough that it is not considered to be a significant contributor of PM_{10} [EPA 1991; Richards and Brozell 2001]. Nonetheless, various best operational practices (BOPs) and blasting techniques will be utilized for reducing gaseous and particulate emissions from blasting.

Tintina will use the following blasting BOPs:

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

- Optimize drill hole placement and utilization of sequential detonation. Optimizing drill hole placement will ensure that all material is successfully detonated, and additional explosives are not needed in order to achieve complete fragmentation.

- Optimize usage of explosive. Proper usage of explosive prevents the detonation of unnecessary, excess explosive and resulting excess emissions.

- Mine planning will result in blasting that is conducted in a manner that prevents overshooting and minimizes the area to be blasted.

Because the imposition of an emission standard is infeasible for blasting, Tintina proposes that BACT for reducing blasting emissions is a work practice condition to use proper blasting techniques, proper explosive selection, optimized application of explosives, and the utilization of best operating practices. These work practice conditions collectively reduce the amount of gaseous and particulate emissions resulting from explosives detonation.

BACT for Fugitive Particulate Emissions from Roads

Particulate emissions from fugitive road dust will result from vehicle and equipment travel on roadways within the BBCP mine site. BBCP roadway categories include permanent haul roads, temporary haul roads (used primarily during development phase), and mine access roads. Emissions were calculated for those roads based on vehicle type, activity, and frequency of trips. However, the overall control strategy for the roads will be discussed as a whole. The table below lists particulate control technologies available for reducing roadway fugitive emissions.

Technology	Description
No Add-on Control	This is the base case for proposed roadways.
Vehicle Restrictions	Restrict vehicle speed to reduce fugitive dust and increase distance between vehicles.
Surface Improvement	Improve roadway surfaces by paving with asphaltic concrete or other additives.
Surface Treatment	Wet suppression or surface treatment with chemical dust suppressants.

Initially, surface improvement using asphaltic concrete appears to be the most desirable road surface material and potential control technology. It offers a high coefficient of road adhesion and creates a surface that reduces dust problems. However, using this road composition has a seasonal disadvantage in climates with snow or freezing rain. The smooth surface of asphalt offers little resistance to the development of ice or snow causing the roadway to become extremely slick and remain so until a facility employs corrective measures. This could constitute a serious threat to operational safety in mining areas where rapid and frequent freeze conditions prevail. South-central Montana experiences many freeze/thaw periods throughout the year creating a potential safety hazard from the use of paved mine haul roadways.

The Design of Surface Haulage Roads Manual further states that "the high cost of asphaltic road surface severely restricts its feasibility on roads of short life. In most cases, a 4-inch layer of road surface may be accepted as the minimum requirement road depth due to the extreme weight of vehicles constantly traveling haul road surfaces. The cost of constructing a 4-inch thick layer ranges from $46 to $57 per square yard for labor, equipment, and material. Using the higher figure for a 5-mile road 30 feet wide would necessitate an expenditure of $440,000 for paving alone." Additionally, a sufficient sub- base and base coarse must be established prior to placing the asphalt. The necessary base course is an additional expense to be considered in total construction cost.

The Design of Surface Haulage Roads Manual continues to state that a great number of surface mining operations throughout the country are currently using gravel and crushed stone surface haulage roads. They provide a stable roadway that resists deformation and provides a relatively high coefficient of road adhesion with low rolling resistance. The Manual states that it would be impractical to use a permanent surface improvement control such as asphaltic concrete in areas where haul roads are subject to relocation or must accommodate heavy tracked vehicles.

A significant amount of traffic on BBCP roads will consist of haul trucks and other heavy machinery. Consequently, BBCP determined that surface improvement control techniques utilizing asphaltic concrete are both economically impractical and potentially hazardous.

The BBCP roads vary in both silt and moisture content and produce a varying degree of fugitive road dust emissions. A combination of surface treatments and vehicle restrictions are proposed to reduce fugitive road dust emissions
Tintina proposes the utilization of water as a surface treatment for all mine roads and along mine roads, with chemical dust suppressants considered as necessary (particularly on high traffic areas near private ranch buildings). Water sprays will be utilized to increase the moisture content of mine access roadway material in order to conglomerate particles and reduce the likelihood of fugitive particulate. The water sprays will be applied as necessary. Further vehicle restrictions will also be enforced as necessary in order to control fugitive emissions from mine access road travel. This includes the limitation of vehicle speed. These measures, as well as available reasonable precautions, will maintain compliance with ARM.17.8.304 and ARM 17.8.308.

BACT for Fugitive Particulate Emissions from Material Handling, Removal, and Stockpiles/Storage

Contemporaneous reclamation of disturbances will be a priority during the construction period. Maintaining reclaimed areas will be an ongoing BBCP focus. Surface disturbances related to cut and fill slopes associated with roads, ditches, embankment faces, and the disturbed perimeter of facility footprints will be reclaimed immediately where possible after final grades have been established. Reclamation includes: grading, slope stabilization, drainage control, topsoil and subsoil placement, and seeding. It is expected that these reclaimed areas will be fully revegetated within two to four years following construction. Temporary waste rock and life-of-mine copper-enriched rock storage areas will also be watered as necessary to minimize dust while loading or unloading material. Monitoring by site personnel during each shift will ensure watering is done to the level required to minimize the effects of dust at the site.

Construction-related disturbances that may generate dust and are not needed operationally will be recontoured, soil placed, and revegetated as quickly as possible following construction. This will include road cut-and-fill slopes, facility berms (Waste Rock storage and mill facility), embankments and berms of the Cemented Tailings Facility, Contact Water Pond, Process Water Pond, WRS and NCWR, buried pipelines, water diversion ditches, and soil/subsoil stockpiles. Dust control from the CTF is not expected to be problematic because the material will be moist (20%) and will be stabilized with cement additions to provide a non-flowable mass.

Other components of the dust control plan include (other specific emitting units are covered previously):

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

These measures, as well as available reasonable precautions, will maintain compliance with ARM.17.8.304 and ARM 17.8.308.

The control options selected have controls and control costs comparable to other recently permitted similar sources and are capable of achieving the appropriate emission standards.

IV. Emission Inventory

This project was modeled by finding the highest emissions for any activity during the proposed mine life, and assuming those activities all occur at the same time and in the same year. This provided a worst-case analysis to demonstrate there will be no violations of either NAAQS or MAAQS. The emitting units below include not only individual emitting units but also activities which generate emissions and were modeled. For example, underground blasting emissions are assigned as an emitting unit ID as are each of the various road sections for particulate matter emissions.

EMITTING UNIT ID	NAME
P1	250 TPH Portable Conical Crusher
P2	325-hp Portable Diesel Eng/Gen
P3	2 – Portable Screens (400 TPH each)
P4	131-hp Portable Diesel Eng/Gen
P5	545-kW/914-hp Portable Diesel Eng/Gen
P6	320-kW/536-hp Portable Diesel Eng/Gen
P7A & P7B	2- 1000-kW/1675-hp Diesel Eng/Gen - Emergency backup
P8	100-hp Diesel Eng/Gen – Emergency evac hoists
P9	50-hp Diesel Fire Pump – Emergency
P10A	23 MMBtu/hr Propane-fired Heater – Intake Vent for Upper Copper Zone
P10B	52 MMBtu/hr Propane-fired Heater – Intake Vent for Lower Copper Zone
P11	3 Temporary diesel heaters at Portal - (1.2 MMBtu/hr total)
P12	3640 TPD Jaw Crusher
P13A	Mill Building (mill, lime storage, etc.)
P13B	Mill Building (lime area/slurry mix tank)
P14	Surge Bin Discharge

EMITTING UNIT ID	NAME
P15	Water Treatment Plant Lime Area
P16A	Backfill Plant Cement/Fly Ash Hopper
P16B	Backfill Plant Cement/Fly Ash Silo
P17	4- Portable Diesel Eng/Gen (400-hp total)
P18	Air Compressor - 275-hp Diesel Engine
UG	ANFO
F1	Road Dust, Mine Operating Year (MOY) 0 to 1
F2	Road Dust, MOY 1 to 2
F3	Road Dust, MOY 2 to 15, Annual Average
F4	Road Dust, MOY 16 and 17, Annual Average
F5	Road Dust, MOY 18
F6	Material Transfer to Temporary Stockpile, MOY 0 to 1.5
F7	Temporary Construction Stockpile
F8	Embankment Construction, MOY 0 to 1.5
F9	Backfill, NCWR Embankment Material to CTF, MOY 16 to 18
F10	Material Transfer to South Stockpile, MOY 0 to 1
F11	Excess Reclamation Stockpile (South)
F12	Material Transfer from South Stockpile, MOY 16 to 17
F13	Material Transfer to North Stockpile, MOY 0 to 1
F14	Excess Reclamation Stockpile (North)
F15	Material Transfer from North Stockpile, MOY 16 to 18
F16	Soil Removal and Stockpiling, MOY 0 to 1
F17	Topsoil Pile
F18	Subsoil Pile
F19	Soil Return, MOY 16 to 18
F20	Copper-enriched Rock Drop to Stockpile, MOY 2 to 3
F21	Copper-enriched Rock Stockpile (Mill Feed)
F22	Waste Rock Drop at WRS Pad, MOY 0 to 1.5, at CTF, MOY 1.5 to 4 and 8
F23	Temporary WRS
F24	Waste Rock Transfer from WRS to CTF, MOY 2 to 3
F25	Waste Rock Storage Pad Reclamation, MOY 3
F26	11 - 14-hp Portable Diesel-powered Light Plants (only 4 units will be used in Production Phase)
F27	500-gal Gasoline Storage Tank
F28	9 -Temporary Portable Propane-fired Heaters (37.8 MMBtu/hr total) (only 3 will be used in Production Phase)
F29	Road Dust, Construction Access Road, Year 0-2 Avg.
F30	Road Dust, Main Access Road, Year 2-15 Avg.
IEU1	Diesel Storage Tanks (250-gal, 500-gal, 10,000- gal)

The point source and fugitive emission inventory totals prepared for the modeling demonstration in the ambient air quality analysis against the MAAQS and NAAQS is summarized in the below table.

Source Cat.	Model Type	Modeled Emissions (Tons/Year)				
		PM_{10}	**$PM_{2.5}$**	**CO**	**NO_2**	**SO_2**
EVL	Point	1.020	1.000	28.090	19.460	0.630
EVU	Point	2.830	2.800	78.389	54.299	1.770
HEATER	Point	1.260	1.260	13.590	23.580	0.099
LIGHT	Point	1.480	1.480	4.510	20.900	0.008
P10A	Point	0.449	0.449	4.824	8.365	0.035
P10B	Point	1.021	1.021	10.908	18.912	0.079
P11	Point	0.050	0.050	0.190	0.750	0.080
P12	Point	3.190	3.190	n/a	n/a	n/a
P13A	Point	0.190	0.190	n/a	n/a	n/a
P13B	Point	1.240	1.240	n/a	n/a	n/a
P14	Point	1.880	1.880	n/a	n/a	n/a
P15	Point	1.240	1.240	n/a	n/a	n/a
P16A	Point	0.230	0.230	n/a	n/a	n/a
P16B	Point	0.450	0.450	n/a	n/a	n/a
P17	Point	1.150	1.150	14.400	13.540	0.210
P18	Point	0.400	0.400	6.930	7.920	0.150
P2	Point	0.470	0.470	8.190	9.360	0.170
P4	Point	0.280	0.280	4.720	3.770	0.070
P5	Point	1.320	1.320	23.020	42.101	0.490
P6	Point	0.770	0.770	13.520	15.450	0.030
PORTAL	Point	0.950	0.940	26.300	18.220	0.590
FUGITIVE	Volume	0.004	0.002	n/a	n/a	n/a
P1	Volume	0.591	0.109	n/a	n/a	n/a
P3A	Volume	1.296	0.088	n/a	n/a	n/a
P3B	Volume	1.296	0.088	n/a	n/a	n/a
ROAD	Volume	84.519	8.471	n/a	n/a	n/a
STOCKPILES	Volume	3.180	0.832	n/a	n/a	n/a
TRANSFERS	Volume	7.000	3.040	n/a	n/a	n/a
Total		**119.757**	**34.439**	**237.581**	**256.627**	**4.411**

Abbreviations:

EVL = Mine Ventilation Exhaust Lower Copper Zone
EVU = Mine Ventilation Exhaust Upper Copper Zone
Heater = Sum of Temporary Propane Heaters
Light = Sum of Diesel-fired Light Plants
Portal = Main Portal Exhaust
Road = Volume Sources for Roads
Stockpiles = Particulate Emissions from various stockpiles of material
Transfers = Particulate Emissions from material handling

PM_{10} = particulate matter with an aerodynamic diameter of 10 microns or less
$PM_{2.5}$ = particulate matter with an aerodynamic diameter of 2.5 microns or less
CO = carbon monoxide
NO_2 = oxides of nitrogen

SO_2 = sulfur dioxide

The emission inventory reflects maximum allowable emissions for all pollutants based on maximum production and year-round operation for most operations (8,760 hours) with the following exceptions. Emergency generators are limited to 500 hours of operation per year and P10A and P10B are used on a seasonal basis for heating the interior of the mine. Road fugitive totals were averaged across the emissions during each year in the production phase.

VOC and PM emissions were also totaled for sources and do not have ambient air quality standards to compare to, but are shown here for completeness.

Potential Emissions Summary - PM and VOC

Point #	Emitting Unit	PM tons per year	VOC tons per year
	POINT SOURCES		
P1	250 TPH Portable Conical Crusher	1.31	--
P2	325-hp Portable Diesel Engine/generator	0.47	3.52
P3	2 Portable Screens (400 TPH each)	7.71	--
P4	131-hp Portable Diesel Engine/generator	0.28	1.42
P5	545-kW /914-hp Diesel Engine/generator	1.32	9.88
P6	320-kW /536-hp Diesel Engine/generator	0.77	5.80
P7	1000-kW /1675-hp Diesel Engine/generators (2) - Emergency	0.28	2.07
P8	100-hp Diesel Engine/generator - Emergency evac hoists	0.02	0.06
P9	50-hp Diesel Fire Pump - Emergency	0.01	0.03
P10A	23 MMBtu/hr Propane-fired heater @ Intake Vent for Upper Copper Zone	0.45	0.64
P10B	52 MMBtu/hr Propane-fired heater @ Intake Vent for Lower Copper Zone	1.01	1.45
P11	3 Temporary diesel heaters at Portal - (1.2 MMBtu/hr total)	0.05	0.02
P12	Jaw Crusher (3640 TPD), Building/Dust Collector	3.19	--
P13A	Mill Building (mill, lime storage, etc.) Dust Collector	0.19	--
P13B	Mill Building (lime area/slurry mix tank) Dust Collector	1.24	--
P14	Surge Bin Discharge Dust Collector	1.88	--
P15	Water Trtmt Plant Lime Area Dust Collector	1.24	--
P16A	Backfill Plant Cement/Fly Ash Hopper Dust Filter/Collector	0.23	--
P16B	Backfill Plant Cement/Fly Ash Silo Dust Filter/Collector	0.45	--
P17	Portable diesel engine/generators (total of 400 hp, 4 units)	1.15	4.33
P18	Air Compressor - Diesel Engine (275 hp)	0.40	2.98
F26	Diesel-powered Light plants - 11 - 14 hp each	1.48	1.67
F27	Gasoline storage tank (double-walled 500 gal)		0.07
F28	Temporary portable propane heaters (37.8 MMBtu/hr total) - 9	1.27	1.81
UG	ANFO	0.11	--
	TOTAL POINT SOURCES	**26.49**	**35.74**
UG - EVU	Mine Ventilation Exhaust Upper Copper Zone - EVU		17.36
UG - EVL	Mine Ventilation Exhaust Lower Copper Zone - EVL		6.22
UG - P	Mine Ventilation Exhaust - Mine Portal		5.82
	ANFO (included in UG sources)		

Fugitive ID and Year of Emissions		PM Tons Per Year
F1	Road Dust, Mine Operating Year 0 to 1	152.7
F2	Road Dust, Mine Operating Year 1 to 2	56.42
F3	Road Dust, Mine Operating Year 2 to 15, annual average	17.79
F4	Road Dust, Mine Operating Years 16 and 17, annual average	73.8
F5	Road Dust, Mine Operating Year 18	11.68
F6	Material transfer to Temporary Stockpile, MOY 0 to 1.5	3.13
F7	Temporary construction stockpile	0.36
F8	Embankment Construction, Mine Operating Year 0 to 1.5	3.13
F9	Backfill, NWCR Embankment Material to CTF, MOY 16 to 18	1.78
F10	Material transfer to South Stockpile, MOY 0 to 1	1.49
F11	Excess reclamation stockpile (South)	0.08
F12	Material transfer from South Stockpile, MOY 16 to 17	1.49
F13	Material transfer to North Stockpile, MOY 0 to 1	2.13
F14	Excess reclamation stockpile (North)	0.17
F15	Material transfer from North Stockpile, MOY 16 to 18	0.82
F16	Soil Removal and Stockpiling, Mine Operating Year 0 to 1	4.99
F17	Topsoil pile	0.08
F18	Subsoil pile	0.44
F19	Soil Return, Mine Operating Year 16 to 18	4.17
F20	Copper-enriched rock drop to stockpile, MOY 2 to 3	0.16
F21	Copper-enriched rock stockpile (mill feed)	0
F22	Waste Rock Drop -at WRS Pad, MOY 0 to 1.5, at CTF, MOY 1.5 to 4 and 8	0.87
F23	Temporary waste rock storage (WRS)	0.019
F24	Waste Rock Transfer from WRS to CTF, MOY 2 to 3	1.39
F25	Waste Rock Storage Pad Reclamation, MOY 3	1.65
F29	Road Dust, Construction Access Road, Year 0 - 2 Avg.	0.9
F30	Road Dust, Main Access Road, Year 2 - 15 Avg.	102.19
	Emissions are shown by Mine Operating Year (MOY)	

V. Existing Air Quality

This permit is for an underground copper mine and surface mill buildings in Meagher County, Montana. Meagher County has been designated unclassified/attainment with all ambient air quality standards.

VI. Ambient Air Impact Analysis

The project is scheduled to occur in three phases; development, production and reclamation. For demonstration with NAAQS and MAAQS, highest emitting activities have been assumed to occur at the same time regardless of which phase they actually occur in. This assumption shows that even with a conservative approach, the emitting units and sources of criteria pollutants will not violate ambient air quality standards. The project would be classified as a minor source for PSD-NSR and a major source under Title V regulations. Temporary engines utilized in the development phase of the mine, trigger the Title V major status. Tintina could later decide to revisit the Title V major status following the development phase but as currently presented, Tintina would need to apply for a Title V Operating permit within 12-months after commencing operation of the engines and temporary equipment presented for operation during the development phase.

Tintina conducted a screening analysis on CO, NO_2, SO_2, PM_{10}, and $PM_{2.5}$ for various long and short-term averaging periods. All emissions were held constant across all averaging periods. Tintina modeled 26 discrete point sources, and 1583 volume sources. The Heater and Light points represent multiple units distributed across the site and the four emergency generators are not included in the 26 point source total. The majority of volume sources were equally spaced road segments, modeled for fugitive dust emissions of PM_{10} and $PM_{2.5}$.

The table below reports the total emissions modeled for each pollutant.

Source Cat.	Model Type	Modeled Emissions (Tons/Year)				
		PM_{10}	**$PM_{2.5}$**	**CO**	**NO_2**	**SO_2**
EVL	Point	1.020	1.000	28.090	19.460	0.630
EVU	Point	2.830	2.800	78.389	54.299	1.770
HEATER	Point	1.260	1.260	13.590	23.580	0.099
LIGHT	Point	1.480	1.480	4.510	20.900	0.008
P10A	Point	0.449	0.449	4.824	8.365	0.035
P10B	Point	1.021	1.021	10.908	18.912	0.079
P11	Point	0.050	0.050	0.190	0.750	0.080
P12	Point	3.190	3.190	n/a	n/a	n/a
P13A	Point	0.190	0.190	n/a	n/a	n/a
P13B	Point	1.240	1.240	n/a	n/a	n/a
P14	Point	1.880	1.880	n/a	n/a	n/a
P15	Point	1.240	1.240	n/a	n/a	n/a
P16A	Point	0.230	0.230	n/a	n/a	n/a
P16B	Point	0.450	0.450	n/a	n/a	n/a
P17	Point	1.150	1.150	14.400	13.540	0.210
P18	Point	0.400	0.400	6.930	7.920	0.150
P2	Point	0.470	0.470	8.190	9.360	0.170
P4	Point	0.280	0.280	4.720	3.770	0.070
P5	Point	1.320	1.320	23.020	42.101	0.490
P6	Point	0.770	0.770	13.520	15.450	0.030
PORTAL	Point	0.950	0.940	26.300	18.220	0.590
FUGITIVE	Volume	0.004	0.002	n/a	n/a	n/a
P1	Volume	0.591	0.109	n/a	n/a	n/a
P3A	Volume	1.296	0.088	n/a	n/a	n/a
P3B	Volume	1.296	0.088	n/a	n/a	n/a
ROAD	Volume	84.519	8.471	n/a	n/a	n/a
STOCKPILES	Volume	3.180	0.832	n/a	n/a	n/a
TRANSFERS	Volume	7.000	3.040	n/a	n/a	n/a
Total		**119.757**	**34.439**	**237.581**	**256.627**	**4.411**

The application also included the use of four emergency generators for 728 hours per year (permit contains a limit for 500 but modeling was done at 728) for each. These emissions were modeled separately on the assumption that normal operations would cease if the emergency generators were activated. The table below shows the emissions for the emergency generators.

Source	Emissions (Tons/Year)				
	$PM_{2.5}$	**PM_{10}**	**NO_2**	**CO**	**SO_2**
P7A	2.409	2.409	77.176	42.216	0.889
P7B	2.409	2.409	77.176	42.216	0.889
P8	0.289	0.289	3.373	3.592	0.053
P9	0.144	0.145	1.691	1.800	0.027
Total	5.251	5.252	159.416	89.823	1.857

The SIL and MAAQS/NAAQS compliance demonstrations were conducted using the latest available version of AERMOD and associated preprocessors. Specifically:

- AERMOD version 16216r: Air dispersion model
- AERMET version 16216: processes on-site and NWS meteorological data for input to AERMOD
- AERSURFACE version 13016: processes 1992 National Land Cover Data surface characteristics for input to AERMET
- AERMAP version 11103: Processes National Elevation Data from the USGS to determine elevation of sources and receptors for input into AERMOD
- BPIPPRM version 04274: characterizes building downwash for input to AERMOD
- BEEST version 11.10: GUI used for easier processing of AERMOD inputs and outputs.

Regulatory default options were used for all model runs. Rural dispersion coefficients were applied because less than 50% of the site location is classified into a developed land use category. All of Montana currently meets this criterion. Metrological data was obtained from an on-site meteorological tower at the proposed facility location. Data was collected from May 2012, through April 2017, and used in the modeling analysis. National Weather Service data from the Helena Regional Airport (WBAN 24144) was used to supplement missing on-site data for the five-year period. The Great Falls Upper Air station (WBAN 04102) was used for upper air data.

Source parameters were provided by Tintina and remained constant across all pollutants and averaging times. The tables below outline the source parameters used for point and volume sources for the facility, followed by parameters for the emergency generators.

Point source parameters for the facility operations are listed below.

Source Cat.	Source	Stack Height (m)	Stack Temp(K)	Stack Vel. (m/s)	Stack Diam. (m)
EVL	EVL	0.91	294.25	7.28	4.88
EVU	EVU	0.91	294.25	20.32	4.88
Heater	PROA	1.83	755.35	8.79	0.1

Source Cat.	Source	Stack Height (m)	Stack Temp(K)	Stack Vel. (m/s)	Stack Diam. (m)
	PROB	1.83	755.35	8.79	0.1
	PROC	1.83	755.35	8.79	0.1
Light	LIGHTA	0.91	866.45	9	0.08
	LIGHTB	0.91	866.45	9	0.08
	LIGHTC	0.91	866.45	9	0.08
	LIGHTD	0.91	866.45	9	0.08
P10A	P10A	0.91	294.25	20.32	4.88
P10B	P10B	0.91	294.25	7.28	4.88
P11	P11	1.22	810.95	18.1	0.1
P12	P12	10	ambient temp	17.78	0.61
P13A	P13A	25	ambient temp	13.71	0.15
P13B	P13B	25	ambient temp	20.14	0.36
P14	P14	15	ambient temp	18.7	0.46
P15	P15	10	ambient temp	20.14	0.36
P16A	P16A	15	ambient temp	19.74	0.15
P16B	P16B	15	ambient temp	17.54	0.23
P17	P17	1.22	838.75	36.96	0.1
P18	P18	1.68	737.15	43.54	0.15
P2	P2	1.68	737.15	50.11	0.15
P4	P4	1.83	755.37	32.83	0.1
P5	P5	2.13	791.35	52.63	0.23
P6	P6	2.44	743.15	25.46	0.23
PORTAL	PORTAL	0.3	294.25	6.04	5.18

Volume source parameters for the facility operations are listed below.

Source Cat.	Source	Release Height (m)	Init Sy (m)	Init Sz (m)
Fugitive	DRAIN_CTF	2	10.47	1.86
	DRAIN_PWP	2	7.44	1.86
	POWDER	2	10.23	1.86
P1	P1	2.16	3.09	2.01
P3A	P3A	2.45	2.77	2.28
P3B	P3B	2.45	2.77	2.28
Road	ACC	2.11	6.48	1.96
	CON	2.11	3.88	1.96
	CTF Road	3.5	7.44	3.25
	Service Road	3.5	4.51	3.25
Stockpiles	CUPILE	9	16.28	8.37
	NPILE	4.5	33.72	4.19
	SPILE	4.5	27.91	4.19
	SUBS	4.5	32.09	4.19
	TEMP	3.05	18.14	2.84
	TOPS	4.5	27.91	4.19
	WRS	7.5	53.49	6.98
Transfers	CTF_T	2	36.05	1.86
	CUPILE_T	2	16.28	1.86
	CWP_T	2	17.83	1.86
	MILL_T	2	20.93	1.86
	NCWR_T	2	29.07	1.86
	PORTAL_T	2	13.37	1.86
	PWP_T	2	22.67	1.86
	WRS_T	2	17.83	1.86

The emergency generators' source parameters are listed below.

Source	Source Parameters				
	Base Elev. (m)	Stack Height (m)	Stack Temp(K)	Stack Vel. (m/s)	Stack Diam. (m)
P7A	1785	6.1	746.55	49.05	0.3
P7B	1785	6.1	746.55	49.05	0.3
P8	1768.9	1.22	838.75	36.96	0.1
P9	1785	1.22	810.95	18.1	0.1

Tintina conducted a screening analysis in concurrence with the NAAQS/MAAQS analysis to determine whether the proposed project would result in predicted concentrations exceeding any of the significant impacts levels (SILs) for any of the criteria pollutants for the various averaging periods. The results of the screening analysis from the Tintina MAQP application are shown below.

Pollutant	Avg. Period	Modeled Conc. (µg/m3)	Class II SIL (µg/m3)	Significant (Y/N)
PM_{10}	24-hr	108.6	5	Y
$PM_{2.5}$	24-hr	16.6	1.2	Y
	Annual	4.2	0.3	Y
NO_2	1-hr	263	7.52	Y
	Annual	11.7	1	Y
SO_2	1-hr	13.8	7.8	Y
	3-hr	20.5	25	N
	24-hr	3.6	5	N
	Annual	0.19	1	N
CO	1-hr	2725	2,000	Y
	8-hr	459.2	500	N

SILs were exceeded for 24-hr PM_{10}, 24-hr and annual $PM_{2.5}$, 1-hr and annual NO_2, 1-hr SO_2 and 1-hr CO. Thresholds above the SILs requires that a compliance demonstration using existing nearby industrial sources in addition to background concentrations be conducted with the resulting concentrations compared to NAAQS and MAAQS. As the proposed project site is not in close proximity with other existing industrial facilities, no nearby sources were included in the NAAQS and MAAQS compliance demonstration. Therefore, the compliance demonstration was simplified to adding the modeled concentrations from the proposed project to approved background concentrations.

Tintina also conducted a screening analysis for emergency operations in concurrence with the NAAQS/MAAQS analysis to determine whether the emergency operations would result in predicted concentrations exceeding any of the significant impacts levels (SILs) for any of the criteria pollutants for the various averaging periods. The results of the screening analysis from the Tintina MAQP application are shown below.

Pollutant	Avg. Period	Modeled Conc.(a) (µg/m^3)	Class II SIL (µg/m^3)	Significant (Y/N)
PM_{10}	24-hr	1.4	5	N
$PM_{2.5}$	24-hr	0.97	1.2	N
	Annual	0.03	0.3	N
NO_2	1-hr	240	7.52(b)	Y
	Annual	0.79	1	N
	1-hr	5.6	7.8(c)	N

Pollutant	Avg. Period	Modeled Conc.[(a)] (μg/m^3)	Class II SIL (μg/m^3)	Significant (Y/N)
SO_2	3-hr	3.8	25	N
	24-hr	0.48	5	N
	Annual	0.013	1	N
CO	1-hr	398	2,000	N
	8-hr	70	500	N

Background concentrations prepared by Tintina were collected at the Sieben Flats NCore monitoring station (Lewis and Clark County) and the Lewistown monitoring station (Fergus County). The Sieben Flats station monitors background air quality data is part of the National Core (NCore) multi-pollutant monitoring network which addresses monitoring objectives including long-term health assessments contributing to ongoing reviews of the NAAQS and the support of 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 with characteristics similar to the region surrounding the BBCP. Monitoring data from the Sieben station was used for all pollutants collected at the station, which included all criteria pollutants except for NO_2 and PM_{10}. The Lewistown station provides another set of monitoring data characteristic to the BBCP location and was used for NO_2 and PM_{10} background concentration values.

Pollutant	Averaging Period	Background[(a)] Concentration (μg/m^3)	Monitoring Station
PM_{10}[(b)]	24-hour	30.3[(c)]	Lewistown
$PM_{2.5}$[(b)]	24-hour	10	Sieben Flatts NCORE
	Annual	2.5	Sieben Flatts NCORE
SO_2	1-hour	5.24[(d)]	Sieben Flatts NCORE
CO[(b)]	1-hour	1031[(c)]	Sieben Flatts NCORE
NO_2	1-hour	20.7[(e)]	Lewistown
	Annual	1[(f)]	Lewistown

(a) NAAQS design values provided in 2017 Network Plan produced by Montana DEQ unless noted otherwise.
(b) Values exclude EPA or DEQ defined exceptional events.
(c) NAAQS design values derived from EPA Monitoring Values Report data.
(d) Concentration represents 2 ppb.
(e) Concentration represents 11 ppb.
(f) Concentration represents 0.5 ppb. Value not a regulatory calculated. Internally calculated arithmetic mean provided in 2017 Network Plan. Used in lieu of no NO_2 Annual NAAQS Design Value

The compliance demonstration for the modeled inputs against the NAAQS and MAAQS is shown below.

Pollu-tant	Avg. Period	Modeled Conc. (µg/m³)	Background Conc. (µg/m³)	Ambient Conc. (µg/m³)	NAAQS (µg/m³)	% of NAAQS	MAAQS (µg/m³)	% of MAAQS
PM_{10}	24-hr	89.7[a]	30.3	120	150	80%	150	80%
$PM_{2.5}$	24-hr	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%[g]
	Annual	11.7[c]	1	12.7	100	13%	94	13%
SO_2	1-hr	5.8[e]	5.24	11.03	196	6%	1309	1%
CO	1-hr	1890[f]	1031	2921	40,000	7%	26,450	11%

(a) Modeled concentration is the high-6th-high modeled over a 5-year concatenated met period.
(b) Modeled concentration is the high-8th-high modeled over a 5-year concatenated met period.
(c) Modeled concentration is the highest annual average over the modeled five-year period.
(d) Modeled concentration is the high-8th-high modeled over a 5-year concatenated met period.
(e) Modeled concentration is the high-4th-high modeled over a 5-year concatenated met period.
(f) Modeled concentration is the high-2nd-high modeled over a 5-year concatenated met period.
(g) Modeled concentration is the high-2nd-high modeled impact over a 5-year concatenated met period. High-2nd-high concentration is 184 ug/m3 and was not included in the table. With the addition of the 20.7 ug/m3 background value the ambient impact is 36% of the MAAQS.

The compliance demonstration for the emergency operations for NO_2 1-hr are shown against the NAAQS and MAAQS below.

Pollu-tant	Avg. Period	Modeled Conc. (µg/m³)	Background Conc. (µg/m³)	Ambient Conc. (µg/m³)	NAAQS (µg/m³)	% of NAAQS	MAAQS (µg/m³)	% of MAAQS
NO_2	1-hr	139.26[a]	20.7	159.96	188	85%	------	------

Modeled results of the full facility indicate the 1-hr NO_2 standard and 24-hr PM_{10} standard are at 81% and 80% of the NAAQS, respectively. Modeling results of the emergency operations indicate the 1-hr NO_2 standard is 85% of the NAAQS. These are the highest modeled concentrations with the next highest being the 24-hr $PM_{2.5}$ concentrations. Given the modeling approach of assuming the highest emitting activities occur at the same time, emission estimates are generally over-stated and since no pollutant is over either the NAAQS or MAAQS for any averaging period, the proposed project has demonstrated compliance with the NAAQS and MAAQS.

The Department determined, based on the modeling analysis, accompanying assumptions and conditions including BACT methods established in MAQP #5200-00 that the impacts from this permitting action will be minor. The Department believes it will not cause or contribute to a violation of any ambient air quality standard. The full modeling analysis submitted with the MAQP application, is on-file with the Department.

VII. Taking or Damaging Implication Analysis

As required by 2-10-105, MCA, the Department conducted the following private property taking and damaging assessment.

YES	NO	
X		1. Does the action pertain to land or water management or environmental regulation affecting private real property or water rights?
	X	2. Does the action result in either a permanent or indefinite physical occupation of private property?
	X	3. Does the action deny a fundamental attribute of ownership? (ex.: right to exclude others, disposal of property)
	X	4. Does the action deprive the owner of all economically viable uses of the property?
	X	5. Does the action require a property owner to dedicate a portion of property or to grant an easement? [If no, go to (6)].
		5a. Is there a reasonable, specific connection between the government requirement and legitimate state interests?
		5b. Is the government requirement roughly proportional to the impact of the proposed use of the property?
	X	6. Does the action have a severe impact on the value of the property? (consider economic impact, investment-backed expectations, character of government action)
	X	7. Does the action damage the property by causing some physical disturbance with respect to the property in excess of that sustained by the public generally?
	X	7a. Is the impact of government action direct, peculiar, and significant?
	X	7b. Has government action resulted in the property becoming practically inaccessible, waterlogged or flooded?
	X	7c. Has government action lowered property values by more than 30% and necessitated the physical taking of adjacent property or property across a public way from the property in question?
	X	Takings or damaging implications? (Taking or damaging implications exist if YES is checked in response to question 1 and also to any one or more of the following questions: 2, 3, 4, 6, 7a, 7b, 7c; or if NO is checked in response to questions 5a or 5b; the shaded areas)

Based on this analysis, the Department determined there are no taking or damaging implications associated with this permit action.

VIII. Environmental Assessment

An EA is not being conducted as part of this preliminary determination, as the proposed underground mine and mill is being evaluated by the Department of Environmental Quality and a separate Environmental Impact Statement (EIS) is in the process of being developed. All project-related documents including the EIS related documents are being posted on the DEQ website at: http://deq.mt.gov/Land/hardrock/tintinamines.

Analysis Prepared By: Craig Henrikson
Date: March 3, 2019

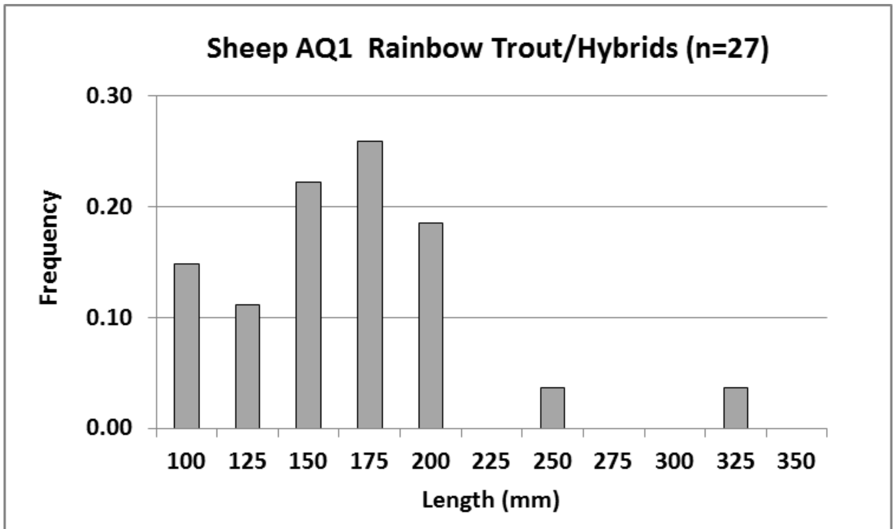
APPENDIX K

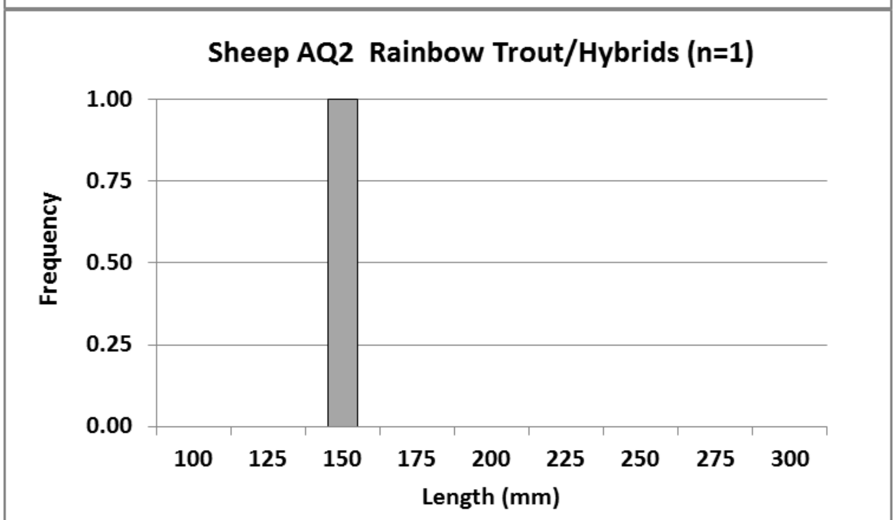
Seasonal Fish Size-Frequency Data

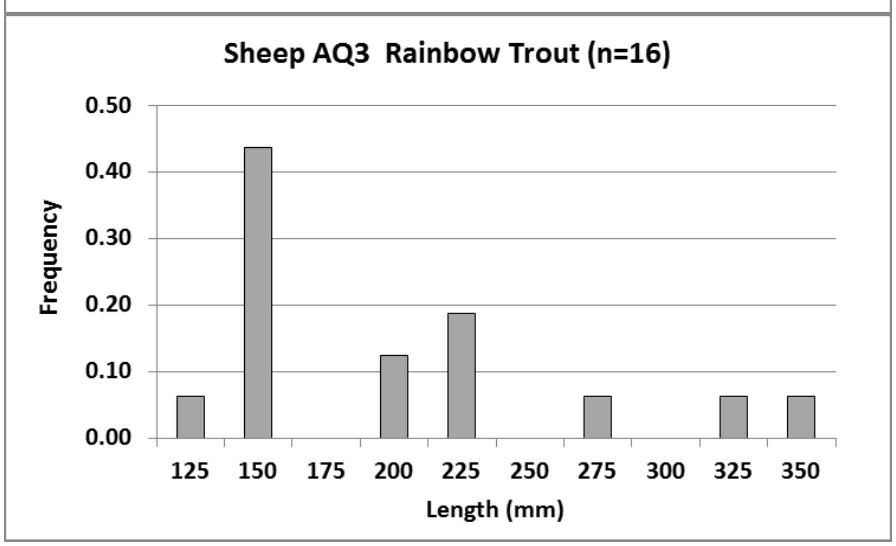
Pages extracted from:

Stagliano, D. 2015. Baseline Aquatic Survey and Assessment of Streams in the Tintina Black Butte Copper Project Area of Meagher County, MT. Tintina Resources Inc. White Sulphur Springs, Montana.

Size frequency collection data for Rainbow Trout and “Cutt-bows” collected at the Tintina Black Butte Mine Sites.







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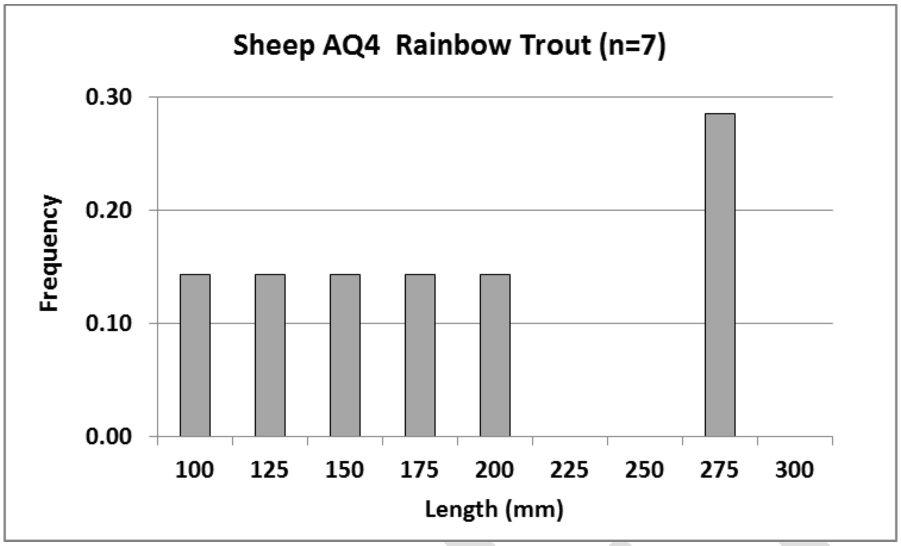
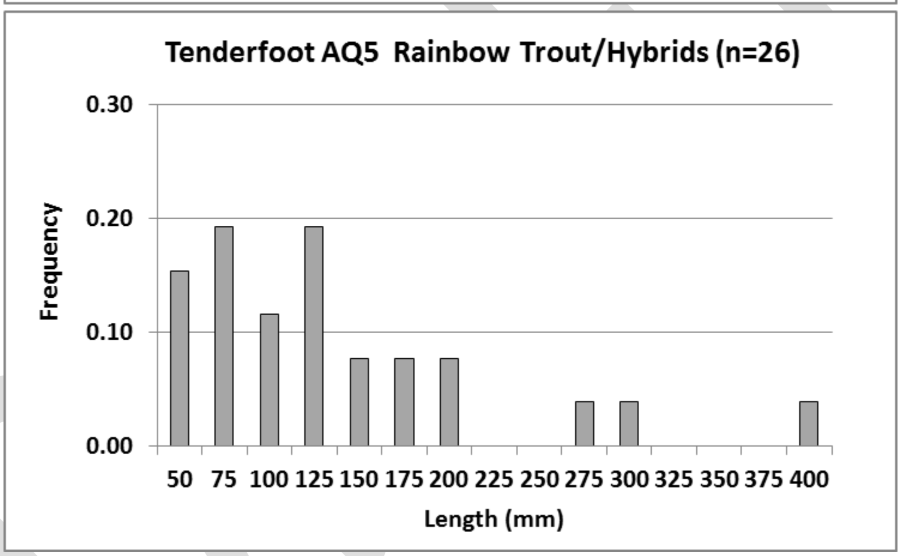
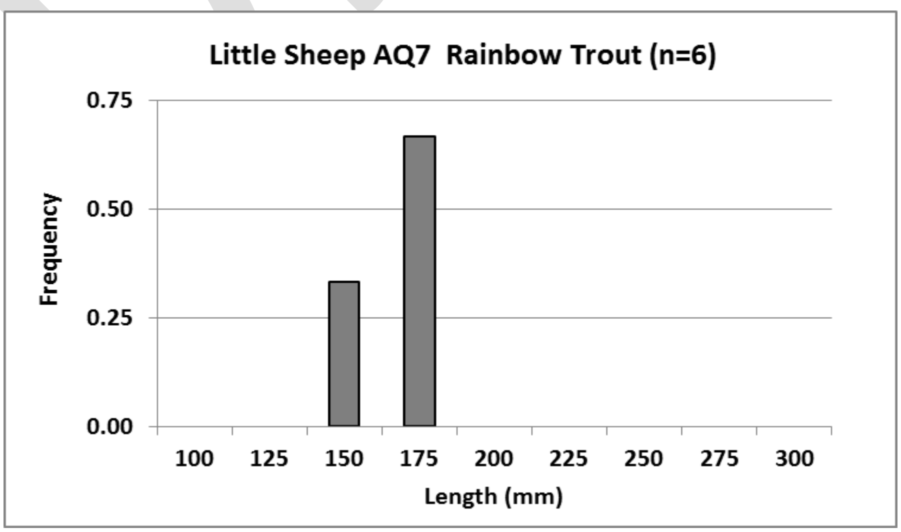
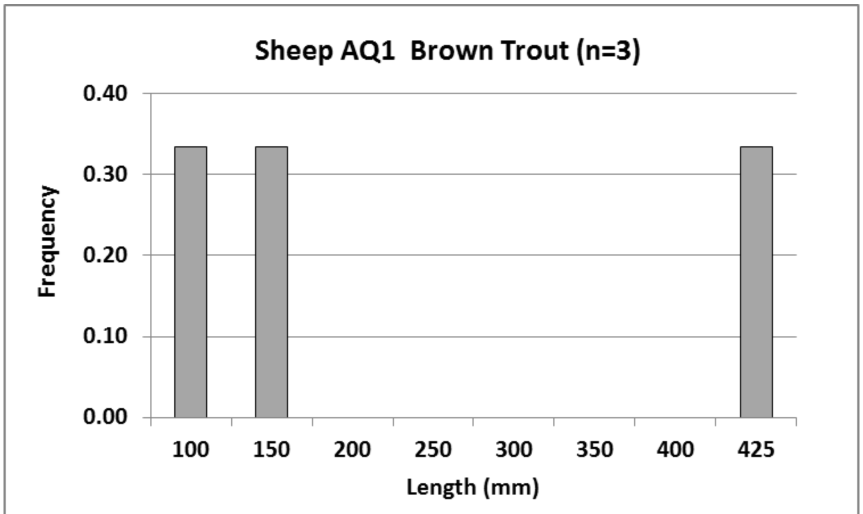
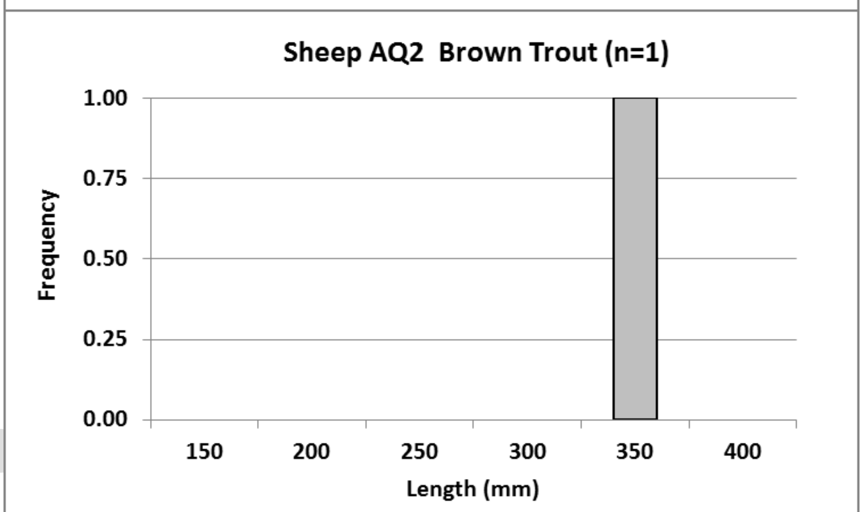


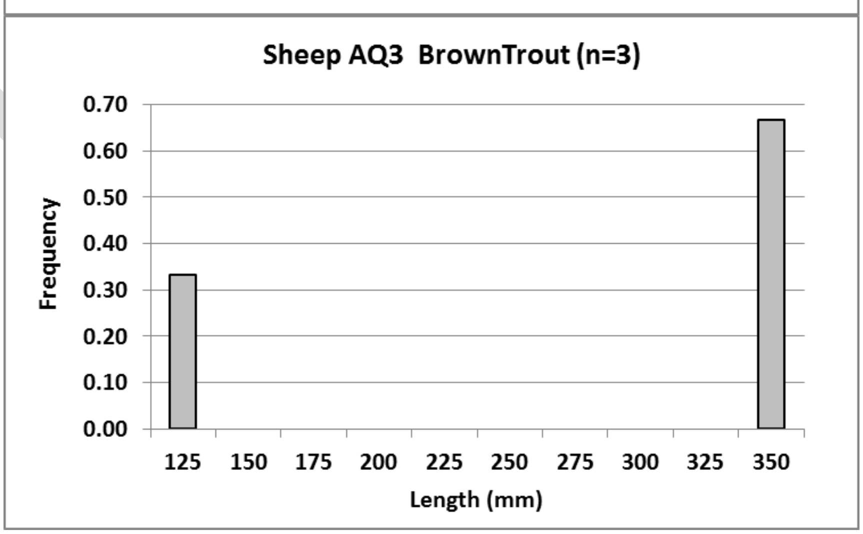




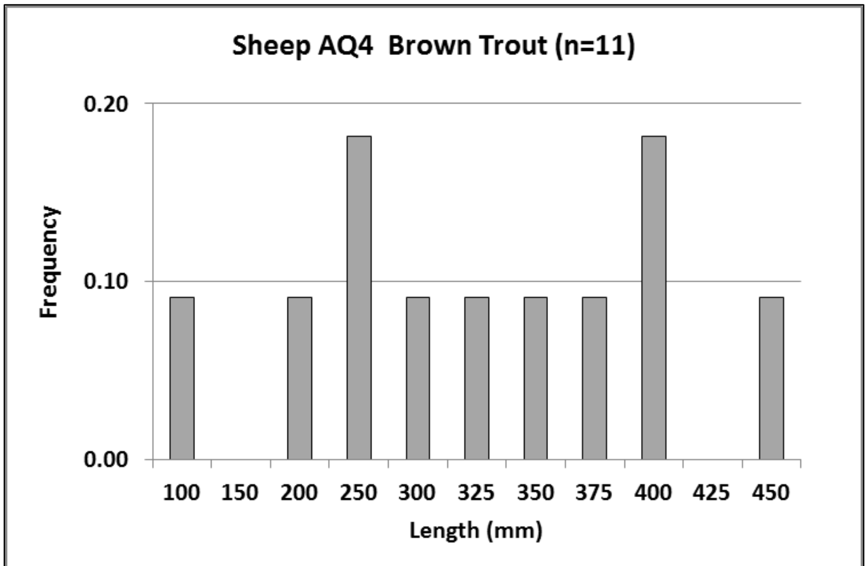
Size frequency collection data for Brown Trout collected at the Tintina Black Butte Mine Sites

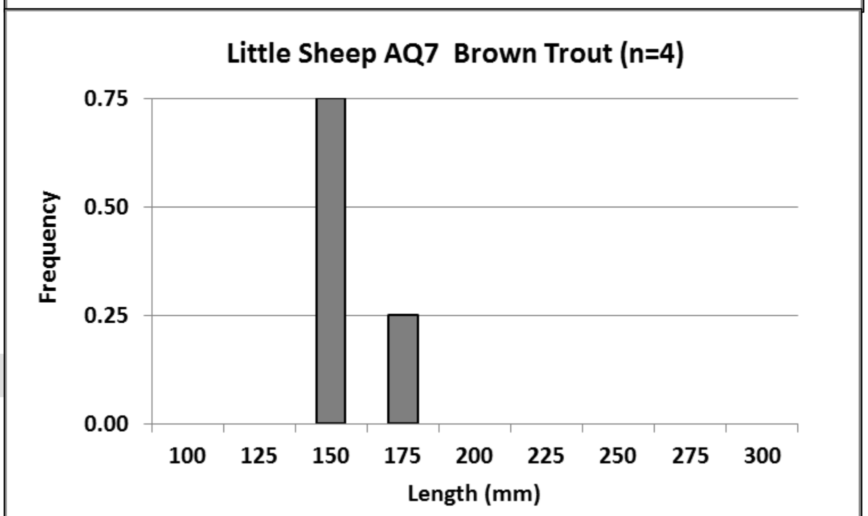


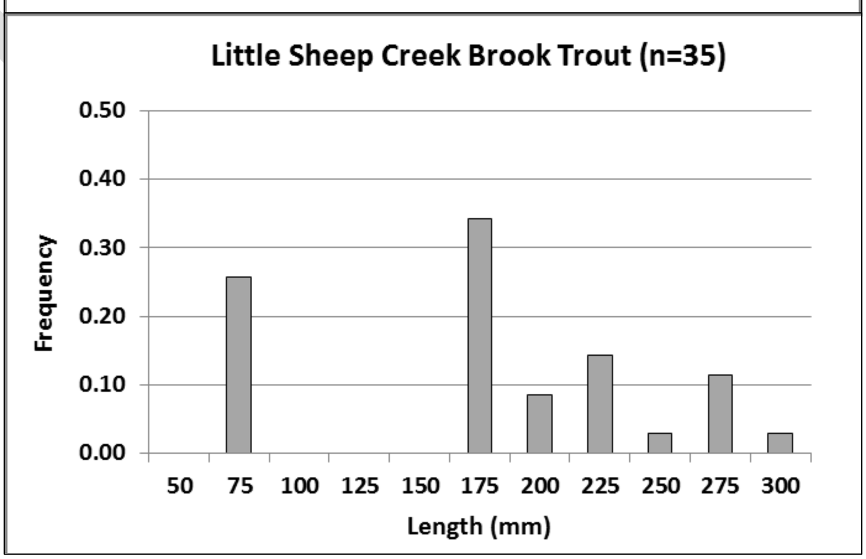




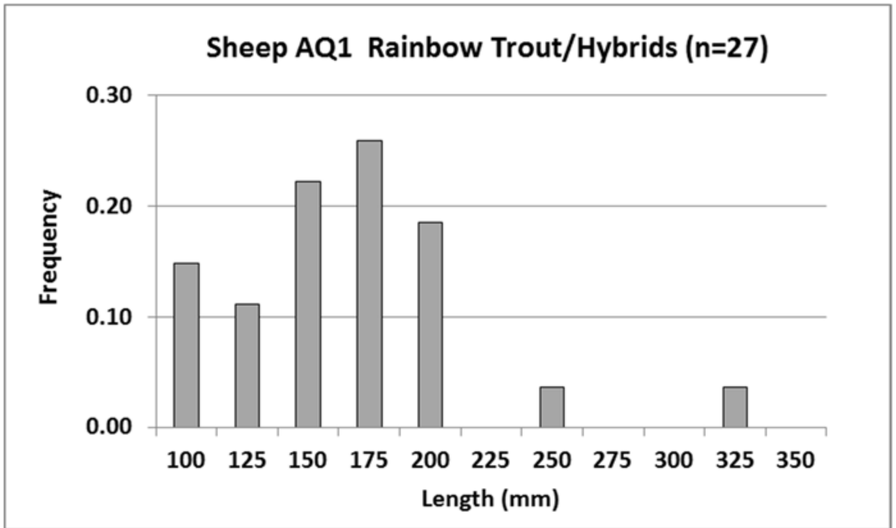
Size-frequency collection data for Brown Trout and Brook Trout collected at the Tintina Black Butte Mine Sites

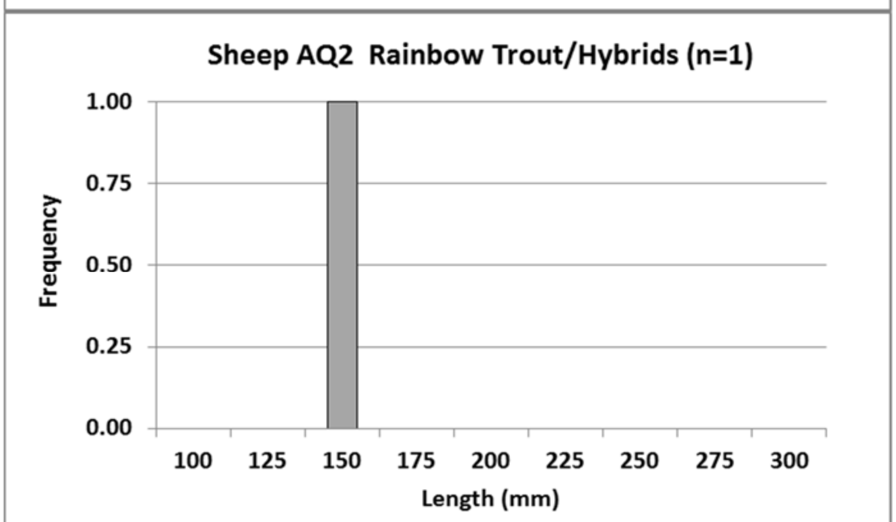


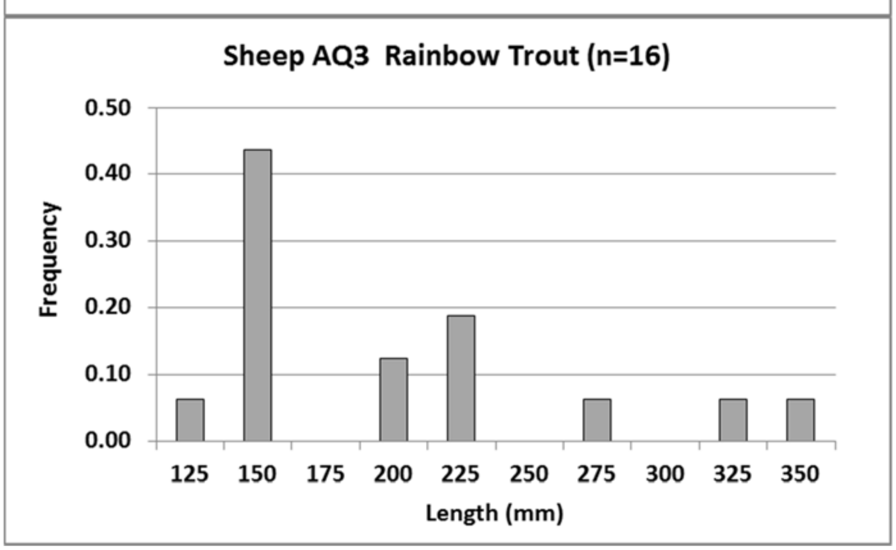




Size frequency collection data for Rainbow Trout and “Cutt-bows” collected during fall 2014 at the Tintina Black Butte Mine Sites.







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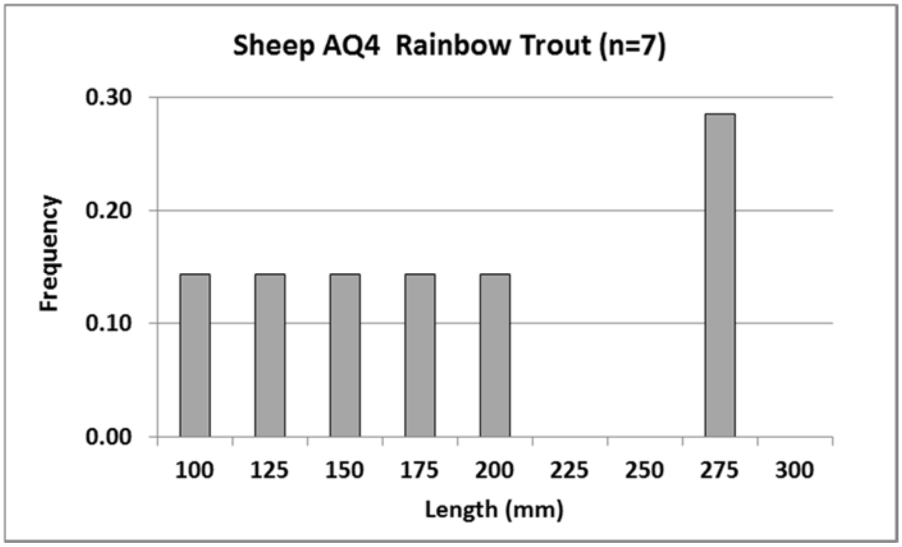
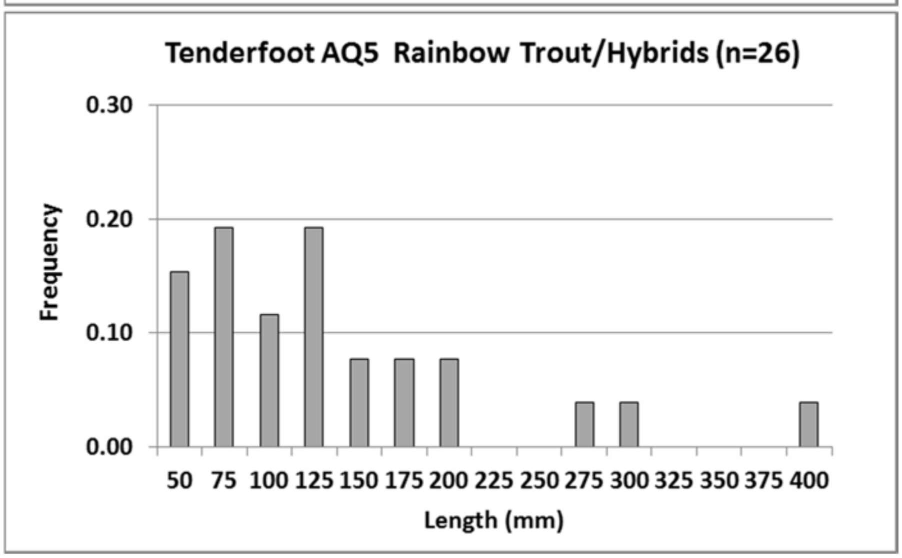
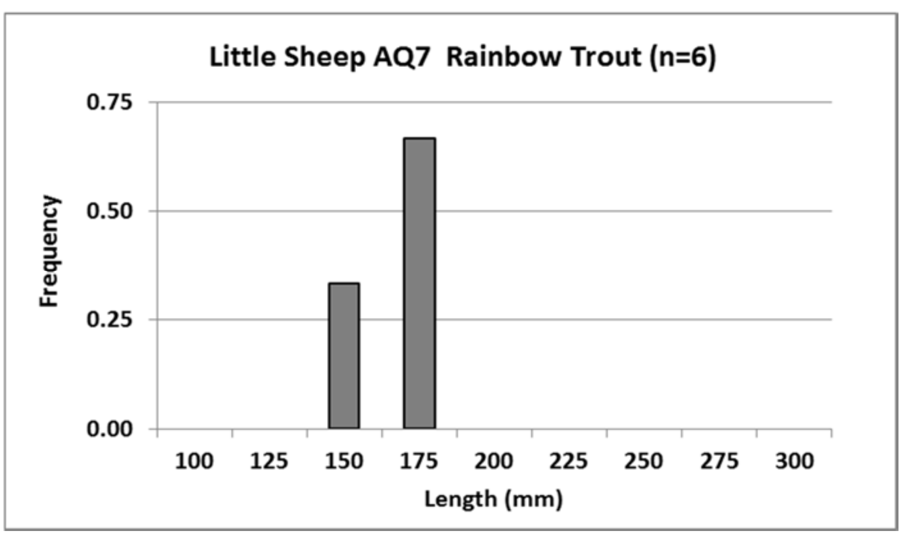
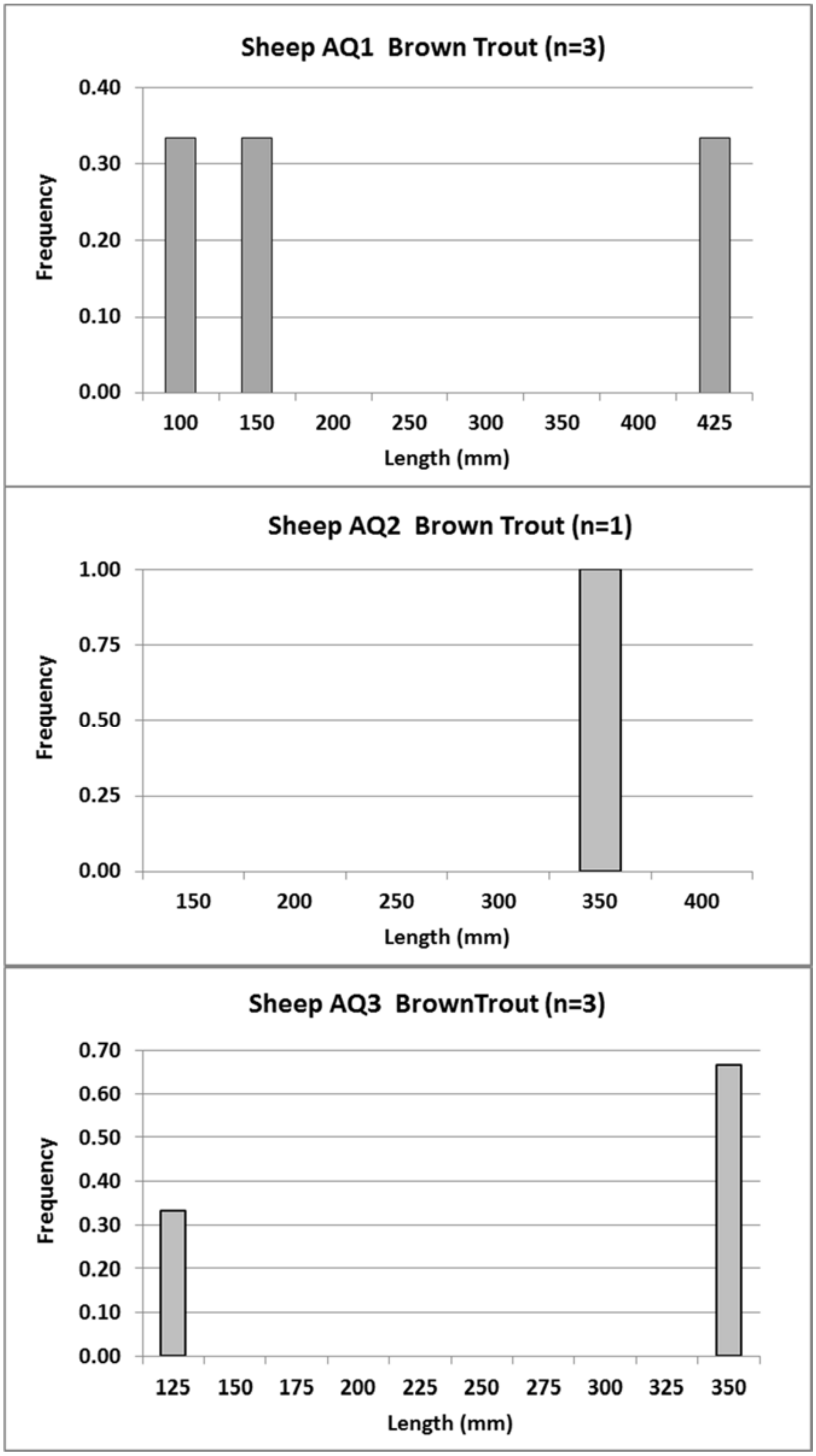


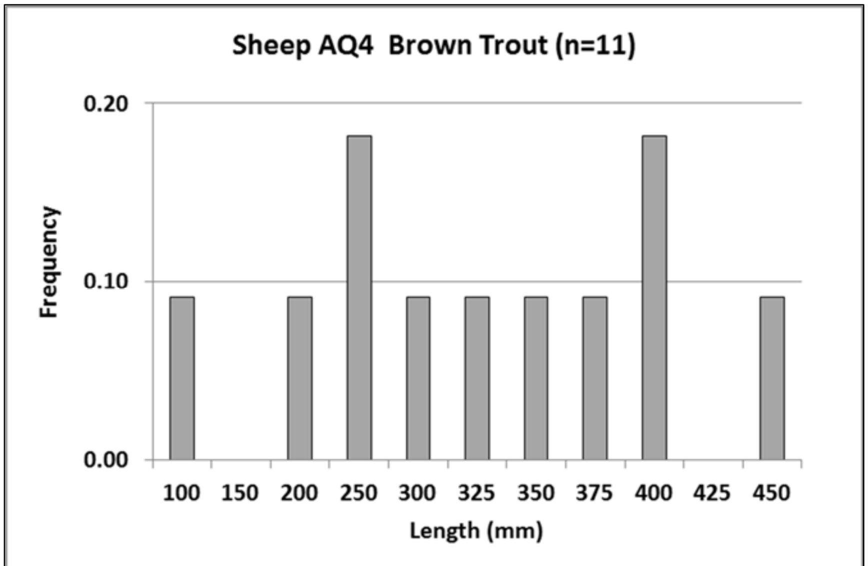


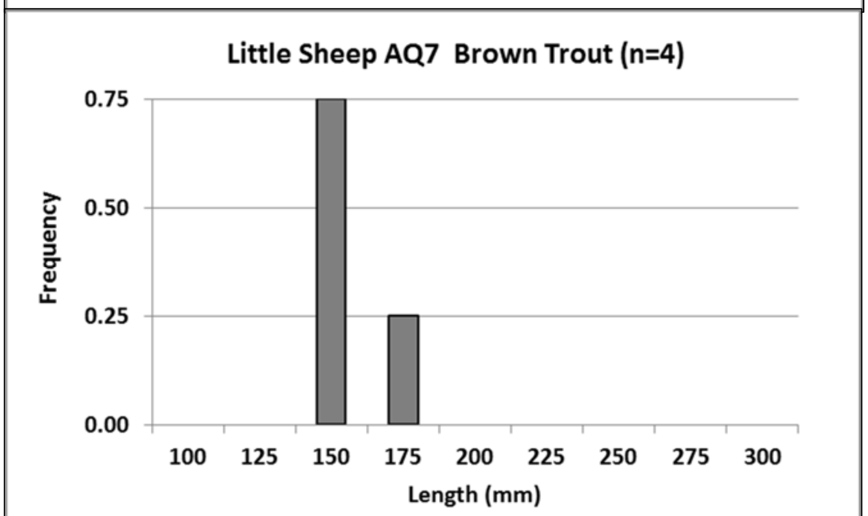


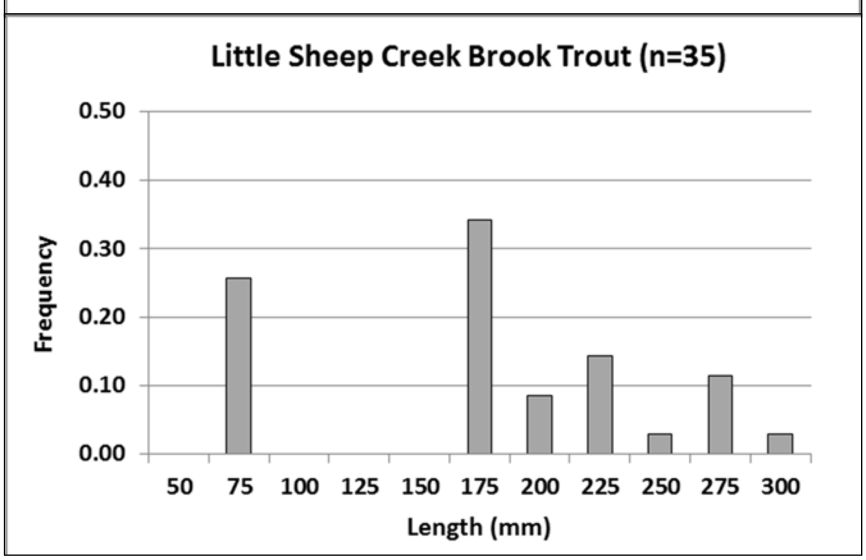
Size frequency collection data for Brown Trout collected during fall 2014 at the Tintina Black Butte Mine Sites



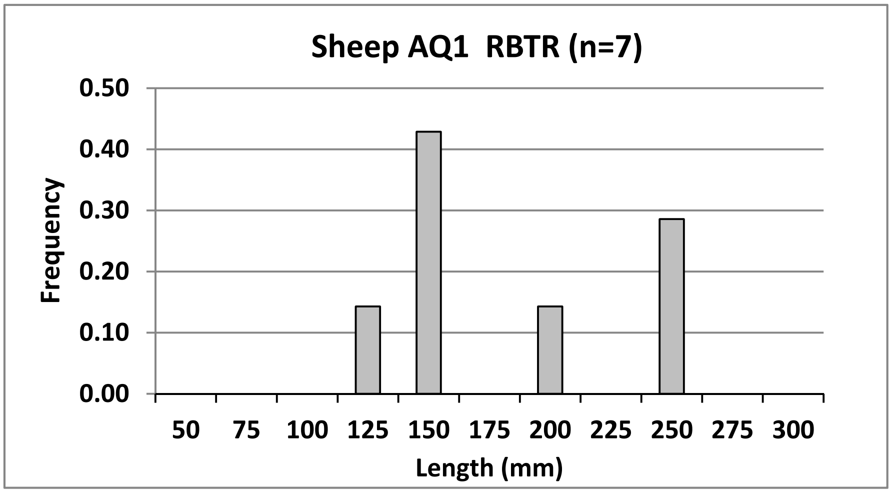
Size-frequency collection data for Brown Trout and Brook Trout collected during fall 2014 at the Tintina Black Butte Mine Sites

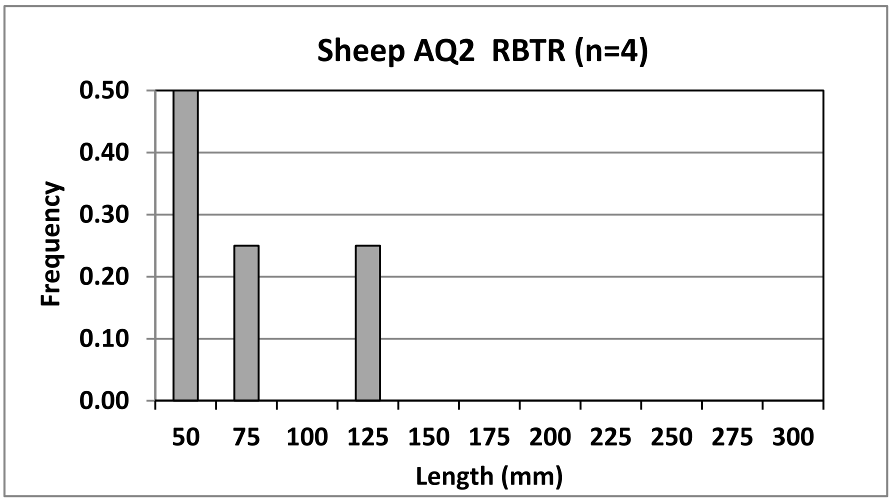


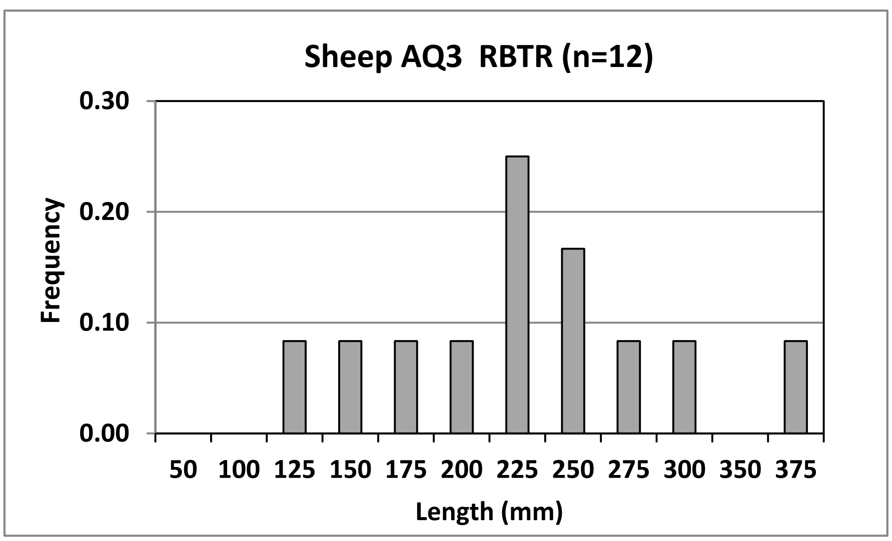




Size frequency collection data for Rainbow Trout collected during summer 2015 at the Tintina Black Butte Mine Sites







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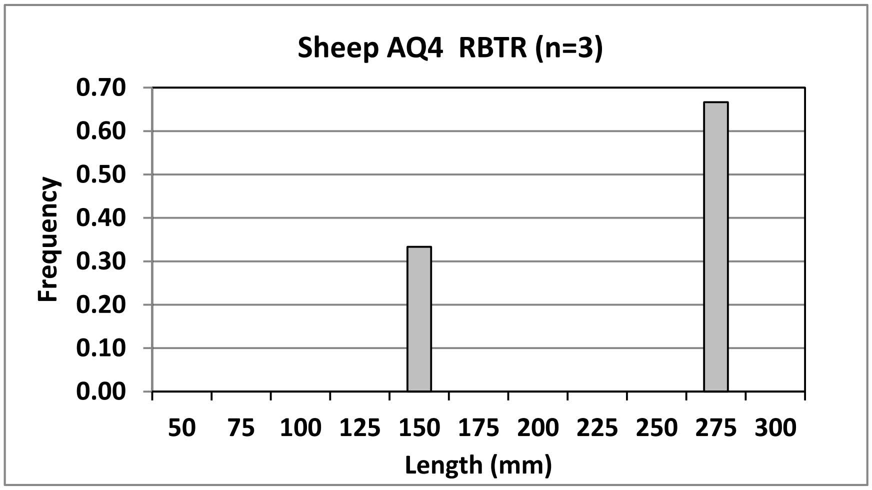
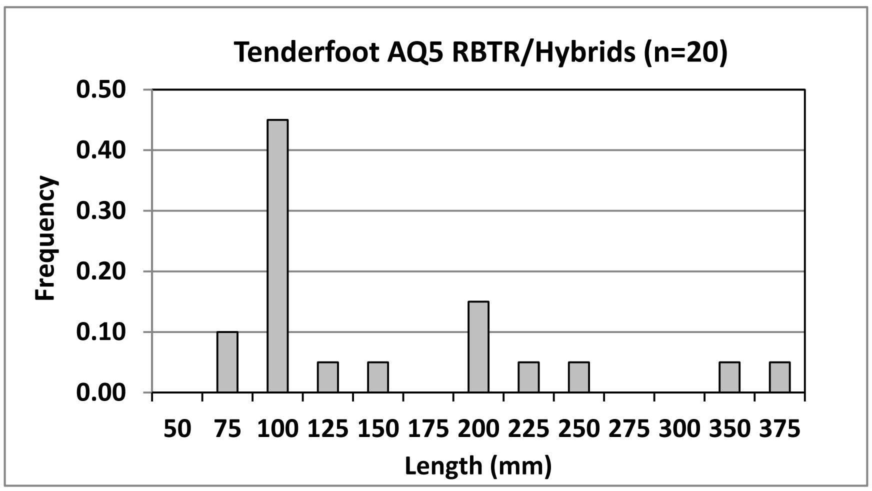
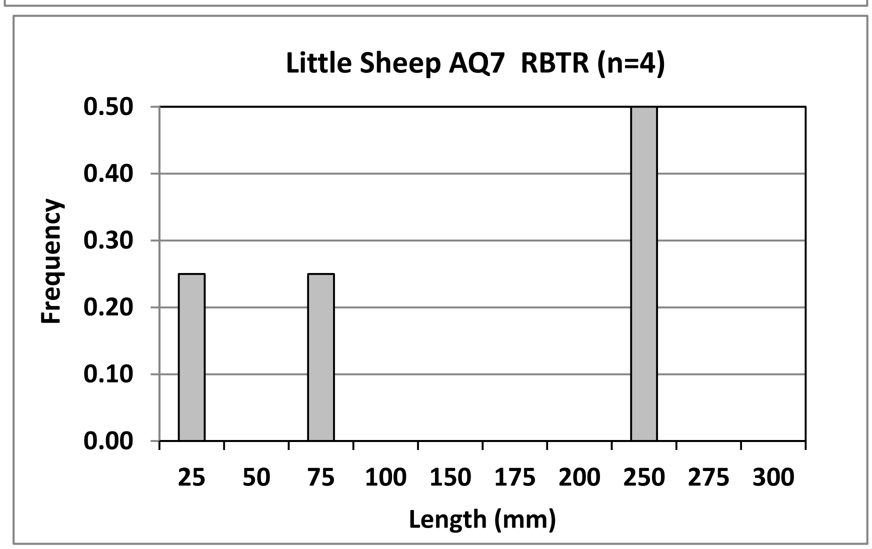
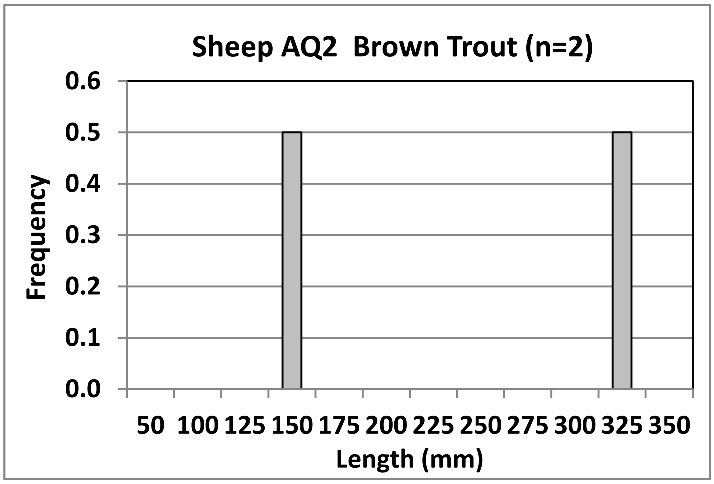
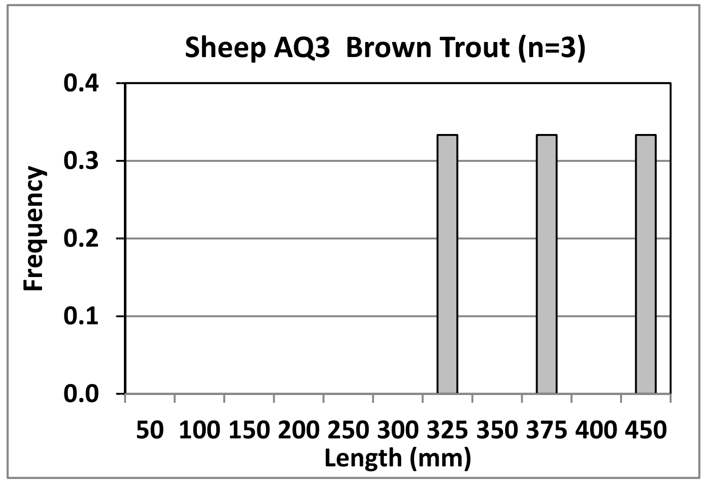


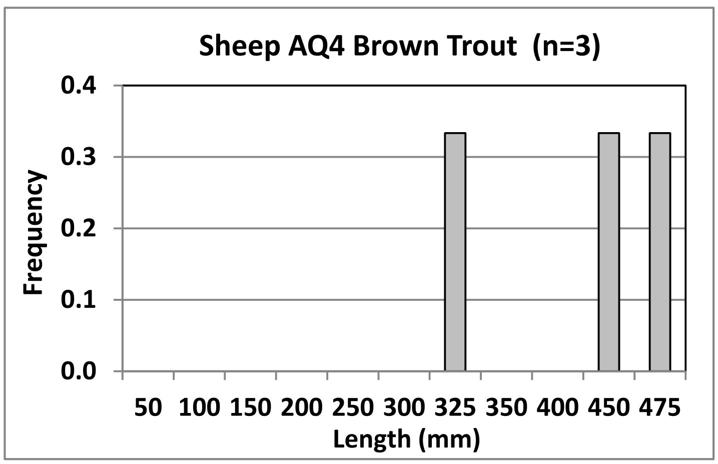


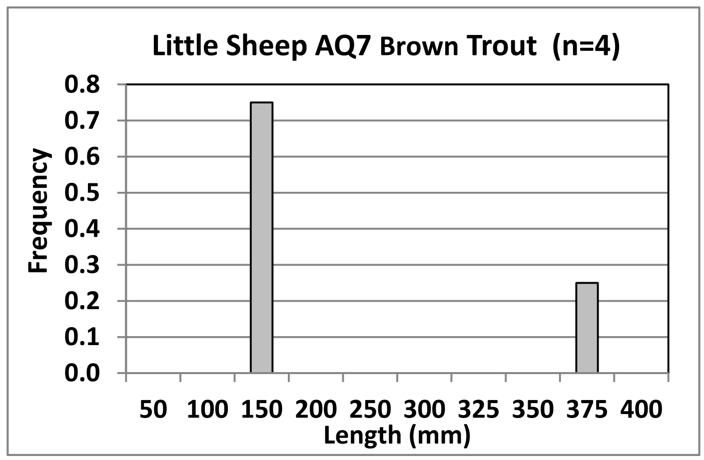


Size frequency collection data for Brown Trout collected during summer 2015 at the Tintina Black Butte Mine Sites

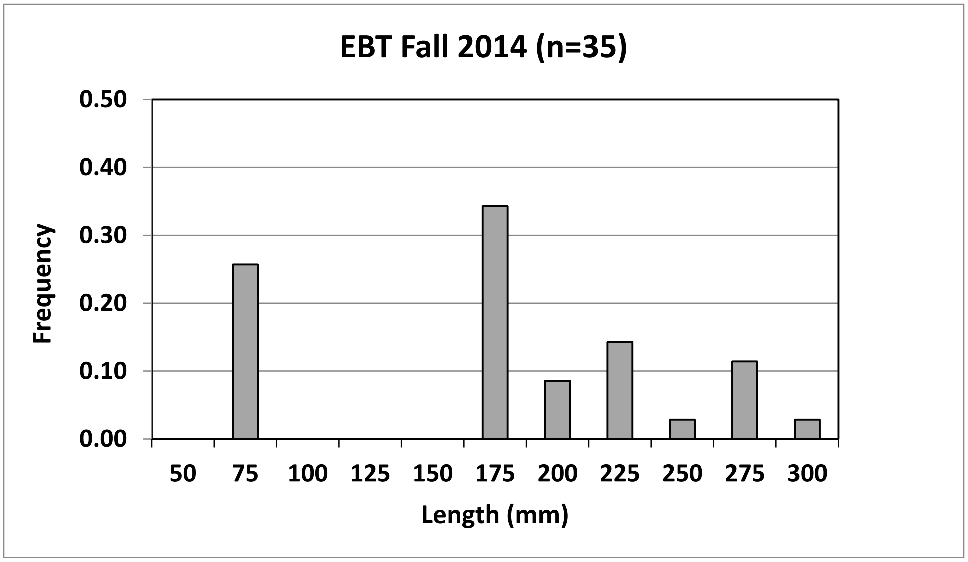


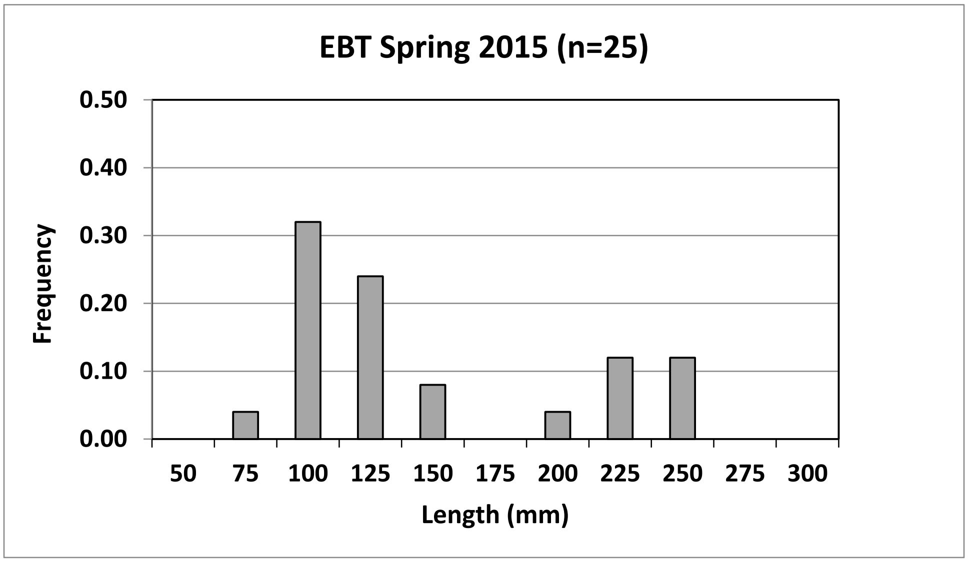


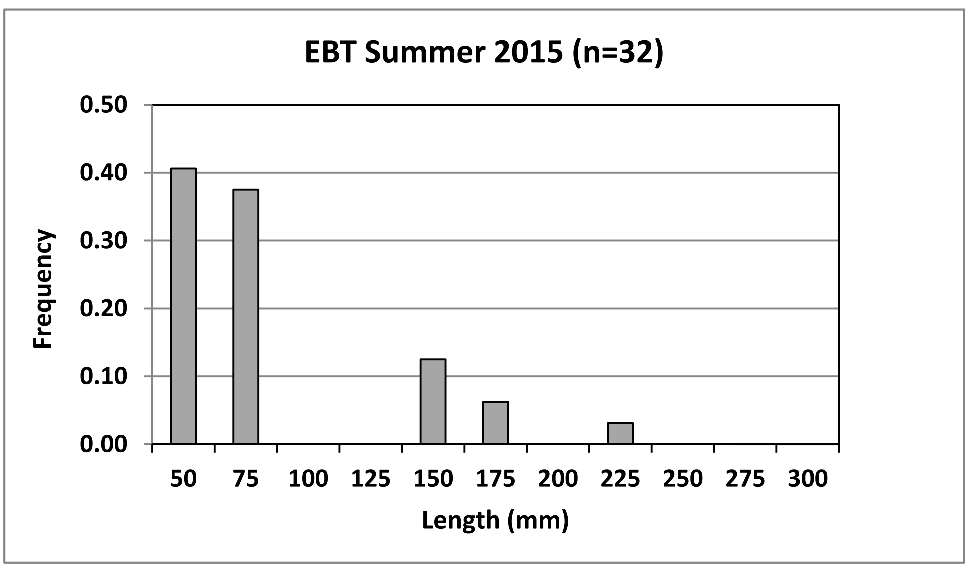




Little Sheep Creek seasonal Brook trout (EBT) size-frequency graphs



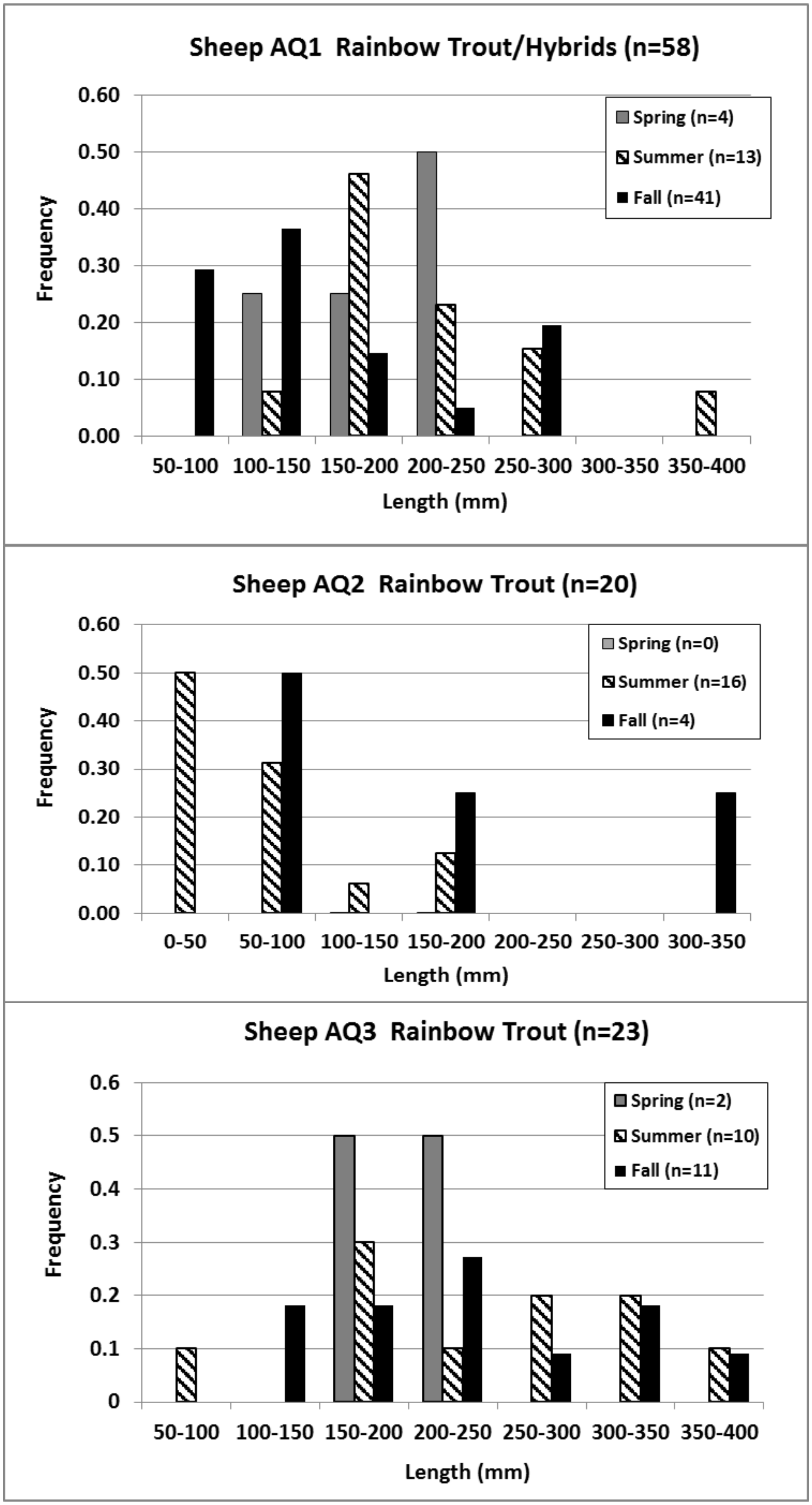




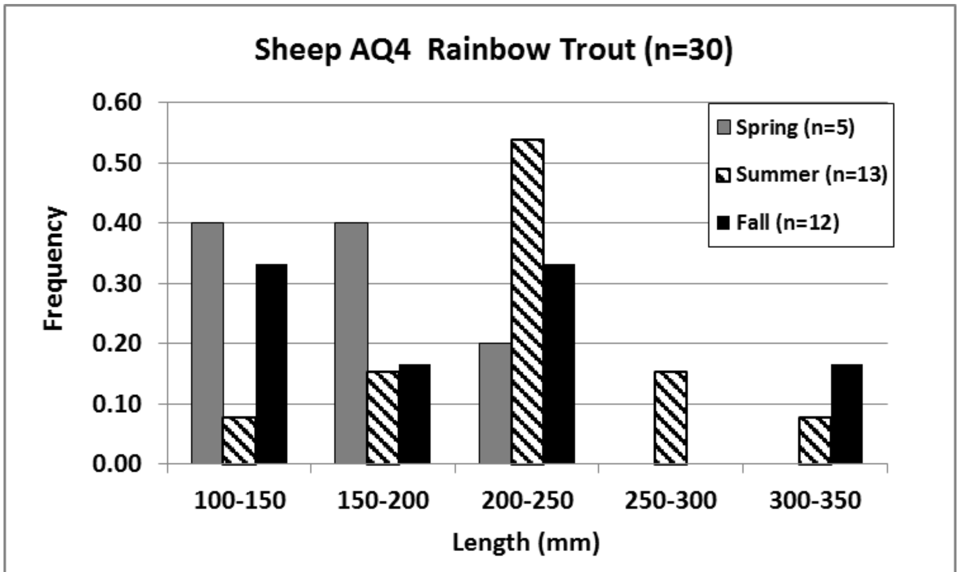
Pages extracted from:

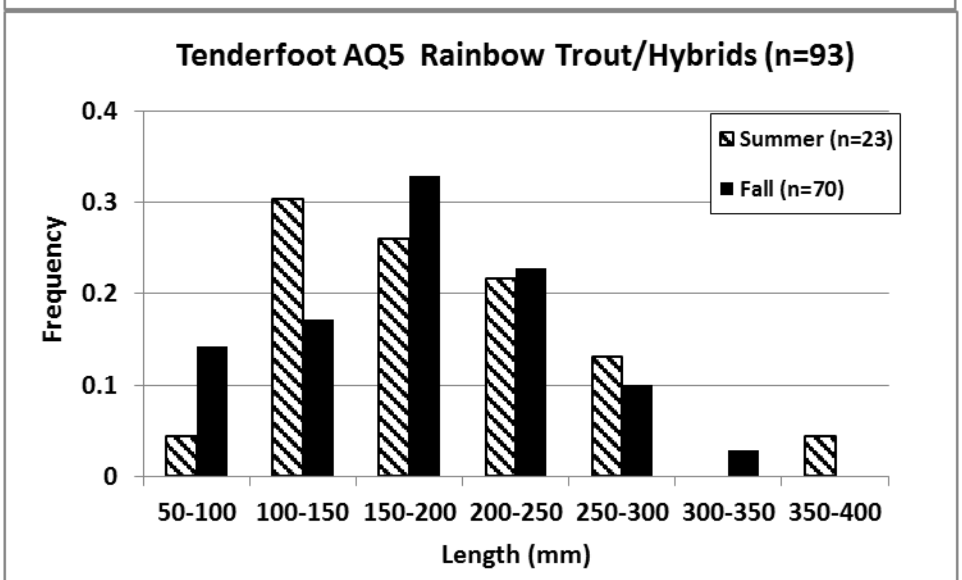
Stagliano, D. 2017a. 2016 Baseline Aquatic Surveys and Assessment of Streams in the Tintina Black Butte Copper Project Area of Meagher County, MT. May 2017. Tintina Resources Inc. White Sulphur Springs, Montana.

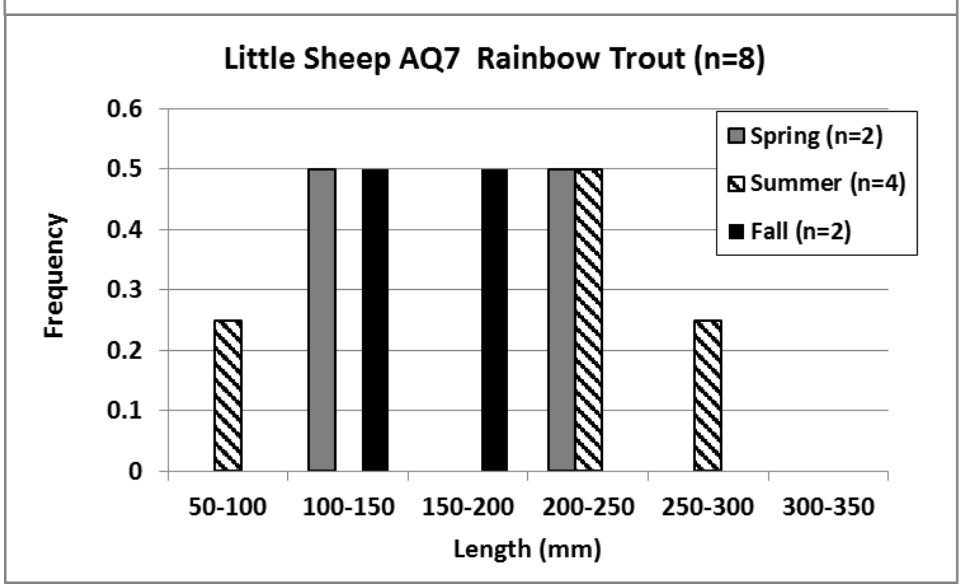
Appendix C. Sheep Creek seasonal Rainbow trout (RBTR) size-frequency graphs for 2016. Catchable size is considered >200mm (8 inches).



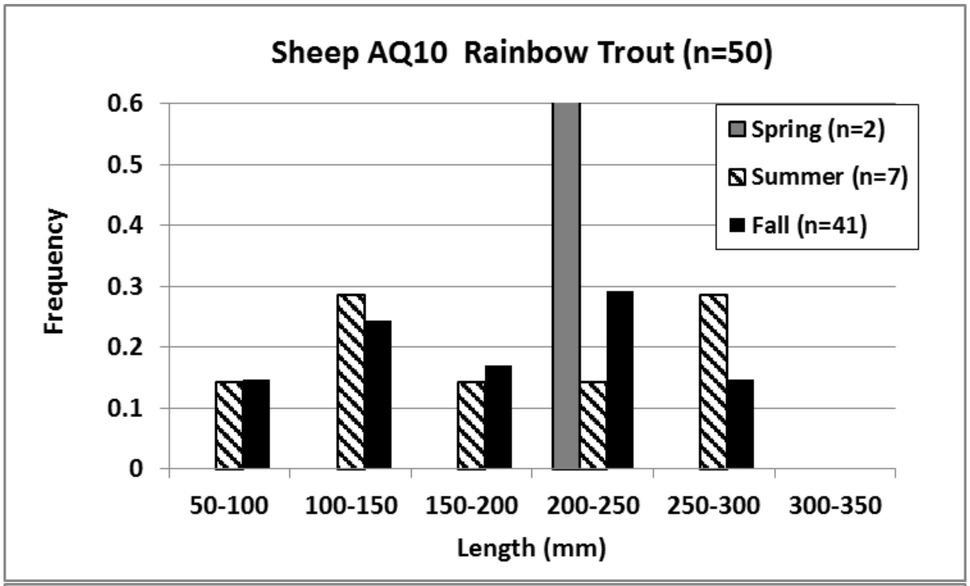
Appendix C. Sheep Creek seasonal rainbow trout (RBTR) size-frequency graphs for 2016. Catchable size is considered >200mm (8 inches).

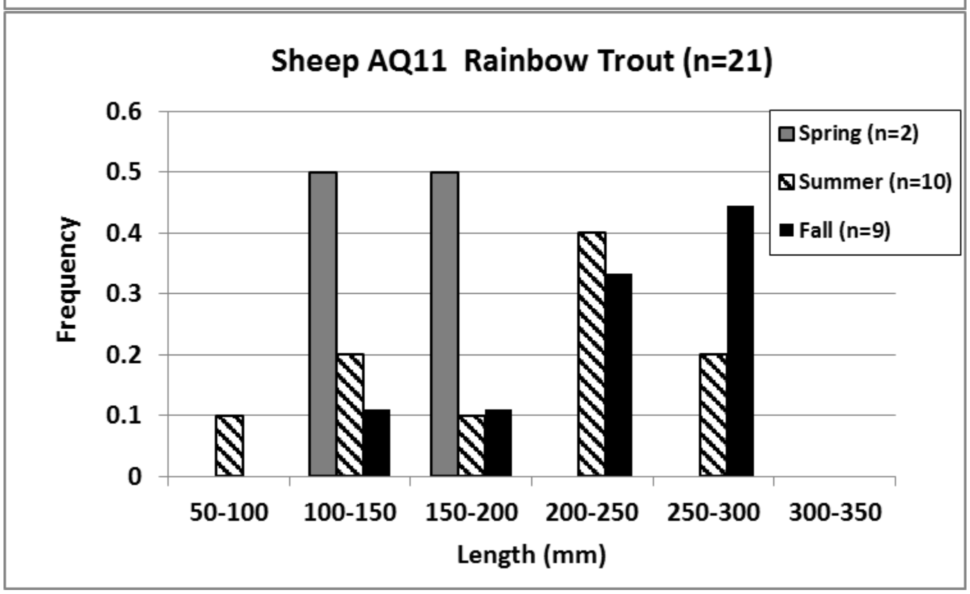




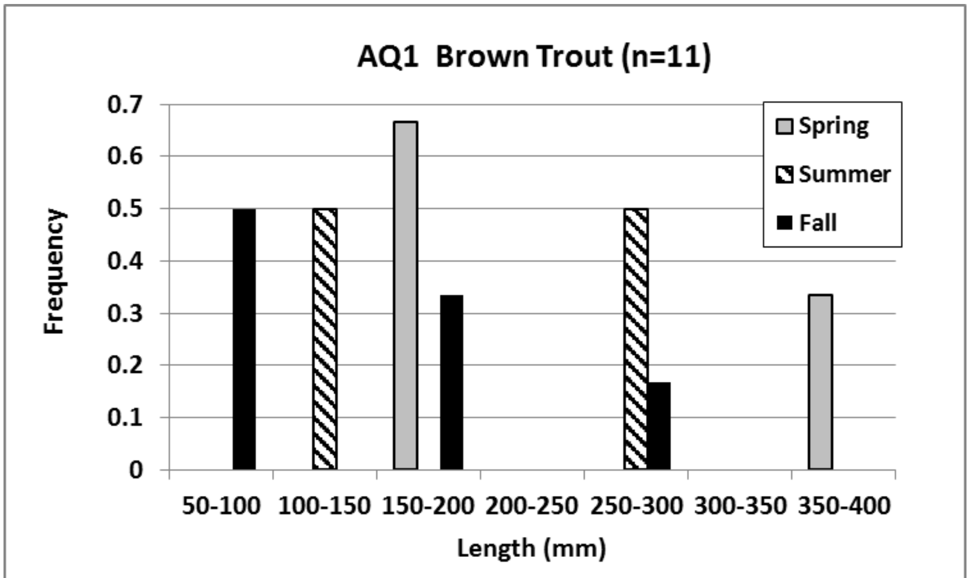


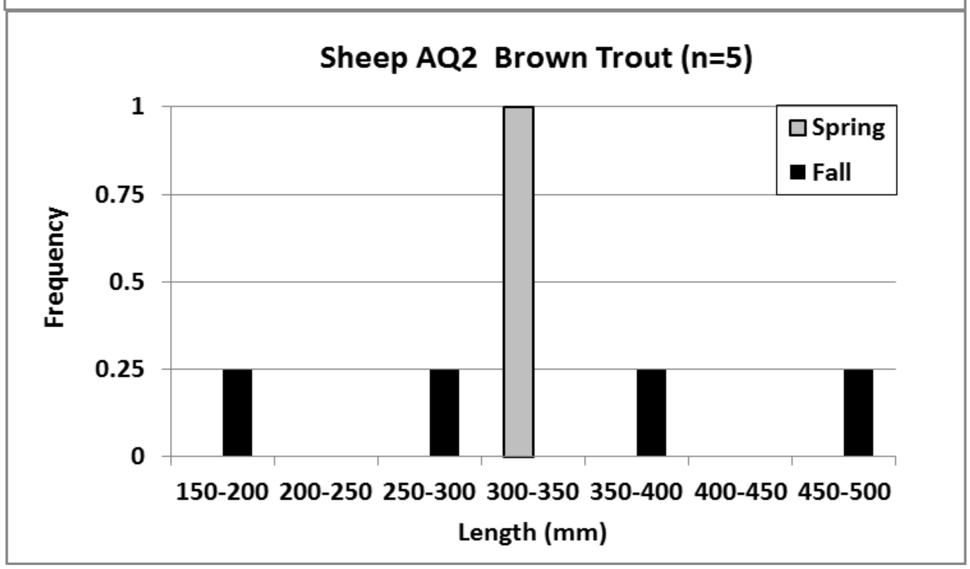
Appendix C. Sheep Creek seasonal rainbow trout (RBTR) size-frequency graphs for 2016. Catchable size is considered >200mm (8 inches).

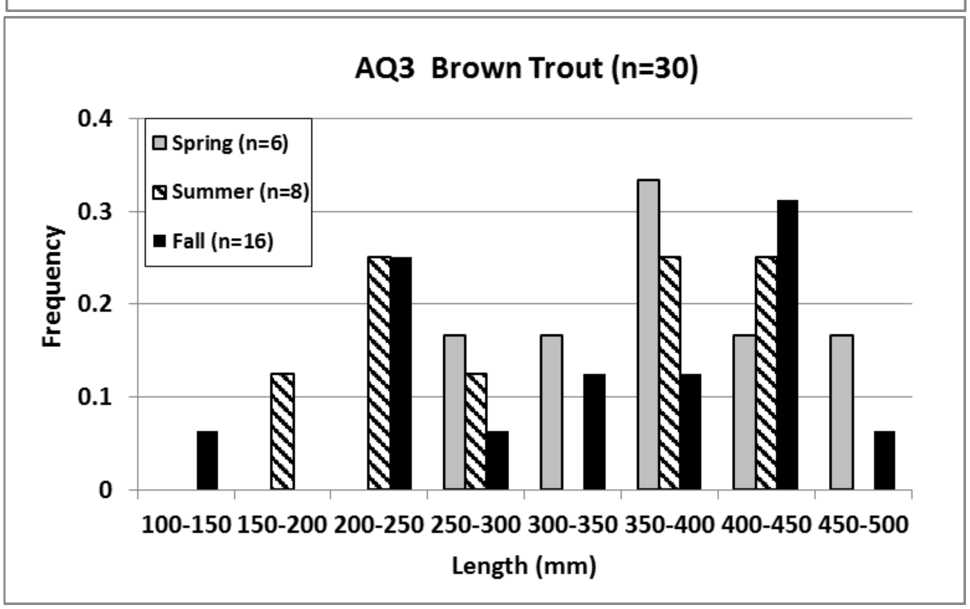




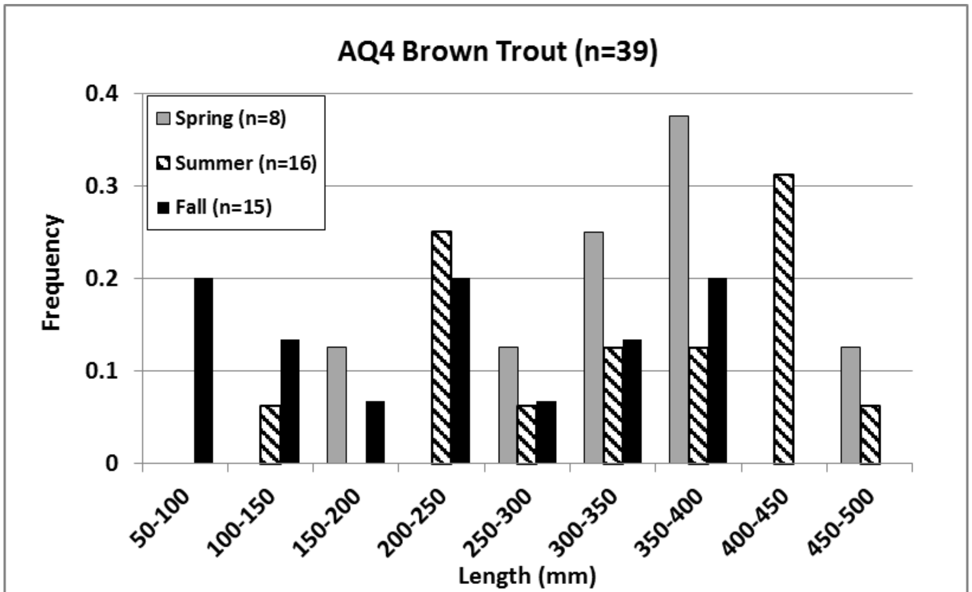
Appendix C. Sheep Creek seasonal Brown trout (LOLE) size-frequency graphs for 2016. Catchable size is considered >200mm (8 inches).

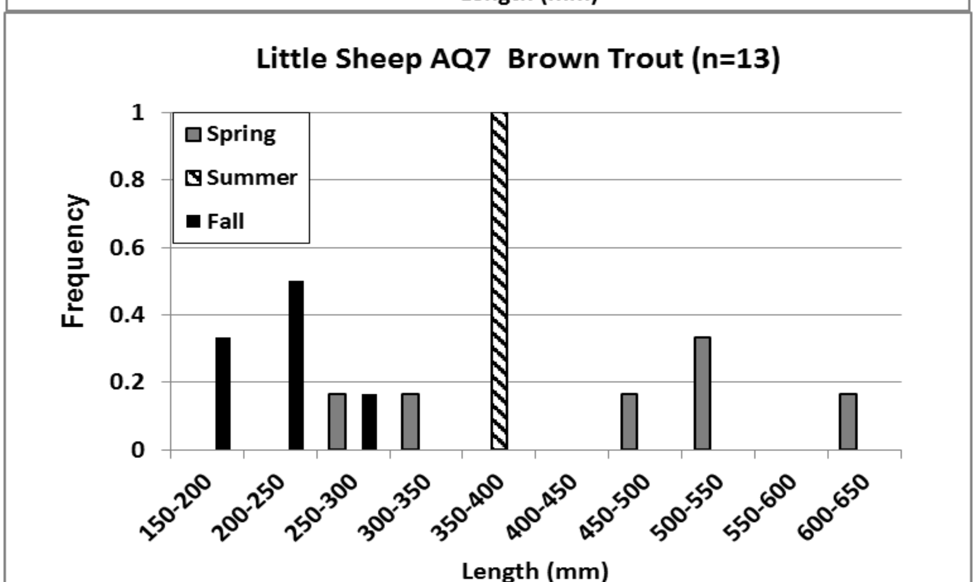


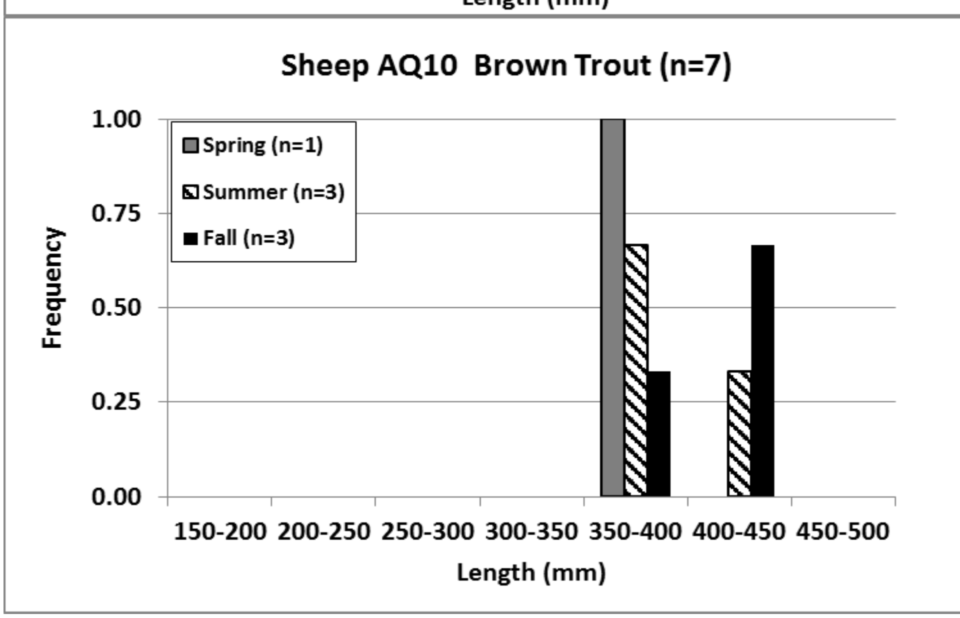




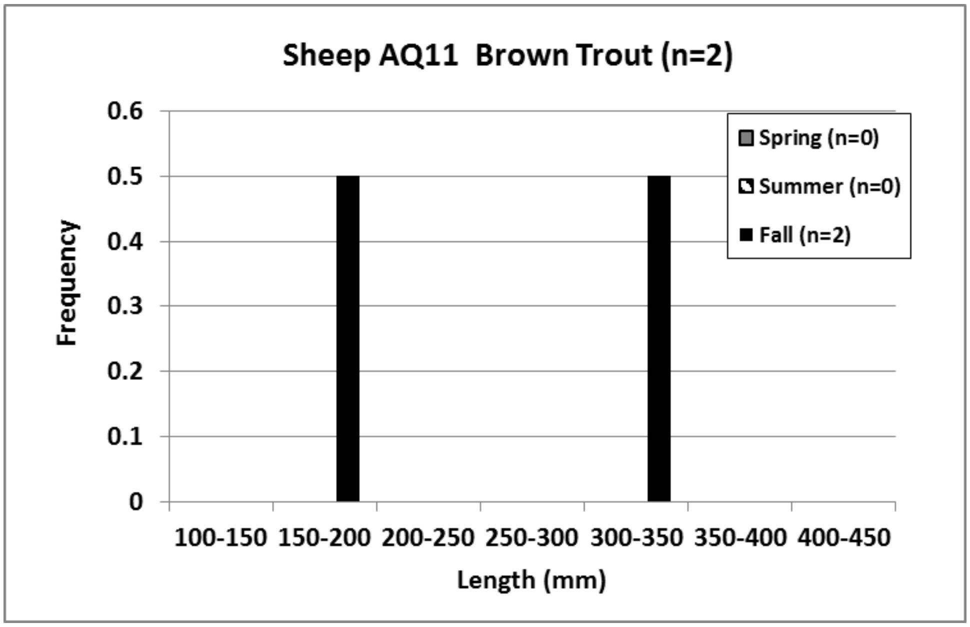
Appendix C. Sheep Creek seasonal Brown trout (LOLE) size-frequency graphs for 2016. Catchable size is considered >200mm (8 inches)



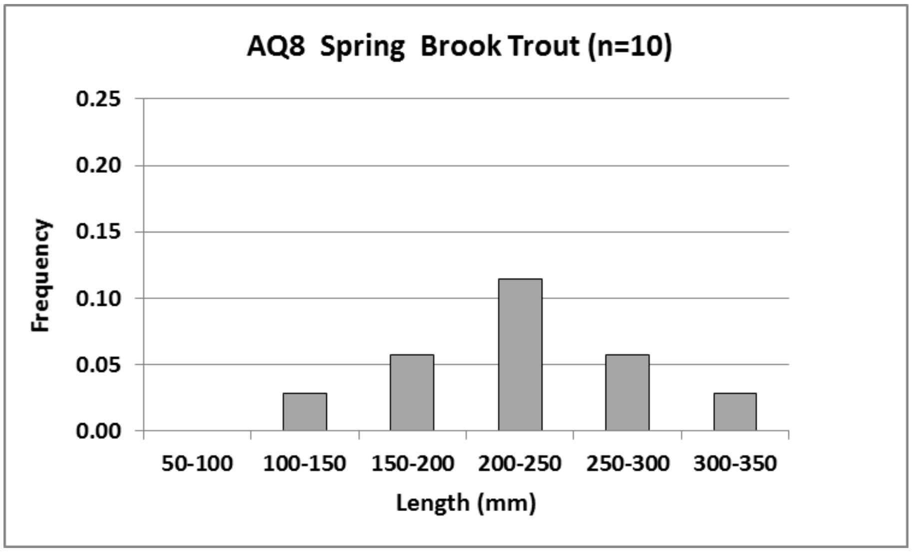


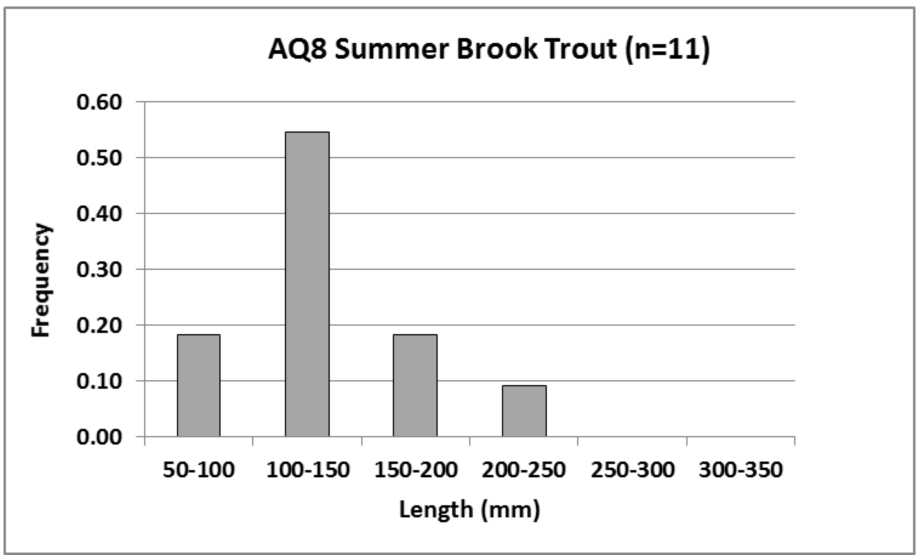


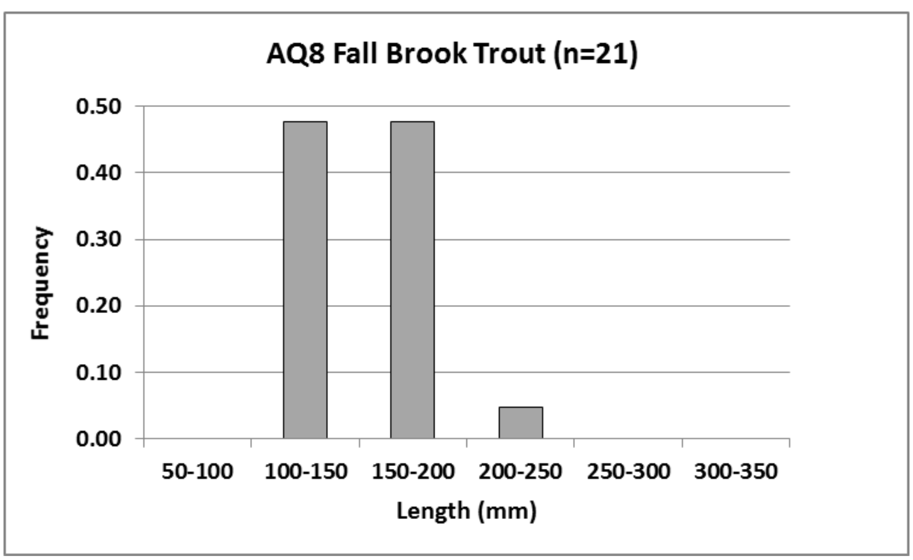
Appendix C. Sheep Creek seasonal Brown trout (LOLE) size-frequency graphs for 2016. Catchable size is considered >200mm (8 inches)



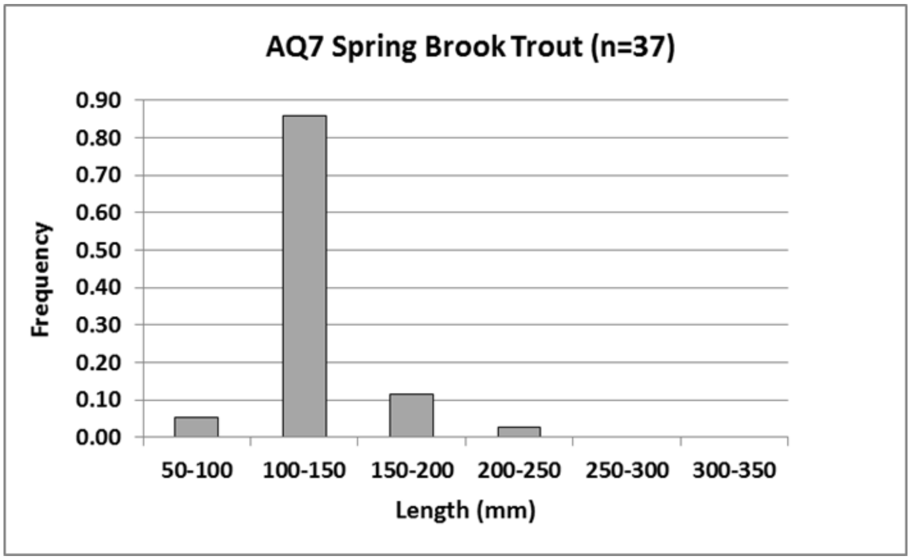
Appendix C. Little Sheep Creek seasonal Brook trout (EBT) size-frequency graphs for 2016

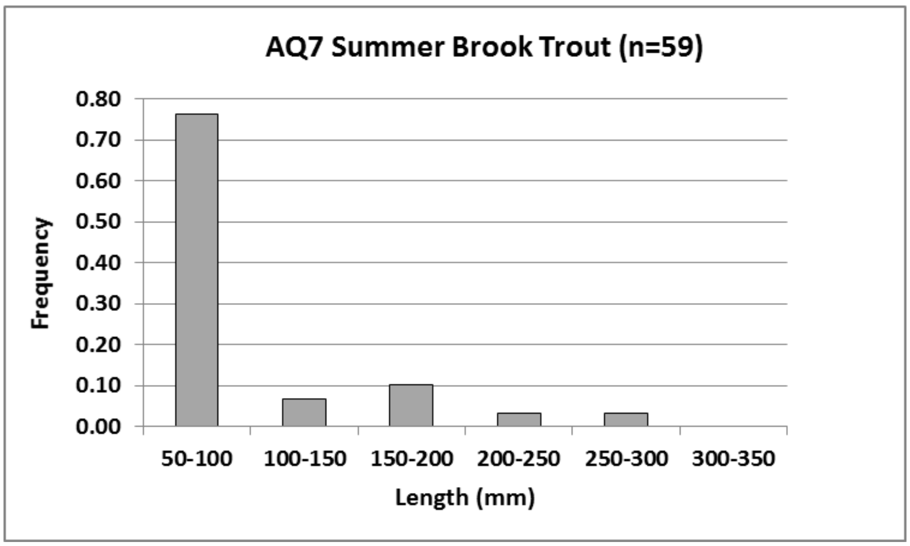


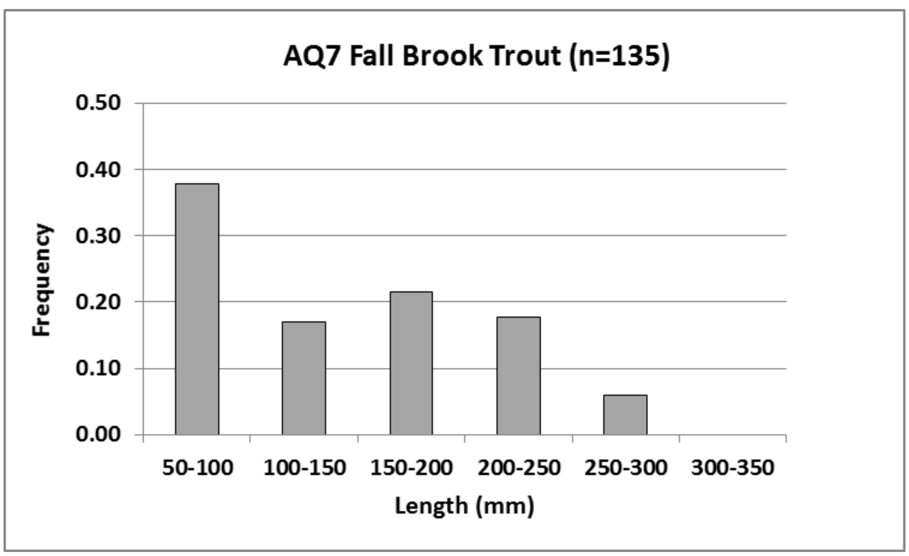




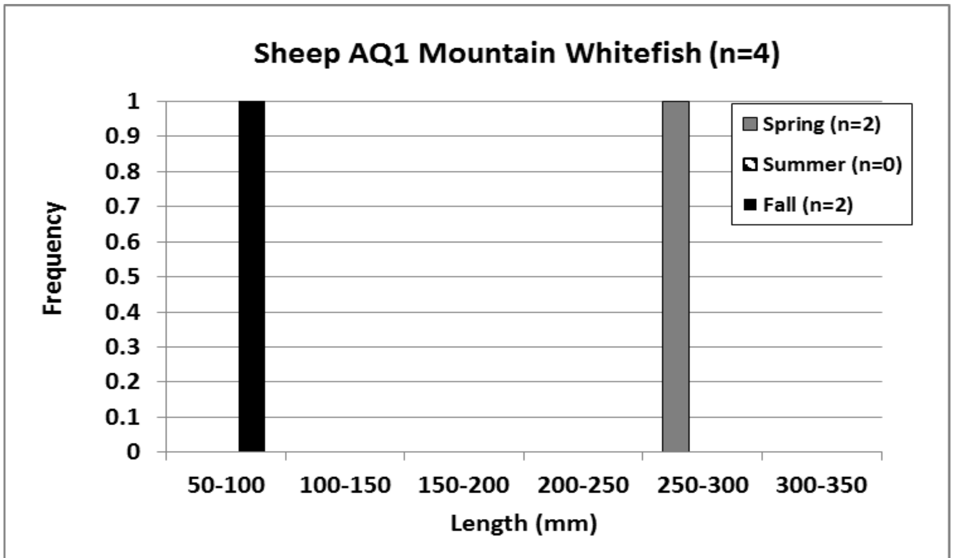
Appendix C. Little Sheep Creek seasonal Brook trout (EBT) size-frequency graphs for 2016

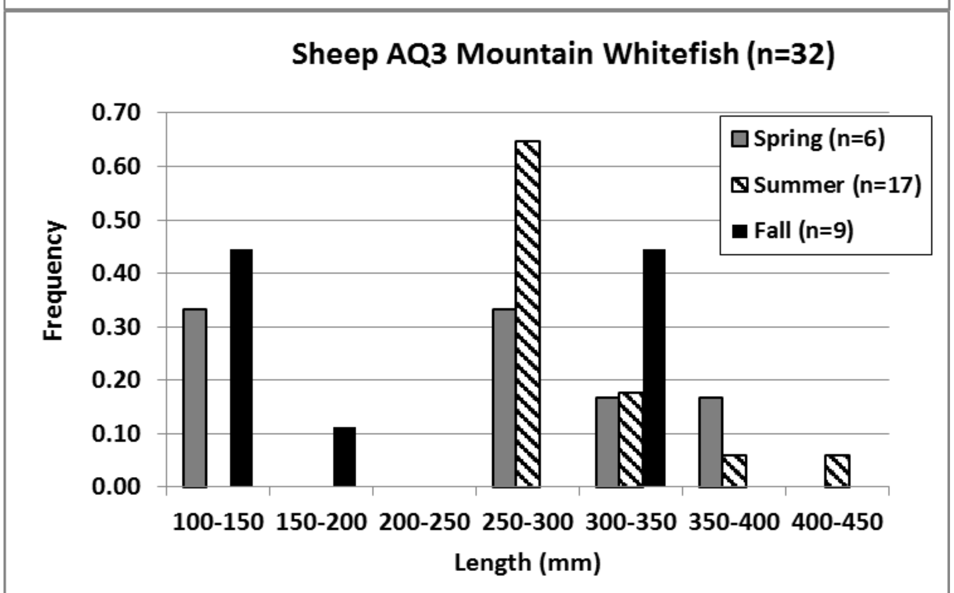


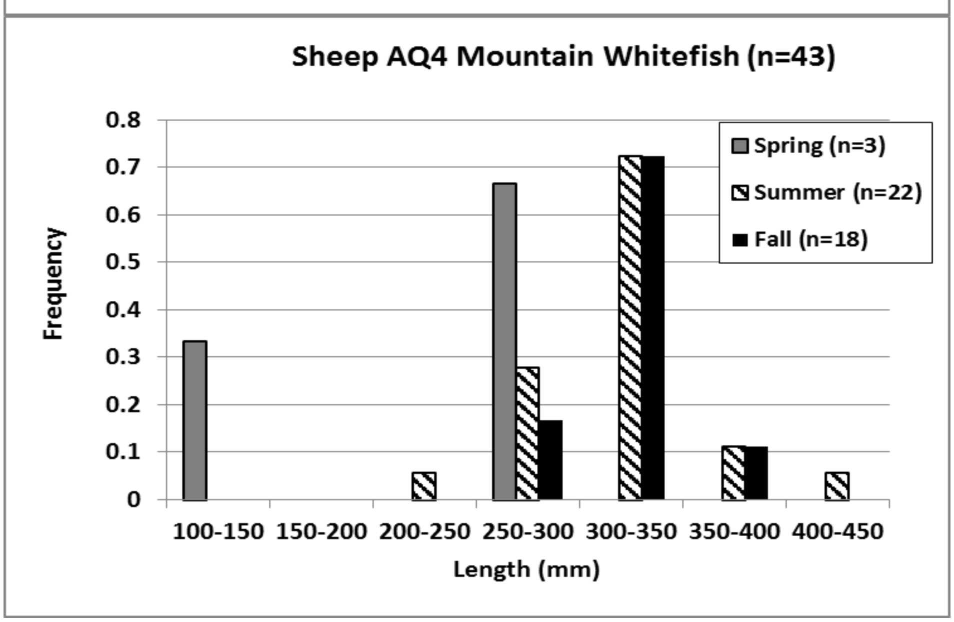




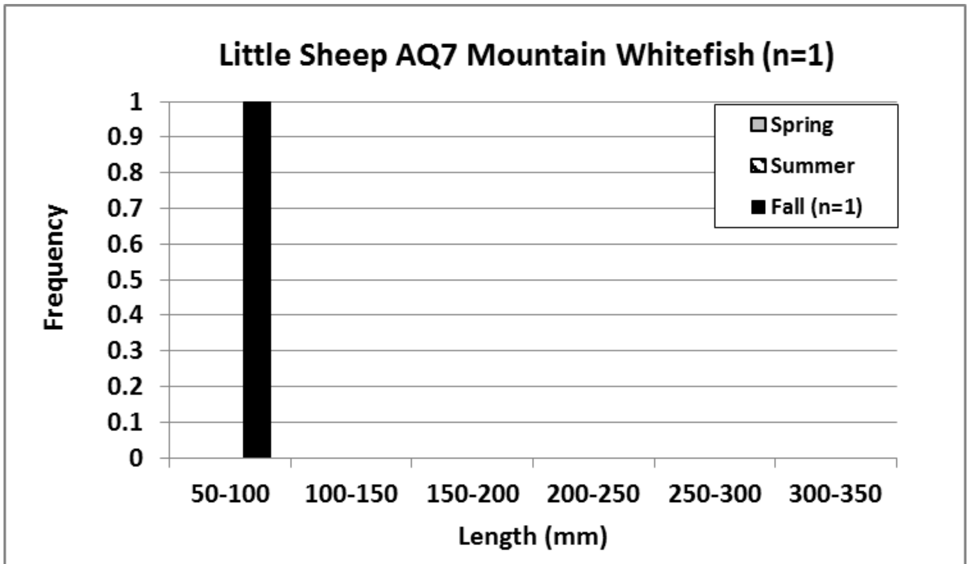
Appendix C. Sheep Creek seasonal Mountain Whitefish (MOWH) size-frequency graphs for 2016. Catchable size is considered >200mm (8 inches).

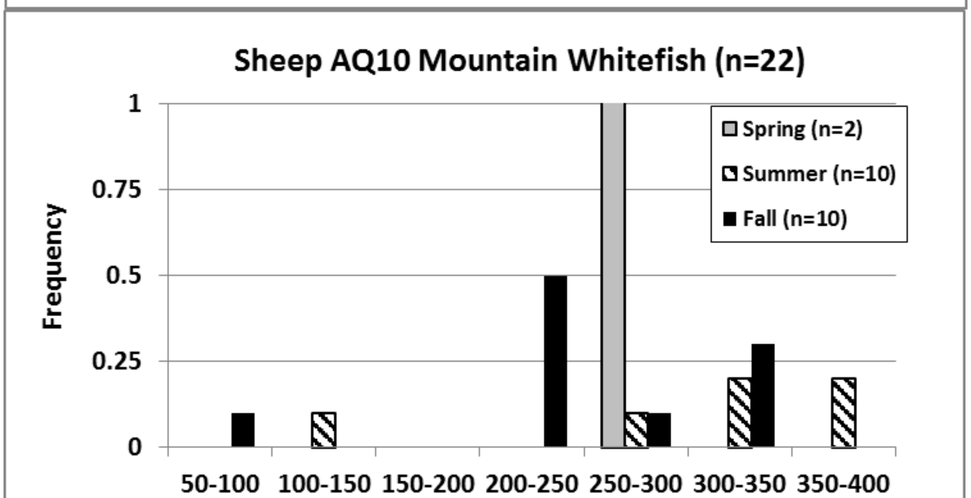


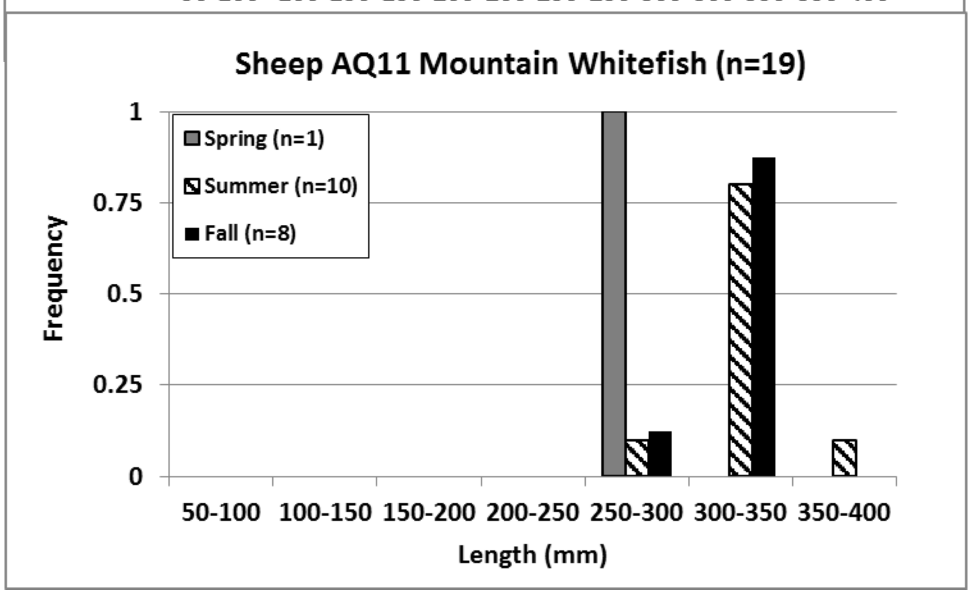




Appendix C. Sheep Creek seasonal Mountain Whitefish (MOWH) size-frequency graphs for 2016. Catchable size is considered >200mm (8 inches)



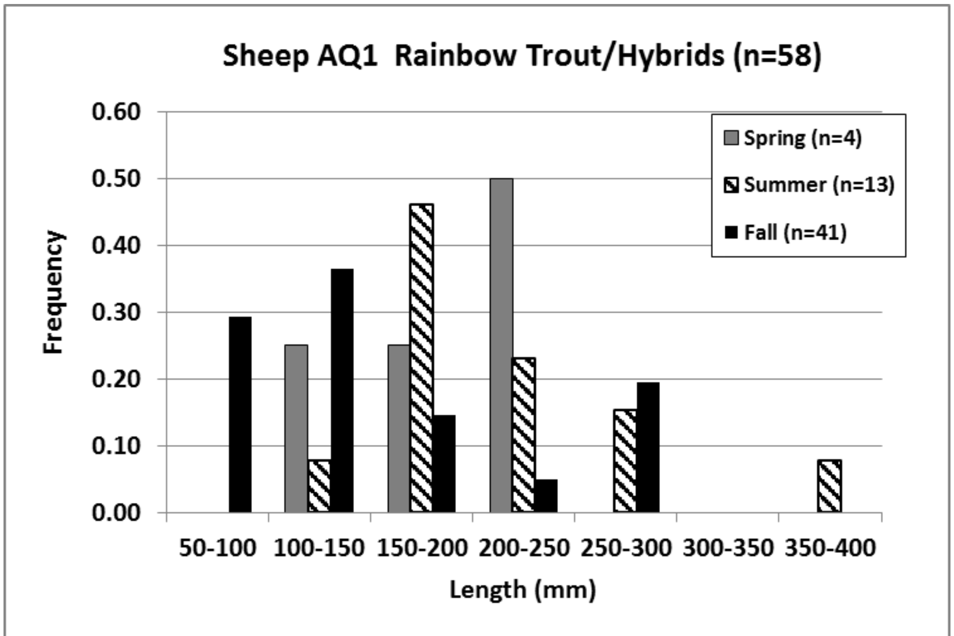


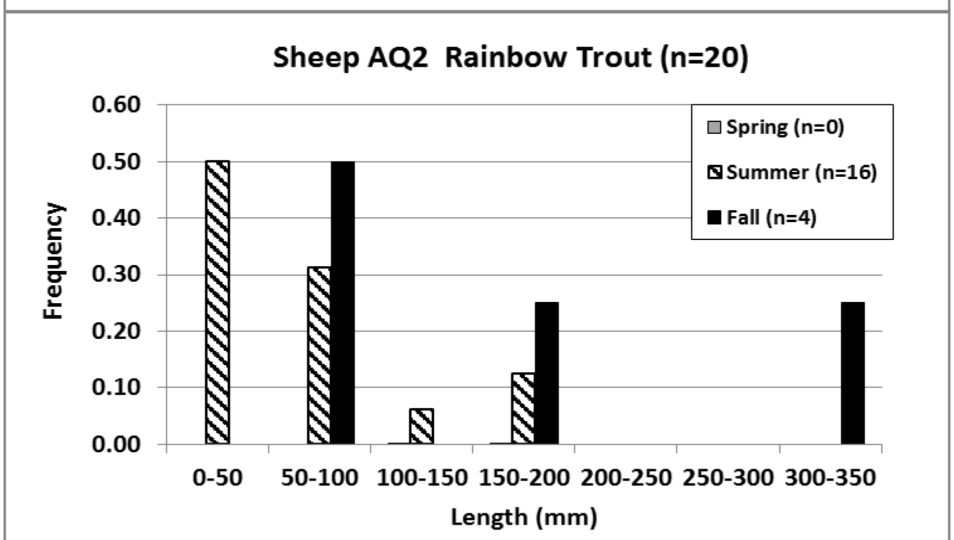


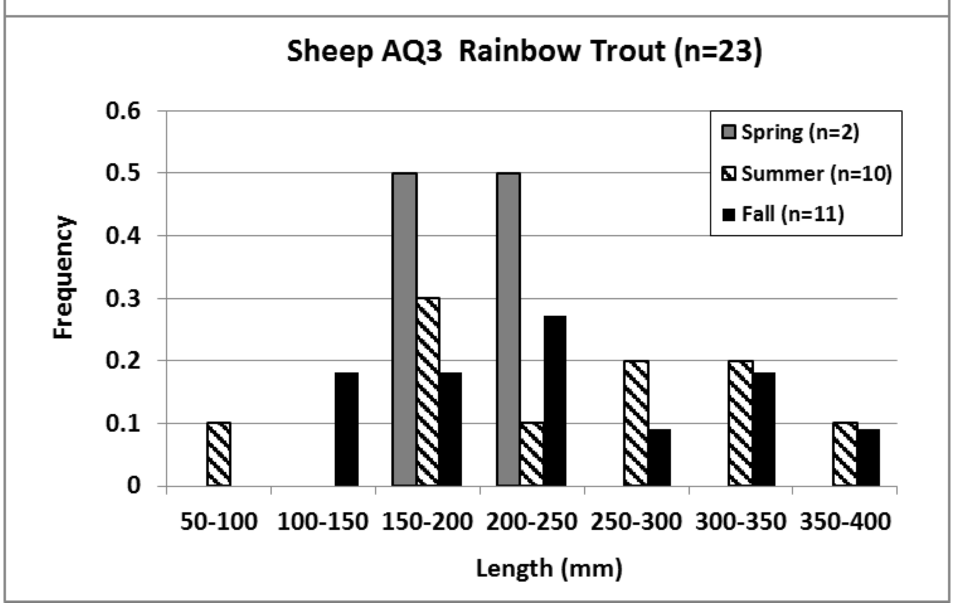
Pages extracted from:

Stagliano, D. 2017b. Draft: Baseline Aquatic Surveys and Assessment Summary 2014–2017 of Streams in the Tintina Black Butte Copper Project Area of Meagher County, MT. Tintina Resources Inc. White Sulphur Springs, Montana.

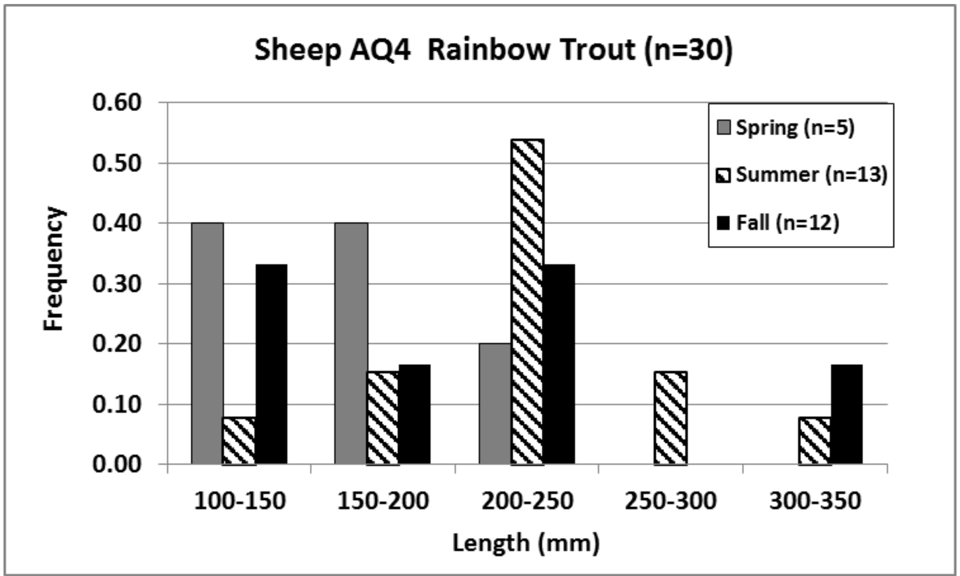
Appendix C. Sheep Creek seasonal Rainbow trout (RBTR) size-frequency graphs for 2016. Catchable size is considered >200mm (8 inches).

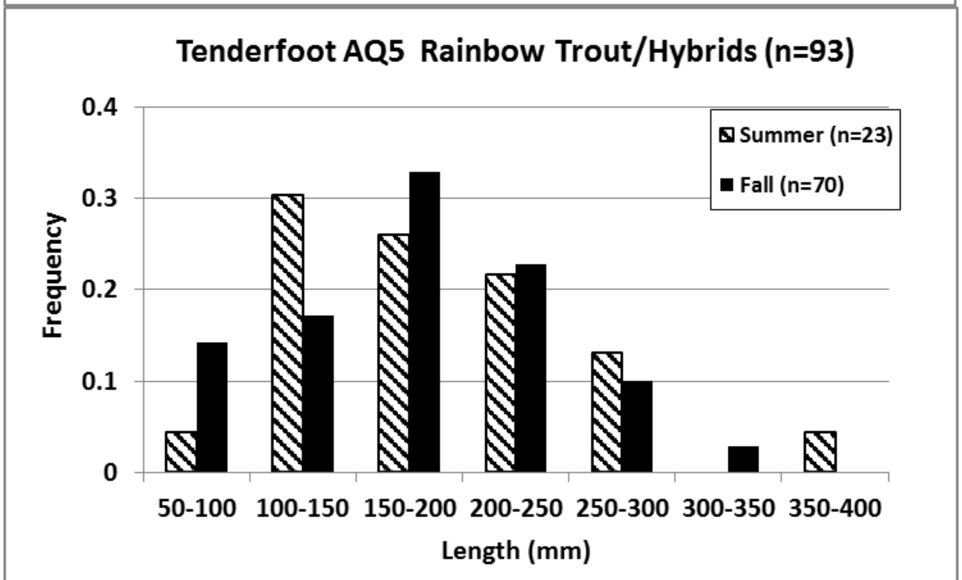


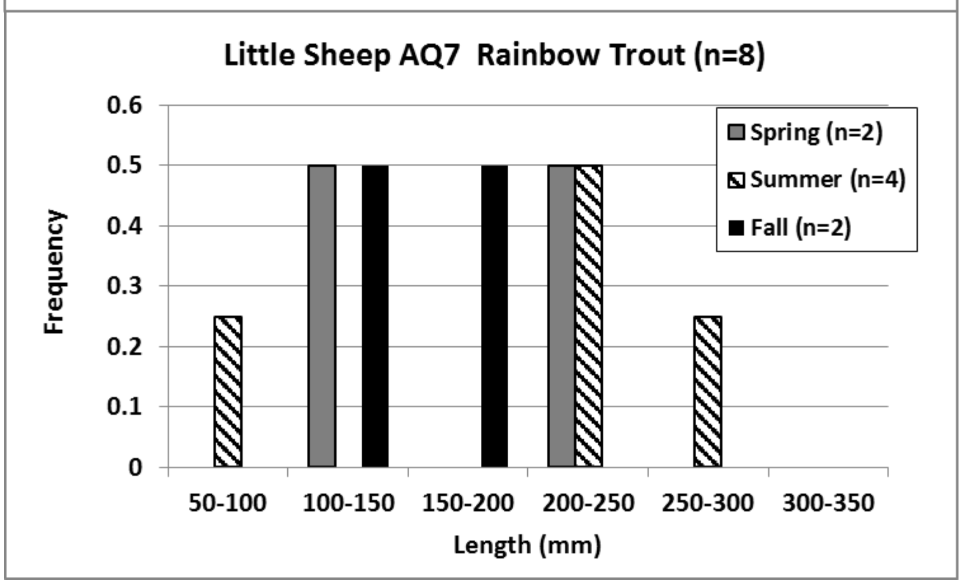




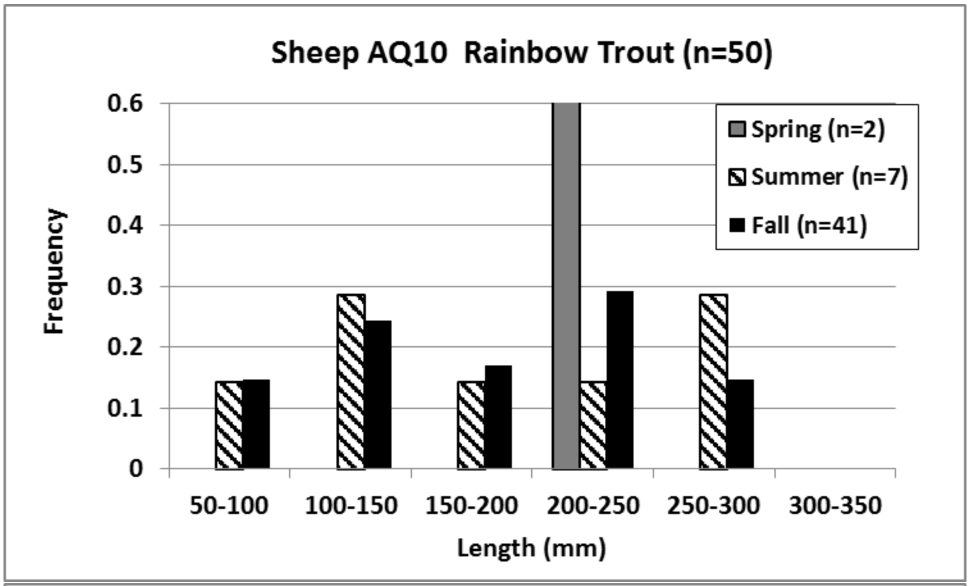
Appendix C. Sheep Creek seasonal rainbow trout (RBTR) size-frequency graphs for 2016. Catchable size is considered >200mm (8 inches).

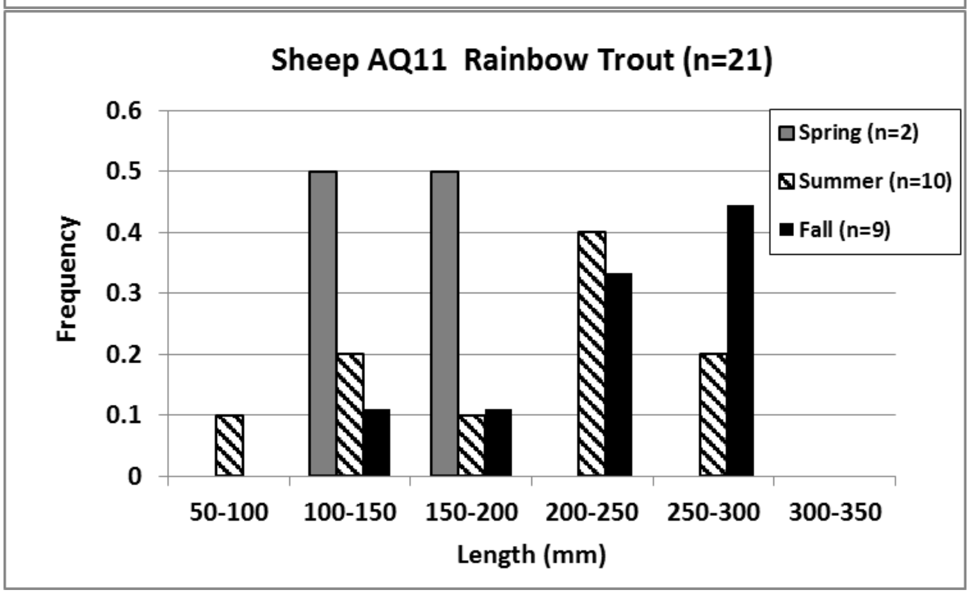




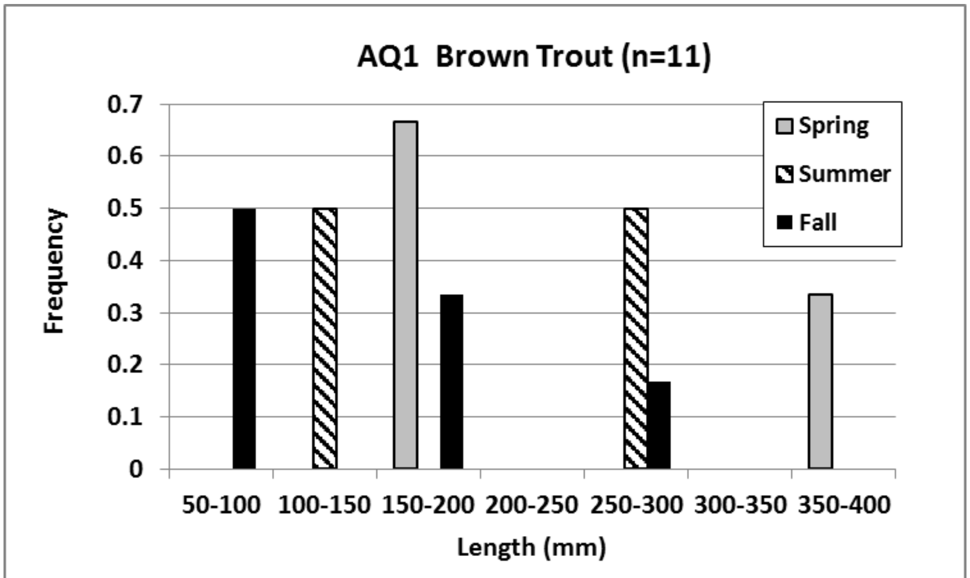


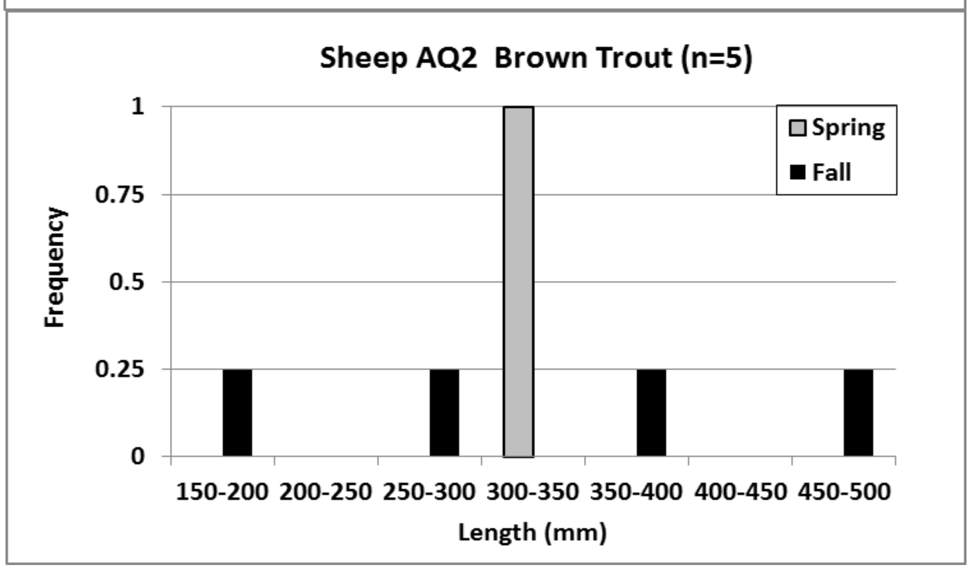
Appendix C. Sheep Creek seasonal rainbow trout (RBTR) size-frequency graphs for 2016. Catchable size is considered >200mm (8 inches).

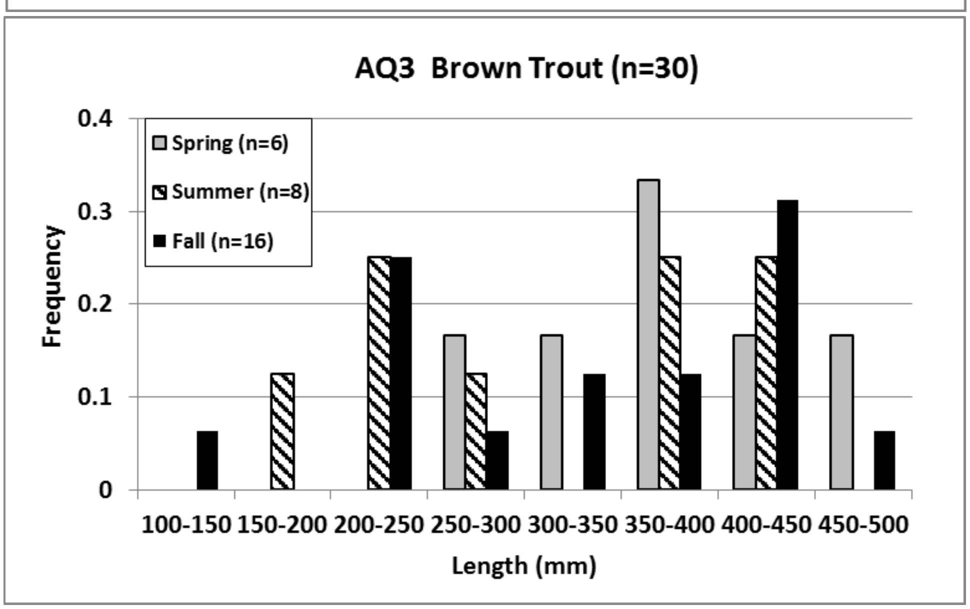




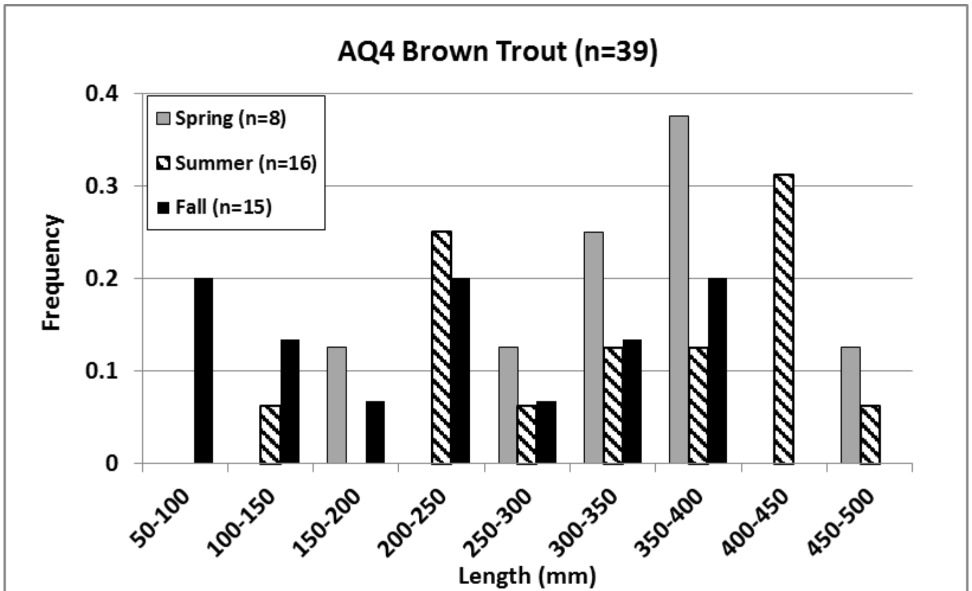
Appendix C. Sheep Creek seasonal Brown trout (LOLE) size-frequency graphs for 2016. Catchable size is considered >200mm (8 inches).

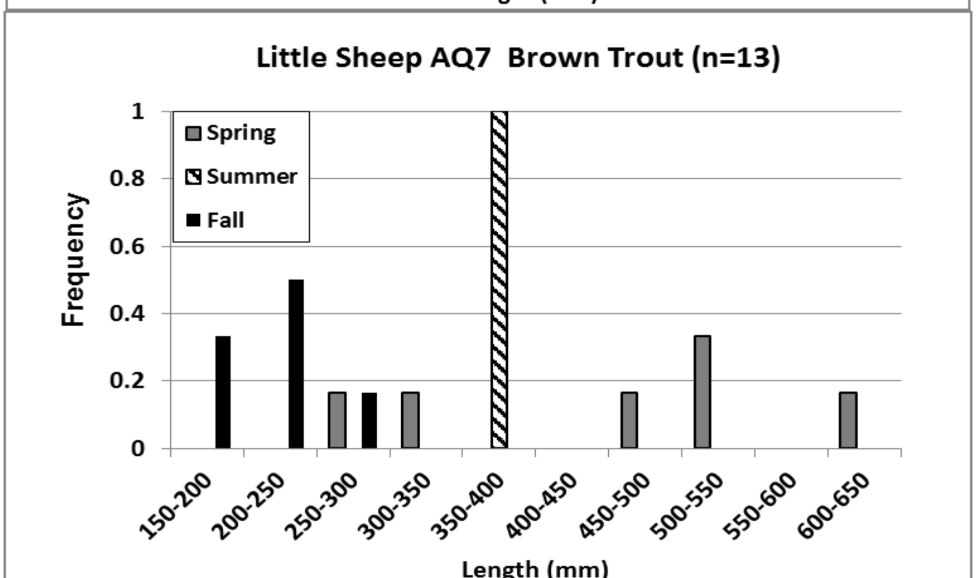


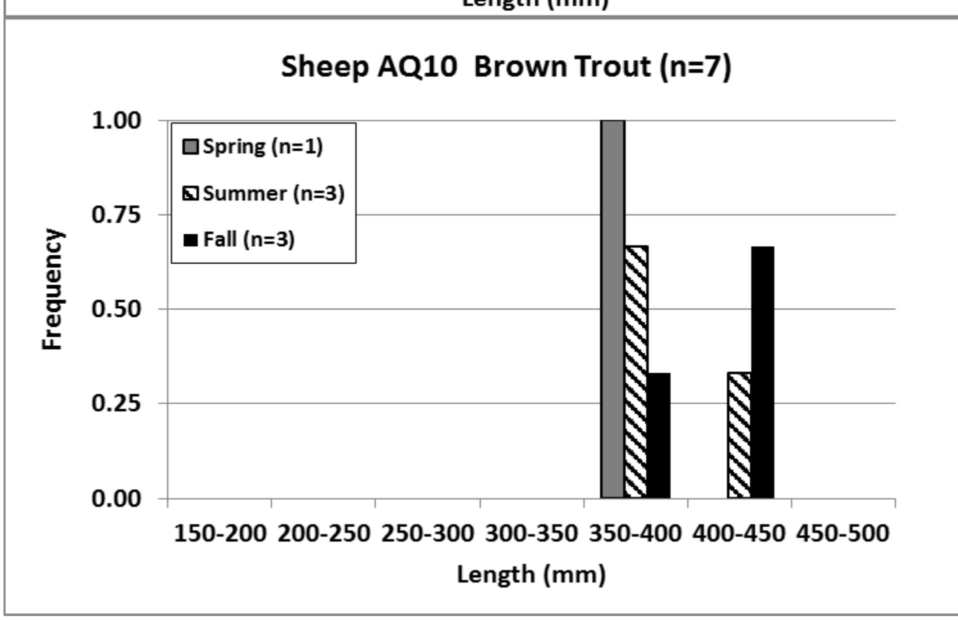




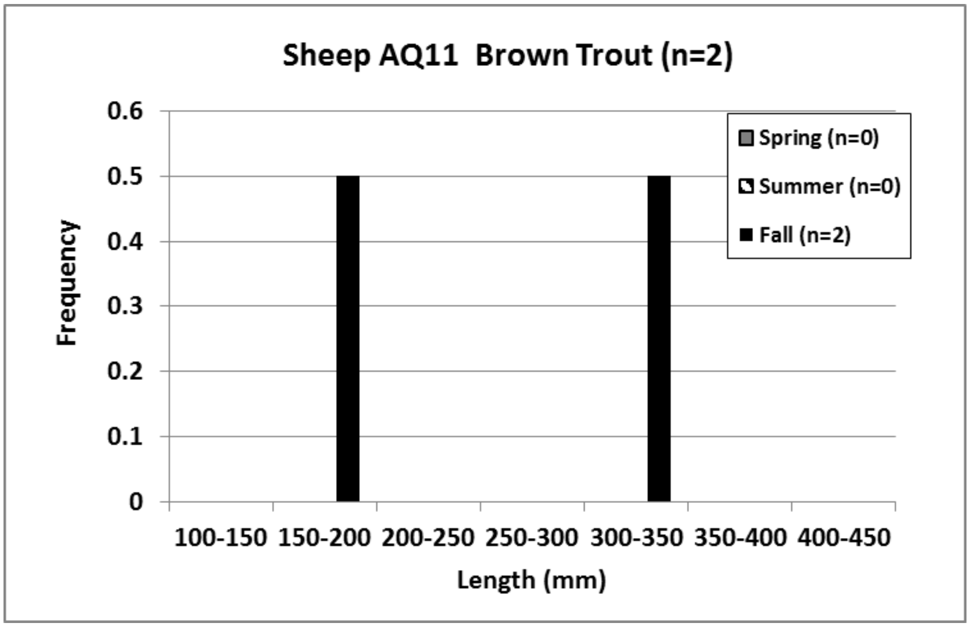
Appendix C. Sheep Creek seasonal Brown trout (LOLE) size-frequency graphs for 2016. Catchable size is considered >200mm (8 inches)



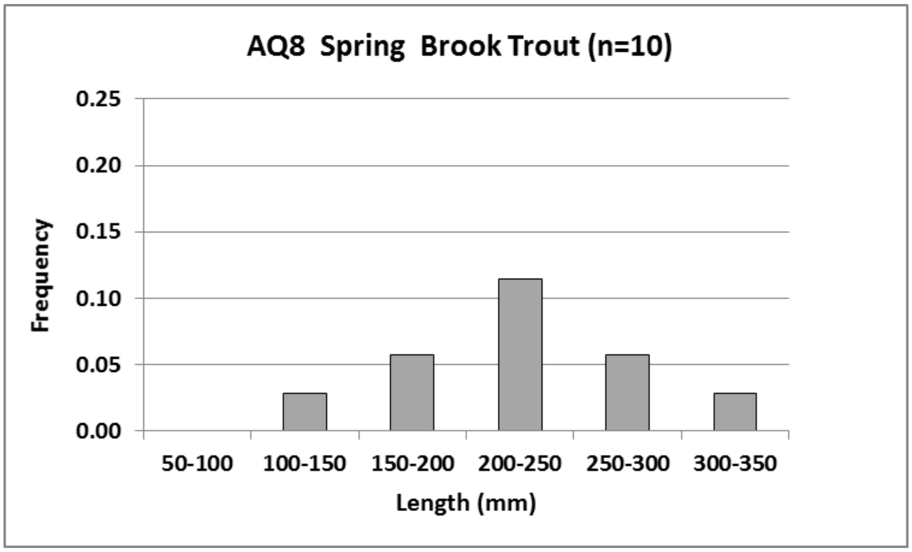


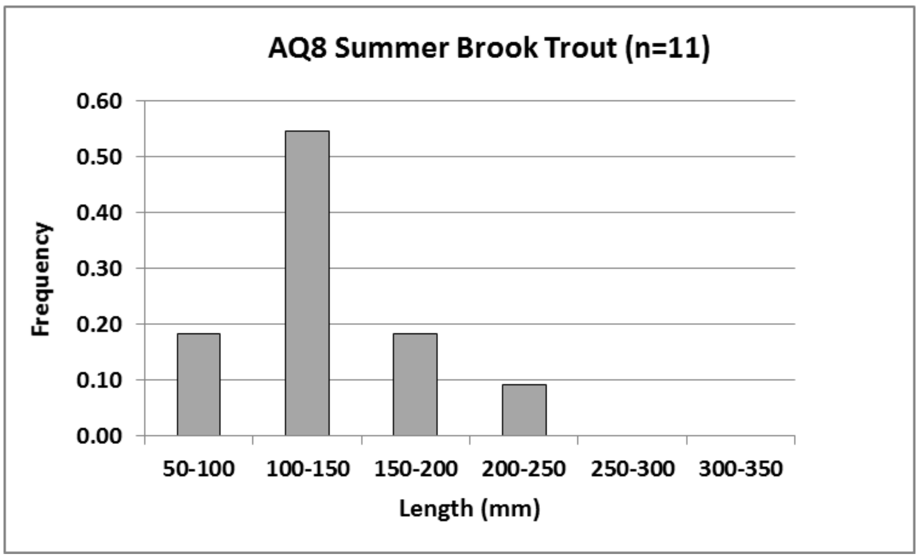


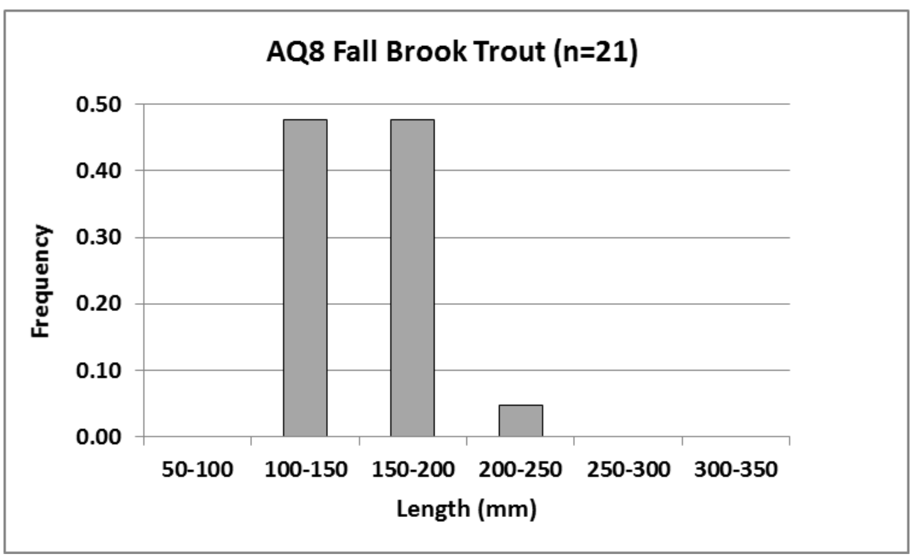
Appendix C. Sheep Creek seasonal Brown trout (LOLE) size-frequency graphs for 2016. Catchable size is considered >200mm (8 inches)



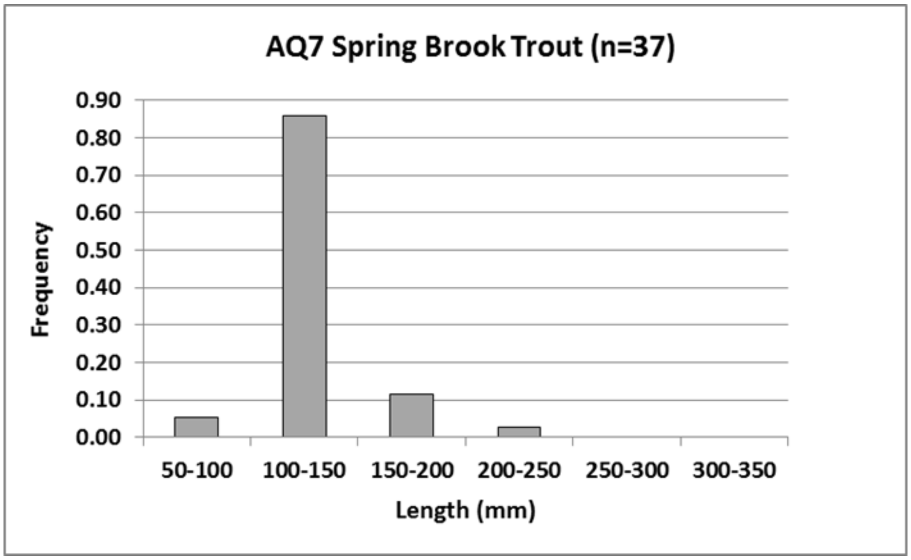
Appendix C. Little Sheep Creek seasonal Brook trout (EBT) size-frequency graphs for 2016

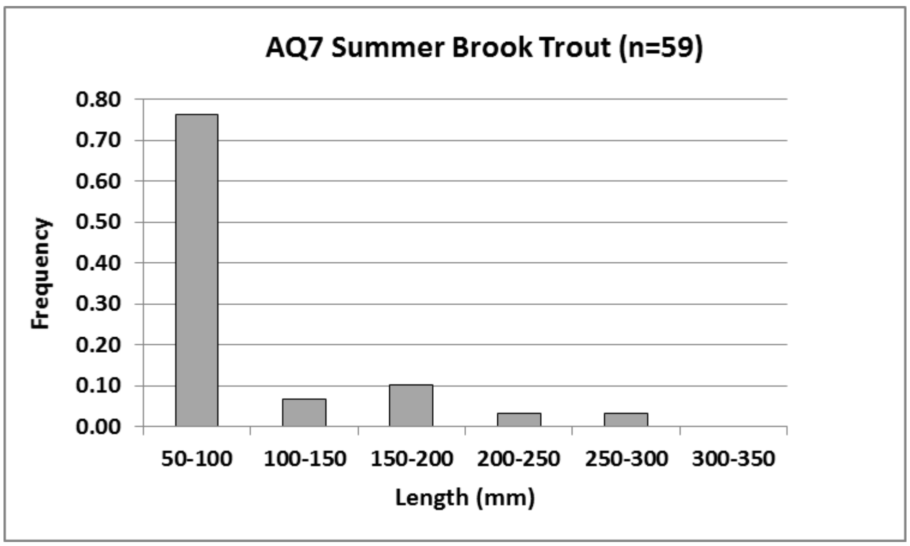


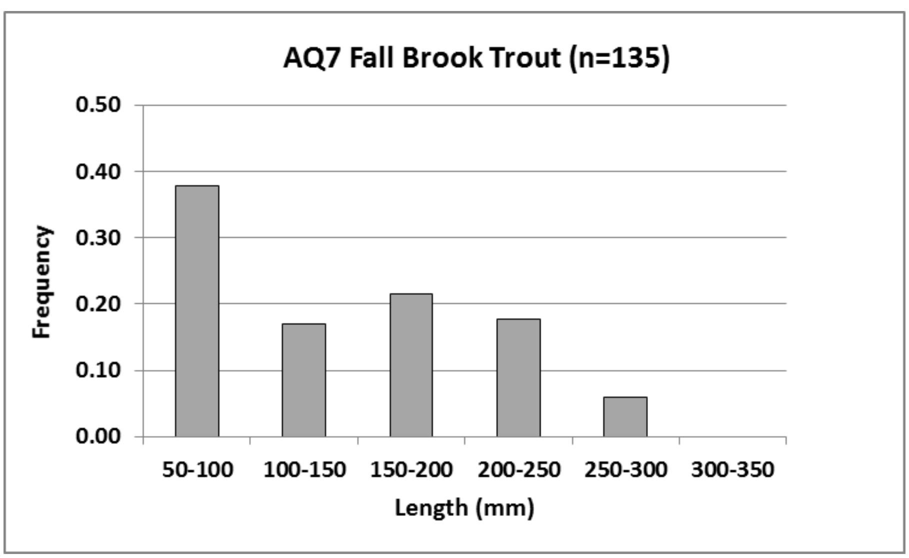




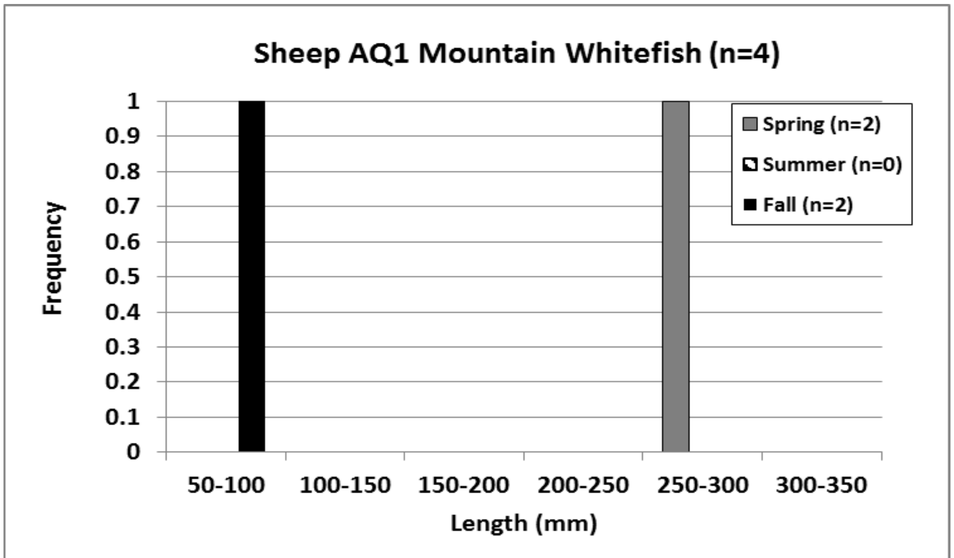
Appendix C. Little Sheep Creek seasonal Brook trout (EBT) size-frequency graphs for 2016

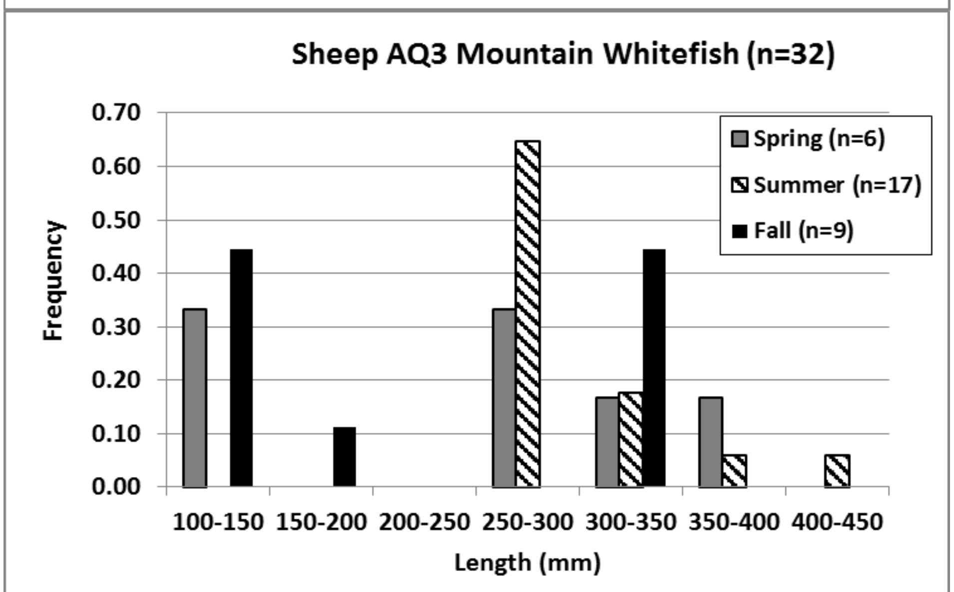


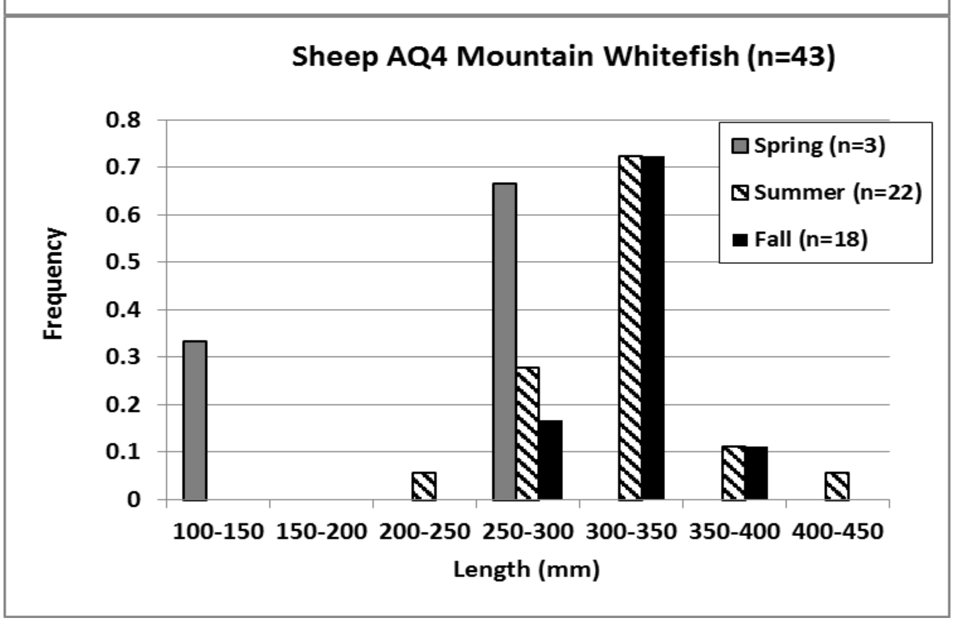




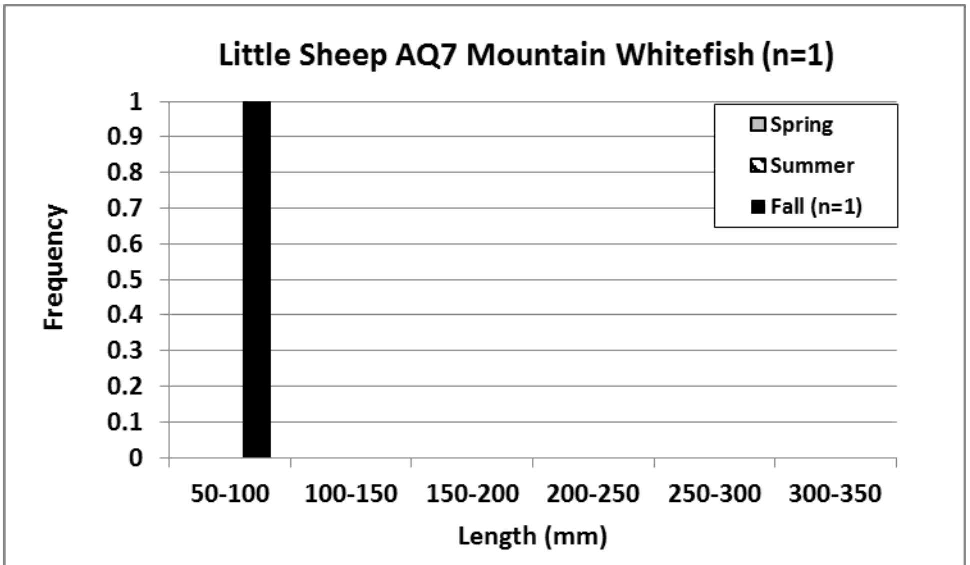
Appendix C. Sheep Creek seasonal Mountain Whitefish (MOWH) size-frequency graphs for 2016. Catchable size is considered >200mm (8 inches).

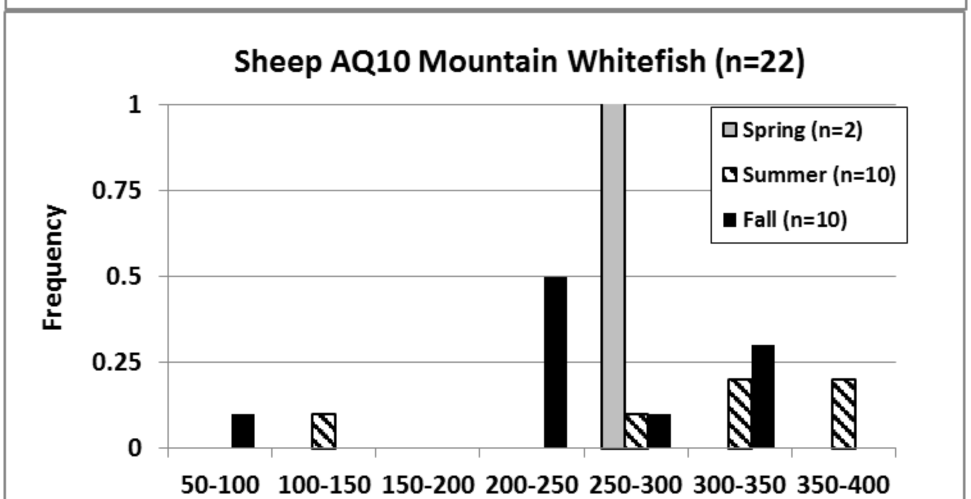


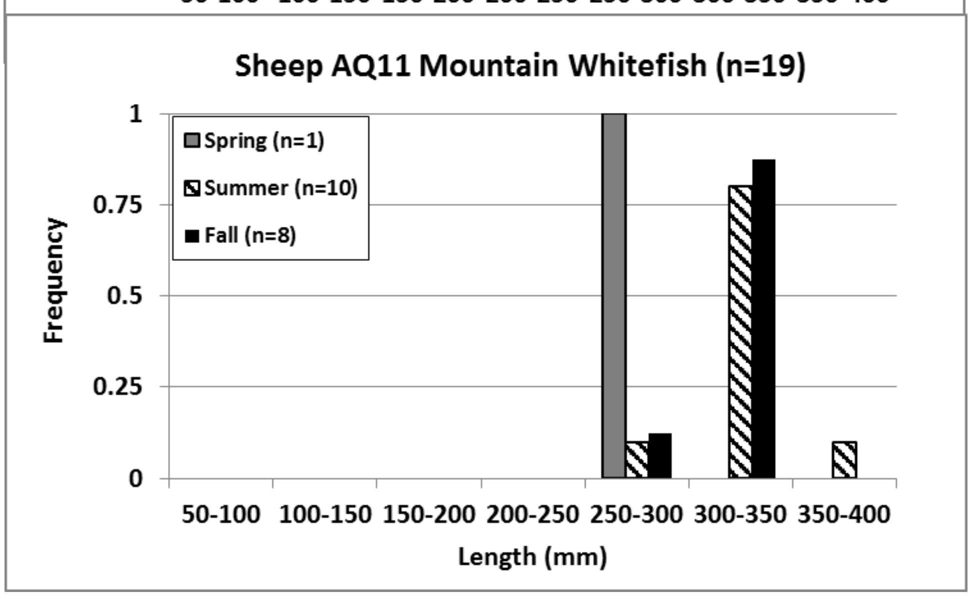




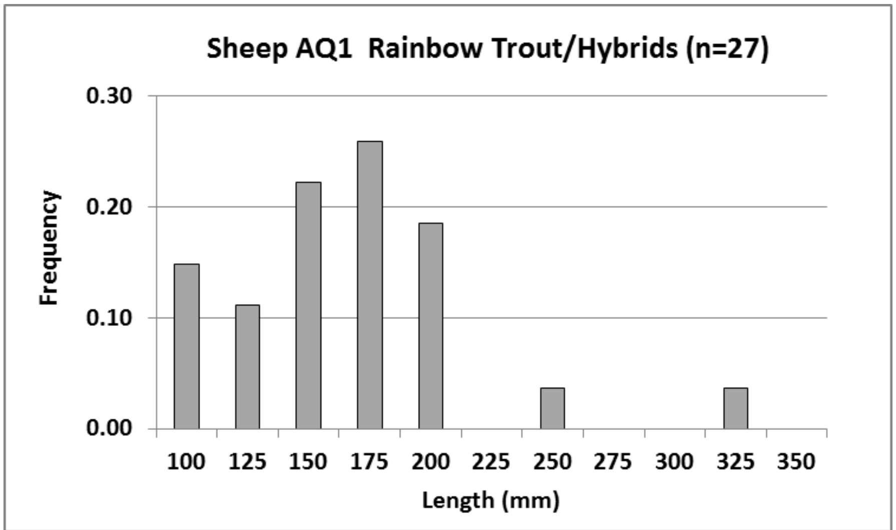
Appendix C. Sheep Creek seasonal Mountain Whitefish (MOWH) size-frequency graphs for 2016. Catchable size is considered >200mm (8 inches)

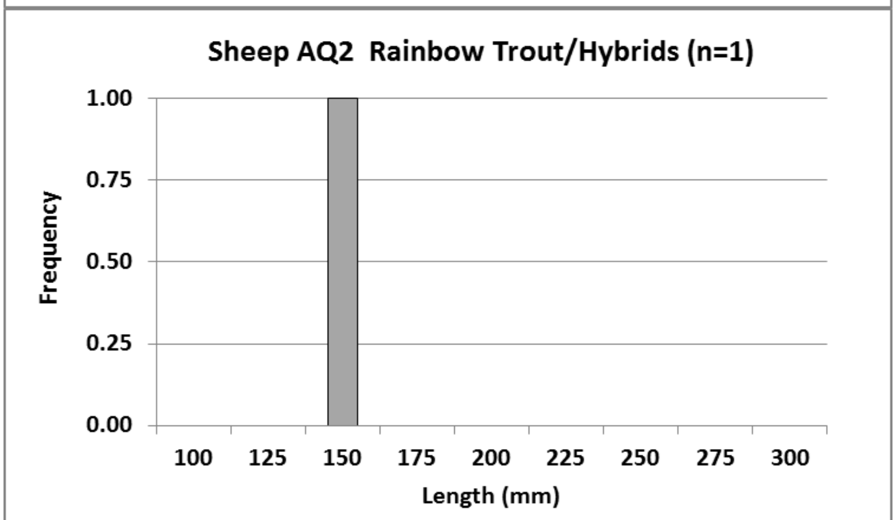


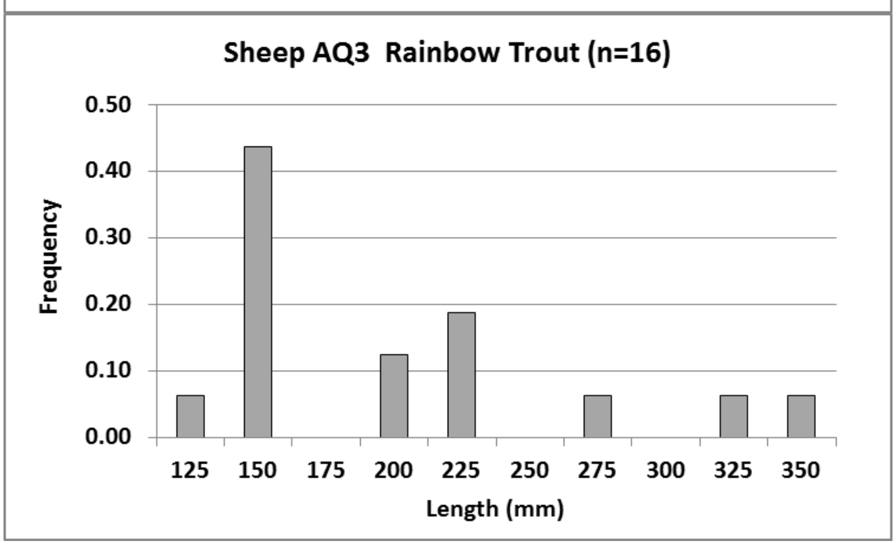




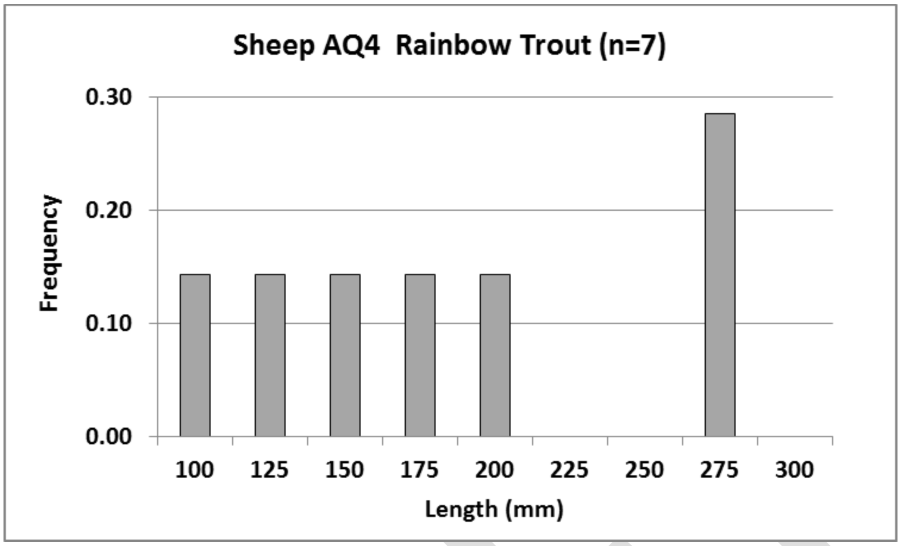
Size frequency collection data for Rainbow Trout and "Cutt-bows" collected at the Tintina Black Butte Mine Sites.

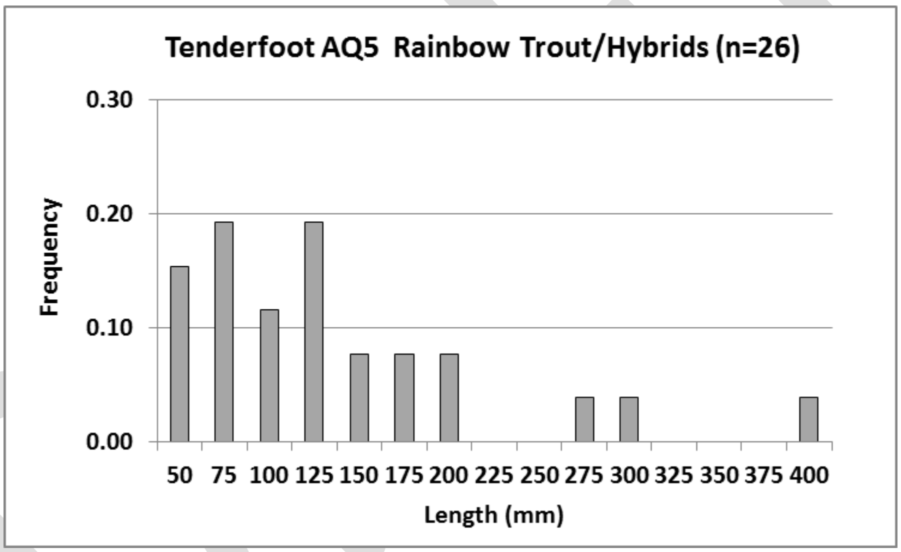


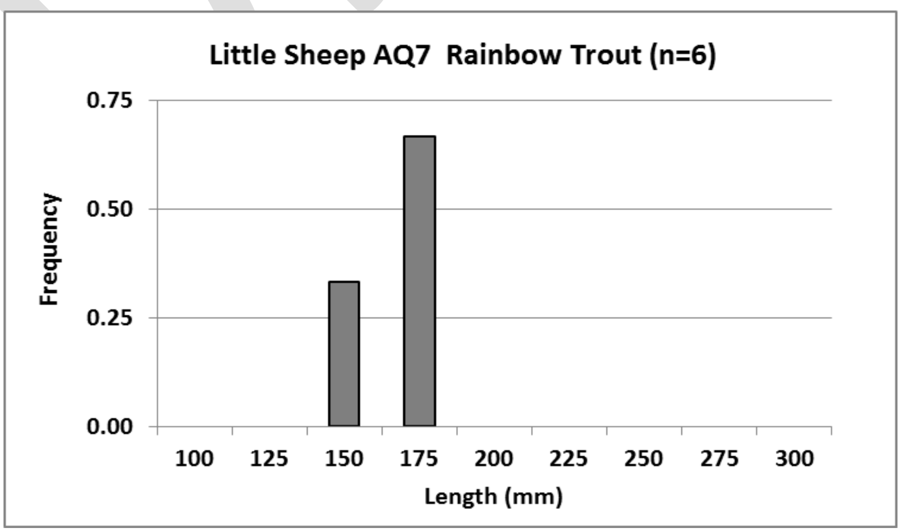




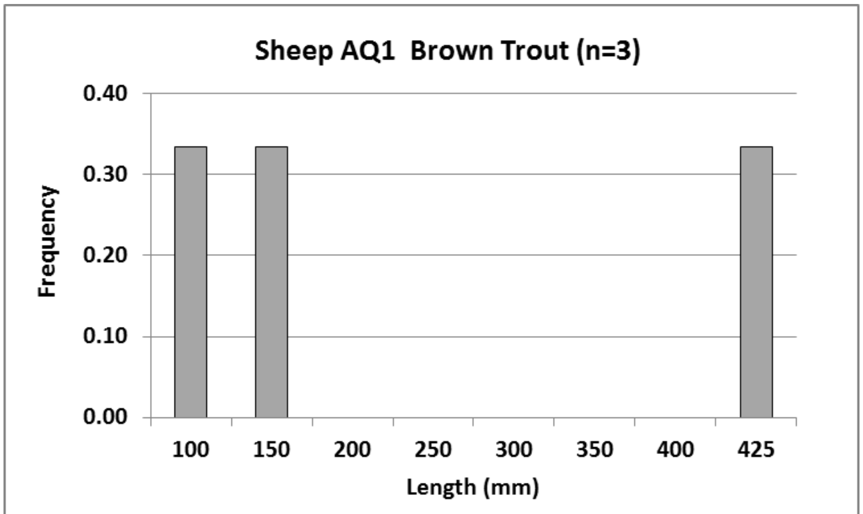
Size frequency collection data for Rainbow Trout and "Cutt-bows" collected at the Tintina Black Butte Mine Sites.

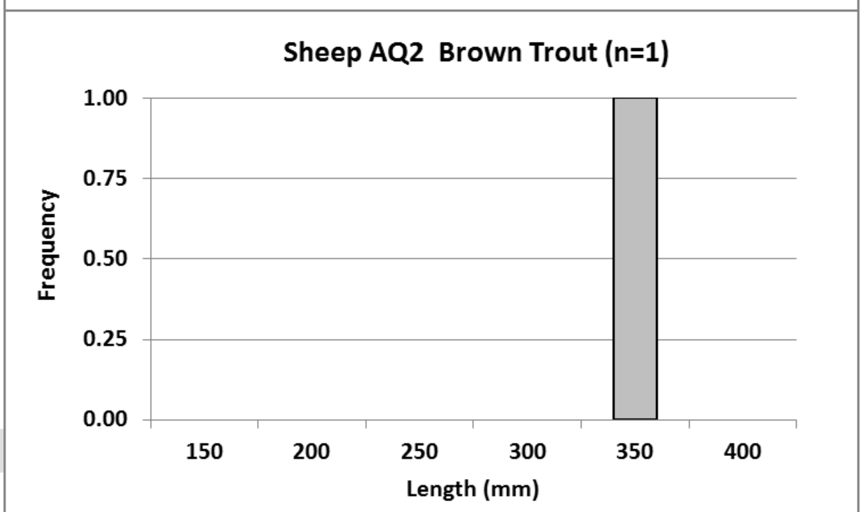


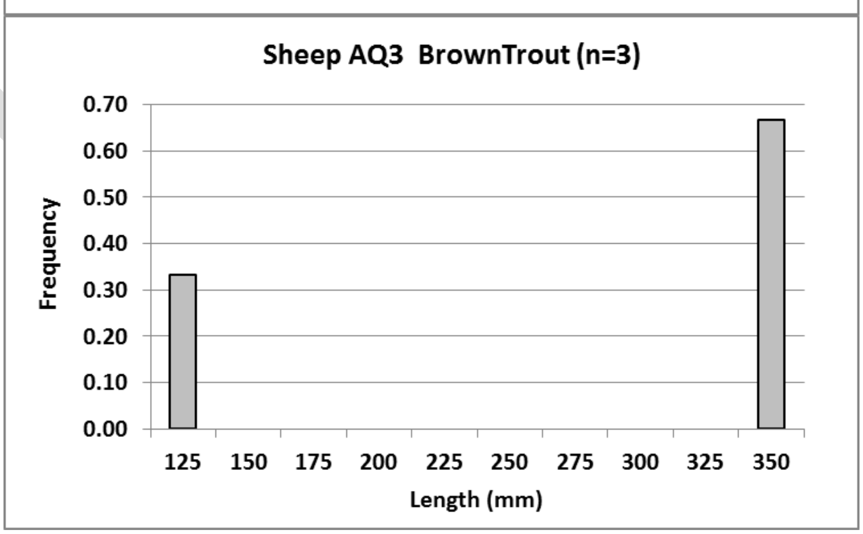




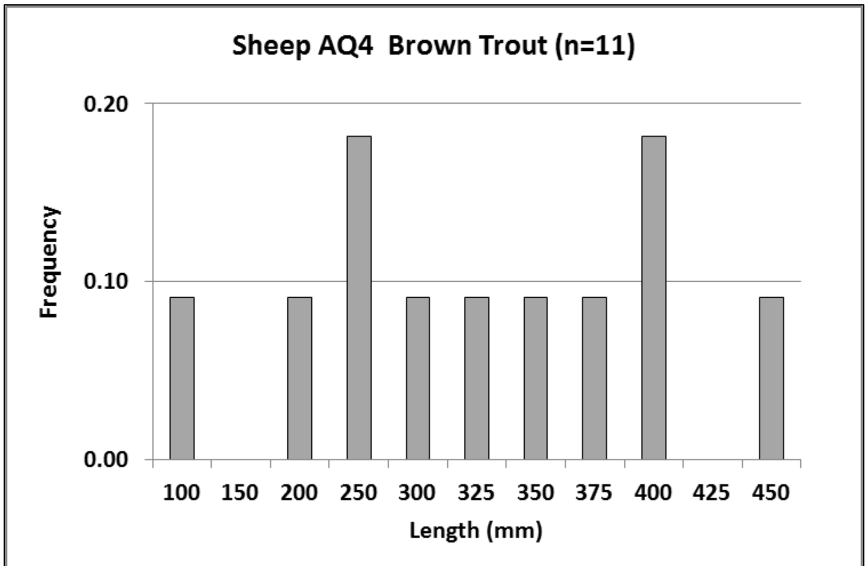
Size frequency collection data for Brown Trout collected at the Tintina Black Butte Mine Sites

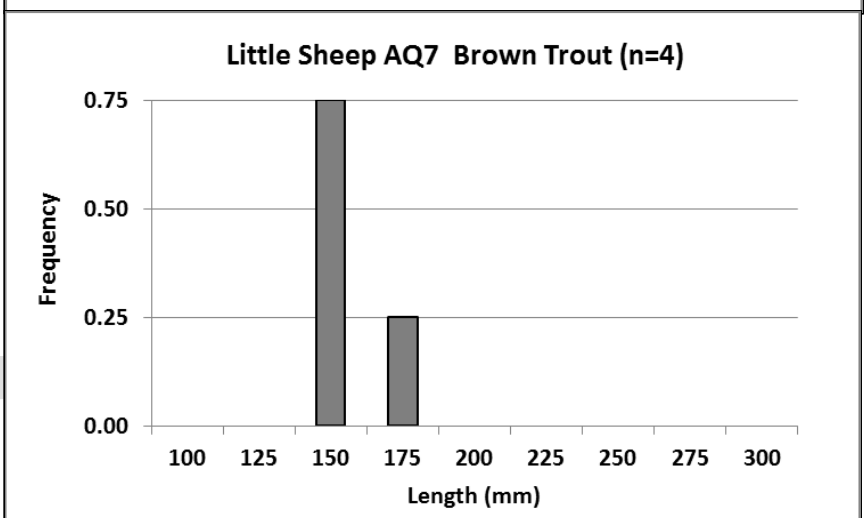


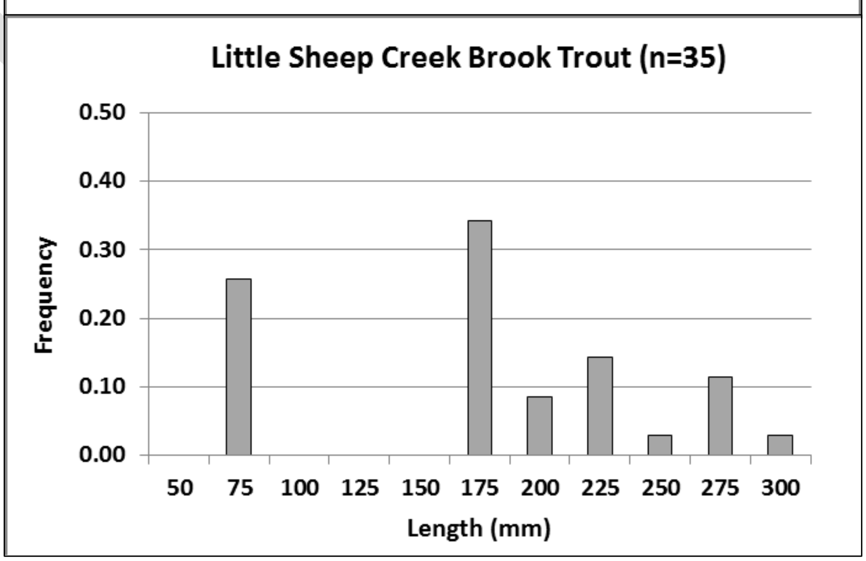




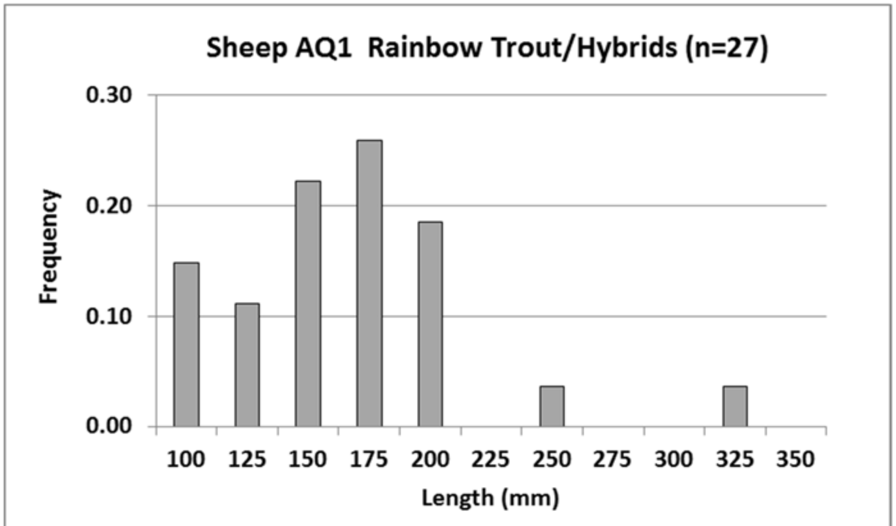
Size-frequency collection data for Brown Trout and Brook Trout collected at the Tintina Black Butte Mine Sites

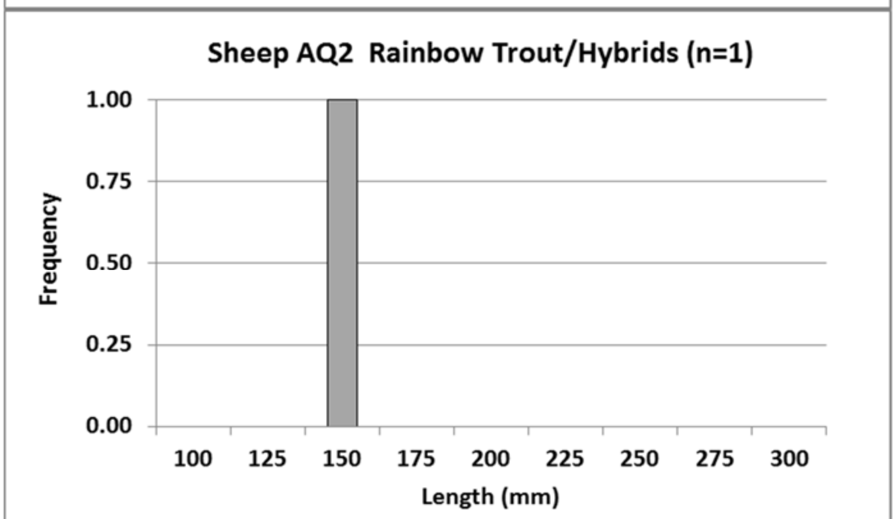


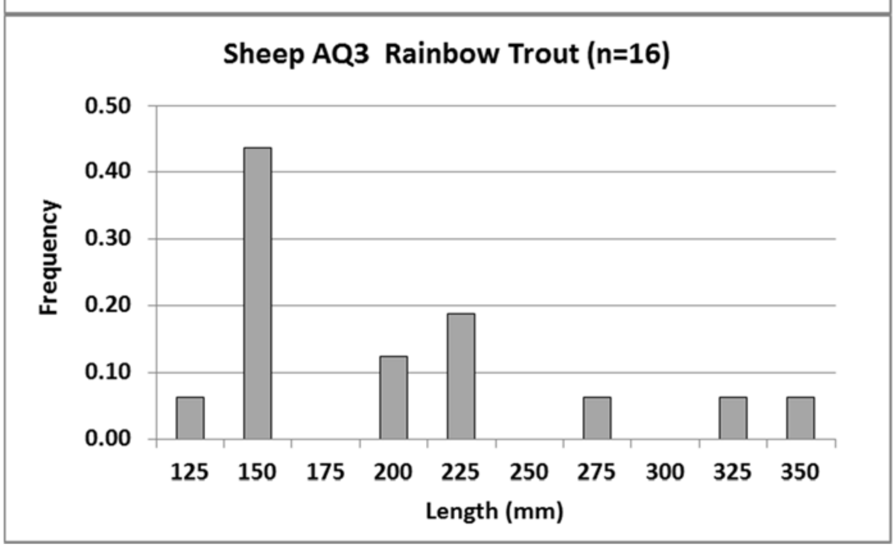




Size frequency collection data for Rainbow Trout and "Cutt-bows" collected during fall 2014 at the Tintina Black Butte Mine Sites.







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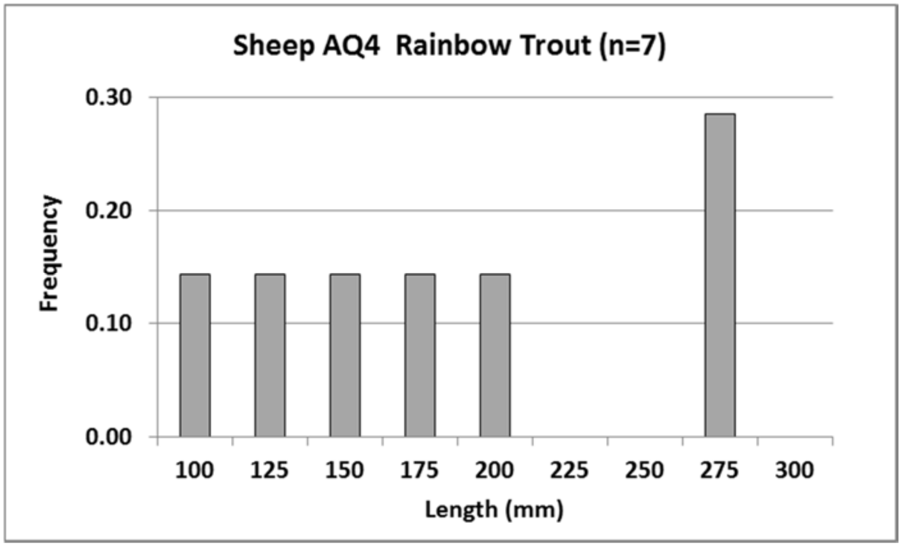
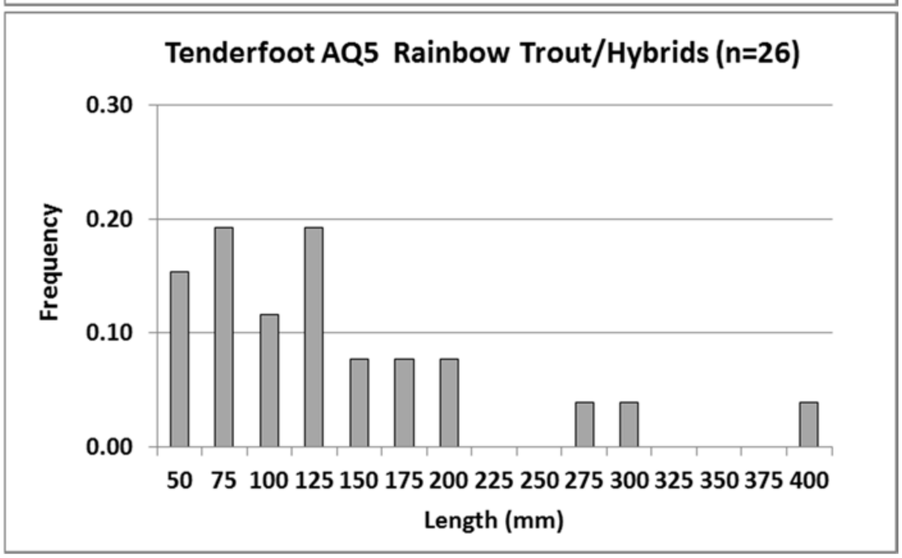
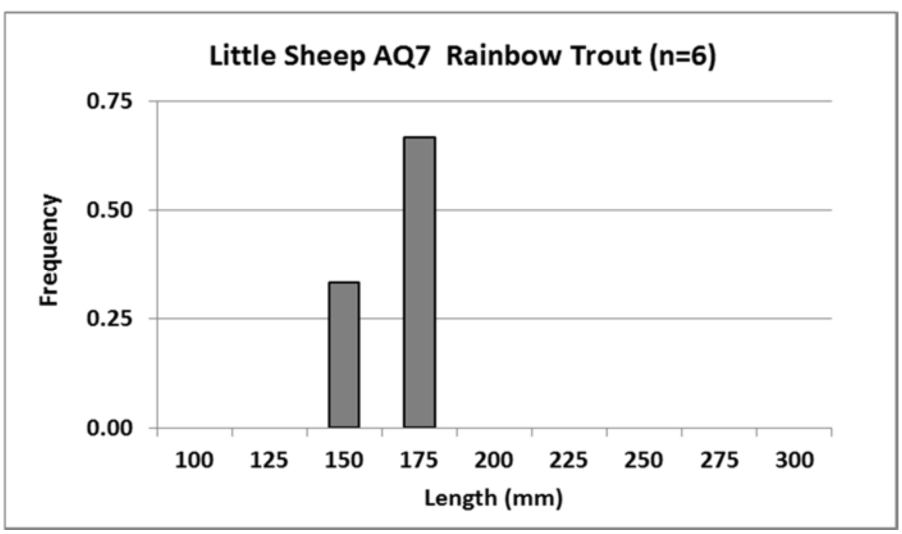
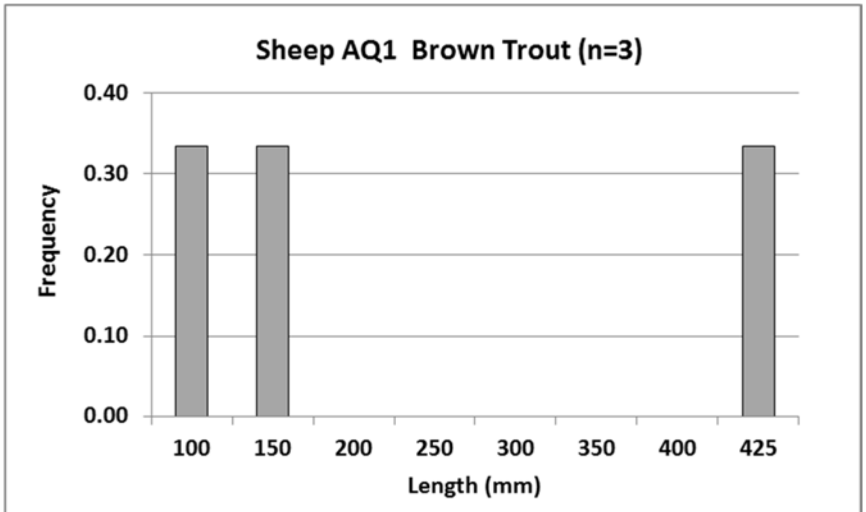
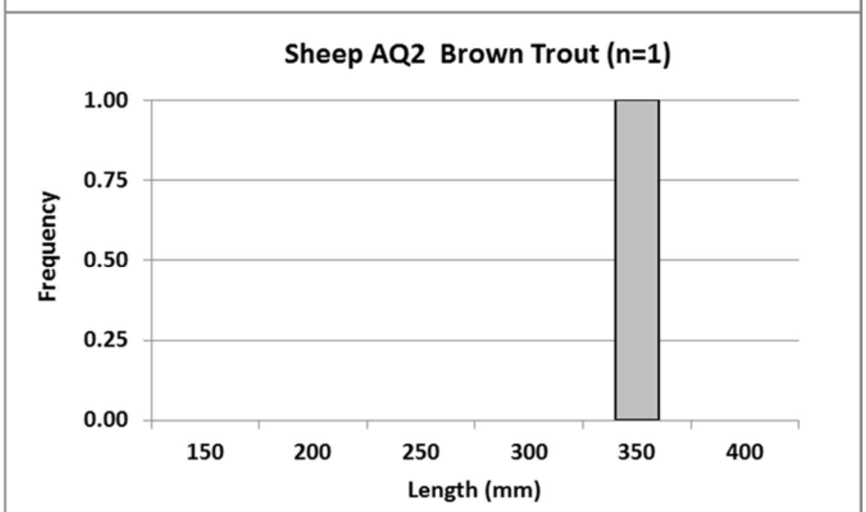


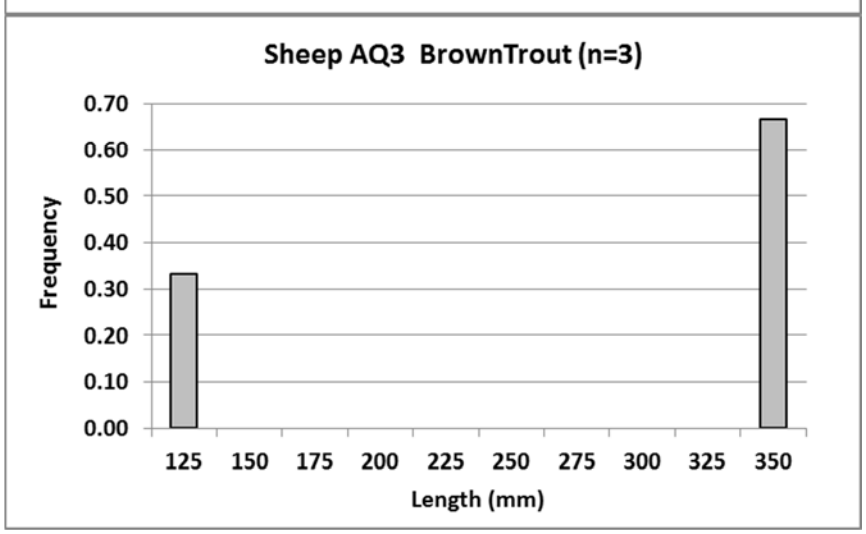




Size frequency collection data for Brown Trout collected during fall 2014 at the Tintina Black Butte Mine Sites







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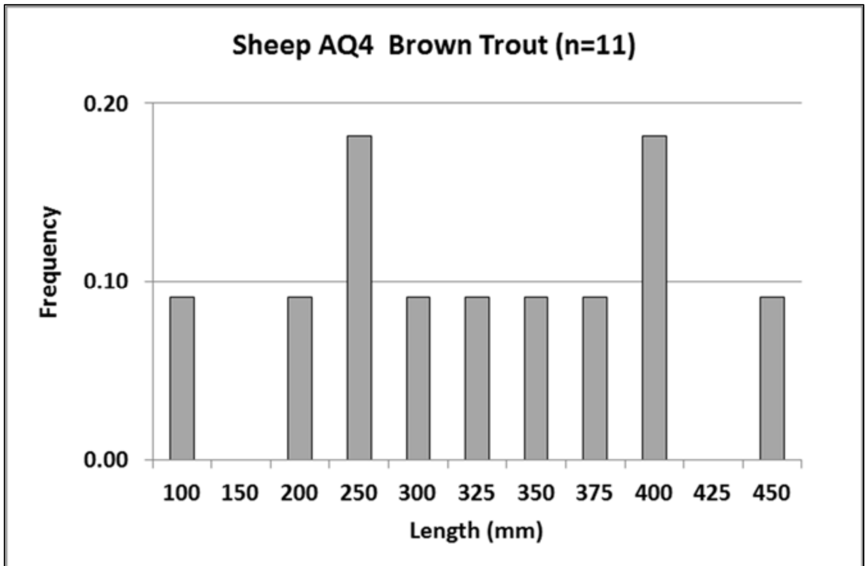
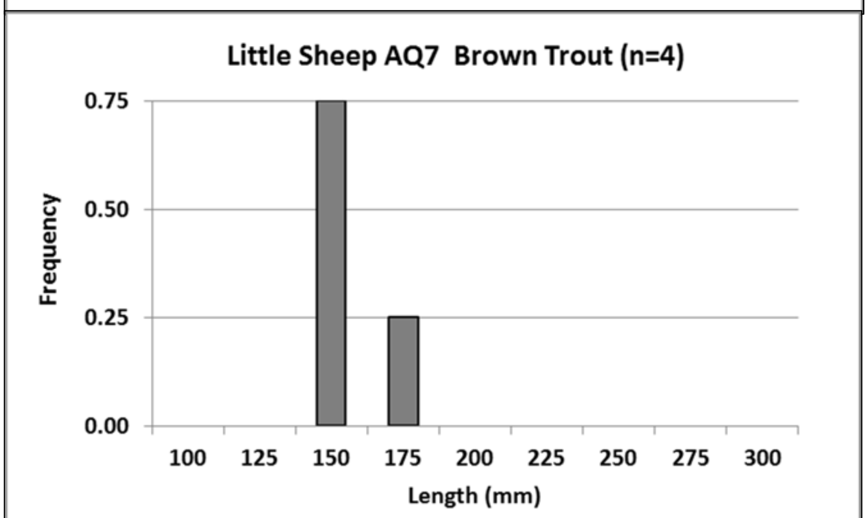
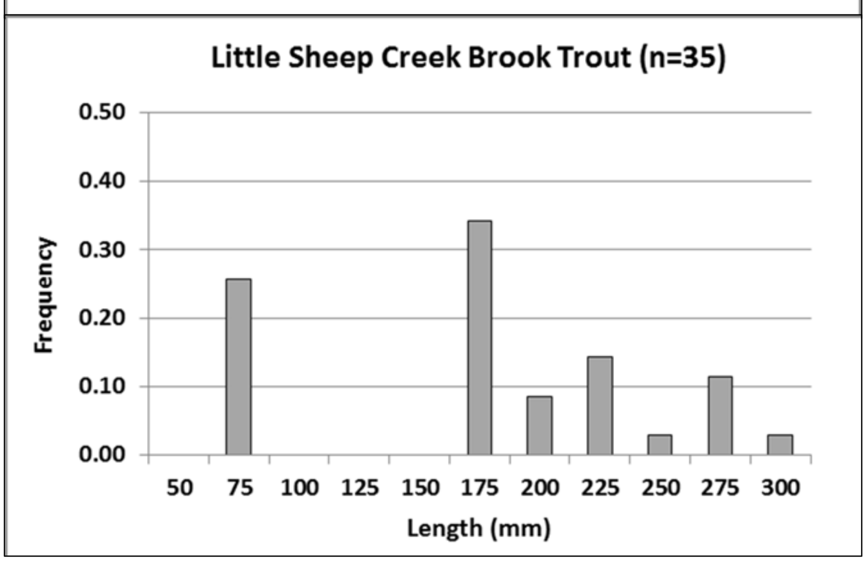
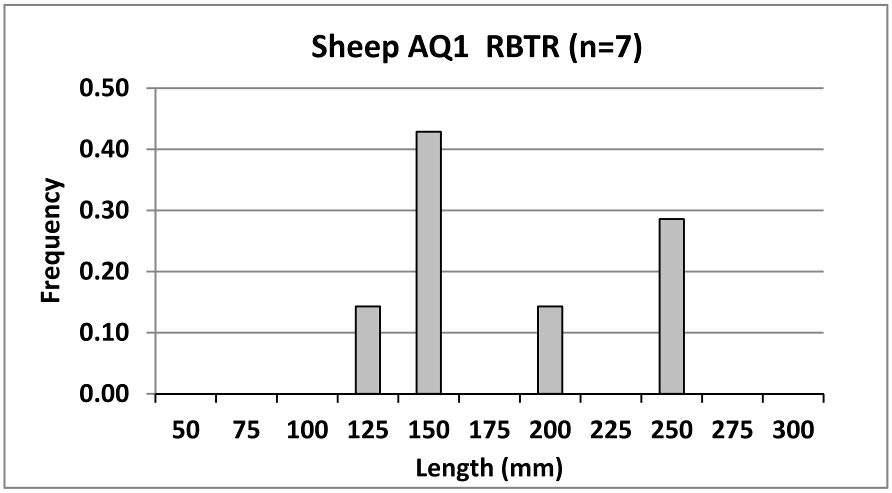
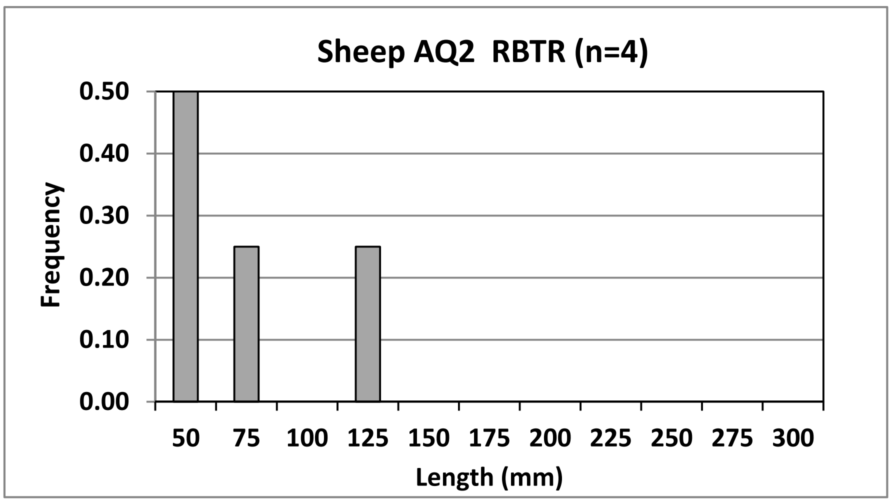


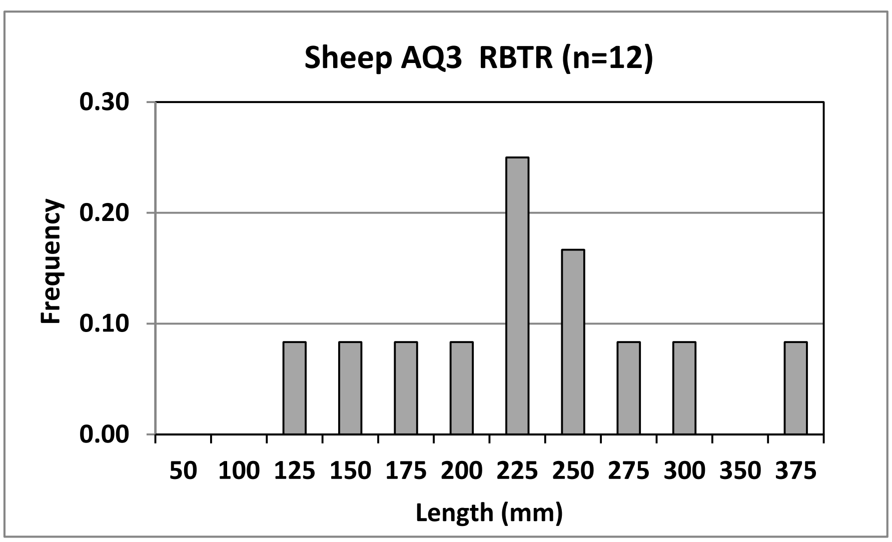




Size frequency collection data for Rainbow Trout collected during summer 2015 at the Tintina Black Butte Mine Sites







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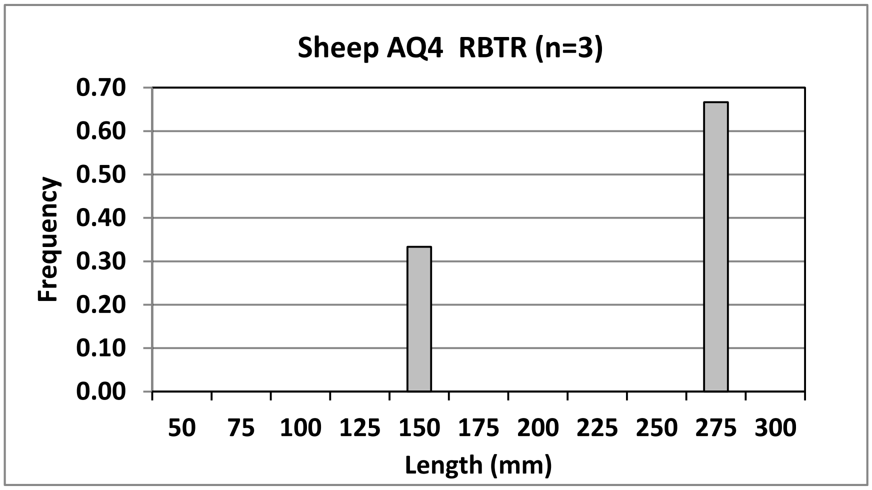
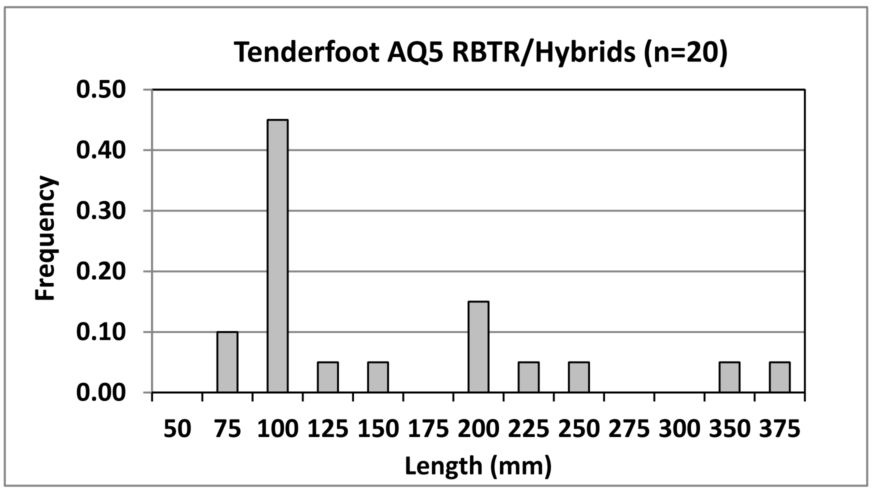
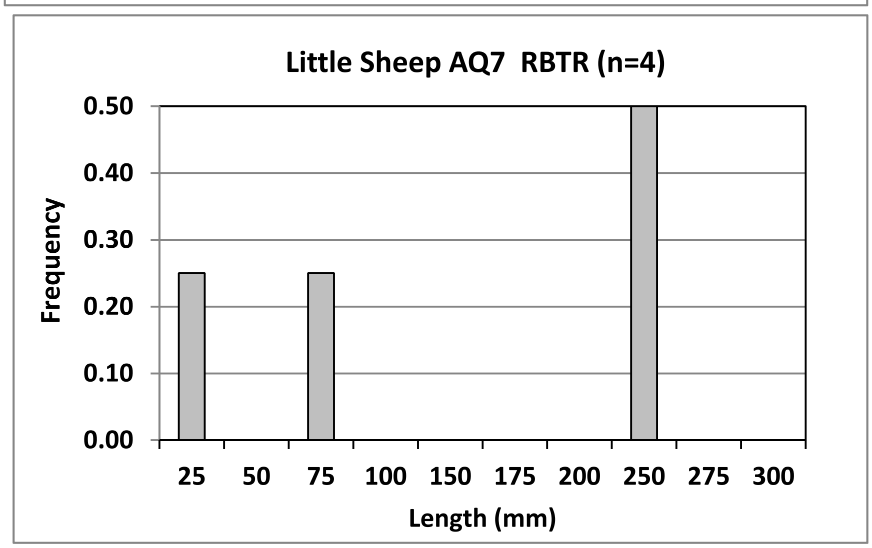
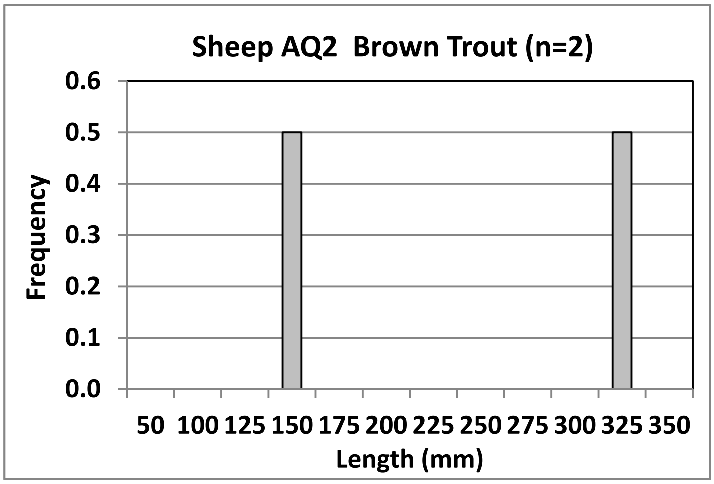
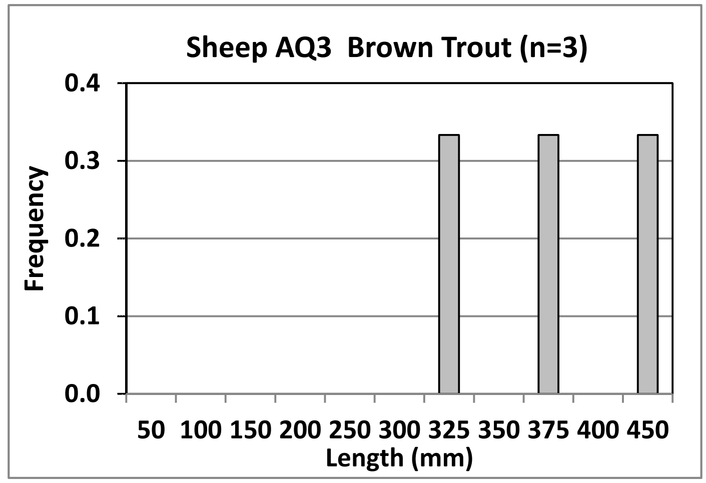


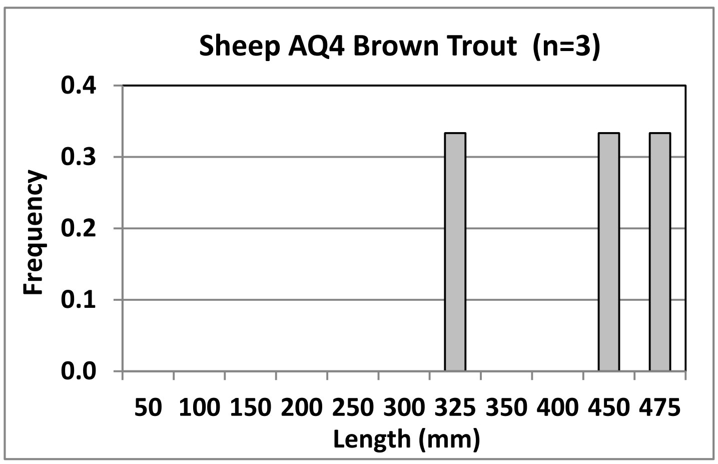


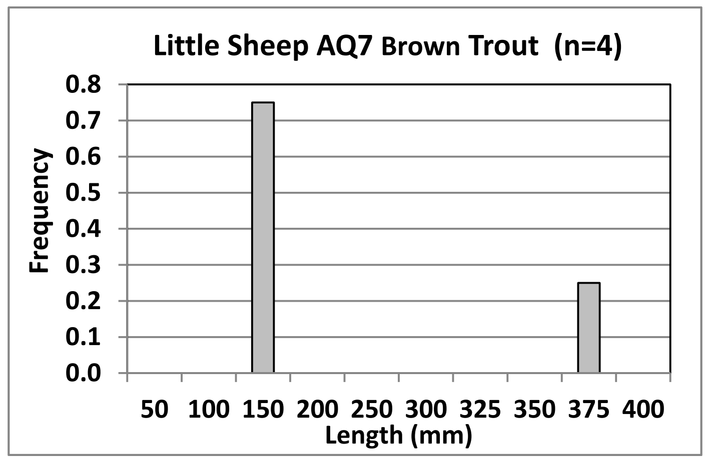


Size frequency collection data for Brown Trout collected during summer 2015 at the Tintina Black Butte Mine Sites









Pages extracted from:

Stagliano, D. 2018. Baseline Aquatic Surveys and Assessment Summary 2014–2017 of Streams in the Tintina Black Butte Copper Project Area of Meagher County, MT. Tintina Resources Inc. White Sulphur Springs, Montana.

Appendix C. Seasonal salmonid size-frequency tables for fall 2017. EBT = brook trout, RBT = rainbow trout, LOLE = brown trout, CTxRBT= cutthroat-rainbow trout hybrid, WSCT= westslope cutthroat trout, MWF = mountain whitefish, LNDA = longnose dace, MSU = mountain sucker, WHSU = white sucker. Catchable size is considered >200mm (8 inches).

Sheep SH.22.7/AQ2 Fall

EBT	# per reach	# per 1000ft	# per mile	Avg # per mile (95% CI)	% of total catch
50-100 mm	4.0	4.0	20.8	21	27%
100-150mm	3.0	3.0	15.6	16.0	20%
150-200 mm	4.0	4.0	20.8	21	27%
200-250 mm	0.0	0.0	0	0	0%
250-300 mm	1.0	1.0	5.2	5	7%
300-350 mm	2.0	2.0	10.4	10	13%
>350 mm	1.0	1.0	5.2	5	7%
total	**15.0**	**15.0**	**78**	**78 (78-78)**	**100%**

LOLE	Avg # per section	Avg # per 1000ft	Avg # per mile	Avg # per mile (95% CI)	% of total catch
50-100 mm	3.0	3.0	15.6	16	30%
100-150mm	2.0	2.0	10.4	11	20%
150-200 mm	1.0	1.0	5.2	5	10%
200-250 mm	0.0	0.0	0	0	0%
250-300 mm	0.0	0.0	0	0	0%
300-350 mm	1.0	1.0	5.2	5	10%
350-400 mm	1.0	1.0	5.2	5	10%
400-450 mm	2.0	2.0	10.4	10	20%
total	**10.0**	**10.0**	**52**	**52 (52-52)**	**100%**

RBT	Avg # per section	Avg # per 1000ft	Avg # per mile	Avg # per mile (95% CI)	% of total catch
50-100 mm	5.0	5.0	26	26 (21-31)	50%
100-150mm	3.0	3.0	15.6	16	30%
150-200 mm	1.0	1.0	5.2	5	10%
200-250 mm	1.0	1.0	5.2	5	10%
250-300 mm	0.0	0.0	0	0	0%
total	**10.0**	**10.0**	**52**	**52 (47-57)**	**100%**

Sheep SH.19.2/AQ3 Fall

EBT	Avg # per section	Avg # per 1000ft	Avg # per mile	Avg # per mile (95% CI)	% of total catch
50-100 mm	0.0	0.0	0	0	0%
100-150mm	0.0	0.0	0	0	0%
150-200 mm	10.0	10.0	52	52 (36-68)	67%
200-250 mm	5.0	5.0	26	26	33%
250-300 mm	0.0	0.0	0	0	0%
>300 mm	0.0	0.0	0	0	**0%**
total	**15.0**	**15.0**	**78**	**78 (68-88)**	**100%**

Appendix C. Sheep Creek seasonal size-frequency graphs for 2017. EBT = brook trout, RBT = rainbow trout, LOLE = brown trout, CTxRBT= cutthroat-rainbow trout hybrid, WSCT= westslope cutthroat trout, MWF = mountain whitefish, LNDA = longnose dace, MSU = mountain sucker, WHSU = white sucker,Catchable size is considered >200mm (8 inches).

Sheep SH.19.2/AQ3 Fall

RBT	Avg # per section	Avg # per 1000ft	Avg # per mile	Avg # per mile (95% CI)	% of total catch
50-100 mm	0.0	0.0	0	0	0%
100-150mm	4.0	4.0	20.8	21	33%
150-200 mm	1.0	1.0	5.2	5	8%
200-250 mm	3.0	3.0	15.6	16	25%
250-300 mm	2.0	2.0	10.4	11	17%
>300 mm	2.0	2.0	10.4	11	17%
total	**12.0**	**12.0**	**62.4**	**63 (52-73)**	**100%**

LOLE	Avg # per section	Avg # per 1000ft	Avg # per mile	Avg # per mile (95% CI)	% of total catch
50-100 mm	7.0	7.0	36.4	37 (26-46)	23%
100-150mm	4.0	4.0	20.8	21	13%
150-200 mm	10.0	10.0	52	52 (47-57)	32%
200-250 mm	3.0	3.0	15.6	16 (13-19)	10%
250-300 mm	4.0	4.0	20.8	21	13%
300-350 mm	1.0	1.0	5.2	5	3%
350-400mm	1.0	1.0	5.2	5	3%
400-450mm	0.0	0.0	0	0	0%
450-500mm	1.0	1.0	5.2	5	3%
total	**31.0**	**31.0**	**161.2**	**161 (156-166)**	**100%**

MOWH	Avg # per section	Avg # per 1000ft	Avg # per mile	Avg # per mile (95% CI)	% of total catch
50-100 mm	6.0	6.0	31.2	32 (26-36)	60%
100-150mm	0.0	0.0	0	0	0%
150-200 mm	2.0	2.0	10.4	10	20%
200-250 mm	0.0	0.0	0	0	0%
250-300 mm	0.0	0.0	0	0	0%
300-350 mm	2.0	2.0	10.4	10	20%
total	**10.0**	**10.0**	**52**	**52 (47-57)**	**100%**

LNDA	# per section	# per 1000ft	# per mile	Avg # per mile (95% CI)	% of total catch
50-100 mm	5.0	5.0	26	26 (26-26)	100%
total	**5.0**	**5.0**	**26**	**26 (26-26)**	**100%**

WHSU	# per section	# per 1000ft	# per mile	Avg # per mile (95% CI)	% of total catch
150-200 mm	1.0	1.0	5.2	5	100%

Appendix C. Sheep Creek seasonal size-frequency graphs for 2017. EBT = brook trout, RBT = rainbow trout, LOLE = brown trout, CTxRBT= cutthroat-rainbow trout hybrid, WSCT= westslope cutthroat trout, MWF = mountain whitefish, LNDA = longnose dace, MSU = mountain sucker, WHSU = white sucker,Catchable size is considered >200mm (8 inches).

Sheep SH.18.3/AQ4 Fall

RBT	Avg # per section	Avg # per 1000ft	Avg # per mile	Avg # per mile (95% CI)	% of total catch
50-100 mm	3.0	3.0	15.6	16	9%
100-150mm	16.0	16.0	83.2	83 (78-88)	50%
150-200 mm	7.0	7.0	36.4	37	22%
200-250 mm	4.0	4.0	20.8	21	13%
250-300 mm	1.0	1.0	5.2	5	3%
>300 mm	1.0	1.0	5.2	5	3%
total	**32.0**	**32.0**	**166.4**	**166 (161-172)**	**100%**

LOLE	# per section	# per 1000ft	# per mile	Avg # per mile (95% CI)	% of total catch
50-100 mm	10.0	10.0	52	52 (47-57)	46%
100-150mm	4.0	4.0	20.8	21	18%
150-200 mm	4.0	4.0	20.8	21	18%
200-250 mm	0.0	0.0	0	0	0%
250-300 mm	2.0	2.0	10.4	10	9%
300-350 mm	1.0	1.0	5.2	5	5%
350-400 mm	1.0	1.0	5.2	5	5%
total	**22.0**	**22.0**	**114.4**	**114 (110-118)**	**100%**

MOWH	# per section	# per 1000ft	# per mile	Avg # per mile (95% CI)	% of total catch
50-100 mm	2.0	2.0	10.4	10 (10-10)	65%
100-150mm	0.0	0.0	0	0	0%
150-200 mm	0.0	0.0	0	0	0%
200-250 mm	1.0	1.0	5.2	6	35%
250-300 mm	0.0	0.0	0	0	0%
total	**3.0**	**3.0**	**15.6**	**16 (16-16)**	**100%**

LNDA	# per section	# per 1000ft	# per mile	Avg # per mile (95% CI)	% of total catch
50-100 mm	5.0	5.0	26	26 (26-26)	100%
total	**5.0**	**5.0**	**26**	**26 (26-26)**	**100%**

Appendix C. Sheep Creek seasonal size-frequency graphs for 2017. EBT = brook trout, RBT = rainbow trout, LOLE = brown trout, CTxRBT= cutthroat-rainbow trout hybrid, WSCT= westslope cutthroat trout, MWF = mountain whitefish, LNDA = longnose dace, MSU = mountain sucker, WHSU = white sucker,Catchable size is considered >200mm (8 inches).

Sheep SH17.5/AQ1 Fall

RBT	# per section	# per 1000ft	# per mile	Avg # per mile (95% CI)	% of total catch
50-100 mm	40.0	30.0	156	156 (146-166)	53%
100-150mm	29.0	21.8	113.1	113 (109-117)	38%
150-200 mm	4.0	3.0	15.6	16	5%
200-250 mm	3.0	2.3	11.7	12	4%
250-300 mm	0.0	0.0	0	0	0%
>300 mm	0.0	0.0	0	0	0%
total	**78.0**	**58.5**	**304.2**	**304 (280-328)**	**100%**

LOLE	# per section	# per 1000ft	# per mile	Avg # per mile (95% CI)	% of total catch
50-100 mm	9.0	6.8	35.1	35	**45%**
100-150mm	3.0	2.3	11.7	12	**15%**
150-200 mm	6.0	4.5	23.4	24	**30%**
200-250 mm	2.0	1.5	7.8	8	**10%**
250-300 mm	0.0	0.0	0	0	**0%**
>300 mm	0.0	0.0	0	0	**0%**
total	**20.0**	**15.0**	**78**	**78 (78-78)**	**100%**

CTxRBT	# per section	# per 1000ft	# per mile	Avg # per mile (95% CI)	% of total catch
100-150mm	1.0	0.8	3.9	4	20%
150-200 mm	3.0	2.3	11.7	12	60%
200-250 mm	1.0	0.8	3.9	4	20%
total	**5.0**	**3.8**	**19.5**	**20 (20-20)**	100%

MOWH	# per section	# per 1000ft	# per mile	Avg # per mile (95% CI)	% of total catch
50-100 mm	7.0	7.0	36.4	36 (26-46)	87%
100-150mm	0.0	0.0	0	0	0%
150-200 mm	1.0	1.0	5.2	6	13%
200-250 mm	0.0	0.0	0	0	0%
total	**8.0**	**8.0**	**41.6**	**42 (31-52)**	**100%**

Appendix C cont.. Sheep Creek seasonal size-frequency graphs for 2017. EBT = brook trout, RBT = rainbow trout, LOLE = brown trout, CTxRBT= cutthroat-rainbow trout hybrid, WSCT= westslope cutthroat trout, MWF = mountain whitefish, LNDA = longnose dace, MSU = mountain sucker, WHSU = white sucker. Catchable size is considered >200mm (8 inches).

Sheep SH15.5U/AQ10 Fall

RBT	# per section	# per 1000ft	Avg # per mile	Avg # per mile (95% CI)	% of total catch
50-100 mm	1.0	0.8	3.9	4	10%
100-150mm	0.0	0.0	0	0	0%
150-200 mm	3.0	2.3	11.7	12	30%
200-250 mm	3.0	2.3	11.7	12	30%
250-300 mm	3.0	2.3	11.7	12	30%
total	**10.0**	**7.5**	**39**	**39 (31-47)**	**100%**

LOLE	Avg # per section	Avg # per 1000ft	Avg # per mile	Avg # per mile (95% CI)	% of total catch
100-150mm	1.0	0.8	3.9	4	16%
150-200 mm	1.0	0.8	3.9	4	16%
250-300 mm	1.0	0.8	3.9	4	16%
300-350 mm	1.0	0.8	3.9	4	16%
350-400 mm	1.0	0.8	3.9	4	16%
400-450 mm	1.0	0.8	3.9	4	16%
total	**6.0**	**4.5**	**23.4**	**24 (20-28)**	**100%**

MOWH	# per section	# per 1000ft	Avg # per mile	Avg # per mile (95% CI)	% of total catch
100-150mm	1.0	0.8	3.9	4	9%
150-200 mm	1.0	0.8	3.9	4	9%
200-250 mm	2.0	1.5	7.8	8	18%
250-300 mm	2.0	1.5	7.8	8	18%
300-350 mm	3.0	2.3	11.7	12	27%
350-400 mm	2.0	1.5	7.8	8	18%
total	**11.0**	**8.3**	**42.9**	**43 (35-51)**	**100%**

EBT	# per section	# per 1000ft	Avg # per mile	Avg # per mile (95% CI)	% of total catch
50-100 mm	**1.0**	**1.0**	**5.2**	**5**	**100%**

Sheep SH15.5D/AQ11

RBT	Avg # per section	Avg # per 1000ft	Avg # per mile	Avg # per mile (95% CI)	% of total catch
50-100 mm	29.0	21.8	113.1	113 (108-118	30%
100-150mm	39.0	29.3	152.1	152 (143-162)	41%
150-200 mm	13.0	9.8	50.7	51	15%
200-250 mm	12.0	9.0	46.8	47	13%
250-300 mm	1.0	0.8	3.9	4	1%
300-350 mm	0.0	0.0	0	0	0%
total	**95.0**	**71.3**	**370.5**	**371 (363-378)**	**100%**

LOLE	# per section	# per 1000ft	# per mile	Avg # per mile (95% CI)	% of total catch
100-150mm	1.0	0.8	3.9	4	25%
150-200 mm	2.0	1.5	7.8	8	50%
200-250 mm	0.0	0.0	0	0	0%
250-300 mm	0.0	0.0	0	0	0%
300-350 mm	0.0	0.0	0	0	0%
350-400 mm	0.0	0.0	0	0	0%
400-450 mm	1.0	0.8	3.9	4	25%
total	**4.0**	**3.0**	**15.6**	**16 (8-24)**	**100%**

MOWH	Avg # per section	Avg # per 1000ft	Avg # per mile	Avg # per mile (95% CI)	% of total catch
50-100 mm	9.0	6.8	35.1	35 (31-39)	43%
100-150mm	4.0	3.0	15.6	16	19%
150-200 mm	0.0	0.0	0	0	0%
200-250 mm	1.0	0.8	3.9	4	5%
250-300 mm	0.0	0.0	0	0	0%
300-350 mm	7.0	5.3	27.3	27	33%
total	**21.0**	**15.8**	**81.9**	**82 (82-82)**	**100%**

Brook Trout	# per section	# per 1000ft	# per mile	Avg # per mile (95% CI)	% of total catch
50-100 mm	2.0	1.5	7.8	8	40%
100-150mm	1.0	0.8	3.9	4	20%
150-200 mm	2.0	1.5	7.8	8	40%
200-250 mm	0.0	0.0	0	0	0%
250-300 mm	0.0	0.0	0	0	0%
300-350 mm	0.0	0.0	0	0	0%
total	**5.0**	**3.8**	**19.5**	**20 (20-20)**	**100%**

LODA	# per section	# per 1000ft	# per mile	Avg # per mile (95% CI)	% of total catch
50-100 mm	5.0	3.8	19.5	20 (17-23)	33%
100-150mm	10.0	7.5	39	39	67%
150-200 mm	0.0	0.0	0	0	0%
total	**15.0**	**11.3**	**58.5**	**59 (55-63)**	**100%**

Appendix C cont.. Tenderfoot Creek seasonal size-frequency graphs for 2017. EBT = brook trout, RBT = rainbow trout, LOLE = brown trout, CTxRBT= cutthroat-rainbow trout hybrid, WSCT= westslope cutthroat trout, MWF = mountain whitefish, LNDA = longnose dace, MSU = mountain sucker, WHSU = white sucker. Catchable size is considered >200mm (8 inches).

Tenderfoot TN9.4/AQ6 Fall

RBT	# per section	# per 1000ft	# per mile	Avg # per mile (95% CI)	% of total catch
50-100 mm	16.0	12.0	62.4	63 (53-74)	22%
100-150mm	21.0	15.8	81.9	82 (75-89)	28%
150-200 mm	22.0	16.5	85.8	86 (78-94)	30%
200-250 mm	11.0	8.3	42.9	43	15%
250-300 mm	3.0	2.3	11.7	12	4%
300-350 mm	1.0	0.8	3.9	4	1%
total	**74.0**	**55.5**	**288.6**	**289 (277-308)**	**100%**

CT x RBT Hybrid	# per section	# per 1000ft	# per mile	Avg # per mile (95% CI)	% of total catch
50-100 mm	7.0	5.3	27.3	28	11%
100-150mm	22.0	16.5	85.8	86 (76-96)	36%
150-200 mm	20.0	15.0	78	78	33%
200-250 mm	12.0	9.0	46.8	47	20%
250-300 mm	0.0	0.0	0	0	0%
total	**61.0**	**45.8**	**237.9**	**238 (234-242)**	**100%**

Brook Trout	# per section	# per 1000ft	# per mile	Avg # per mile (95% CI)	% of total catch
50-100 mm	1.0	0.8	3.9	4	13%
100-150mm	2.0	1.5	7.8	7	25%
150-200 mm	3.0	2.3	11.7	12	38%
200-250 mm	2.0	1.5	7.8	8	25%
total	**8.0**	**6.0**	**31.2**	**31 (27-35)**	**100%**

Appendix C. Moose and Little Sheep Creek seasonal size-frequency graphs for 2017. EBT = brook trout, RBT = rainbow trout, LOLE = brown trout, CTxRBT= cutthroat-rainbow trout hybrid, WSCT= westslope cutthroat trout, MWF = mountain whitefish, LNDA = longnose dace, MSU = mountain sucker, WHSU = white sucker,Catchable size is considered >200mm (8 inches).

Moose Creek MO.1 (Fall)

Rainbow Trout	# per section	# per 1000ft	# per mile	Avg # per mile (95% CI)	% of total catch
50-100 mm	22.0	31.7	164.7	165 (157-172)	38%
100-150mm	13.0	18.7	97.3	97.3	22%
150-200 mm	16.0	23.0	119.8	119.8	28%
200-250 mm	7.0	10.1	52.4	52.4	12%
total	58.0	83.5	434.3	434 (427-442)	100%
CT x RBT Hybrid	**# per section**	**# per 1000ft**	**# per mile**	**Avg # per mile (95% CI)**	**% of total catch**
50-100 mm	13.0	18.7	97.3	104 (67-142)	50%
100-150mm	4.0	5.8	30.0	30	15%
150-200 mm	4.0	5.8	30.0	30	15%
200-250 mm	4.0	5.8	30.0	30	15%
250-300 mm	1.0	1.4	7.5	8	4%
total	26.0	37.4	194.7	195 (172-232)	100%
Brook Trout	**# per section**	**# per 1000ft**	**# per mile**	**Avg # per mile (95% CI)**	**% of total catch**
50-100 mm	13.0	18.7	97	97 (83-111)	27%
100-150mm	16.0	23.0	119	119 (112-127)	33%
150-200 mm	12.0	17.3	90	114 (104-125)	25%
200-250 mm	4.0	5.8	30	57	8%
250-300 mm	2.0	2.9	15	15	4%
250-300 mm	1.0	1.4	7.5	7.5	2%
total	48.0	69.1	359.5	360 (345-375)	100%

Little Sheep LS.1 Fall

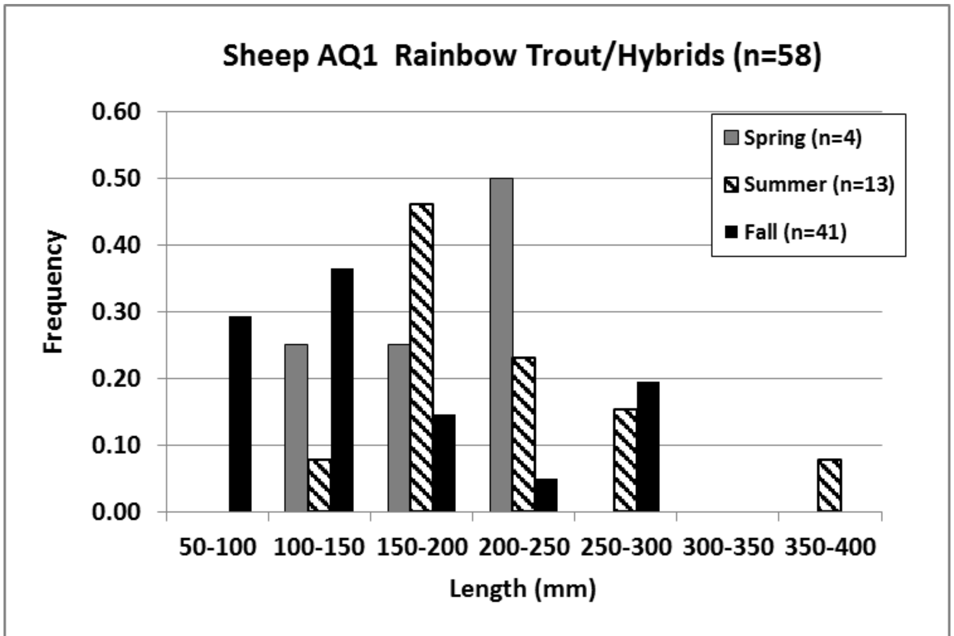
Brook Trout	# per section	# per 1000ft	# per mile	Avg # per mile (95% CI)	% of total catch
50-100 mm	62.0	124.0	644.8	645 (635-655)	45%
100-150mm	9.0	18.0	93.6	94	6%
150-200 mm	49.0	98.0	509.6	510 (500-520)	35%
200-250 mm	17.0	34.0	176.8	177	12%
250-300 mm	2.0	4.0	20.8	21	1%
>300 mm	0.0	0.0	0	0	0%
total	**139.0**	**278.0**	**1445.6**	**1,446 (1435-1456)**	**100%**

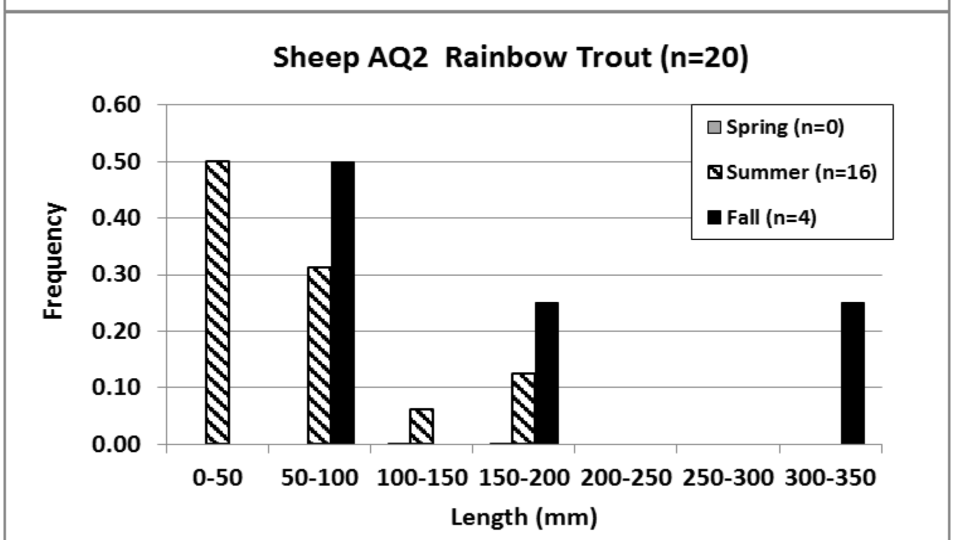
Appendix C. Seasonal salmonid size-frequency tables for fall 2017. Catchable size is considered >200mm (8 inches).

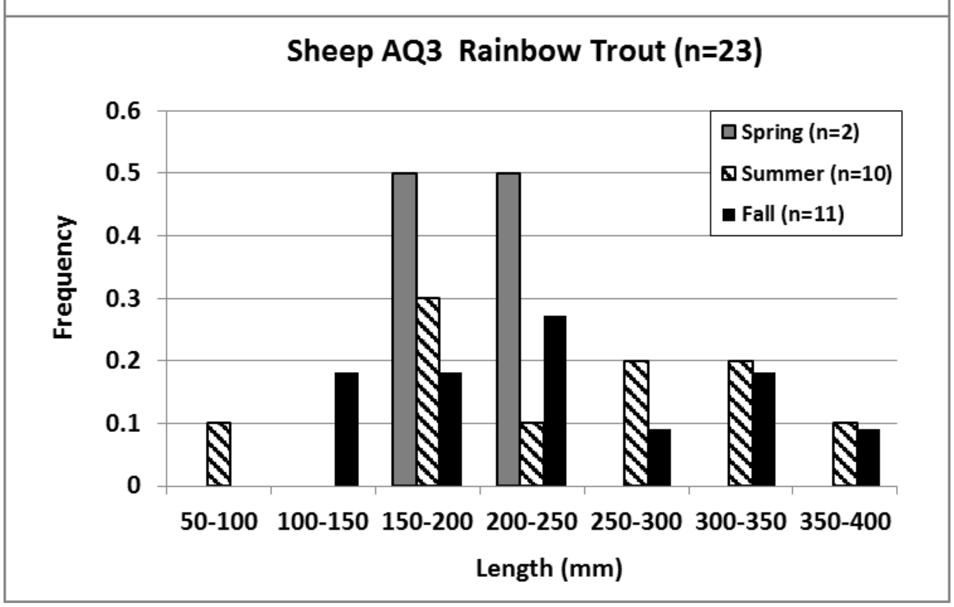
Little Sheep LS.1 Fall

Brown Trout	# per section	# per 1000ft	# per mile	Avg # per mile (95% CI)	% of total catch
50-100 mm	3.0	6.0	31.2	31 (31-31)	75%
100-150mm	1.0	2.0	10.4	11	25%
150-200 mm	0.0	0.0	0	0	0%
total	**4.0**	**8.0**	**41.6**	**42**	**100%**
MOWH	**# per section**	**# per 1000ft**	**# per mile**	**Avg # per mile (95% CI)**	**% of total catch**
50-100 mm	6.0	12.0	62.4	63	100%
100-150mm	0.0	0.0	0	0	0%
150-200 mm	0.0	0.0	0	0	0%
total	**6.0**	**12.0**	**62.4**	**63**	**100%**
WHSU	**# per section**	**# per 1000ft**	**# per mile**	**Avg # per mile (95% CI)**	**% of total catch**
50-100 mm	1.0	2.0	10.4	11	20%
100-150mm	3.0	6.0	31.2	31	60%
150-200 mm	1.0	2.0	10.4	10	20%
total	**5.0**	**10.0**	**52**	**52**	**100%**

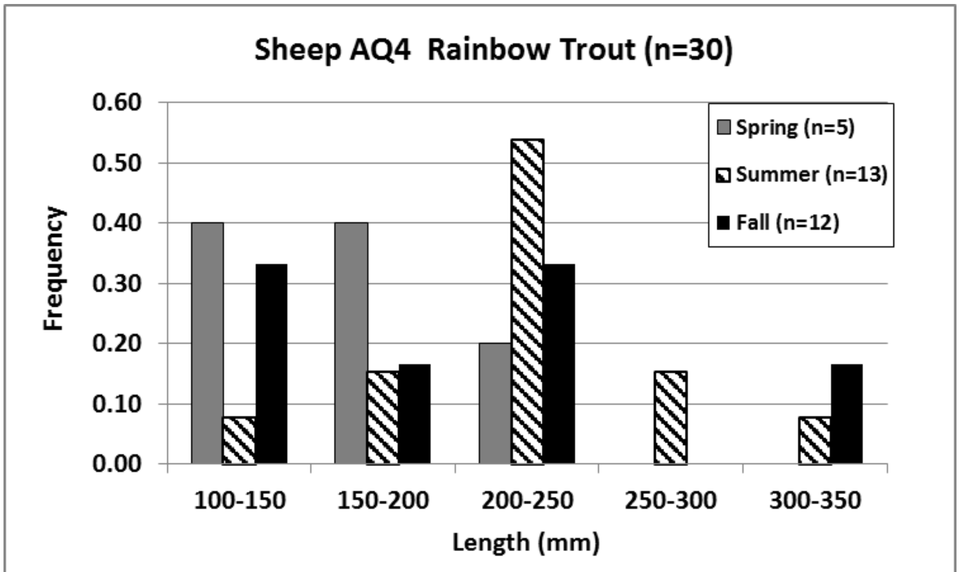
Appendix C. Sheep Creek seasonal Rainbow trout (RBTR) size-frequency graphs for 2016. Catchable size is considered >200mm (8 inches).

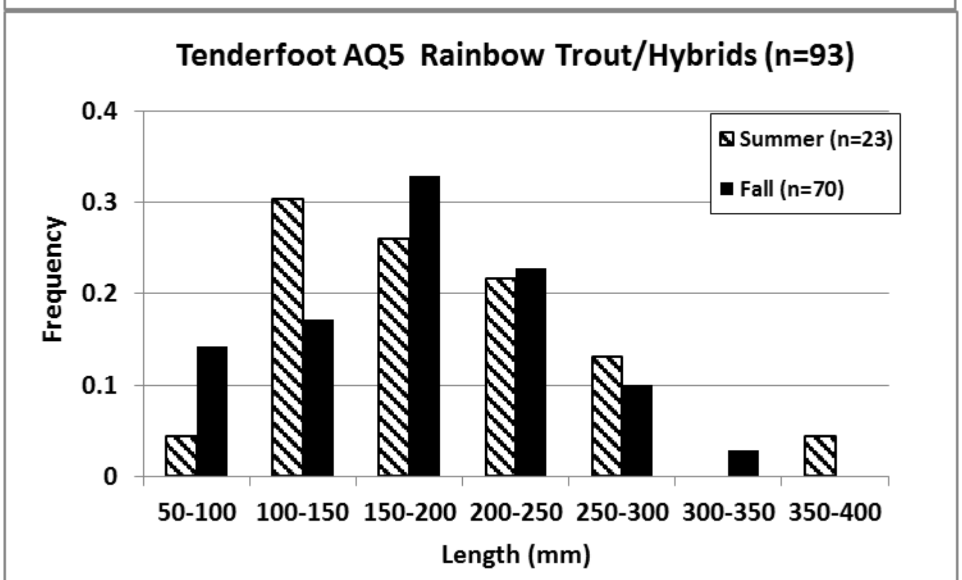


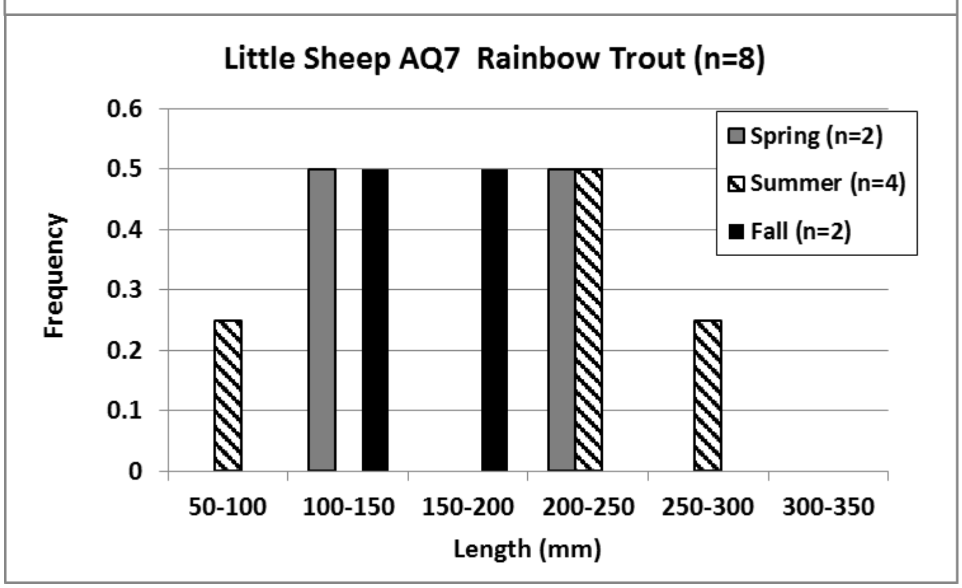




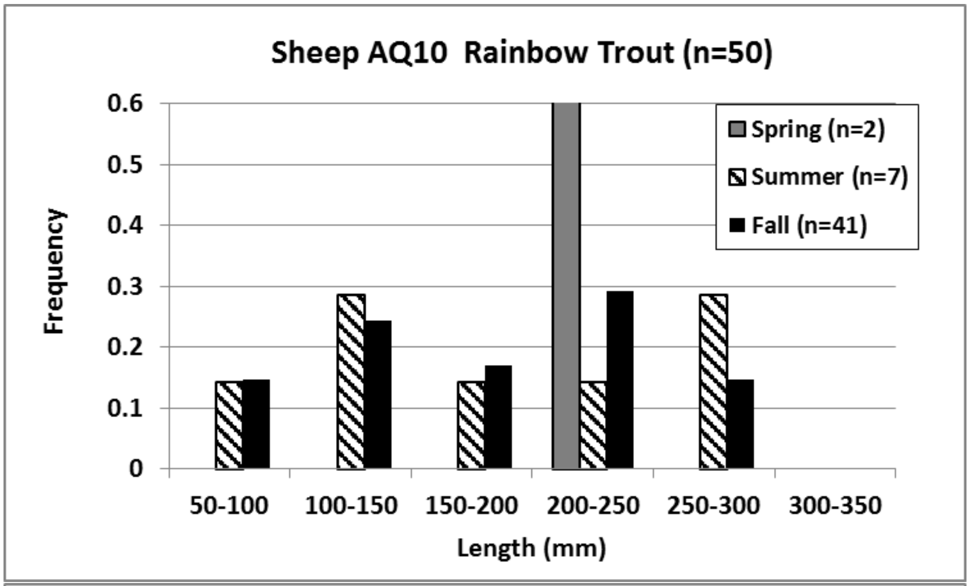
Appendix C. Sheep Creek seasonal rainbow trout (RBTR) size-frequency graphs for 2016. Catchable size is considered >200mm (8 inches).

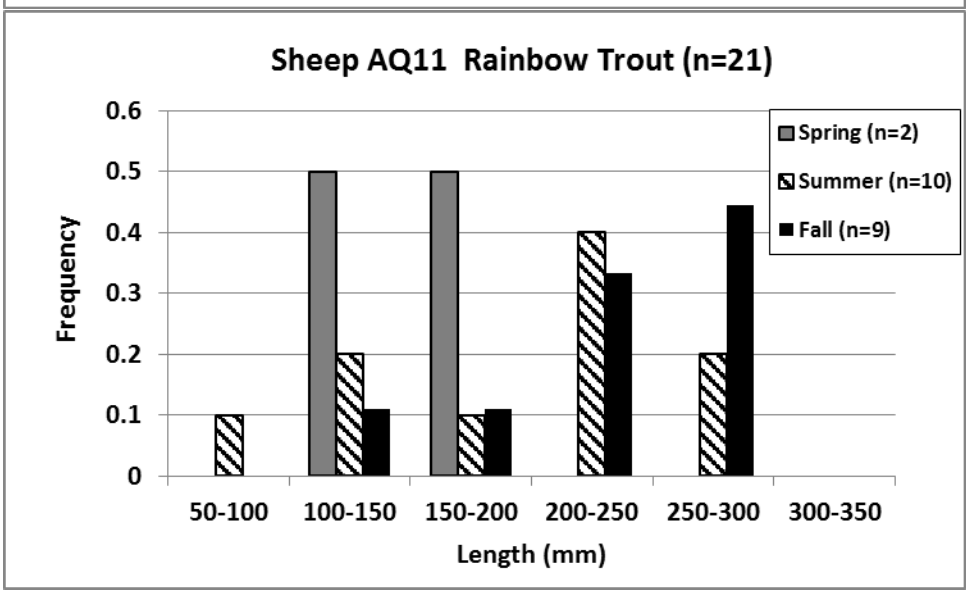




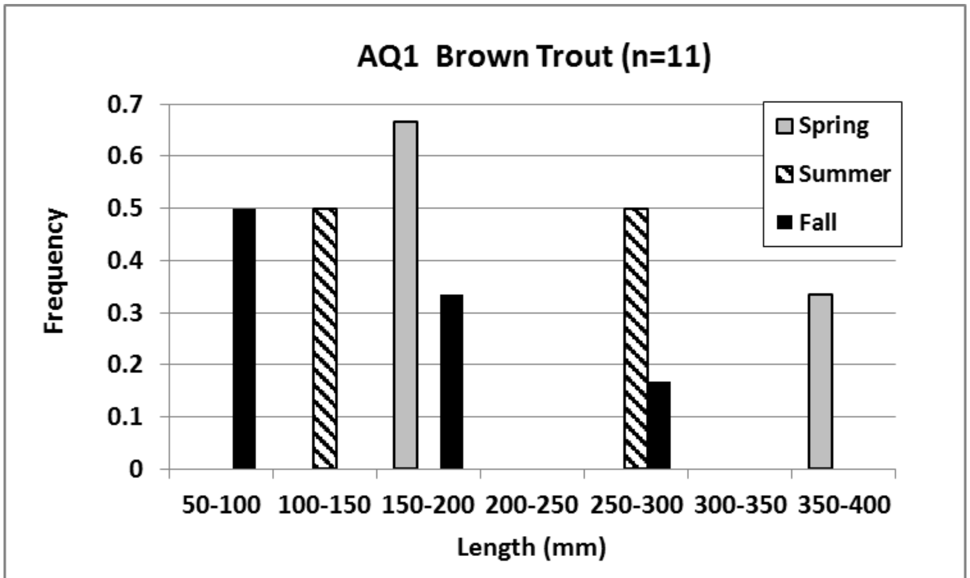


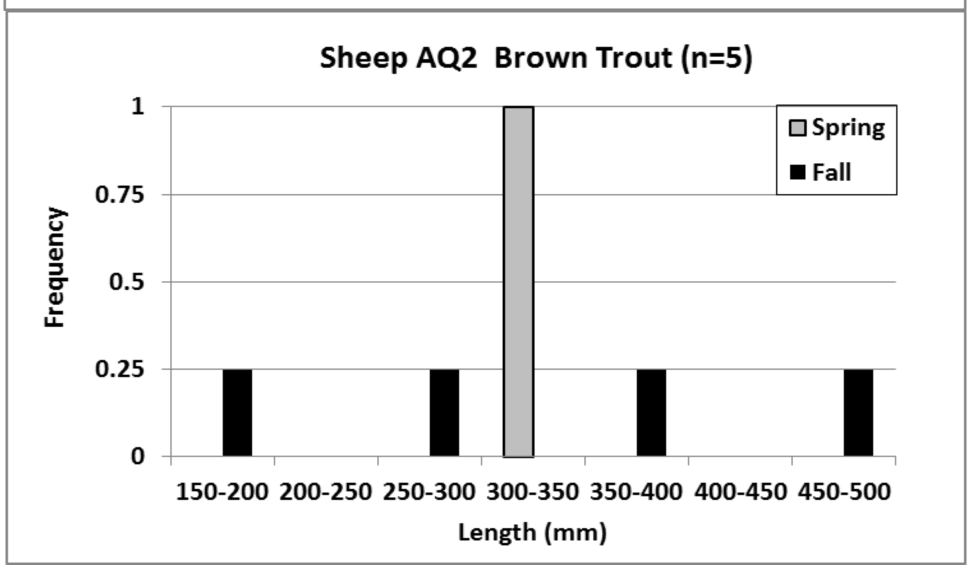
Appendix C. Sheep Creek seasonal rainbow trout (RBTR) size-frequency graphs for 2016. Catchable size is considered >200mm (8 inches).

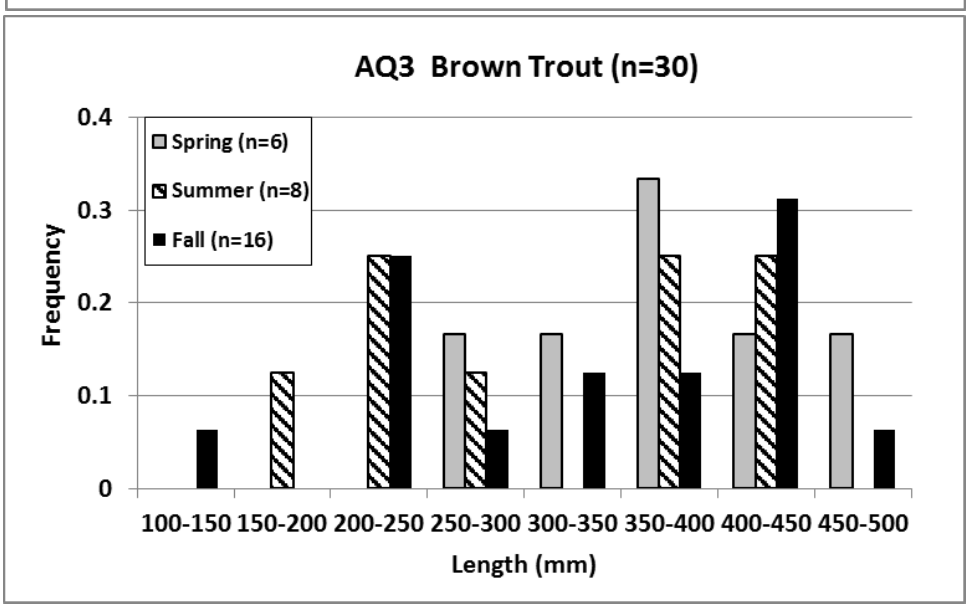




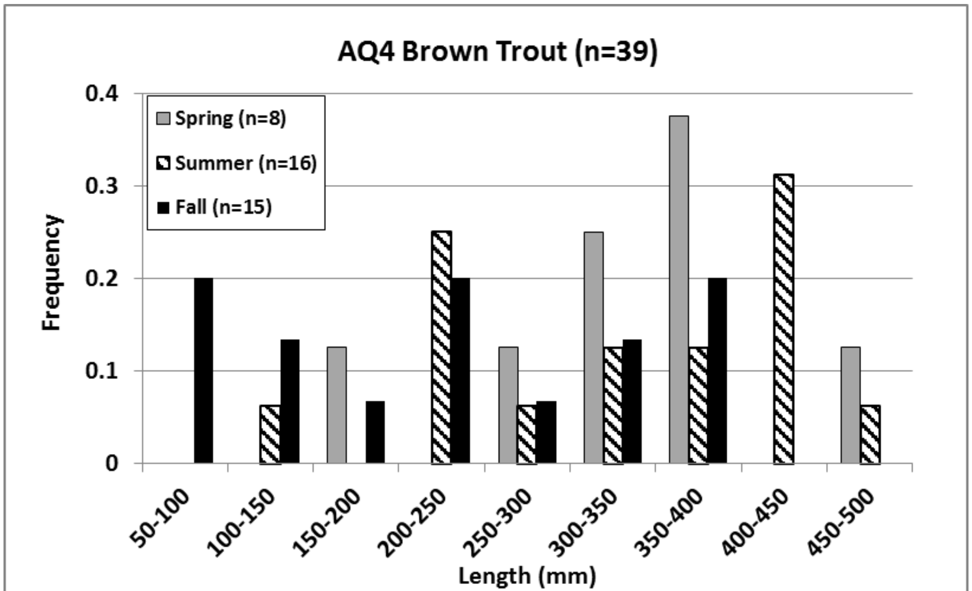
Appendix C. Sheep Creek seasonal Brown trout (LOLE) size-frequency graphs for 2016. Catchable size is considered >200mm (8 inches).

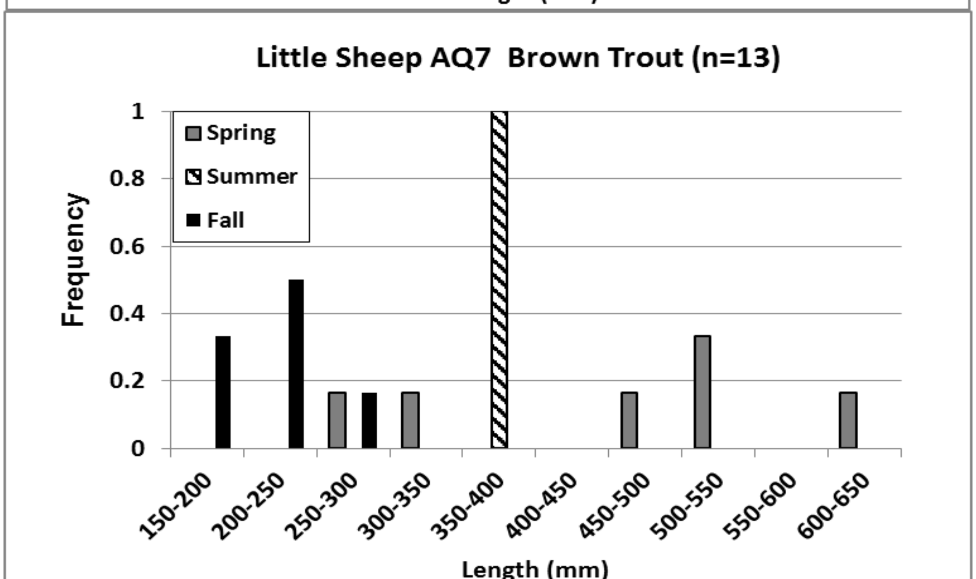


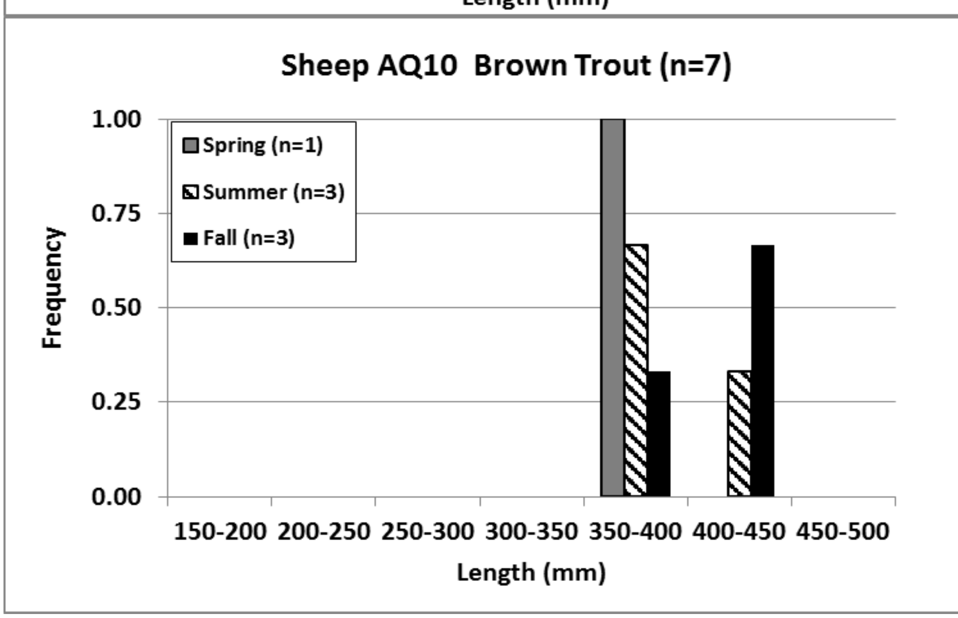




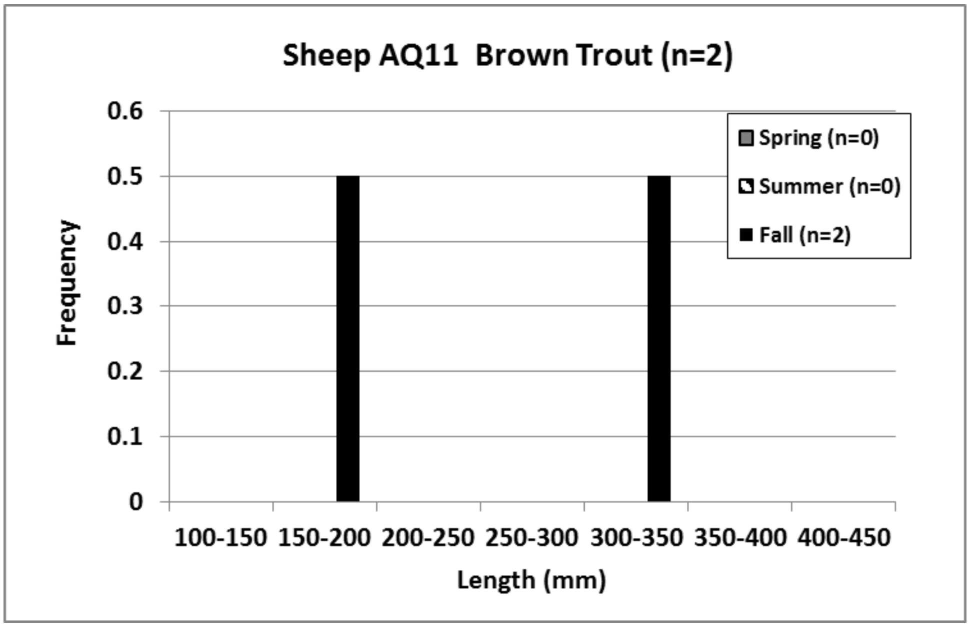
Appendix C. Sheep Creek seasonal Brown trout (LOLE) size-frequency graphs for 2016. Catchable size is considered >200mm (8 inches)



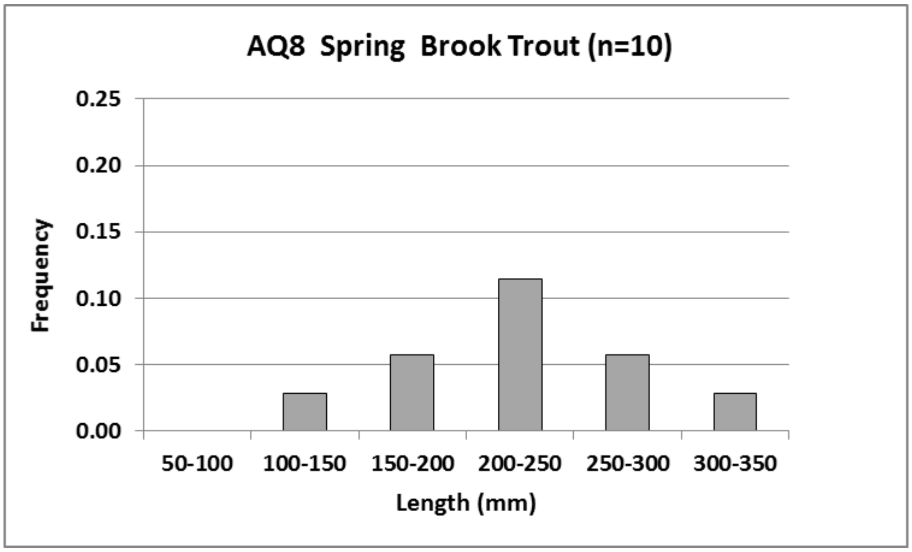


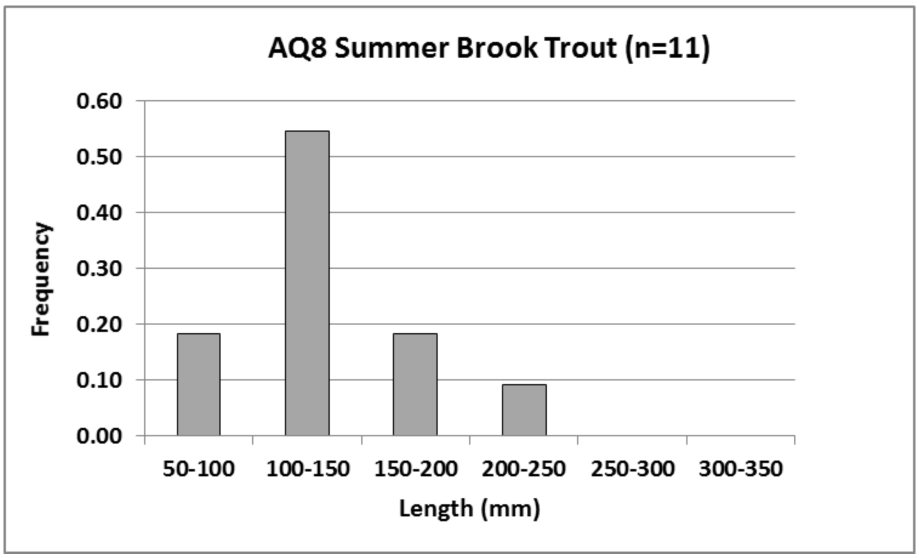


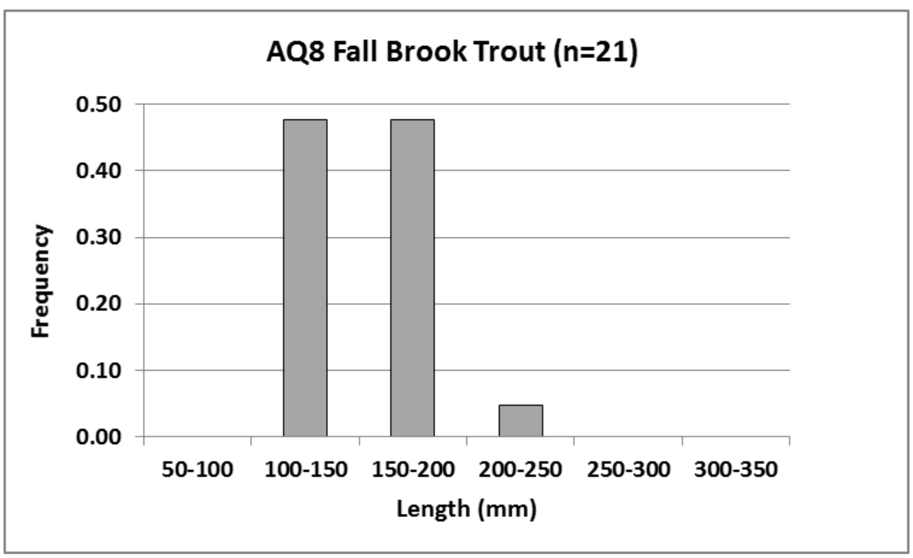
Appendix C. Sheep Creek seasonal Brown trout (LOLE) size-frequency graphs for 2016. Catchable size is considered >200mm (8 inches)



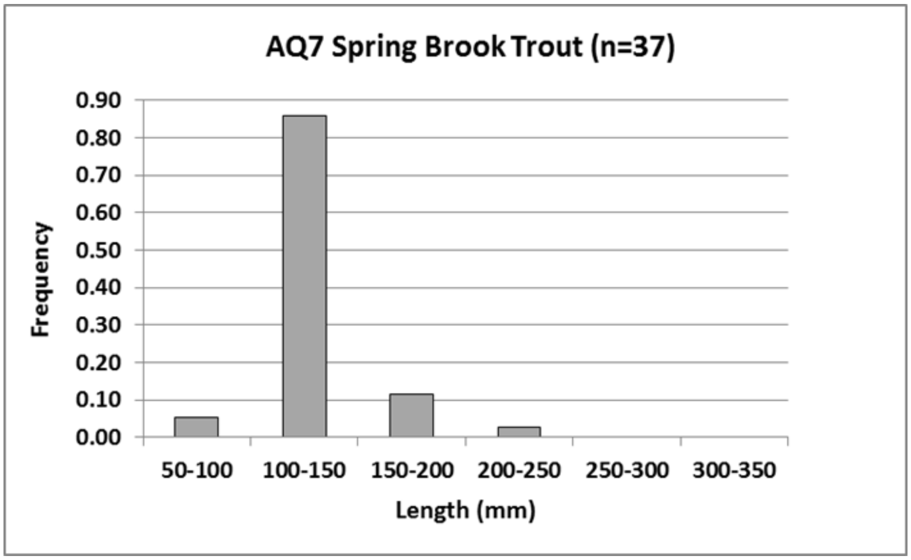
Appendix C. Little Sheep Creek seasonal Brook trout (EBT) size-frequency graphs for 2016

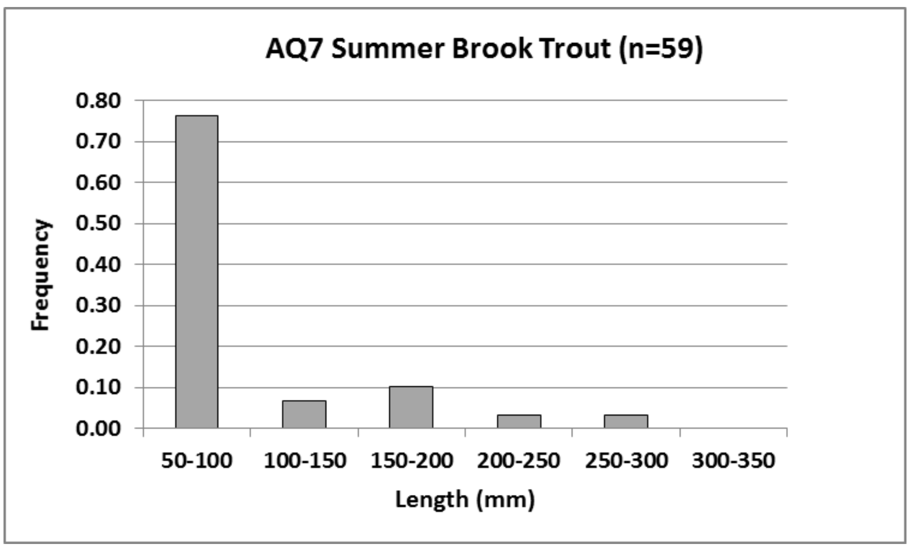


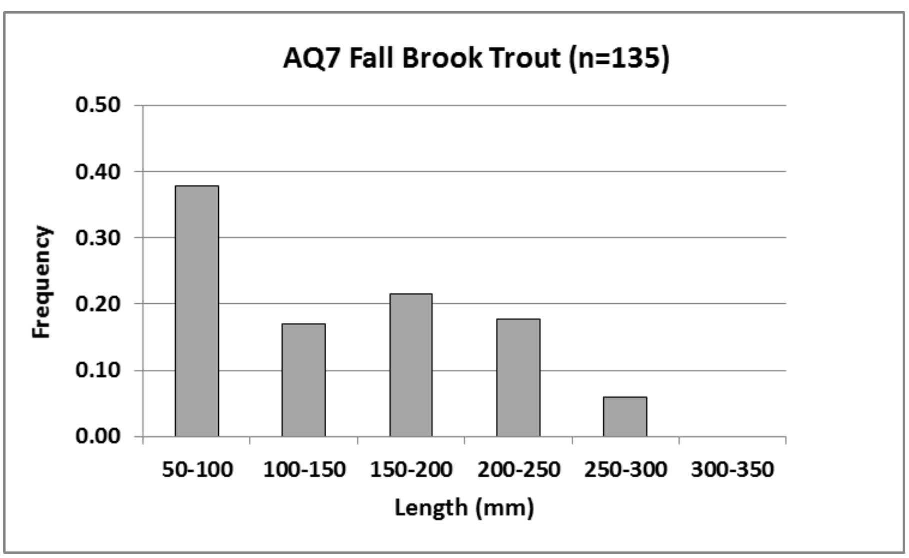




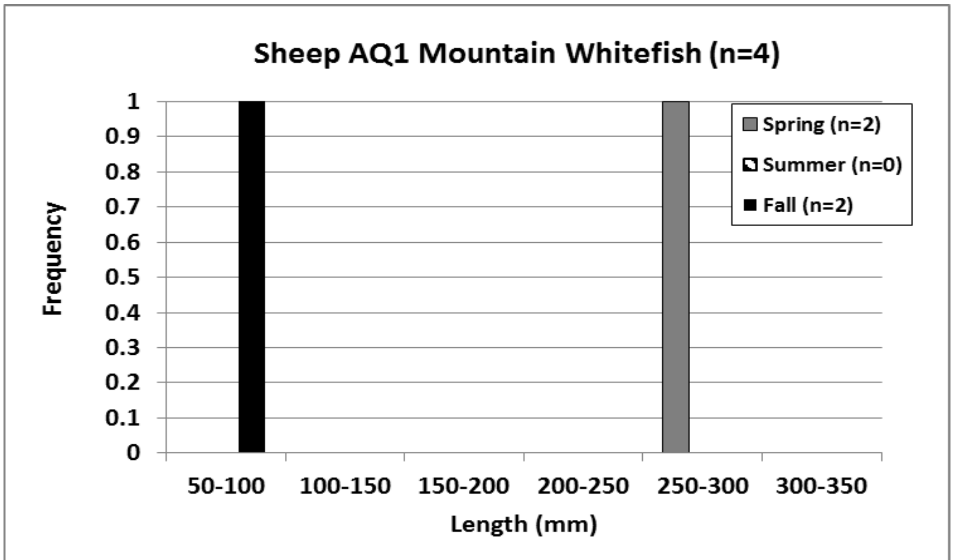
Appendix C. Little Sheep Creek seasonal Brook trout (EBT) size-frequency graphs for 2016

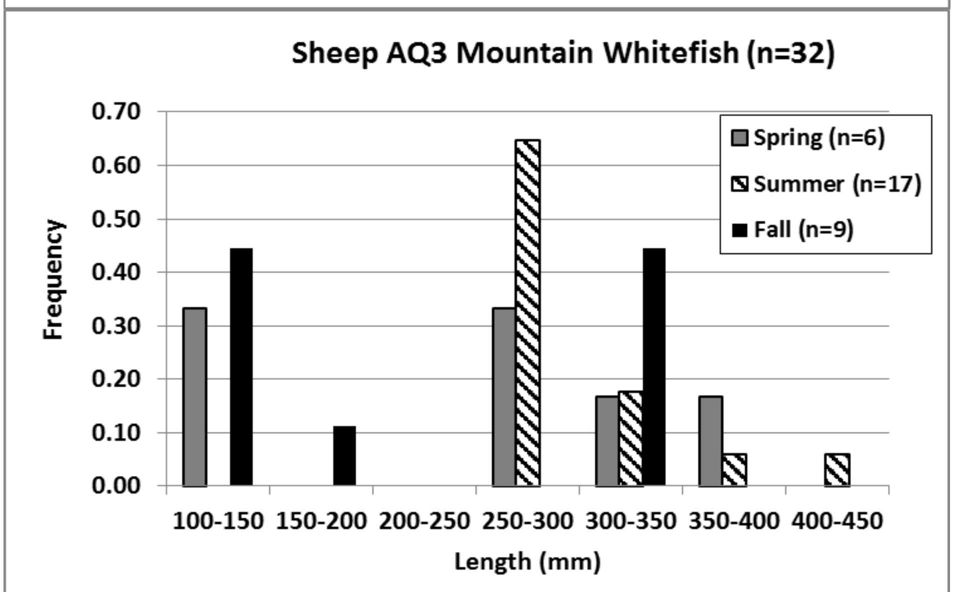


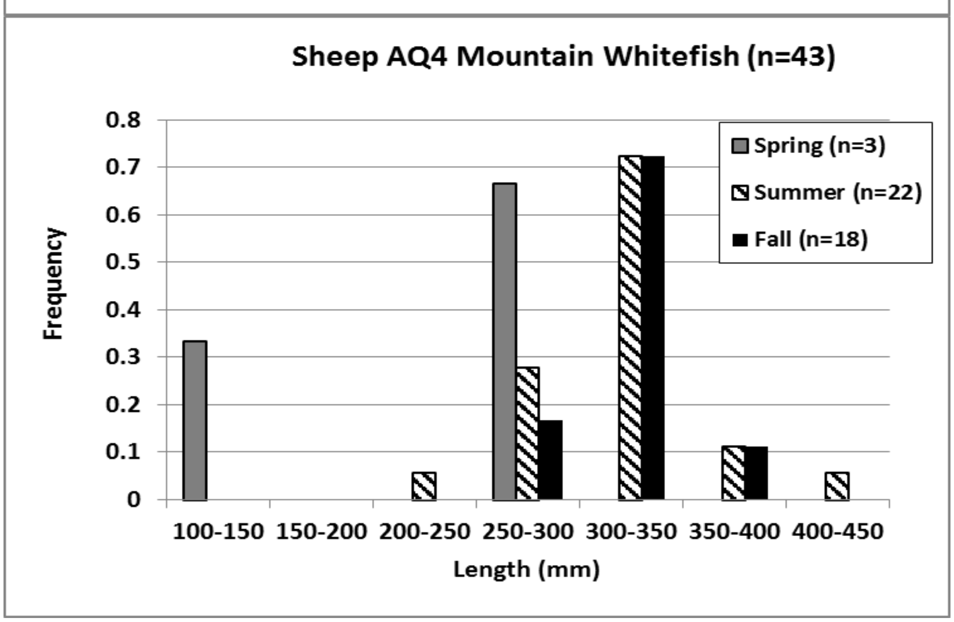




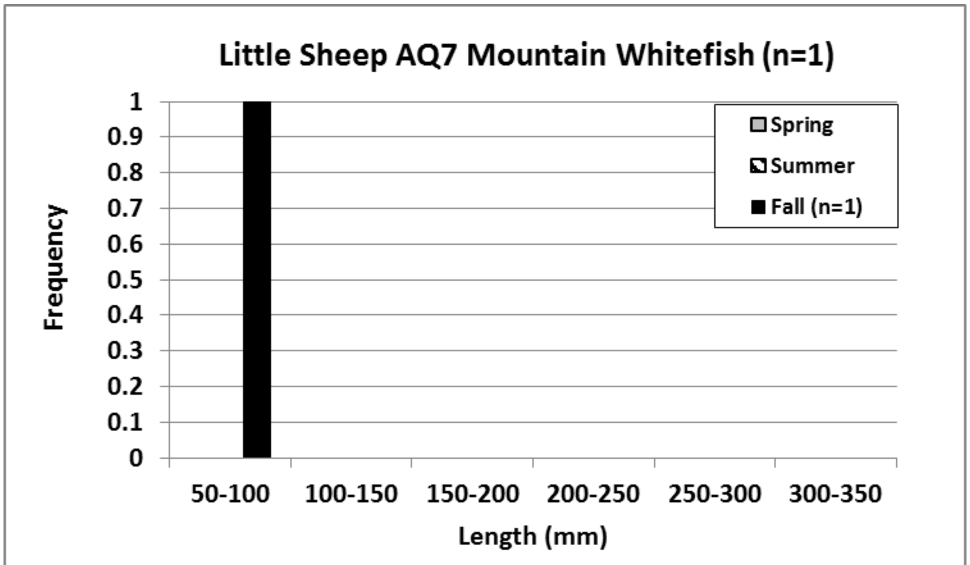
Appendix C. Sheep Creek seasonal Mountain Whitefish (MOWH) size-frequency graphs for 2016. Catchable size is considered >200mm (8 inches).

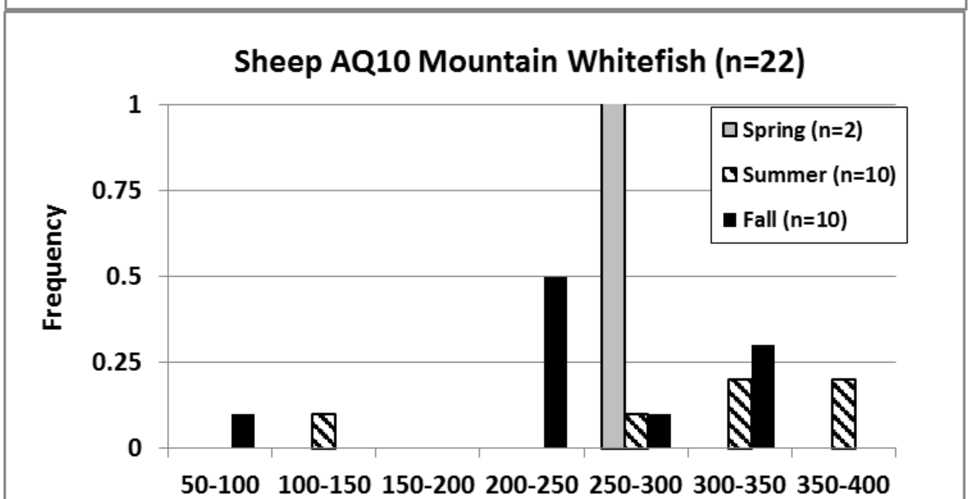


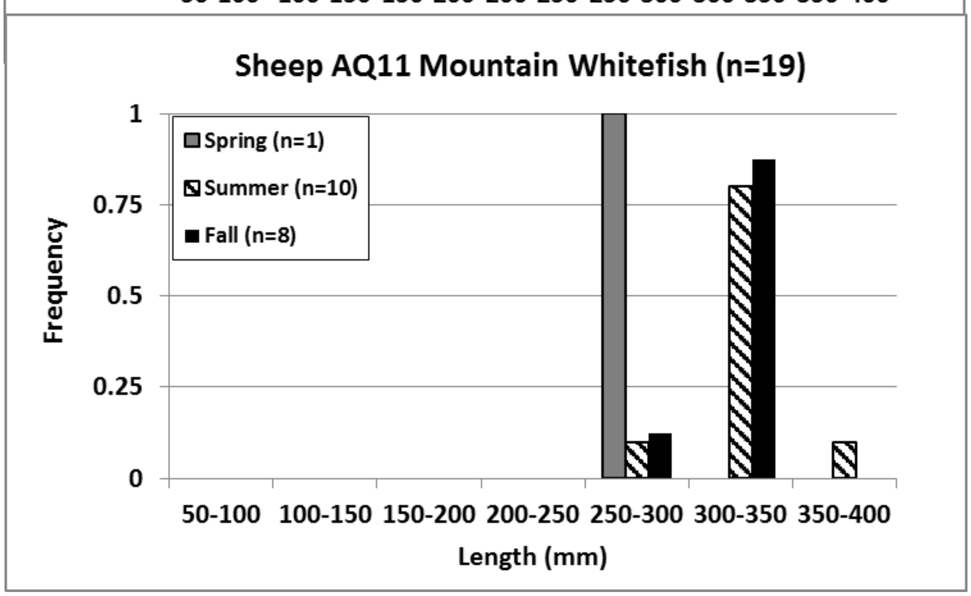




Appendix C. Sheep Creek seasonal Mountain Whitefish (MOWH) size-frequency graphs for 2016. Catchable size is considered >200mm (8 inches)







Pages extracted from:

Stagliano, D. 2019. Aquatic Monitoring Plan and Assessment Summary for Streams in the Tintina Black Butte Copper Project Area of Meagher County, MT 2014-2018. Prepared for Tintina Montana, Inc., White Sulphur Springs, Montana. Montana Biological Survey, Helena, Montana. April 2019.

Appendix C. Summer salmonid size-frequency tables for 2018. EBT = brook trout, RBT = rainbow trout, LOLE = brown trout, CTxRBT= cutthroat-rainbow trout hybrid, WSCT= westslope cutthroat trout, MWF = mountain whitefish, LNDA = longnose dace, MSU = mountain sucker, WHSU = white sucker. Catchable size is considered >200mm (8 inches).

Sheep SH.22.7/AQ2 Summer

EBT	# per section	# per 1000ft	# per mile	Petersen Pop. Est. # per mile (95% CI)	% of total catch
50-100 mm	0.0	0.0	0.0	0	0%
100-150mm	0.0	0.0	0.0	0	0%
150-200 mm	1.0	0.8	4.0	14	25%
200-250 mm	2.0	1.5	7.9	20	50%
300-350 mm	1.0	0.8	4.0	14	25%
total	**4.0**	**3.0**	**15.8**	**48 (36-60)**	**100%**

LOLE	Avg # per section	Avg # per 1000ft	Avg # per mile	Avg # per mile (95% CI)	% of total catch
400-450 mm	1.0	1.5	7.8	8	100%

RBT	# per section	# per 1000ft	# per mile	Petersen Pop. Est. # per mile (95% CI)	% of total catch
<50mm	**2.0**	1.5	7.9	24	25%
50-100 mm	1.0	0.8	4.0	12	12%
100-150mm	1.0	0.8	4.0	12	12%
150-200 mm	2.0	1.5	7.9	24	25%
200-250 mm	0.0	0.0	0.0	0	0%
250-300 mm	2.0	1.5	7.9	24	25%
total	**8.0**	**6.1**	**32**	**96 (78-114)**	**100%**

Sheep SH.19.2/AQ3 Summer

LOLE	# per section	# per 1000ft	# per mile	Petersen Pop. Est. # per mile (95% CI)	% of total catch
100-150mm	4.0	2.7	13.9	21	18%
150-200 mm	2.0	1.3	7.0	10	8%
200-250 mm	4.0	2.7	13.9	21	18%
250-300 mm	5.0	3.4	17.4	26	22%
300-350 mm	1.0	0.7	3.5	5	4%
350-400 mm	1.0	0.7	3.5	5	4%
400-450 mm	4.0	2.7	13.9	21	18%
450-500 mm	2.0	1.3	7.0	10	8%
total	**23.0**	**15.4**	**80.1**	**119 (110-130)**	**100%**

Sheep SH.19. 2/AQ3 Summer (cont.)

EBT	# per section	# per 1000ft	# per mile	Petersen Pop. Est. # per mile (95% CI)	% of total catch
100-150mm	1.0	0.7	3.5	5	19%
150-200 mm	1.0	0.7	3.5	5	19%
200-250 mm	3.0	2.0	10.5	16	62%
250-300 mm	0.0	0.0	0.0	0	0%
total	**5.0**	**3.4**	**17.4**	**26 (21-31)**	**100%**

RBT	# per section	# per 1000ft	# per mile	Petersen Pop. Est. # per mile (95% CI)	% of total catch
100-150mm	1.0	0.7	3.5	7	15%
150-200 mm	1.0	0.7	3.5	7	15%
200-250 mm	2.0	1.3	7.0	15	32%
250-300 mm	5.0	3.4	17.4	35	74%
300-350 mm	0.0	0.0	0.0	0	0%
total	**9.0**	**6.0**	**31.4**	**64 (32-96)**	**100%**

MOWH	# per section	# per 1000ft	# per mile	Petersen Pop. Est. # per mile (95% CI)	% of total catch
200-250 mm	1.0	0.7	3.5	5	14%
250-300 mm	0.0	0.0	0.0	0	0%
300-350 mm	5.0	3.4	17.4	26	72%
350-400 mm	1.0	0.7	3.5	5	14%
total	**7.0**	**4.7**	**24.4**	**50 (46-54)**	**100%**

WHSU	# per section	# per 1000ft	# per mile	Petersen Pop. Est. # per mile (95% CI)	% of total catch
250-300 mm	2.0	1.3	7.0	10	50%
350-400 mm	1.0	0.7	3.5	5.2	25%
400-450 mm	1.0	0.7	3.5	5.2	25%
total	**4.0**	**2.7**	**13.9**	**21 (21-21)**	**100%**

Sheep SH.18.3/AQ4 Summer

LOLE	# per section	# per 1000ft	# per mile	Petersen Pop. Est. # per mile (95% CI)	% of total catch
100-150mm	1.0	0.7	3.5	7	8%
150-200 mm	2.0	1.3	7.0	18	21%
200-250 mm	1.0	0.7	3.5	7	8%
250-300 mm	1.0	0.7	3.5	7	8%
300-350 mm	1.0	0.7	3.5	7	8%
350-400 mm	1.0	0.7	3.5	7	8%
400-450 mm	3.0	2.0	10.5	24	29%
450-500 mm	1.0	0.7	3.5	7	8%
total	**11.0**	**7.4**	**38.3**	**84 (66-102)**	**100%**

Appendix C. Summer salmonid size-frequency tables for 2018. EBT = brook trout, RBT = rainbow trout, LOLE = brown trout, CTxRBT= cutthroat-rainbow trout hybrid, WSCT= westslope cutthroat trout, MWF = mountain whitefish, LNDA = longnose dace, MSU = mountain sucker, WHSU = white sucker,Catchable size is considered >200mm (8 inches).

Sheep SH.18.3/AQ4 Summer (cont.)

RBTR	# per section	# per 1000ft	# per mile	Petersen Pop. Est. # per mile (95% CI)	% of total catch
50-100 mm	0.0	0.0	0.0	0	0%
100-150mm	0.0	0.0	0.0	0	0%
150-200 mm	2.0	1.3	7.0	8	22%
200-250 mm	3.0	2.0	10.5	14	39%
250-300 mm	1.0	0.7	3.5	7	19%
300-350 mm	1.0	0.7	3.5	7	19%
total	**7.0**	**4.7**	**24.4**	**36 (24-58)**	**100%**

MOWH	# per section	# per 1000ft	# per mile	Pop Est. Peterson per mile (95% CI)	% of total catch
150-200 mm	0.0	0.0	0.0	0	0%
200-250 mm	0.0	0.0	0.0	0	0%
250-300 mm	3.0	2.0	10.5	15	21%
300-350 mm	8.0	5.4	27.9	31	43%
350-400 mm	4.0	2.7	13.9	20	28%
350-400 mm	1.0	0.7	3.5	6	8%
total	**16.0**	**10.7**	**55.7**	**72 (60-84)**	**100%**

EBT	# per section	# per 1000ft	# per mile	Petersen Pop. Est. # per mile (95% CI)	% of total catch
100-150mm	0.0	0.0	0.0	0	0%
150-200 mm	0.0	0.0	0.0	0	0%
200-250 mm	1.0	0.7	3.5	8	50%
250-300 mm	1.0	0.7	3.5	8	50%
total	**2.0**	**1.3**	**7.0**	**16 (8-24)**	**100%**

Sheep SH17.5/AQ1 Summer

LOLE	# per section	# per 1000ft	# per mile	Petersen Pop. Est. # per mile (95% CI)	% of total catch
50-100 mm	0.0	0.0	0.0	0	0%
100-150mm	8.0	5.4	27.9	41	65%
150-200 mm	3.0	2.0	10.5	15	24%
200-250 mm	1.0	0.7	3.5	7	11%
250-300 mm	0.0	0.0	0.0	0	0%
300-350 mm	0.0	0.0	0.0	0	0%
total	**10.0**	**6.7**	**34.8**	**63 (56-70)**	**100%**

Appendix C. Summer salmonid size-frequency tables for 2018. EBT = brook trout, RBT = rainbow trout, LOLE = brown trout, CTxRBT= cutthroat-rainbow trout hybrid, WSCT= westslope cutthroat trout, MWF = mountain whitefish, LNDA = longnose dace, MSU = mountain sucker, WHSU = white sucker. Catchable size is considered >200mm (8 inches).

Sheep SH17.5/AQ1 Summer (cont.)

EBT	# per section	# per 1000ft	# per mile	Petersen Pop. Est. # per mile (95% CI)	% of total catch
50-100 mm	0.0	0.0	0.0	0	0%
100-150mm	2.0	1.5	7.9	8	66%
150-200 mm	0.0	0.0	0.0	0	0%
200-250 mm	1.0	0.8	4.0	4	33%
300-350 mm	0.0	0.0	0.0	0	0%
total	**3.0**	**2.3**	**11.9**	**12 (6-18)**	**100%**

RBT	# per section	# per 1000ft	# per mile	Petersen Pop. Est. # per mile (95% CI)	% of total catch
50-100 mm	1.0	0.7	3.5	7	3%
100-150mm	14.0	9.4	48.8	98	44%
150-200 mm	12.0	8.0	41.8	83	37%
200-250 mm	4.0	2.7	13.9	29	13%
250-300 mm	1.0	0.7	3.5	7	3%
300-350 mm	0.0	0.0	0.0	0	0%
total	**32.0**	**21.4**	**111.5**	**224 (170-274)**	**100%**

MOWH	# per section	# per 1000ft	# per mile	Petersen Pop. Est. # per mile (95% CI)	% of total catch
100-150 mm	2.0	1.3	7.0	7	50%
150-200 mm	0.0	0.0	0.0	0	0%
250-300 mm	2.0	1.3	7.0	7	50%
total	**4.0**	**2.7**	**13.9**	**14 (10-18)**	**100%**

Tenderfoot Creek TN.9.3/AQ5 Summer

RBT	# per section	# per 1000ft	# per mile	# per mile (95% CI)	% of total catch
50-100 mm	1.0	1.0	5.2	5.2	10%
100-150mm	1.0	1.0	5.2	5.2	10%
150-200 mm	8.0	8.0	41.6	46.8	80%
200-250 mm	0.0	0.0	0	0	0%
250-300 mm	0.0	0.0	0	0	0%
total	**10.0**	**10.0**	**52**	**52 (47-57)**	**100%**

Appendix C. Summer salmonid size-frequency tables for 2018. EBT = brook trout, RBT = rainbow trout, LOLE = brown trout, CTxRBT= cutthroat-rainbow trout hybrid, WSCT= westslope cutthroat trout, MWF = mountain whitefish, LNDA = longnose dace, MSU = mountain sucker, WHSU = white sucker. Catchable size is considered >200mm (8 inches).

Tenderfoot TN.9.3/AQ5 Summer (cont.)

CTxRBT	Avg # per section	Avg # per 1000ft	Avg # per mile	Avg # per mile (95% CI)	% of total catch
50-100 mm	1.0	1.0	5.2	5.2	16%
100-150mm	1.0	1.0	5.2	5.2	16%
150-200 mm	4.0	4.0	20.8	20.8	65%
200-250 mm	0.0	0.0	0	0	0%
250-300 mm	0.0	0.0	0	0	0%
>300 mm	0.0	0.0	0	0	0%
total	**6.0**	**6.0**	**31.2**	**32 (32-32)**	**100%**

WSCT	Avg # per section	Avg # per 1000ft	Avg # per mile	Avg # per mile (95% CI)	% of total catch
100-150 mm	**1.0**	**1.0**	**5.2**	**6 (6-6)**	**100%**

Appendix C cont.. Sheep Creek seasonal size-frequency graphs for 2018. EBT = brook trout, RBT = rainbow trout, LOLE = brown trout, CTxRBT= cutthroat-rainbow trout hybrid, WSCT= westslope cutthroat trout, MWF = mountain whitefish, LNDA = longnose dace, MSU = mountain sucker, WHSU = white sucker. Catchable size is considered >200mm (8 inches).

Sheep SH15.5U/AQ10 Summer

RBT	Avg # per section	Avg # per 1000ft	Avg # per mile	Avg # per mile (95% CI)	% of total catch
50-100 mm	4.0	2.7	13.9	13.9	5%
100-150mm	37.0	24.8	128.9	128.9	44%
150-200 mm	27.0	18.1	94.1	94.1	32%
200-250 mm	8.0	5.4	27.9	27.9	10%
250-300 mm	5.0	3.4	17.4	17.4	6%
>300 mm	3.0	2.0	10.5	10.5	4%
total	**84.0**	**56.3**	**292.7**	**293 (253-333)**	**100%**

LOLE	Avg # per section	Avg # per 1000ft	Avg # per mile	Avg # per mile (95% CI)	% of total catch
100-150mm	3.0	2.0	10.5	10.5	27%
150-200 mm	3.0	2.0	10.5	10.5	27%
200-250 mm	2.0	1.3	7.0	7.0	18%
250-300 mm	1.0	0.7	3.5	3.5	9%
300-350 mm	1.0	0.7	3.5	3.5	9%
350-400 mm	1.0	0.7	3.5	3.5	9%
total	**11.0**	**7.4**	**38.3**	**39 (34-44)**	**100%**

EBT	Avg # per section	Avg # per 1000ft	Avg # per mile	Avg # per mile (95% CI)	% of total catch
50-100mm	0.0	0.0	0.0	0.0	0%
100-150mm	0.0	0.0	0.0	0.0	0%
150-200 mm	6.0	4.0	20.9	20.9	60%
200-250 mm	4.0	2.7	13.9	13.9	40%
total	**10.0**	**6.7**	**34.8**	**35 (30-40)**	**100%**

CT x RBT	Avg # per section	Avg # per 1000ft	Avg # per mile	Avg # per mile (95% CI)	% of total catch
50-100mm	0.0	0.0	0.0	0.0	0%
100-150mm	6.0	4.0	20.9	20.9	60%
150-200 mm	2.0	1.3	7.0	7.0	20%
200-250 mm	2.0	1.3	7.0	7.0	20%
total	**10.0**	**6.7**	**34.8**	**35 (31-39)**	**100%**

MOWH	Avg # per section	Avg # per 1000ft	Avg # per mile	Avg # per mile (95% CI)	% of total catch
50-100mm	1.0	0.7	3.5	3	3%
100-150mm	6.0	4.0	20.9	21	19%
150-200 mm	4.0	2.7	13.9	14	12%
200-250 mm	4.0	2.7	13.9	14	12%
250-300 mm	4.0	2.7	13.9	14	12%
300-350 mm	10.0	6.7	34.8	35	31%
350-400 mm	3.0	2.0	10.5	10	9%
total	**32.0**	**21.4**	**111.488**	**112 (102-122)**	**100%**

Appendix C. Moose and Little Sheep Creek seasonal size-frequency graphs for 2018. EBT = brook trout, RBT = rainbow trout, LOLE = brown trout, CTxRBT= cutthroat-rainbow trout hybrid, WSCT= westslope cutthroat trout, MWF = mountain whitefish, LNDA = longnose dace, MSU = mountain sucker, WHSU = white sucker. Catchable size is considered >200mm (8 inches).

Moose Creek MO.1 (Summer/Fall)

RBT	Avg # per section	Avg # per 1000ft	Avg # per mile	Avg # per mile (95% CI)	% of total catch
<50 mm	132.0	184.8	961.0	961.0	45%
50-100 mm	139.0	194.6	1011.9	1011.9	47%
100-150mm	17.0	23.8	123.8	123.8	6%
150-200 mm	5.0	7.0	36.4	36.4	2%
200-250 mm	2.0	2.8	14.6	14.6	1%
250-300 mm	0.0	0.0	0.0	0.0	0%
>300 mm	1.0	1.4	7.3	7.3	0%
total	**296.0**	**414.4**	**2154.9**	**2155 (2148-2163)**	**100%**

CT x RBT	Avg # per section	Avg # per 1000ft	Avg # per mile	Avg # per mile (95% CI)	% of total catch
50-100mm	0.0	0.0	0.0	0.0	0%
100-150mm	5.0	7.0	36.4	37.0	83%
150-200 mm	1.0	1.4	7.3	7.0	17%
200-250 mm	0.0	0.0	0.0	0.0	0%
total	**6.0**	8.4	**43.7**	**44 (44-44)**	**100%**

EBT	Avg # per section	Avg # per 1000ft	Avg # per mile	Avg # per mile (95% CI)	% of total catch
50-100mm	13.0	18.2	94.6	94.6	37%
100-150mm	9.0	12.6	65.5	65.5	26%
150-200 mm	6.0	8.4	43.7	43.7	17%
200-250 mm	3.0	4.2	21.8	21.8	9%
250-300 mm	4.0	5.6	29.1	29.1	11%
total	**35.0**	**49.0**	**254.8**	**255 (248-262)**	**100%**

Appendix C. Seasonal salmonid size-frequency tables for summer 2018. Catchable size is considered >200mm (8 inches).

Little Sheep LS.1 Summer

EBT	Avg # per section	Avg # per 1000ft	Avg # per mile	Avg # per mile (95% CI)	% of total catch
50-100 mm	19.0	38.0	197.6	197.6	54%
100-150mm	8.0	16.0	83.2	83.2	23%
150-200 mm	7.0	14.0	72.8	72.8	20%
200-250 mm	1.0	2.0	10.4	10.4	3%
250-300 mm	0.0	0.0	0	0	0%
total	**35.0**	**70.0**	**364.0**	**364 (302-416)**	**100%**

LOLE	Avg # per section	Avg # per 1000ft	Avg # per mile	Avg # per mile (95% CI)	% of total catch
100-150 mm	1.0	2.0	10.4	10.4	50%
400-450 mm	1.0	2.0	10.4	10.4	50%
total	**2.0**	**4.0**	20.8	**21 (21-21)**	**100%**

RBT	Avg # per section	Avg # per 1000ft	Avg # per mile	Avg # per mile (95% CI)	% of total catch
300-350 mm	1.0	1.0	5.2	5.2	**100%**
total	**1.0**	1.0	**5.2**	**5.0 (5.0-5.0)**	**100%**

Little Sheep LS.7 Summer

EBT	Avg # per section	Avg # per 1000ft	Avg # per mile	Avg # per mile (95% CI)	% of total catch
50-100 mm	0.0	0.0	0	0	0%
100-150mm	0.0	0.0	0	0	0%
150-200 mm	4.0	8.0	41.6	42	40%
200-250 mm	6.0	12.0	62.4	62	60%
250-300 mm	0.0	0.0	0	0	0%
total	**10.0**	**20.0**	**104.0**	**104 (104-104)**	**100%**