DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR THE PROPOSED AMENDMENT 006 TO PERMIT NO. 00013 FOR THE REGAL MINE

December 2019

Regal Mine
Barretts Minerals, Inc.
Madison County, Montana

DEQ Montana Department of Environmental Quality

EXECUTIVE SUMMARY

This Executive Summary provides an overview of the Environmental Impact Statement (EIS) for the proposed Amendment 006 to Barretts Minerals, Inc. (BMI) Operating Permit No. 00013 related to the expansion of the Regal Mine and changes to associated facilities. The EIS describes the resources potentially affected by the proposed amendment activities. This summary does not provide all of the information contained in the EIS. If more detailed information is preferred, please refer to the EIS, reports, and other sources referenced within.

This EIS describes the Proposed Action and alternatives, including (1) the No Action Alternative and other alternatives described in Chapter 2.0, Description of Alternatives; (2) descriptions of the affected environment for all potentially affected resources (Chapter 3.0, Affected Environment and Environmental Consequences); (3) an analysis of the impacts of the alternatives (Chapter 3.0, Affected Environment and Environmental Consequences and Chapter 4.0, Cumulative, Unavoidable, Irreversible and Irretrievable, and Secondary Impacts and Regulatory Restrictions); and (4) a summary and comparison of the alternatives in Chapter 5.0, Comparison of Alternatives.

Purpose and Need

The Montana Department of Environmental Quality's (DEQ) purpose and need in conducting the environmental review is to act upon BMI's application to amend Operating Permit No. 00013. BMI currently mines talc ore at the Regal Mine and has identified additional ore reserves that would extend the mine life. The permit amendment (or Proposed Action) would increase the total area of Operating Permit No. 00013 by approximately 136.9 acres and increase disturbance by 60.2 acres, increase the size of the mine pit from 36.6 to 45.4 acres, and increase the size of the waste rock disposal facility (WRDF) from 123.3 to 164.7 acres. A storm water management system at the WRDF, seven new dewatering wells, a settling pond, and a new infiltration gallery (IF-3) to replace IF-2 would also be included in the permit amendment. The Proposed Action would include several modifications to local creeks. The expanded pit would intersect Hoffman Spring Creek and require approximately 730 feet of channel to be permanently relocated to the northeast. The new channel would be lined to prevent seepage, and changes would include an upstream catchment basin and a downstream subsurface cutoff wall. Approximately 600 feet of Hoffman Creek would be sealed with bentonite clay. The permit amendment would allow for an additional 6 years of operation of the mine at current production levels. Benefits of the Project would include talc production to help meet public demand and prolong employment and tax payments from the Regal Mine in the area.

DEQ's Record of Decision (ROD) will document the decision on the permit amendment which is based on information provided in the Amendment Application, the analysis in the EIS, and the substantive provisions of the Montana Metal Mine Reclamation Act (MMRA) (Section 82-4-301, *et seq*., Montana Code Annotated [MCA]). DEQ's ROD would be published no sooner than 15 days after publication of the Final EIS. The Final EIS will include comments received on the Draft EIS and the agency's responses to substantive comments.

The Montana Environmental Policy Act (MEPA) (Section 75-1-201, *et seq*., MCA) requires an environmental review of actions taken by the state of Montana that may significantly affect the quality of the human environment. The EIS was prepared to satisfy these MEPA requirements. Before beginning its environmental review under MEPA, DEQ reviewed BMI's Amendment Application and determined that it was complete and compliant with the MMRA and, on March 18, 2019, issued a draft permit amendment. Pursuant to § 82-4-337(1)(f), MCA, issuance of the draft permit amendment as a final permit amendment is the proposed state action subject to this environmental review.

Project Location and History

The Regal Mine is an open pit talc mine located in western Madison County, Montana (**Figure ES-1**). The mine and proposed expansion area are within Sections 2 and 3 of Township 8 South, Range 7 West, and Sections 20, 34, and 35 of Township 7 South, Range 7 West, Montana Meridian. The site is 11 miles southeast of Dillon, Montana, on private land accessed via Sweetwater Road and situated between two perennial streams: Carter Creek to the west and Hoffman Creek to the northeast. Ore is hauled to a transfer station 4.5 miles northwest of the mine and transported for processing to BMI's mill southwest of Dillon (under Operating Permit No. 00009).

The open pit mine has been in operation since 1972. BMI currently mines talc ore from the Regal Mine using conventional open pit methods of drilling, blasting, loading, and hauling. The current mine permit encompasses 243.2 acres of privately owned land with approximately 162 acres of disturbance. The mine permitting history of the Regal Mine is summarized in **Table ES-1** and included in Section 1.3, Project Location and History.

Public Involvement and Scoping

On May 3, 2019, DEQ issued a press release stating that BMI's Amendment Application was complete and the environmental review was scheduled to begin (DEQ 2019a). The press release disclosed the time and location of the public scoping meeting as well as information regarding the EIS and permit application. The press release requested public comment on the Project until June 3, 2019.

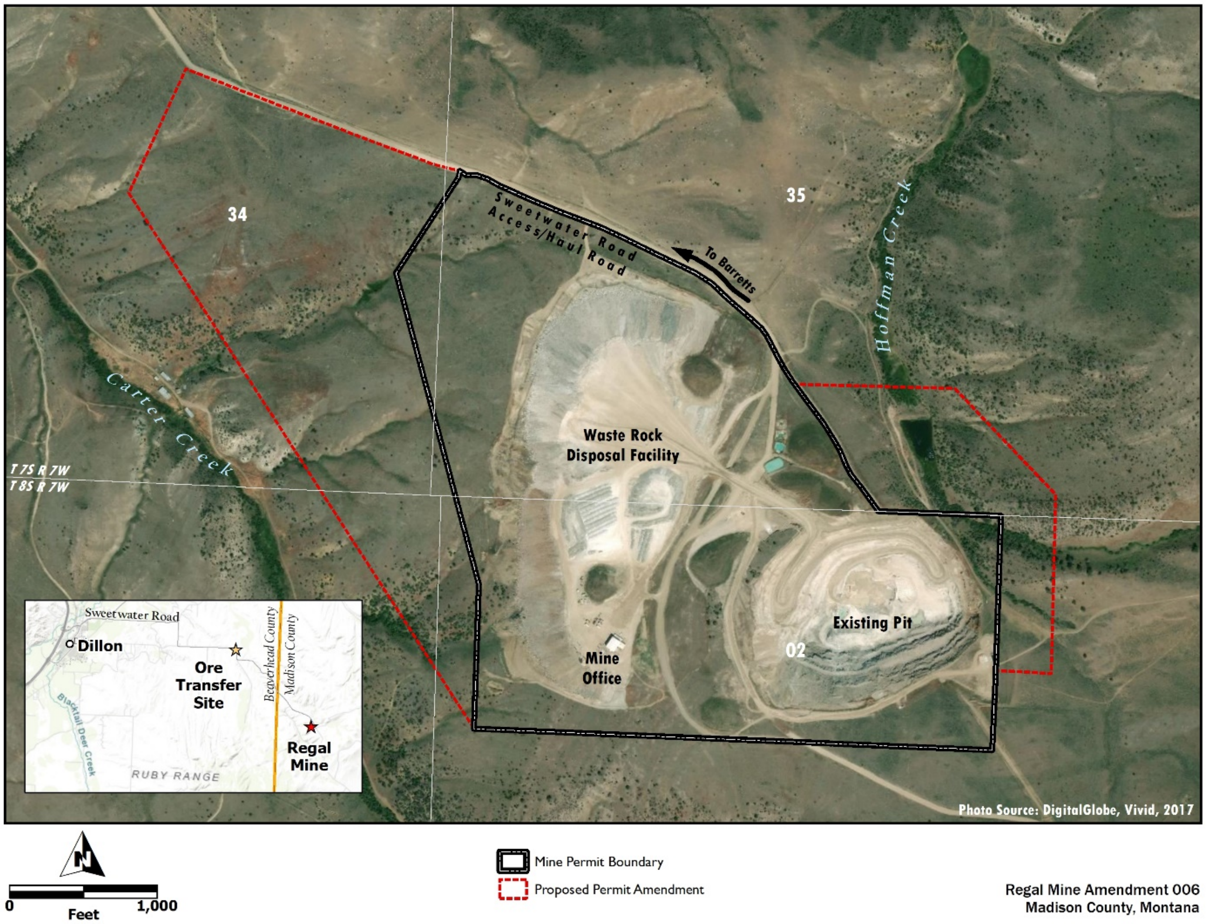

Figure ES-1
Location of Barretts Minerals, Inc.'s Regal Mine Showing the No Action Permit Boundary and Proposed Action Permit Boundary

DEQ held a public comment scoping period from May 3, 2019, to June 3, 2019. On May 16, 2019, a public meeting was held at the Beaverhead County High School in Dillon, Montana. During the public scoping period, DEQ received written and oral comments from the public that were submitted via email, mail, or at the public meeting.

Table ES-1
Summary of Mine Permitting and Regulatory History of the Regal Mine

Year	Permit	Description
1972	Operating Permit No. 00013	Approval of original permit
1977	Operating Permit No.00013A	Preparation of preliminary environmental review
1992	Amendment 001	Acreage of disturbance adjusted for omitted 27 acres
1993	Amendment 002	Added 4.9 acres of disturbance
1992?	Amendment 003	Consolidation of Operating Permits No. 00013 and 00013A
1996	Minor amendment to Operating Permit No. 00013	Consolidation of previously permitted areas as well as documentation of Plan of Operations, reclamation plans, and permit stipulations
2001	Amendment 004	Added 63 acres of new disturbance and 13 acres of new permit area including pit expansion, revising the WRDF design, and implementing a pit dewatering system
2005	Minor Revision 05-001	Addition of a 6.5-acre ore stockpile and transfer site approximately 4.5 miles northwest of the Regal Mine
2005	Minor Revision 05-002	Infiltration testing for water disposal via infiltration galleries
2007	Amendment 005	Expansion of the WRDF from 63.3 acres to 123.3 acres. Implementation of a revised pit dewatering plan; permanent realignment of Sweetwater Road
2015	Minor Revision 15-001	Reclassification of a monitoring well as a dewatering well
2015	Minor Revision 15-002	Installation of two new dewatering wells
2016	Minor Revision 16-001	Installation of four additional monitoring wells
2016	Minor Revision 16-002	Placement of a temporary pipeline in Hoffman Creek to route surface flow through a pipeline to reduce surface flow losses

Issues of Concern

DEQ collected comments on the Proposed Action and the issues to be considered through the public scoping meeting, letters, and emails. All comments were reviewed to identify specific issues or concerns. The following primary issues of concern are related to the Proposed Action:

- Cultural Resources
- Ground Water
- Surface Water
- Water Rights

These issues have been evaluated in detail to address impacts to resources and help determine reasonable alternatives for the permit amendment, including the Proposed Action.

Alternatives

No Action Alternative

MEPA requires an analysis of the No Action Alternative for all environmental reviews that include an alternatives analysis. The No Action Alternative compares environmental conditions with the proposal and establishes a baseline for evaluating the Proposed Action and other alternatives. MEPA requires that the No Action Alternative be considered, even if it fails to meet the purpose and need or would not be able to satisfy environmental permitting standards.

Under the No Action Alternative, BMI would continue to operate under its existing operating permit that would allow mining operations to continue through approximately 2021. Mining would be limited to the current permit (i.e., Operating Permit 00013) and the associated amendments, modifications, and revisions. The current permitted boundary encompasses 243.2 acres with 189.9 acres of currently permitted disturbance. Under the No Action Alternative, no acreage would be disturbed outside of the current permitted area, the pit and WRDF would not be increased outside of the current permitted size, and no changes would occur to the associated mine facilities. A detailed description of the existing permit is in Section 2.2, No Action Alternative: Existing Permit.

Proposed Action

The Proposed Action would expand and deepen the mine pit, increase the size of the WRDF, and expand the mine's water management system. BMI is seeking to add 136.9 acres to the mine permit boundary to increase the size of the permit to approximately 380.1 acres. The Proposed Action would increase disturbance by 60.2 acres to a total of 250.1 acres. The expansion would extend the life of the mine by approximately 6 years.

The open pit would be expanded by almost 8.8 acres for a total pit area of 45.4 acres. As part of the expansion, the pit walls would be pushed back on the north and east sides and deepened to a final pit-bottom elevation of approximately 5,990 feet above mean sea level (amsl) (i.e., 540 feet deep). Approximately 8.3 million cubic yards of waste rock would be extracted under the Proposed Action, including approximately 39,500 cubic yards of potentially asbestiform rocks. Mining methods, equipment, haulage, ore processing, and workforce would be the same as current operations

The WRDF would be expanded to the west and northwest of the currently permitted extent. The size would increase by 41.4 acres for a total area of 172 acres. Waste rock disposal would occur by end dumping and dozer grading in lifts that range in height from 30 to 75 feet. The top elevation of the WRDF would be 6,480 feet with a maximum fill height of 220 feet. Four desilting basins would be constructed below the downstream end of the diversion channels to reduce flow velocities and suspended sediment concentrations.

Disturbance associated with water management would increase by 10 acres. The Proposed Action would include seven new pit dewatering wells, a settling pond, and a new infiltration gallery (IF-3) to replace existing IF-2. Ground water would continue to be intercepted by the dewatering wells and diverted into the proposed infiltration pond. The infiltration gallery would be designed to accept a continuous flow of 500 gallons per minute.

Impacts to surface water flows in Hoffman and Carter creeks and Spring SP-1 are anticipated to occur as a result of pit dewatering. During active mining operations, pit dewatering water disposal would mitigate impacts. BMI would augment stream flow postclosure as a mitigation measure to ensure that beneficial use is supported and water rights are not negatively impacted.

The Proposed Action would include several modifications to Hoffman Spring Creek and Hoffman Creek. The expanded pit would intersect Hoffman Spring Creek and impact approximately 730 feet of channel to the northeast of the mine pit. Approximately 530 feet of channel would be removed and reconstructed on a safety bench located at the top of the proposed pit expansion highwall. The new channel would be lined to prevent seepage, and changes would include an upstream catchment basin and a downstream subsurface cutoff wall. Mitigating impacts to Hoffman Spring Creek and Hoffman Creek are required as part of the Proposed Action under the approved U.S. Army Corps of Engineers 404 permit and DEQ 401 certification. Approximately 600 feet of Hoffman Creek would be sealed with bentonite clay.

Department of Environmental Quality Permit Stipulations

With a history of nesting occurring near the proposed disturbance, mitigation of impacts to raptors and migratory birds is required. As a permit stipulation, a nest survey of the entire area of disturbance will be performed by a qualified biologist shortly before vegetation is cleared. If the nest that was originally discovered in 2016 or any other nests are observed within an area that would be disturbed, the nest can only be destroyed when the nest is inactive and outside of the active breeding season. The Migratory Bird Treaty Act does not prohibit the destruction of the nest if it is done when the nest is inactive. Nests located outside of the disturbance footprint could be left alone and the birds would either continue nesting in that area or find a new nesting location.

Waste Rock Disposal Facility and Mosaic Vegetation Alternative

Based upon a review of the Proposed Action and preliminary environmental impacts, the final reclamation design of the WRDF could be improved to reduce environmental impacts. Other than changes to the WRDF reclamation, all other aspects of this Agency Modified Alternative are the same as the Proposed Action.

The alternative geomorphic design would use the current WRDF configuration surface and incorporate micro-topography (i.e. small topographic changes) to create a drainage density that mimics the natural hydrologic balance. This design would better tie the WRDF into the existing topography in the area. Topographic alterations of this alternative would include a series of natural drainageways, gullies, swales, and ridges. The top elevation and overall slope of the WRDF would also remain similar to the Proposed Action. The Agency Modified Alternative would also create mosaic vegetation patterns to develop specifically tailored micro-environments or ecological niches for targeted plant species and would also positively impact wildlife diversity. This alternative design would have a more natural appearance that blends with the landscape.

Alternatives Considered and Dismissed

Under MEPA, a reasonable alternative is one that is practical, technically possible, and economically feasible. Any alternative under consideration must also meet the purpose and need of the Proposed Action. During scoping and development of the EIS, alternatives to the Proposed Action were suggested and discussed by agency representatives and BMI as required by MEPA at § 75-1-201(1)(b)(iv)(C)(II), MCA. Some alternatives considered were dismissed from further analysis. Each alternative and the reason for dismissal is described in Section 2.6, Alternatives Considered but Dismissed From Detailed Analysis. The following alternatives were dismissed:

- Connect Pit Lake to Hoffman Creek;
- Stream Diversion Construction Alternative;
- Partial Pit Backfill;
- Reduced Ground Water Dewatering; and
- Alternate and Flexible Water Injection Sites.

Each of these alternatives or alternative components was considered and eliminated from detailed study for a variety of reasons, including operational feasibility, an increase in environmental impacts, or failure to meet the purpose and need of the project.

Summary of Impacts

This EIS discloses and analyzes the environmental consequences that may result from selection and implementation of the Proposed Action and alternatives described in Chapter 2.0, Description of Alternatives. The more substantive consequences are presented in **Table ES-2**, which summarizes and compares the impacts of the three alternatives considered in detail. The Proposed Action would have similar impacts as the No Action Alternative on cultural resources, noise, transportation, and air quality. Detailed resource impacts analyses are provided in Chapter 3.0, Affected Environment and Environmental Consequences (primary impacts) and Chapter 4.0 Cumulative, Unavoidable, Irreversible and Irretrievable, and Secondary Impacts and Regulatory Restrictions (cumulative and secondary impacts).

Preferred Alternative

Administrative Rules of Montana (ARM) 17.4.617(9) requires an agency to state a preferred alternative in the Draft EIS, if one has been identified, and provide its reason for the preference. DEQ has identified the Waste Rock Disposal Facility Grading and Mosaic Vegetation Alternative as the agency's preferred alternative. Under this alternative, WRDF reclamation would be modified to create a natural and stable geomorphic landform that recreates a natural drainage network.

DEQ's review of an application for an operating permit amendment is governed by Section 82-4-337, MCA. That law requires DEQ to make an initial determination as to whether or not the permit Amendment Application contains all necessary information and whether or not the proposed amendment satisfies the substantive requirements of the MMRA. DEQ determined that BMI's permit Amendment Application was complete and compliant on March 18, 2019, and issued a draft permit amendment. The analysis contained in this Draft EIS does not change DEQ's determination that the proposal contained in the permit Amendment Application, which is the Proposed Action, complies with the substantive requirements of the MMRA. Unless the analysis set forth in the Final EIS reaches a contrary determination, DEQ will be required to select the Proposed Action. However, if after the public comment period, DEQ prefers an alternative, DEQ and BMI could voluntarily agree to the alternative.

Table ES-2
Summary of Primary Impacts of the No Action Alternative, Proposed Action, and Agency Modified Alternative Organized by Resource Area

Chapter	Resource Area/ Impact	No Action Alternative	Proposed Action	Agency Modified Alternative
3.2	Cultural Resources	No impacts.	No impacts to significant cultural resources are anticipated.	No impacts.
3.3	Geology and Geochemistry	No change from the current permitted extraction.	Disturbance of the geology would occur within the expanded and deepened mine pit as talc ore is mined and waste rock (including a zone of potentially asbestiform rock) is removed.	Same as the Proposed Action.
3.4	Ground Water Resources	Continued dewatering would lower the ground water table near the pit by an additional 180 feet or 280 feet below the premining water table.	The mine pit would continue to be dewatered for an additional 6 years and the ground water table would be reduced by approximately 395 feet. Predicted drawdown of 100 feet would extend 3,000 feet upgradient of the pit and 240 feet downgradient. Dewatering impacts to Hoffman and Carter creek flows would be offset by proposed flow augmentation.	Same as the Proposed Action.
3.5	Surface Water Resources	No change from the current condition.	Approximately 730 feet of the Hoffman Spring Creek channel would be permanently relocated at the top of the pit highwall. A 600-foot section of Hoffman Creek would have bentonite materials added into the channel to reduce infiltration. Flow depletions are	Impacts to Hoffman Creek, Hoffman Spring Creek, and Carter Creek would be the same as the Proposed Action. Post-reclamation drainage on the WRDF

Chapter	Resource Area/ Impact	No Action Alternative	Proposed Action	Agency Modified Alternative
			anticipated in sections of Carter Creek, Hoffman Creek, and the unnamed tributaries of Hoffman Creek but would be mitigated by recharge and flow augmentation.	would better mimic natural drainage.
3.6	Water Rights	Dewatering would cease once mining is completed. The water right for SP-1 and other water rights on Hoffman Creek may be impacted.	During the dewatering phase of the Proposed Action, flows within the simulated drawdown area are likely to be impacted, although impacts to water rights depend on extent of the water use and impacts to creek flows would be offset by proposed flow augmentation.	Same as the Proposed Action.
3.7	Geotechnical Engineering	No change from the current condition.	The east wall of the pit would be steeper, but slope-scale failures or other geotechnical impacts are not anticipated.	Same as the Proposed Action.
3.8	Land Use	No change from the current condition.	A total of 60.2 acres of existing land use would be temporarily impacted. All proposed disturbance would be reclaimed back to the existing uses after mine closure except for 8.8 acres, which would become a pit lake.	Same as the Proposed Action.
3.9	Visual Resources and Aesthetics	No change from the current condition.	Visibility of the WRDF and open pit from surrounding landowners and travelers would increase slightly. Reclamation would improve the landscape to more a natural-appearing landscape to minimize permanent visual impacts.	The post-reclamation landscape would better blend with the landscape and be more aesthetically pleasing.

Chapter	Resource Area/ Impact	No Action Alternative	Proposed Action	Agency Modified Alternative
3.10	Socioeconomics	No change from the current condition.	A beneficial impact of jobs and tax revenue would occur for a longer duration.	Same as the Proposed Action.
3.11	Soils and Reclamation	No change from the current condition.	Impacts to the native soils include soil salvage and stockpiling ahead of disturbing an additional 60.2 acres. Pit and WRDF reclamation would be similar to previously permitted reclamation and includes grading, capping, and revegetating the WRDF, select benches of the pit, and other associated mining facilities.	Soil disturbance would be the same as the Proposed Action. Excess available soil would be used for WRDF grading, and the alternative would also reduce material erosion and create a more stable landform.
3.12	Vegetation	No change from the current condition.	Approximately 8.8 acres associated with the pit would be permanently converted from grassland to open water and highwall or talus slope. Approximately 51.4 additional acres of disturbance to grassland, shrublands, and forested lands would occur for the duration of active mining.	Post-reclamation vegetation on the WRDF would be more diverse in species but would be more difficult to seed and treat weeds.
3.13	Wetlands	No change from the current condition.	Approximately 0.72 acre of delineated wetlands along Hoffman Spring Creek and Hoffman Creek would be disturbed. Mitigation would require purchasing wetland credits.	Same as the Proposed Action.
3.14	Wildlife	No change from the current condition.	Habitat would be lost (especially sagebrush) associated with the 60.2	The alternative would diversify the wildlife habitat on the WRDF and attract a

Chapter	Resource Area/ Impact	No Action Alternative	Proposed Action	Agency Modified Alternative
			acres of additional disturbance during operations.	greater number of animals and species to the site after revegetation.
3.15	Noise	No change from the current condition.	No change from the current condition other than the extended 6 years of mine life.	Same as the Proposed Action.
3.16	Transportation	No change from the current condition.	No change from the current condition other than the extended 6 years of mine life.	Same as the Proposed Action.
3.17	Air Quality	No change from the current condition.	Air quality would have minor primary impacts with no increase in ambient air impacts, but the potential for long-term impacts is increased.	Enhanced grading and mosaic vegetation of the WRDF may reduce post-reclamation erosion and dust generated from the WRDF.

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GLOSSARY

Term	Definition
active mining	Mining operations such as drilling, blasting, loading, and hauling that are taking place during ore extraction.
air pollutant	Any substance in air that could, in high enough concentration, harm animals, humans, vegetation, and/or materials. Such pollutants may be present as solid particles, liquid droplets, or gases. Air pollutants fall into two main groups: (1) those emitted from identifiable sources and (2) those formed in the air by interaction between other pollutants.
air quality	A measure of the health-related and visual characteristics of the air, often derived from quantitative measurements of the concentrations of specific injurious or contaminating substances.
alkalinity	The extent to which water or soil contains soluble mineral salts.
alluvium	Unconsolidated material that is deposited by flowing water.
alternative	A Montana Environmental Policy Act (MEPA) term that refers to a way of achieving the same purpose and need for a project that is different from the recommended proposal; alternatives should be studied, developed, and described to address any proposal which involves unresolved conflicts concerning different uses of available resources. Analysis scenarios presented in a comparative form, to facilitate a sharp definition of the issues resulting in a basis for evaluation among options by the decision-maker and the public.
ambient	Surrounding, existing. Of the environment surrounding a body, encompassing on all sides. Most commonly applied to air quality and noise.
analysis area	The geographical area being targeted in the analysis as related to the area of the proposed project.
aquifer	A water-bearing geological formation capable of yielding water in sufficient quantity to constitute a usable supply.
area of potential effect	Defined in Section 106 regulations as the geographic area or areas within which a project may directly or indirectly cause changes in the character or use of historic properties.

Term	Definition
attainment	In compliance with one or more of the National Ambient Air Quality Standards (NAAQS) for sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and particulate matter, as designated by the U.S. Environmental Protection Agency (USEPA).
backfilling	The operation of refilling an excavation and finishing the surface.
Bald and Golden Eagle Protection Act	An act enacted in 1940 that prohibits "take" of a bald or golden eagle without a permit from the Secretary of the Interior. "Take" is defined as "take, possesses, sell, purchase, barter, offer to sell, export, or import, at any time or in any manner, any bald eagle … [or any golden eagle], alive or dead, or any part, nest, or egg thereof."
base flow	Sustained flow of a stream in the absence of direct runoff and includes natural and human-induced stream flows. Natural base flow is sustained largely by ground water discharges.
baseline	The existing conditions against which impacts of the alternatives are compared.
bench	A ledge that forms a single level of operation above which mineral or waste materials are mined back to a bench face. The mineral or waste is removed in successive layers, each of which is a bench. Several benches may be in operation simultaneously in different parts of, and at different elevations in an open pit mine.
beneficial use	Under the Clean Water Act, all surface waters are designated with specific beneficial uses they should be capable of supporting including drinking, food processing, bathing, recreation, wildlife, agriculture, and industry.
berm	A horizontal shelf or ledge built into the embankment or sloping wall of an open pit to break the continuity of an otherwise long slope and to strengthen its stability or to catch and arrest slide material.
best management practices	Structural, nonstructural, and managerial techniques that are recognized to be the most effective and practicable means to reduce or prevent pollution.
biodiversity	A term that describes the variety of life-forms, the ecological role they perform, and the genetic diversity they contain.

Term	Definition
blasting	The act of removing, opening, or forming by or as if by an explosive.
bond release	Return of a performance bond to the mine operator after the regulatory agency has inspected and evaluated the completed reclamation operations and determined that all regulatory requirements have been satisfied.
catchment basin	A storage area (such as a small reservoir) that delays the flow of water downstream.
cone of depression	Occurs in an aquifer when ground water is pumped from a well. In an unconfined aquifer (water table), this is an actual depression of the water levels. In confined aquifers (artesian), the cone of depression is a reduction in the pressure head surrounding the pumped well.
confluence	The point where two streams meet.
corridor	A defined tract of land, usually linear. Can also refer to lands through which a species must travel to reach habitat suitable for reproduction and other life-sustaining needs.
criteria air pollutant	A set of air pollutants that cause smog, acid rain, and other health hazards. They are typically products of fossil-fuel combustion and are emitted from many sources in industry, mining, transportation, electricity generation, and agriculture. The first set of pollutants recognized by USEPA as needing standards on a national level were particulate matter, nitrogen oxides, ozone, carbon monoxide, sulfur oxides, and lead.
criteria pollutant	An air pollutant that is regulated by the NAAQS. Criteria pollutants include sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and two size classes of particulate matter, less than 10 micrometers (0.0004 inch) in aerodynamic diameter, and less than 2.5 micrometers (0.0001 inch) in aerodynamic diameter. Pollutants may be added to, or removed from, the list of criteria pollutants as more information becomes available. Note: Sometimes pollutants regulated by state laws also are called criteria pollutants.
cumulative impact	The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other

Term	Definition
	actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.
cutoff wall	Wall of impervious material such as concrete or asphalt used to exclude ground water from an excavation.
degradation	A process by which water quality in the natural environment is lowered. When used specifically in regard to Montana Department of Environmental Quality's (DEQ) nondegradation rules, this term can relate to a reduction in quantity as well.
desilting	Removal of earthy materials (i.e., fine sand) carried by running water and deposited as sediment.
dewatering	Controlling ground water by pumping to locally lower ground water levels in the vicinity of an excavation.
diabase	A dark-colored igneous rock.
dike	A sheet of rock that is formed in a fracture in a preexisting rock.
dilution	The reduction of a concentration of a substance in air or water.
disturbed area	An area where vegetation, topsoil, or overburden is removed or upon which topsoil, spoil, and processed waste is placed as a result of mining.
downgradient	The direction that ground water flows, which is from areas of high ground water levels to areas of low ground water levels.
drawdown	Lowering of the ground water surface caused by pumping, measured as the difference between the original ground water level and current pumping level after a period of pumping.
drilling	The act of boring or driving a hole into something solid.
effluent	Waste liquid discharge.
embankment	A wall or bank of earth or stone built to prevent flooding of an area or to impound water.
emergent	As described for vegetation, plants that have roots below and foliage or stems that extend above water such as rushes, cattails, or sedges.

Term	Definition
emission	Effluent discharged into the atmosphere, usually specified by mass per unit time, and considered when analyzing air quality.
endangered species	Any species of plant or animal that is in danger of extinction throughout all or a significant portion of its range. Endangered species are identified by the Secretary of the Interior in accordance with the 1973 Endangered Species Act.
Endangered Species Act	An act of Congress, enacted in 1973, to protect and recover threatened or endangered plant or animal species and their habitats. The Secretary of the Interior, in accordance with the act, identifies or lists the species as “threatened” or “endangered.”
Environmental Assessment (EA)	A concise public document that an agency prepares under MEPA to provide sufficient evidence and analysis to determine whether or not a proposed action requires preparation of an Environmental Impact Statement (EIS) or whether a Finding of No Significant Impact can be issued. An EA must include brief discussions on the need for the proposal, the alternatives, the environmental impacts of the proposed action and alternatives, and a list of agencies and persons consulted.
environmental consequences	Environmental effects of project alternatives, including the proposed action, which cannot be avoided; the relationship between short-term uses of the human environment, and any irreversible or irretrievable commitments of resources which would be involved if the proposal should be implemented.
Environmental Impact Statement (EIS)	A document prepared to analyze the impacts on the environment of a proposed action and released to the public for review and comment. An EIS must meet the requirements of MEPA, Council on Environmental Quality, and the directives of the agency responsible for the proposed action.
ephemeral drainage	A system of streams that flows only as a direct response to rainfall or snowmelt events and has no baseflow from ground water.
evaporation	The physical process by which a liquid is transformed to a gaseous state.

Term	Definition
fascine	A bundle of sticks or other material used to strengthen a structure and reduce erosion.
fault	A fracture or fracture zone where there has been displacement of the sides relative to one another.
floodplain	Flat land bordering a river and made up of alluvium (sand, silt, and clay) deposited during floods. When a river overflows, the floodplain is covered with water.
forb	Any herbaceous plant, usually broadleaved, that is not a grass or grass-like plant.
fugitive emissions	(1) Emissions that do not pass through a stack, vent, chimney, or similar opening where they could be captured by a control device. (2) Any air pollutant emitted to the atmosphere other than from a stack. Sources of fugitive emissions include pumps; valves; flanges; seals; area sources such as ponds, lagoons, landfills, piles of stored material (e.g., ore); and road construction areas or other areas where earthwork is occurring.
geomorphic	Relating to the form of the earth or the forms of its surface.
grading	The operation of finishing a surface after backfilling an excavation.
growth media	The material that plants grow in consisting of soil and organic matter.
hardness	A measure of the amount of calcium and magnesium dissolved in the water.
hazardous air pollutants (HAPs)	Air pollutants not covered by NAAQS but which may present a threat of adverse human health effects or adverse environmental effects. Those specifically listed in 40 CFR 61.01 are asbestos, benzene, beryllium, coke oven emissions, inorganic arsenic, mercury, radionuclides, and vinyl chloride. More broadly, HAPs are any of the 189 pollutants listed in or pursuant to section 112(b) of the Clean Air Act. Very generally, HAPs are any air pollutants that may realistically be expected to pose a threat to human health or welfare.
heavy metals	Metallic elements with high molecular weights, generally toxic in low concentrations to plants and animals.
highwall	The face of exposed overburden and mineral in surface mining operations or for entry to underground mining operations.

Term	Definition
historic properties	Cultural resources that are listed on or eligible for listing on the National Register of Historic Places.
home range	An area in which an individual animal spends most of its time doing normal activities.
hydraulic conductivity	The rate of flow of water through geologic material.
hydric soil	A soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part.
impoundment	A body of water confined within an enclosure (as a reservoir).
infiltration	Process by which water on the ground surface enters the soil.
incised	Having a margin that is deeply and sharply notched.
intermittent stream	A stream or reach of stream that is below the local water table for at least some of the year and obtains its flow from both surface runoff and ground water discharge.
jurisdictional wetland	Wetlands or other waters that are subject to federal control are referred to as “jurisdictional waters” because they are within the regulatory jurisdiction of federal law such as the Clean Water Act.
land use	The activities and inputs undertaken in a certain land cover type, or the way in which land is managed (e.g., grazing pastures, and managed forests).
lek	An area (often sparsely vegetated) where sage-grouse congregate in the spring and male sage-grouse display to females as part of courtship.
lenses	Bodies of ore or rock that are thick in the middle and thin at the edges, resembling convex lenses in cross section.
life-of-mine	Length of time after permitting during which minerals are extracted and mine-related activities can occur.
lithologic	Pertaining to the structure and composition of a rock formation.
loading	The quantity of material or chemicals entering the environment, such as a receiving waterbody.
loam	Soil composed mostly of sand and silt with minor clay-sized particles.

Term	Definition
mean	The average number of a set of values. The sum of the values divided by the count of values.
median	A numerical value in the midpoint of a range of values with half the value points above and half the points below.
Migratory Bird Treaty Act	Enacted in 1918 between the United States and several other countries. The act forbids any person without a permit to "pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird, included in the terms of this Convention…for the protection of migratory birds…or any part, nest, or egg of any such bird."
mitigation	An action to avoid, minimize, reduce, eliminate, replace, or rectify the impact of a management practice.
Montana Natural Heritage Program	Provides information on Montana's species and habitats, emphasizing those of conservation concern.
National Ambient Air Quality Standards (NAAQS)	The allowable concentrations of air pollutants in the ambient (public outdoor) air. NAAQS are based on the air quality.
National Emissions Standards for Air Quality	Emissions standards set by the USEPA for air.
No Action Alternative	A MEPA term that refers to the alternative in which the Proposed Action is not taken. For many actions, the No Action Alternative represents a scenario in which current conditions and trends are projected into the future without another Proposed Action, such as updating a land management plan. In other cases, the No Action Alternative represents the future in which the action does not take place and the project is not implemented.
nonattainment area	An area that the USEPA has designated as not meeting (i.e., not being in attainment of) one or more of the NAAQS for sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and particulate matter. An area may be in attainment for some pollutants, but not for others.

Term	Definition
nonpermeable/ impermeable	Preventing the passage of fluids.
noxious weed	Any exotic plant species established or that may be introduced in the state that may render land unfit for agriculture, forestry, livestock, wildlife, or other beneficial uses, or that may harm native plant communities.
open pit mine	A method of mining, usually for metallic ores, in which the waste and ore are completely removed from the sides and bottom of a pit which gradually becomes a large, canyonlike depression.
overburden	Geologic material of any nature that overlies a deposit of ore or coal, excluding topsoil.
particulate matter (pm)	A complex mixture of extremely small particles and liquid droplets that get into the air. Once inhaled, these particles can affect the heart and lungs and cause serious health effects. PM_{10} includes only those particles equal to or less than 10 micrometers (0.0004 inch) in aerodynamic diameter; $PM_{2.5}$ includes only those particles equal to or less than 2.5 aerodynamic micrometers (0.0001 inch) in diameter.
peak flow	The maximum flow of a stream in a specified period of time.
pedon	A soil profile showing the characteristics of all soil horizons or layers from the O horizon (organic material) to the R horizon (consolidated rock).
perennial stream	A stream or reach of a stream that flows continuously year-round as a result of ground water discharge or surface runoff.
pH	A method of expressing the acidity or basicity of a solution; the pH scale runs from 0 to 14, with a value of 7 indicating a neutral solution. Values greater than 7 indicate basic or alkaline solutions, and those below 7 indicate acidic solutions.
postmining land use	The specific use or management-related activity to which a disturbed area is restored after mining and reclamation have been completed.
postmining topography	The relief and contour of the land that remains after backfilling of the mine pit, grading, and recontouring have been completed.

Term	Definition
potentiometric surface	A hypothetical surface representing the level to which ground water would rise if not trapped in a confined aquifer (i.e., an aquifer in which the water is under pressure because of an impermeable layer above it that keeps it from seeking its level).
Potentially Asbestiform Rock (PAR)	Serpentine and amphibole mineralization in non-ore rock.
primary impact	An impact caused by an action and occurs at the same time and place as the action. Also referred to as a "direct" impact.
prime farmland	Land that (a) meets the criteria for prime farmland prescribed by the United States Secretary of Agriculture in the Federal Register and (b) historically has been used for intensive agricultural purposes.
Proposed Action	A MEPA term that refers to a plan that contains sufficient details about the intended actions to be taken, or that will result, to allow alternatives to be developed and its environmental impacts analyzed.
public health	The science of protecting the safety and improving the health of communities through education, policy making, and research for disease and injury prevention.
raptors	Birds of prey (e.g., hawks, owls, vultures, and eagles).
reclamation	Per the Metal Mine Reclamation Act (MMRA) (17.24.102, Montana Code Annotated (MCA)) reclamation means the return of lands disturbed by mining or mining-related activities to an approved postmining land use that has stability and utility comparable to that of the premining landscape except for rock faces and open pits, which may not be feasible to reclaim to this standard.
revegetation	Plant growth that replaces original ground cover following land disturbance.
rip rap	Loose stone used to form a foundation for a breakwater or other structure.
riparian areas	Areas with distinct resource values and characteristics that comprise an aquatic ecosystem, and adjacent upland areas that have direct relationships with the aquatic system (includes floodplains, wetlands, and lake shores).
ripped	Torn, split apart, or opened.

Term	Definition
secondary impact	An impact caused by an action but that occurs later in time (reasonably foreseeable) or farther away in distance.
Section 106	Section 106 of the National Historic Preservation Act of 1966 requires federal agencies to consider the effects on historic property of projects they carry out, assist, fund, permit, license, or approve.
Section 110	Section 110 of the National Historic Preservation Act of 1966 requires federal agencies to establish an historic preservation program for the identification and protection of historic properties under their direct control or ownership.
sedge	A grass-like plant, often associated with moist or wet environments.
sediment-control pond/sediment trap	A sediment-control structure, including a barrier, dam, or excavation depression, that slows down runoff water to allow sediment to settle out.
seep	A place where ground water flows slowly out of the ground.
seismic	Of or produced by earthquakes. Of or relating to an earth vibration caused by something else (e.g., an explosion).
sensitive species	Those species (i.e., plant and animal) identified by the Montana Natural Heritage Program for which population viability is a concern, as evidenced by (1) significant current or predicted downward trends in population numbers or density or (2) significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.
soil texture	Soil textural units are based on the relative proportions of sand, silt, and clay.
Species of Concern	Species that are either known to be rare or declining, or declining because of the lack of basic biological information.
specified head boundary	In a numeric ground water model, a boundary where the head (water level) is set to a known value.
spoil	Overburden that has been removed during surface or underground mining operations.
spring	A localized point of discharge where ground water emerges onto the land or into a surface waterbody.
stratigraphy	The arrangement of strata (layers).

Term	Definition
sump	A small basin or low spot in the mine pit that collects precipitation and ground water inflow so that the water can then be pumped out.
sustainable	The ability of a population to maintain a relatively stable population size over time.
swale	A low or hollow place, especially a marshy depression between ridges.
talus	Pile of rocks that accumulates at the base of a cliff, chute, or slope.
taxonomic level	A hierarchical defined group of organisms such as genus, species, or family.
threatened species	Any species likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range, as identified by the Secretary of the Interior in accordance with the 1973 Endangered Species Act.
total dissolved solids	A measure of the amount of material dissolved in water (mostly inorganic salts).
vein	A tabular or sheet-like body of crystallized minerals within a rock.
water right	A property right to use (but not own) surface or ground water in Montana, as affirmed by the Montana Constitution, the Montana Supreme Court, and by state law. Because it is a property right, a water right can be sold, leased, and/or severed from the property where it has historically been put to beneficial use.
water table	The level below which the ground is saturated with water. The water table fluctuates both with the seasons and yearly because it is affected by climatic variations and the amount of precipitation used by vegetation. It also is affected by withdrawing excessive amounts of water from wells or by recharging them artificially.
watershed	A ridge of high land dividing two areas that are drained by different river systems. On one side of a watershed, rivers and streams flow in one direction; on the other side they flow in another direction.
total maximum daily load	A regulatory term in the Clean Water Act that describes a plan for restoring impaired waters that identifies the maximum amount of a pollutant that a waterbody can receive while still meeting water quality standards.

Term	Definition
total suspended solids	A measure of the amount of undissolved particles suspended in water.
toxic	Referring to a chemical that has an immediate, deleterious effect on the metabolism of a living organism.
transect	A line, strip, or series of plots from which biological samples, such as vegetation, are taken.
tributary	A stream that flows into a larger waterbody.
upgradient	The direction from which ground water flows.
viability	Ability of a population to maintain sufficient size so that it persists over time in spite of normal fluctuations in numbers; usually expressed as a probability of maintaining a specific population for a specific period.
viewshed	The portion of the surrounding landscape that is visible from a single observation point or set of points.
water of the US	Waters including all interstate waters used in interstate or foreign commerce, tributaries of these, territorial seas at the high-tide mark, and wetlands adjacent to all of these.
watershed	The lands drained by a system of connected drainages. The area of land where all of the water that falls in it and drains off of it goes to a common outlet.
wetlands	Areas that are inundated or saturated by surface or ground water for a sufficient duration and frequency to support a prevalence of vegetation typically adapted for such conditions and that exhibit characteristics of saturated soils.

ACRONYMS

Acronym	Definition
AMA	Agency Modified Alternative
APE	Area of Potential Effect
ARM	Administrative Rules of Montana
BGEPA	Bald and Golden Eagle Protection Act
BLM	Bureau of Land Management
BMI	Barretts Minerals, Inc.
CAA	Clean Air Act
CRABS	Cultural Resource Annotated Bibliography System
CRIS	Cultural Resource Information System
DEQ	Department of Environmental Quality
DNRC	Department of Natural Resources and Conservation
EIS	Environmental Impact Statement
ESA	Endangered Species Act
GLO	General Land Office
gpm	gallons per minute
HAP	hazardous air pollutants
HDPE	high-density polyethylene
LOM	life-of-mine
MAQP	Montana Air Quality Permit
MBTA	Migratory Bird Treaty Act
MCA	Montana Code Annotated
MDLI	Montana Department of Labor & Industry
MDSL	Montana Department of State Lands
MEPA	Montana Environmental Policy Act
MFWP	Montana Fish, Wildlife and Parks
MMRA	Metal Mine Reclamation Act
MPDES	Montana Pollutant Discharge Elimination System
MSHA	Mine Safety and Health Administration
MTNHP	Montana Natural Heritage Program
NAAQS	National Ambient Air Quality Standards
NESHAP	National Emission Standards for Hazardous Air Pollutants

Acronym	Definition
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetland Inventory
OP	Operating Permit
OSHA	Occupational Safety and Health Administration
PAR	potentially asbestiform rocks
PCI	per capita income
PM	particulate matter
SHPO	State Historic Preservation Office
SOC	Species of Concern
TDS	total dissolved solids
TES	threatened and endangered
TSS	total suspended solids
UCS	Unconfined compressive strength
UIC	Underground Injection Control
USACE	U.S. Army Corps of Engineers
USBLS	U.S. Bureau of Labor Statistics
USEPA	U. S. Environmental Protection Agency
USFWS	U.S. Fish & Wildlife Service
USGS	U.S. Geological Survey
WRDF	waste rock disposal facility
WUS	Waters of the US
yd^3	cubic yards

1.0 PURPOSE AND NEED

1.1 INTRODUCTION

This draft Environmental Impact Statement (EIS) was prepared on an application for Amendment 006 to Operating Permit No. 00013 submitted by Barretts Minerals, Inc. (BMI) for the Regal Mine expansion (the Project) in Dillon, Montana, to the Montana Department of Environmental Quality (DEQ). BMI submitted the Amendment Application on March 29, 2018. The Montana Environmental Policy Act (MEPA) requires state agencies to prepare an EIS before taking a state action that significantly affects the quality of the human environment (§ 75-1-201(1)(b)(iv), Montana Code Annotated [MCA]). DEQ has prepared this EIS before taking state action. The permit amendment would expand and deepen the existing mine pit, increase the size of the waste rock disposal facility (WRDF), modify the ground water capture and infiltration system, and realign Hoffman Spring Creek.

DEQ prepared this EIS to present the analysis of possible environmental consequences of three alternatives: No Action Alternative, Proposed Action, and WRDF Grading and Mosaic Vegetation Alternative. The alternatives are described in detail in Chapter 2.0, Description of Alternatives.

1.2 PURPOSE AND NEED

DEQ's purpose and need in conducting the environmental review is to act upon BMI's application to amend Operating Permit No. 00013. BMI currently mines talc ore at the Regal Mine and has identified additional ore reserves that would extend the mine life. The permit amendment (or Proposed Action) would increase the total area of Operating Permit No. 00013 by approximately 136.9 acres and increase disturbance by 60.2 acres, increase the size of the mine pit from 36.6 to 45.4 acres, and increase the size of the WRDF from 123.3 to 164.7 acres. A storm water management system at the WRDF, seven new dewatering wells, a settling pond, and a new infiltration gallery (IF-3) to replace IF-2 would also be included in the permit amendment. The Proposed Action would include several modifications to local creeks. The expanded pit would intersect Hoffman Spring Creek and require approximately 730 feet of channel to be permanently relocated to the northeast. The new channel would be lined to prevent seepage, and changes would include an upstream catchment basin and a downstream subsurface cutoff wall. Approximately 600 feet of Hoffman Creek would be sealed with bentonite clay. The permit amendment would allow for an additional six years of operation of the mine at current production levels. Benefits of the Project would include talc production to help meet public demand and prolong employment and tax payments from the Regal Mine in the area.

MEPA (Section 75-1-201, *et seq.*, MCA) requires an environmental review of actions taken by the state of Montana that may significantly affect the quality of the human environment. The EIS was prepared to satisfy these MEPA requirements. Before beginning its environmental review under MEPA, DEQ reviewed BMI's Amendment Application, determined that it was complete and compliant with the Metal Mine Reclamation Act (MMRA) (Section 82-4-301, *et. seq.,* MCA) and, on March 18, 2019, issued a draft permit amendment. Pursuant to § 82-4-337(1)(f), MCA, issuance of the draft permit amendment as a final permit amendment is the proposed state action subject to this environmental review.

DEQ will decide which alternative should be approved in DEQ's Record of Decision based on information provided in the Amendment Application, the analysis in the EIS, and the substantive provisions of the MMRA. DEQ's Record of Decision would be published no sooner than 15 days after publication of the Final EIS. The Final EIS will include comments received on the Draft EIS and the agency's responses to substantive comments.

1.3 Project Location and History

The Regal Mine is an open pit talc mine located in western Madison County, Montana (**Figure 1.3-1**). The mine and proposed expansion area are within Sections 2 and 3 of Township 8 South, Range 7 West, and Sections 20, 34, and 35 of Township 7 South, Range 7 West, Montana Meridian. The site is 11 miles southeast of Dillon, Montana, on private land accessed via Sweetwater Road and situated between two perennial streams: Carter Creek to the west and Hoffman Creek to the northeast. Ore is hauled to a transfer station 4.5 miles northwest of the mine and transported for processing to Barrett's Mill southwest of Dillon (under Operating Permit No. 00009).

Background information on the history and regulatory context of the Regal Mine is provided in the following text. This information is necessary to evaluate the permit amendment and any alternatives or stipulations.

Operating Permit No. 00013 for the Regal Mine was approved by the Montana Department of State Lands (MDSL) on March 17, 1972, and issued to Pfizer, Inc. (previous owner and operator of the Regal Mine). MDSL was the agency that preceded DEQ as administrator of the MMRA. A preliminary environmental review was prepared by MDSL in April 1977 for proposed Operating Permit No.00013A for the Regal Mine. Operating Permit No. 00013A that was issued by MDSL on April 22, 1977, incorrectly listed the number of acres associated with the area of disturbance. In August 1992, MDSL approved Amendment 001 Operating Permit No. 00013A to adjust the acreage of disturbance (the addition of an omitted 27 acres).

Amendment 002 to Operating Permit No. 00013A was issued in April 1993 and added 4.9 acres of disturbance to the mine operation. Amendment 003 was approved in 1992 and Operating Permits No. 00013 and 00013A were consolidated to manage the permits. In 1996, Regal Mine

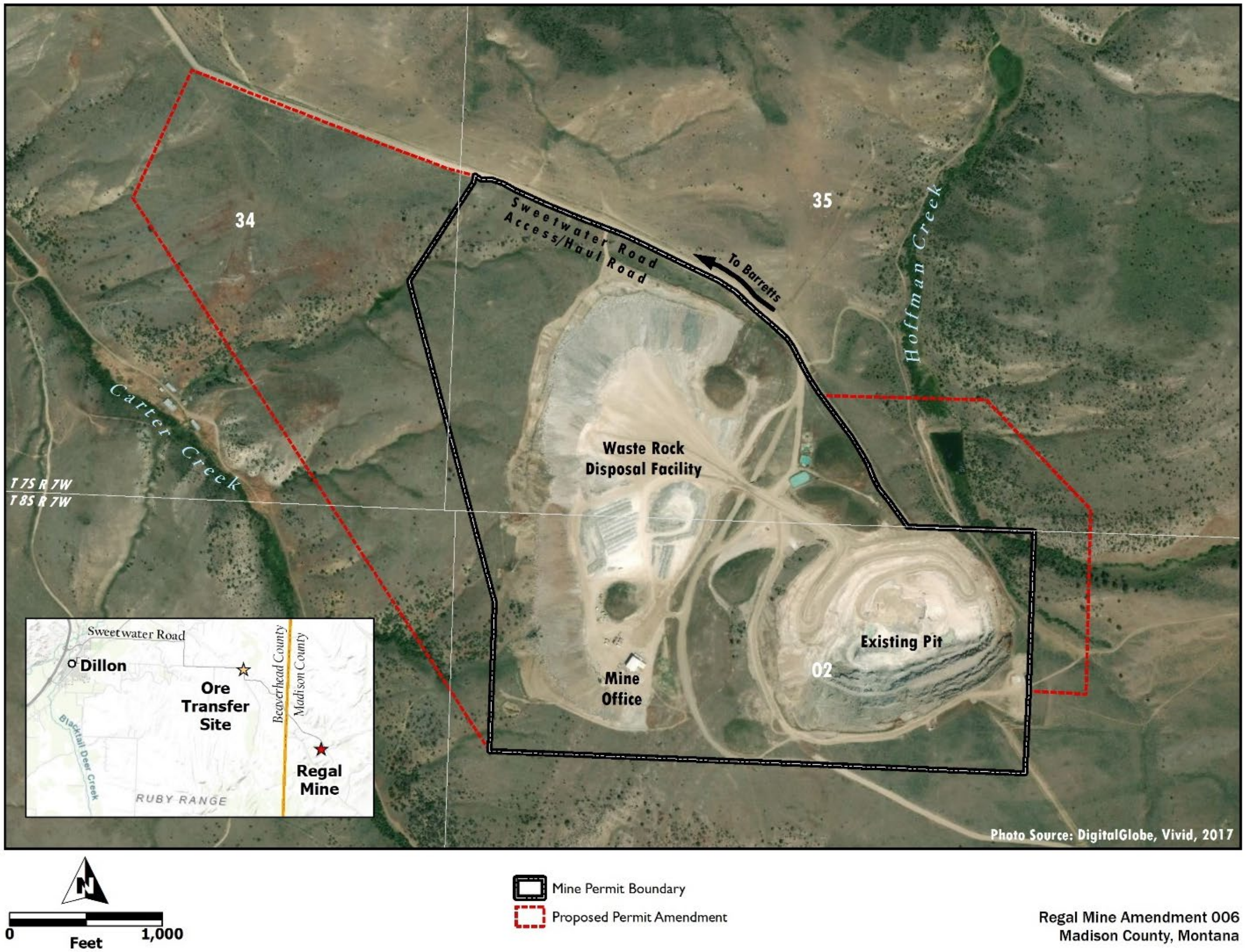

Figure 1.3-1
Project Location, No Action Permit Boundary, and Proposed Action Permit Boundary for the Barretts Minerals Amendment 006 Application

completed a minor Amendment Application to Operating Permit No. 00013 to consolidate previously permitted areas as well as documenting items such as Plan of Operations, reclamation plans, and permit stipulations.

Amendment 004 was issued in 2001 and included expanding the pit to the north, revising the WRDF design (i.e., increasing the footprint and reducing the height of the facility), and implementing a pit dewatering system. Amendment 004 added 63 acres of new disturbance and 13 acres of new permit area.

Minor Revision 05-001 was approved on July 8, 2005, and consisted of a 6.5-acre ore stockpile and transfer site located on private land approximately 4.5 miles northwest of the Regal Mine on Sweetwater Road. The infiltration testing for water disposal via infiltration galleries was approved by DEQ as Minor Revision 05-002 to the operating permit in 2005.

Amendment 005, authorized in 2007, consisted of expanding the WRDF (from 63.3 acres to 123.3 acres) and implementing a revised pit dewatering plan in drainages near the mine for disposing pit water. Amendment 005 also included permanently realigning the Sweetwater Road through the mine site as stipulated in Amendment 004.

Minor Revision 15-001 (approved in February 2015) reclassified a monitoring well as a dewatering well. Minor Revision 15-002 (approved in May 2015) established two new dewatering wells along the east highwall outside the rim of the pit. All three of these dewatering wells discharge to an Underground Injection Control Class V injection well downgradient from the pit. The Environmental Protection Agency approved the UIC well on April 1, 2015. Minor Revision 16-001 allowed for installing four additional monitoring wells, and Minor Revision 16-002 allowed for placing a temporary pipeline in Hoffman Creek channel to temporarily route surface flow through a pipeline (corrugated plastic pipe laid in existing channel) around the mine pit area to reduce surface flow losses.

BMI applied for Amendment 006 to DEQ on March 29, 2018; responded to DEQ comments on June 27, 2018, November 13, 2018, and January 17, 2019; and submitted application revisions on March 18, 2019, and September 27, 2019.

1.4 Scope of the Document

This EIS describes the potential direct, secondary, and cumulative environmental impacts that could result from the No Action Alternative, Proposed Action, and Agency Modified Alternative (AMA) considered in detail. The geographic scope of this EIS covers the lands within the amendment permit area and new disturbance areas within the existing permit boundary.

This document is organized into the following seven 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 WRDF Grading and Mosaic Vegetation Alternative considered in detail. These alternatives were developed based on key issues raised by the public and, as required by MEPA, in consultation with BMI.
- Chapter 3. Affected Environment and Environmental Consequences: Chapter 3 describes in detail the current environment and the potential direct and secondary impacts that result from the No Action Alternative, the Proposed Action, and the WRDF Grading and Mosaic Vegetation Alternative considered. 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 of present and future actions in the area as well as summarizes unavoidable, irreversible and irretrievable, and secondary impacts.
- Chapter 5. Comparison of Alternatives: Chapter 5 provides a summary comparison of the No Action Alternative, Proposed Action, and AMA.
- Chapter 6. Consultation and Coordination: Chapter 6 provides a listing of agencies, groups, or individuals who were contacted or who contributed information.
- Chapter 7. List of Preparers: Chapter 7 provides a list of preparers for the EIS.
- Chapter 8. Response to Comments: Chapter 8 provides a response to comments obtained on the Draft EIS.
- Chapter 9. References: Chapter 9 provides a list of the source materials that were used in preparing the EIS.

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

- Appendix A. Technical Memorandum 1: Barretts Regal Mine Project – Partial Pit Backfill Evaluation
- Appendix B. Technical Memorandum 2: Barretts Regal Mine Project – Water Rights Assessment
- Appendix C. Technical Memorandum 3: Barretts Regal Mine Project –Ground Water Model and Creek Design Assessment

1.5 Agency Roles and Responsibilities

DEQ is the agency responsible for administrating the MMRA and the administrative rules adopted to implement the MMRA. DEQ is responsible for issuing and amending mine operating permits under the MMRA. This EIS is being prepared to provide a comprehensive analysis of potential environmental impacts of the Project. Before the expansion project could begin, other permits, licenses, or approvals may be required from federal, state, and local agencies.

1.5.1 State Agencies

The state agencies listed in **Table 1.5-1** have relevant permits or reviews that would potentially be required for the Project. County permits or approvals are not required for the Project.

Table 1.5-1
Regulatory Authority and Responsibilities of State Agencies Related to the Barretts Minerals Permit Amendment

Potential Permits or Reviews Required (Statutory Reference)	Purpose
Montana Department of Environmental Quality	
Montana Environmental Policy Act, Analysis of Impacts (Title 75, chapter 1, parts 1 through 3, MCA)	MEPA requires that DEQ prepare an EIS before taking state action for any projects that significantly affect the quality of the human environment.
Metal Mine Reclamation Act, Operating and Reclamation Plans (Title 82, chapter 4, part 3, MCA)	Mining must comply with state environmental laws and administrative rules. The MMRA established reclamation standards for lands that are disturbed by mining and generally require that the lands be reclaimed to comparable stability and utility as that of adjacent areas. Reclamation must provide sufficient measures to ensure public safety and prevent air or water pollution and adjacent land degradation.
Montana Water Quality Act, Montana Pollutant Discharge Elimination System (MPDES) (Title 75, chapter 5, MCA)	MPDES establishes effluent limits and treatment standards and regulates point-source discharges of pollutants into state surface waters or to ground water hydrologically connected to state surface waters through MPDES permits. State water quality standards, including nondegradation standards, specify the allowable changes in surface water or ground water quality. An MPDES permit may also authorize discharges of construction storm water and would require developing a Storm Water Pollution Prevention Plan.

Potential Permits or Reviews Required (Statutory Reference)	**Purpose**
Montana Water Quality Act, Section 401 Certification (Title 75, chapter 5, part 4,MCA)	Federal permits related to discharges to state waters must obtain certification from the state that discharges comply with state water quality standards. On February 27, 2018, DEQ certified that the Project would not violate water quality standards under Section 401.
Clean Air Act of Montana, Air Quality Permit (Title 75, chapter 2, parts 1 through 4, MCA)	An Air Quality Permit is required for constructing, installing, and operating facilities and equipment that may cause or contribute to air pollution. Air Quality Permit #3086-01 for the Regal Mine was approved December 28, 2010.
Montana Hazardous Waste Act (Title 75, chapter 10, part 4, MCA)	The act regulates the management of hazardous waste in Montana, including storage and disposal.
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. Sites that are eligible or potentially eligible to the National Register of Historic Places 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 BMI 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 BMI to implement protection, mitigation, and monitoring as approved by SHPO.
Montana Sage Grouse Habitat Conservation Program	
Executive Order 12-2015 and 21-2015	The Montana Sage Grouse Habitat Conservation Program works to sustain viable sage-grouse populations and conserve habitat. The executive order provides for conservation, regulatory protection, and management of sage-grouse in Montana, particularly in Core Areas.

Potential Permits or Reviews Required (Statutory Reference)	Purpose
Montana Department of Natural Resources & Conservation	
Montana Water Use Act (Title 85, chapter 2, parts 1 through 4, MCA)	Surface water or ground water use is controlled through issuance of water rights. BMI's two active water rights are Groundwater Certificate Nos. 41B 86002-00 and 41B 30047773; these water rights are permitted for use as dust control and vehicle cleaning. A new or amended water right would be required to provide potable water for use at the mine.
(§ 85-2-102(4), *et. seq.,* MCA)	Montana Water Law requires a water right whenever an action involves diverting water from its source for a beneficial use or when one wishes to protect a quantity of water in the source for a beneficial use. Pumping ground water away from a mining site and returning it to a specific location for the express purpose of providing flow augmentation in nearby creeks and/or ground water sources is a beneficial use of water and requires a water right.
Montana Natural Streambed and Land Preservation Act (310 Law) (Title 75, chapter 7, part 1, MCA)	As part of the joint application for proposed work in Montana's streams, wetlands, floodplains, and other waterbodies, a 310 permit is required from the local conservation district. The Ruby Valley Conservation District approved a 310 permit on March 7, 2018.

NA = not applicable.

1.5.2 Other Agency Roles

The permit required by the U.S. Army Corps of Engineers (USACE) is listed in **Table 1.5-2**, which has been obtained.

Table 1.5-2
Federal Agencies – Potential Requirements

Potential Permits or Reviews Required (Statutory Reference)	Purpose
U.S. Army Corps of Engineers (USACE)	
Clean Water Act, Section 404 Permit (33 USC § 1344) Permit No. NWO-2013-01385-MTH	The USACE has responsibilities under Section 404 of the Clean Water Act and 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 disposing dredged or fill materials. The USACE also requires Section 401 certification from DEQ (see **Table 1.5-1**). BMI submitted a Section 404 permit application to the USACE for the Project for impacts to Hoffman Spring Creek, Hoffman Creek, and adjacent wetlands. The USACE issued a Department of the Army permit (NWO-2015- 00766-MTH) for discharging fill into Waters of the United States on July 3, 2018.

1.6 Public Involvement and Scoping

On May 3, 2019, DEQ issued a press release stating that BMI's Amendment Application was complete and the environmental review was set to begin (DEQ 2019a). The press release disclosed the time and location of the public scoping meeting, as well as information regarding the EIS and permit application. The press release requested public comment on the Project until June 3, 2019.

DEQ prepared a legal notice for the public scoping meeting. In addition to providing information about the public meeting, the notice described the purpose of the scoping meeting, provided a web link to access the permit application, and identified methods to submit EIS scoping comments. The notice was published in the *Dillon Tribute* (a weekly newspaper) on May 4, 11, 18, and 25, 2019, and June 2, 2019.

DEQ established a public comment scoping period from May 3, 2019, to June 3, 2019 (i.e., 32 calendar days). During this time, DEQ received written and oral comments from the public that were submitted via email, mail, or public meetings. On May 16, 2019, a public meeting was held at the Beaverhead County High School in Dillon, Montana.

1.7 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). Substantive comments pertained to the analysis and contained information or suggestions to be carried forward into the alternative development process. DEQ identified four topic issues to be considered in more detail in the EIS that are briefly discussed in the following sections.

1.7.1 Cultural Resources

The EIS should evaluate cultural and archaeological resources that could be affected by the Project. This issue is discussed in Section 3.2, Cultural Resources.

1.7.2 Ground Water

The EIS should review the impacts to ground water levels from pit dewatering. This issue is discussed in Section 3.4, Ground Water Hydrology.

1.7.3 Surface Water

The EIS should examine the Project's impacts to surface water flow. This issue is discussed in Section 3.5, Surface Water Hydrology.

1.7.4 Water Rights

The EIS should evaluate the Project's potential impacts on water rights. This issue is discussed in Section 3.6, Water Rights.

2.0 DESCRIPTION OF ALTERNATIVES

This chapter describes the alternatives that were evaluated in the environmental review, the alternative screening process, and the rationale for alternatives considered but not analyzed in detail.

2.1 DEVELOPMENT OF ALTERNATIVES

This section describes the process and outcomes of considering reasonable alternatives to the Project. Alternatives with different processes or designs that could potentially minimize the environmental impacts of the Project may be included.

To be considered for further analysis, each potential alternative had to meet the purpose and need of accessing additional ore by increasing the pit size as well as increasing the storage capacity of the waste rock disposal facility (WRDF). Under the Montana Environmental Policy Act (MEPA), an alternative must be reasonable in that it is (1) achievable under current technology, (2) economically feasible as determined solely by the economic viability for similar projects having similar conditions and physical locations, and (3) determined without regard to the economic strength of the specific project sponsor (§ 75-1-201, (1)(b)(iv)(C)(I), Montana Code Annotated [MCA]). Alternatives may include design parameters, mitigation, or controls other than those incorporated into a Proposed Action by an applicant or by Department of Environmental Quality (DEQ) before preparing an Environmental Assessment or draft Environmental Impact Statement (EIS) (Administrative Rules of Montana 17.4.603(2)(a)(ii)). An alternatives analysis for a project that is not a state-sponsored project does not include an alternative facility or an analysis of alternatives to the proposed project itself (§ 75-1-220(1), MCA).

MEPA requires the analysis of environmental impacts of the Proposed Action, a range of reasonable alternatives, and the No Action Alternative. Potential alternatives were identified and developed based on the Amendment Application including DEQ's comments, internal DEQ deliberations and analysis of technical documents (e.g., technical memoranda in Appendices A through C), and public scoping comments. During an initial review of the application, DEQ conducted an environmental analysis and considered and dismissed several alternatives that either had greater impacts to the human environment than the Proposed Action, would not meet the purpose and need, or did not meet the reasonableness criteria. These alternatives are summarized in Section 2.6, Alternatives Considered but Dismissed From Further Analysis.

2.2 NO ACTION ALTERNATIVE: EXISTING PERMIT

The No Action Alternative compares environmental conditions with the proposal and establishes a baseline for evaluating the Proposed Action and other alternatives. MEPA requires that the No Action Alternative be considered, even if it fails to meet the purpose and need or would not be able to satisfy environmental permitting standards.

2.2.1 No Action Overview

Under the No Action Alternative, Barretts Minerals, Inc. (BMI) would continue to operate under its existing operating permit that would allow mining operations to continue through 2021. Mining would be limited to the current permit (i.e., Operating Permit No. 00013) and the associated amendments, modifications, and revisions. The operating permit and amendments are summarized in Section 1.3, Project Location and History.

2.2.2 Permit Boundary and Description of Disturbed Areas

The permit boundary for the currently permitted Operating Permit No. 00013 is shown on **Figures 1.3-1** and **2.2-1**. The current permitted boundary encompasses 243.2 acres located in portions of Sections 2 and 3 of Township 8 South, Range 7 West, and Sections 20, 34, and 35 of Township 7 South, Range 7 West, Montana Meridian. Operating Permit 00013 includes 6.5 acres for the ore transfer site located in Section 20, Township 7 South, Range 7 West (approximately 4.5 miles northwest of the Regal Mine).

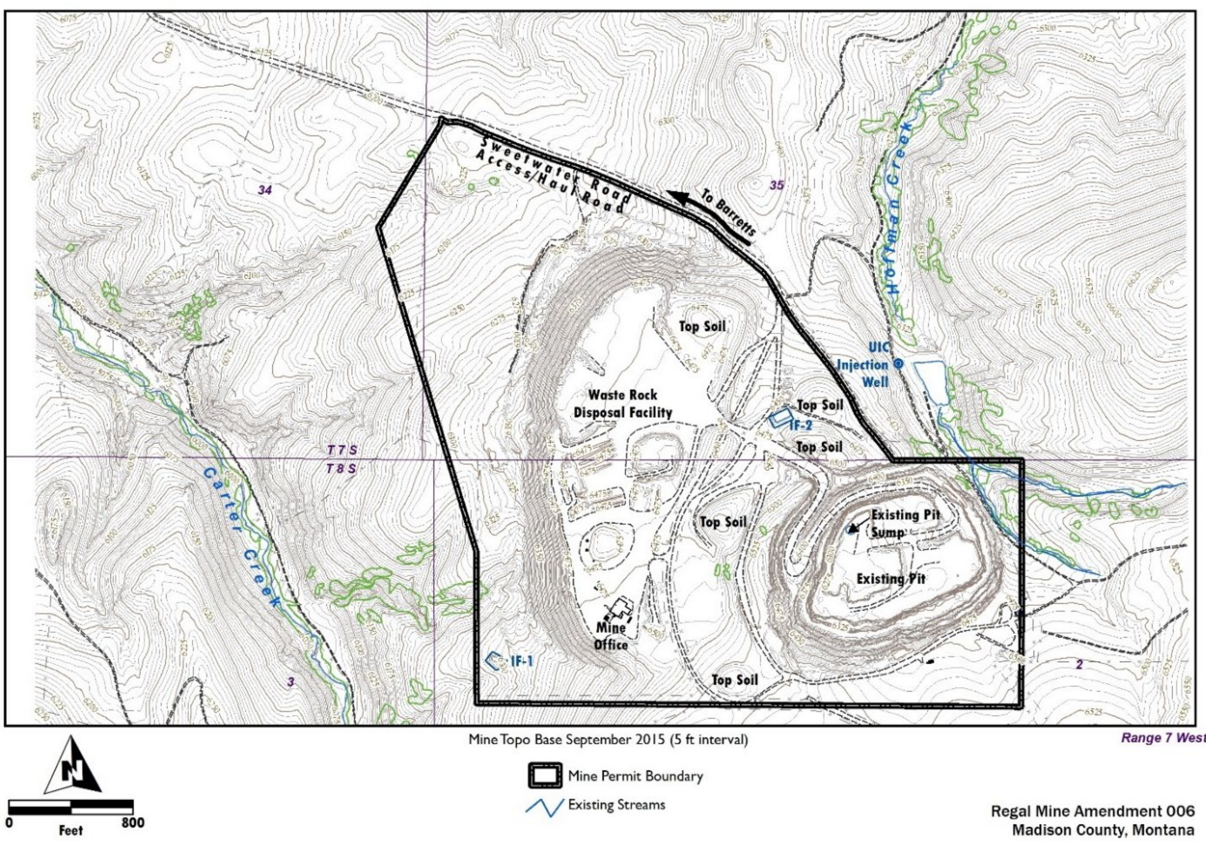

Figure 2.2-1
Existing Site Facilities

Under the No Action Alternative, no acreage would be disturbed outside of the current permitted area; the pit and WRDF would not be increased outside of the current permitted size. Currently permitted disturbance acreage is shown in **Table 2.2-1** (BMI 2019a).

Table 2.2-1
Acreages Associated With Barretts Minerals Currently Permitted Operations

Location or Facility	**No Action Permitted Disturbance (Acres)**
Open Pit	36.6
Waste Rock Disposal Facility	123.3
Soil Stockpiles	11.7
Haul and Access Roads	3.4
Mine Office and Support Facilities	1.7
Ore Transfer Site	6.5
Infiltration Trenches, Wells, Pipelines	6.7
Miscellaneous Disturbances[a]	0
Temporary Reclamation/Revegetated Soil Stockpiles[b]	0
Total Currently Permitted Disturbance	**189.9**

Source: BMI (2019a)
[a] Includes miscellaneous disturbances from last 12 months
[b] Areas reclaimed/revegetated but not released from bond.

The permitted disturbance is 189.9 acres. As of May 2017, approximately 162 acres have been disturbed. The WRDF has a permitted size of 123.3 acres, of which 65.2 acres have been disturbed as of May 2017 (BMI 2019a).

Under the No Action Alternative, no changes would occur to the associated facilities permitted under Operating Permit No. 00013. The current mine facilities at the Regal Mine are shown on **Figure 2.2-1** and summarized in the following text. Mining operations under the No Action Alternative would likely continue through 2021 and mine capacity, design, and processes would be limited to the current permit.

2.2.3 Mine Pit and Operations

Talc ore occurs as lenses and tabular veins that strikes east and west, and dips to the north along the contact between the lower schist and overlying dolomitic marble. Waste rock at the Regal Mine includes dolomitic marble, amphibolite, diabase dikes, schist, and gneiss. Mining at the Regal Mine uses a conventional open pit method that consists of drilling, blasting, loading, and hauling. Mining equipment includes 50-ton haul trucks, dozers, grader, loader, water truck for dust control, lubricant truck for servicing, and light duty vehicles. Drilling is conducted to prepare 30-foot benches for blasting with an emulsion-type explosive. To minimize fines, ore is normally mined using an excavator, loader, and/or shovel; if required, minimal explosive charges are used. Annual ore production of approximately 200,000 tons would continue through 2021 (BMI 2019a).

The open pit encompasses approximately 38 acres along the eastern edge of the mine permit boundary (**Figure 2.2-1)**. The permitted pit design is 450 feet deep with a pit-bottom elevation of approximately 6,080 feet and a rim elevation of 6,530 feet. The mine pit is constructed using double benching, which leaves a 27-foot-wide catch bench at 60-foot intervals or every two 30-foot-high production bench. The 60-foot-wide pit access ramp is located on the north wall of the pit and has an 8 percent grade. The access ramp at the bottom benches is a single-lane, 35-foot-wide road with a 10 percent grade.

2.2.4 Waste Rock Disposal Facility

Overburden and waste rock are transported from the mine pit to the WRDF (**Figure 2.2-1**). The facility is constructed with a combination of valley/side hill fill by end dumping in a single lift (Hydrometrics, Inc. 1996). The WRDF is permitted for up to 123.3 acres of disturbance, and as of May 2017, the facility consisted of 65.2 disturbed acres. The permitted WRDF design has a flat top at an elevation of approximately 6,475 feet and is approximately 200 feet high.

2.2.5 Water Management System

Water management at the Regal Mine includes means for capturing, handling, and disposing of water. Infiltration features, wells, and pipelines make up approximately 1.6 acres of disturbance (as of May 2017).

2.2.5.1 Dewatering Well System

Ground water is captured by six dewatering wells located around the perimeter of the mine pit. In 2016, dewatering wells pumped a total of 135 gallons per minute (gpm) on a year-round basis to keep the water level below the bottom of the pit (Hydrometrics, Inc. 2019a). Two wells (RMG-1 and RMG-3) are used for dust suppression; water rights from these wells restrict maximum volume to a combined 10.53 acre-feet (ac-ft) per year and a maximum flow rate of 55 gpm (BMI 2019). BMI submitted an application to DNRC to increase the appropriation on well RMG-3 to 10 ac-ft per year, which would increase the combined total appropriation from the two wells to 19.67 ac-ft per year and a maximum combined extraction rate of 70 gpm (BMI 2019a) (BMI 2019d).

2.2.5.2 Pit Sump

A pit-bottom sump pump captures ground water and storm water at a rate of approximately 8 gpm (Hydrometrics, Inc. 2019b). Nitrate concentrations in the pit sump water have averaged 3.66 milligrams per liter since 2014. This concentration is below the allowable ground water discharge criteria of 7.5 milligrams per liter for nitrate, and when comingled with dewatering well water, is further diluted before being discharged.

2.2.5.3 Infiltration Galleries

Water collected during pit dewatering flows through piping and is released to two existing infiltration basins (IF-1 and IF-2) (**Figure 2.2-1**). Infiltration basins (also referred to as infiltration ponds, infiltration trenches, or infiltration galleries within the Amendment Application) are structures that allow water to infiltrate or seep back into the underlying soil and ground water. IF-1 is used to reinject ground water into the subsurface in the Carter Creek drainage. In 2016, the injection rates into IF-1 and IF-2 were 70 and 16 gpm, respectively (Hydrometrics, Inc. 2019a).

2.2.5.4 Underground Injection Control Well

The U.S. Environmental Protection Agency approved an Underground Injection Control (UIC) well at the Regal Mine in 2015. A UIC well operates like a water well but in reverse (i.e., pumping water into the ground rather than out). The UIC well is located downgradient of the pit and adjacent to Hoffman Creek. The well reinjects water (from pit dewatering well water) and provides recharge to the alluvium below the pond on Hoffman Creek. The UIC well is designed to inject up to 120 gpm (Hydrometrics, Inc. 2019a). The injection rate in 2016 was 93 gpm.

2.2.5.5 Hoffman Spring Creek and Hoffman Creek

Alluvial ground water seeping into the pit resulted in measurable reduced flow in Hoffman Creek. Current flow mitigation is achieved by using a temporary pipeline that is laid in the channel of Hoffman Creek as approved in Minor Revision 16-002.

2.2.6 Soil Salvage and Stockpiles

Soil or growth media material is salvaged from slopes with less than 50 percent grade. The uppermost foot of soil is stockpiled separately from the subsoil and coarse fragments. Stockpiles are seeded to minimize erosion and runoff. Based on 2017 data, the site currently has 13.2 acres of disturbance for soil stockpiles and an additional 15.8 acres that are described as temporarily reclaimed soil stockpiles. Existing stockpiles cover approximately 29 acres and contain approximately 287,155 cubic yards (yd^3). Existing stockpiles are sufficient to meet reclamation requirements (BMI 2019a). Stockpiles are located between the mine pit and the WRDF, as shown on **Figure 2.2-1**.

2.2.7 Transportation, Haul, and Access Roads

Access to the mine occurs via Sweetwater Road, which is a public gravel road that passes through the mine permit boundary between the pit and the WRDF. Sweetwater Road passes through an underpass culvert with haul traffic from the pit to the waste dump passing overhead.

The haulage route from the mine uses Sweetwater Road. Ore is hauled in 50-ton trucks from the mine pit to an ore transfer station. The ore transfer site is located 4.5 miles northwest of the Regal Mine on Sweetwater Road; the site is 6.5 acres and owned and maintained by the ore haulage contractor. From the ore transfer site, talc ore is transported in 20-ton trucks to BMI's existing mill facility. At the current production, haul rates from the ore transfer station to BMI's mill average 10 to 15 round trips per day (BMI 2019a).

With the No Action Alternative, access roads and pit haul roads would continue to be maintained for safe conditions. Haul traffic would continue to occur 4 days per week, 9 to 10 hours per day, approximately 200 days per year through 2021.

2.2.8 Ore Processing

BMI's mill is located approximately 8 miles south of Dillon, MT. At the mill, talc is crushed, screened, and processed in wet or dry cycles before packaged for shipment via truck or rail.

2.2.9 Workforce

Under the No Action Alternative, workforce levels would be expected to remain the same and operations would continue into approximately 2021. Although ore reserves would support operations beyond 2021, the mine life would not be extended because additional pit disturbance and waste rock disposal capacity would not be available. The Regal Mine employs approximately 15 staff, and the contracted haulers employ approximately 12 staff. BMI's mill employs 65 people; the mill is operated using source material talc from both the Regal Mine and the Treasure Mine (i.e., 60/40 split).

2.2.10 Reclamation

Information in this section regarding the existing reclamation plan for the current permitted mine operations for the Regal Mine (the No Action Alternative) is summarized from the Barretts Minerals, Inc. Life-of-Mine Expansion Plan Regal Mine, Madison County, Montana (RMA 2006). The existing permitted closure design is shown on **Figure 2.2-2**.

2.2.10.1 Pit Reclamation

The pit reclamation plan includes a pit lake, retained highwalls, talus slopes, soil placement, and seeding select areas. At the time of Amendment No. 005, the pit lake was estimated to be at

23 acres in size with a lake elevation of approximately 6,380 feet (RMA 2006). Talus (or broken rock piles) would be generated using blasting or backfilling and placed in the pit on the southwestern side of the pit to enhance geotechnical stability. The final pit access ramp would be sloped at 8 percent in the zone of the pit lake water level to provide shallow water areas for aquatic habitat. Benches would be left in stable condition, topsoiled, and seeded. The pit would be surrounded by a 4-foot-high berm and 4.5-foot-high fence.

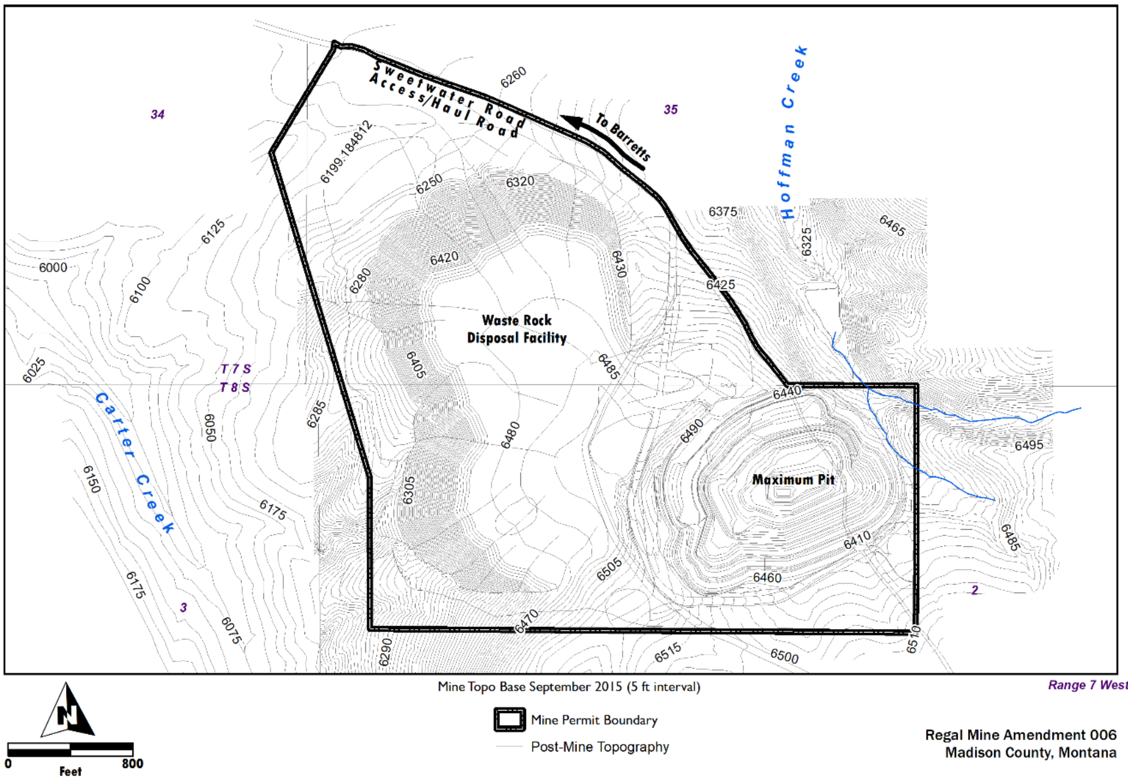

Figure 2.2-2
Permitted Postclosure Topography

2.2.10.2 Waste Rock Disposal Facility Reclamation

The reclamation plan for the WRDF includes graded surfaces, topsoil, seeding, and erosion-control measures. The reclaimed slopes would be graded to slopes less than 50 percent and blended with adjacent drainages and landforms. The WRDF would be reclaimed by adding 24 inches of stockpiled soil to the top of the facility and slopes less than 33 percent. For slopes steeper than 33 percent, 12 inches of soil would be added. Drainages on the waste rock would be lined with rock to control erosion.

2.2.10.3 Reclamation of Other Disturbances

Haul roads and the ore transfer site would be reclaimed with 24 inches of topsoil and revegetated. Sweetwater Road would remain as a public access road and the culvert would be removed. Pipeline corridors would be reclaimed immediately following construction and would remain buried at closure. Infiltration galleries would be reclaimed. Dewatering wells and the UIC well would be properly plugged and abandoned.

2.2.10.4 Soils and Revegetation

Before applying topsoil, areas with compacted soils would be ripped and graded. Reclamation soils would be applied evenly, and seeding would be conducted shortly following seedbed preparation. Fertilizer amendments, reseeding, or other measures would be used if needed.

As of 2019, no areas within the Regal Mine have been released from reclamation bond. Under the No Action Alternative, no areas would be disturbed outside of the existing permit boundary; therefore, no additional reclamation planning or actions would be necessary other than what is currently permitted.

2.3 Proposed Action

BMI submitted an Amendment Application that proposes to enlarge the open pit and expand the WRDF to extend the life of the Regal Mine. The proposed amendment also proposes modifications to the ground water capture and infiltration system that would realign Hoffman Spring Creek and modify Hoffman Creek.

2.3.1 Proposed Action Overview

The Proposed Action would expand and deepen the mine pit, increase the size of the WRDF, and expand the mine's water management system. BMI is seeking to add 136.9 acres to the mine permit boundary to increase the size of the permit to approximately 380.1 acres and expand the open pit by almost 8.8 acres for a total pit area of 45.4 acres. As part of the expansion, the pit walls would be pushed back on the north and east sides and deepened to a final pit-bottom elevation of approximately 5,990 feet above mean sea level (i.e., 540 feet deep). BMI expects it would recover an additional 0.45 million yd^3 of talc ore with the permit amendment and the proposed amendment would increase the size of the WRDF by 41.4 acres for a total area of 172 acres. The expansion would extend the life of the mine by approximately 6 years.

The Proposed Action would include seven new pit dewatering wells, a settling pond, and a new infiltration gallery (IF-3) to replace existing IF-2. Ground water would continue to be intercepted by the dewatering wells and diverted into the proposed infiltration pond. The infiltration gallery would be designed to accept a continuous flow of 500 gpm.
The Proposed Action would include several modifications to Hoffman Spring Creek and Hoffman Creek. The expanded pit would intersect Hoffman Spring Creek and require approximately 730 feet of channel to be permanently relocated to the northeast. The new channel would be lined to prevent seepage, and changes would include an upstream catchment

basin and a downstream subsurface cutoff wall. Approximately 600 feet of Hoffman Creek would be sealed with bentonite clay.

2.3.2 Expansion Boundary and Description of Disturbed Areas

In total, the Proposed Action would expand the mine permit boundary by 136.9 acres, including 31.0 acres to the east of the existing permit boundary to accommodate the proposed pit expansion and associated Hoffman Spring Creek realignment, and 105.9 acres to the west of the existing permit boundary to accommodate the expanded WRDF and new infiltration pond (IF-3).

The Proposed Action would increase disturbance by 60.2 acres to a total of 250.1 acres and increase the total open pit by 8.8 acres. The WRDF would increase by 41.4 acres. Disturbance associated with water management would increase by 10 acres and includes a new infiltration gallery (IF-3), sedimentation pond (SED-1), new dewatering wells, new pipelines, and surface water runoff ditches and desilting basins below the WRDF. All of the soil stockpiles, haul and access roads, mine office and support facilities, and the ore transfer site are within the existing permit boundary and, therefore, do not contribute to new disturbances.

Table 2.3-1 compares the acreage of disturbance components between the No Action Alternative and the Proposed Action. The change in permit boundary acreage does not directly equate to new disturbance, because some newly proposed disturbance occurs within the current mine permit boundary. A map of the Proposed Action site facilities is provided on **Figure 2.3-1**.

2.3.3 Mine Pit and Operations

The Proposed Action would increase the open pit size by 8.8 acres. Six acres would be located inside the current permit boundary and 2.8 acres would be located within the expansion boundary (**Figure 2.3-1**). Under the Proposed Action, the pit walls would be pushed back on the north and east sides. The mine pit would be deepened an additional 90 feet to a final pit-bottom elevation of approximately 5,990 feet above mean sea level (i.e., 540 feet deep). The Proposed Action pit topography is shown on **Figures 2.3-2** and **2.3-3**.

The premining water table elevation was approximately 6,360 feet and the proposed pit would extend approximately 370 feet into the local bedrock aquifer, as shown on **Figure 2.3-3**, which would require dewatering as described in Section 2.3.5, Water Management System. The proposed pit expansion includes realigning a portion of Hoffman Spring Creek located on the northeast side of the pit (see Section 2.3.6, Flow Augmentation).

Table 2.3-1
Acreages Associated With Barretts Minerals Operations – No Action Alternative and Proposed Action

Location or Facility	No Action Alternative (Acres)	Proposed Action (Acres)	Total (Acres)
Open Pit	36.6	8.8	45.4
WRDF	123.3	41.4	164.7
Soil Stockpiles	11.7	0	11.7
Haul and Access Roads	2.6	0	2.6
Relocated Sweetwater Road	0.8	0	0.8
Mine Office and Support Facilities	1.7	0	1.7
Ore Transfer Site	6.5	0	6.5
Infiltration Trenches, Wells, Pipelines	6.7	10	16.7
Total Disturbance	**189.9**	**60.2**	**250.1**
Permit Boundary	**243.2**	**136.9**	**380.1**

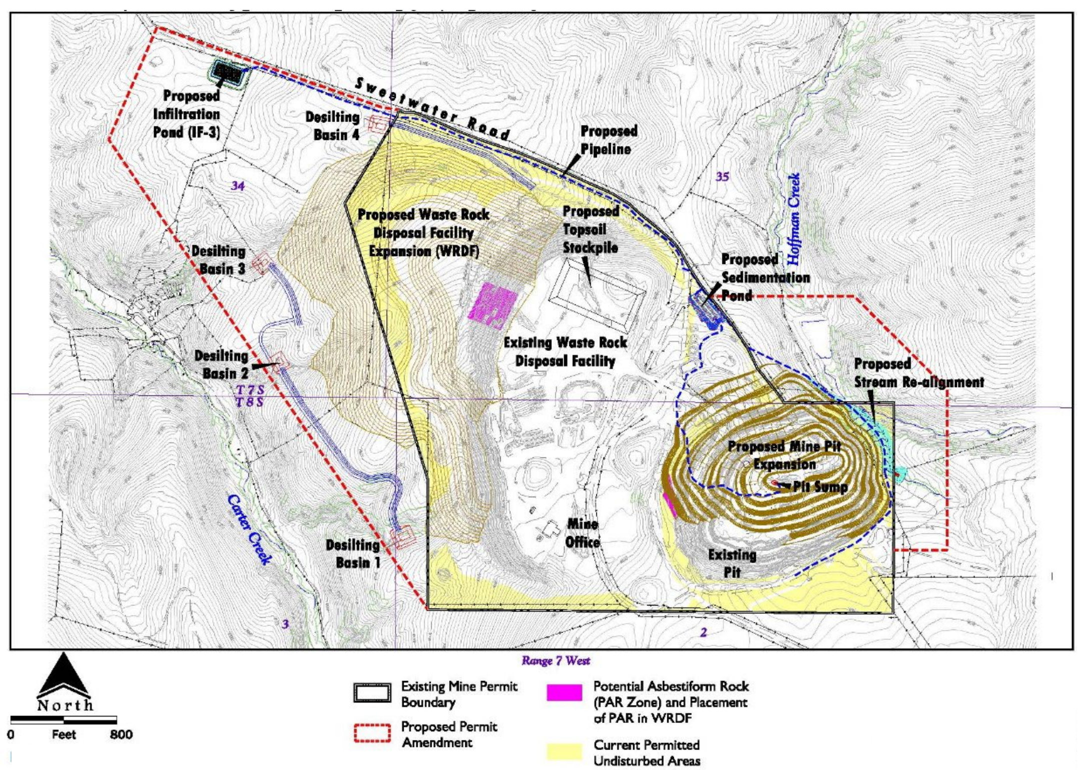

Figure 2.3-1
Proposed Action New and Expanded Site Facilities

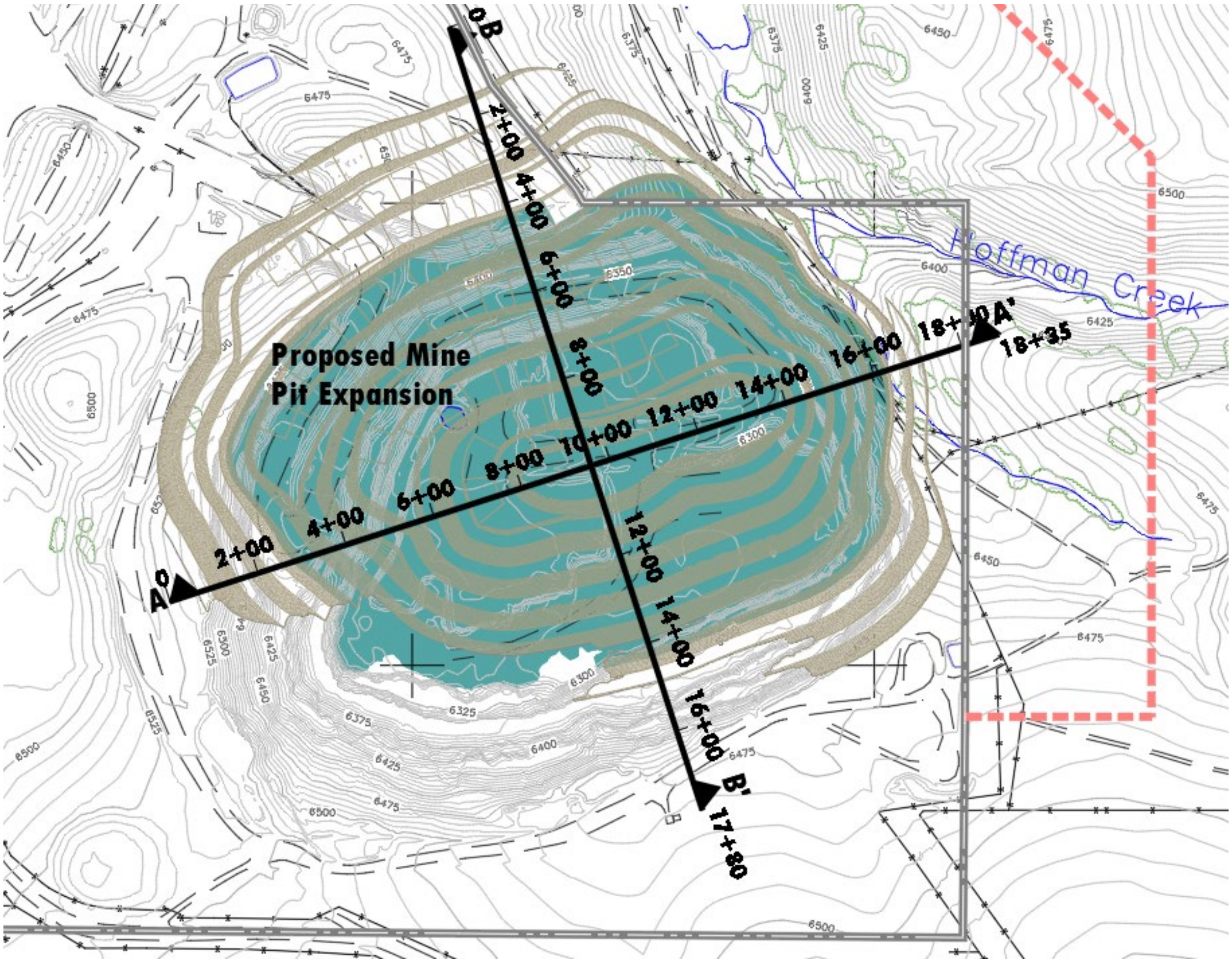

Figure 2.3-2
Proposed Action Pit Slope Design

Mining methods and equipment would be the same as current operations described under the No Action Alternative (Section 2.2.3, Mine Pit and Operations). Benching and pit access design would be similar as the permitted pit.

BMI expects it would recover 0.45 million yd^3 of talc ore from the mine pit expansion. Approximately 8.3 million yd^3 of waste rock would be extracted under the Proposed Action, including approximately 39,500 yd^3 of potentially asbestiform rocks. Geology and geochemistry of ore, waste rock, and potentially asbestiform rocks are described in Section 3.3, Geology and Geochemistry.

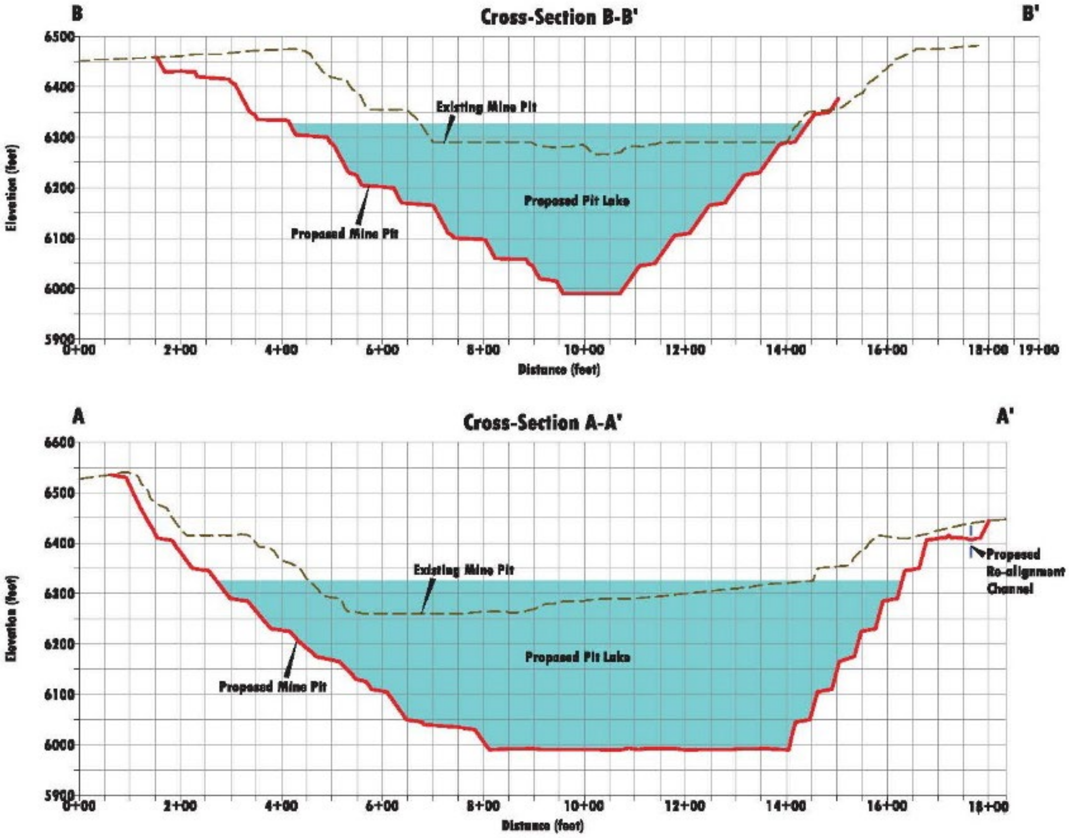

Figure 2.3-3
Proposed Action Pit Cross Section; Existing Mine Pit Profile Based on 2015 Topography (Cross-Section Locations Shown on Figure 2.3-2)

2.3.4 Waste Rock Disposal Facility

The location of the WRDF and proposed final topography are shown on **Figures 2.3-4** and **2.3-5**. The WRDF would be expanded to the west and northwest of the currently permitted extent. The toe of the facility will be approximately 760 feet from Carter Creek.

Under the Proposed Action, the size of the WRDF would be expanded by 41.4 acres, of which 23.9 acres would be located within the expanded permit boundary (**Figure 2.3-4**). The proposed WRDF expansion would have a total designed capacity of up to 11.6 million yd^3, although only approximately 8.3 million yd^3 of waste rock would be placed in the WRDF expansion.

Before expanding the WRDF, vegetation and soil would be removed and stockpiled. Waste rock disposal would occur by end dumping and dozer grading in lifts that range from 30 to 75 feet in height. The top elevation of the WRDF would be 6,480 feet with a maximum fill height of 220 feet. The side slopes would be constructed at an angle of 2.5 horizontal to 1 vertical (2.5:1).

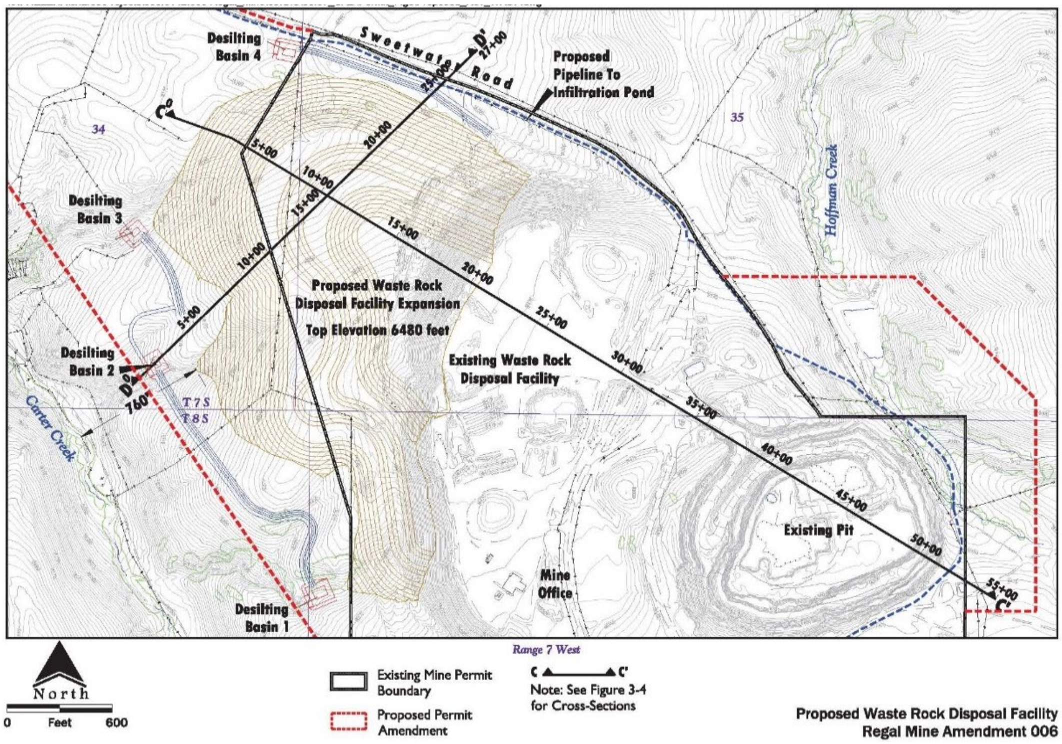

Figure 2.3-4
Proposed Action Waste Rock Disposal Facility

Approximately 7.3 acres would be disturbed as part of the storm water management system associated with the WRDF expansion. Diversion channels would be constructed with rock along the slopes to collect and divert runoff from the 100-year/24-hour design storm. Four desilting basins would be constructed below the downstream end of the diversion channels to reduce flow velocities and suspended sediment concentrations before releasing flow into natural drainages (**Figure 2.3-4**). The desilting basins would have capacity to accommodate a 2-year/24-hr storm.

2.3.5 Water Management System

The Proposed Action would add seven new pit dewatering wells, a settling pond (SED-1), and a new infiltration gallery (IF-3) to replace IF-2. Ground water would continue to be intercepted by the dewatering wells and diverted into the proposed infiltration pond.

2.3.5.1 Dewatering Well System

Under the Proposed Action, seven new dewatering wells would be installed to replace the existing dewatering wells. Three of the existing dewatering wells would become too shallow to draw down the water table and three wells would be removed as the pit is expanded. The proposed well locations are shown on **Figure 2.3-6**. The new dewatering wells would extract a combined 595 gpm.

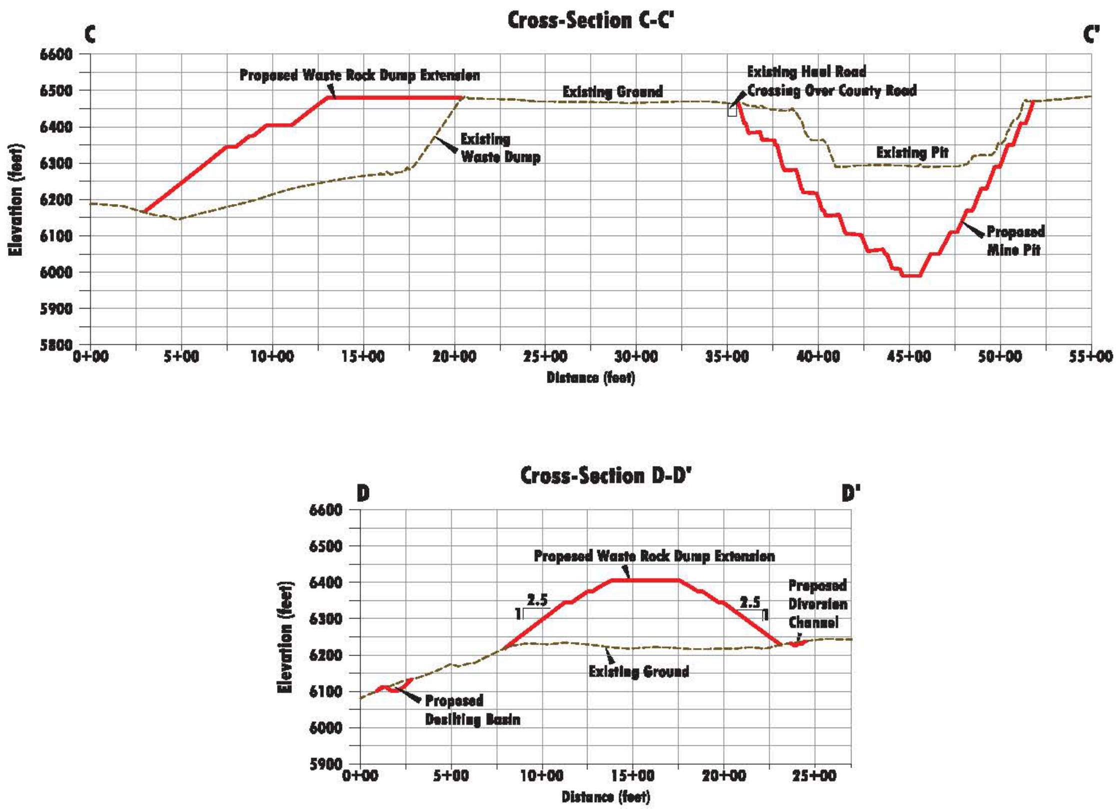

Figure 2.3-5
Proposed Action Waste Rock Disposal Facility Cross Section; Existing Mine Pit Profile Based on 2015 Topography (Cross-Section Locations Shown on Figure 2.3-4)

Existing wells RMG-1 and RMG-3, which are used for dust suppression, would continue to be used, though the wells would likely need to be deepened or replaced with another nearby well to continue to provide water.

2.3.5.2 Pit Sump

Consistent with the No Action Alternative, water that reaches the bottom of the mine pit would be pumped out of the pit sump. The mine pit sump is excavated 10 to 15 feet below the bottom of the active pit and would be pumped using a submersible or self-priming pump. Because the mine pit will be deeper under the Proposed Action, flow to the pit sump would be greater (approximately 25 gpm).

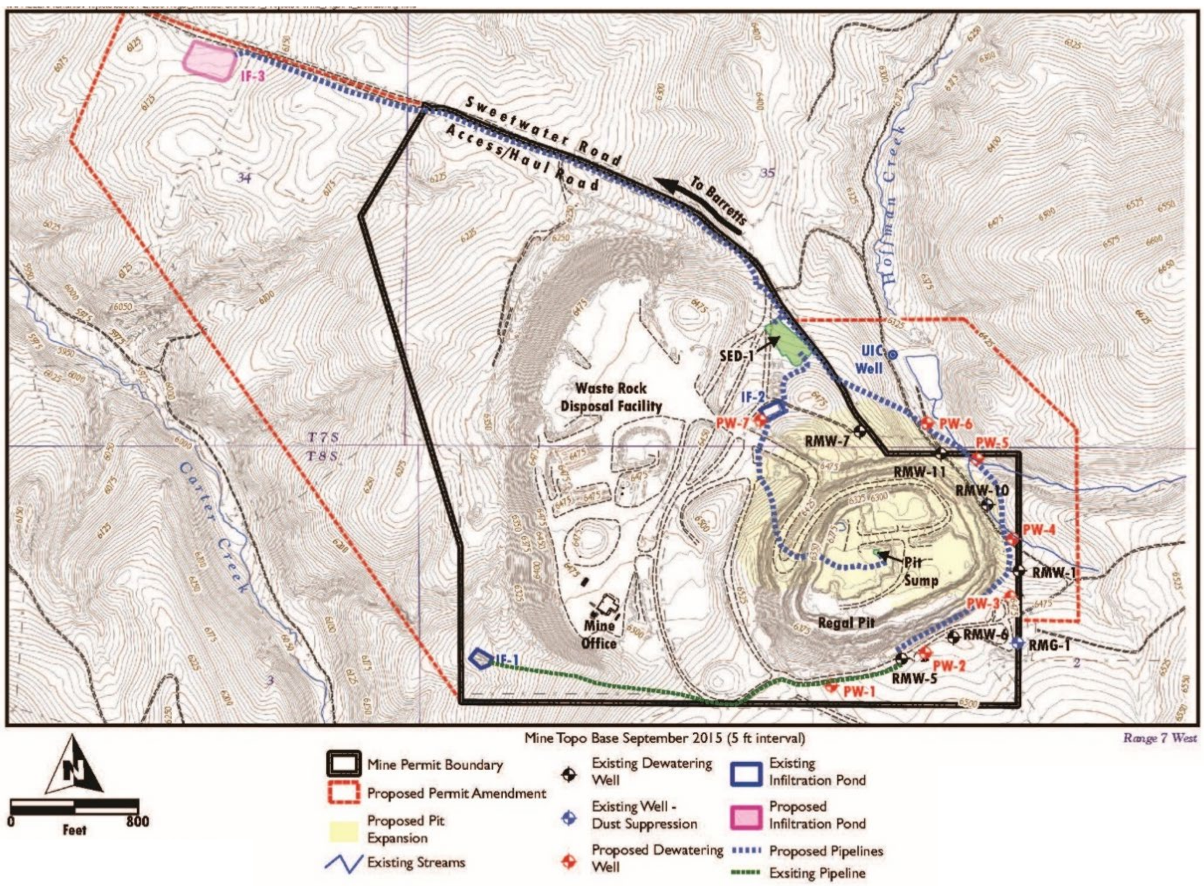

Figure 2.3-6
Current and Proposed Pit Dewatering and Infiltration Components

2.3.5.3 Infiltration Basins

A new infiltration basin (IF-3) would be constructed and existing IF-2 would be closed and reclaimed. IF-3 would be located approximately 0.75 mile northwest of the mine pit (between the Hoffman Creek and Carter Creek watersheds) and downgradient to ensure that pumped ground water does not flow back into the pit. IF-3 would have a footprint of 0.4 acre, total depth of 6.8 feet, and design water storage depth of 4.8 feet (96,000 cubic feet [ft^3]). The basin would be lined with a geotextile and rock and would accept a continuous flow up to 500 gpm.

A new pipeline would be constructed along Sweetwater Road to route water to IF-3. The pipeline would be buried 5 feet below the ground surface to protect it from freezing and damage from mine equipment. The locations of existing and proposed infiltration basins, as well as a proposed new water pipeline, are shown on **Figure 2.3-6**.

2.3.5.4 Underground Injection Control Well

The existing UIC well is shown on **Figure 2.3-6**. Under the Proposed Action, this well would continue to inject water into the alluvium along Hoffman Creek during and after mining until flow augmentation of Hoffman Creek is no longer required.

2.3.5.5 Settling Pond

The Proposed Action includes a new 1-acre settling pond (SED-1) located north of the mine pit (**Figure 2.3-6**). The settling pond would be constructed to accept up to 250 gpm with a hydraulic retention time of 18 hours and would be used to reduce suspended sediment concentrations in the pit sump water before being piped to IF-3. Based on an influent TSS value of 200 mg/L, the sediment pond would have a 1-year solids retention volume (4,860 cubic feet).

2.3.6 Flow Augmentation

Impacts to surface water flows in Hoffman Creek and Carter Creek are anticipated to occur as a result of pit dewatering. BMI would dispose of dewatering water during operations, and as a mitigation measure to ensure that beneficial use is supported and water rights are not negatively impacted, BMI would augment stream flow during the postclosure phase of the project. BMI would augment flow in Hoffman and Carter creeks as necessary in accordance with the nondegradation requirements under ARM 17.30.715(I)(a) and 82-4-355, MCA.

During operations, Spring SP-1 would be impacted by dewatering, although discharge of dewatering water from one of the new dewatering wells or RMG-1 or RMG-3 would be discharged into a collection trap or pond at the head of the new portion of Hoffman Spring Creek near SP-1.

Following the end of pit dewatering, flow augmentation may be required in Hoffman and Carter creeks. Water for augmentation would be pumped from wells RMG-1 and/or RMG-3; the calculated volume of water needed for flow augmentation is 10.81 acre-feet per year.

Flow augmentation of Carter Creek would be accomplished by recharging the alluvium associated with IF-1 at rates ranging from 1.4 to 2.9 gpm for the period of December through February. For Hoffman Creek, the UIC well could be used to inject water into the alluvium; estimated flow augmentation rates range from 5.6 to 29 gpm for Hoffman Creek for the period between August and March. The ground water modeling results predict that flow augmentation may be required for 15 years on Carter Creek and 65 years on Hoffman Creek [Hydrometrics, Inc. 2019c]. Flow augmentation infrastructure would remain in place for a minimum of 5 years following cessation of active mine operations and until sufficient flow conditions are reestablished to meet regulatory criteria.

2.3.7 Modifications to Hoffman Spring Creek and Hoffman Creek

The proposed mine pit expansion and associated safety bench and pit berm would extend into a portion of a tributary to Hoffman Creek, which is referred to as Hoffman Spring Creek. Hoffman Spring Creek is a spring-fed tributary with intermittent flow. The Proposed Action stream design was based on an iterative process between BMI, DEQ, U.S. Army Corps of Engineers (USACE), and Madison County Conservation District. The Proposed Action would include several modifications to Hoffman Spring Creek and Hoffman Creek, as shown on **Figure 2.3-7**.

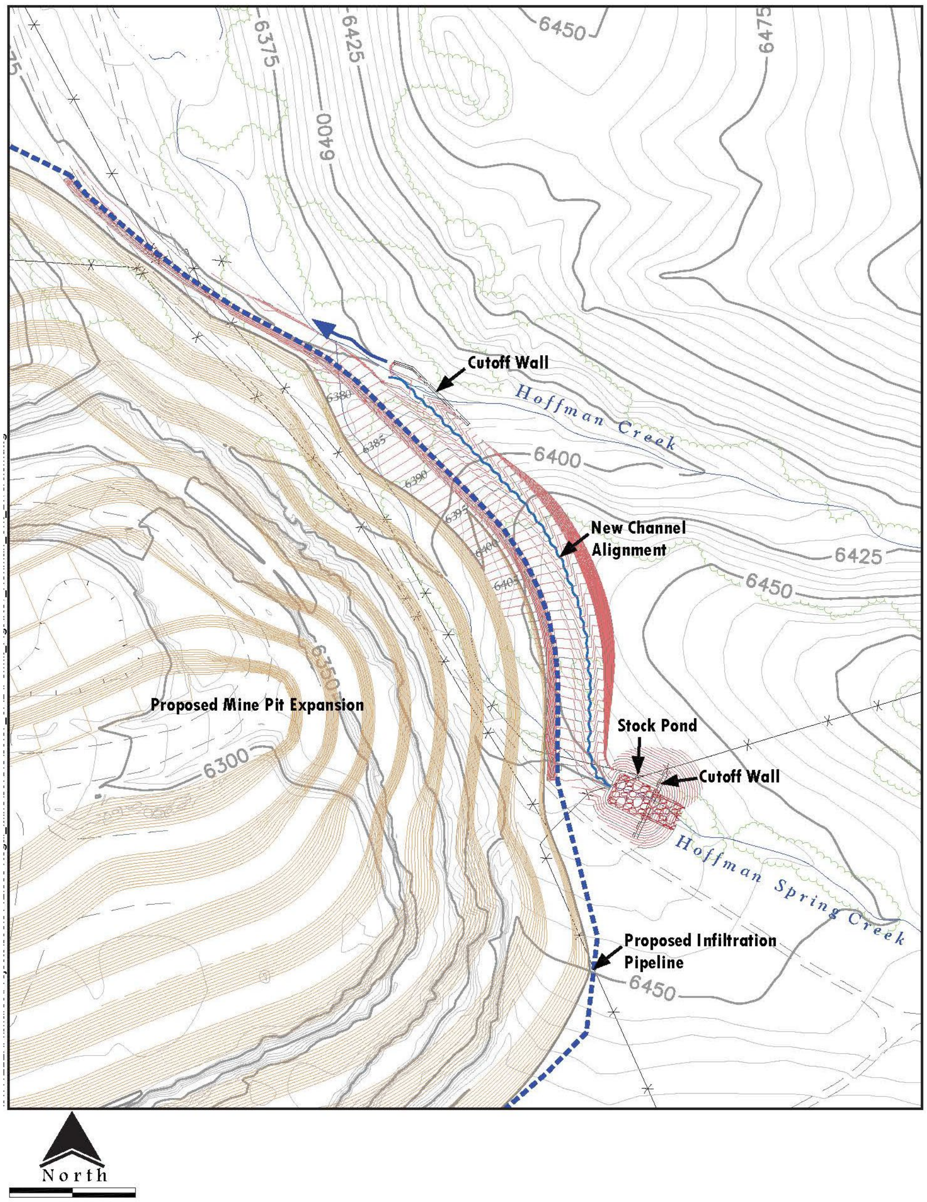

Figure 2.3-7
Proposed Action Hoffman Spring Creek Alterations

2.3.7.1 Hoffman Spring Creek

The expanded pit would intersect Hoffman Spring Creek and impact approximately 730 feet of channel to the northeast of the mine pit. Approximately 530 feet of channel would be removed and reconstructed on a safety bench located at the top of the proposed pit expansion highwall. The cut slope into the eastern side of the channel is steep with a slope of 0.5 horizontal to 1 vertical (0.5:1). The new channel segment would be lined with 100 mil (i.e., 0.1 inch) thick, high-density polyethylene and geoweb to prevent infiltration. The channel is designed to convey flow from a 100-year/24-hr storm event, and the rock armoring would withstand flow from a 10-yr/24-hr storm event.

The Proposed Action would also include an upstream pond to collect natural flow, direct water into the realigned channel, and provide water for livestock (**Figure 2.3-7**). Two subsurface cut off walls would be constructed to direct shallow alluvial ground water flow into the creeks; one wall would be located at the upstream side of the new catchment basin and the other at the upstream side of the confluence of Hoffman Creek and Hoffman Spring Creek.

2.3.7.2 Hoffman Creek

To reduce surface water infiltration from Hoffman Creek into the bedrock and the Regal Mine pit, BMI proposes to seal approximately 600 feet of the Hoffman Creek channel. The channel sealing would involve removing rock and surface debris from the existing channel bed and bank, incorporating bentonite granules into the bed and bank, and replacing rock and surface debris with additional fascines (i.e., a bundle or sticks or other material used to strengthen a structure and reduce erosion) to capture suspended sediment. After the seal is completed, the corrugated piping would be removed to reestablish flow in the channel. The USACE approved this channel modification using bentonite in BMI's 404 Permit (404 Permit No. NWO-2015-00766-MTH) (USACE 2018).

2.3.7.3 Permitted Mitigation

Mitigating impacts to Hoffman Spring Creek and Hoffman Creek are required as part of the Proposed Action under approved USACE 404 permit and DEQ 401 certification. This permit and certification include the following specific conditions:

- Mitigating permanent stream and wetland impacts by purchasing credits from the Upper Missouri River Mitigation Bank;
- Using best management practices to minimize turbidity, erosion, and other water quality impacts such as:
  - Isolating in-water work areas to the maximum extent practicable;
  - Implementing practical best management practices on disturbed banks and within waters to minimize turbidity during in-water work;
  - Using clean fill material free of toxic materials in toxic amounts;

- Stockpiling construction debris, excess sediment, and other waste material above the ordinary high water mark;
- Preventing contamination to any surface water by inspecting all equipment for petroleum leaks and repairing equipment and by fueling, operating, maintaining, and storing vehicles in upland areas that minimize disturbance to habitat; and
- Stabilizing and revegetating cut slopes adjacent to waterbodies for erosion prevention.

2.3.8 Transportation, Haul, and Access Roads

Under the Proposed Action, haul roads would be extended from the mine pit to the expanded WRDF and constructed within the footprint of the mine pit and the WRDF (**Figure 2.3-1**). Mine access and traffic, including ore transport, would be the same as the No Action Alternative (Section 2.2.7, Transportation, Haul, and Access Roads).

2.3.9 Ore Processing

Ore would continue to be processed off site at BMI's mill, which is the same as the No Action Alternative (Section 2.2.8, Ore Processing).

2.3.10 Workforce

Workforce at the Regal Mine and BMI's mill would be the same as the current workforce described under the No Action Alternative (Section 2.2.9, Workforce).

2.3.11 Reclamation

Regal Mine reclamation under the Proposed Action would be similar to the No Action Alternative, but additional acreage would be incorporated that would include reclaiming new Proposed Action facilities (including the new infiltration gallery IF-3, sediment pond, diversion ditches, wells, and pipelines). With the exception of the lower lifts of the WRDF, the Proposed Action reclamation would begin at the end of mining and be completed within 2 years.

2.3.11.1 Pit Reclamation

The expanded mine pit reclamation would to be similar to the No Action Alternative or currently permitted reclamation plan, but the final pit would be larger under the Proposed Action. At closure, the open pit would be 45.4 acres with a 27-acre pit lake. After mining and dewatering activities are completed, the pit would gradually fill with water. The pit lake is predicted to receive inflow from the ground water flow system as well as direct precipitation. Outflow would occur as downgradient ground water flow and evaporation. The pit lake would contain approximately 1.45 billion gallons (i.e., 4,460 acre-feet) of water and would be derived primarily from native ground water and to a lesser extent, direct precipitation. The ground water modeling predicts that water levels in the pit would achieve 90 percent recovery in approximately 39.3 years at the end of dewatering and reach an equilibrium elevation of

6,335 feet (or 25 feet below the premine potentiometric surface) approximately 115 years after the end of dewatering (Hydrometrics, Inc. 2019a).

State requirements dictate that the highwalls of the pit be structurally competent. Waste rock and blasting would be used to create talus slopes on the southern and western pit edges. The final pit access ramp would extend from the rim of the pit to the pit lake and provide a point of egress for wildlife to exit the pit. Select pit benches and the access ramp that is projected to be above the pit lake elevation would be covered with 24 inches of soil or growth media and seeded. Similar to the No Action Alternative, the entire pit area would be fenced and a 4 feet high safety berm surrounding the pit would be soiled, seeded, and remain in place as a physical and visual barrier. **Figure 2.3-8** shows the Proposed Action pit reclamation.

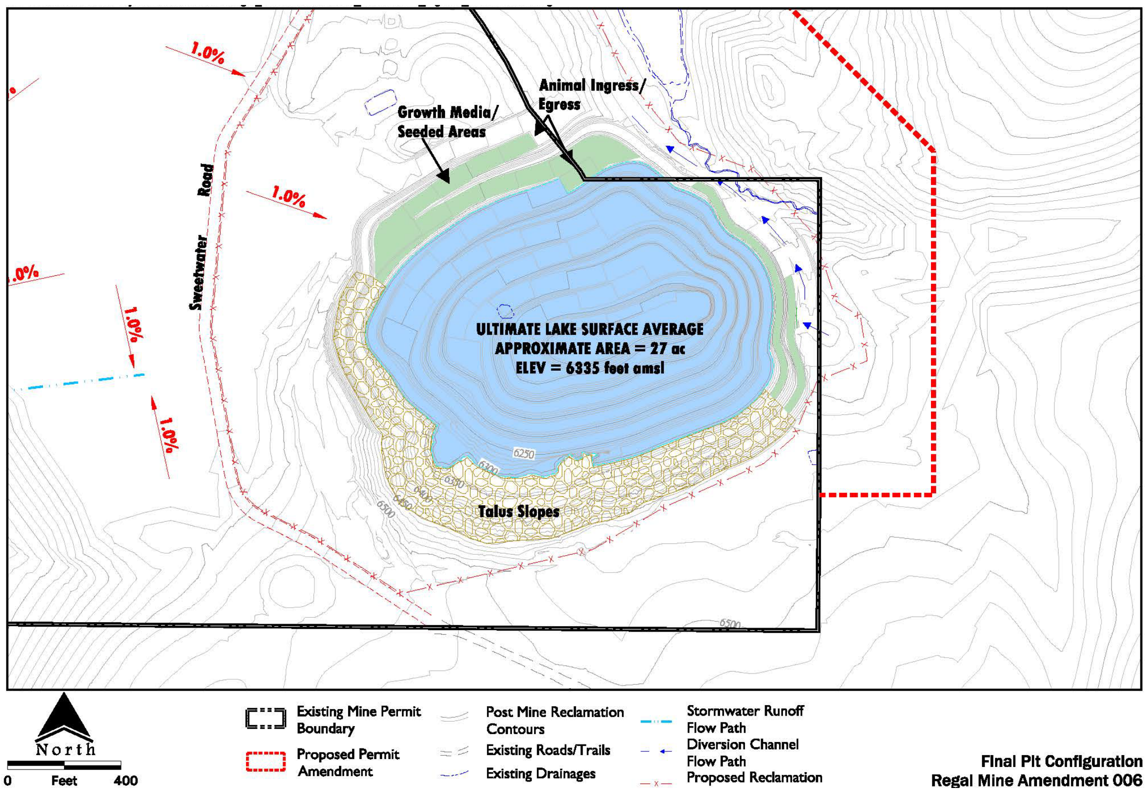

Figure 2.3-8
Proposed Action Final Pit Configuration

2.3.11.2 Waste Rock Disposal Facility Reclamation

The Proposed Action design of the WRDF would consist of mixed slopes to restore a more natural-appearing landscape. Temporary drainage ditches consisting of gravel (2-in- to 8-in-diameter rock approximately 12 inches deep) would be included to direct surface water flow off the face of the facility and would remain in place until vegetation is established and erosion control is no longer necessary. Reclaiming the lowermost lifts of the WRDF would be initiated in the first growing season after the lift is constructed. The entire WRDF would be reclaimed within 2 years after mining is completed. Other aspects of reclamation of the WRDF, including soil thickness and seeding, would be the same as the No Action Alternative. The location and topography of the WRDF at closure is shown on **Figures 2.3-4** and **2.3-5**.

2.3.11.3 Reclamation of Other Disturbances

Reclamation of other disturbances would be conducted in the same manner as the No Action Alternative and includes new Proposed Action facilities (SED-1, IF-3, dewatering wells, pipelines, and the storm water system). Components of the flow augmentation, system, including IF-1 and the UIC well, would remain in place until sufficient natural flow on Hoffman Creek and Carter Creek supports their removal.

2.3.11.4 Soils and Revegetation

Suitable soil would be salvaged from all Proposed Action disturbance areas with slopes less than 50 percent grade. A minimum of 20 inches of soil would be salvaged with the upper foot stockpiled separately from the subsoil as feasible.

The mine site has an estimated 287,155 yd^3 of soil stored in the stockpiles, and an additional 274,508 yd^3 of soil are yet to be salvaged from remaining disturbance areas under Amendment 005 and the Proposed Action Amendment 006 (BMI 2019a). A combined total of 561,663 yd^3 of soil would be available for reclamation (**Table 2.3-2**). Rock used for talus along the west and south pit slopes would be sourced from waste rock generated during the final phases of mining; the waste rock material would be temporarily stored adjacent to the pit rather than from older material in the WRDF.

Table 2.3-2
Volume of Soil Available for Reclamation

Soil Source Location	Area (Acres)	Salvaged Thickness (Inches)	Volume Available (yd^3)
Open Pit Expansion and Hoffman Spring Creek Channel Realignment	8.8	20	23,567
WRDF Expansion	41.4	20	110,875
Ancillary Disturbances (infiltration galleries, sedimentation pond, pipelines, desilting basins)	10	20	26,781
WRDF Remaining Permitted Disturbance	42.3	20	113,285
Total Volume From Proposed Amendment 006 and Remaining Under Amendment 005			274,508
Existing Stockpiles			287,155
Total Available			**561,663**

Site preparation, soil spreading, seedbed preparation, fertilizer, and reseeding would be conducted in the same manner as the No Action Alternative. **Table 2.3-3** summarizes the volume of soil required to meet reclamation goals, with replacement thickness of 12 inches of soil along the sloped areas of the WRDF and 24 inches for all other areas. Approximately 410,940 yd^3 of soil are needed for reclamation; based on the available soil volume, an excess of soil should be available on site.

Table 2.3-3
Volume of Soil Required for Reclamation

Mine Facility	Area (Acres)	Replacement Thickness (Inches)	Volume Required (yd^3)
WRDF Flat Surfaces	52.9	24	170,690
WRDF Slopes	88.7	12	143,102
Open pit Accessible Benches	3.5	24	11,293
Haul Road	3.4	24	10,970
Ancillary Facilities	16.7	24	53,885
Ore Transfer Site	6.5	24	21,000
Total Required			**410,940**

2.4 DEQ's Permit Stipulations

DEQ evaluated the addition of permit stipulations to address raptor and migratory bird impacts. A wildlife survey in 2016 noted the presence of a raptor nest between Hoffman Spring Creek and Hoffman Creek inside the proposed permit boundary but outside of proposed disturbance areas (Pfister 2019). Other migratory birds were also observed in and around the Proposed Action permit boundary. Area wildlife and analysis of impacts to wildlife are discussed in Section 3.14, Wildlife.

With a history of nesting occurring near the proposed disturbance, mitigation of impacts to raptors and migratory birds is required. As a permit stipulation, a nest survey of the entire area of disturbance would be performed by a qualified biologist shortly before vegetation is cleared. If the nest that was originally discovered in 2016 or any other nests are observed within an area that would be disturbed, the nest can only be destroyed when the nest is inactive and outside of the active breeding season. The Migratory Bird Treaty Act does not prohibit the destruction of the nest if it is done when the nest is inactive. Nests located outside of the disturbance footprint could be left alone and the birds would either continue nesting in that area or find a new nesting location.

2.5 Waste Rock Disposal Facility Grading and Mosaic Vegetation Alternative

2.5.1 Introduction to the Alterative

The proposed reclamation design for the WRDF is described in the permit Amendment Application and Section 2.3.11.2, Waste Rock Disposal Facility Reclamation. In developing the Proposed Action, BMI consulted with neighboring landowners who indicated that the WRDF needed to stay out of the Carter Creek drainage and should better mimic natural land topography (Raffety 2019). The Proposed Action consists of mixed slopes to restore a more natural-appearing landscape and includes storm water collection channels and erosion-control measures that are to remain in place until vegetation is established. Based upon review of the Proposed Action and preliminary environmental impacts, the final reclamation design of the WRDF could be improved to reduce environmental impacts. Other than changes to the WRDF reclamation, all other aspects of this WRDF Grading and Mosaic Vegetation Alternative are the same as the Proposed Action.

2.5.2 Alternative Components Different From the Proposed Action

Under this alternative, WRDF reclamation would be modified to create a natural and stable geomorphic landform that recreates a natural drainage network. The top elevation and overall slope of the WRDF would also remain similar to the Proposed Action. To keep the same disturbance area size and location of the WRDF, and to modify the grading to replicate the original drainage density, storage capacity of the WRDF would be slightly reduced. Because the Proposed Action design of the WRDF has excess capacity, a minor reduction in design storage capacity would still allow the alternative WRDF to contain all of the waste rock generated from the expansion.

The alternative geomorphic design would use the current WRDF configuration surface and incorporate micro-topography (i.e., small topographic changes) to create a drainage density that mimics the natural hydrologic balance. This design would better tie the WRDF into the existing topography in the area. This alternative design eliminates the planar and smooth slopes that are common in reclamation work in favor of a landform with swales and drainages that better mimic the natural landscape. The resulting post-reclamation landscape would be superior in terms of appearance and performance, with a more natural appearance that blends with the landscape.

Topographic alterations of this alternative would include a series of natural drainageways, gullies, swales, and ridges approximately every 100 to 200 feet along the edge of the WRDF. The stepped terraces of the Proposed Action would be eliminated and smoothed. Construction of micro-topography could be aided by GPS machine guidance.

According to the Amendment Application, approximately 150,000 yd^3 of excess soil would remain beyond what is needed for the Proposed Action reclamation plan (see Section 2.3.11.4, Soils and Revegetation). Soil replacement depths under the Proposed Action are 12 inches along the slopes of the WRDF. Under this Alternative, the minimum soil replacement depth on the slopes of the WRDF would still be 12 inches; however, the excess soil would be used to increase the topsoil thickness up to 24 inches in places.

The WRDF Grading and Mosaic Vegetation Alternative design would allow the landform to convey storm water in a nonerosive, natural manner. The alternative design surface would be a stable, natural-acting, and generally maintenance-free surface that behaves more like a native surface in flood events. Erosion of reclaimed topsoil would be reduced, and slope stability would be increased without requiring long-term maintenance and repair. The final grading and reclamation would eliminate the need for more defined channels and some of the other erosion-control measures such as sediment-control logs, sediment fences, and rip rap that would be needed under the Proposed Action. The reclaimed WRDF runoff water quality would be more comparable to surrounding undisturbed lands.

The WRDF Grading and Mosaic Vegetation Alternative would also create mosaic vegetation patterns to develop specifically tailored micro-environments or ecological niches for targeted plant species. The micro-environments that would be created would encourage growth of specific plant species and would encourage and promote greater biodiversity even within the permitted seed mixture. Vegetation diversity would be enhanced by the variations in sunlight, water infiltration, and topsoil thickness. Shrubs and species that require more water would be more likely to grow and thrive within swales and drainages. Vegetation diversity could also positively impact wildlife diversity.

The modified design would optimize material placement in the WRDF during mining to accelerate the WRDF reclamation. The proposed natural grading would also lead to the overall reclamation success and bond release.

2.6 Alternatives Considered but Dismissed From Detailed Analysis

Under MEPA, a reasonable alternative is one that is practical, achievable under current technology, and 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 (§ 75-1-201(1)(b)(iv)(C)(I), MCA). Pursuant to § 75-1-220(1), MCA, an “alternative analysis” under MEPA does not include evaluating an alternative facility or an alternative to the proposed project itself. Any alternative under consideration must be able to meet the purpose and need of the Proposed Action.

During scoping, alternatives to the Proposed Action were suggested and discussed by DEQ agency representatives and BMI as required by MEPA. Alternatives covered in this section include alternatives or alternative components that were considered and eliminated from detailed study. For each alternative discussed, a synopsis of the changes proposed and a discussion of why the alternative or component was dismissed from further analysis are included.

2.6.1 Connect Pit Lake to Hoffman Creek

As documented in BMI's May 2019 "Project Options Analysis Regal Mine Expansion," one of the preliminary pit designs that was considered but dismissed involved a pit with a larger footprint and greater disturbance to the east toward Hoffman Creek (BMI 2019b). The preliminary and dismissed design would have enlarged the pit into the creek channel and routed Hoffman Creek and/or Hoffman Spring Creek flow into the pit; as the pit filled, it would eventually spill into Hoffman Creek. This considered alternative of connecting the pit lake to Hoffman Creek originated after DEQ reviewed this preliminary design; however, the pit design and creek modifications in the Proposed Action are not the same as in the preliminary designs. The results of geotechnical slope-stability analysis (Golder Associates Inc. 2016) allowed for a pit design with steeper pit slopes that decreased the disturbance footprint of the pit and increased the distance of the pit from Hoffman Creek. The Proposed Action, as presented in the permit Amendment Application, indicated that the predicted pit lake elevation (6,335 feet) would be approximately 40 feet lower in elevation than the elevation of Hoffman Creek and the rerouted Hoffman Spring Creek. At its closest point to the northeast rim of the pit, Hoffman Creek is 35 to 40 feet from the pit's rim.

If the pit lake were connected to the creek using the proposed pit layout, a waterfall would be created into the pit and result in a sink where surface water would enter the pit and not return to surface flow but, rather, enter the ground water flow system. This was not the intention of either the preliminary design plan or the Proposed Action design. Eliminating the flow in Hoffman Creek and/or Hoffman Spring Creek at the site of the pit would negatively impact downstream surface water flow and water rights. In addition to flows and water rights concerns, if Hoffman Spring Creek is not realigned but is allowed to flow directly into the pit instead, a quantifiable loss of stream channel length would result and its associated riparian and wetland area. Riparian and wetland areas improve water quality by filtering nutrients and sediment and provide habitat for aquatic and terrestrial life. Furthermore, routing surface water into the pit would impose a discontinuity in habitat for species that rely upon riparian habitat.

2.6.2 Stream Diversion Construction Alterations

A description of changes to streams as part of the Proposed Action are described in Section 2.3.7, Modifications to Hoffman Spring Creek and Hoffman Creek. An analysis of the Proposed Action stream diversion designs and proposed construction for Hoffman Spring Creek and Hoffman Creek were performed to determine the design adequacy to limit environmental impact and produce a stable hydrologic system (Appendix B). The review included a list of design enhancements that could be constructed. Such potential design enhancements could include woody revegetation and stream drop structures. DEQ determined that those enhancements would not substantially reduce the environmental impact of the Proposed Action realignment of Hoffman Spring Creek and modifications of Hoffman Creek. The USACE; the local conservation district; and Montana Fish, Wildlife, and Parks have permitted the proposed work in Hoffman Spring Creek and Hoffman Creek.

In summary, this alternative was dismissed because the Proposed Action in comparison was adequate and the alternative did not substantially lessen potential negative impacts for the following reasons:

- The proposed floodplain section appears appropriately sized to achieve conveyance of the estimated 100-year peak discharge on Hoffman Spring Creek.
- The proposed construction of Hoffman Spring Creek includes dimensions that are large enough for locating the high-density polyethylene, 100-mil liner to reduce infiltration into the pit, bounding fabric to protect against bank damage, geotextile to provide long-term channel stability and prevent significant scouring of the stream bed, and revegetation of grasses and shrubs to enhance stability.
- The sinuous design of the stream bed within the realignment corridor would help reduce the water velocity and erosion.

2.6.3 Partial Pit Backfill

The Metal Mine Reclamation Act requires that reclamation of mine pits must ensure that the highwalls are structurally stable, that the pit area will be useful to humans and the surrounding natural system to the extent feasible, that the pit area blends in appearance with its surroundings to the extent feasible, and that objectionable effluents that might form in the pit must be controlled (§ 82-4-336(9), MCA). Three backfill reclamation alternatives were considered but eliminated from further study: (1) partial open pit backfilling and reclamation of the open pit concurrent with active mining, (2) partial open pit backfilling and reclamation of the open pit following completion of mining, and (3) total backfilling of the open pit following the completion of mining.

2.6.3.1 Partial Open Pit Backfilling During Operations

Partial backfilling of the open pit during active mining operations would reduce the size of the waste rock dump and the depth of the postmine pit lake. The proposed life-of-mine Regal Mine open pit is not large enough or configured to accommodate active mining and waste backfilling concurrently. The majority of the open pit area would be included in mining activities or used for haul roads and ramps throughout the mine life. This option would still require operating the Proposed Action dewatering system until the end of mining operations and backfilling was complete. A potential for limited operational backfilling of the open pit would not occur until very late in the life-of-mine development. Because the mine cannot deepen the pit to extract talc while simultaneously backfilling the pit, partial backfilling during active mining would reduce the amount of talc that could be produced, which is critical to the purpose of the expansion project. BMI's technical ability would be reduced to achieve the goals of its life-of-mine expansion plan and operations would not be able to continue for an additional 6 years as proposed. Therefore, backfilling the pit during operations would not meet the purpose and need of the Project (extending the life of the mine and availability of talc product), and this option will not be carried forward for further investigation (Appendix A).

2.6.3.2 Partial Open Pit Backfilling at Completion of Mining

Reducing the depth of the final open pit by 50 percent (from a bottom elevation of 5,990 feet to 6,250 feet) would require approximately 9.1 million tons (3.86 million yd^3) of waste rock backfill. Under this option, the size of the pit lake would remain the same as the Proposed Action (i.e., 27 acres), but the depth of the pit lake would be reduced by 260 feet (from 345 feet to 85 feet). This option would also reduce the size of the final WRDF.

To accomplish this partial backfilling scenario, approximately 183,000 round trips from the waste dump to the open pit by 50-ton-capacity haul trucks would be required. This activity would require 2.7 years to complete, assuming two 10-hour shifts per day, 4 days a week for 50 weeks a year. This assumption is based on five haul trucks and a 15-minute cycle time per truck. To complete this task, the dewatering and disposal system would have to be maintained for the duration of the backfilling process, thereby delaying the reclamation of these facilities and stabilization of the ground water and surface water flow systems.

A concern is that the waste rock could contribute nitrate to ground water moving through the backfilled portion of the pit and cause a contaminant plume downgradient of the pit, which could increase nitrate concentrations in the shallow pit lake. Nitrates could flush out of the backfill over a period of months or years. Nitrate concentrations could exceed ground water standards. Although this scenario is technically feasible, partial backfilling is dismissed from detailed analysis because it could impair ground water quality and add to the reclamation time (Appendix A).

2.6.3.3 Total Open Pit Backfilling at Completion of Mining

Approximately 33.5 million tons (14.6 million yd^3) of waste rock would be required to completely fill the open pit at the completion of mining. The Amendment 006 application indicates that the final WRDF would contain approximately 19.5 million yd^3 of material; therefore, sufficient material is available for complete backfill. Under the complete backfill scenario, the final WRDF would be smaller than in the Proposed Action and only contain approximately 4.9 million yd^3 of waste rock.

Using the same assumptions as described in Section 2.6.3.2, Partial Open Pit Backfilling at Mining Completion, it would take approximately 10 years to completely backfill the open pit. This option would also require the dewatering system to be operated until the pit was backfilled to above the ground water table, thereby delaying the reclamation of these facilities and stabilization of the ground water and surface water flow systems. Complete backfilling would eliminate the pit lake. This option would require final grading to restore natural hydrological conditions to the area and developing a Stormwater Pollution Prevention Plan that includes erosion control using best management practices.

A concern that the waste rock could contribute nitrate to ground water moving through the backfilled pit and cause a contaminant plume downgradient of the pit, which could increase nitrate concentrations in the shallow pit lake. Nitrates could flush out of the backfill over a period of months or years. Nitrate concentrations could exceed ground water standards. Although this scenario is technically feasible, complete backfilling of the pit is dismissed from detailed analysis because it would not provide sufficient environmental benefit to justify increasing the site reclamation time by 10 years, adding significant fuel usage, extending the dewatering period and impacts to ground water and surface water, and potentially increasing nitrates in ground water (Appendix A).

2.6.4 Reduced Ground Water Dewatering

During scoping, landowners expressed concerns over impacts to water level and spring flows because of the Proposed Action mine pit dewatering. The Proposed Action would dewater the mine pit using seven new deeper dewatering wells that would replace five existing dewatering wells.

Two main approaches to mine dewatering are pumping and exclusion. The first approach is dewatering with dewatering wells and in-pit pumping, which is most common and suitable for a variety of site hydrogeological conditions. Mine dewatering through pumping impacts water levels and spring flows near dewatering wells and mine workings during operations and recovery. This approach was chosen for dewatering in the Proposed Action.

An alternative approach to mine dewatering would be the exclusion methods to prevent or reduce ground water inflow into the mine pit. By reducing ground water inflow, impacts to ground water levels and spring flow are decreased. Exclusion methods include ground water cut off walls, grouting, or freezing. Artificial ground freezing and grouting are methods to reduce the permeability of aquifers and fractures zones to reduce ground water inflow.

Because of the bedrock aquifer and the pit-bottom depths, a ground water cut off wall solution is not technically feasible for the site. Freezing is energy intensive; would require hundreds to thousands of drillholes, and is best suited for smaller, temporary shallow excavations or mine shafts. Freezing is not a technically feasible alternative for the Regal Mine pit.

Grouting is most effective to reduce inflow along fractures in small zones and not intended to provide a complete water barrier around a large mine pit. If a high permeability zone in the mine pit was encountered that contributes significant inflow, a localized grouting program could be considered to reduce inflow. However, grouting would not eliminate the need to dewater the mine pit using dewatering wells and would generally not reduce impacts to ground water levels from dewatering. No alternatives to ground water dewatering meet the Proposed Action objectives.

2.6.5 Alternate and Flexible Water Injection Sites

A scoping comment recommended that the EIS evaluate alternative water injection sites to determine if a more suitable site would better mimic natural flows of ground water proximal to the mine. A specific recommendation was to locate the new infiltration pond north of the mine pit.

To meet the purpose and need of the Proposed Action, the infiltration must be located downstream of the mine pit to allow pit dewatering but then return the water back to the ground water system and not be consumed. The 2017 ground water level map indicates that flow at the Regal Mine is toward the northwest; therefore, downgradient infiltration would be northwest of the mine pit (Hydrometrics, Inc. 2019a). The Proposed Action would extract ground water from in and around the expanded mine pit between Hoffman Creek and Carter Creek watersheds. Water would be reinjected back into the ground water flow system via several injection design features, including a shallow UIC well located just north of the pit on Hoffman Creek, infiltration gallery (IF-1) between the WRDF and Carter Creek, and a new infiltration pond (IF-3) located approximately 1 mile northwest of the mine pit between Hoffman Creek and Carter Creek.

Dewatering the pit for mining does not require a water right, particularly because the Proposed Action calls for reinjecting water back into the ground water system downstream of the pit without consuming water or putting the water to beneficial use. However, placing the infiltration infrastructure off the mine's property for the express purposes of augmenting flow in springs located several miles from the mine site becomes a beneficial use of water, and BMI would need to obtain a water rights permit to undertake such an action. Impacts to ground water are detailed in Section 3.4, Ground Water, and water rights are described in Appendix B and Section 3.6, Water Rights.

A related scoping comment also recommended that the mine permit be flexible to allow the mine to relocate its injection sites based on changes in spring flow. The location of injection sites is a disturbance and a mine feature that needs to be defined and located in the mine permit. If changes to infiltration and flow augmentation were required to mitigate flow losses, future changes to injection would require a permit amendment or technical revision. Additional UIC wells, if required, would be permitted through the U.S. Environmental Protection Agency. A blanket flexibility to the mine on injection sites is not permissible. The Proposed Action would require flow augmentation, and modifications to flow rates, to obtain the beneficial use on Hoffman Creek and Carter Creek.

2.7 Preferred Alternative

ARM 17.4.617(9) requires an agency to state a preferred alternative in the EIS, if one has been identified, and to give reasons for the preference. DEQ has identified the WRDF Grading and Mosaic Vegetation Alternative as the agency's preferred alternative. The WRDF Grading and Mosaic Vegetation Alternative incorporates all of the features of the Proposed Action Alternative except WRDF reclamation would be modified. The alternative design for the WRDF would eliminate the planar and smooth slopes that are common in reclamation work in favor of a landform with swales and drainages that better mimic the natural landscape. This design would also better tie the facility into the existing topography in the area. The preferred alternative includes a permit stipulation for the disturbance of a raptor nest. A nest survey of the entire area of disturbance would be performed by a qualified biologist shortly before vegetation is cleared. If the nest that was originally discovered in 2016 or any other nests are observed within an area that would be disturbed, the nest can only be destroyed when the nest is inactive and outside of the active breeding season.

3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1 INTRODUCTION

This chapter describes the affected environment and potential impacts of the No Action Alternative, Proposed Action, and the Agency Modified Alternative (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. Environmental consequences are also referred to as potential impacts.

The analysis of environmental consequences is based on a thorough review of relevant scientific information, an evaluation of proposed and industry practices, and results from on-site surveys and studies. Each resource area discussion includes information on the data reviewed, how each data source was collected, and the geographic limits of the review. Most resources are described for the area in and around the Regal Mine permit boundary, but some may cover larger areas relevant to the potential for impacts. With several narrow exceptions, an environmental review conducted under Montana Environmental Policy Act (MEPA) "may not include a review of actual or potential impacts beyond Montana borders. The environmental review may not include actual or potential impacts that are regional, national, or global in nature" (§ 75-1-201(2)(a), Montana Code Annotated [MCA]). The resource topics that could be subject to potential impacts are discussed in this chapter and include the following:

- Cultural Resources
- Geology and Geochemistry
- Ground Water Resources
- Surface Water Resources
- Water Rights
- Geotechnical Engineering
- Land Use
- Visual Resources and Aesthetics
- Socioeconomics
- Soils
- Vegetation
- Wetlands
- Wildlife
- Noise

- Transportation
- Air Quality

3.1.1 Location Description and Study Area

The mine permit area is 11 miles southeast of the city of Dillon, Montana, and is accessed via Sweetwater Road (**Figure 1.3-1**). The permit boundary of the Regal Mine facilities currently covers 243.2 acres, and the Proposed Action would add 136.9 acres to the permit boundary for a total of 380.1 acres. Permitted disturbance is 189.9 acres (No Action Alternative) and the Proposed Action would add 60.2 acres of disturbance for a total of 250.1 acres. The Study Area includes all lands and resources in the expansion boundary as well as additional areas identified in each resource-specific analysis area as defined with its respective subsection in this chapter.

The Regal Mine and expansion areas are located between the Hoffman and Carter creek watersheds, with upper Hoffman Creek drainage to the north and east and Carter Creek drainage to the south. Elevations in and around Regal Mine range from approximately 6,300 feet to 6,500 feet above mean seal level. Daily precipitation data are available from the Dillon Airport and Western Montana College weather stations, which are located approximately 11 miles west of the Regal Mine at an elevation about 1,000 feet lower than the Regal Mine. For the period 1971–2000, annual precipitation averaged 9.94 inches and 11.65 inches at the airport (Station 242404) and college (Station 242409) stations, respectively (Barretts Minerals, Inc. [BMI] 2019a). Precipitation is greatest in May and June and least during December through February.

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.

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.

The level of assessment is generally proportionate to its potential impacts. Potential impacts were characterized in terms of impact duration, severity, and likelihood. Where impacts would occur, the duration is quantified as follows:

- Short term: Impacts that would not last longer than the life of the project, including final reclamation.
- Long term: Impacts that would remain or occur following project completion.

The severity is a function of its geographic extent, magnitude, duration, reverse-ability, and if it surpasses an environmental threshold such as a water quality or air quality standard. The severity of the impacts is evaluated using the following categories:

- No impact—No change from current conditions.
- Negligible—An adverse or beneficial effect would occur but would be at the lowest levels of detection.
- Minor—The effect would be noticeable but would be relatively small and would not affect the function or integrity of the resource.
- Moderate—The effect would be easily identifiable and would influence the function or integrity of the resource.

The likelihood of a potential impact occurring comprises 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).

3.2 Cultural Resources

This section addresses potential impacts to known cultural resources within the boundary of Barretts Minerals Proposed Amendment 006 and areas that have not been authorized for disturbance within the boundaries of the current Operating Permit (OP) No. 00013. This assessment was prepared to fulfill the requirements of the MEPA and Metal Mine Reclamation Act (MMRA).

Publicly managed land surface or minerals are not being considered as part of the proposed expansion. The Proposed Action is not federally funded and involves only private land, so federal permits or approvals are not required; therefore, federal cultural resource regulations, including Sections 106 and 110 of the National Historic Preservation Act, would not apply. State lands would not be impacted under the Proposed Action. However, MEPA requires that state agencies perform interdisciplinary analysis of state actions that have an impact on the human environment in Montana, and the Montana State Historic Preservation Office (SHPO) issues guidance for cultural investigations that are administered by state agencies that do not fall under the direct auspice of federal or state cultural resource protection legislation. Montana Department of Environmental Quality (DEQ) is required to consult with SHPO and assess impacts to cultural resources.

Cultural resources are those associated with human life or activities that have significant value to a culture, are significantly representative of a culture, or contain significant information about a culture. Tangible resources are categorized as historic and prehistoric sites, buildings, structures, and objects that are identified as having historic, artistic, scientific, religious, or social significance.

3.2.1 Analysis Methods

The purpose of this section is to identify and assess impacts to cultural resources that have the potential to be disturbed by the Proposed Action's construction, operation, and reclamation. Cultural resources may also include properties that play a significant traditional role in a community's historically based practices, customs, and beliefs. Evaluating the significance of a cultural resource typically falls under the guidelines of the National Register of Historic Places (NRHP). The NRHP is a listing maintained by the federal government of cultural resources that are considered significant at a local, state, or national level. Cultural resources must meet the NRHP criteria for significance and must maintain sufficient integrity to be considered eligible for listing in the NRHP, and those historic properties that meet the federal criteria are considered to be resources that warrant special consideration and historic preservation efforts.

The Area of Potential Effect (APE) for cultural resource consideration is a total of 160.4 acres and includes the proposed expanded permit boundary of 136.9 acres and 23.5 acres that are located inside of the OP, where new disturbances will occur.

The potential for adverse effects to cultural resources was determined in part by conducting a state record search to ascertain if studies have been conducted within the APE and an in-depth review of those studies to determine if previously recorded sites exist in the APE. The SHPO maintains the Montana Antiquities Database, which contains digital data regarding known historic and archaeological properties as well as previously conducted cultural resource inventories. This section summarizes the results of the Cultural Resource Information System (CRIS) and Cultural Resource Annotated Bibliography System (CRABS) record searches that were conducted by the Cultural Records Manager at the Montana SHPO on May 16, 2019 (Murdo 2019a) (Murdo 2019b). The record searches were conducted using the legal locations of the Proposed Action and OP boundaries. The CRIS/CRABS searches revealed that the entire area within the Proposed Action has been previously inventoried for cultural resources and that one historic site and two isolated finds (i.e., isolates) have been documented within the APE. The site consists of a historic homestead with a prehistoric component, and the isolates are portable agricultural feeders associated with the Christensen Ranch. None of the previously documented cultural resources are recommended as being eligible for listing in the NRHP and, therefore, none of the three resources necessitate special consideration or historic preservation efforts.

A majority of the information presented herein is based on the review of the CRIS/CRABS data on file at the SHPO. The area of analysis is limited to known cultural resources located within the APE, therefore, the analytical scope is primarily constrained to the information provided in the *Class III Cultural Resource Inventory of Barretts Minerals, Inc. Proposed Amendment 006, Regal Mine, Madison County, Montana*, which was conducted by GCM Services Inc. in 2015 (Meyer 2015). The 2015 cultural resource inventory covers the entire 136.9 acres located in the proposed Amendment boundary and is the only archaeological survey conducted in the APE that located cultural resources. Additional studies that have taken place within the APE are also summarized in this section.

Impacts on cultural resources have been assessed by a 2015 Class III cultural resource survey completed by GCM Services Inc. The study located and documented three cultural resources within the proposed Amendment boundary. In addition to the 2015 study, the record search results indicated that three other cultural resource inventories have been previously conducted in the APE and include a 1980 spring development survey and two inventories associated with mine expansion. The mine-expansion studies cover small portions of the proposed expansion area as well as the entire acreage located within the boundaries of the current OP (Ferguson

1994, Light 2005). These three studies resulted in a report of no findings, and no cultural resources were located within the APE. A summary of the previous cultural resource studies that have taken place in the APE are listed in **Table 3.2-1** and described in the following text.

Table 3.2-1
Previous Studies Conducted Within the Area of Potential Effect

Report Year	Author	Title	Results
1981	Earle, B. J.	Cultural Resources Class III Inventory Report: Prospect Spring and Pipeline	No findings/No eligible properties
1994	Ferguson, D. (GCM Services, Inc.)	Cultural Resource Inventory and Assessment: Barretts Mineral, Inc. Regal Mine	No Findings/No eligible properties
2005	Light, P. (Lone Wolf Archaeology)	Class III Cultural Resource Inventory of Barretts Minerals, Inc. Regal Mine Expansion, Madison County, Montana	No Findings/No eligible properties
2015	Meyer, G. (GCM Services, Inc.)	A Class III Cultural Resource Inventory of Barretts Minerals, Inc. proposed Amendment 006, Regal Mine	One site and two isolates documented/evaluated, none of which are recommended as being eligible for listing in the NRHP

A spring development survey was conducted by Archaeologist J. B. Earle in 1980. The study included a 5-acre, 1.2-mile pedestrian survey for pipeline and spring development located throughout the northeast quarter of Section 2 in Township 8 South, Range 7 West. The project may have overlapped with the southeastern corner of the proposed Amendment boundary, but no cultural resources were observed or documented during this study (Earle 1981).

The earliest documented Class III cultural resource inventory and evaluation of cultural resources for the Regal Mine was conducted by GCM Services Inc. in October 1994. This 138-acre study mainly focused on the original permitted area of the mine in Section 2 of T8S, R7W, and Section 35 of T7S, R7W, and overlapped with lands located in the southwest section of the proposed Amendment boundary. The Project area, which essentially includes the southern half of the current OP, where the pit and office are currently located, was examined by a pedestrian survey, with two archaeologists walking 20-meter-wide transects. The study noted that because of the area's topography, which includes relatively steep, dry slopes, the Hoffman Creek drainage was considered the only area of moderate prehistoric site potential and no historic sites were anticipated. The documentation noted that historic activities in the area, if any, appeared to be related to mineral claims and investigations but the evidence had been obscured by contemporary mining-related activities. The inventory methods followed federal guidelines for Class III inventories and resulted in no cultural resources observed or documented within the boundaries of the proposed Amendment or current OP boundaries (Ferguson 1994).

In 2005, Lone Wolf Archaeology of Missoula, Montana, conducted a Class III cultural resource inventory and evaluation of a waste rock disposal facility (WRDF) expansion area as well as several drainages that were identified for use as water infiltration discharge. Approximately 121 acres of private land was inventoried as part of the 2005 survey. The 2005 expansion area comprised 110 acres for the additional WRDF and 11 acres in the four drainages. The study essentially covered the northern half of the current OP in Sections 2 and 3 of Township 8 South, Range 7 West, and Sections 34 and 35 in Township 7 South, Range 7 West (where the current WRDF, proposed WRDF expansion, and proposed stockpile are located). The study also included small sections of land that are located in the western portion of the proposed Amendment area. The Project area was inventoried by a series of parallel, pedestrian transects spaced 30 meters apart. A majority of the Study Area was documented as being dry and sloping with little to offer in terms of campsite locations or other resources. The study did not reveal any cultural resources and cultural clearance was recommended (Light 2005).

The study that inventoried the land within the boundary of proposed Amendment 006 is a Class III cultural survey that was completed in September 2015. The 2015 survey covered the entire proposed Amendment boundary of 136.9 acres located in Sections 2 and 3 in T8S, R7W, and Sections 34 and 35 in T7S, R7W. The inventory located and documented one site and two isolates. The documented site comprises Hoffman Homestead (i.e., Site 24MA2385), which is located along a terrace on the south side of Hoffman Creek in the NWNE ¼ of Section 2 in T8S, R7W.The site also comprises a parcel of ground with the remains of a foundation, historic artifacts, and a single piece of prehistoric debitage. The two isolates are located in the SWSE and NESE ¼ of Section 34 in T7S, R7W and are believed to be portable stock feeders associated with the Christensen Ranch complex. The Christensen Ranch lies to the west of the proposed Amendment boundary. The Hoffman Homestead (Site 24MA2385) and the two isolates were not recommended as being eligible for listing in the NRHP.

The existing data suggest an overall low density of cultural resource sites and a very low probability of encountering new sites in the APE. All of the previous studies and inventories were conducted according to professional federal standards and guidelines for inventory methods and Class III inventories. The cultural resources located during the inventories were fully documented and properly evaluated to determine their significance and integrity, and none of the cultural resources are recommended as eligible for listing in the NRHP.

3.2.2 Affected Environment

The Project area is located at an elevation of approximately 6,500 feet above sea level in the western foothills of the Ruby Range in southwestern Montana. The topography is hilly and vegetation consists mostly of dry native grasslands and foothill sagebrush vegetation. The climate is a semiarid environment with relatively low precipitation. Based on material recovered from archaeological sites, southwestern Montana is known to have been occupied by human groups for the last 12,000 years and is evidenced by a wide variety of projectile point types and other stone tools found, as well as paleoenvironmental data, which provides insight into how humans adapted to environmental challenges.

The Ruby Range has three minerals that have mining development potential: talc, vermiculite, and garnets. Soapstone, comprised primarily of talc, was discovered and used by early Native Americans. The soapstone deposits found in the Ruby Mountains east of Dillon, Montana, are easy to carve and served as a source for making items such as bowls and peace pipes.

The Project area is located in the Ruby Range Mining District. The district has only had a few mineral prospects claimed for copper, iron, and precious metals. Historic gold and silver mines around Dillon, Montana, have been reported but were depleted many years ago. The Regal Mine is located in a talc corridor that essentially runs east/west from Dillon, Montana, to Cameron, Montana. The corridor has many bodies of talc, and production in some areas of the Ruby Mountains dates back to the 1940s (DEQ 2019b).

A review of the 1870 and 1916 General Land Office (GLO) maps for the Project area indicates that historically, little homesteading and few cultural features were mapped anywhere within close range of the Proposed Action. The earliest homestead that is located near the APE is the historic Hoffman Place, which was mapped by GLO in 1916 and is located to the northeast of the Hoffman Homestead (24MA2385). With the exception of fencing, no other structures were mapped by GLO within the boundaries of the Proposed Action (GLO 1870, 1916).

Table 3.2-2 provides a summary of the previously recorded cultural resources that were identified in the SHPO record search within the boundary of the APE/Proposed Action. The sites and isolates generally consist of structural remains, historic debris, and stock feeders associated with the area's homesteads. A location map of this site is provided in Meyer (2015).

Site 24MA2385 is associated with the Hoffman Homestead. According to the 2015 GCM Services study, Louis R. Hoffman is the mostly likely person to be associated with the site, although he is never listed as a resident of the site location (Meyer 2015). The presence of a more substantial ranch associated with Hoffman is located approximately ¼ mile to the northeast of Site 24MA2385 in Section 3 of T8S, R7W, and may indicate that Site 24MA2385 represents an earlier residence, a bunkhouse, or some other ranching-related function. Site 24MA2385 is located along a terrace on the south side of Hoffman Creek in the NWNE of Section 2, in T8S, R7W and contains a parcel of ground with the remains of a foundation, historic artifacts, and a single piece of prehistoric debitage (small chalcedony or quartz tertiary flake). The homestead patent was not granted until 1921, but the parcel may have been homesteaded by Louis R. Hoffman as early as 1910. The site experienced a loss of integrity and is not associated with significant people or events. The prehistoric component is sparse, and no other prehistoric cultural material was observed. Site 24MA2385 was, therefore, recommended as being ineligible for listing in the NRHP, and no further study or work regarding this site was recommended (Meyer 2015). According to a written communication, the Compliance Officer at the SHPO has concurred with this determination (Bush 2018).

Table 3.2-2
Summary of Previously Recorded Cultural Resources Located Within the Area of Potential Effect

Site Number	Site Type/ Description	NRHP Eligibility	Location
24MA2385	Hoffman Homestead	Not Eligible	NWNE ¼ S2, T8S, R7W
IF1	Portable stock feeder	Not Eligible	NESE ¼ S34, T7S, R7W
IF2	Portable stock feeder	Not Eligible	SWSE ¼ S34, T7S, R7W

Two portable stock feeders were documented as isolated finds (i.e., IF1 and IF2) and are located in the SWSE and NESE of Section 34 in Township 7 South, Range 7 West. The stock feeders are set on skids that can be hitched and pulled to different locations. These stock feeders are built of boards, plywood, and sheet metal and were associated with the nearby Christensen Ranch, which was abandoned at the time of the study. Typically, isolates are transportable artifacts that represent a single activity, often lacking in data potential, and rarely eligible for listing in the NRHP. The stock feeders were recommended as being ineligible for listing in the NRHP, and no further study or work regarding these isolates was recommended.

3.2.3 Environmental Consequences

Impacts to cultural resources that are eligible for listing in the NRHP are typically evaluated using an assessment of Adverse Effect, which is defined as an action that directly impacts the integrity of a resource by diminishing, altering, or destroying the character of a cultural resource. For the purpose of assessing environmental consequences, cultural resources determined to be eligible for listing in the NRHP are evaluated for impacts (or adverse effects). Cultural resources that have been determined to be ineligible for listing in the NRHP have been eliminated from the assessment of impacts. Based on the results of cultural resource investigations and the recommendations provided in those studies, the three cultural resources located within the boundary of the Proposed Action lack the significance and/or integrity necessary to warrant further historic preservation efforts and have been recommended as being ineligible for listing in the NRHP. For an analysis of environmental consequences for the Proposed Action, cultural resources located within the APE will be evaluated based solely upon GCM Services' 2015 inventory report recommendations and SHPO's concurrence with those findings. These determinations will form the basis for the environmental consequences analysis for each of the alternatives described in the following text.

3.2.3.1 No Action Alternative

Under the No Action Alternative, no change would occur in the disturbance area; therefore, cultural resources would not incur additional impacts or have adverse effects. The mine would continue to operate within the current boundary and no additional ground disturbance would occur with the potential to disturb cultural resources.

3.2.3.2 Proposed Action

Based on the current available information, the Proposed Action would have no significant impacts to cultural resources, because Sites 24MA2385, IF1, and IF2 have been recommended as being ineligible for listing in the NRHP. Therefore, the Proposed Action would have no effect on Sites 24MA2385, IF1, or IF2.

3.2.3.3 WRDF Grading and Mosaic Vegetation Alternative

Under the WRDF Grading and Mosaic Vegetation Alternative, the disturbance footprint of the mining-related impacts would be the same as described for the Proposed Action; therefore, no additional impacts to cultural resources would occur.

3.3 Geology and Geochemistry

Geology provides the primary framework for this environmental assessment and influences the location of mineralization, mining methods, geochemistry, and contributions of constituents to water quality. Together, geology and geochemistry determine the potential impact of mining on water resources and air quality.

3.3.1 Analysis Methods

The Regal Mine permit boundary and the proposed amendment boundary are the focus of the geology analysis area and includes an overview of the regional geologic setting. The geochemical analysis area encompasses the rock from which ore and waste rock would be mined.

Much of the analysis and description of the geology of the proposed mine-expansion areas presented in this section is based on the Application for Amendment 006 to OP No. 00013 (BMI 2019a) and past permit amendments. The following sections summarize the collected background information on geology and geochemistry and the environmental consequences of the Project.

3.3.2 Affected Environment

The regional and deposit geology has been described in several publications and maps and is summarized in BMI's Amendment 006 application (BMI 2019a), Amendment 004 (Hydrometrics, Inc. 1996), and DEQ's previous MEPA documents (DEQ 2001, 2007). The following subsections summarize this information.

3.3.2.1 Regional Geologic Setting

The Regal Mine is located on the western slopes of the Ruby Range in southwestern Montana. The Ruby Range is an uplifted block of highly deformed Precambrian rocks that have been folded, faulted, and metamorphosed. Younger Paleozoic and Mesozoic rocks are exposed in the northeastern portion of the Ruby Mountains but have been eroded off the southwestern portion of the range. The northwestern side of the Ruby Range is bound by a steeply dipping, northeast-trending, normal fault that juxtaposes Precambrian rocks on the east with Quaternary and Tertiary sediments in the Beaverhead River Valley on the west. Recurrent movement along the fault is thought to have occurred during Tertiary and Quaternary time, with the possibility that the fault was active as early as the late Mesozoic (James 1990). A geologic map of the region is illustrated on **Figure 3.3-1**.

The northwestern slopes of the Ruby Mountains are underlain by the Archean-aged (2.5 billion years) Cherry Creek Group (James 1990). The Cherry Creek Group is predominantly made up of metamorphic gneiss, schist, and dolomitic marble and also contains banded iron formation, pegmatite, and intrusive dikes. North-south-trending amphibolite and diabase dikes in the region can be up to several hundred feet wide and up to 8 to 10 miles long (Hydrometrics, Inc. 1996). The structural complexity of the sequence has made establishing age relationships of units within the Cherry Creek Group difficult (James 1990).

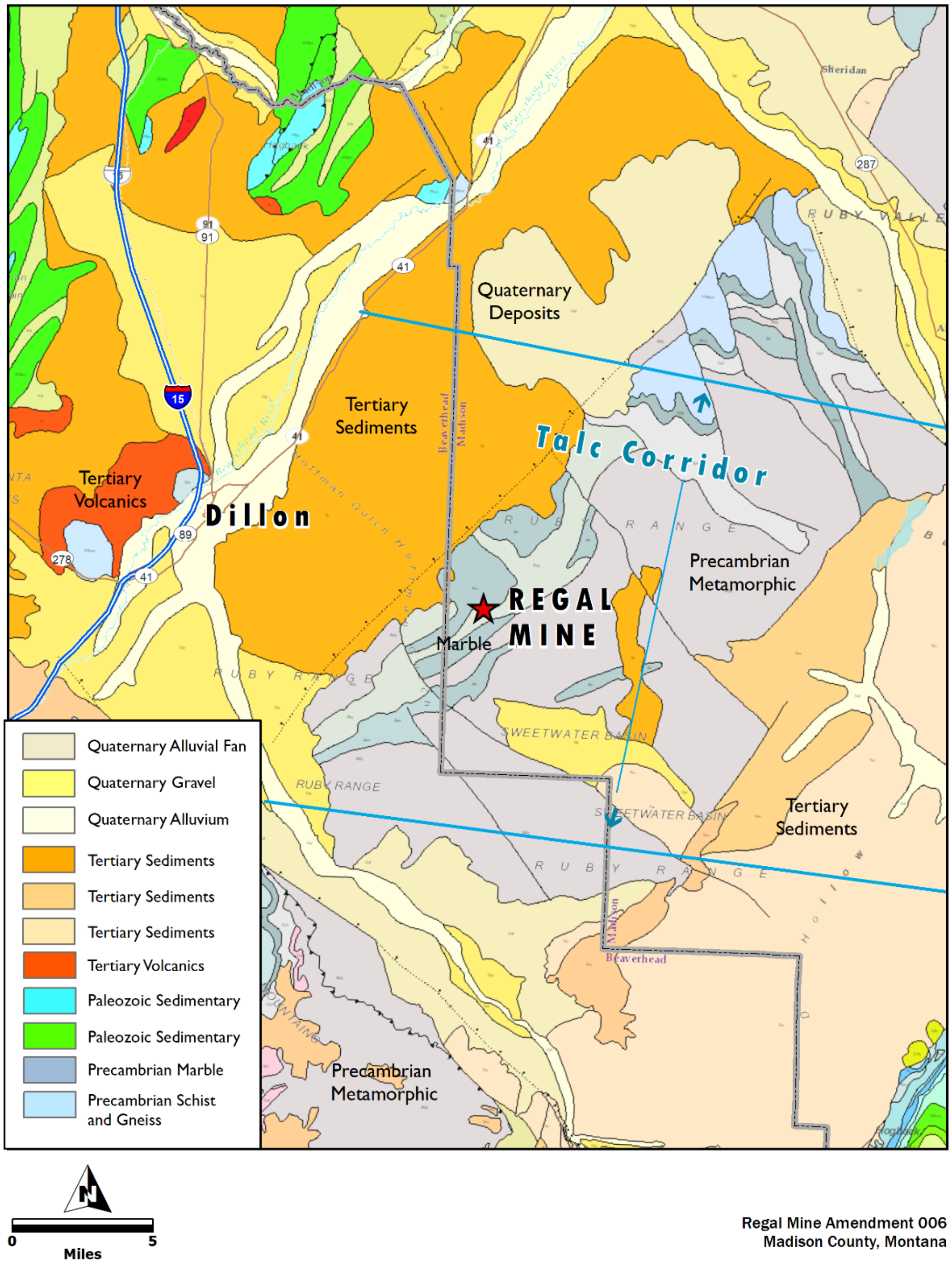

Figure 3.3-1
Regional Geology (Modified From Vuke *et al.* 2007)

Talc deposits occur in southwestern Montana along an east-west-trending talc corridor between Dillon and Cameron, Montana (**Figure 3.3-1**). Three currently operating talc mines (i.e., Regal, Treasure, and Yellowstone), four historic mines, and several talc prospects are located within the talc corridor (Childs 2017). Local talc deposits formed in response to a 1.36-billion-year-old tectonic event that included retrograde metamorphism and hydrothermal alteration of dolomitic marble host rocks (Underwood *et al.* 2014). Talc deposits up to 650 feet thick occur as lenticular to tabular veins or pods that are generally oriented parallel to the foliation or strike of the bedding (Hydrometrics, Inc. 1996). Other minerals associated with the talc deposits include magnesite, siderite, ankerite, calcite, pyrite, graphite, chlorite, serpentine, quartz, iron oxides, and tremolite (Hydrometrics, Inc. 1996).

Southwestern Montana is within the Centennial Tectonic Belt and is seismically active. Several Quaternary-age faults surround the Regal Mine. While most recorded earthquakes have been below Magnitude 3.0, larger earthquakes have occurred in the region (BMI 2019a). The largest earthquake near the Regal Mine was the 1959 Hebgen Lake Earthquake, which was a Magnitude 7.2 earthquake approximately 80 miles east of the Regal Mine in Yellowstone National Park (Golder Associates Inc. 2016). In 2005, a Magnitude 5.6 earthquake occurred along the Ruby Range western range front fault approximately 16 miles from the Regal Mine. A 2017 investigation by DEQ reported that this earthquake event may have resulted in loss of flow from springs nearby the fault (DEQ 2017). The following Quaternary-age faults are located within the region surrounding the Regal Mine: Ruby Range western range front fault (1.5 to 2 miles northwest), Sweetwater Fault (4 miles south), Cottonwood section of the Blacktail Fault (11 miles south), and Ruby Range north border fault (14 miles north) (Golder Associates Inc. 2016).

3.3.2.2 Local Geologic Setting and Stratigraphy

The Regal Mine pit site overlies an area of the Cherry Creek Group. The primary rock types that occur in the Regal ore deposit are dolomitic marble; talc; schist; gneiss; and diabase, amphibolite, and basaltic dike intrusions. Archean dolomitic marble, schist, amphibolite, and diabase dikes occur below the current and proposed extent of the WRDF (**Figure 3.3-2)**. Dolomitic marble and talc characterize the rocks in almost the entire mine pit, and schist and gneiss occur below the talc along the southern pit highwall (**Figure 3.3-2)**. The distribution of rock types and structural trends are shown on the geologic map on **Figure 3.3-2** and the cross sections on **Figure 3.3-3**. The following text describes the rock types within the Cherry Creek Group and occurrence.

- **Dolomitic Marble** – The dolomitic marble is associated with a high-grade metamorphic sequence (Golder Associates Inc. 2016). The dolomitic marble has a total thickness of 800 to 1,200 feet (DEQ 2007). At the Regal Mine, this unit is exposed on the north, east, and west pit slopes of the current pit and will be exposed in the final pit slopes.

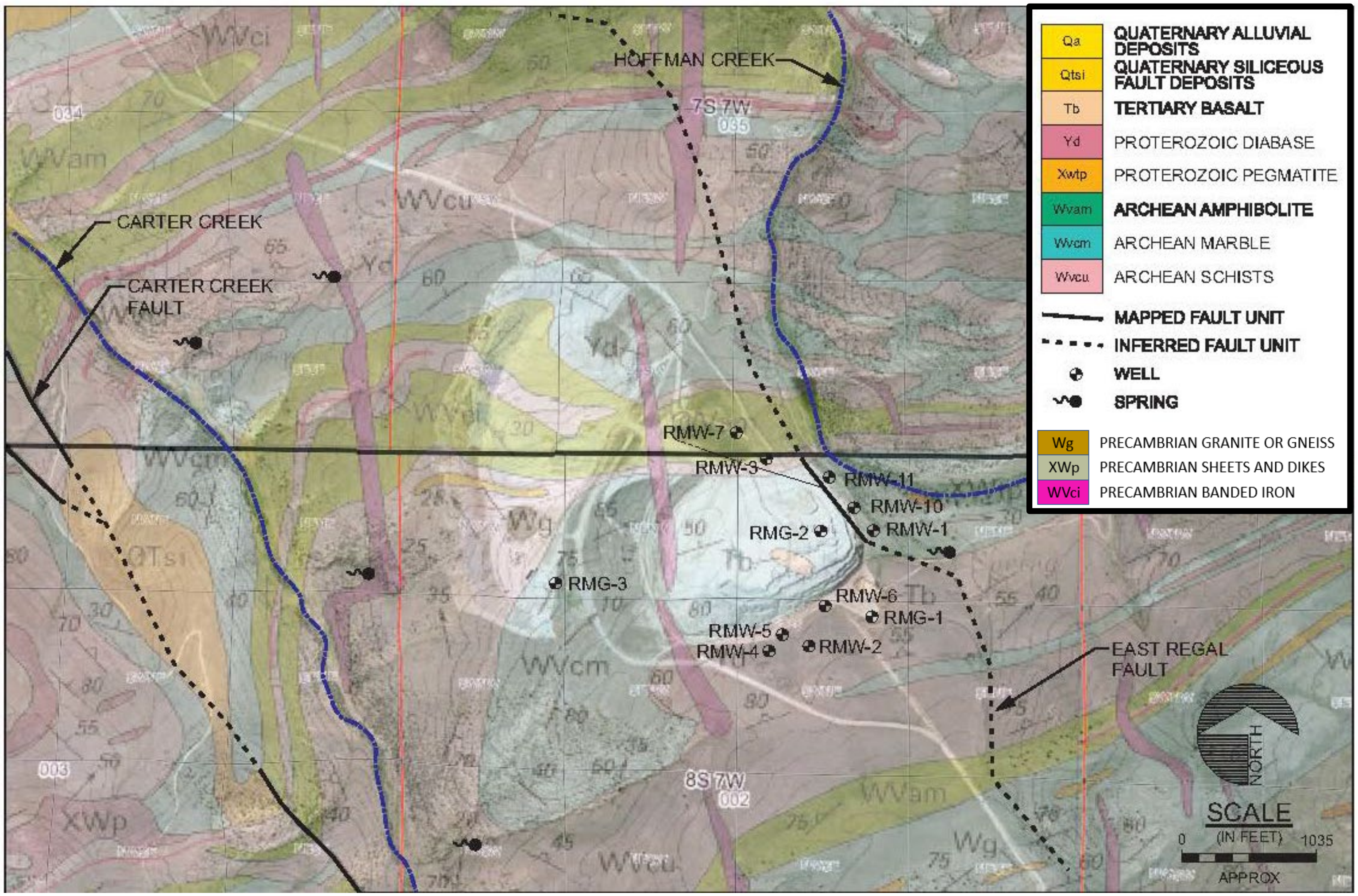

Figure 3.3-2
Geologic Map of the Regal Mine (Hydrometrics, Inc. 2019a)

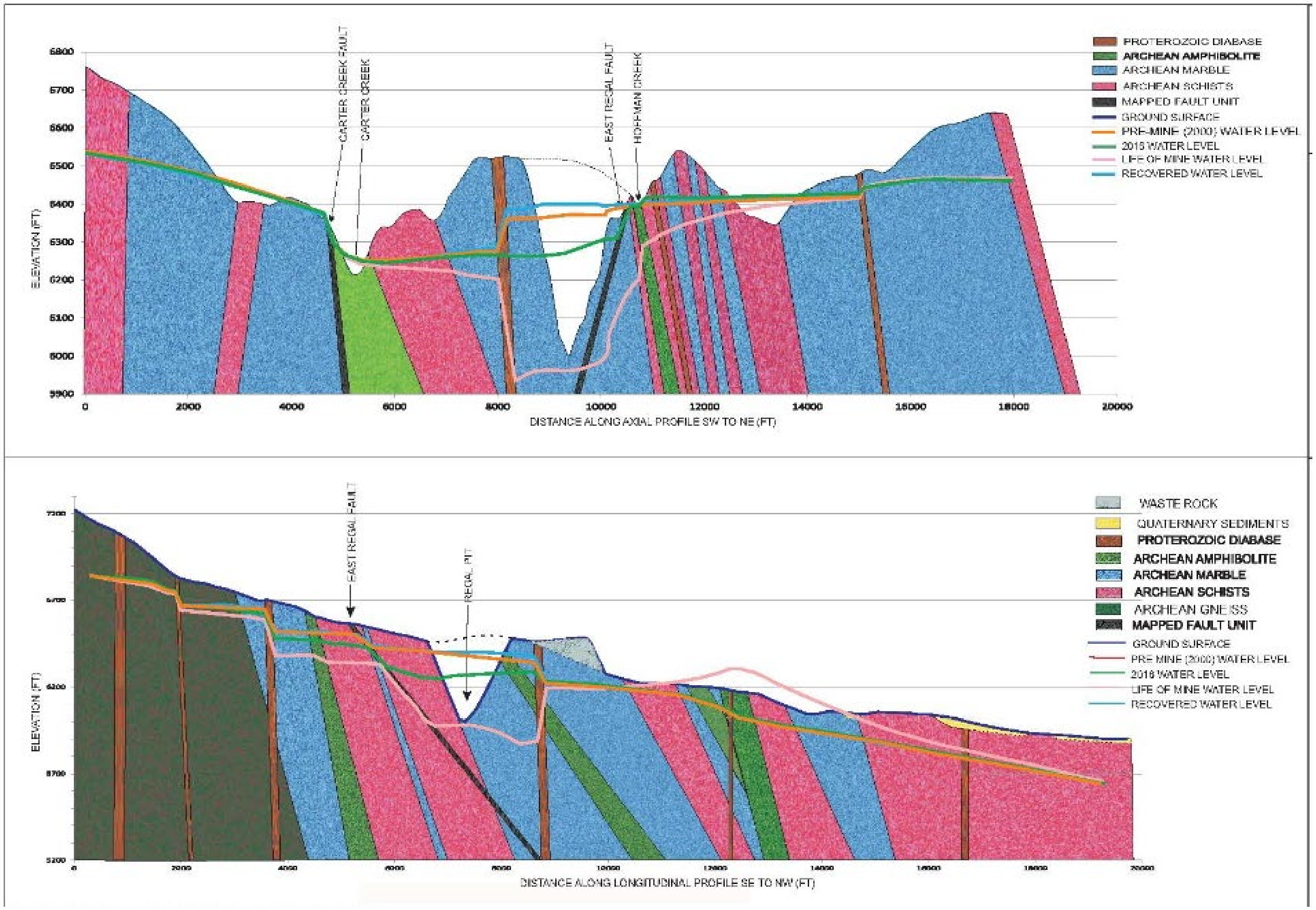

Figure 3.3-3
Geologic Cross Sections (Hydrometrics, Inc. 2019a)

- **Talc** – The talc orebodies occur as lenses and tabular veins entirely within dolomitic marble directly above the contact with the lower footwall schist and gneiss. The west end of the talc abuts a diabase dike, and at the east end of the talc zone, some mineralization replaces quartzo-feldspathic gneiss and pegmatite (Hydrometrics, Inc. 1996). The talc mineralization is a product of hydrothermal alteration of the dolomitic marble. Where the talc is massive and not mixed with other rock types, it is mined and hauled to the process plant.
- **Schist** – The schist is a medium-grained, biotite-muscovite-garnet-sillimanite schist (DEQ 2007). The schist occurs below the dolomitic marble and is exposed in the upper benches of the existing pit. Schist will be exposed above an elevation of approximately 6,300 feet in the final pit shown on **Figure 3.3-4**.
- **Gneiss –** This unit contains quartz-rich gneiss, biotite-quartzo-feldspathic gneiss, and schistose gneiss (DEQ 2007). Gneiss is exposed only in the upper benches on the north wall of the existing pit and will form the upper five benches of the final pit.
- **Diabase Dikes** – Archean rocks are intruded by Proterozoic diabase dikes that trend north-northwest in the Project area. Only one dike is exposed on the west wall of the current pit and will only be exposed in the upper bench of the final pit (Golder Associates Inc. 2016).
- **Amphibolite Dike** – A major amphibolite dike strikes approximately east-west across the bottom of the current pit. Where this dike intersects the west side of the pit, it dips south 40 degrees, and where it intersects the pit slope in the southeast portion of the pit, the dike dips north 60 degrees (Golder Associates Inc. 2016).
- **Basalt Dikes** – Tertiary basalt dikes are also exposed in the pit. The basal dikes (up to a few tens of feet thick) strike nearly east-west and steeply dip to the north and south.

The metamorphic rocks in the vicinity of the Regal Mine are intensely deformed and folded. These rocks have a northeasterly strike and northwest dip of approximately 45 degrees (BMI 2019a). The dolomitic marble in the pit is in limbs of a tight isoclinal, plunging, syncline fold (Underwood *et al.* 2014). Moderately to steeply northwest-dipping foliation in the schist extends throughout and beyond the limits of the mine pit (James 1990).

Several faults have been mapped within and near the Regal Mine. The East Fault trends north-northwest, is located along the eastern edge of the current mine pit, and cuts off the talc ore (**Figure 3.3-2**). Two other major faults are located in the pit—the North Pit Upper and North Pit Lower faults. These parallel faults strike east-west, dip north 45 degrees, and intersect the north side of the current pit (Golder Associates Inc. 2016). The Carter Creek Fault is a part of a system of major northwest-trending faults. The Carter Creek Fault is just west of Carter Creek and about 1/2 mile west of the mine pit (**Figure 3.3-2**) (Hydrometrics, Inc. 1996). James (1990) reports that the northwest-trending faults, including the Carter Creek Fault, typically have several thousand feet of left-lateral displacement and were active in the Precambrian age, with recurrent movement in late Mesozoic to late Tertiary time. No evidence or recent movement along these faults has been identified (BMI 2019a). The Ruby Range western range front fault is approximately 2 miles northwest of the Regal Mine pit and is the closest active fault.

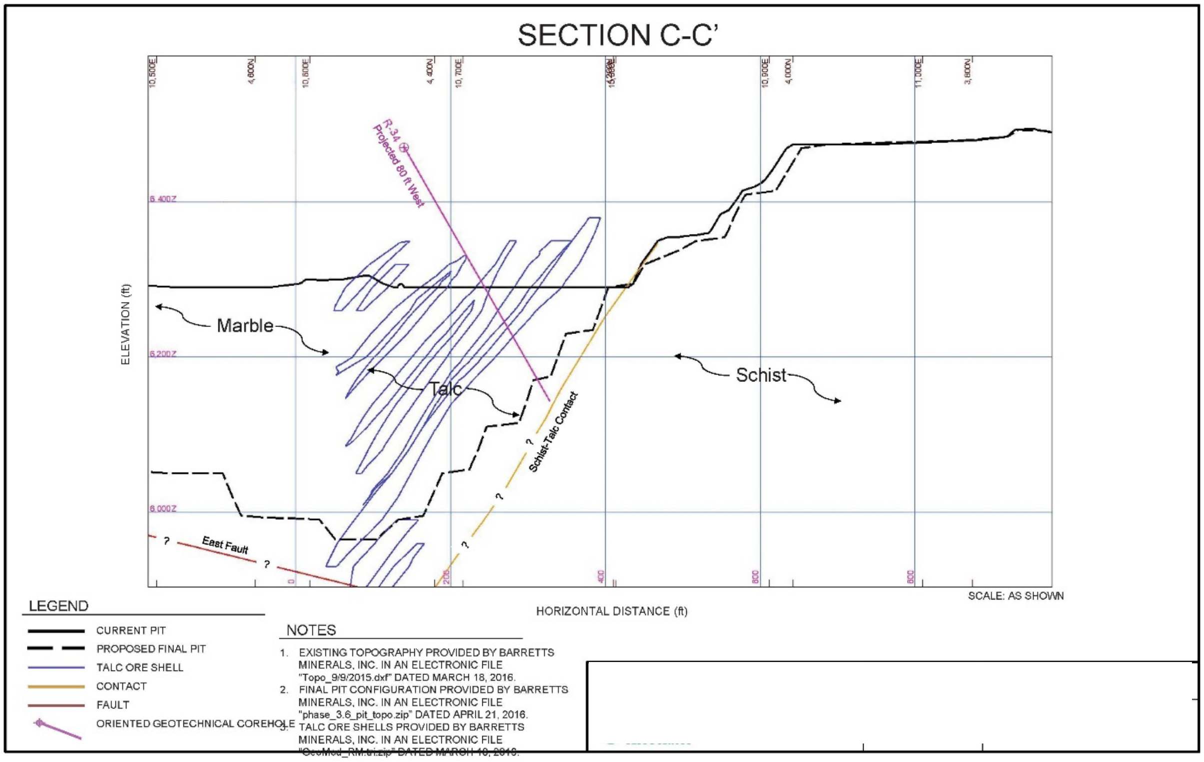

Figure 3.3-4
Talc Orebodies in North-South Cross Section (Golder Associates Inc. 2016)

3.3.2.3 Talc Deposit Geometry and Mineral Resources

The Regal Mine talc deposit occurs as lenses and tabular veins in a zone of hydrothermally altered dolomitic marble directly above the contact with the footwall schist. The talc orebodies are shown on the cross section on **Figure 3.3-4**. The talc zone is approximately 1,100 feet long, up to 250 feet wide, and ranges in thickness from 100 to 200 feet (BMI 2019a). The dolomitic host bed at the Regal Mine has a total thickness of 800 to 1,200 feet (Hydrometrics, Inc. 1996). The talc deposit terminates on the west side of the mine pit at the northwest-trending diabase dike. On the east side of the mine pit, the orebody is cut off by a north-northwest-trending, near-vertical, brecciated fault zone (Golder Associates Inc. 2016).

The talc mineralization likely formed because of hydrothermal fluids that react with the dolomitic marble and is an alteration product. The same process that formed the talc mineralization also resulted in altering minerals in the gneiss and schist to chlorite. Underwood *et al.* (2014) provides a summary of the mineralization processes that are thought to have formed the orebody. The Regal talc deposit consists primarily of talc ($Mg_3Si_4O_{10}OH_2$) with minor amounts of chlorite and dolomitic marble and trace amounts of other minerals (e.g., iron oxide, graphite, apatite, magnesite, calcite, mica, hematite, pyrite, microcline, alpha quartz, and rutile) (Hydrometrics, Inc. 1996).

3.3.2.4 Asbestiform Minerals

Asbestiform minerals can occur in rocks associated with talc deposits. No asbestos has been identified at the Regal Mine, although minerals associated with asbestos, or potentially asbestiform rocks (PAR), occur in isolated zones. This section describes the mineralogy and occurrence of PAR along with current sampling and monitoring plans.

Six naturally occurring minerals have asbestiform characteristics of long, thin, fibrous crystals and include chrysotile, amosite, crocidolite, asbestiform anthophyllite, asbestiform tremolite, and asbestiform actinolite. The mineral morphology and physical characteristics result in asbestiform properties more so than the chemical composition; this is particularly the case for anthophyllite, tremolite, and actinolite, which can occur in asbestiform and non-asbestiform crystal shapes (DEQ 2001). PAR is defined as serpentine and amphibole mineralization in non-ore rock. These PAR minerals, if present, may or may not include asbestiform crystals.

Ore and waste-rock sampling at the Regal Mine identified chrysotile in an isolated area. At the Regal Mine, PAR is defined as asbestiform chrysotile in concentrations greater than 0.25 percent (i.e., the detection level). Concentrations of chrysotile in the PAR zone at the Regal Mine varies from below detection to 47 percent and averages 0.50 percent (DEQ 2001). PAR was identified as discontinuous veins and lenses in a 35-foot-wide zone at the lithologic contact of dolomite marble and amphibolite in the northwestern corner of the mine pit (DEQ 2001). **Figure 2.3-1** depicts the approximate location of PAR that would be extracted as part of the Proposed Action. Within this zone, chrysotile occurrence is sporadic with variable concentrations over a 15-foot-wide zone near the geologic contact. In locations north of the mine pit, chrysotile mineralization has also been identified along the same contact (DEQ 2001). Chrysotile mineralization occurs in a block of rock that is 380 feet long, 40 feet wide, and 70 feet thick (BMI 2019a). The volume of PAR is calculated to be 93,500 tons (BMI 2019a). Exposures of PAR are likely common throughout the southern Ruby Range near the Regal Mine and may provide a natural background contribution of asbestiform mineral fibers (DEQ 2001).

No asbestiform minerals other than chrysotile were identified in the Regal Mine area (DEQ 2001). No asbestiform minerals or fibers have been detected in the talc ore, intrusive rock, or schist rock units. Approximately 28,000 tons of PAR were mined in April 2001 (BMI 2019c). No airborne asbestos fibers were detected during air monitoring at the Regal Mine while excavating PAR in 2001 (DEQ 2001, Maxim Technologies, Inc. 2001).

3.3.2.5 Waste-Rock Geochemistry

Waste rock generated at the Regal Mine consists primarily of dolomitic marble, schist, and igneous intrusions (Maxim Technologies, Inc. 2000a). Waste-rock geochemical evaluations for the Regal Mine were conducted by BMI from 1998 to 2000 to address agency concerns regarding waste rock, acid rock drainage potential, and metal mobility (Maxim Technologies, Inc. 2000a). Rock samples were collected from dolomitic marble, schist, intrusive, and talc. Sulfide content is very low and acid-base accounting tests indicate little risk of acid generation within the non-ore rock and from non-ore lithologies in the exposed pit walls (Maxim Technologies, Inc. 2000a). Metal mobility tests indicate that metals dissolved from non-ore rock (i.e., aluminum, barium, cadmium, chromium, copper, and iron from the schist, as well as barium, strontium, and zinc releases from the dolomitic marble and schist) occur in concentrations well below state and federal regulations (Maxim Technologies, Inc. 2000a).

3.3.3 Environmental Consequences

The predicted environmental impacts of PAR geochemistry are discussed in Section 3.17 Air Quality. The following sections describe how mine materials are proposed to be mined and managed as a consequence of the local geology and geochemical results.

3.3.3.1 No Action Alternative

Under the No Action Alternative, the proposed Amendment would not be approved, and BMI would continue to operate under its existing OP. Mining would continue until approximately 2021 when the open pit and WRDF would reach their permitted disturbance limits. Impacts to the geology and mineral resources would not change from what has been permitted for the mine, such as removing ore and waste rock from the Regal Mine pit and placing waste rock in the WRDF within the currently approved disturbance boundary. The geochemistry of the ore and waste rock do not have the potential to generate acid or release various heavy metals in excess of ground water quality standards.

No additional PAR would be disturbed under the current mine plan. BMI would continue to implement their Non-Ore Rock Management Plan (Maxim Technologies, Inc. 2000a) to address asbestiform mineralogy at the Regal Mine. BMI will continue to collect a random sample of each non-ore rock type twice annually (when operating) and a sample of ore from the pit highwall annually to test for the presence of asbestiform mineralization. BMI monitors talc for asbestiform fiber content as part of its standard operational procedures. This practice has been in effect at BMI's mill since before the startup of the Regal Mine. BMI will continue to monitor and manage PAR to meet worker exposure regulations as specified in 30 CFR Parts 56, 57, and

71 (U.S. Department of Labor/Mine Safety Health Administration 2018). These regulations specify worker exposure limits, laboratory analysis, and reporting requirements for PAR. The regulations are administered by the U.S. Mine Safety and Health Administration (MSHA).

3.3.3.2 Proposed Action

Under the Proposed Action, BMI would continue to mine talc and extract waste rock, including a PAR zone. Approximately 0.45 million cubic yards (yd^3) of talc ore would be mined as part of the expansion. The majority of waste rock would be similar to what is currently extracted (primarily dolomitic marble). Waste rock would be exposed on the pit walls and disposed of in the expanded WRDF . The results of the geochemical analyses show that land disposal of waste rock related to the expansion of the Regal Mine would not adversely affect the environment or water quality (DEQ 2007).

BMI would continue to adhere to the Final Barretts Regal Mine Non-Ore Rock Management Plan (Maxim Technologies, Inc. 2000a) as part of the Proposed Action. As part of the open pit expansion, approximately 39,500 yd^3 of PAR would be extracted and stored per the Non-Ore Rock Management Plan (Maxim Technologies, Inc. 2000a). The PAR material represents roughly 0.5 percent of the remaining waste-rock tonnage to be extracted under the Proposed Action. **Figure 2.3-1** depicts the approximate location of in-place PAR and the proposed PAR disposal location. A PAR zone occurs on the southwest highwall of the pit and would be extracted during a 3-day period within the first 18 months of the pit expansion under the Proposed Action (BMI 2019a). Drilling in any PAR zone would use wet drilling techniques, and mine operators would work in enclosed and pressurized cabs (DEQ 2001). As specified in the Non-Ore Rock Management Plan, personal air monitoring would be conducted during PAR disturbance. The PAR material would be disposed of in a designated area within the boundaries of the WRDF shown on **Figure 2.3-1** and encapsulated with other non-PAR waste rock and soil.

Air-quality impacts of airborne chrysotile fibers are discussed in Section 3.17 Air Quality. and worker safety and industrial hygiene are discussed in Section 3.18 Industrial Safety.

3.3.3.3 WRDF Grading and Mosaic Vegetation Alternative

No aspect of the WRDF Grading and Mosaic Vegetation Alternative would affect the amount or extent of excavation of the Regal Mine or the overall disturbance area of the WRDF. The impacts to the geology resources and geochemistry under this alternative would be identical to the Proposed Action.

3.4 Ground Water Resources

This section summarizes the regulatory framework, describes the ground water environment in detail, and presents a discussion of primary impacts to ground water resources in the area surrounding the Regal Mine for the proposed alternatives. The regulatory framework for water resources in Montana includes but is not limited to the following:

- Federal Clean Water Act;
- Montana Water Quality Act (Title 75, chapter 5, MCA);
- Nondegradation Rules (Administrative Rules of Montana [ARM] Title 17, chapter 30, subchapter 7);
- Montana MMRA (Title 82, chapter 4, part 3, MCA);
- Montana Pollutant Discharge Elimination System; and
- Montana Nonpoint Source Management Plan.

The Federal Clean Water Act provides for the maintenance and restoration of the physical, chemical, and biological integrity of the nation's water (33 USC § 1251). The U. S. Environmental Protection Agency (USEPA) delegated most of the implementation of the Clean Water Act to the State of Montana. Designated beneficial uses of Montana's state waters include recreation, water supply, fisheries, aquatic life, and wildlife.

DEQ may not approve a reclamation plan unless it provides sufficient measures to prevent water pollution. The reclamation bond that a mine operation must submit before DEQ issues a permit or work begins on an approved permit amendment must also be sufficient to ensure compliance with the Montana MMRA. OPs must also comply with the Montana Water Quality Act, which provides a regulatory framework for protecting, maintaining, restoring, and improving water quality for beneficial uses. Pursuant to the Montana Water Quality Act, DEQ developed water quality classifications and standards, as well as a permit system to control discharges into state waters. Mining operations must comply with Montana's regulations and standards for surface water and ground water.

3.4.1 Analysis Methods

Analysis methods for understanding the existing ground water conditions at the Regal Mine included reviewing the Amendment Application and supporting documentation provided by BMI, including studies, reports, and testing conducted by Hydrometrics, Inc. Specifically, the following primary resources were reviewed and relied upon for this section:

- Hydrometrics, Inc. 2019c. Barretts Minerals, Inc. "2018 Ground Water Modeling Report Barretts Regal Mine, Dillion, Montana;"

- Hydrometrics, Inc. 2019a. "Barretts Minerals, Inc. Regal Mine Water Management Plan;" and
- Technical Memorandum 3 – Barretts Regal Mine Project – Ground Water Model and Creek Design Assessment (Appendix C).

The Proposed Action for water management calls for dewatering the pit by using several perimeter dewatering wells (phased in over time) and discharging the water to percolation basins that are located northwest of the mine pit and an injection well. Several investigations were conducted to evaluate potential ground water inflows to the pit and the feasibility of water handling and disposal including the following:

- Expanded spring and seep inventory;
- Stable isotope analysis;
- Synoptic stream flow surveys;
- Infiltration testing;
- Aquifer characterization;
- Completion and testing of additional monitoring wells;
- Tracer studies; and
- Ground water analytical modeling (e.g., Analytic Aquifer Simulation [AnAqSim]).

3.4.2 Affected Environment

Ground water in the mine area occurs in a confined-to-semiconfined aquifer within the local metamorphic rock, which consists of dolomitic marble, gneisses, schists, and amphibolite units. These units are highly deformed and folded, trend to the northeast, and dip to the northwest. The units are intersected by diabase dikes that generally trend northwest along fault systems. The known faults in the area include the Carter Creek Fault, the Stone Creek Fault and the East Regal Fault. These faults predate the diabase dike formation. **Figure 3.4-1** depicts the geology around the mine area. Ground water flow is highly controlled by local structure, the diabase dikes, fault systems and on the lithologic sequence of metamorphic rock.

Wells completed through these units upgradient of the talc deposit initially yielded flows on the order of 100 to 200 gallons per minute (gpm), but more recent data show well yield at one-half that rate because the ground water table has been lowered due to mine development and dewatering. One of the initial wells (RMG-2) that was completed in talc-rich lithologies demonstrated a lower yield and suggested that a lower permeability is associated with the ore zone. This lower yield is further demonstrated by more recent (June 2015) drilling of dewatering wells RMW-10 and RMW-11. These wells are completed in the dolomitic units, which result in low well yields (RMW-10 at 8 gpm and RMW-11 at 10 gpm). However,

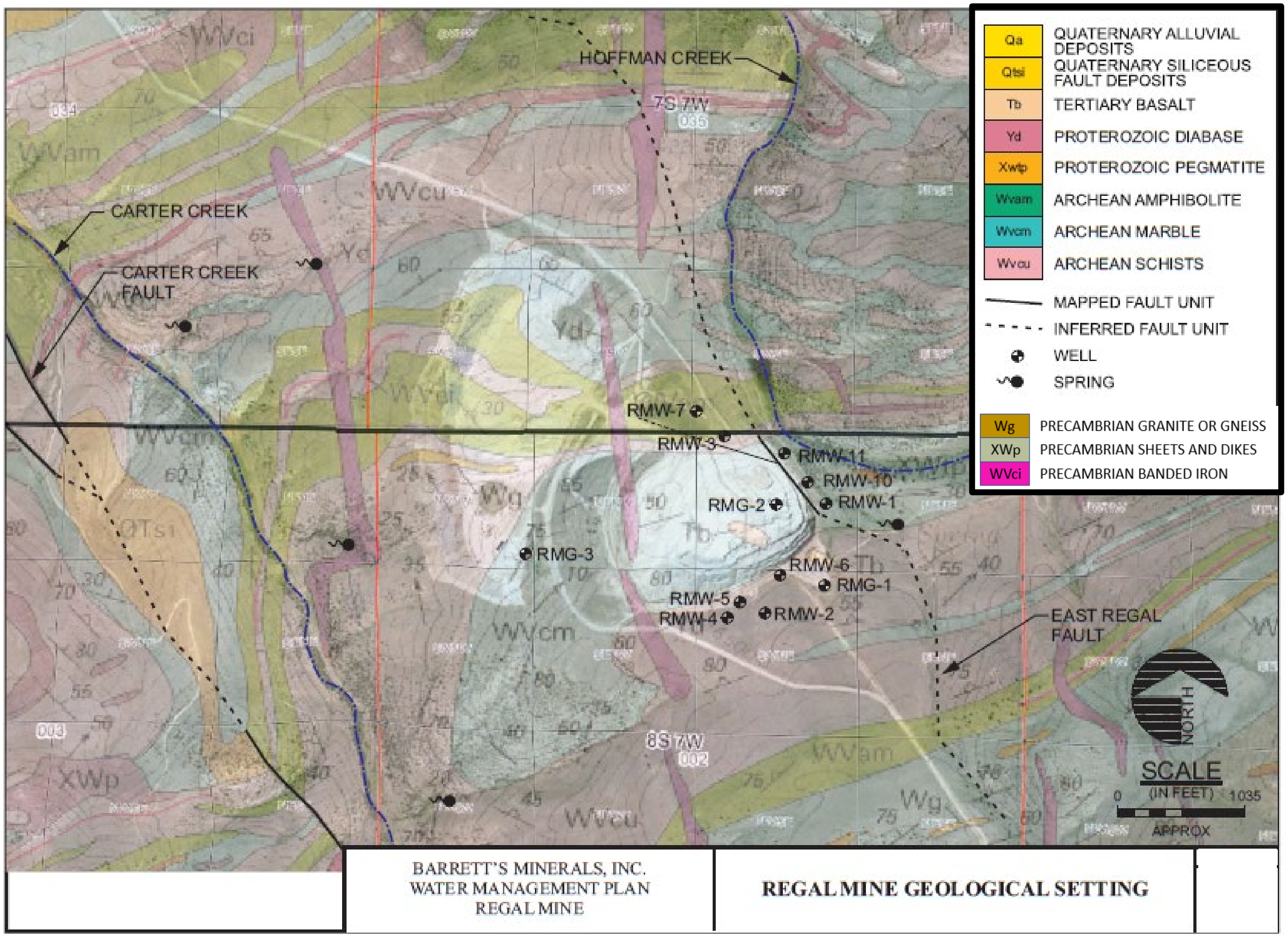

Figure 3.4-1
Regal Mine Geologic Setting (Hydrometrics, Inc. 2019c)

monitoring well (RMW-3), which was completed hydraulically downgradient of the ore body in an amphibolite unit, initially produced 200 gpm (Hydrometrics, Inc. 1999). This difference in flow indicates a large variation in yields in wells around the mine area.

Observed potentiometric (i.e., water table elevation) data for the area around the Regal Mine site show that ground water flows generally to the northwest across the mine site toward the Beaverhead Valley. An observed potentiometric surface has been projected using springs and stream locations, and static water levels from October 2016 and is illustrated on **Figure 3.4-2**.

Aquifer tests conducted by Water Management Consultants and Hydrometrics, Inc. (Hydrometrics, Inc. 2019a) confirmed the presence of a nonpermeable barrier during pumping tests. As mining progressed, the East Regal Fault was identified and exposed in the east highwall of the pit. The fault was mapped and projected on either side of the pit. Concurrently, as mining progressed, ground water inflows into the pit increased, which led to installing additional dewatering wells along the east highwall. To verify direction and flow, a fluorescence tracer test was conducted on surface waters along the margin of the east highwall in 2014 (Hydrometrics, Inc. 2019a).

Recent changes to the dewatering system have temporarily changed dewatering and reinjection of ground water in Hoffman Creek's shallow alluvial system. Noted initially in 2004, additional ground water flows were seen along the east highwall of the pit. Fluorescent dye tracer studies (2014 and 2015) (Hydrometrics, Inc. 2019a) confirmed a hydraulic connection between Hoffman Creek and the water flowing into the pit. To capture this ground water, several actions were undertaken. Monitoring Well RMW-1 was reclassified as a dewatering well and two new dewatering wells (RMW-10 and RMW-11) were installed outside the rim of the pit along the east highwall. All three of these wells discharge to an Underground Injection Control (UIC) Class V injection well downgradient from the pit. The UIC injection well injects the unaltered ground water into the shallow aquifer to reestablish the recharge zone in Hoffman Creek, which naturally occurs below the existing Hoffman Creek Pond. The water quality of these wells meets all of the drinking water maximum and secondary maximum criteria. The USEPA approved the UIC well on April 1, 2015. Minor Revision MR15-001 was approved by DEQ in February 2015 and MR15-002 was approved in May 2015.

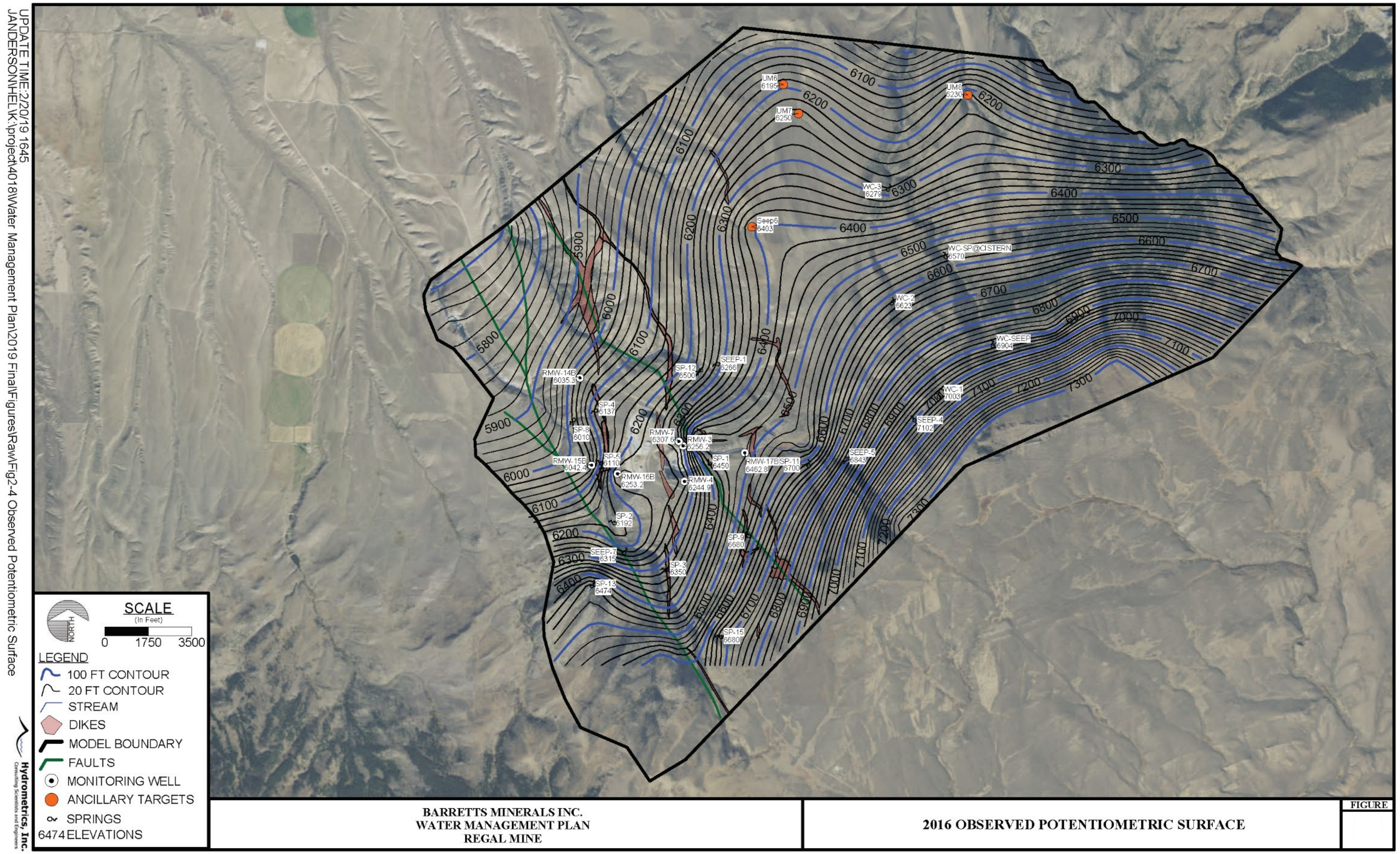

Figure 3.4-2
Potentiometric Surface (Hydrometrics, Inc. 2019c)

3.4.2.1 Ground Water Monitoring Sites

Ground water investigations began in the late 1990s with the installation of four monitoring wells and currently includes a network of 16 wells (see **Figure 3.4-3** and **Table 3.4-1**). Nearby springs and seeps, presumed to be part of the local ground water system, have been monitored since the early 2000s and current monitoring includes 13 springs and 4 seeps (see **Figure 3.4-4** and **Table 3.4-2**). The following sections present the existing ground water conditions***.***

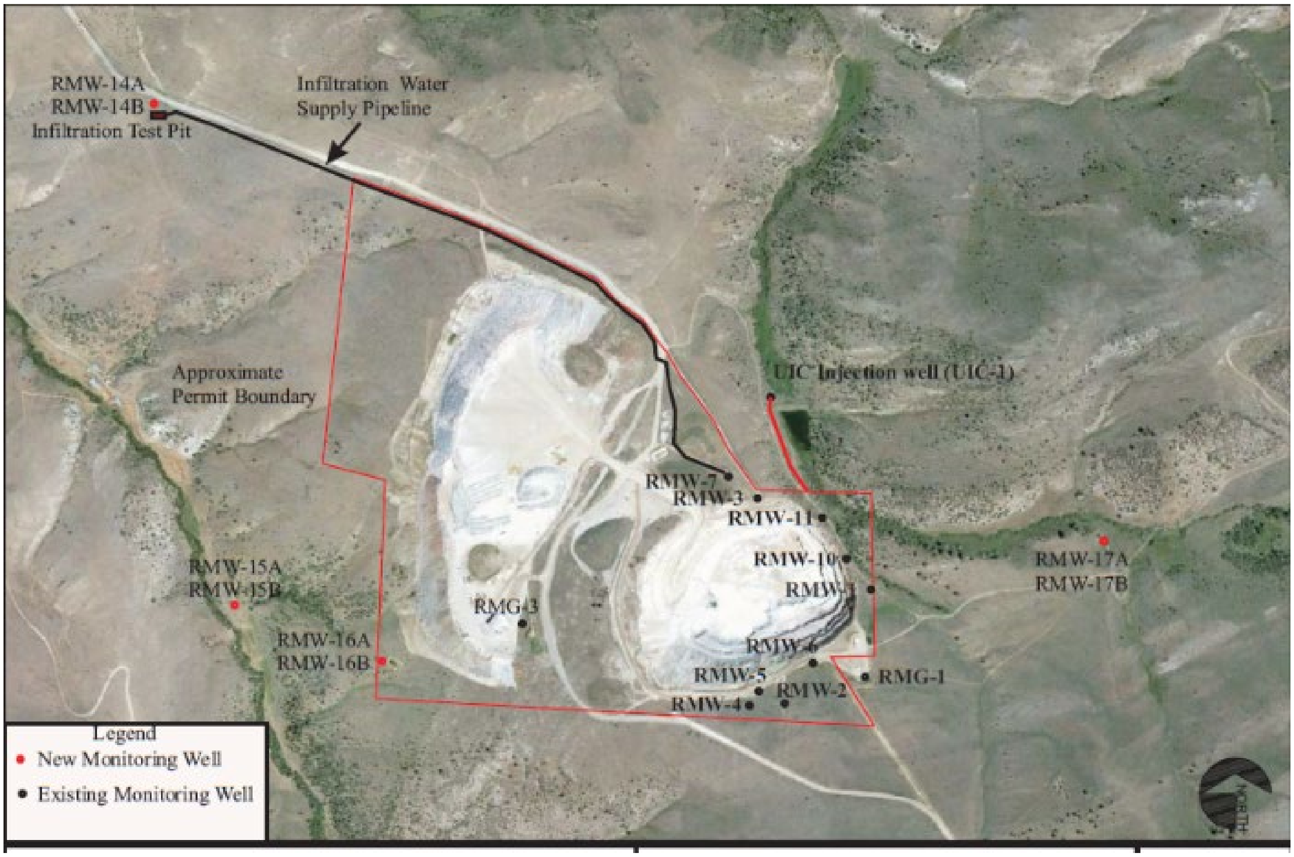

Figure 3.4-3
Proposed and Existing Ground Water Monitoring Wells (Hydrometrics, Inc. 2019c)

3.4.2.2 Hydrogeologic Setting

The aquifer in the mine is confined to semiconfined within the local metamorphic rock, which consist of dolomitic marble, gneisses, schists, and amphibolite units. These units are highly deformed and folded, trend to the northeast, and dip to the northwest. The units are intersected by diabase dikes that generally trend northwest along fault systems. The known faults predate the diabase dike formation (see **Figure 3.4-1**). Ground water flow is highly controlled by local structure, the diabase dikes, fault systems, and the lithologic sequence of metamorphic rock.

Table 3.4-1
Monitoring Well Completion Details (Hydrometrics, Inc. 2019a)

Well Name	Northing (feet)	Easting (feet)	Ground Surface Elevation (feet, amsl)	Measuring Point Elevation (feet, amsl)[a]	Total Depth (feet, bgs)	Screen Interval (feet, bgs)	Sand Pack Interval (feet, bgs)
	State Plane (MT83IF)						
RMW-1	350,625.8086	1,215,049.5559	6,437.25	6,438.66	228	178–228	50–245
RMW-2	349,779.72	121,4462.71	NS	6,494.89[b]	194	144–194	90–194
RMW-3	351,263.9404	1,214,228.4191	NS	6,465.59[b]	300	250–300	70–300
RMW-4	349,828.1685	1,214,282.8075	NS	6,484.35[b]	449	399–449	68–449
RMW-5	349,958.0073	1,214,315.5248	6,476.81	6,479.40	410	150–170 210–230 270–410	70–409
RMW-6	350,141.9458	1,214,641.4265	NS	6,473.26[b]	480	300–480	50–480
RMW-7	351,447.7922	1,214,058.0357	NS	6,463.58[b]	420	Open Bottom	Open Bottom
RMW-8	7/9/2008 Destroyed 2009				200	30–200	20–200
RMW-9	May 2012 Destroyed 2012						none
RMW-10	350,856.2168	1,214,880.998	6,416.44	6,419.65	304	200–300	30–304
RMW-11	351,169.1216	1,214,683.9227	6,390.75	6,393.41	203	100–200	29–200
RMW-12	351,979.72	121,4402.71	NS	NS	20	15–20	none
RMW-13	350,460.77	121,4699.76	NS	NS	30	20–30	5–30
RMG-1	350,032.4749	1,215,020.858	6,484.22	6,486.59	310	290–310	NA
RMG-3	350,358.0506	1,212,576.9887	6,483.51	6,485.69	NA	NA	NA
RMW-14A	354,017.4685	1,210,059.7509	6,110.27	6,111.02	50	29.3–49.3	26–50
RMW-14B	354,018.4449	1,210,057.3617	6,110.25	6,111.54	150	129.7–149.7	129–150
RMW-15A	350,476.3541	1,210,523.1988	6,062.86	6,064.59	50	29.1–49.1	27–50
RMW-15B	350,478.6198	1,210,525.3208	6,063.23	6,064.15	150	127–147	122–147
RMW-16A	350,139.6666	1,211,575.3987	6,281.73	6,282.38	50	29.4–49.4	25–49.4
RMW-16B	350,137.1604	1,211,574.1637	6,281.68	6,283.21	150	130–150	127–150
RMW-17A	350,985.9435	1,216,725.7904	6,495.08	6,497.34	50	28.5–48.5	20–48.5
RMW-17B	350,988.4043	1,216,724.1892	6,494.65	6,496.57	150	128–148	125–148
RMW-18	350,496.8107	1,215,581.1473	6,462.81	6,465.92	NA	NA	NA

[a] Measuring point elevation revision August 2018
[b] Measuring point at top of casing
amsl = above mean sea level
bgs = below ground surface

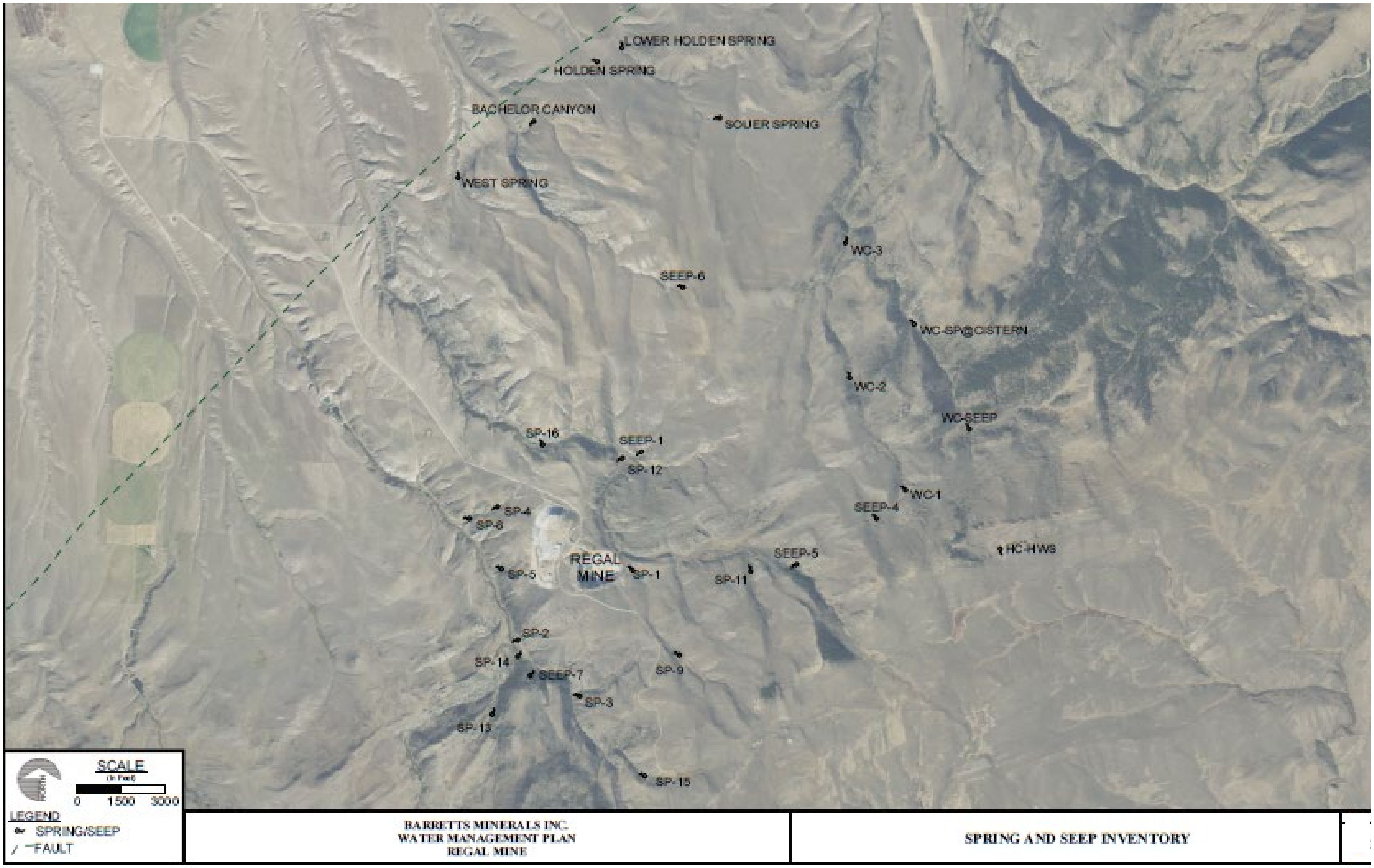

Figure 3.4-4
Spring and Seep Locations (Hydrometrics, Inc. 2019c)

Table 3.4-2
Spring and Seep Identification and Locations (Hydrometrics, Inc. 2019a)

Spring I.D.	Location		Elevation (amsl)	Specific Conductance	Measured Flow (gpm)	
	State Plane (MT83IF)			µS/cm (Mar 017)	Initial (year)	Current (Mar 2017)
	Northing	Easting				
SP-1	350490.97	1215578.63	6,462	430	27 (2000)	4.4
SP-2	348158.27	1211424.54	6,171	433	26 (2000)	2.3
SP-3	346304.49	1213461.76	6,370	335	42 (2000)	17.1
SP-4	352674.94	1210734.67	6,125	441 (2012)	1(2008)	0.5 (2012)
SP-5	350574.03	1210865.85	6,154	641	1(2008)	0.6
SP-6	349790.26	1211199.02	6,218	Not active, no flow	1(2008)	N/A
SP-7	352448.54	1212062.81	6,277	No longer accessible	3(2011)	N/A
SP-8	352304.45	1209778.13	6,019	671	0.5 (2014)	1
SP-9	347646.05	1216901.76	6,766	169	2.6 (2016)	3.4
SP-10	349947.92	1217015.85	6,606	No flow	No flow	No flow
SP-11	350633.46	1219321.55	6,696	335	2.5 (2016)	0.6
SP-12	354325.3	1214967.67	6,249	496	0.5 (2016)	0.5
SP-13	346924.63	1211116.55	6,474	501	(2017)	17.1
SP-14	347606.22	1211426.03	6,309	790	(2017)	0.5
SP-15	343544.81	1215739.71	6,670	535	(2017)	2.3
SP-16	354797.62	1212259.99	6,068	502	(2017)	0.5
Seep-1	352290.12	1223600.3	7,102	N/A	(2017)	N/A
Seep-2	354883.86	1216023.56	6,325	N/A	(2017)	N/A
Seep-3	356401.43	1217339.18	6,434	N/A	(2017)	N/A
Seep-4	1209653.55	356100.3	5,945	N/A	(2017)	N/A

3.4.2.3 Ground Water Levels and Flow

Potentiometric data for the area around the Regal Mine show that ground water generally flows southeast to northwest across the mine toward the Beaverhead Valley. A potentiometric surface was created using springs and stream locations, as well as static water levels in wells from October 2016 (**Figure 3.4-2).** Static water level depths range from approximately 22 feet to over 240 feet. Ground water flow gradient ranges from approximately 0.05 to 0.06.

3.4.2.4 Aquifer Testing

Five aquifer test investigations have been conducted at the Regal Mine to characterize the ground water setting and evaluate the potential magnitude of ground water inflows to the pit once mining intercepts the regional ground water system. Aquifer test investigations have included single-well and multiple-well tests as described in the following text. The results of all historic Regal Mine aquifer tests are shown in **Table 3.4-3**.

- The August 1994 single-well test (i.e., office domestic water supply well RMG-1) consisted of pumping well RMG-1 for 24 hours at 44 gpm and monitoring aquifer drawdown and recovery.
- The January 1995 single-well tests on RMG-2 (pit well) consisted of two aquifer drawdown and recovery tests. These tests included a 40-hour test pumping at 56 gpm and an 8-hour test pumping at 58 gpm. Well RMG-2 was located near the center of the pit and was removed in the second quarter of 1998 as part of pit excavation activities.
- Two pumping tests were conducted in November 1998 as part of the ground water characterization and affects assessment. The first test was a multiple-well, 72-hour test that pumped Well RMW-4 at 78 gpm and monitored drawdown and recovery at wells RMW-4 and RMW-2. The second test consisted of pumping Well RMW-1 at 78 gpm for 120 hours. Although several wells were monitored during the RMW-1 test, measurable drawdown was only observed at the pumping well.
- A long-term pumping test was performed in September 2003 to aid in estimating pit dewatering rates. Well RMW-5 was installed and pumped for approximately 43 days at an average rate of 57 gpm. Recovery lasted approximately 83 days. Water levels were recorded in the pumping well and four observations wells.
- A second long-term pumping test was performed in the spring of 2005 to confirm the conclusions of the previous test. A new pumping well (RMW-6) and an additional monitoring well (RMW-7) were installed. The new well was pumped for approximately 35 days at an average rate of 60 gpm and allowed to recover for approximately 26 days. Water levels were recorded in the pumping well and six observation wells.

Analytical models that incorporate observed site gradients and aquifer test results indicate that ground water flows ranging from 1,100 gpm to as high as 2,200 gpm may be encountered as the pit bottom is advanced to an elevation of 6,080 feet (the current permitted depth is 6,100 feet). The 1,100-gpm to 2,200-gpm estimate is based on a bulk site hydraulic conductivity of 2.0 feet per day. If this hydraulic conductivity value is bracketed with lower and higher estimates of 0.8 feet per day and 3.0 feet per day, then potential pit inflows range from 400 gpm to 3,300 gpm (Hydrometrics, Inc. 1999). Note that these data were generated from pump tests on RMW-1 sited east of the mapped East Regal Fault along the east highwall of the pit. An analysis of the pumping test data for RMW-6 west of the East Regal Fault showed reduced flow rates and lower overall dewatering rates (500 gpm) for the life of the mine. The most recent aquifer test data were used to determine drawdown in particular lithological units in which the wells are completed.

Table 3.4-3
Regal Mine Aquifer Test Results (Hydrometrics, Inc. 2019a)

Study Method	Hydraulic Conductivity (ft/day)								
	RMW-1	**RMW-2**	**RMW-3**	**RMW-4**	**RMW-5**	**RMW-6**	**RMW-7**	**RMG-1**	**RMG-2**
Hydrometrics, Inc. 1994 Theis,dd Cooper Jacob (t/dd) Theis, recovery								2.69 6.55 2.90	
Hydrometrics, Inc. 1995 Theis,dd Cooper Jacob (t/dd) Theis, recovery									0.23 0.22 0.21
Hydrometrics, Inc. 1998 Theis,dd Cooper Jacob (t/dd) Theis, recovery	1.00 2.46 2.06	10.4 5.07 2.82		0.86 3.63 ND -					
WMC 2002 Theis,dd Cooper Jacob (t/dd) Cooper Jacob (t/dist/dd) Theis, recovery	0.133 0.983 0.983 1.09	0.527 0.562 0.597 0.492	0.597 0.948 1.05 0.878	0.597 0.597 0.632 0.527	ND ND ND 0.983				
WMC 2004 Theis,dd Theis, recovery Theis, steady state		0.527 0.492 0.105	0.140 0.281 0.105	0.527 0.176 0.105	0.281 0.176 0.105	0.0702 ND ND	0.140 0.140 0.105		
	Transmissivity (ft^2/day)								
	RMW-1	**RMW-2**	**RMW-3**	**RMW-4**	**RMW-5**	**RMW-6**	**RMW-7**	**RMG-1**	**RMG-2**
Hydrometrics, Inc. 1994 Theis,dd Cooper Jacob (t/dd) Theis, recovery								360 878 389	
Hydrometrics, Inc. 1995 Theis,dd Cooper Jacob (t/dd) Theis, recovery									30 29 28
Hydrometrics, Inc. 1998 Theis,dd Cooper Jacob (t/dd) Theis, recovery	150 419 310	3629 1771 985		300 377 1268					
WMC 2002 Theis,dd Cooper Jacob (t/dd) Cooper Jacob (t/dist/dd) Theis, recovery	55 406 403 446	216 230 245 202	245 389 432 360	245 245 259 216	ND ND ND 403				
WMC 2004 Theis,dd Theis, recovery Theis, steady state		216 202 43.2	57.6 115 43.2	216 72.0 43.2	115 72.0 43.2	28.8 ND ND	57.6 57.6 43.2		
	Storativity Coefficient								
	RMW-1	**RMW-2**	**RMW-3**	**RMW-4**	**RMW-5**	**RMW-6**	**RMW-7**	**RMG-1**	**RMG-2**
Hydrometrics, Inc. 1994 Theis,dd Cooper Jacob (t/dd) Theis, recovery									
Hydrometrics, Inc. 1995 Theis,dd Cooper Jacob (t/dd) Theis, recovery									
Hydrometrics, Inc. 1998 Theis,dd Cooper Jacob (t/dd) Theis, recovery	0.016 0.00317	0.0307 0.025		0.0417 0.000156 0.0122					

Study Method	Hydraulic Conductivity (ft/day)								
	RMW-1	RMW-2	RMW-3	RMW-4	RMW-5	RMW-6	RMW-7	RMG-1	RMG-2
WMC 2002 Theis,dd Cooper Jacob (t/dd) Cooper Jacob (t/dist/dd) Theis, recovery	0.019 0.026 0.026	0.012 0.011 0.001	0.006 0.005 0.005	0.054 0.05 0.049					
WMC 2004 Theis,dd Theis, recovery Theis, steady state		0.000206	0.0087	0.0049	0.0021	0.0084	0.0070		

3.4.2.5 Ground Water Quality

Water quality from the perimeter dewatering wells and infiltration basin (IF-1) has been monitored according to the OP conditions over time. A summary of the current dewatering well water quality is included in Hydrometrics, Inc. (2019a). Ground water quality in the Regal Mine area is generally moderately hard, calcium-bicarbonate-type water with moderate concentrations of total dissolved solids (TDS) and low concentrations of sulfate, nutrients, and metals. Dewatering typically meets applicable ground water quality standards. Ground water samples taken over the last 6 years show that ground water quality has not changed significantly since its initial characterization in 1999 and is similar to the quality of surface water in Hoffman and Carter creeks. Data analysis and summaries for each ground water quality monitoring location are in Hydrometrics, Inc. (2019a).

Pit sump and infiltration basin (IF-2) water samples have been analyzed for constituents that were required under the OP since 2006. These results and a full suite of metals analyses were conducted in April 2016 to represent pit water quality (see **Table 3.4-4**). A summary of pit water quality is included in Hydrometrics, Inc. (2019a). Monitoring from 2008 through 2012 showed an increase in nitrates (ranging from 2.2 to 49.9 milligrams per liter [mg/L]), which resulted in shutting down the infiltration activities. BMI modified their blasting practices to maximize detonation of blasting agents and minimize unburned nitrate residue. Since 2014, nitrate concentrations have decreased to an average of 3.66 mg/L. At this concentration, the mine-pit waters meet the nondegradation requirements of 7.5 mg/L for nitrate concentrations.

Ambient ground water quality observed in the site monitoring wells at the Regal Mine is high quality and like surface water quality in Hoffman and Carter creeks. Ground water near the Regal Mine is calcium-bicarbonate-type water with moderate concentrations of TDS and low concentrations of sulfate, nutrients, and metals. Concentrations of dissolved metals are generally at or below the detection limits and are below the Montana Numeric Water Quality Standards. Presently, the pit bottom is below the regional ground water system, and dewatering is ongoing to prevent ground water flow into the pit. Ground water and surface water data are presented within the Water Management Plan, Appendix C (Hydrometrics, Inc. 2019a).

Table 3.4-4
Pit Sump and Infiltration Basin IF-2 Water Quality (Hydrometrics, Inc. 2019a)

Site Code	Infiltration Pond IF-2 and Pit Sump water quality (mg/L)				Ambient GW WQ 75% tile	Nonsignificant Increases to Receiving Water Under ARM 17.30.715	Mixed Water Quality in Pipeline to Infiltration Pond		
	Count	Min	Max	Mean			1x Dilution With Unaltered Ground Water	2x Dilution With Unaltered Ground Water	3x Dilution With Unaltered Ground Water
ANTIMONY (Sb) dis	1		<0.00050		< 0.0005	0.0014	0.0005	0.000495	0.0005
ARSENIC (As) dis	1		0.003		0.003	0.003	0.003	0.00297	0.003
BARIUM (Ba) dis	8	0.01	0.060	0.032	0.06	0.210	0.06	0.0594	0.06
BERYLLIUM (Be) dis	1		<0.0008		0.001	0.001	0.0009	0.000924	0.00095
CADMIUM (Cd) dis	1		<0.00005		0.0001	0.0009	0.000075	0.0000825	0.0000875
CHROMIUM (Cr) dis	1		< 0.001		0.01	0.025	0.0055	0.00693	0.00775
COPPER (Cu) dis	1		< 0.002		0.002	0.197	0.002	0.00198	0.002
LEAD (Pb) dis	1		0.0006		0.003	0.026	0.0018	0.002178	0.0024
MERCURY (Hg) dis	1		<0.000050		0.0006	0.00060	0.000325	0.0004125	0.0004625
NICKEL (Ni) dis	1		< 0.002		0.0042	0.019	0.0031	0.003432	0.00365
SELENIUM (Se) dis	13	0.001	0.0050	0.0015	0.0042	0.0117	0.0046	0.004422	0.0044
SILVER (Ag) dis	1		< 0.0002		0.003	0.018	0.0016	0.002046	0.0023
STRONTIUM (Sr) dis	1		0.080		0.35	0.950	0.215	0.2574	0.2825
THALLIUM (Tl) dis	1		< 0.0002		0.0002	0.0005	0.0002	0.000198	0.0002
URANIUM (U) dis	1		0.0018		0.007	0.007	0.0044	0.005214	0.0057
ZINC (Zn) dis	7	0.01	0.010	0.009	0.085	0.38500	0.0475	0.0594	0.06625
PH FLD (S.U.)	26	6.29	8.26	7.59	7.83	6.0-9.0	8.05	7.89	7.94
NITRATE + NITRITE AS N	11	1.99	7.4	3.97	1.46	7.5	4.4	3.4	2.9
TOTAL SUSPENDED SOLIDS (TSS)	19	10.00	124	28.6	32.5	ND	78.3	62.4	55.4
PHOSPHORUS (P) TOT	1		0.012		0.067	ND	0.040	0.048	0.053
SPECIFIC CONDUCTIVITY (UMHOS/CM)	26	294	746	523	514	<1000	630	585	572
TDS	19	240	618	310	320.5	500	469	415	395
TOTAL ALKALINITY AS CACO3	19	170	300	215	190	ND	245	224	218
ALUMINUM (AL) dis	141	0.01	0.100	0.042	0.1	ND	0.10	0.10	0.1
IRON (FE)	1		1.21		0.03	ND	0.62	0.42	0.33
CALCIUM	19	39	67	48.5	66	ND	66.5	65.7	66.3
CHLORIDE	19	8	89	22.4	21.5	ND	55.3	43.6	38.4
FLUORIDE	19	0.1	0.4	18.4	0.3	0.60	0.35	0.33	0.325
SODIUM	19	9.0	33	14	14.5	ND	23.8	20.5	19.1
MAGNESIUM	19	21	65	31	22.5	ND	43.8	36.3	33.1

Site Code	Infiltration Pond IF-2 and Pit Sump water quality (mg/L)				Ambient GW WQ 75% tile	Nonsignificant Increases to Receiving Water Under ARM 17.30.715	Mixed Water Quality in Pipeline to Infiltration Pond		
	Count	Min	Max	Mean			1x Dilution With Unaltered Ground Water	2x Dilution With Unaltered Ground Water	3x Dilution With Unaltered Ground Water
SULFATE (SO4)	19	13.0	33	21	55.5	250	44.3	47.5	49.9
TOTAL HARDNESS AS CACO3	1		216		474.7	ND	345	385	410

NAI = No Allowable Increase (applies to all Carcinogen and Toxics with BCF >300)

ND = No data

Statistics calculated using the value of detection limit when analysis results are less that detection limits. Nitrate and Nitrite values are from sampling data from 2014 to 2017.

* Sulfate and TDS treatment levels based on EPA Secondary Maximum Drinking Water Standard

3.4.3 Environmental Consequences

This section presents environmental consequences and impacts to ground water associated with the project alternatives. Consequences unique to each alternative are discussed under separate headings.

3.4.3.1 No Action Alternative

Under the No Action Alternative, BMI would continue to operate under its existing OP that would allow mining operations to continue through 2021. Mining would be limited to the current permit (i.e., OP 00013) and the associated amendments, modifications, and revisions (see Section 1.3, Project Location and History). Under the No Action Alternative, ground water conditions at the Regal Mine are likely to remain the same.

Under the No Action Alternative, operating the existing ground water dewatering and infiltration system would continue for approximately 2 years (**Figure 2.2-1**). Ground water would continue to be captured by six dewatering wells located around the perimeter of the mine pit that pump an average 135 gpm (Hydrometrics, Inc. 2019c). Well RMG-1 would continue to be used for dust suppression and the average water extraction from this well would continue to be 32 gpm (Hydrometrics, Inc. 2019c). Water collected during pit dewatering would continue to be released to two existing infiltration (IF) basins (IF-1 and IF-2) (**Figure 2.2-1**). Injection rates into IF-1 and IF-2 would be approximately 70 gpm and 16 gpm, respectively (Hydrometrics, Inc. 2019c).

The resulting ground water conditions would approximately be represented by the 2016 current conditions of the AnAqSim model (**Figure 3.4-2**) (Hydrometrics, Inc. 2019c). Continued dewatering would lower the potentiometric surface and reduce the flow gradient. However, the flow conditions upgradient and downgradient of the mine pit would remain largely unaffected. Ground water quality is likely to remain unchanged from existing conditions.

3.4.3.2 Proposed Action

Under the Proposed Action, the mine pit would continue to be dewatered for an additional 6 years and the ground water table would be reduced by approximately 90 feet below currently approved drawdown (or a total drawdown of approximately 395 feet) (BMI 2019a). Use of wells RMG-1 and RMG-3 would continue to be pumped for flow augmentation on Hoffman and Carter creeks at a rate of approximately 10.81 acre-feet (ac-ft) per year (6.7 gpm) until sufficient surface water flow conditions are reestablished to meet regulatory criteria. After dewatering ceases, the ground water table is projected to recover to within 50 feet of the baseline levels within 60 years.

Under the Proposed Action, the Regal Mine pit would be deepened and enlarged. The changes to the dewatering and infiltration system are shown on **Figure 2.3.6** and described in Section 2.3.5, Modifications to Water Management System. In summary, under the Proposed Action, seven new dewatering wells would be installed to replace the existing dewatering wells. The new dewatering wells would extract a combined 595 gpm. Existing well RMG-1, which is used for dust suppression, would continue to be used, although the well would likely need to be deepened or replaced to continue providing water for dust suppression. The modeling estimates that approximately 25 gpm would flow to the pit sump and require extraction. A new infiltration pond (IF-3) would be constructed to accept a continuous flow up to 500 gpm. The existing IF-2 would be closed and reclaimed. IF-3 would be located approximately ¾ mile northwest of the mine pit (between the Hoffman Creek and Carter Creek watersheds) and located downgradient of the mine pit to ensure that pumped ground water does not flow back into the pit. As part of the Proposed Action, BMI would install two new ground water monitoring wells (one located northwest of IF-3 and one south-southeast of the pit) with transducers to record the elevation of the potentiometric surface (Hydrometrics, Inc. 2019a).

Impacts to ground water resources resulting from the Proposed Action during and after dewatering have been evaluated using two AnAqSim simulations (Hydrometrics, Inc. 2019c). An analysis of the details and adequacy of model predictions is presented in Appendix C, Technical Memorandum 3, Barretts Regal Mine Project – Ground Water Model and Creek Design Assessment. Impacts to water rights are discussed in Section 3.6, Water Rights, and Appendix B, Technical Memorandum 2, Barretts Regal Mine Project – Water Rights Assessment.

The predictive drawdown scenarios include the proposed Life-of-Mine (LOM) conditions, dewatering simulation, and the infiltration plan. Based on a 10-year pumping period, a transient model projected that seven wells would be required to dewater the LOM pit at a rate of 595 gpm. The ground water model did not simulate the pumping of RMG-1 and/or RMG-3 for postmining flow augmentation. The drawdown predicted by this model at the end of dewatering is shown on **Figure 3.4-5** and summarized below:

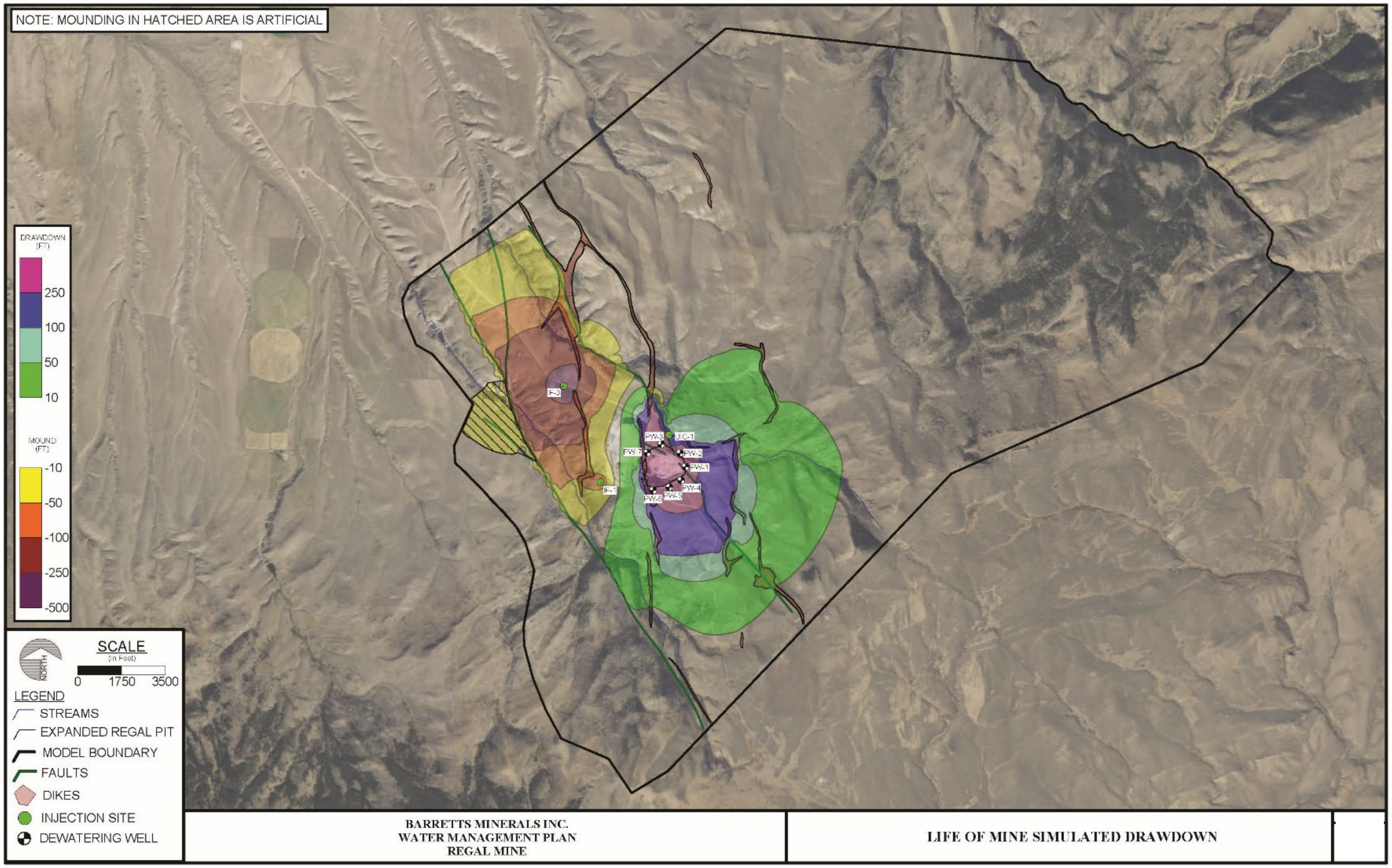

Figure 3.4-5
Proposed Action Life-of-Mine Potentiometric Surface Showing Areas of Drawdown and Mounding

- To the south (upgradient), drawdown of 100 feet reaches 3,000 feet from the pit;
- To the east (cross-gradient), drawdown of 100 feet reaches 2,100 feet from the mine pit;
- To the west-northwest (downgradient), drawdown of 100 feet extends 240 feet from the mine pit; and
- Drawdown to the west is mitigated by infiltration features in this area.

Ground water drawdown was calculated for the LOM to ensure dewatering advances ahead of mining operations. At closure, the ground water level near the mine would be at an elevation of approximately 5,965 feet, which would result in a decline in the site ground water level of 395 feet over the course of mining operations.

The model also predicts that mine dewatering would decrease ground water discharge to Hoffman and Carter creeks, but this decrease is more than offset by re-infiltration of the pumped water. Predicted effects on local springs include increases, decreases, and no change in flow. These predictions are reasonable based on the model configuration and the observed aquifer conditions.

The postmining recovery simulation predicts that, following cessation of mining and dewatering, ground water levels would stabilize in approximately 80 years. Flow augmentation of Carter Creek would be accomplished by recharging the alluvium associated with IF-1 and, for Hoffman Creek, the UIC well would be used. The modeling results predict that flow augmentation may be required for 15 years on Carter Creek and 65 years on Hoffman Creek [BMI 2019d]. The infrastructure for flow augmentation would remain in place until sufficient flow conditions are reestablished.

Recharge analysis was conducted to determine long-term drawdown effects to the ground water system. The analysis calculated pit inflow verses time and compared it to pit volume versus elevation; a set of curves were constructed from the data. The pit lake formed during ground water recovery was simulated in the model using a wellbore 1,040 feet in diameter and a net storativity value of 0.8 (net storativity value represents the wellbore across all 500 feet of the model thickness). The pit lake was allowed to recover for 100 years. Recovery data were converted to inflow into the wellbore by evaluating the change in volume for each time increment. This recovery data represents the aquifer recovery but lacks the precipitation/ evaporation and storm water influences to the developing pit lake. **Figure 3.4-6** summarizes the results from the pit lake recovery model.

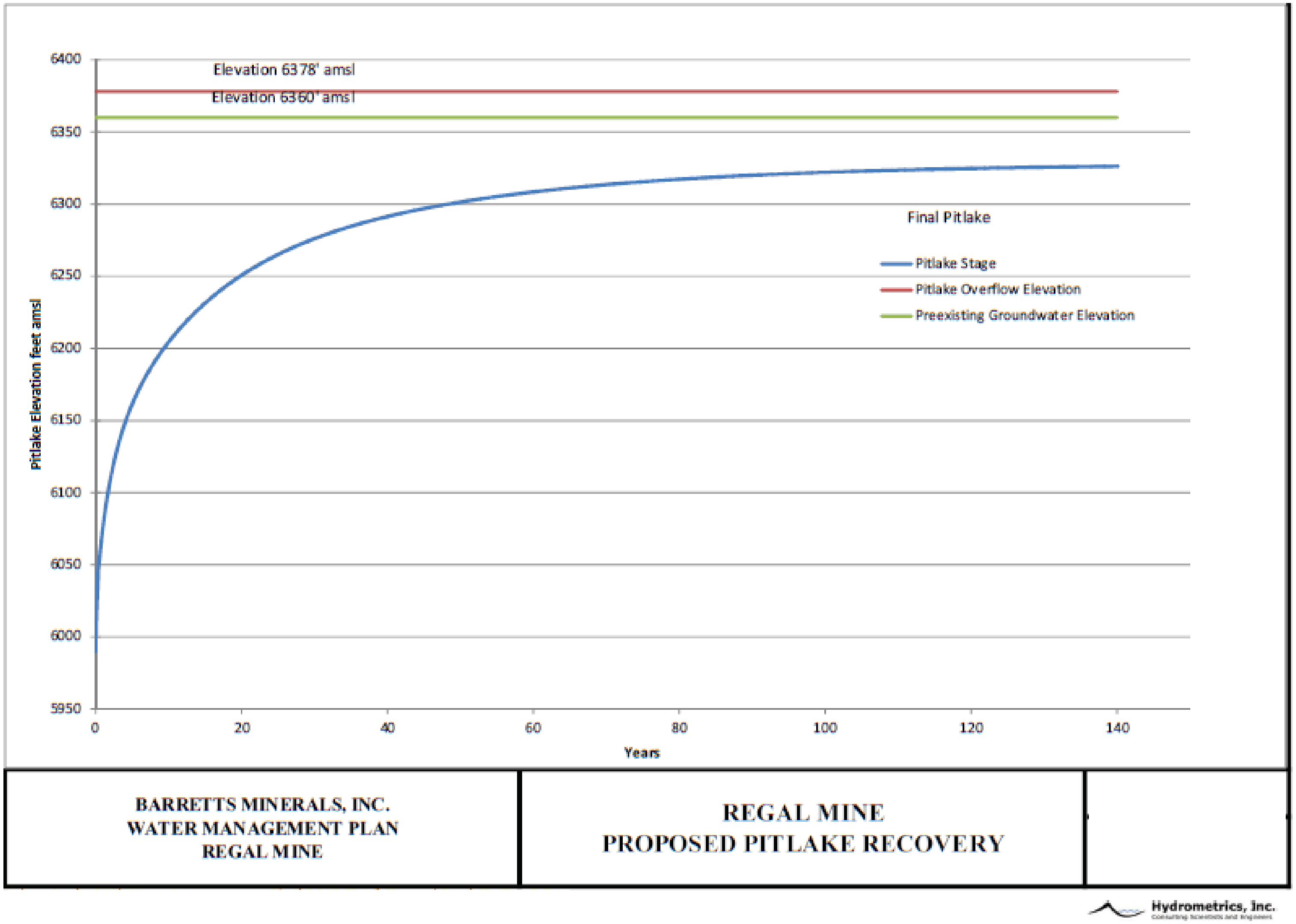

Figure 3.4-6
Proposed Action Pit Lake Recovery

Ground water quality around the Regal Mine is very good and reinjection of ground water captured upgradient of the pit should not pose any water quality issues. However, the potential exists for elevated total suspended solids (TSS) and nitrate concentrations if ground water is captured after it has entered the pit and potentially contacted blast materials or nitrate residue from blasting agents. Based on the analysis presented in Table 3.4-4, mine-pit sump waters would meet the requirements under the nondegradation rule ARM 17.30.715 for nonsignificant increases to the ground water system. Further reduction in parameter concentrations would be realized with dilution in the pipeline routing dewatering well water to IF-3.

Water captured in mine-pit sumps may periodically contain elevated concentrations of TSS, which may require treatment or filtering to reduce TSS before disposal so that sediment does not seal off the bottom of IF-3. The proposed treatment for mine sump water that contains excessive TSS would be to route this water to a new settling pond (SED-1) sited north of the pit along the old county road. Water collected in the mine-pit sump would be pumped out of the pit and discharged in the SED-1 pond. The settling pond would be large enough to provide enough residence time for most sediment to settle out of the water column before being routed for disposal. The pond would be lined with 60-mill-thick high-density polyethylene liner to prevent infiltration. The pond has a discharge structure that would allow settled water to flow into the pipeline routed to the IF-3 infiltration basin.

3.4.3.3 WRDF Grading and Mosaic Vegetation Alternative

The only aspect of the WRDF Grading and Mosaic Vegetation Alternative that differs from the Proposed Action would occur during the WRDF reclamation. Minor alterations to the topography and soil thickness would have localized changes in infiltration rates; however, the majority of water that infiltrates into the soil placed over the WRDF would be absorbed by vegetation and very little, if any, would be expected to make its way into the ground water system. The WRDF Grading and Mosaic Vegetation Alternative would not change the geochemistry of the WRDF material and would not be expected to influence ground water quality below or downgradient of the WRDF. Therefore, impacts to ground water resources would be similar to the Proposed Action.

3.5 Surface Water Resources

This section summarizes the regulatory framework, describes the affected surface water environments, and presents a discussion of primary impacts to surface water resources in the area surrounding the Regal Mine for the proposed alternatives. The regulatory framework for water resources in Montana includes but is not limited to the following:

- Federal Clean Water Act;
- Montana Water Quality Act;
- Nondegradation Rules (ARM Title 17, chapter 30, subchapter 7);
- Montana MMRA (Title 82, chapter 4, part 3, MCA);
- Montana Pollutant Discharge Elimination System;
- Montana Nonpoint Source Management Plan.

The Federal Clean Water Act provides for the maintenance and restoration of the physical, chemical, and biological integrity of the nation's water (33 USC § 1251). The USEPA delegated most of the implementation of the Clean Water Act to the State of Montana. Designated beneficial uses of Montana's state waters include recreation, water supply, fisheries, aquatic life, and wildlife.

DEQ may not approve a reclamation plan unless it provides sufficient measures to prevent water pollution. The reclamation bond that a mine operation must submit before DEQ issues a permit or approves a permit amendment must also be sufficient to ensure compliance with the MMRA and the Montana Water Quality Act, which provides a regulatory framework for protecting, maintaining, restoring, and improving water quality for beneficial uses. Pursuant to the Montana Water Quality Act, DEQ developed water quality classifications and standards, as well as a permit system to control discharges into state waters. Mining operations must comply with Montana's regulations and standards for surface water and ground water.

3.5.1 Analysis Methods

Analysis methods for understanding the existing surface water environments at the Regal Mine included reviewing the Amendment Application and supporting documentation provided by BMI, including the Montana Joint Permit Application and the associated approved permits that authorize the proposed surface water modifications, and a technical memorandum. Specifically, the following primary resources were reviewed and relied upon for this section:

- Application for Amendment 006 to OP No. 00013 for the Regal Mine, Madison County, Montana (BMI 2019a);
- Barretts Minerals, Inc. Regal Mine Water Management Plan (Hydrometrics, Inc. 2019a);

- Technical Memorandum: Preliminary Construction Plans for Barretts Minerals Regal Mine Hoffman Creek Realignment (Hydrometrics, Inc. 2015a);
- Technical Memorandum 3 – Barretts Regal Mine Project – Ground Water Model and Creek Design Assessment (Appendix C);
- Montana Joint Permit Application for Regal Mine (BMI 2017);
- Army Corps of Engineers Section 404 Authorization Permit Number NWO-2015-00766-MTH (U.S. Army Corps of Engineers 2018);
- Ruby Valley Conservation District 310 Permit (Ruby Valley Conservation District 2018); and
- DEQ 401 Authorization (2018).

Technical Memorandum 3, Barretts Regal Mine Project – Ground Water Model and Creek Design Assessment (Appendix C) evaluated the technical adequacy of the Proposed Action modifications to Hoffman Spring Creek and Hoffman Creek.

3.5.2 Affected Environment

The affected environment includes surface water resources on and around the Regal Mine permit area and proposed expansion boundary. The Regal Mine is situated on the west flank of the Ruby Range off the Sweetwater Divide at an elevation of approximately 6,500 feet. The Regal Pit is within the Hoffman Creek Watershed to the east and the WRDF is located within the Carter Creek drainage on the west. The National Hydrography Dataset indicates that the Carter and Hoffman Creek drainages are within the Beaverhead subbasin of the Missouri Headwaters in the Hydrologic Unit Code 12-100200020602. Carter Creek is located west of the mine site and Hoffman Creek and Hoffman Spring Creek are located along the eastern corner of the existing permit boundary. These streams are shown on **Figure 3.5-1**.

3.5.2.1 Existing Surface Water Resources

Three primary surface water resources are affected by the Proposed Action: Carter Creek, Hoffman Creek, and Hoffman Spring Creek. Carter Creek is perennial in its upper reaches and becomes intermittent approximately 2 miles downstream of the Regal Mine area. The perennial reach of Carter Creek terminates near the storage ponds that were constructed to hold water for irrigation purposes. Flows in Carter Creek above the mine site have been measured between 180 and 840 gpm; below the mine site, and flow have been measured between 180 and 1,900 gpm (Hydrometrics, Inc. 2019a).

Hoffman Creek in the vicinity of the mine is a ground-water-fed perennial stream that is supported by springs above the mine site. Most of the perennial reach of Hoffman Creek is gaining flow by ground water inflow. Flow in Hoffman Creek becomes intermittent 2.6 miles downstream from the mine site, which coincides with the location where the Carter Creek Fault crosses the Hoffman Creek drainage. Hoffman Creek also flows intermittently downstream of a small man-made pond (i.e., Hoffman Pond) that is located adjacent to the northeastern corner of the existing permit boundary. Flows in Hoffman Creek at the Hoffman Homestead have been measured between 1 and 70 gpm, and flows below the mine site (HC-2) have been measured between 1 and 270 gpm (Hydrometrics, Inc. 2019a).

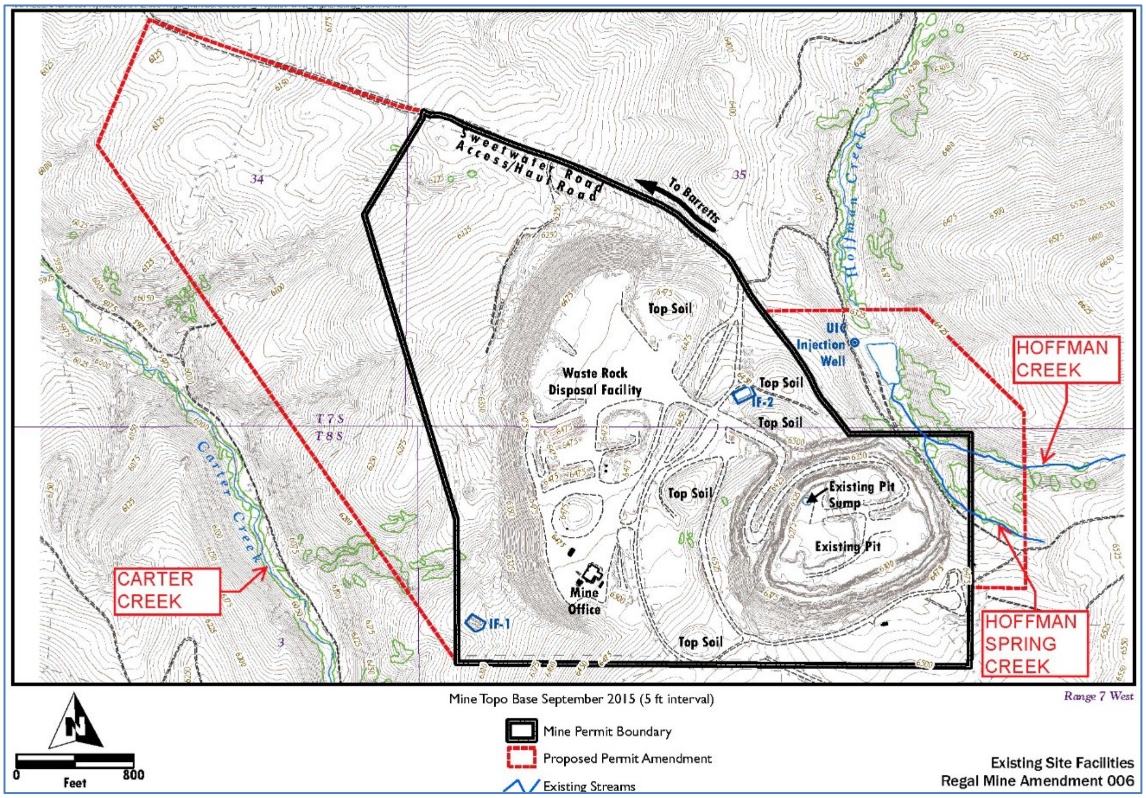

Figure 3.5-1
Surface Water Resources in the Vicinity of the Regal Mine (Modified From BMI 2019a)

Hoffman Spring Creek, a perennial spring-fed stream that is a tributary to Hoffman Creek, is characterized by a discontinuous channel carrying intermittent surface water flow. Hoffman Spring Creek's spring source originates just east of the existing mine permit boundary.

Local shallow ground water from alluvium/colluvium is currently seeping into the existing mine pit, which results in some dewatering of Hoffman Spring Creek because of the interconnection of surface water with shallow ground water. BMI is currently mitigating mining effects to Hoffman Spring Creek by routing surface flow in a section of the creek through a pipeline (corrugated plastic pipe laid in existing channel) around the mine pit area (BMI 2019a).

3.5.2.2 Flow Monitoring and Ground Water and Surface Water Interactions

Long-term monitoring has been conducted on Hoffman and Carter creeks since 1997. During this time period, semiannual events were conducted to develop baseline conditions and evaluate increases or decreases in stream flow over time. Flow measurements showed that under summer conditions, Carter Creek gains flow upgradient of the existing mine, maintains approximately equal flow past and downgradient of the mine, and loses flow downgradient of the ponds. Hoffman Creek data show flow measurements similar to Carter Creek—gaining flow in the upper reaches and then losing flow further downstream. Flow data are summarized in Hydrometrics, Inc. (2019a); modeled current flow conditions for Carter Creek and Hoffman Creek were 220 and 115 gpm, respectively.

Mean monthly stream flow rates are used to determine at what flow conditions augmentation is required to comply with nondegredation requirements (17.30.715(I)(a) ARM). Existing streamflow data are limited; therefore, BMI used StreamStats (developed by the US Geological Survey) to estimate mean monthly flow rates. The mean monthly flow calculated for Hoffman Creek ranges from a low of 6.6 gpm in February to a high flow rate of 1,375 gpm in June (BMI 2019a). The mean monthly flow calculated for Carter Creek ranges from 13.8 gpm in February to 2,101 gpm in June (BMI 2019a).

To further evaluate conditions in Hoffman Creek, a synoptic flow study and multiple injection point-tracer tests were conducted. The results of the synoptic flow study showed that limited flows were seen in Hoffman Creek above the existing mine pit with flow infiltrating into the subsurface proximal to the pit. Monitoring below the pond embankment confirmed that Hoffman Creek receives subsurface recharge with comparable flow from what is assumed to be seepage from the pond embankment and ground water recharge. The portions of Hoffman Spring Creek and Hoffman Creek infiltrating into the Regal Mine pit and areas of ground water recharge are shown on **Figure 3.5-2**.

To validate the assumption of flow paths into the Regal Mine pit, a tracer study was undertaken to evaluate the areal location of the lithologic units that may be dewatering Hoffman Creek. The results from the tracer test were conclusive for hydraulic connectivity between Hoffman Spring Creek and inflow into the Regal Mine pit. The tracer study also confirmed subsurface flow from injection points to Hoffman Creek Pond. Limited connectivity was observed between Hoffman Creek and the Regal Mine pit (Hydrometrics, Inc. 2019a).

3.5.2.3 Water Quality Monitoring

Surface water samples collected from Hoffman and Carter creeks as part of the original baseline water quality investigation in the 1990s were analyzed for common ions, total recoverable and dissolved metals, and nutrients. Surface water has been characterized as being hard, slightly alkaline, calcium-bicarbonate-type water with low concentrations of TDS, sulfate, nutrients, and metals. Additional surface water monitoring sites have been established along Hoffman and Carter creeks since 2006 with the purpose of monitoring water quality upstream and downstream of infiltration test sites. Surface water quality is monitored at the following locations:

- Upstream Carter Creek monitoring station CC-1;
- Downstream Carter Creek monitoring station RMS-2;
- Upstream Hoffman Creek monitoring station RMS-1; and
- Downstream Hoffman Creek monitoring station HC-2.

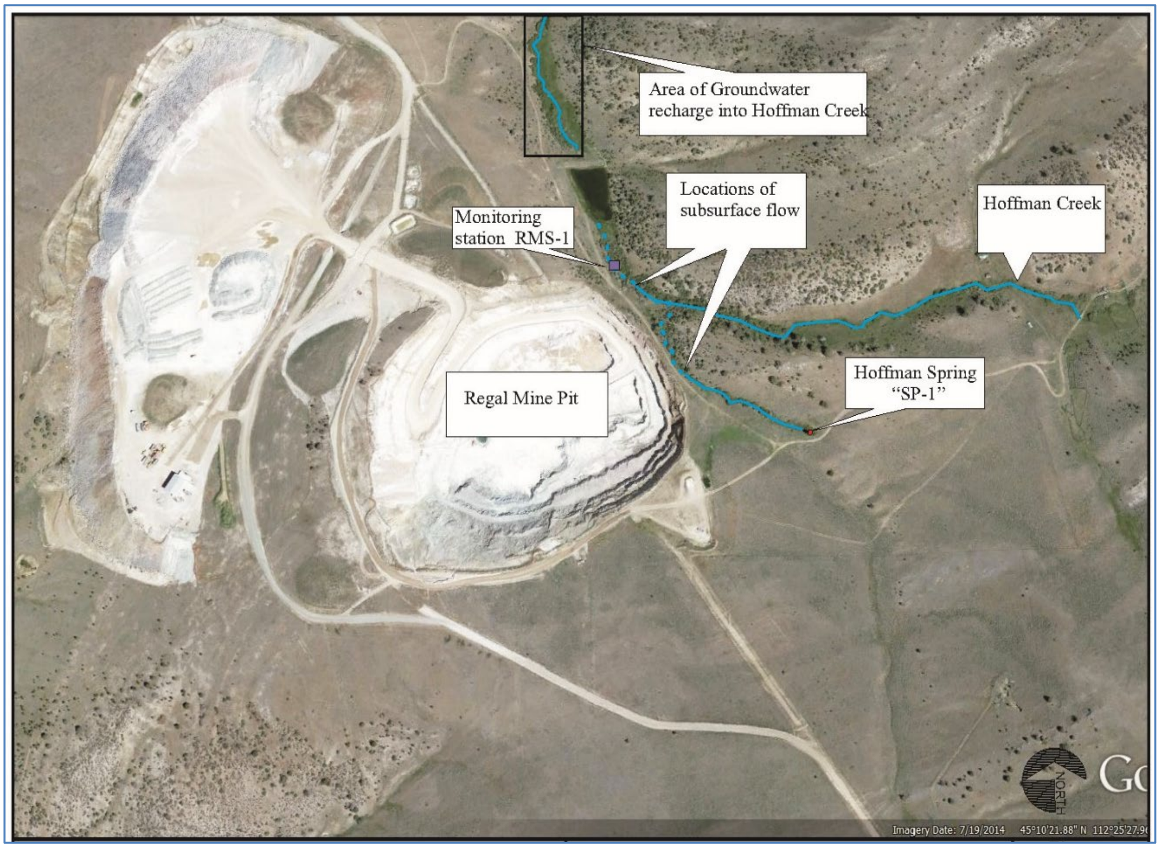

Figure 3.5-2
Locations of Flow Loss (Subsurface Flow) and Recharge on Portions of Hoffman Spring Creek and Hoffman Creek (Modified From Hydrometrics, Inc. 2019a)

Surface water data have been collected since as early as 1994 at monitoring sites RMS-1 and RMS-2. Additional surface water monitoring locations along Hoffman Creek and Carter Creek were established to monitor discharge of pit water and dewatering wells through infiltration pits around 2006 or later. The data have been analyzed throughout the history of monitoring activities and monitored levels have not triggered a regulatory reporting requirement. However, these data are still useful to evaluate whether or not an indication exists of a statistically significant trend in surface water quality regarding metals and nutrients at the mine site.

As a result of the findings from sampling and data evaluations in 2014 and 2016, statistical testing for aluminum, selenium, and zinc in surface water has been discontinued at the Regal Mine. Historical datasets for each of these parameters had shown a high incidence of nondetect results. Statistical data evaluations indicated that the characteristics of upstream and downstream as well as pre- and post-infiltration datasets for aluminum, selenium, and zinc were comparable, which suggests that these metals do not significantly affect the chemical quality of Carter or Hoffman creeks (Hydrometrics, Inc. 2019a). These metals are also at or below detection limits in all samples from the pit sump [BMI 2019a]. BMI discontinued aluminum, selenium, and zinc analyses beginning in 2016 based on these findings. The most recent surface water quality evaluation focused on nitrite plus nitrate and barium at surface water sites that were previously studied in the Carter Creek and Hoffman Creek drainages.

An assessment of the BMI Regal Mine surface water indicates that the statistical characteristics for total recoverable barium in Carter Creek have some variation between upstream and downstream data. This variation may indicate an actual change in the concentration of this parameter; however, no statistically significant trend of increasing concentrations was identified. Carter Creek data evaluations also did not result in a statistically significant trend of increasing concentrations for barium at RMS-2 when comparing pre- and post-infiltration data, or for any nitrate plus nitrite as N datasets in Carter Creek. The barium and nitrate plus nitrite parameters in Hoffman Creek appear to indicate an actual change in the concentration of these parameters from upstream (ambient or pre-infiltration conditions) to downstream (post-infiltration conditions) (Hydrometrics, Inc. 2019a).

Comparing the statistical characteristics of upstream (RMS-1) and downstream (HC-2) data revealed variation between datasets, including statistically different mean/medians. The downstream mean/median was greater than the upstream for both barium and nitrate plus nitrite, and concentration trends increased over time for downstream sites.

Concentrations of parameters in the Hoffman Creek datasets continue to be well below the surface water human health standards of 1.0 milligrams per liter for total recoverable barium and 10 milligrams per liter for nitrate plus nitrite as N. However, further monitoring and evaluating total recoverable barium and nitrate plus nitrite as N is warranted.

3.5.3 Environmental Consequences

This section presents environmental consequences to surface water resources associated with the project alternatives. The alternatives affect surface water resources during mine operations and closure periods, which are both discussed for each alternative.

As part of the EIS process, a technical memorandum has been prepared to evaluate the potential impacts to surface water resources under different alternatives in detail (see Appendix C, Technical Memorandum – Barretts Regal Mine Project – Ground Water Model and Creek Design Assessment). The following impacts analysis draws upon the conclusions of this technical memorandum. A detailed treatment of the technical foundations of the following impacts analysis is located in the technical memorandum.

3.5.3.1 No Action Alternative

Under the No Action Alternative, BMI would continue to operate under its existing OP that would allow mining operations to continue through approximately 2021. The primary environmental consequences are related to surface water flow rates and water quality implications under the No Action Alternative, which are discussed in the following text.

Flow Rate

While mining operations continue, water collected during dewatering would continue to be routed through piping and released to two existing infiltration basins (i.e., IF-1 and IF-2), that are located in drainages near the mine site, and to the UIC Class V injection well downgradient from the pit. IF-1 is used to reinject ground water into the subsurface in the Carter Creek drainage, and noncontact ground water is injected in the UIC well that is completed in the shallow aquifer to recharge Hoffman Creek.

Hoffman Creek surface water seeping into the pit would continue to be mitigated with the temporary pipeline in the channel of Hoffman Creek until operations cease. At the end of mining, the existing pipeline in Hoffman Creek would be removed and the creek restored. Under this alternative, the pit would eventually recover, and surface water resources should return to within 15 percent of the mean monthly flow shortly after mining ceases.

Water Quality

The primary environmental concern associated with water quality is for the ground water that is pumped during dewatering operations and infiltrated for water disposal. Under the No Action Alternative, the current dewatering and infiltration approach would be maintained throughout the life of the mine. Because repeated nondetect levels for aluminum, selenium, and zinc have been recorded over the historical dataset, these constituents are not likely present in the system and are of low concern. The primary constituents of concern are barium and nitrate plus nitrite as N. No statistically significant difference in water quality upstream and downstream of the mine could be made for Carter Creek. However, comparing upstream and downstream of mine sites in Hoffman Creek resulted in variations between datasets, including statistically different mean/medians. The downstream mean/median were greater than the upstream for both parameters, and concentration trends increased over time for downstream sites. Concentrations of parameters in the Hoffman Creek datasets continue to be well below surface water human health standards.

3.5.3.2 Proposed Action

Under the Proposed Action, Hoffman Spring Creek and Hoffman Creek would be altered from their current condition before expanding mining operations. These alterations are intended to be permanent and would not be included in postmining reclamation activities.

During the expanded mining operations, dewatering activities and associated discharge would impact Carter Creek, Hoffman Creek, and Hoffman Spring Creek. The ground water model predicts diminished stream flows during the postmining period as the pit fills to become a pit lake and equilibrium is reached. Once mining operations cease, active dewatering activities would cease but flow augmentation would occur until stream flow reductions no longer exceed the nondegradation criteria (i.e., 15 percent of the mean monthly flow).

Alterations to Hoffman Spring Creek and Hoffman Creek, along with surface water flow rate impacts and water quality implications for the Proposed Action, are discussed in the following text.

Alterations to Surface Water Resources

The Proposed Action would establish a permanent diversion channel for the segment of Hoffman Spring Creek that would be removed by the expanded mine pit. The length of stream channel that will be permanently removed is approximately 730 feet. The proposed realigned channel is approximately 620 feet, which would result in a permanent loss of stream length of approximately 110 feet. The Proposed Action intends to limit surface water flow in Hoffman Spring Creek from seeping into the mine pit by using a high-density polyethylene liner buried beneath the new floodplain. The liner will extend throughout the entire floodplain cross section for the entire length of the realigned stream and floodplain corridor. The Proposed Action also intends to modify the Hoffman Creek channel to incorporate bentonite granular materials into approximately 600 feet of the channel substrate to reduce infiltration from Hoffman Creek into the pit.

Changes to the natural flow, sediment, and gradient characteristics of a stream would disrupt the dynamic equilibrium and induce a geomorphic response. The response is generally observed in changes to the dimension, plan, and profile of the stream. The Proposed Action would alter the natural flow regimes of Carter Creek and Hoffman Creek through proposed flow augmentations, channel linings, and cutoff wall installations. Construction of the realigned channel of Hoffman Spring Creek and incorporation of the bentonite liner in Hoffman Creek would generate sediment, which would likely be released into the system.

The Proposed Action surface water modifications are summarized below:

- The proposed floodplain section appears appropriately sized to achieve conveyance of the estimated 100-year peak discharge on Hoffman Spring Creek;
- The proposed construction of Hoffman Spring Creek includes dimensions large enough for locating the 100-mill high-density polyethylene liner to reduce infiltration into the pit, bounding fabric to protect against bank damage, geotextile to provide long-term channel stability and prevent significant scouring of the stream bed, and revegetation of grasses and shrubs to enhance stability; and
- The sinuous design of the stream bed within the realignment corridor would help reduce the water velocity and erosion.

The proposed profile for the engineered Hoffman Spring Creek diversion channel is relatively steep with an 8.0 percent grade for the upper reach and a 9.5 percent grade for the lower reach (compared to the natural gradient of approximately 7 percent) before returning to a slope of 2 percent grade at the confluence with Hoffman Creek. During the 100-year flood design event, this steep slope imposes supercritical flow conditions through the engineered channel and, as flow transitions to the 2 percent grade on Hoffman Creek channel, a hydraulic jump would occur. Aside from the geogrid geotextile, the geoweb will be backfilled with 1 to 2 inch sized rock (riprap) to help provide scour protection. During appreciable flow events, a scour hole may develop and potentially compromise the diversion channel and introduce additional sediment to the system.

The U.S. Army Corps of Engineers (USACE); the local conservation district, and Montana Fish, Wildlife and Parks (MFWP) have permitted the proposed work in Hoffman Spring Creek and Hoffman Creek.

Flow Rate

Under the Proposed Action, flow rates in Hoffman Spring Creek, Hoffman Creek, and Carter Creek are expected to be affected by dewatering during mine operations. Once the pit is expanded eastward and pit dewatering is operational, the ground water table would decline and may result in currently gaining stream reaches to become losing reaches. The network of dewatering wells upgradient of the pit would also steepen the hydraulic gradient and promote reductions in surface water flow. In the case of Carter Creek, upgradient ground water interception and dewatering would reduce the amount of subsurface water interfacing with surface water similar to Hoffman and Hoffman Spring creeks.

After dewatering of the pit area ceases, the ground water model predicts that flow rates in Hoffman and Carter creeks may be reduced (Hydrometrics, Inc. 2019c). The model-predicted maximum stream depletion rate is approximately 35 gpm (10.06 acre-ft per year) on Hoffman Creek and 5 gpm (0.75 acre-ft per year) on Carter Creek (Hydrometrics, Inc. 2019c).

Flow augmentation may be required to meet the requirements under § 82-4-355, MCA, and ARM 17.30.715(1)(a). BMI proposed to augment flows through ground water injection to address these requirements. As stated in the Amendment Application, BMI would manage flow in Carter and Hoffman creeks during the active mining/dewatering and postclosure phases of the project in accordance with requirements under ARM 17.30.715(1)(a): “activities that would increase or decrease the mean monthly flow of a surface water by less than 15 percent or the 7-day, 10-year low flow by less than 10 percent.”

The estimated augmentation flow rates are relatively low and range from 5.6 to 29 gpm for Hoffman Creek for the 8-month period of August through March and from 1.4 to 2.9 gpm for Carter Creek for the 3-month period of December through February. Estimates of depleted flow rates, percent depletion, and flow augmentation rates and volume for both Hoffman Creek and Carter Creek are tabulated in **Table 3.5-1**. The ground water model predicted that flow augmentation may be required after ceasing dewatering up to 15 years on Carter Creek and 65 years on Hoffman Creek (Hydrometrics, Inc. 2019c).

Water from one of the new dewatering wells would be discharged into the collection trap at the head of the constructed Hoffman Creek Spring channel to dispose of dewatering water during mining and augment flow postmining. Flow augmentation in the Hoffman Creek drainage would be addressed through infiltrating dewatering water into the UIC well. Water disposal and flow augmentation in the Carter Creek drainage would be accomplished through recharging the alluvial system associated with IF-1. Infiltration associated with the dewatering period is designed to discharge excess water generated from the dewatering wells and not necessarily to augment stream flow, because the potential need for augmentation would more likely occur during the post-dewatering period.

Table 3.5-1
Predicted Flow Augmentation for Hoffman and Carter Creeks (BMI 2019a)

Hoffman Creek								
Model-Predicted Maximum Stream Depletion Rate = 35 gpm								
Month	Mean Monthly Flow[a]		Depleted Flow[b]	Percent Depletion	85% of Monthly Flow Rate	Augmentation Rate	Augmentation Volume (annual)	
	cfs	gpm	gpm	%	gpm	gpm	gallons	acre-feet
January	0.0178	8.0	0.0	100	6.8	6.8	239,543	0.74
February	0.0147	6.6	0.0	100	5.16	5.6	178,680	0.55
March	0.0839	37.6	2.6	93	31.9	29.4	1,037,650	3.18
April	0.665	298	263	12	–	–	–	–
May	2.99	1,340	1,305	3	–	–	–	–
June	3.07	1,375	1,340	3	–	–	–	–
July	1.07	479	444	7	–	–	–	–
August	0.436	195	160	18	166.0	5.7	201,466	0.62
September	0.364	163	128	21	138.6	10.5	360,441	1.11
October	0.391	175	140	20	148.9	8.7	298,388	0.92
November	0.28	116	80.6	30	98.2	17.7	604,054	1.85
December	0.0266	11.9	0.0	100	10.1	10.1	357,969	1.10
							Total Annual	**10.06**
Carter Creek								
Model-Predicted Maximum Stream Depletion Rate = 5 gpm								
Month	**Mean Monthly Flow[a]**		**Depleted Flow[b]**	**Percent Depletion**	**85% of Monthly Flow Rate**	**Augmentation Rate**	**Augmentation Volume (annual)**	
	cfs	**gpm**	**gpm**	**%**	**gpm**	**gpm**	**gallons**	**acre-feet**
January	0.036	16.1	11.1	31	13.7	2.6	91,205	0.28
February	0.0307	13.8	8.8	36	11.7	2.9	103,792	0.32
March	0.159	71.2	66.2	7	–	–	–	–
April	1.14	511	506	1	–	–	–	–
May	4.59	2,056	2,051	0	–	–	–	–
June	4.69	2,101	2,096	0	–	–	–	–
July	1.65	739	734	1	–	–	–	–
August	0.68	305	300	2	–	–	–	–
September	0.576	258	253	2	–	–	–	–
October	0.638	286	281	2	–	–	–	–
November	0.448	201	196	2	–	–	–	–
December	0.0532	23.8	18.8	21	20.3	1.4	50,358	0.15
							Total Annual	**0.75**
							Total Mitigation Required	**10.81**

NOTES:
cfs - cubic feet/second; gpm - gallons/minute.
[a] Calculated using: https://streamstats.usgs.gov/ss/
[b] Calculated by subtracting the model-predicted maximum stream depletion rate from mean monthly flow

Water Quality

The primary environmental concern associated with water quality is for the ground water pumped during dewatering operations and infiltrated to augment surface water flows in Carter and Hoffman creeks. Under the Proposed Action, the expanded dewatering and flow augmentation approach would be conducted during the mine life and continue following mine closure until stream flow reductions no longer exceed nondegradation criteria or 15 percent of the mean monthly flow.

Because repeated nondetect levels for aluminum, selenium, and zinc have been recorded over the historical dataset, these constituents are not likely present in the system and are of low concern. The primary constituents of concern are barium and nitrate plus nitrite as N. Hoffman Creek has shown differences in mean/medians between upstream and downstream of mine for barium and nitrate plus nitrite as N and increasing concentration trends over time for downstream sites for barium; the expanded mine may exacerbate those trends. Although Carter Creek did show some measurable increases and trends, they are not statistically different.

3.5.3.3 WRDF Grading and Mosaic Vegetation Alternative

The only aspect of the WRDF Grading and Mosaic Vegetation Alternative that differs from the Proposed Action would occur during the WRDF reclamation. Minor alterations to the topography, soil thickness, and reclaimed vegetation would have localized changes in infiltration rates and surface runoff. Under this alternative, the diverse vegetation could result in reduced surface runoff. However, the WRDF Grading and Mosaic Vegetation Alternative would not be expected to influence flow rate or surface water quality below or downgradient of the WRDF. Therefore, impacts to surface water resources would be similar to the Proposed Action.

3.6 Water Rights

This section describes the water rights in the area of the Regal Mine and addresses the potential impacts to water rights that may occur as a result of the Proposed Action.

3.6.1 Analysis Methods

The analysis methods for reviewing water rights in the area around BMI's Regal Mine include reviewing the proposed Amendment to the OP for the mine and the Water Management Plan that was developed by Hydrometrics, Inc. (2019a). Water rights data (both spatial and tabular) were gathered from the Montana Department of Natural Resources and Conservation (DNRC) via the Montana State Library Natural Resources Information System (2019). Individual water right file records from DNRC were also reviewed. The specific resources relied upon for this section include the following:

- Application for Amendment 006 to OP No. 00013 for the Regal Mine, Madison County, Montana (BMI 2019a).
- BMI Regal Mine Water Management Plan prepared by Hydrometrics, Inc. February 2019 (Hydrometrics, Inc. 2019a).
- DNRC Water Rights Query System; http://wrqs.dnrc.mt.gov/default.aspx accessed June 12, 2019.
- Montana State Library Natural Resource Information System; http://nris.msl.mt.gov/ accessed May 20, 2019.
- Technical Memorandum 2 – Barretts Regal Mine Project – Water Rights Assessment (Appendix B).

3.6.2 Affected Environment

The affected environment includes water rights for surface water and ground water in the vicinity of and in the drainages below the mine site. The two named surface water sources in the affected area are Hoffman Creek and Carter Creek. Technical Memorandum 2 in Appendix B also describes existing water rights and potential impacts.

3.6.2.1 Hoffman Creek Water Rights

Hoffman Creek arises east of the mine with a portion of the channel bordering the eastern edge of the site and flows generally west-northwest toward Beaverhead River. Hoffman Creek is fed by ground water from springs in the area above the mine. Measurements taken over the years indicate that it is a gaining reach from the headwaters above the mine to approximately 2.6 miles downstream from the mine site (BMI 2019a). In this stretch, Hoffman Creek is a perennial flowing stream. The portion of the creek below this point is intermittent.

Eleven water rights are on Hoffman Creek, its named (Bishop Creek) and unnamed tributaries, and on springs that appear to be directly connected to Hoffman Creek. All of these water rights except one are for stock use and mainly for livestock to drink directly from the surface water sources where water is available. One of the rights is for domestic use. The flow rates and volumes for these rights are not usually quantified. Montana Water Law protects these uses to the extent that they have been historically and beneficially exercised. No data have been presented regarding the extent to which the water rights have been used in the past.

Synoptic stream flow data are included for several measuring sites on Hoffman Creek from 2006 through 2017 (Hydrometrics, Inc. 2019a). From 2013 through 2016, flows in Hoffman Creek as measured at Site RMS-1 were affected by inflows into the mine pit (Hydrometrics, Inc. 2019a). According to the Amendment Application, this situation has been resolved.

Hoffman Creek Above the Simulated Drawdown Footprint of the Mine

Only one water right exists on Hoffman Creek with diversions above the simulated drawdown footprint of the mine—Statement of Claim 41B 196140 owned by Rebish & Helle, Inc. The source of water for the water right is described as a spring tributary of Hoffman Creek. This claim allows stock animals to drink directly from the surface water (livestock direct from source). The period of use of this claim is from April 1 through November 1 of each year.

This water right has no quantified flow rate or volume, which is common with historical stock claims that are characterized as livestock direct from source. Due to the difficulty of assigning an appropriate flow rate and volume to this type of use, the Montana Water Court decrees these rights with generic statements that indicate the flow rate and volume of the water rights are limited to the amount historically used. This statement does not mean no flow rate or volume associated with the water right, only that the value has not been numerically quantified. In a situation where the flow rate or volume is disputed, the water right owner is required to provide information to substantiate those values.

Hoffman Creek Below the Simulated Drawdown Footprint of the Mine

Four water rights exist on Hoffman Creek with diversions below the simulated drawdown footprint of the mine. These water rights are listed in **Table 3.6-1**, and the location of the diversions is depicted on **Figure 3.6-1**. These water rights are for year-round use of surface water characterized as livestock direct from source. Of the four water rights, two have quantified flow rates and volumes.

For the purposes of this analysis, the total flow rate of the water rights on Hoffman Creek below the mine is assumed to be greater than 65 gpm (**Table 3.6-1**). The flow data presented in Hydrometrics, Inc. (2019a) indicate that during a period from 2013 to 2016, flows of Hoffman

Creek were affected by flows from the creek into the mine pit. According to Hydrometrics, Inc. (2019a), a bypass for Hoffman Creek reestablished the flows in 2016. Outside of this time period, the flows at the downstream surface water monitoring sites (i.e., HC-1, HC-2, & HC-5), when available, were measured at levels greater than the upstream site (RMS-1). Mine activities appeared to impact stream flows during the period from 2013 to 2016; however, that situation appears to have been mitigated and the current mine activities do not appear to be impacting the flows of Hoffman Creek.

Table 3.6-1
Hoffman Creek Drainage Below Mine – Water Right Flow Rate and Volume Data (DNRC 2019)

Water Right Number	Period of Diversion	Flow Rate	Volume[a]
41B 132586 00	01/01 to 12/31	NQ	NQ
41B 137165 00	01/01 to 12/31	NQ	NQ
41B 30117195	01/01 to 12/31	30 gpm	21.8 Ac-ft
41B 30119197	01/01 to 12/31	35 gpm	17 Ac-ft
Flow Rate Totals in gpm:		65+	

[a] Flow rate and volume numbers represent the amount of water the water right owner says they use. Water right volumes do not reflect the flow rate running continuously.

NQ = Flow rate/volume not numerically quantified.

gpm = gallons per minute

3.6.2.2 Carter Creek Water Rights

Carter Creek arises south of the mine and traverses northwest along the western border of the mine. According to the Amendment Application, it is perennial in its upper reaches, and becomes intermittent approximately 2 miles downstream of the Regal Mine area (BMI 2019a). Carter Creek is fed by ground water in the perennial reach (Hydrometrics, Inc. 2019a). The Amendment Application asserts that the perennial reach of Carter Creek terminates near the location of certain irrigation ponds located on the creek (Hydrometrics, Inc. 2019a). The referenced ponds are assumed to be those located in the NE1/4 of Section 33, Township 7S, Range 7W, Beaverhead County. Synoptic flow data for several sites on Carter Creek are presented in Hydrometrics, Inc. (2019a).

Twelve water rights exist on Carter Creek and unnamed tributaries of Carter Creek, and two of those rights are in the reach between the headwaters and the irrigation ponds (DNRC 2019). Those two rights are for stock use direct from the source. The remaining ten water rights from Carter Creek are for irrigation pond use, as well as stock and domestic uses below the ponds.

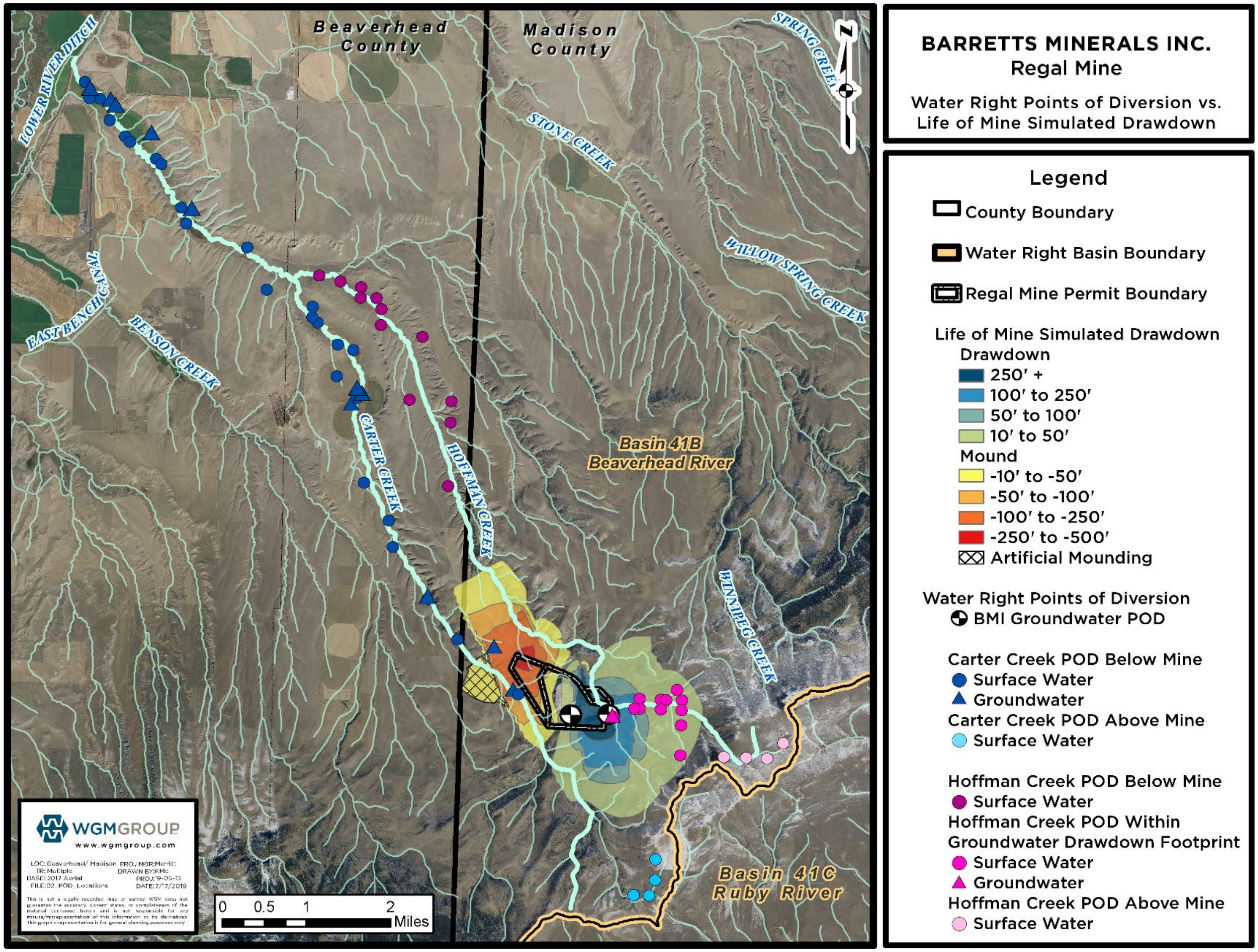

Figure 3.6-1
Water Right Points of Diversion and Life-of-Mine Simulated Drawdown

Carter Creek Above the Simulated Drawdown Footprint of the Mine

One water right exists on Carter Creek above the simulated drawdown footprint of the mine—Statement of Claim 41B 196142. This water right is an unquantified livestock direct for use form April 1 through November 1 each year. The diversions for this right are in the very upper reach of one of the tributaries to Carter Creek (outside the simulated drawdown area) (Hydrometrics 2019a). The closest measurement site is CC-1, which is above the mine but downstream of the diversions for Claim 41B 196142. The water measurements at this site range from 152 gpm to over 1,500 gpm.

Carter Creek Below the Simulated Drawdown Footprint of the Mine

Carter Creek drainage below the simulated drawdown footprint of the mine has a variety of water rights, including ten ground water, nine surface water, and two springs. **Table 3.6-2** lists the water right number, source, use, period, and rate of diversion.

3.6.2.3 Springs and Ground Water Claims

BMI identified and monitored three seeps and sixteen springs in the vicinity of the mine. Information collected about these seeps and springs is presented in Hydrometrics, Inc. (2019a). Based on the results of site monitoring, the springs appear to be supplied by deeper ground water and the seeps are associated with shallow structures and flow in response to runoff and infiltration of precipitation (BMI 2019a). The only spring in this inventory that appears to be associated with a specific water right is Spring SP-1, which is located at the upper end of Hoffman Spring Creek.

Several monitoring wells have been installed and ground water data have been gathered over several years. According to the Amendment Application (BMI 2019a), the aquifer near the mine area is semiconfined. One ground water right is within 1 mile of the mine site, and a second ground water right is within approximately 2 miles of the mine site. All other ground water rights for wells are located near Carter Creek, which is over 2 miles downstream from the mine site (Appendix B).

3.6.2.4 Water Rights from Multiple Sources Within the Simulated Drawdown Area

The water rights owned by neighboring landowners, with diversions in the simulated drawdown area, were reviewed separately from those above and below the simulated drawdown footprint of the mine site. These water rights are most at risk to be impacted by the Proposed Action because they are within the area that is expected to be affected by drawdown from the dewatering wells (Appendix B). **Table 3.6-3** contains a list of the water rights in this area.

Table 3.6-2
Carter Creek Drainage Below Mine – Water Right Flow Rate and Volume Data (DNRC 2019)

Water Right Number	Source Name	Use	Period of Div.	Flow Rate	Volume	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
41B 107872 00	GROUND WATER	DM/ST	01/01 to 12/31	10 gpm	2.42 AF	10	10	10	10	10	10	10	10	10	10	10	10
41B 132585 00	CARTER CREEK	ST	01/01 to 12/31	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ
41B 179293 00	GROUND WATER	ST	01/01 to 12/31	10 gpm	NQ	10	10	10	10	10	10	10	10	10	10	10	10
41B 2306 00	GROUND WATER	IR	05/01 to 10/01	448 gpm	160.3 AF					448	448	448	448	448	448		
41B 24604 00**	GROUND WATER	DM/ST	01/01 to 12/31	15 gpm	3.3 AF	15	15	15	15	15	15	15	15	15	15	15	15
41B 30028813	GROUND WATER	ST	01/01 to 12/31	35 gpm	10 AF	35	35	35	35	35	35	35	35	35	35	35	35
41B 30117196	CARTER CREEK	ST	01/01 to 12/31	30 gpm	21.8 AF	30	30	30	30	30	30	30	30	30	30	30	30
41B 77937 00**	GROUND WATER	DM/LG	01/01 to 12/31	11 gpm	6 AF	11	11	11	11	11	11	11	11	11	11	11	11
41B 82215 00	GROUND WATER	DM/ST	01/01 to 12/31	25 gpm	1.87 AF	25	25	25	25	25	25	25	25	25	25	25	25
41B 88337 00	GROUND WATER	DM	01/01 to 12/31	20 gpm	1.5 AF	20	20	20	20	20	20	20	20	20	20	20	20
41B 88600 00	CARTER CREEK	IR	01/01 to 12/31	224.4 gpm	NQ	224.4	224.4	224.4	224.4	224.4	224.4	224.4	224.4	224.4	224.4	224.4	224.4
41B 88601 00	CARTER CREEK	IR	01/01 to 12/31	336.6 gpm	NQ	336.6	336.6	336.6	336.6	336.6	336.6	336.6	336.6	336.6	336.6	336.6	336.6
41B 88602 00	CARTER CREEK	IR	01/01 to 12/31	1.25 CFS	NQ			561	561	561	561	561	561	561	561	561	
41B 88739 00	CARTER CREEK	IR	03/01 to 11/01	6.25 CFS	NQ			2.805	2,805	2,805	2,805	2,805	2,805	2,805	2,805	2,805	
41B 88740 00	CARTER CREEK	ST	03/01 to 11/01	NQ	NQ			NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	
41B 88741 00	CARTER CREEK	IR	04/01 to 11/01	300 gpm	NQ				300	300	300	300	300	300	300	300	
41B 88742 00	SPRING, UT OF CARTER CREEK	ST	01/01 to 12/31	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ
41B 88745 00	GROUND WATER	ST	01/01 to 12/31	2 gpm	NQ	2	2	2	2	2	2	2	2	2	2	2	2
41B 88772 00	GROUND WATER	ST	01/01 to 12/31	35 gpm	NQ	35	35	35	35	35	35	35	35	35	35	35	35
41B 92149 00	SPRING, UT OF CARTER CREEK	DM	01/01 to 12/31	35 gpm	7 AF	35	35	35	35	35	35	35	35	35	35	35	35
41B 92150 00	CARTER CREEK	ST	01/01 to 12/31	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ
			MONTHLY FLOW RATE TOTALS IN gpm:			789	789	4,155	4,455	4,903	4,903	4,903	4,903	4,903	4,903	4,455	789

Table 3.6-3
Hoffman Creek Drainage Within Life-of-Mine Drawdown Footprint – Water Right Flow Rate and Volume Data

Water Right Number	Source Name	Period of Div.	Flow Rate	Volume	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
41B 194153 00	BISHOP CREEK	03/01 to 11/01	NQ	NQ			NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ		
41B 194159 00	HOFFMAN CREEK	03/01 to 11/01	NQ	NQ			NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ		
41B 194157 00	SPRING, UT OF HOFFMAN CREEK (Ground water)	01/01 to 12/31	35 gpm	NQ	35	35	35	35	35	35	35	35	35	35	35	35
41B 194152 00	SPRING, UT OF HOFFMAN CREEK (Surface Water)	01/01 to 12/31	10 gpm	0.01 AF	10	10	10	10	10	10	10	10	10	10	10	10
41B 194158 00	SPRING, UT OF HOFFMAN CREEK (Surface Water)	03/01 to 11/01	NQ	NQ			NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ		
41B 30106951	UT OF HOFFMAN CREEK	03/01 to 11/01	NQ	NQ			NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ		
Monthly Flow Rate Totals in gpm					45	45	45+	45+	45+	45+	45+	45+	45+	45+	45	45

UT = Unnamed Tributary
NQ = Not numerically quantified

The water rights listed in **Table 3.6-3** include surface water and ground water, and all are for stock-watering purposes. As noted in the **Table 3.6-3**, some of the rights are for year-round use while others allow use from March 1 through November 1. Four out of the six rights do not have quantified flow rates or volumes. The rights with quantified flow rates are for ground water and surface water related to a spring adjacent to the location on the U.S. Geological Survey (USGS) Topographic map labeled "Hoffman Place" and are 41B 194157 and 194152, respectively. The remaining water rights in this area are for livestock direct from source with no quantified flow rates or volumes.

3.6.3 Environmental Consequences

This section describes the projected impacts to water rights for each of the alternatives.

3.6.3.1 No Action Alternative

Under the No Action Alternative, mining and dewatering would cease at the expiration of the existing mining permit. The following text discusses the projected impacts of the No Action Alternative including the result of the post-dewatering phase activities.

Hoffman Creek

Under the No Action Alternative, relocating Hoffman Spring Creek would not occur. The existing bypass pipeline in Hoffman Creek channel would ultimately be removed. The current mine activities do not appear to be impacting the flows or water rights of Hoffman Creek. However, the water right for SP-1 and other water rights on Hoffman Creek may possibly be impacted under the No Action Alternative if the pit is deepened under the existing permit and correspondingly dewatered. Currently, water from the dewatering wells injected into the UIC well discharges to the Hoffman Creek alluvium and creek flow is sustained. This practice has been approved by the U.S. Environmental Protection Agency (BMI 2019a) and is expected to continue throughout the duration of active mining under the No Action Alternative. Flow augmentation postmining is not included under the No Action Alternative.

Carter Creek

Under the No Action Alternative, no new dewatering wells would be installed. The current mine activities do not appear to be impacting the flows or water rights of Carter Creek.

3.6.3.2 Proposed Action

Under the Proposed Action, the mine pit would continue to be dewatered for an additional 6 years and the ground water table would be reduced by approximately 90 feet below currently approved drawdown (or a total drawdown of approximately 395 feet) (BMI 2019a). After dewatering ceases, the ground water table is projected to recover to within 50 feet of the baseline levels within 60 years.

Given the general connectivity between ground water and surface water that has been referenced in the Amendment Application (BMI 2019a), the ground water model predicts that surface water flow in Carter Creek, Hoffman Creek, and the unnamed tributaries of Hoffman Creek may possibly be diminished during operation and potentially after operation. Whether or not reduced stream flow actually results in an impact to the water rights depends on the full extent of the water use, which is largely unknown, and flow augmentation.

As stated in the Amendment Application, BMI would manage flow in Carter and Hoffman creeks during the active mining/dewatering and postclosure phases of the project in accordance with requirements under ARM 17.30.715(1)(a). During the dewatering phase of the Proposed Action, water from the dewatering wells is proposed to be discharged into IF-1, IF-3, and a UIC well to dispose of water without using the water for a beneficial use. During the closure phase, BMI proposes to pump water from wells RMG-1 and RMG-3 into the infiltration basins and the UIC well with the express purpose of mitigating depletions/augmenting flows in Hoffman Creek and Carter Creek; this action can only be conducted if one or more of BMI's water rights is changed to allow flow augmentation as a beneficial use of water under BMI's existing water right 41B 86002 and/or proposed amendment to water right 41B 30047773.

Modeling estimates that augment flow rates are relatively low and range from 5.6 to 29 gpm for Hoffman Creek for the 8-month period of August through March and from 1.4 to 2.9 gpm for Carter Creek for the 3-month period of December through February. Estimates of depleted flow rates, percent depletion, and flow augmentation rates and volume for both Hoffman Creek and Carter Creek are tabulated in **Table 3.5-1**.

During the dewatering phase of the Proposed Action, some water rights may be impacted; specifically, those water rights within the simulated drawdown area as listed in **Table 3.6-3**. Because quantified values of these water rights are lacking (i.e., the water right does not define a specific flow rate or volume number, although this does not mean that these values are zero), determining impacts on these unquantified water rights is difficult.

Hoffman Creek

BMI's comparison of predicted mean monthly flow and the ground water model-predicted maximum stream depletion rate indicates that flows will be depleted below 65 gpm between December and March; current mean monthly flow is estimated to be below 65 gpm during the time frame regardless of future mine dewatering (Amendment Application Table 3-4, Page 29). Based on this analysis, the Proposed Action may impact water rights listed in **Table 3.6-1**, although impacts would be mitigated provided an adequate amount of water is discharged (BMI 2019a).

Dewatering at the mine would not likely impact water rights on Hoffman Creek above the mine. However, because no plan is implemented to direct any water from the dewatering wells to the location, any flow depletions would not be mitigated under the Proposed Action.

The Proposed Action impacts are predicted to be mitigated through flow augmentation and overall is not anticipated to negatively impact water rights on Hoffman Creek below the mine outside of the simulated drawdown area (**Figure 3.6-1**). The following components of the Proposed Action may impact Hoffman Creek or its tributaries:

- Lining sections of Hoffman Spring Creek and Hoffman Creek (BMI 2019a) would reduce seepage, protect flows in the creek, and preserve water for use by existing water right holders.
- The Proposed Action would discharge water from the dewatering wells to a new pond or catchment basin that would be constructed on a portion of Hoffman Spring Creek for stock-watering use and where water from one of the dewatering wells would be supplied to mitigate flow impacts to the creek and to SP-1 (water right 41B 194158) (BMI 2019a). This action is proposed to offset the depletions that are predicted to SP-1.
- Injecting water into the UIC well during the dewatering period would continue for an additional 6 years. An ancillary benefit is that this practice also recharges the Hoffman Creek alluvium and contributes flows back to the stream.
- The Proposed Action would build a new infiltration pond (IF-3), which would be located northwest of the expanded WRDF and designed to accommodate a continuous flow of 500 gpm. The ground water model predicts that infiltration from IF-3 would likely increase flows on Hoffman Creek and Carter Creek.

Carter Creek

The Proposed Action is not likely to reduce upgradient flows on Carter Creek. Only one water right is on Carter Creek above the simulated drawdown footprint of the mine and it would not be impacted (Appendix B).

Below the simulated drawdown footprint of the mine on Carter Creek, flow depletions are anticipated to occur during dewatering but would be mitigated by recharge that would occur as a result of discharge to IF-1 and IF-3. As part of the Proposed Action, the existing infiltration basin (IF-1) and the new infiltration basin (IF-3) will receive water from the dewatering wells during operations and in the closure period and recharge alluvium associated with Carter Creek. During the dewatering period and flow augmentation, impacts to stream flow and water rights on Carter Creek below the mine would be mitigated provided an adequate amount of water is discharged (BMI 2019a).

3.6.3.3 WRDF Grading and Mosaic Vegetation Alternative

The only aspect of the WRDF Grading and Mosaic Vegetation Alternative that differs from the Proposed Action would occur during the WRDF reclamation. The changes to the WRDF grading and revegetation plan are not predicted to result in additional impacts to downstream water rights on Carter Creek or Hoffman Creek. Impacts to water rights would be the same as the Proposed Action.

3.7 Geotechnical Engineering

This section describes analysis and environmental impacts of the slope stability of the pit and WRDF at the Regal Mine.

3.7.1 Analysis Methods

The affected environment for geotechnical engineering was assessed by reviewing general modes of potential failure and instability as well as slope-stability reports included as part of BMI's Amendment Application.

3.7.1.1 Modes of Instability

In the Regal Mine pit, the possibility for bench-scale wedge and planar sliding failures has been identified, as well as some potential for slope-scale rock-mass failures resulting in larger landslides. The WRDF is only subject to slope-scale failures and is an engineered fill structure; thus, the potential for landslides is generally lower than unengineered slopes.

Bench-scale instability caused by foliation, bedding planes, and other joint sets in the rock mass are typical in hard-rock open pits. These types of failures can take multiple forms but are usually grouped into three categories: slides, topples, and wedges. Slides occur along joint planes that dip less steeply than the bench face. Topples occur when joint planes dip into the slope at a steep angle to form "dominos" that are stacked together and able lean and break off, falling out of the bench face. Wedges are characteristically similar to sliding failures but form when two or more joint sets intersect, and their intersection line plunges out of the slope. In all of these cases, however, rocks released by the instability can bounce and tumble down the slope and threaten equipment, facilities, and people. Catchment benches in open pits are designed to catch these events and mitigate the rockfall risks.

Slope-scale instability can occur in both soil and rock slopes. In soil slopes, failures often occur along existing planes of weakness such as layers of clay soil, forming planar or stepped failure surfaces that follow the plane(s) of weakness. Planar and stepped failure surfaces are more common in natural soils because of material property heterogeneity. In more homogenous soils such as engineered fill embankments, failure planes may develop on nearly circular geometries and follow the critical line of stress in the slope. In these cases, the soil usually has similar strength properties throughout, and slope geometry, external loading, and water conditions are the critical controls on the failure surface location and shape. Note however, that both circular and noncircular failure planes can exist in a given soil slope failure because of the combination of debuttressing effects of slope failures and variability in slope materials.

Rock slopes are also subject to slope-scale instability and often result from the combined behavior of intersecting joints and faults within the rock mass. A highly fractured rock mass can behave as though each jointed block is a grain of soil, displacing together and forming a nearly circular failure plane. In other cases, where continuous and persistent planes of weakness such as bedding planes, weak layers, or faults exist, the slope can fail along planar or stepped surfaces. Failure can occur in slope-scale wedges or as a series of cascading bench-scale failures where multiple persistent planes of weakness intersect. For example, a single slide can debuttress a weak zone above it, and that, in turn, can release another slide above it, and so on. This type of slope failure is not uncommon in open pits and, in most cases the actual mode of slope-scale instability is a combination of the various modes of instability described previously.

All types of slope instability are worsened by earthquake hazards. Earthquakes are common triggers for landslides and rockfall because they introduce horizontal and vertical accelerations to the slope that may increase the forces driving the failure and/or reduce the forces resisting failure. If all other conditions are equal, seismically active regions have increased risks associated with slope instability than regions will little to no seismicity.

3.7.1.2 Pit Wall Stability Analyses

Two geotechnical studies have been performed to evaluate the impacts on pit slope stability of the Proposed Action (Golder Associates Inc. 2016, 2017). The first study was performed as part of the preliminary pit slope design in 2016 and included geotechnical drilling, field mapping, laboratory testing, and geotechnical characterization of the Regal Mine pit slopes. The first study also included a review of previous work by Call & Nicholas (1995, 2009, 2014). A second follow-up study was performed in 2017 to address the possibility of steepening the east wall overall slope angle from 47 to 54 degrees by increasing the bench-face angle from 65 to 75 degrees while maintaining the original catch bench width of 27 feet. The Golder Associates Inc. study that was performed in 2017 was based on the data and information provided by the Golder Associates Inc. study that was performed in 2016.

Geotechnical drilling for Golder Associates Inc. (2016) included five HQ-size (approximately 2.5-inch) coreholes 356 and 451 feet deep. Core was logged and photographed on site. Televiewer logs for measuring discontinuity orientations were collected before the holes were abandoned. Following delivery of boxed core to the BMI’s core-storage facility, point-load tests were performed on suitable samples at intervals of 5 to 20 feet and the televiewer logs were reconciled with the core samples. Standard core-logging practices were used and included recording joint and discontinuity information and estimating rock recovery and rock quality.

Rock strength properties were estimated using a combination of point-load tests on core samples and laboratory testing. Laboratory tests included 14 unconfined compressive strength (UCS) tests, 14 Brazilian tensile strength, and 8 discontinuity direct shear tests. The ratio of tensile strength to UCS was used to determine outliers in the UCS tests. The remaining values were adjusted for rock fabric and rock-mass quality indices (standard practice in geotechnical engineering) to estimate the Hoek-Brown strength parameters of the rock masses in different sectors of the pit. Direct shear tests on discontinuities were used to develop estimated cohesion and friction angle values under the Mohr-Coulomb failure criterion. The rock-mass (Hoek-Brown) and discontinuity (Mohr-Coulomb) strength properties were used in limit-equilibrium models to evaluate slope-scale stability.

Field mapping data, including joint and bench-face orientation at several locations throughout the Regal Mine pit were used in bench-scale stability models. Structure type, orientation, and details of the observed discontinuity (e.g., clay infilling and roughness) were recorded. Kinematic analyses were performed using these and the televiewer discontinuity orientation data. Combined with the direct shear test results, kinematic analyses were used to estimate the bench-scale stability for distinct sectors of the pit, and the likelihood of topples, slides, and wedges in these sectors were evaluated.

The review of Call & Nicholas (1995, 2009, 2014) performed by Golder Associates Inc. (2016) yielded valuable site geology information including foliation, bedding, joint set orientations, and conclusions related to observed ground movements in the southwest corner of the pit. This information was incorporated into the Golder Associates Inc. (2016) study and partially provided the basis for the new pit design.

The limit-equilibrium slope-scale stability models performed by Golder Associates Inc. (2016) showed relatively high factors of safety for both the current pit and their proposed pit design with a range from 3.87 to 6.36. Models were run for two slope profiles: one along the northern portion of the east wall and one along the southern wall. Seismic loads corresponding to the USGS-produced events were included in the slope-stability models. Safety factors in the slope-stability models were well above the typical values used for stable pit designs. Slope-scale stability was not modeled on the north or west walls, presumably because data and observations did not indicate significant risk of slope-scale failures in these pit sectors.

Based on the kinematic analysis performed by Golder Associates Inc. (2016), bench-scale stability of the north and south walls was found to be controlled by planar joints in the rock fabric at relatively shallow angles (approximately 65 degrees). The steepness of the bench faces would, therefore, be limited to the dip of those structures because of small sliding failures developing along those joints. Achieving steeper (> 65 degrees) bench-face angles on the east and west walls were found to be possible if blasting and scaling controls were implemented correctly. The Golder Associates Inc. (2016) study contains additional details on specific pit sectors.

Golder Associates Inc. (2017) included analyses of slope-scale stability along two profiles, assuming steeper bench-face and overall pit slope angles. This analysis was in response to BMI's wishes to explore steepening the slopes on the east wall to minimize environmental impacts. The same seismic loading and material property conditions were used as in Golder Associates Inc. (2016). Predicted factor-of-safety values were well above commonly used values and ranged between 3.88 and 6.95.

3.7.1.3 Waste Rock Disposal Facility Slope-Stability Analysis

One geotechnical study was performed to evaluate the expanded WRDF stability under the Proposed Action (NewFields 2017). The study was a requisite component of the expanded WRDF design and included drilling, field soil sampling and Standard Penetration Tests (SPTs), laboratory soil testing, and slope-scale stability modeling.

The material strength properties used for stability of the WRDF foundation are reasonable and conservative (c = 0 pounds per square inch, ϕ = 33 degrees). The properties used are similar to assuming that the WRDF is built on top of well-graded sand rather than schist bedrock. Strength data are based on either a correlation between SPTs and foundation strength (NewFields 2017) or were estimated from the previous pit slope design study (Golder Associates Inc. 2016).

Native soils were shallow (< 15 feet) and largely comprising nonplastic to moderate-plasticity sandy silts, silty sands, and weathered-in-place bedrock sands (i.e., regolith). Direct shear tests were performed on a soil sample collected from the existing WRDF. The material had a nonlinear, shear-normal strength envelope because of the interlocking of larger grains mobilizing intact rock strength under high normal stresses. For this reason, a normal-shear function was used instead of typical Mohr-Coulomb failure criterion in the model. However, the laboratory data did not show a significant nonlinear behavior in the material's strength behavior. A linear fit prepared by NewFields' (2017) laboratory testing subcontractor appears to be reasonable, and the mobilization of intact rock strength is not immediately obvious in the data.

Slope-scale stability was modeled along two cross sections of the expanded WRDF slope. Factor-of-safety values in the slope models were between 1.4 and 2.0 under both static and pseudo-static (i.e., seismic) loads. These values are equal to or greater than commonly used design criteria (e.g., between 1.1 to 1.4) that are used for engineered fill embankment designs.

3.7.2 Affected Environment

Bedrock units that underlie the Regal Mine pit, WRDF, and other mining facilities are Archean-age metasediments comprising dolomitic marbles, garnetiferous sillimanite mica schists, and quartzo-feldpathic and quartz-rich gneisses. The region has experienced intense folding and moderate faulting, and rocks dip moderately to steeply to the northwest. Significant prehistoric displacement has occurred on the northwest-southeast-trending Carter Creek normal fault, which is located approximately 0.5 mile to the southwest of the Regal Mine pit. Some northeast-southwest-trending faults are noted in the area, and larger, more active faults exist in the region surrounding the Regal Mine (Golder Associates Inc. 2017).

Overburden soils are relatively thin (< 10 to 15 feet) with variable Tertiary and Quaternary alluvial and colluvial deposits comprising silts, sandy silts, and silty sands with some isolated coarse sand and gravel. Competent bedrock is present immediately beneath the overburden. Additional information on the geologic setting of the Regal Mine is included in Golder Associates Inc. (2016), NewFields (2017), and Section 3.3, Geology and Geochemistry.

Regal Mine is in a seismically active region, and seismic risks are considered moderate. Most seismic activity is small, but larger events are possible in the region that surround the mine (e.g., Magnitude 7.2 Hebgen Lake earthquake near Yellowstone National Park in 1959, approximately 80 miles to the east). As reported by the USGS, peak ground accelerations for probable earthquake events in the area range from 0.14 g (gravitational constant g = 9.8 m/s/s) for a 475-year return period event to 0.49 g for a 9,950-year return period event. Additional information on the seismic setting of the Regal Mine is included in Golder Associates Inc. (2016) and NewFields (2017).

The mine site currently includes an open pit that encompasses approximately 38 acres. The permitted pit design is 450 feet deep and, in October 2016, the pit was approximately 200 feet deep. The mine pit is constructed using 30-foot tall production benches that are stacked to form a double-bench 60 feet tall with 27-foot-wide catch benches between them (see Section 2.2 No Action Alternative). A sliding slope failure has occurred in recent years along the southwestern wall of the pit. The slide, approximately 500 feet wide extending from the pit crest to the bench above production bench levels, is slow moving with movement increasing during the spring (presumably related to increases in ground water levels). Other ground movements (e.g., falls, topples, and slides) at the Regal Mine are not documented. The primary potential failure modes for the Regal Pit highwall and Regal WRDF facilities were identified in geotechnical studies conducted before this EIS and included in DEQ submissions (Golder Associates Inc. 2016, NewFields 2017).

3.7.3 Environmental Consequences

3.7.3.1 No Action Alternative

Mine Pit

A single slope-scale failure event on the southwestern wall of the mine pit has been reported. The failure is a complex multiple-wedge failure in which rapid, large-scale slope failure is unlikely caused by the resisting friction forces of interlocking wedges that dip steeper than the overall pit slope angle. Based on the analyses performed by the mine operator and their consultants, additional slope-scale, rock-mass failures developing is unlikely, and the continual safe operation of the mine is expected.

Waste Rock Disposal Facility

Under the No Action Alternative, the WRDF would not be expanded and the general design would remain as permitted. No slope-scale failures are known to have occurred at the WRDF. Current geometry and operations appear to be maintaining safe slopes with relatively low slope failure risk.

3.7.3.2 Proposed Action

Mine Pit

The Proposed Action includes expanding slopes on the west, north, and east walls of the Regal Mine pit. The planned pit would have an ultimate depth of 540 feet with a crest elevation of 6,530 feet and a pit-bottom elevation of 5,990 feet (BMI 2019a). North and east expansions would require expanded permit boundaries and, to minimize watershed impacts, the design of the east wall of the pit would include steeper bench faces and overall slope angles in comparison to the No Action Alternative.

Existing slope-scale instability in the southwestern corner of the Regal Mine pit is not expected to be affected. Maintenance of the extended-width catchment bench below the failure is planned and likely necessary to prevent initiating or exacerbating ground movements on the southwestern wall. Additional slope-scale failures outside of the southwestern wall are not expected if the blasting and scaling procedures outlined in Golder Associates Inc. (2016, 2017) are followed. Regular as-built comparisons with designs and monitoring methods such as those outlined in Golder Associates Inc. (2016) are crucial for managing health and safety risks associated with slope-scale instability.

Favorable geology on the east, west, and north sides of pit reduce the risk of bench-scale failures. The Proposed Action includes similar overall pit slope angles, bench heights, and bench-face angles as the current Regal Mine pit for the west, north, and southeastern walls. ,. The increased steepness of the east wall of the pit would require using improved mining methods above and beyond current practices in specific sectors of the pit to maintain safe slope conditions during the mine life (e.g., trim blasting, scaling, and presplit blasting methods). More information on the wall condition improvement methods is in Golder Associates Inc. (2016, 2017). Risks of bench-scale failures during the mine's life can be managed effectively if the procedures defined in Golder Associates Inc. (2016, 2017) are followed. Blasting and scaling operations are particularly important for maintaining safe slopes.

Seismic hazards do not increase significantly if the Proposed Action design and slope management plans are followed. Slope-scale and bench-scale failures are more likely with steeper and deeper pit walls, but this risk is dramatically reduced by limiting blast damage with presplit and final trim blasts and removing loose rocks via scaling.

Waste Rock Disposal Facility

The WRDF extension would require excavating overburden soils and emplacing waste rock fill. Native soils will be excavated and stored for reclamation purposes, which would leave a bedrock foundation for constructing the expanded WRDF. The ultimate WRDF crest elevation of 6,480 feet will be achieved in lifts between 30 and 75 feet. The overall slope angle would be maintained at 2.5 Horizontal:1 Vertical during WRDF construction, and slope reclamation (including seeding and vegetation) would be conducted following each lift (BMI 2019a). This approach would allow for slope reclamation as the WRDF extension is built. The expanded WRDF would require extending the permitted mine boundary and include installing surface water control structures.

Slope instability is not expected if proper construction, operations, and maintenance methods are used. The expanded WRDF at the Regal Mine is expected to meet mining industry slope-stability criteria. Conservative values for material strengths were used in the slope-stability analyses, and the construction approach of using staged lifts would further increase stability by allowing ongoing revegetation. Based on the reported data, conservative values were used, and seismic hazards were appropriately considered in the slope-stability evaluation.

3.7.3.3 WRDF Grading and Mosaic Vegetation Alternative

Under the WRDF Grading and Mosaic Vegetation Alternative, the final topography of the WRDF would be similar to the Proposed Action. The slopes of the WRDF would be more stable under the AMA. The predicted stability of the mine pit would not change.

3.8 LAND USE

The following sections discuss the affected environment of BMI Regal Mine and potential impacts of the No Action Alternative, Proposed Action, and the WRDF Grading and Mosaic Vegetation Alternative on land use. The Amendment Application provides additional land-use information including history of use in the permit area.

3.8.1 Analysis Methods

The BMI OP; BMI's Amendment Application; Geographic Information System data from the Montana State Library, Bureau of Land Management's (BLM) Navigator Web Service, and Montana's Cadastral Database; BLM's East Bank Watershed Assessment Report, various city and county websites; and several DNRC lease documents were reviewed to evaluate land use at and near the Regal Mine. **Figure 3.8-1** presents a map of land ownership in the vicinity of the Regal Mine.

3.8.2 Affected Environment

The Regal Mine is located in a rural area in west Madison County in Sections 20, 34 and 35 of Township 7 South, Range 7 West, and Sections 2 and 3 of Township 8 South, Range 7 West (Montana State Library 2017). Dillon, Montana, is the nearest major population area and is located approximately 11 miles to the northwest of the Project area. The mine is accessed by Sweetwater Road, which is a county road between Dillon and the Project area. Sweetwater Road approaches the mine from the northwest, traverses through the mine, and continues to the southeast.

Current land use within the boundaries of the existing permit of Regal Mine includes mining-related activities associated with an open pit talc mine, including removing and transporting ore. Main features of the Regal Mine include the open mine pit, haul roads, WRDF, soil stockpiles, and office and support facilities. The Regal Mine permit area, as well as land adjacent to the mine site, is privately owned (BMI 2019a, Montana State Library and Montana Department of Revenue 2019).

Land outside of BMI's property is typically used for ranching and livestock grazing and provides wildlife habitat. Large-lot residential properties, ranches, and cabins are present along Sweetwater Road. Public access to privately owned land adjacent to the mine site is allowed at individual landowner discretion (RMA 2006). Portions of the present mine site and the proposed mine-expansion area along Hoffman Spring Creek and Hoffman Pond are used for livestock grazing by private landowners who have large land holdings in the area.

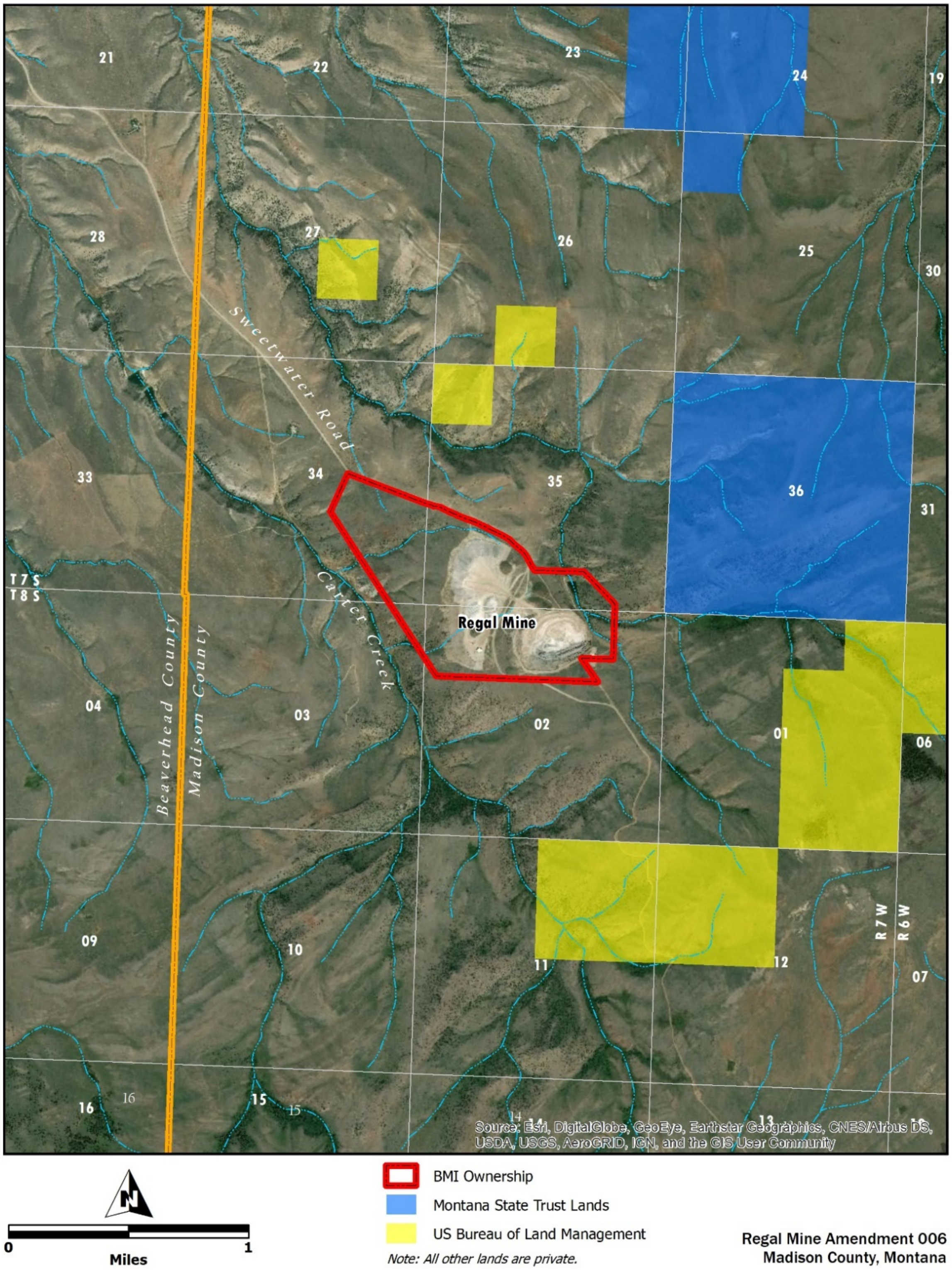

Figure 3.8-1
Land Ownership

Two DNRC State Trust parcels northeast of the permit area (Montana State Library 2019) are used primarily for grazing (**Figure 3.8-1**). A recreational-use permit for trapping on the northernmost State Trust parcel recently expired, and the south State Trust parcel in Section 36, Township 7 South, Range 7 West has an active grazing lease (DNRC 2011, 2018).

Scattered BLM parcels (BLM 2011) with active grazing leases are located north, east, and south of the Regal Mine (**Figure 3.8-1**). There are active grazing leases on these lands, including BLM's Hoffman Creek, Carter Creek, and Big Sheep grazing allotments, all of which are custodial allotments for sheep and/or cattle (BLM 2018).

No public recreation areas, trails, or wilderness areas are located adjacent to or in the near vicinity of the Project area. The closest campgrounds and recreation areas are within or near Dillon (11 miles away), including Clarks Lookout State Park, Chris Kraft County Park, several golf courses, and various city parks and playgrounds (aFabulousTrip 2019, City of Dillon 2019, Montana State Library *et al.* 2016, Visit Montana 2006).

3.8.3 Environmental Consequences

3.8.3.1 No Action Alternative

The No Action Alternative assumes that BMI would continue all activities at the Regal Mine approved under its current permit. Mining would continue through 2021, livestock from adjacent private lands would continue to have access to Hoffman Pond and Hoffman Spring Creek for grazing, no acreage would be disturbed outside of the current permitted design area, and reclamation plans as outlined in BMI's LOM Expansion Plan would be implemented (RMA 2006). The post-reclamation land use would be domestic grazing and wildlife habitat. Fresh water in the reclaimed pit lake would potentially allow for hay or crop irrigation and possibly support fish populations (RMA 2006). Impacts to adjacent land uses and ownership would be negligible under the No Action Alternative.

3.8.3.2 Proposed Action

Under the Proposed Action, the total permit area would be increased by 136.9 acres but only 60.2 of those acres would be disturbed. Therefore, changes in land use as a result of the Proposed Action would be limited to those 60.2 acres, all of which are owned by BMI. Of those disturbed acres, 36.7 acres would be outside the existing permit boundary and 23.5 acres of new disturbance would occur inside the existing permit boundary. Most of the proposed disturbance (i.e., 41.4 acres) would be associated with the expansion of the WRDF to the west. The open pit expansion would result in 8.8 acres of new disturbance, and expanding the water management system, including dewatering and discharge systems, would produce another 10 acres of disturbance (BMI 2019a).

The proposed mine-expansion activities would not impact the primary land uses of livestock grazing and wildlife habitat on private lands that are adjacent to the proposed expansion areas. BMI owns all lands within the current permit boundary and the lands to be added to the permit under the Proposed Action. Land use that would be disturbed by the Proposed Action within the existing permit boundary is already mine related with limited grazing and wildlife habitat. On currently undisturbed areas to be added to the permit, disturbance associated with the expanded WRDF and open pit would temporarily change land use from grazing to mine disturbance. Livestock would temporarily lose access to current grazing in the WRDF expansion area and along Hoffman Spring Creek. However, livestock would gain access to the proposed new stock pond on upper Hoffman Spring Creek (**Figure 2.3-7**) after it is created, which would provide additional grazing areas during mine operations.

Mining would continue with the Proposed Action and, as a result, the temporary impacts to any grazing and wildlife land uses inside the expanded permit boundary would continue until reclamation begins in 2027 and grazing and wildlife land uses are restored. After mining activities are completed, with the exception of pumping equipment needed to augment existing water rights, mine equipment and facilities would be removed, and disturbed land would be reclaimed and revegetated. A 27-acre pit lake owned by BMI would remain after reclamation is completed.

Whereas changes in existing wildlife and grazing land uses would only be temporary in areas associated with expansion of the WRDF and water management system, disturbance associated with the expanded open pit could change land uses permanently. Postmine use of the pit lake and other permit-area land could include wildlife and livestock use but would be subject to BMI's discretion and any pending water rights. Postclosure use of the remainder of the mine site would consist of wildlife habitat, agriculture, and livestock grazing (BMI 2019a).

3.8.3.3 WRDF Grading and Mosaic Vegetation Alternative

The only aspect of the WRDF Grading and Mosaic Vegetation Alternative that differs from the Proposed Action would occur during the WRDF reclamation. The disturbance footprint of the WRDF Grading and Mosaic Vegetation Alternative would be the same as described for the Proposed Action; therefore, no additional impacts to land use would occur. Because the WRDF Grading and Mosaic Vegetation Alternative would enhance vegetation diversity after reclamation is complete, postclosure use of the WRDF may provide a more diverse wildlife habitat than the Proposed Action.

3.9 Visual Resources and Aesthetics

Visual resources and aesthetics are the visible physical features (i.e., landforms, water, vegetation, and structures) within the assessment area. The components contribute to the landscape's overall scenic and aesthetic quality. The following sections present a discussion of the affected environment of BMI's Regal Mine and potential impacts on visual resources and aesthetics.

3.9.1 Analysis Methods

The assessment of impacts on visual resources included visual simulations developed for the OP Application (BMI 2019a) and a site visit on May 17, 2019, USGS Topo Maps, and Google Earth mapping.

3.9.2 Affected Environment

The Regal Mine is located in a rolling, open, foothill setting on the western slopes of the Ruby Range in southwestern Montana (RMA 2006). In addition to the open pit talc mining at Regal Mine, adjacent land is used for livestock grazing and serves as open space for wildlife.

According to U.S. Environmental Protection Agency mapping of ecoregions, the Project area is located in Level IV Ecoregion 17ab – Dry Gneissic-Schistose-Volcanic Hills, which is characterized as largely treeless areas, semiarid shrubby hills and foothills prairie with grazing, mining, and wildlife habitat as the primary land uses (Woods *et al.* 2002). Elevations range from approximately 5,100 feet at Dillon to more than 9,000 feet on higher peaks of the Ruby Range. Sagebrush and grasses dominate vegetation surrounding the Regal Mine. Widely scattered trees and rock outcrops occur on adjacent hillsides. Higher peaks of the Ruby Range are tree-covered, but limber pine and mountain mahogany are the dominant species on the hills in the Regal Mine area. These different vegetation communities provide an intermingled mosaic of color and texture near the Regal Mine site (DEQ 2000a). Historical development, mining, and grazing has impacted the native landscape around the Project area. Ranches and homesites are scattered along Sweetwater Road, which provides access to the Regal Mine from Dillon.

The current WRDF is a notable landform in the area. The white-colored waste rock contrasts with the surrounding grassland. The WRDF is visible from Interstate 15, Sweetwater Road, and surrounding private lands. Sweetwater Road provides access to the mine and bisects the permitted mine boundary with the WRDF and offices located to the west and the mine pit located to the east. When approaching the mine from the northwest along Sweetwater Road, the WRDF is clearly visible and becomes the dominant feature of the landscape near the mine permit boundary (**Figure 3.9-1**). The mine office facilities and open pit are visible from a portion of Sweetwater Road that traverses through the Regal Mine. When approaching Regal

Mine from the south along Sweetwater Road, the open pit, soil stockpiles, and office facilities are clearly visible (RMA 2006).

Figure 3.9-1
Current Visual Setting of the Waste Rock Disposal Facility Looking Southeast From Sweetwater Road

Typically, visual impacts are often a concern from nearby landowners, but the Regal Mine has been part of the landscape since 1972 and is a familiar sight to residences located along the Sweetwater Road between the mine site and Dillon (BMI 2019a).

3.9.3 Environmental Consequences

3.9.3.1 No Action Alternative

Under the No Action Alternative, the current landscape and visual resources would be unaffected by the Proposed Action. The Regal Mine would continue to operate for another 2 years under the existing permit. Travelers on highways and other access roads in the vicinity of Regal Mine would continue to view the existing WRDF, fencing, and other features associated with mining and human development. The visual impacts to residences and travelers along Sweetwater Road and other local roads would continue through operation and reclamation under the existing permit.

After mining is completed, reclaiming disturbed areas would help reduce the contrast of the waste-rock dump and other disturbed land. Reclamation would be completed within 2 years after the end of mining operations, or by approximately 2023. A large open pit with several benches, areas of rock talus slopes, and a 22.9-acre pit lake would remain after pit reclamation operations (RMA 2006, DEQ 2007). The entire pit area would be fenced and a 4-foot-high safety berm surrounding the pit would be soiled, seeded, and remain in place as physical and visual barriers (DEQ 2007). The flat-topped look of the WRDF would be rounded on the profile to allow for a more natural appearance.

3.9.3.2 Proposed Action

The visibility of the WRDF and open pit would not be significantly different than the No Action Alternative. Impacts would be minor because of the long-term existence of the mine and relatively small size and scale of the proposed expansion compared to the No Action Alternative. Although the Proposed Action would increase the acreage of the WRDF, the height would not change, and any visual impacts to the landscape would be minimal. The scoping process for the Proposed Action did not result in any landowner comments or concerns about visual resources.

Under the Proposed Action, mining would continue for an additional 6 years and extend the time period of increased visual impacts from mining activities and postpone visual improvements that would be realized through reclamation. The Proposed Action would increase disturbance at the Regal Mine by 60.2 acres. The current landscape and visual resources would be affected by the increase in size of mining facilities and temporary replacement of grazing and wildlife habitat with mining activities on currently undisturbed areas.

The proposed expansion would increase the size of the open pit by 8.8 acres. The expanded pit would not be visible to any residences but could be slightly more visible to those traveling along Sweetwater Road from the south toward the mine. The footprint of the WRDF would be increased by 41.4 acres but would have the same elevation or height as the No Action Alternative. Because of the size increase, the expanded WRDF could be slightly more visible from Sweetwater Road and other surrounding lands. The Proposed Action would include constructing and reclaiming the WRDF in lifts, which would allow for some revegetation and enhanced visual appeal while mining is still ongoing.

A conceptual view of the Proposed Action after reclamation is shown on **Figure 3.9-2**. After mining activities are completed, mine equipment and facilities would be removed and disturbed land would be reclaimed and revegetated. The mine pit would be 8.8 acres larger than the pit under the No Action Alternative and contain a pit lake that is approximately 4 acres larger than the No Action Alternative, but the pit would otherwise be reclaimed similar to the No Action Alternative. Post-reclamation, the 4-foot berm, upper benches and talus slopes, and potentially the pit lake could be intermittently visible from elevated locations in the area and portions of the Sweetwater Road located immediately adjacent to the pit. A mixed-slope design for the WRDF and reclamation of 5.5 acres of the pit highwall as talus slopes and rock faces would improve the landscape to a slightly more a natural-appearing landscape. Postclosure use of the mine site would consist of wildlife habitat, agriculture, and livestock grazing (BMI 2019a).

Figure 3.9-2
Conceptual Post-Reclamation View of the Proposed Action

3.9.3.3 WRDF Grading and Mosaic Vegetation Alternative

The only aspect of the WRDF Grading and Mosaic Vegetation Alternative that differs from the Proposed Action would occur during the WRDF reclamation. During mining of the expansion area, visual impacts would be the same as under the Proposed Action. The post-reclamation landscape of the WRDF Grading and Mosaic Vegetation Alternative would include a more natural appearance that blends with the landscape and, therefore, produce more aesthetically pleasing views.

3.10 SOCIOECONOMICS

The Regal Mine is located within Madison County, but the majority of employees reside in Beaverhead County near Dillon, Montana (BMI 2019a). Based on the mine location and proximity to Dillon, which is the county seat of Beaverhead County, the radius of influence for evaluating the socioeconomic existing conditions and potential impacts from each alternative includes Madison and Beaverhead counties, Montana.

3.10.1 Analysis Methods

Most of the information in this section was sourced from the BMI Amendment Application Appendix A-5 (BMI 2019a) and updated from the original sources as available. Data were also collected from federal and state sources, including the U.S. Office of Management and Budget, U.S. Census Bureau, U.S. Bureau of Labor Statistics (USBLS), U.S. Bureau of Economic Analysis, and the Montana Department of Labor & Industry (MDLI). BMI provided additional information regarding recent state and local school, property, and miscellaneous tax payments.

Information collected for Beaverhead and Madison counties was considered to represent the radius of influence for socioeconomic resources including population, employment, and income. The Proposed Action would not result in any changes in mine employment, housing, schools, and government and community services were not addressed.

3.10.2 Affected Environment

3.10.2.1 Population

The Regal Mine is located in a rural area of Madison and Beaverhead counties that is dominated by large tract cattle and sheep grazing lands and natural resource areas. Dillon is the largest city within 20 miles of the Regal Mine and had a 2010 population of 4,134 persons (U.S. Census Bureau, 2019a). The nearest micropolitan area is Butte-Silver Bow located 77 miles north of the Regal Mine with a 2018 estimated population of 34,284 persons (U.S. Census Bureau 2019a). Beaverhead and Madison counties have estimated 2018 populations of 9,404 and 8,768 persons, respectively. The estimated population of Madison County has increased by 14 percent since the 2010 census and is outpacing growth statewide (7.4 percent) and growth throughout the US (6 percent). Beaverhead County had an estimated growth over the same period of 1.7 percent (U.S. Census Bureau 2019b).

Table 3.10-1 describes the percent of race distribution for Beaverhead and Madison counties compared to statewide and nationwide averages. Based on 2018 population estimates, race within Beaverhead and Madison counties were predominantly white (90.7 percent and 93.3 percent, respectively) compared to statewide averages of 86.2 percent white and a nationwide average of 60.7 percent white (U.S. Census Bureau 2019b). Hispanic or Latino populations represent 4.5 percent and 3.5 percent of the white populations from Beaverhead and Madison counties, respectively; the percentage of Hispanic or Latino persons is 3.8 percent in Montana and 18.1 percent nationwide. Montana has a high percentage of American Indians (6.7 percent across the state compared to the nationwide average of 1.3 percent). American Indian populations in Beaverhead and Madison counties are 1.9 percent and 0.9 percent, respectively. Indian reservations are not located within either of these two counties.

Table 3.10-1
Ethnicity and Income Characteristics for Beaverhead and Madison County, Montana, and the United States in 2018

Ethnicity (percent)	Beaverhead County (%)	Madison County (%)	Montana (%)	US (%)
White alone	96.3	94.6	89.1	76.6
Black or African American alone	0.4	0.5	0.6	13.4
American Indian and Alaska Native alone	1.9	0.9	6.7	1.3
Asian alone	0.5	0.5	0.8	5.8
Native Hawaiian and Other Pacific Islander alone	0.4	<0.1	0.1	0.2
Two or more races	2.2	1.9	2.8	2.7
Hispanic or Latino	4.5	3.5	3.8	18.1
White alone, not Hispanic or Latino	90.7	93.3	86.2	60.7
Income	**Beaverhead County ($)**	**Madison County ($)**	**Montana ($)**	**US ($)**
Median household income in 2017 dollars	43,880	47,900	50,801	57,652
Per capita income in past 12 months (2013–2017) in 2017 dollars	28,240	31,620	28,706	31,177
Percent of persons in poverty	13.8%	10.0%	12.5%	12.3%

Source: (U.S. Census Bureau 2019b)

Household income measures the income of all persons living in a household, whether or not they are related. The Beaverhead County median household income in 2018 was 76 percent of the US median and 86 percent of the overall Montana median income (U.S. Census Bureau 2019b). The Madison County median household income in 2018 was 83 percent of the US median and 94 percent of the overall Montana median income (U.S. Census Bureau 2019b). Per capita income (PCI) is the total personal income of an area divided by that area's population. Respectively, the PCI for Beaverhead and Madison counties was 91 percent and 101 percent of the US PCI and 98 percent and 110 percent of Montana's PCI (U.S. Census Bureau 2019b). When comparing national and statewide averages, poverty rates were slightly higher in Beaverhead County but lower in Madison County.

3.10.2.2 Employment

BMI employs 15 workers at the Regal Mine site and an additional 65 persons at the mill site (Raffety 2019). BMI subcontracts to a trucking company to transport ore to the mill site. The contract hauler employs 12 persons for the BMI work (Raffety 2019). Employment (the number of jobs) within Beaverhead County has increased at a rate of 2 percent annually from 2014 to 2017. The 2017 average annual employment in Beaverhead County was 3,848 jobs (USBLS 2019). From 2014 through 2016, Madison County had average annually increases of 3.4 percent, but average annual jobs were reduced by 0.9 percent from 2016 to 2017. The 2017 average annual employment in Madison County was 3,969 jobs (USBLS 2019). Unemployment rates from 2014 to 2018 decreased from 3.7 percent to 3.1 percent in Beaverhead County and from 4.6 percent to 3.5 percent in Madison County (USBLS 2019).

The USBLS reports employment by industrial sector; these data help to understand an area's economic diversity and its ability to withstand downturns in any one sector. **Table 3.10-2** illustrates the employment and average pay by industry in Beaverhead and Madison counties. The sector of natural resources and mining is among the highest paid industries in Beaverhead County.

The top private employers in Beaverhead and Madison counties by size class are shown in **Tables 3.10-3** and **3.10-4**, respectively (MDLI 2019).

3.10.2.3 Tax Revenue and Community Contributions

BMI's tax contributions to the State of Montana for Beaverhead and Madison counties are shown in **Tables 3.10-5** and **3.10-6**, respectively.

3.10.3 Environmental Consequences

3.10.3.1 No Action Alternative

The No Action Alternative assumes that BMI would continue all of the activities approved under its current permit. The current permit would allow mining to continue through 2021 (Raffety 2019). An estimated 60 percent of the talc ore processed at BMI's mill is derived from the Regal Mine and 40 percent is derived from the Treasure Mine. Ceasing mining operations at the Regal Mine may result in reduced production at BMI's mill unless production is increased at the Treasure Mine or other talc ore reserves can be identified and mined. Direct job losses from the mine closure are estimated to be 15 to 25 employees including contract haulers.

Table 3.10-2
Beaverhead and Madison County Employment and Average Pay by Industry Sector, 2017

NAICS	Industry	Beaverhead County		Madison County	
		Employment	Annual Pay ($)	Employment	Annual Pay ($)
1011	Natural resources and mining	384	46,328	322	42,010
1012	Construction	189	34,287	185	41,220
1013	Manufacturing	62	25,562	114	29,401
1021	Trade, transportation, utilities	685	30,075	409	33,150
1022	Information	35	41,194	23	50,293
1023	Financial activities	190	50,085	126	42,144
1024	Professional and business services	127	44,035	132	35,730
1025	Education and health services	558	40,081	186	44,973
1026	Leisure and hospitality	152	17,181	1,898	36,413

Source: (USBLS 2019)

Table 3.10-3
Top Private Employers in Beaverhead County, 2017

Business Name	Type of Service	No. Employees
Barrett Hospital and Healthcare	Health Services	250–499
BMI	Mining	50–99
Safeway	Grocery	50–99
Town Pump	Gas Station and Hotel	50–99

Source: (MDLI 2019)

Table 3.10-4
Top Private Employers in Madison County, 2017

Business Name	Type of Service	No. Employees
Big Sky Resort	Leisure and hospitality	500–999
Yellowstone Club	Leisure and hospitality	250–499
A.M. Welles Inc.	Trucking-heavy hauling	50–99
Garnet USA	Mining	50–99
Ruby Valley Hospital	Health services	50–99

Source: (MDLI 2019)

Table 3.10-5
Property, School, and Other Taxes for Beaverhead County

Tax Category	5-Year Totals ($)	2018 ($)	2017 ($)	2016 ($)	2015 ($)	2014 ($)
Taxable Value	3,497,197	721,903	707,912	692,413	718,318	656,651
Total County	598,158	130,461	121,227	117,218	118,770	110,482
Total Other	65,394	13,697	13,235	12,930	13,213	12,320
Total School	1,418,933	300,550	305,393	263,435	286,566	262,989
Totals	2,082,485	444,708	439,855	393,583	418,549	385,791

Source: (Rafferty 2019)

Table 3.10-6
Property, School, and Other Taxes for Madison County

Tax Category	5-Year Totals ($	2018 ($	2017 ($	2016 ($	2015 ($	2014 ($
Taxable Value	6,589,706	1,502,408	1,405,320	1,258,212	1,222,408	1,201,358
Total County	634,765	135,232	124,455	130,414	127,448	117,217
Total Other	333,188	78,494	67,935	62,837	60,897	63,024
Total School	2,211,390	461,950	497,645	428,652	419,333	403,810
Totals	3,179,343	675,676	690,035	621,903	607,678	584,050

Source: (Rafferty 2019)

The estimated direct job losses may be less than 1 percent of the total employment in Beaverhead County. The actual economic affects to Beaverhead County may be greater because BMI's pay represents some of the highest in the County and potential losses of contract work to the mill and mine. A loss of indirect spending could result in more job losses in the service industry. Beaverhead County's population growth is slower than the state average and the loss of BMI jobs could result in a decline in population in Beaverhead County. The net effect would be reduced spending in Dillon and Beaverhead and reduced tax revenues that could impact schools and funding for city and county public services.

3.10.3.2 Proposed Action

The Proposed Action would allow the mine to operate for another 6 years beyond 2021; therefore, the jobs provided by BMI would be available for this time period. No new jobs would be created by the Proposed Action. BMI would continue to employ 15 workers at the Regal Mine site and an additional 12 jobs through the contract hauler. The Proposed Action would not have any direct negative impact to jobs or employment within Beaverhead or Madison County, and the employment rates would continue its current trend.

Direct tax revenues from BMI and through payroll taxes would be maintained under the Proposed Action and not have any negative effect on local school or government revenues. The Proposed Action would not result in additional demand and attendance in local schools and, therefore, would not cause increased spending on additional teachers or school infrastructure. The Proposed Action would not put increased demands on available housing nor would it trigger an increase in housing vacancies. With little direct effect on housing, the Proposed Action would not cause direct changes to housing and real-estate values.

Local government spending would not be significantly changed by the Proposed Action. The Proposed Action would not trigger greater demands on local water, wastewater, and transportation infrastructure. The state and county would benefit from tax revenue derived from BMI beyond 2021. Essentially, the current operations would be maintained under the Proposed Action for an additional 6 years.

3.10.3.3 WRDF Grading and Mosaic Vegetation Alternative

The only aspect of the WRDF Grading and Mosaic Vegetation Alternative that differs from the Proposed Action would occur during the WRDF reclamation. The WRDF Grading and Mosaic Vegetation Alternative reclamation would change the construction and reclamation of the WRDF and may require additional time to complete reclamation. The additional time and resources for WRDF Grading and Mosaic Vegetation Alternative reclamation would be relatively minor related to local government revenues and impacts; therefore, socioeconomic impacts of the WRDF Grading and Mosaic Vegetation Alternative would be the same as the Proposed Action.

3.11 Soils and Reclamation

This section describes the affected environment and potential impacts of the proposed mine expansion on soils and reclamation.

3.11.1 Analysis Methods

A study of soils in the mine permit boundary was originally conducted in 1995, including chemical analysis of soil samples (Hydrometrics, Inc. 1995). Soils within the Regal Mine proposed Amendment boundary were surveyed, described, and sampled in 2016 by NewFields (2016). Soils scientists traversed the Study Area on foot to identify preliminary map unit boundaries based on landform, surface soil characteristics, and occurrences of rock outcrop. Representative sites were selected for excavation and observation of soil conditions. Seven soil pits were hand-excavated to 20 to 40 inches or contact with bedrock. Two additional pits were excavated with a backhoe to expose the entire soil profile, and a tenth profile was exposed by mine-related disturbance.

Soil characteristics such as horizon designation, depth, texture, structure, coarse fragment content, effervescence, and color were described at each site. The extent of each soil type was mapped in the field on aerial photograph-based maps. Data collected during profile examinations and site reconnaissance were used to classify soil (to the extent practical), refine map unit boundaries, and assess the suitability for reclamation. Based on the historical soil chemical data, NewFields determined that the soils were chemically suitable for reclamation and additional laboratory analyses of soil samples were not conducted. Soil profiles or pedons that did not directly correlate with the soil series mapped were considered similar enough to include in the soils map based on their characteristics for reclamation. The Study Area for the soils survey and mapped soil units are shown on **Figure 3.11-1**.

3.11.2 Affected Environment

The Regal Mine is an existing open pit talc mine that has been operating since 1972. Waste rock is kept on site in the WRDF. Existing soil stockpiles are located in several places within the permit boundary, primarily between the pit and the WRDF. Existing mine facilities are described in Section 2.2 No Action Alternative: Existing Permit and shown on **Figure 2.2-1**.

The proposed pit expansion would disturb an additional 8.8 acres. An expansion of the WRDF by an additional 41.4 acres is proposed to contain future waste, although some waste and/or overburden will be used to construct talus slopes during final reclamation. A proposed topsoil stockpile is located north of the WRDF.

The general soil types, physical and chemical characteristics, and suitability for reclamation for the area encompassing the No Action Alternative and Proposed Action are described in the following text.

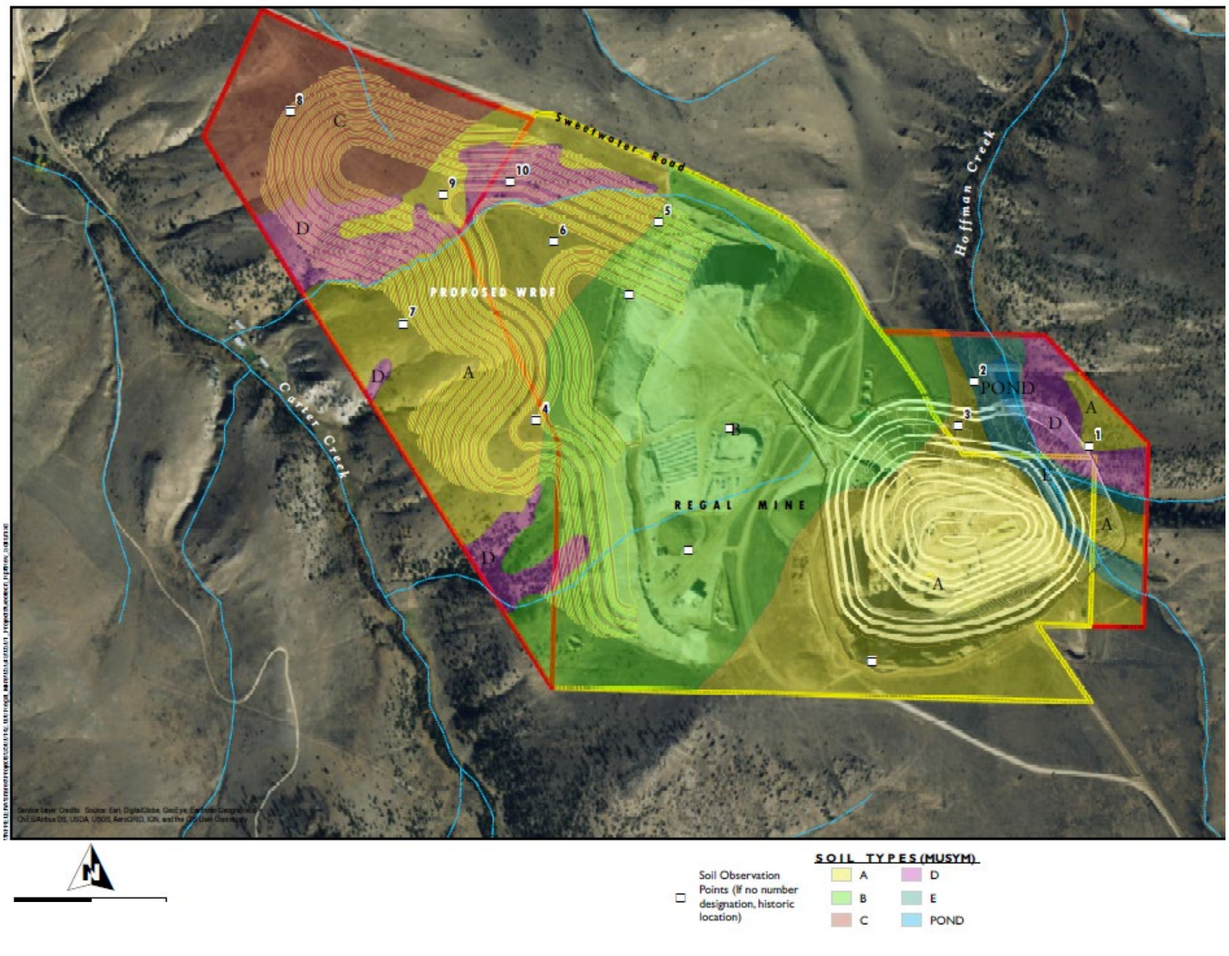

Figure 3.11-1
Soil Types Map

3.11.2.1 General Soil Types

Soils in the Study Area consist of shallow, poorly developed soils formed on steep slopes and ridges with a skeletal well-drained structure as well as well-developed loamy soils. Some of the poorly developed soils are likely to contain a large portion of coarse fragments, especially as they become shallower and will intermittently contain calcic horizons. These soil types are found on steeper hill slopes and ridges of the site. The well-developed soils are found in the valleys on the eastern proposed expansion area and in the already developed mine area. These soils are somewhat poor to poorly drained and have deeper soils profiles.

Topsoil thickness is estimated at a minimum of 5 inches for all units and can be as deep as 25 inches. The Hanson-Rock outcrop (unit A) and Oro Fino-Poin (unit B) will comprise the majority of salvaged growth medium and have topsoil thickness averaging 6 and 12 inches, respectively. Subsoil varies in thickness from 6 to 18 inches and is considered suitable growth medium.

3.11.2.2 Soils Descriptions

Soil map units identified in NewFields (2016) soil survey are described in the following text. Some map units have highly variable top and subsoil thicknesses, and other units contain areas that are largely rock outcrops.

Map Unit A: Hanson-Rock Outcrop Complex

This map unit is dominated by areas previously mapped as Whiteore-Hanson Association (Hydrometrics, Inc. 1995) where survey data indicate Haplocryolls (e.g., Hanson) are more prevalent than Calcicryepts (Whiteore). The map unit consists of primarily deep or moderately deep soil developed from calcareous alluvium and colluvium on gently sloping to steep hillslopes.

Hanson is characterized by deep loamy-skeletal profiles with mollic epipedons and calcic horizons. While surface materials typically have less than 20 percent coarse fragments, the content increases with depth and bedrock is often encountered at depths of 40 to 60 inches. A representative profile of the Hanson Series was described in the 1994 Survey Report (Hydrometrics, Inc. 1995). The most common taxadjuncts were coarse-loamy pedons with less than 35 percent coarse fragments in the subsoil.

Rock outcrops and associated shallow to moderately deep profiles occur sporadically throughout the unit. Transitional soil between rock outcrops and Hanson typically have calcic or at least very strongly calcareous horizons, indicating similarity to Hanson, but with moderate depth.

Map Unit B: Oro Fino-Poin Complex

This map unit is dominated by areas previously mapped as similar to Oro Fino-Poin-Hapgood Association (Hydrometrics, Inc. 1995). The unit consists of shallow (lithic) to deep, well-drained, fine-loamy to loamy-skeletal soil on hillslopes and ridges. The majority of this map unit was previously disturbed so mapping could not be validated; however, based on historical profile examinations, it appears that thick mollic epipedons typifying Hapgood are uncommon on the hilltops and ridges, which suggests that Oro Fino and Poin are more dominant. This finding is consistent with the Madison County Soil Survey (U.S. Department of Agriculture [USDA] 2015).

Oro Fino is characterized by deep, fine-loamy profiles with calcic and argillic horizons developed from colluvial materials. A representative profile of the Oro Fino Series was described in the 1994 Survey Report (Hydrometrics, Inc. 1995). Pedons similar to Oro Fino observed in 2016 lacked well-developed argillic horizons; this observation is supported by historical laboratory data (Table 3-2, Hydrometrics, Inc. 1995). Oro Fino does appear to be the most similar soil in the cryic temperature regime identified in the Madison County Soil Survey (USDA 2015).

Poin consists of shallow profiles (less than 20 inches to bedrock) with loamy-skeletal textures and typically occurs on ridges and hillslopes, likely in association with rock outcrops. A representative profile of the Poin Series was described in the 1994 Survey Report (Hydrometrics, Inc. 1995).

Map Unit C: Nuley-Rock Outcrop Complex

This map unit occurs in the northwestern corner of the Study Area and is generally consistent with the Madison County Soil Survey (USDA 2015). The unit is dominated by deep, well-drained, fine-loamy soil developed from colluvial materials on ridge tops and hill slopes.

Nuley is characterized by deep, fine-loamy profiles with calcic and argillic horizons. Pedons are very similar to Oro Fino (see pedon description, Hydrometrics, Inc. 1995) but do not have a cryic temperature regime because of is occurrence on lower elevations. The Nuley pedon observed in 2016 had a very weakly developed argillic horizon (potentially nonqualifying), which is similar to the 1994 Oro Fino pedon noted previously.

Rock outcrops are common in this map unit. Associated limiting shallow and moderately deep pedons likely occur in transition between rock outcrops and Nuley pedons.

Map Unit D: Rock Outcrop-Poin Complex

This map unit occurs on steep slopes adjacent to Carter Creek and Hoffman Creek drainages and is dominated by rock outcrops and associated weakly developed pedons (e.g., entisols and inceptisols) with loamy-skeletal or coarse-loamy textures. The Poin series is present on stable slopes between rock outcrops and in locations transitional to adjacent map units.

Map Unit E: Houlihan-Wetland Complex

This map unit occurs on mid- to toe-slopes and the Hoffman Creek drainage bottom in the easternmost portion of the Study Area where deep, well-drained, loamy soil transitions to deep loamy alluvial deposits with somewhat poor to poor drainage.

Houlihan is a deep, fine-loamy soil developed from colluvial and alluvial materials. In the Study Area, Houlihan occurs in depositional areas below Hanson, Oro Fino, and similar series in adjacent map units. The Houlihan series was not identified in the previous mine surveys but occurs in Madison County (USDA 2015). The partial pedon recorded at 2016 Observation Site 2 (Figure 3) is described in Table 3. Taxadjuncts and similar series are likely present in this map unit where coarse fragment content and moisture regimes are variable.

Houlihan and similar series transition to Aquolls and other hydric soil associated with wetlands in the drainage bottom adjacent to Hoffman Creek and the pond.

3.11.2.3 Suitability for Reclamation

Soil salvage depths were derived from data collected as part of the soil survey conducted by NewFields (2016). Soil salvage depths were determined in consideration of soil horizons, coarse fragment content less than 50 percent by volume on slopes less than 50 percent grade (2.0 horizontal:1.0 vertical), and depth to bedrock. Soil salvage depth would be a minimum of 20 inches. Limitations imposed by coarse fragments and bedrock will be most evident in shallow to moderately deep soils on ridges, slopes, and in incised drainages. Actual volumes of soil available for salvage would vary because of the presence of large, coarse fragments and intermittent rock outcrops within many salvage areas.

3.11.2.4 Physical and Chemical Properties

Soil physical properties indicate a soil's mineral composition and how the material may interact with water and the measured chemical characteristics. Physical properties can create complications in the reclaimed surface and are measured to avoid salvaging soils that contain deleterious properties relating to saturation percent, texture, or rock fragment content. Saturation percentage indicates water retention and can be looked at with the chemical properties to determine a soil's tendency toward unsuitability. Textural classes can indicate water availability problems that might occur during the wet or dry season. Rock fragment content would limit grass growth.

During the soil survey of the proposed expansion area ten soil pits were examined to determine soil horizon thicknesses and identify soil horizon characteristics. Horizon information was collected at each pit, including designation, depth, texture, structure, coarse fragment content, effervescence, and color, which were all used to identify the soils. Soil characteristics were described previously.

Soil samples were not collected and sent to a laboratory for analysis of soil physical or chemical properties in 2016 (NewFields 2016). Therefore, quantitative statements regarding soil chemical or physical properties of soil in the proposed expansion area cannot be made.
Soils are typically well drained with varying percentages of coarse fragments. Calcic horizons are common and the depth of the soil profiles changes with its location on topography, where

soils on steeper slopes and ridges are shallower and those near the toes or valleys are deeper. The percentage of coarse fragments increases as depth to bedrock becomes shallower.

3.11.2.5 Prime and Unique Farmland

Prime farmland and unique farmland are not located within the project boundary.

3.11.3 Environmental Consequences

This section evaluates the potential effects of the Proposed Action and alternatives on the soils that may influence the effectiveness of soil salvage or use of a soil for reclamation purposes. The two primary factors influencing the salvage and reclamation potential of soils are slope and coarse fragment content. Soil texture and calcic horizons are less influential considerations.

3.11.3.1 No Action Alternative

The No Action Alternative has no effect on undisturbed soil within the expansion area. Impacts to native soils include soil salvage and stockpiling ahead of construction and mineral extraction. Current permits allow for mining and, thus, soil salvage and stockpiling, through mine closure. At that time, closure and reclamation would occur and existing soil stockpiles would be used for reclamation. The mine site has an estimated 287,155 yd^3 of soil stored in current stockpiles. A summary of the No Action Alternative reclamation plan is in Section 2.2.10 Reclamation.

3.11.3.2 Proposed Action

Impacts to the native soils include soil salvage and stockpiling ahead of construction and extraction activities and potential erosion and/or compaction of soil during and after mining activities. The Proposed Action would increase the total open pit by 8.8 acres, the size of the WRDF would increase by 41.4 acres with 10 acres of disturbance associated with ancillary water management features.

Reclamation of the Regal Mine and associated facilities would follow the consolidated reclamation plan accepted by DEQ in Amendment 004 of OP No. 00013. A summary of the Proposed Action reclamation plan is in Section 2.3.11 Reclamation. Differences to reclamation between the No Action Alternative and the Proposed Action would include the following:

- Soils would be stripped from the expanded areas of the pit, WRDF, and water management infrastructure areas (approximately 60.2 acres of additional disturbance).
- Where concurrent reclamation of disturbances does not occur, soils will be stockpiled in an area of approximately 5.2 acres.
- Reclamation of the lowermost lifts of the WRDF during the first season would be followed by completing the stripping for the pit layback.

- Concurrent reclamation would include growth medium placement and seeding after grading and sloping of each lift in the WRDF.
- Removal and reclamation of newly permitted facilities (including Regal Pit, SED-1, IF-3, dewatering wells, storm water system) would occur within 2 years after mining ceases.
- Removal and reclamation of infrastructure (IF-1, UIC well, SP-1) used for infiltration of dewatering water to deliver water to Hoffman and Carter creek alluvium during operations would occur after 5 years of active dewatering and mining operations cease or until sufficient flow information is gathered to support their removal.
- A 27-acre pit lake is to remain in perpetuity after completion of reclamation.

Suitable soil would be salvaged from all Proposed Action disturbance areas with slopes less than 50 percent grade. A minimum of 20 inches of soil would be salvaged, with the upper foot stockpiled separately from the subsoil as feasible. Total volume of soil or growth media material available by location or activity are provided in **Table 3.11-1**. The mine site has an estimated 287,155 yd^3 of soil stored in the stockpiles and an additional 274,508 yd^3 of soil are yet to be salvaged from remaining disturbance areas under Amendment 005 and the Proposed Action Amendment 006 (BMI 2019a). The total available suitable growth medium from existing and new stockpiles would be approximately 561,663 yd^3 (**Table 3.11-1**).

Table 3.11-1
Volume of Soil Available for Reclamation (BMI 2019a)

Soil Source Location	Area (acres)	Salvaged Thickness (inches)	Volume Available (yd^3)
Open pit expansion and Hoffman Spring Creek channel realignment	8.8	20	23,567
WRDF expansion	41.4	20	110,875
Ancillary disturbances (e.g., infiltration galleries, sedimentation pond, pipelines, desilting basins)	10	20	26,781
WRDF remaining permitted disturbance	42.3	20	113,285
Total volume from Proposed Amendment 006 and remaining under Amendment 005			274,508
Existing stockpiles			287,155
Total Available			**561,663**

Growth media from direct haul and place or from stockpiles would be replaced in 24-inch thickness in all areas of disturbance of less than 50 percent grade and in 12-inch thicknesses for all areas of disturbance greater than 50 percent grade. **Table 3.11-2** summarizes the volume of soil that is required to meet reclamation goals. Approximately 410,940 yd^3 of soil are needed for reclamation. Based on the available soil volume, an excess of soil should be available on site. Final reclamation contours and growth media placement are shown on **Figure 3.11-2**.

Table 3.11-2
Volume of Soil Required for Reclamation (BMI 2019a)

Mine Facility	Area (acres)	Replacement Thickness (inches)	Volume Required (yd^3)
WRDF Flat Surfaces	52.9	24	170,690
WRDF Slopes	88.7	12	143,102
Open Pit Accessible Benches	3.5	24	11,293
Haul Road	3.4	24	10,970
Ancillary Facilities	16.7	24	53,885
Ore Transfer Site	6.5	24	21,000
Total Required			**410,940**

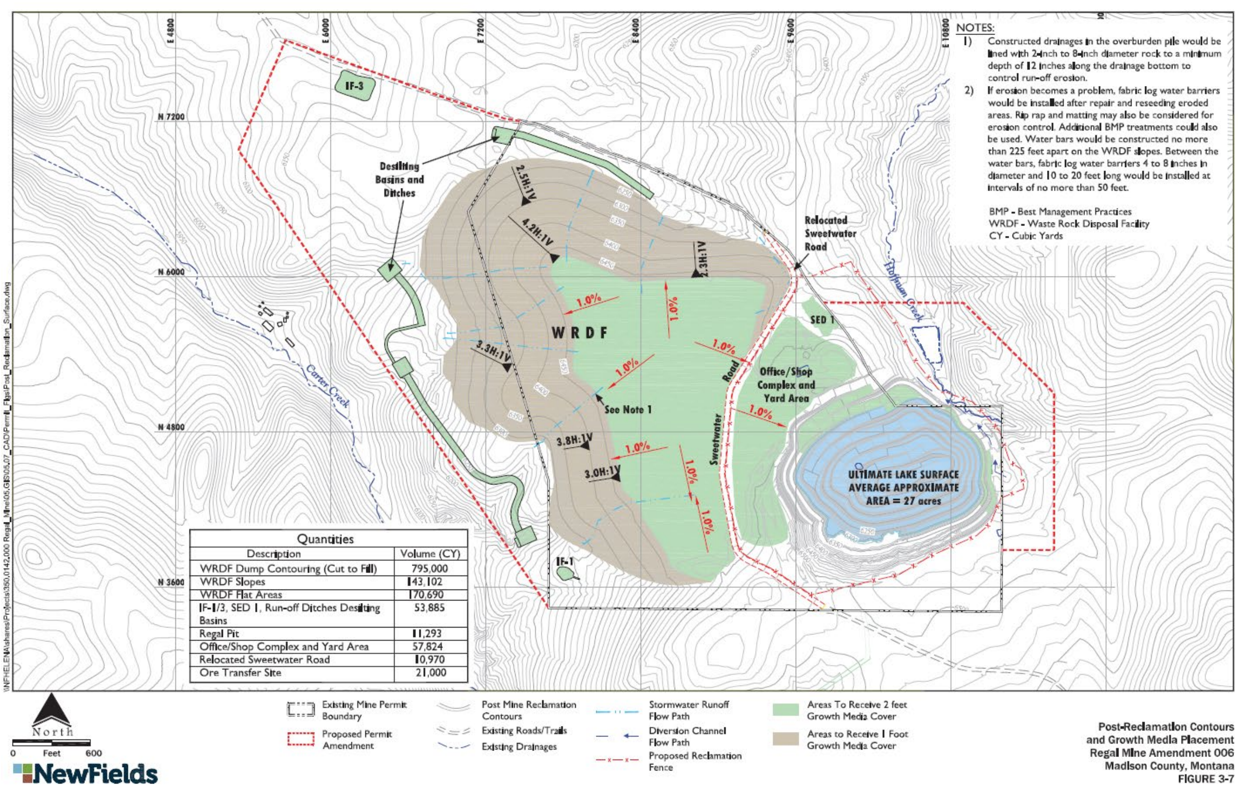

Figure 3.11-2
Final Reclamation Contours and Growth Media Placement

Final reclamation is identified for newly permitted facilities; however, interim reclamation of construction activity associated with their instillation is not described in the Amendment Application. If soil replacement or in situ amelioration followed by seeding of disturbed areas during these activities does not occur, the facilities and immediately surrounding areas would be subject to erosion. Where these activities occur on steep slopes, such as Desilting Basins 1, 2 and 3, the potential for erosion is greater. Road construction for installing these ancillary facilities is not identified in the Amendment Application. Overland travel of heavy equipment would compact and degrade the quality of native soil and limit its capacity to support vegetation. If overland travel is widespread and dispersed, damage to the soils and vegetation would occur.

Soil erosion from wind and water may occur during construction and reclamation of disturbed areas until vegetation has been reestablished. All stockpiled soil would be susceptible to erosion; BMI would continue its process of interim seeding stockpiles to minimize water and wind erosion until the soil is needed for reclamation (BMI 2019a).

The WRDF, safety berms around the pit, and other disturbed areas would be covered with growth media and seeded with the approved seed mix. Seeding would be conducted following seedbed preparation to establish a vegetation cover and assist in preventing wind and water erosion. In the Amendment Application, BMI indicated that drill seeding would be used on low slope areas and broadcast seeding would be applied in steep slope or limited access areas (BMI 2019a). After seeding, revegetated areas would be inspected and if problem areas are identified, additional correction measures would be implemented as appropriate, including the following:

- Fertilization
- Reseeding
- Irrigation
- Placement of additional growth media
- Water bars and fabric log water barriers
- Riprap
- Matting
- Mulching
- Weed-free straw bales
- Sediment fences

In addition to vegetation, the WRDF would be reclaimed using diversion channels that would be designed to collect and divert runoff. Constructed drainages in the WRDF would be designed to pass the 100-year/24-hour event and would be lined with 2-inch- to 8-inch-diameter rock to a minimum depth of 12 inches along the drainage bottom to control runoff erosion (BMI 2019a).

Storm water collection channels would remain in place until a self-sustaining vegetation cover is growing on the WRDF. Soil trapped in the runoff control facilities (ditches and sediment ponds) during project operations would be recovered and returned for use in reclamation (BMI 2019a). These best management practices (BMPs), in combination with coarse fragments in the soil, would limit erosion from the reclaimed surface in areas where vegetation is not well established.

3.11.3.3 WRDF Grading and Mosaic Vegetation Alternative

The WRDF Grading and Mosaic Vegetation Alternative would require additional suitable growth material compared to the Proposed Action. The amounts would be more than the Proposed Action but are not expected to exceed the soil amounts estimated to be available on site. According to the Amendment Application, the WRDF Grading and Mosaic Vegetation Alternative would require approximately 150,000 cubic yards of excess soil beyond what is needed for the Proposed Action reclamation plan (BMI 2019a). Soil replacement depths under the Proposed Action are 12 inches along the slopes of the WRDF. Under the AMA, the minimum soil replacement depth on the slopes of the WRDF would still be 12 inches; however, the excess soil would be used to increase the topsoil thickness up to 24 inches in places.

3.12 Vegetation

This section describes the vegetation and ecological conditions within and proximal to the 137-acre proposed expansion area (hereafter referred to as the Study Area) associated with the WRDF (106 acres) and pit layback (31 acres). The baseline vegetation mapping completed in 1994 and updated in 2016 is used to quantify potential impacts of the alternatives to the vegetation resources in the area.

3.12.1 Analysis Methods

Vegetation communities within and proximal (within a 0.25-mile radius) to the Amendment 006 boundary Study Area were first identified and mapped in 1994 (Elliot 1994) and verified during biological reconnaissance surveys in 2016 (Colescott and Pfister 2016). During the 2016 reconnaissance, a rare plant survey was conducted and Montana State-listed- and county-listed-introduced (i.e., nonnative), invasive, and noxious plant species were documented. This EIS relies on the data collected during the 1994 and 2016 surveys and electronic searches of the Montana Natural Heritage Program (MTNHP) database. Survey methods described in this section are generally from the 2016 biological reconnaissance (Colescott and Pfister 2016).

During the 2016 field survey, the boundaries of each previously mapped vegetative community were reviewed and checked for accuracy. Because of the natural transitional area between plant community types, previously mapped boundaries were considered accurate if the dominant plants from each community were present and the boundaries occurred within the transitional area. Dominant plants for each community type were recorded based on an ocular survey of representative areas within each community. Changes made in community type boundaries were drawn onto field maps and then digitally edited to reflect conditions on the ground (Colescott and Pfister 2016).

3.12.1.1 Special-Status Plant Species

Special-status plant species include those listed under the Endangered Species Act (ESA) as threatened and endangered (TES) by the U.S. Fish and Wildlife Service and Species of Concern (SOC) that are tracked by MTNHP. The SOCs represent plants and animals that are rare or have declining populations and, as a result, are potentially at risk of becoming federally listed as threatened or endangered or are at risk of extinction in Montana. Special-status plant species that are not federally listed as TES are not offered the same regulatory protection as TES species, but designation as a SOC provides resource managers and decision-makers the information needed to make informed, proactive decisions regarding species conservation.

The rare plant survey methodology used in 2016 generally followed the protocol described in General Rare Plant Survey Guidelines (Cypher 2002). Before initiating field surveys, a query of the MTNHP database was requested for Madison and Beaverhead counties, as well as for the area within 5 miles of the Study Area. All special-status plant occurrence records within these areas were reviewed for species occurring on or within close proximity of the Study Area. Records were also reviewed to determine habitat requirements and elevational range of each species to establish the potential (low, moderate, high) for each species to occur in the Study Area. The species with a moderate or high potential to occur were considered target rare plant species. The field surveys were designed to target suitable habitat for these species.

The blooming period for the target species was also researched to establish the survey window that was most likely to observe the rare plants in bloom. Because the site is mid-elevation, a survey window in early July (the middle of most documented blooming periods) was chosen. A single visit rare plant survey was conducted by walking meandering transects through all plant communities on the site, with a focus on areas with the highest likelihood to support rare plants (e.g., gravelly ridges). Plants were keyed to a taxonomic level sufficient to confirm their rarity status and recorded following the nomenclature presented in the "Manual of Montana Vascular Plants" (Lesica *et al.* 2012). Unknown plants were collected and later verified by a senior level botanist.

3.12.1.2 Noxious Weeds

Before conducting the 2016 field survey, NewFields searched the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) website for the list of Montana State-listed-introduced, invasive, and noxious plant species (i.e., noxious weeds). Weed lists for Beaverhead and Madison counties were also reviewed to identify any county-listed species. Observed noxious weeds were recorded and larger infestations were noted on field maps.

3.12.2 Affected Environment

The Study Area is located in a rural landscape located 11 miles southeast of Dillon, Montana. Land use in the area includes ranching and mining. The elevation within the Study Area ranges from about 5,970 to 6,360 feet above mean sea level. The topography is hilly with the southern portion of the Study Area draining south into Carter Creek and the northern portion draining northward to Hoffman Creek. The site is dominated by dry grassland/foothill sagebrush vegetation, with riparian and wetland vegetation adjacent to the two perennial creeks. Vegetative communities were first mapped in 1994 (Elliot 1994) and again in 2016 (Colescott and Pfister 2016). Summaries within this section are excerpted from the Colescott and Pfister (2016) biological reconnaissance survey.

3.12.2.1 Vegetation Communities

The seven vegetation communities documented in the Study Area (excluding existing mine disturbance) and corresponding dominant species are as follows:

- ***Artemisia nova/Festuca idahoensis***: This plant community occupies 106 acres within the Study Area and occurs in the dry, well-drained grassland closest to the existing mine and the waste rock pile. Dominant species include dwarf sage (*Artemisia nova*), Idaho fescue (*Festuca idahoensis*), big sagebrush (*Artemisia tridentate*), bluebunch wheatgrass (*Agropyron spicatum*), junegrass (*Koeleria macrantha*), Sandberg's bluegrass (*Poa secunda*), rubber rabbitbrush (*Chrysothamnus nauseosus*), hood's phlox (*Phlox hoodii*), flax (*Linum lewisii*), prickly-pear cactus (*Opuntia polycantha*), and pussy-toes (*Antennaria microphylla*).
- ***Artemisia tridentate/Festuca idahoensis***: This plant community occupies 210 acres within the Study Area and is similar to the *Artemisia nova/Festuca idahoensis* community but with more juniper and big sagebrush. Dominant species include big sagebrush, Idaho fescue, bluebunch wheatgrass, rubber rabbitbrush, pussy-toes, twin arnica (*Arnica angustifolium*), fringed sagewort (*Artemisia frigida*), Rocky Mountain juniper (*Juniperis scopulorum*), and wavy gold-aster (*Heterotheca villosa*).
- ***Elymus cinereus/Poa pratensis***: This community occupies 17 acres within the Study Area and occurs in much less abundance as small islands and near drainages or swales dominated by the robust Great Basin wildrye. Dominant species include Great Basin wildrye (*Elymus cinereus*), Kentucky bluegrass (*Poa pratensis*), bluebunch wheatgrass, and silver sage (*Artemisia cana*).
- ***Cercocarpus ledifolius/Agropyron spicatum***: This community occupies 17 acres within the Study Area. Bare ground under and between the dominant curl-leaf mountain mahogany is also a prevalent feature of this plant community. Dominant species include curl-leaf mountain mahogany (*Cerocarpus ledifolius*), bluebunch wheatgrass, needle and thread (*Stipa comata*), peppergrass (*Lepiduium densiflorum*), Rocky Mountain juniper, and Indian ricegrass (*Oryzopsis hymenoides*).
- ***Pinus flexilis/Agropyron spicatum***: This community occupies 185 acres within the Study Area and occurs on ridges and other areas with thin soil. Bare ground is also prevalent in this community. Dominant species include limber pine (*Pinus flexilis*), Rocky Mountain juniper, bluebunch wheatgrass, peppergrass, silvery-leaf lupine (*Lupinus argenteus*), needle and thread, Sandberg's bluegrass, Junegrass, fringed sagewort, big sage, and prickly-pear cactus.
- ***Salix/Carex***: This community occupies 24 acres within the Study Area and occurs along the two perennial streams (i.e., Carter and Hoffman creeks) and in frequently flooded or saturated riparian settings. Dominant species include Bebb's willow (*Salix bebbiana*), Booth's willow (*Salix boothii*), water birch (*Betula occidentalis*), beaked sedge (*Carex rostrata*), aquatic sedge (*Carex aquatilis*), Douglas' sedge (*Carex douglasii*), small-headed sedge (*Carex illota*), hard-stem club-rush (*Schoenoplectus acutus*), meadow foxtail (*Alopecurus pratensis*), and fowl mannagrass.

- ***Festuca idahoensis/Agropyron spicatum***: This community occupies 115 acres within the Study Area and is in a heavily grazed area north of Sweetwater Road. The grasses are reduced and the sage and juniper are encroaching. Dominant species include Idaho fescue, bluebunch wheatgrass, pussy-toes, Junegrass, Sandberg's bluegrass, Rocky Mountain Juniper, silver sagebrush, big sagebrush, and rubber rabbitbrush.

Unvegetated areas associated with the existing mine disturbance total 166 acres within the Study Area. The boundaries of the seven vegetation communities and the existing unvegetated area associated with the mine are shown on **Figure 3.12-1**.

3.12.2.2 Special-Status Plant Species

Based on an updated review of MTNHP's county data across Beaverhead and Madison counties to support the proposed Amendment, 96 plant SOC were identified in this two-county area surrounding the Regal Mine site. This updated inventory identifies the range of possible special-status species present in this two-county area, each species' global and state rank, and whether or not it is classified as sensitive by the U.S. Forest Service or BLM. Special-status plant species include state SOC, BLM sensitive species, and candidate species or listed species under ESA. The inventory also provides the number of occurrences and range throughout Montana and assesses the potential for these species to occur on or near the Regal Mine area based on habitat descriptions (BMI 2019a).

A summary of plant SOC and their potential to occur in the Regal Mine area is provided in the Amendment 006 application (BMI 2019a). Of the 99 species reviewed, 6 species have a high potential to occur on or near the Regal Mine area because suitable habitat appears to be present: Railhead milkvetch (*Astragalus terminalis*), Hooker's balsamroot (*Balsamorhiza hookeri*), Sapphire rockcress, Parr's fleabane (*Erigeron parryi*), Mat buckwheat (*Eriogonum caespitosum*), and Lemhi beardtongue. Twenty-five sensitive plant species have a moderate potential to occur on or near to the Regal Mine site with marginal habitat being present, and the remaining 68 species have a low potential to occur on or near the Regal Mine site because of lacking suitable habitat. Based on a June 2016 request, MTNHP records revealed no known occurrences of rare, threatened, endangered, or sensitive plants present on or within 5 miles of the Regal Mine site.

A rare plant survey was conducted on June 13–15, 2016, to coincide with the blooming period of most plants of interest (NewFields 2016). The main purpose of this survey was to document the occurrence of any plant SOC that have a moderate or high potential to occur in the Study Area. The survey did not identify any plant SOC with a moderate or high potential to occur within or proximal to the Study Area.

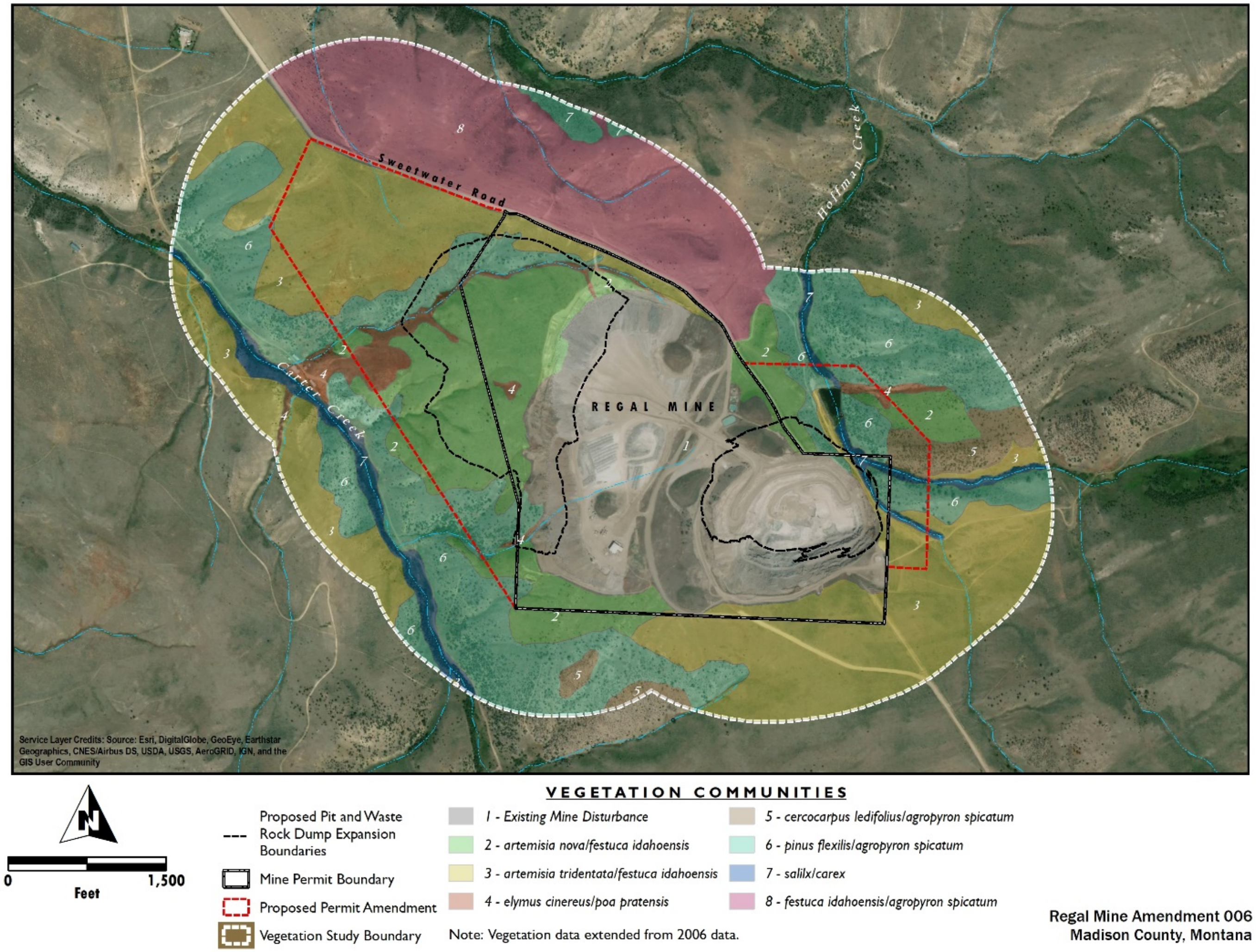

Figure 3.12-1
Vegetation Communities

3.12.2.3 Noxious Weeds

Several plant species designated as noxious weeds under the County Noxious Weed Control Act (7-22- 2101(5), *et seq.,* Montana Code Annotated) and under the specific Noxious Weed Lists for Beaverhead and Madison counties have been previously documented at the Regal Mine site and vicinity (RMA 2006). These plant species include Canada thistle (*Cirsium arvense*), spotted knapweed (*Centaurea maculosa*), hound's tongue (Cynoglossum officinale), musk thistle (*Carduus nutans*), and field scabious (*Knautia arvensis*). During 2016 field activities, pockets of Canada thistle and hound's tongue in particular were observed in areas with relatively heavier human impact and/or heavier grazing activities. A small amount of field scabious was also noted throughout the general area (NewFields 2016).

3.12.3 Environmental Consequences

Amendment 006 would result in expanding the existing mine pit and WRDF and would include various ancillary facilities in support of mining operations. A majority of the pit and waste rock facilities would be expanded into areas currently comprising native vegetation communities that are used for grazing and wildlife habitat. Postmine use of the mine site, following proposed reclamation, would consist of wildlife habitat, agriculture, and livestock grazing. This section is focused on vegetation impacts as a result of the amended permit and reclamation plans following the mine's life.

3.12.3.1 No Action Alternative

Under the No Action Alternative, the permit amendment would not be approved and ongoing land uses would continue. Impacts to vegetation directly related to the proposed Amendment would not occur under this alternative. Noxious weeds at the Regal Mine would continue to be controlled according to the Regal Mine noxious weed control management plan and the Madison County noxious weed control plan. Revegetation would occur under the current approved reclamation plan after current mining operations cease.

3.12.3.2 Proposed Action

Under the Proposed Action, the total permitted area would increase by 136.9 acres for a total of 380.1 acres. The disturbance area would increase by 60.2 acres for a total of 250.1 acres of disturbance in the mine permit boundary. **Table 2.3-1** shows the current and proposed disturbance associated with the various mine components. A majority (41.4 acres) of the proposed Amendment disturbance would be associated with the WRDF, while 8.8 acres would be associated with the open pit expansion and 10.0 acres associated with ancillary disturbances, such as infiltration galleries (i.e., IF-3), SED-1, new wells, pipelines, runoff ditches, and desilting basins. BMI does not plan to build an access road to these ancillary features and would likely access these sites via overland travel, which would have additional temporary impacts to vegetation.

Five of the seven identified plant communities and existing unvegetated areas in the proposed expansion area would be disturbed under the Proposed Action (**Table 3.12-1**). Plant community #2 – *Artemisia nova*/*Festuca idahoensis* would receive the largest area of disturbance (32.3 acres) because it is the primary plant community associated with the expanded WRDF. Plant community #6 – *Pinus Flexis*/*Agropyron spicatum*, also common in the vicinity of the WRDF, would receive the second highest level of disturbance (13.7 acres). Disturbance levels for all other plant communities would be 6.0 acres or less for each community.

Table 3.12-1
Plant Communities Within the Proposed Permit Area and 0.25-Mile Buffer

Plant Community		Acres Within Proposed Permit Area and 0.25-Mile Buffer	Acres of New Disturbance
1	*Unvegetated area (mine disturbance)*	166	2.8
2	*Artemisia nova/Festuca idahoensis* Community	106	32.3
3	*Artemisia tridentata/Festuca idahoensis* Community	210	5.8
4	*Elymus cinereus/Poa pratensis* Community	17	3.7
5	*Cerocarpus ledifolius/Agropyron spicatum* Community	17	0
6	*Pinus flexilis/Agropyron spicatum* Community	185	13.7
7	*Salix/Carex* (Wetland/Riparian) Community	24	1.2
8	Festuca idahoenis/Agropyron spicatum Community	115	0
Total		840	59.5

Before mining disturbance within various plant communities, BMI would strip and stockpile suitable growth media for future use in reclamation activities across the Project area. Anticipated growth media salvage depth in the area of disturbance associated with the proposed Amendment would be a minimum of 20 inches based on the results of the 2016 soil survey. Soil salvage piles would be seeded and allowed to establish plant cover in the short term to prevent noxious weed establishment as well as wind and water erosion.

Reclamation

After mining activities are completed, mine equipment and facilities would be removed and disturbed land would be reclaimed and revegetated. Revegetation would consist of drill-and-broadcast seeding of a specified seed mix following growth media placement. The objective of revegetation at the Regal Mine is to establish a self-sustaining cover of native vegetation with minimum erosion within 2 years of seeding.

In accordance with the requirements of the OP No. 00013, test plots would be established on a variety of slopes and aspects to determine which plant communities may be sustainable with the approved seed mix and if modification in the seed mix is required. Before placing growth media and seeding, compacted surfaces would be scarified or ripped using a dozer. Postmine use of the mine site (i.e., following proposed reclamation and once grass has become established across the site) would consist of wildlife habitat, agriculture, and livestock grazing. The only area within the permit boundary that would not be reclaimed to an upland grass community is the 27-acre pit lake.

Noxious Weeds

Noxious weeds at the Regal Mine would continue to be controlled according to the Regal Mine noxious weed control management plan and the Madison County noxious weed control plan. Weed control would follow the same protocols under the No Action Alternative and Proposed Action.

Special-Status Plants

The Study Area was surveyed for special-status plant species in 2016 during the active growing season. The survey did not identify any plant SOC with a moderate or high potential to occur within or proximal to the Study Area. Additionally, the MTNHP database has no records of special-status species within a 5-mile radius of the Study Area. The proposed Amendment and ongoing mining operations are not expected to have any impacts to special-status plant species.

3.12.3.3 WRDF Grading and Mosaic Vegetation Alternative

The WRDF Grading and Mosaic Vegetation Alternative would create a more natural-looking landform across the WRDF, with various swales, drainages, and ridges that would better mimic the surrounding natural landscape. As a result, vegetation establishment across the WRDF under the WRDF Grading and Mosaic Vegetation Alternative would be more diverse in species composition and structure than under the Proposed Action. Under the Proposed Action, reclaimed slopes across the WRDF would be planar and smooth and likely develop a monotypic stand of seeded grasses with little or no vegetative diversity across the site. The WRDF Grading and Mosaic Vegetation Alternative would create microhabitats and niches where different grass and forb communities, as well as shrubs and trees, could establish over time. Swales, drainages, and ridges proposed with the WRDF Grading and Mosaic Vegetation Alternative may be more difficult to seed. Noxious weeds may also be more difficult to treat than they would be under the current Proposed Action because of the rougher terrain. Other impacts to vegetation associated with the mine pit and other disturbances would be similar to the Proposed Action.

3.13 WETLANDS

This section describes the wetland resources within and proximal to the 137-acre proposed expansion area associated with the WRDF (106 acres) and pit layback and associated Hoffman Spring Creek realignment (31 acres). The wetland survey completed by Hydrometrics, Inc. (2015b) is used to quantify potential impacts of the alternatives to the wetland resources in the area.

3.13.1 Analysis Methods

For planning purposes, wetland resources in the Hoffman Creek drainage and unnamed drainages below the Regal Mine waste dump were first mapped in 2014 by Hydrometrics, Inc. (2015b). Following an Approved Jurisdictional Determination by the USACE, Hydrometrics completed a formal wetland delineation (Hydrometrics, Inc. 2015b) to verify the extent of jurisdictional Waters of the US (WUS) along upper Hoffman Creek; a man-made pond in the Hoffman Creek drainage; and Hoffman Spring Creek, which is a small tributary that occurs within the proposed Regal Mine pit expansion area. The USACE determined in their Jurisdictional Determination letter dated July 13, 2015, that all of the wetlands in the Hoffman Creek and Hoffman Spring Creek drainages are jurisdictional and subject to Section 404 regulations.

Methods used to complete the 2015 wetland delineation are provided in detail in the wetland delineation report for the Regal Mine expansion (Hydrometrics, Inc. 2015b) and summarized in this section. Before the field delineation was completed, a review was conducted of the aerial photographs of the Study Area, U.S. Fish & Wildlife Service (USFWS) National Wetland Inventory (NWI) maps (USFWS 2010) for the Project area, and NRCS soils mapping (USDA 2015).

Wetland delineation fieldwork was completed September 13, 2015. Wetland evaluation and documentation was conducted according to USACE "Wetland Delineation Manual" procedures (Environmental Laboratory 1987) and the USACE "Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region" (USACE 2010). Delineation sites were temporarily flagged and surveyed using a hand-held survey-grade global positioning survey instrument. Indicator status for identified wetland plant species followed the USACE 2014 regional wetland plant list (Lichvar *et al.* 2014).

Under the authority of Section 404 of the Clean Water Act, USACE permits are required for discharging fill material into WUS. WUS include the area below the ordinary high water mark of stream channels and lakes or ponds connected to the tributary system in addition to wetlands adjacent to these waters. Isolated waters and wetlands, as well as man-made channels and ditches, may be WUS in certain circumstances and must be determined on a case-by-case basis. The USACE reviews wetland surveys and makes a determination as to whether or not a wetland or waterway is connected to or influenced by a WUS. Wetland and other WUS impacts associated with proposed activities under Amendment 006 were determined by overlaying wetland boundaries on proposed plan drawings. Wetland impacts associated with proposed mine-expansion activities are detailed in Section 3.13.3, Environmental Consequences.

3.13.2 Affected Environment

The 2014 wetland survey mapped wetland habitat along Hoffman Creek from the headwaters to approximately the Beaverhead County line and also along Carter Creek and five unnamed ephemeral drainages upgradient of Carter Creek. The 2015 wetland survey focused on wetland habitat along Hoffman Creek and Hoffman Spring Creek, because these areas are within the proposed mine pit expansion area. The following text from the Regal Mine pit expansion permit application (BMI 2019a) summarizes wetland habitat mapped during both delineations. The results of wetland delineation within the permit area are illustrated on **Figure 3.13-1**. The Regal Mine pit expansion area wetland delineation identified 5.02 acres of riparian NWI habitat in the Hoffman Creek Study Area, of which 1.98 acres met USACE jurisdictional wetland criteria. The man-made pond on upper Hoffman Creek comprises 0.87 acre of nonwetland riparian NWI habitat.

3.13.2.1 Hoffman Creek

The wetland surveys confirmed that Hoffman Creek surface water flow ends near the Beaverhead County line (northwest of the Regal Mine) with subsurface riparian influence extending approximately 0.25 mile downgradient to the site of a decommissioned impoundment (breached dike) in Section 21 of Township 7 South, Range 7 West located several miles northwest of the Regal Mine. Beyond this point, Lower Hoffman Creek was observed to be a dry drainage with no sign of flow. Flow in upper Hoffman Creek, including upstream (southeast) from the decommissioned impoundment (i.e., breached dike) past the Regal Pit to the headwaters, is primarily surface water with a variable 12- to 24-inch-wide stream channel, although some short segments exhibited no-surface flow.

The wetland delineations generally confirmed USFWS NWI mapping of wetland habitat in the Hoffman Creek drainage. In upper Hoffman Creek, wetlands were documented within a narrow riparian system that extends past the Regal Mine northwest to the decommissioned impoundment in Section 21 of Township 7 South, Range 7 West. In and around the existing mine pit and area that is proposed for pit expansion, the survey noted Hoffman Spring Creek (a tributary of upper Hoffman Creek) is a spring-fed drainage with a discontinuous channel carrying intermittent flow that is subsurface before the confluence with Hoffman Creek.

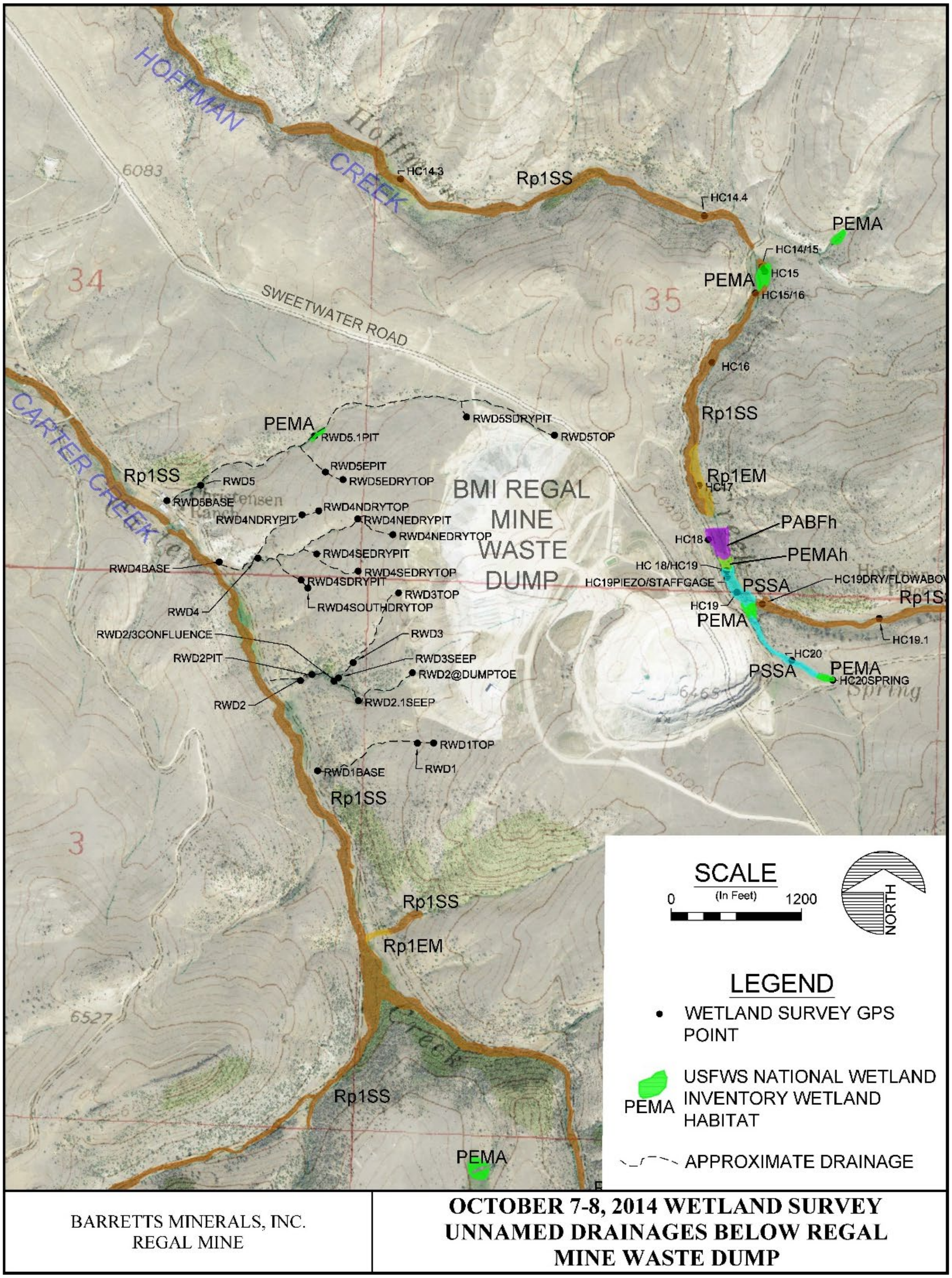

Figure 3.13-1
Wetland Survey (Hydrometrics, Inc. 2015b)

Riparian Scrub-Shrub habitat comprises much of the upper Hoffman Creek drainage, including vegetation in and around Hoffman Spring Creek. The riparian vegetation community is dominated by Rocky Mountain juniper (*Juniperus scopulorum*), water birch (*Betula occidentalis*), quaking aspen (*Populus tremuloides*), red-twig dogwood (*Cornus sericea*), currant (*Ribes aureum*), Booth's willow (*Salix boothii*), Bebb's willow (*Salix bebbiana*), Kentucky bluegrass, Nebraska sedge (*Carex nebrascensis*), beaked sedge (*Carex rostrata*), meadow foxtail (*Alopecurus pratensis*), and redtop (*Agrostis stolonifera*).

The survey also noted a man-made impoundment on upper Hoffman Creek (near the pit expansion) that created a ponded area of approximately 0.9 acres, including Palustrine Emergent habitat. Riparian vegetation communities in this locale are dominated by Nebraska sedge, beaked sedge, meadow foxtail, and redtop.

3.13.2.2 Carter Creek and Unnamed Drainages Below the Waste Rock Disposal Area

A series of five unnamed ephemeral drainages were inspected on October 7–8, 2014, between the existing WRDF and Carter Creek (Hydrometrics, Inc. 2015b). Inspection of these five drainages did not identify any continuous surface water flow, direct connection via surface water flow, and apparent subsurface riparian influence in Carter Creek. Drainages are generally composed of upland vegetation communities with no visual evidence of stream/overland water flow or developed channels. The survey confirmed NWI mapping of one isolated wetland segment of Palustrine Emergent wetland habitat and also identified five additional small isolated wetlands in four drainages that were all observed to be associated with spring/seep occurrences on steep drainage slopes. Seeps appear to be associated with shallow structural elements and not the classical perched ground water system. These seeps generally flow caused by runoff and meteoric water infiltration. Seeps tend to be present after snowmelt/precipitation events and are generally evidenced by different vegetation communities during the latter part of the year.

All isolated wetlands within the Carter Creek drainage are located outside of the proposed limits of disturbance for the expanded WRDF boundary. To protect these isolated wetlands, infiltration basin IF-1 would continue to be used to infiltrate noncontact ground water into the shallow ground water system.

3.13.3 Environmental Consequences

3.13.3.1 No Action Alternative

Under the No Action Alternative, the permit amendment would not be approved and ongoing land uses would continue. Impacts to wetlands directly related to the proposed Amendment would not occur under this alternative.

3.13.3.2 Proposed Action

The Proposed Action would impact approximately 0.72 acre of the delineated wetlands that meet USACE jurisdictional criteria and remove an existing 0.87 acre man-made pond. Approximately 730 linear feet of the Hoffman Spring Creek channel and 600 linear feet of the Hoffman Creek channel would also be impacted.

Hoffman Creek and Hoffman Spring Creek

A portion of the existing upper Hoffman Spring Creek channel (i.e., 730 linear feet) and associated riparian and wetland habitat within the proposed Regal Mine pit expansion area would be impacted by pit expansion activities. Palustrine scrub-shrub wetland impacts in this area would total 0.31 acre. An additional 0.07 acre of Palustrine scrub-shrub wetland impact would occur as a result of constructing the new upper Hoffman Spring Creek channel, catchment basin, and cut off wall for a total of 0.38 acre of wetland impact.

In addition to the upper portion of Hoffman Spring Creek channel that would be impacted by the mine pit expansion described previously, lower Hoffman Spring Creek and Hoffman Creek at the confluence of the two drainages would also be impacted by constructing the new Hoffman Spring Creek channel (0.07 acre) and expanding the mine pit (0.27 acre). The total wetland impacts in this area would be 0.34 acre.

In summary, the Proposed Action would require filling a total of approximately 0.72 acre (31,360 square feet) of the delineated wetlands that meet jurisdictional criteria. This total disturbance or impacted area is shown on **Figure 3.13-2**. Of this total, 0.14 acre of wetlands would be impacted caused by constructing the new realigned Hoffman Spring Creek channel, and 0.58 acre would be impacted caused by expanding the mine pit (including safety bench, berm, and access road).

In addition to the impacted wetland areas described previously, the following drainage channel lengths would be affected by the proposed project (**Figure 3.13-2**):

- 600 linear feet of Hoffman Creek channel would be modified; channel consolidation would seal the channel to prevent surface water from infiltrating into the shallow alluvial aquifer. The affected area totals 0.03 acre (1,200 square feet) assuming an average channel width of 2 feet. The work would be limited to the existing channel and would not disturb any vegetation outside the channel.
- 730 linear feet of Hoffman Spring Creek channel would be removed caused by constructing the catchment basin, realigning the uppermost Hoffman Spring Creek channel, and expanding mine pit (including safety bench, berm, and access road). This channel would be replaced by approximately 620 linear feet of a new engineered diversion channel that would join Hoffman Creek near the current confluence.

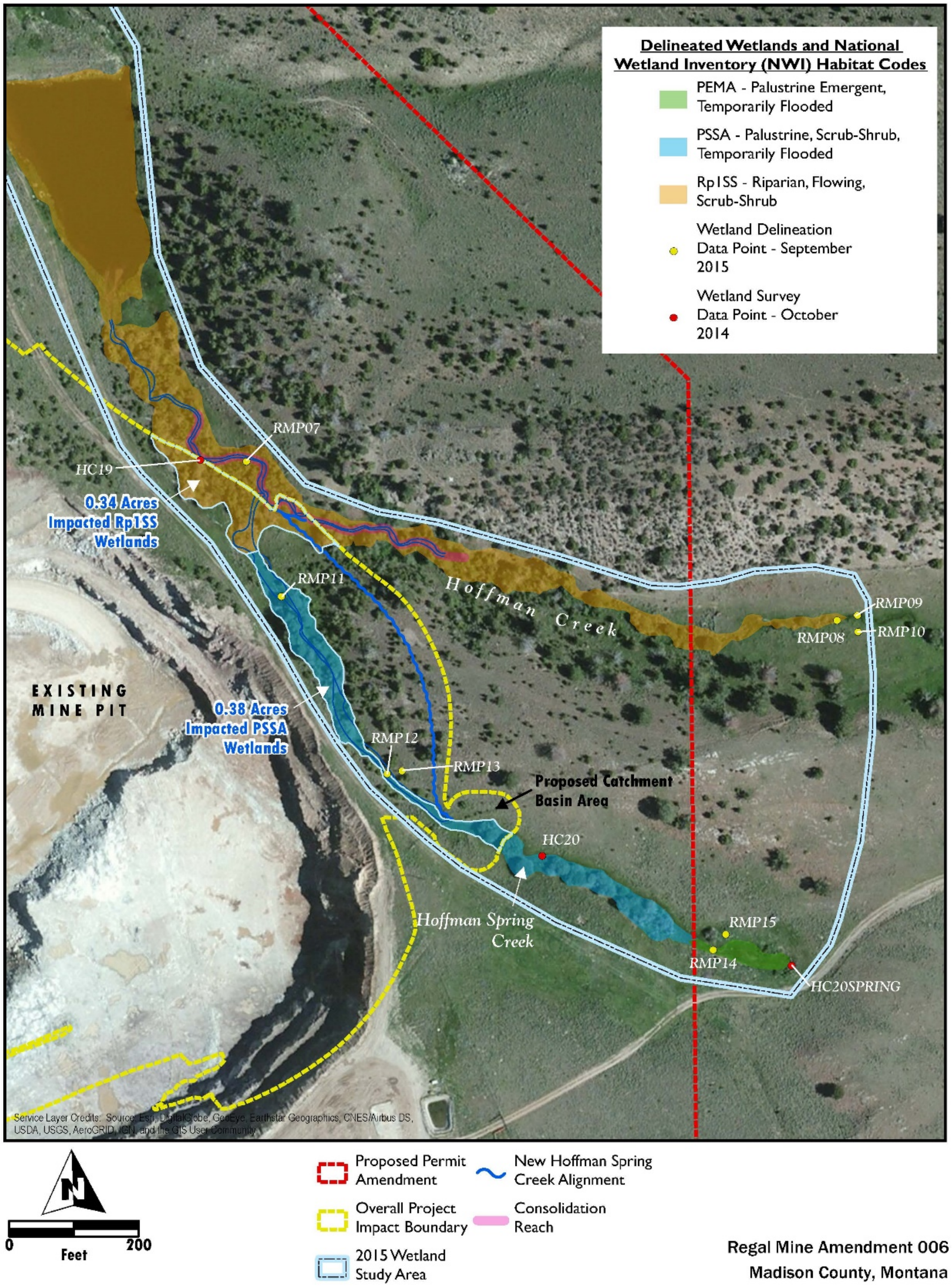

Figure 3.13-2
Wetland Delineation Results

Because beneficial use of waters and aquatic habitat are unavoidably impacted, mitigating impacts to Hoffman Spring Creek and Hoffman Creek are required as part of the Proposed Action under approved USACE 404 permit and DEQ 401certification. These permits include the following specific conditions:

- Mitigating permanent stream and wetland impacts by purchasing credits from the Upper Missouri River Mitigation Bank;
- Using BMPs to minimize turbidity, erosion, and other water quality impacts;
- Isolating in-water work areas to the extent practicable;
- Using clean fill material free of toxic materials;
- Stockpiling construction debris, excess sediment, and other waste material above the high water mark;
- Following a Spill Prevention Plan to prevent water contamination; and
- Constructing cut slopes and revegetating to a stable condition for erosion prevention.

Carter Creek and Unnamed Drainages Below Waste Rock Disposal Area

The affected environment discussed in Section 3.13.2.2, Carter Creek and Unnamed Drainages Below the Waste Rock Disposal Area, would not be impacted by the Regal Mine Permit Amendment 006. All activities associated with the amendment have been designed so that impacts to jurisdictional wetlands in these areas would be avoided. All isolated wetlands within the Carter Creek drainage are located outside of the proposed limits of disturbance for the expanded WRDF boundary. To protect these isolated wetlands, BMI would retain use of IF-1 to infiltrate noncontact ground water into the shallow ground water system.

3.13.3.3 WRDF Grading and Mosaic Vegetation Alternative

The only aspect of the WRDF Grading and Mosaic Vegetation Alternative that differs from the Proposed Action would occur during the WRDF reclamation. Because there are no wetlands associated with the WRDF footprint or wetlands immediately downstream of the WRDF that would be impacted, impacts to wetlands resulting from the WRDF Grading and Mosaic Vegetation Alternative would be the same as the Proposed Action.

3.14 WILDLIFE

This section describes applicable wildlife regulations, the affected environment, and the evaluation of potential impacts on wildlife and wildlife habitat within the Study Area. This section also describes aquatic life that could potentially be impacted by approving the amendment including biota inhabiting Hoffman and Carter creeks and tributaries to those creeks. The Study Area includes the Amendment Application area and surrounding environments.

3.14.1 State and Federal Regulations

The regulatory framework protecting wildlife resources in Montana includes state and federal laws and regulations as described in the following text.

3.14.1.1 State Management

The Montana Natural Heritage Program (MTNHP) serves as the state's information source for animals, plants, and plant communities with a focus on species and communities that are rare, threatened, and/or have declining trends and, as a result, are at risk or potentially at risk of extirpation (i.e., local extinction) in Montana. Jointly with MFWP, the MTNHP identifies species of concern (SOC), which are native Montana animals that are rare or have declining populations and, as a result, are potentially at risk of becoming federally listed as threatened or endangered or are at risk of extinction in Montana.

3.14.1.2 Montana Sage-Grouse Habitat Conservation Program

The Montana Sage-Grouse Habitat Conservation Program (Program) is administratively attached to the Montana DNRC and supported by MFWP, USFWS, and other land and resource management agencies. This program works to sustain viable greater sage-grouse (*Centocercus urophasianus*) populations and conserve habitat in Montana through the collaborative efforts of many private and government stakeholders.

On June 6, 2017, BMI requested consultation and review of the Regal Mine Amendment 06 through the Program. Review of the submitted materials determined that all or a portion of the project is located within General Habitat and a Core Area for sage-grouse. The review also determined that the Project is not within 2 miles of an active sage-grouse lek. The program completed a Density Disturbance Calculation Tool analysis for the proposed project and determined that the Regal Mine Amendment 06 activities are consistent with the Montana Sage Grouse Conservation Strategy (Sime 2017). The lone stipulation attached to the consultation pertains to weed management, which is required within General Habitat and Core Areas for Sage Grouse.

3.14.1.3 Endangered Species Act

The ESA directs the USFWS to identify and protect endangered and threatened species and their critical habitat and provide a means to conserve their ecosystems. Among its other provisions, the ESA requires that the USFWS assess civil and criminal penalties for violations of the ESA or its regulations. Section 9 of the ESA prohibits the take of federally listed species. Take is defined as “harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct” (16 USC § 1532). The term “harm” includes significant habitat alteration that kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering (50 CFR § 17.3).

3.14.1.4 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) is the cornerstone of migratory bird conservation and protection in the US. The MBTA makes it illegal to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird or the parts, nests, or eggs of such a bird except under the terms of a valid Federal permit. (16 USC § 703(a)). “Take” means “to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect” (50 CFR § 10.12). The USFWS maintains a list of all species that are protected by the MBTA at 50 CFR § 10.13. This list includes over 1,000 species of migratory birds, including eagles and other raptors, waterfowl, shorebirds, seabirds, wading birds, and passerines.

3.14.1.5 Bald and Golden Eagle Protection Act

Under authority of the Bald and Golden Eagle Protection Act (BGEPA) (16 USC § 668–668d), bald eagles and golden eagles are afforded additional legal protection. The BGEPA prohibits the take, sale, purchase, barter, offer of sale, purchase, or barter, transport, export or import, at any time or in any manner of any bald or golden eagle, alive or dead, or any part, nest, or egg thereof (16 USC § 668). The BGEPA also defines take to include “pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb,” (16 USC § 668c) and includes criminal and civil penalties for violating the statute. The term “disturb” is defined as agitating or bothering an eagle to a degree that causes, or is likely to cause, injury to an eagle, or either a decrease in productivity or nest abandonment by substantially interfering with normal breeding, feeding, or sheltering behavior (50 CFR § 22.3).

3.14.2 Analysis Methods

The affected environment for wildlife and aquatic resources is described primarily using the following sources:

- Application for Amendment 006 to OP No. 00013 for the Regal Mine, Madison County (March 2019) including Appendices D, E, and G (BMI 2019a);
- Wildlife Baseline Investigation, Mine Expansion and Consolidated OP, Regal Mine, Barretts Minerals, Inc. (Elliot and Butts 1994);
- Greater Sage Grouse Reconnaissance Survey Report, Regal Mine, Madison County, Montana (NewFields 2014);
- MTNHP 2016 Elemental Occurrence records for species in Beaverhead and Madison counties within 5 miles of the Regal Mine;
- USFWS Endangered, Threatened, Proposed and Candidate Species, Montana County List (USFWS 2019); and
- Water Resources Sampling and Monitoring Plan (Hydrometrics, Inc. 2019a).

This assessment is also based on reviewing relevant literature, correspondence with managing fisheries biologists, and information from regulatory agencies. Sampling of fish populations in Hoffman Creek was conducted by MFWP before the permit application was submitted. The results of those sampling efforts were also considered in this assessment. No aquatic invertebrate monitoring data pertaining to the Hoffman or Carter Creeks were available other than the information summarized in the Threatened, Endangered, and Sensitive Species section of the Amendment Application (BMI 2019a).

3.14.3 Affected Environment

Habitats in and around the Regal Mine and vicinity are transitional between lower elevation Intermountain Grassland Meadow and dry, higher elevation foothill sagebrush vegetation types described and mapped by Payne (1973). Wildlife expected on or near the Regal Mine area would generally be those associated with grassland, sagebrush, mountain mahogany, and limber pine habitats in southwestern Montana. Based on available data from MFWP, the area in and around the vicinity of the Regal Mine is considered general range for antelope (*Antilocapra americana)* and moose (*Alces alces),* in addition to winter range for elk (*Cervus canadensis)* and mule deer (*Odocoileus hemionus*). A variety of avian species likely uses the sagebrush, grasslands, riparian habitat, and scattered timber in the Study Area both seasonally during migration and throughout the nesting season.

Springs, seeps, wetlands, and open water habitats likely provide habitat for a variety of species that are closely associated with these habitats, including waterfowl, shorebirds, amphibians, reptiles, and small mammals (including bats). Aquatics habitats in the Study Area are associated with Carter Creek, Hoffman Creek, Hoffman Spring Creek, and other small springs and seeps above Carter Creek.

3.14.3.1 Wildlife Surveys

Wildlife reconnaissance surveys in the Study Area were completed by Elliot and Butts (1994) on July 6 and August 24, 1994, and by NewFields from June 13–15, 2016 (Colescott and Pfister 2016). NewFields also completed a greater sage-grouse reconnaissance survey on May 1, 2014 (NewFields 2014).

During the July and August 1994 surveys, eight bird species and two mammal species were recorded (Elliot and Butts 1994). Bird species included blue-winged teal (*Spatula discors*), swainson's hawk (*Buteo swainsoni*), golden eagle (*Aquila chrysaetos*), common raven (*Corvus corax*), black-billed magpie (*Pica hudsonia*), Clark's nutcracker (*Nucifraga Columbiana*), horned lark (*Eremophila alpestris*), and western meadowlark (*Sturnella neglecta*). Mule deer and extensive mule deer pellet groups were observed during this survey, as well as elk pellet groups and a lone red fox (*Vulpes vulpes*).

During the June 2016 survey, 30 bird species and 10 mammal species or their sign were recorded across the site (Colescott and Pfister 2016). Antelope and mule deer were observed in the Study Area as well as elk and moose signs. Small mammals observed on the site include white-tailed jack rabbit (*Lepus townsendii*), Richardson's ground squirrel (*Urocitellus richardsonii*), Columbian ground squirrel (*Urocitellus columbianus*), yellow-bellied marmot (*Marmota falviventris*), mountain cottontail (*Sylvilagus nuttallii*), and striped skunk (*Mephitis mephitis*). Of the 30 bird species observed, both the Clark's nutcracker and green-tailed towhee (*Pipilo chlorurus*) are SOC in Montana. Also observed in June 2016 were a red-tailed hawk (*Buteo jamaicensis*) nest along Hoffman Creek, a fledgling great horned owl (*Bubo virginianus*), and a sharp-shinned hawk (*Accipiter striatus*) that was thought to be nesting along Carter Creek. With a diversity of small mammals and other bird species to serve as prey, the Study Area is suitable for a number raptor species.

3.14.3.2 Species of Concern

A 2016 review of MTNHP's data for Beaverhead and Madison counties revealed 65 animal SOC including 16 mammals, 36 birds, 2 amphibians, 4 fish, and 7 invertebrates in a two-county area surrounding the Regal Mine site. This inventory identifies the range of possible special-status species present in this two-county area; each species' global and state rank; and whether or not it is classified as threatened, endangered, or a candidate species by the USFWS or classified as sensitive by the U.S. Forest Service or BLM. The inventory also provides the number of observations and range throughout Montana and assesses the probability that each of these species could potentially occur on or near the Regal Mine area (based on habitat use and range of each species). The complete inventory is provided in BMI's Regal Mine permit application**.**

A summary of species with a moderate or high potential to occur in the Regal Mine area is provided in **Table 3.14-1**. Six of these species have a high potential to occur on or near the Regal

Mine site because of the presence of suitable habitat. Eight of the species have a moderate potential to occur on or near to the Regal Mine site. These species were classified as moderate potential because, while suitable foraging and/or nesting habitat may be present nearby, the existing level of disturbance in the area reduces the potential for the occurrence for some species known to be displaced by high levels of human activity. Two species with low potential to occur in the Study Area based on habitat availability—the Clark's nutcracker and green-tailed towhee—have both been documented during field reconnaissance surveys in the Study Area and are included in **Table 3.14-1**. Four small-mammal species (i.e., shrews and pocket mouse) have an unknown potential to occur on or near the Project site. While suitable habitat is present, difficulties in detecting these species may account for the relatively low number of reported observations statewide.

Table 3.14-1
Animal Species of Concern – Potential to Occur in Project Area

Common Name	Scientific Name	Potential to Occur in the Project Area
Mammals		
Townsend's Big- eared Bat	*Corynorhinus townsendii*	Moderate; no caves are present in the survey area but the surrounding limestone areas likely contain fissures that could provide day roosts for this species. Foraging may occur in habitats of the Project area.
Spotted Bat	*Euderma maculatum*	Moderate; suitable rock crevices and ponded creeks are present within the Project area vicinity to provide suitable roosting and foraging habitat.
Hoary Bat	*Lasiurus cinereus*	High; periodic presence during migration and presence of trees in and around the Project area increases the potential for periodic occurrence.
Little Brown Myotis	*Myotis lucifugus*	Moderate; no caves are present in the survey area but the surrounding limestone areas likely contain fissures that could provide day roosts.
Fringed Myotis	*Myotis thysanodes*	High; suitable habitat is present. Difficulties in detecting this species may account for the relatively low number of reported observations.
Birds		
Golden Eagle	*Aquila chrysaetos*	High; suitable nesting habitat not present in the Project area but foraging habitat is present.
Great Blue Heron	*Ardea herodias*	Moderate; suitable nesting habitat is not present but foraging habitat associated with wetlands is present.
Sagebrush Sparrow	*Artemisiospiza nevadensis*	Moderate; habitat is fragmented and disturbed by mining and other activities.

Common Name	Scientific Name	Potential to Occur in the Project Area
Ferruginous Hawk	*Buteo regalis*	Moderate; suitable nesting and foraging habitat is present. High levels of disturbance likely reduced the potential for occurrence.
Greater Sage-Grouse	*Centrocercus urophasianus*	Moderate; suitable nesting and foraging habitat is present. High levels of disturbance likely reduced the potential for occurrence.
Loggerhead Shrike	*Lanius Ludovicianus*	Moderate; suitable breeding habitat is present within the Project area.
Sage Thrasher	*Oreoscoptes montanus*	High; suitable nesting and foraging habitat is present.
Clark's Nutcracker	*Nucifraga columbiana*	Low; observed in Study Area in 1994 and 2016.
Green-tailed Towhee	*Pipilo chlorurus*	Low; suitable shrubby habitat is not present within the Project Area.
Brewer's Sparrow	*Spizella breweri*	High; suitable breeding and foraging habitat is present.
Amphibians		
Western Toad	*Anaxyrus boreas*	High; suitable breeding habitat is present in wetlands and waterbodies.

Source: MFWP 2016

Based on the USFWS list of threatened, endangered, and proposed species for Madison and Beaverhead counties (USFWS 2019) and range/habitat descriptions found in technical literature, the following listed, proposed, and candidate species were considered with respect to this proposed Project:

1. Wolverine (*Gulo luscus*: proposed);
2. Grizzly bear (*Ursus arctos horribilis*: threatened);
3. Canada lynx and Designated Critical Habitat (*Lynx canadensis*: threatened);
4. Red Knot (*Calidris canutus rufa*: threatened);
5. White-bark pine (*Pinus albicaulis*: candidate); and
6. Ute Ladies' Tresses (*Spiranthese diluvialis*: threatened).

Each of these species has a low potential to occur on or near the Regal Mine site because of the lack of suitable habitat and high levels of human activity.

3.14.3.3 Sage-Grouse

Greater sage-grouse is listed as having a moderate potential to occur in the Study Area because of high levels of existing disturbance on suitable nesting and foraging habitat near the Regal Mine site. According to MTNHP records, the greater sage-grouse was documented ten times within the 5-mile vicinity of Regal Mine between 1976 and 2011. Of these occurrences, three sitings were documented within 4 miles of the Regal Mine boundary (all observations occurred 2007 to 2011) and the closest observation was approximately 3 miles southeast of the existing mine pit boundary.

In addition to data provided via MTNHP, MFWP mapped habitat for the greater sage-grouse across Montana and includes areas proximal to the proposed Regal Mine expansion area (**Figure 3.14-1**). Broad- scale sage-grouse habitat delineated by MFWP consists of two categories: (1) sage-grouse core habitat and (2) sage-grouse general habitat. Core habitat is associated with Montana's highest density of sage-grouse and is based on male attendance on leks and sage-grouse lek complexes. General habitat includes stands of sagebrush often interspersed with unsuitable habitat on steep slopes, often supporting stands of limber pine, aspen, and mountain mahogany. Sage-grouse core habitat delineated by MFWP extends to the southeastern boundary of the existing mine pit but does not include the existing facilities. All of the existing mine facilities are located in general habitat; however, the facilities themselves do not provide habitat for sage-grouse.

MFWP maintains Montana's official database of sage-grouse lek locations across the state. Information made available via MFWP in June 2017 indicate that the two known leks (i.e., Sweetwater 3 and 4) that are in proximity to the existing mine site lie more than 4 miles to the southeast of the Regal Mine (**Figure 3.14-1**). The Sweetwater 3 lek has the longest period of record for monitoring attendance during the breeding season (1987–2017). Lek attendance has fluctuated from a high of 34 birds in 1990 to no observations in 1994, 1995, and 2008. The count in 2017 recorded five birds on the lek. Although variations have occurred over the period of record, numbers of grouse on the Sweetwater 3 lek have shown an overall decline. The record for the Sweetwater 4 lek is too short to draw conclusions regarding the activity status during the breeding season. Activities associated with Regal Mine's proposed expansion would not fall within the 0.6-mile no-surface occupancy perimeter of either lek (Montana Executive Order 12-2015).

Field studies conducted on May 1, 2014, by a NewFields biologist did not detect sage-grouse or sage-grouse sign (e.g., fecal pellets, feathers, skeletal remains, or tracks) in the two proposed expansion areas (i.e., mine pit or the waste rock disposal area) or adjacent habitats. The area delineated by MFWP as core habitat and general habitat includes rolling topography with

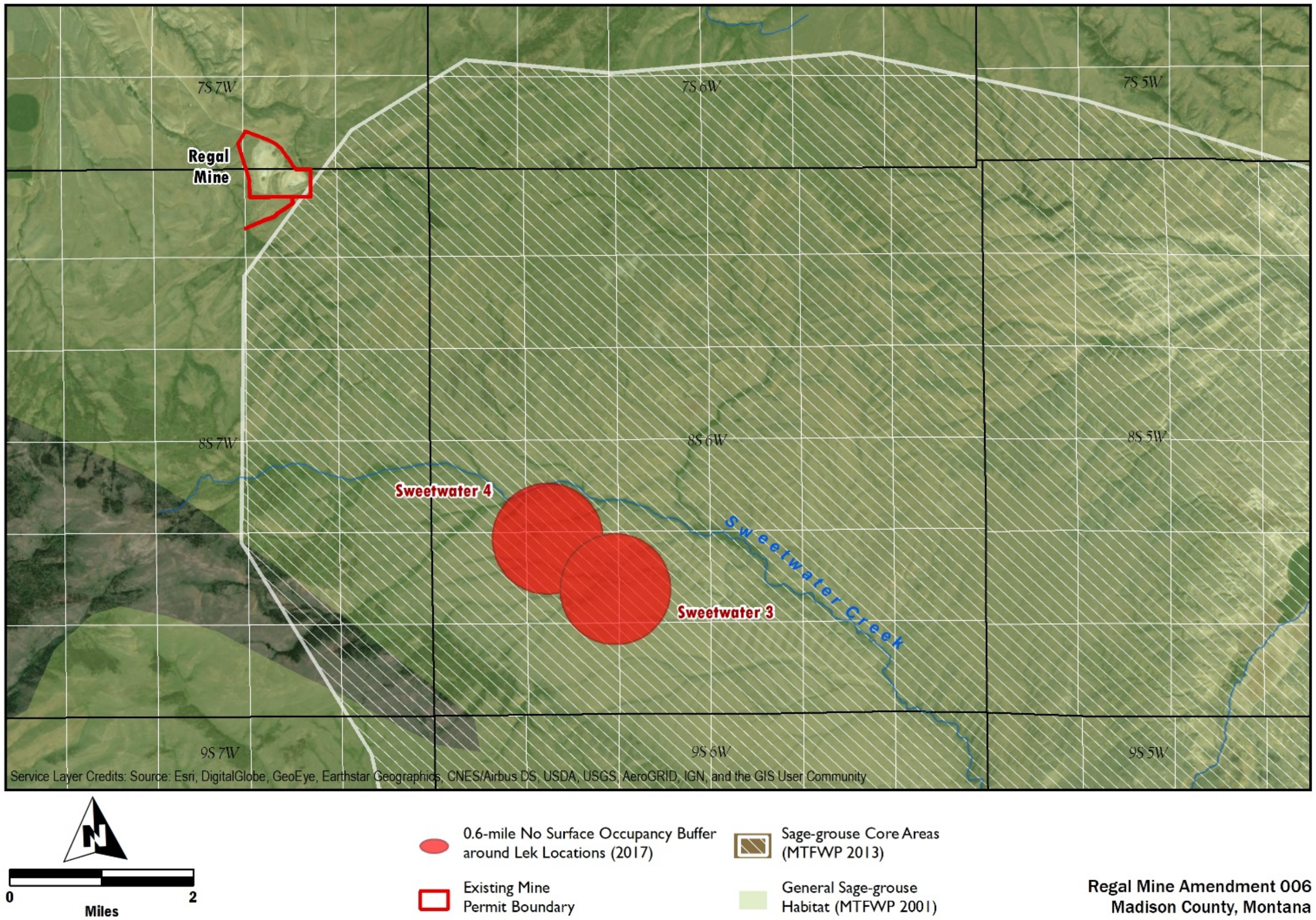

Figure 3.14-1
Greater Sage-Grouse Habitat and Lek Locations in Proximity to the Regal Mine

limber pine and mountain mahogany on the slopes and ridges with shallow soils and exposed bedrock. The proposed mine pit expansion area is mostly unsuitable sage-grouse habitat. The proximity to the existing mine pit disturbance and habitat comprised largely of slopes with limber pine limit the potential of the area to support sage-grouse. The proposed expansion area of the waste rock disposal area contains suitable sage-grouse habitat with a relatively continuous canopy of sagebrush (10 to 40 percent cover) and a diverse understory of grasses and forbs.

3.14.3.4 Aquatic Resources

Two creeks located in the vicinity of the Regal Mine are Hoffman and Carter creeks. Each stream is second order (i.e., having at least one tributary). Hoffman Spring Creek, which is a tributary to Hoffman Creek, joins Hoffman Creek near the mine pit. Biota in all of these surface water resources could potentially be impacted by altering operational actions at the Regal Mine.

Hoffman Creek

Flow on Hoffman Creek has been measured at stream flows up to 270 gallons per minute (Hydrometrics, Inc. 2019a). Upstream from the mine, Hoffman Creek is a gaining stream because of a net gain in ground water inputs (BMI 2019a, Hydrometrics, Inc. 2019a). Downstream from the mine, Hoffman Creek is a losing stream, as there is a net loss of surface water to ground water (BMI 2019a). Hoffman Creek is generally considered perennial above and intermittent below the mine site (BMI 2019a). Current mine operations at the Regal Mine pit have resulted in decreased flows in Hoffman Creek because ground water paths are altered; as a result, some ground water flows into the pit rather than into the Hoffman Creek and Hoffman Spring Creek channels (BMI 2019a). These losses are offset by ground water collected in wells placed in the shallow aquifer and used to recharge those creeks at specific discharge points using noncontact ground water.

Hoffman Creek is believed to be inhabited by nonnative Brook Trout *Salvelinus fontinalis* but not by other fish species (MFWP 2019). However, no literature or data have been reviewed to provide evidence that Brook Trout (or any other fish species) actually inhabit Hoffman Creek. Although sampling efforts have been low, available evidence supports the conclusion that Hoffman Creek may not be inhabited by fish near the mine. MFWP sampled Hoffman Creek at two locations that are described as “Below Upper Forks” and “upstream of pond nest to Mining Pit” on May 30, 2017 (MFWP 2019). A 100-meter reach was sampled by electrofishing at each site and no fish were located at either site (Jaeger 2017, MFWP 2019). No information or data were reviewed that described aquatic invertebrate populations in Hoffman Creek.

Carter Creek

Carter Creek is similar in size, discharge, and flow character (gaining above mine and losing below) to Hoffman Creek (BMI 2019a). Carter Creek is listed within the Beaverhead Total Maximum Daily Load planning area but, as of 2018, no assessments had been made regarding any impairments to beneficial uses for aquatic life, agricultural, drinking water, or primary contact recreation in Carter Creek (DEQ 2019c). Carter Creek has been classified as a B-1 use class stream (DEQ 2019c), which indicates that Carter Creek must be maintained for "suitable for drinking, culinary, and food processing purposes after conventional treatment; bathing, swimming, and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply" (ARM 17.30.623).

Similar to Hoffman Creek, Carter Creek is also believed to be inhabited by nonnative Brook Trout, but no evidence of the presence (or absence) of any fish species in Carter Creek was documented MFWP (2019). Information was not available for Carter Creek in relation to fish sampling, fishing access sites, angling pressure, fish stocking history, stream flow, fish consumption advisories, or other reports (MFWP 2019). No information related to aquatic invertebrate assemblages or populations has been reviewed for Carter Creek for this assessment.

Special-Status Species

The MTNHP listed four fish species and three aquatic invertebrate species as SOC in Beaverhead and Madison counties. Fish SOC include two native cutthroat trout (Yellowstone *Oncorhynchus clarkii bouvieri* and Westslope *O. clarkii lewisi*), lake trout *Salvelinus namaycush*, and arctic grayling *Thymallus arcticus*. Aquatic invertebrate SOC in these counties include Western Pondhawk *Erythemis Collocata*, Rhyacophilan Caddisfly *Rhyacophila potteri*, and Western Pearlshell *Margaritifera falcata*. The potential for any of these species to occur in the Project area was deemed "low" because of "suitable habitat not present" for each (Jaeger 2017). No other data or information was reviewed that could provide evidence of the presence or absence of these species in the Project area.

3.14.4 Environmental Consequences

Amendment 006 would result in expanding the existing mine pit and WRDF and include various ancillary facilities to support mining operations. A majority of the pit and waste rock facilities would be expanded into areas that currently consist of native vegetation communities used by various wildlife species and assemblages. Postmine use of the mine site, following proposed reclamation, would consist of wildlife habitat, agriculture, and livestock grazing. This section is focused on wildlife impacts as a result of the amended permit and reclamation plans following the life of the mine.

3.14.4.1 No Action Alternative

Under the No Action Alternative, the proposed permit amendment would not be approved and the existing Regal Mine pit and WRDF would not be expanded. Disturbed acreage of wildlife habitat would not be increased, and revisions to the existing reclamation and closure plans would not be necessary. Impacts to wildlife resources under the No Action Alternative are those that are ongoing from activities approved under the existing permits. Wildlife in the vicinity of the mine are currently affected by light, noise, and general activity from the mine. Because this level of disturbance has been occurring for decades, wildlife distribution has likely been altered over time and wildlife that have not been displaced and are using the area have likely become acclimated to the disturbance levels.

Abiotic and biotic conditions in Hoffman and Carter creeks would not be affected beyond the levels currently permitted. No additional impacts to aquatic resources would occur under this alternative.

3.14.4.2 Proposed Action

The primary impact to wildlife from the Proposed Action would be the loss of habitat associated with the mine pit expansion and expansion of the WRDF. The greatest habitat loss would be to sagebrush communities to the west of the current WRDF. Additional riparian and wetland habitat loss would occur along Hoffman Spring Creek, which would be impacted by the mine pit expansion. Removing wildlife habitat would reduce the carrying capacity of the land and temporarily or permanently displace wildlife into adjacent habitat.

The Proposed Action would require removing sagebrush, grassland, pine and mahogany timber, riparian shrubs, and wetland vegetation. Project construction could result in direct wildlife mortality primarily to those species with limited mobility and/or those that could conceivably be occupying their burrows or nests at the time of construction (e.g., mice, voles, young birds/eggs, frogs, salamanders, snakes, badgers, and ground squirrels). More mobile species, such as adult deer, fox, and most adult birds, would be able to avoid direct mortality by moving into adjacent habitat.

Raptor nesting has been observed in close proximity to the proposed mine pit expansion near Hoffman Spring Creek and other avian nesting is likely occurring across much of the site. The MBTA provides that it is unlawful to “pursue, hunt, take, capture or kill; attempt to take, capture or kill; possess, offer to or sell, barter, purchase, deliver or cause to be shipped, exported, imported, transported, carried or received any migratory bird, part, nest, egg or product, manufactured or not.” The MBTA does not contain any prohibition that applies to the destruction of an unoccupied migratory bird nest (without birds or eggs), provided that no possession occurs during the destruction. Direct disturbance of an occupied nest is prohibited under the law. Clearing and grubbing of trees, shrubs, and grasslands within the Project limits has the potential to disturb avian nesting.

The collective proposed expansion area provides marginal habitat for sage-grouse because of its fragmented nature and high levels of existing disturbance. Direct removal of habitat, noise associated with the Sweetwater Road, existing mining operations, and visual contrast of existing mine facilities with adjacent undisturbed areas have likely displaced sage-grouse from the vicinity. The relatively small, intact patches of suitable sage-grouse habitat, dissected by incised drainages and interspersed with steep, rocky slopes, provide limited potential for sage-grouse nesting.

Several Montana-listed SOC have the potential to occur in the Proposed Action area based on habitat availability and MTNHP elemental occurrence records within 5 miles of the mine. Impacts to sensitive wildlife species would be similar to those discussed previous for the more common species in the area. Adherence to timing restrictions established for clearing and grubbing would protect nesting avian SOC during the nesting season.

The Proposed Action would not likely adversely affect the federally listed species that could use the Study Area. Canada lynx, grizzly bear, and wolverine would only occasionally wander through the Study Area, if at all, and could avoid the areas of disturbance. The Project area does not provide prime habitat for these species.

No evidence clearly demonstrates that any fish species or any sensitive aquatic species inhabit these creeks and, therefore, no evidence conclude that populations of fish or sensitive aquatic organisms would be negatively affected by the Proposed Action related to flow augmentation, channel realignment, or lining of the realigned channel bed with impermeable substrate. The evidence suggests that any sensitive species inhabiting these creeks are rare. Nonnative Brook Trout are most likely either not present or are present in low abundance, which minimizes the impact of the Proposed Action on fish and nonnative Brook Trout populations. Therefore, the Proposed Action would unlikely impact fish or sensitive aquatic life in a negative manner.

3.14.4.3 WRDF Grading and Mosaic Vegetation Alternative

The WRDF Grading and Mosaic Vegetation Alternative would create a series of swales, drainages, and ridges across the WRDF, creating a diverse wildlife habitat that would attract a greater number of species to the site after revegetation. Wildlife habitat diversity would increase as shrubs, trees, and diverse grass/forb communities establish over time. The diversified habitat would attract additional number and variety of species to the reclaimed WRDF. Other impacts to wildlife associated with the mine pit and other disturbances would be similar to the Proposed Action.

3.15 NOISE

Noise is generally defined as unwanted sound and can be intermittent or continuous, steady or impulsive, stationary or transient. Noise levels heard by humans and animals depend on several variables, including the distance and ground cover between the source and receiver as well as atmospheric conditions. Perception of noise is affected by intensity, frequency, pitch, and duration.

3.15.1 Analysis Methods

A baseline noise investigation was conducted in November 1994 to document ambient noise levels at the Regal Mine facilities at the time and along the haul route that leads to Highway 41 (Hydrometrics, Inc. 1996). As a comparison, the study also measured noise levels along the Stone Creek Road, because ore haul trucks from the BMI Treasure Mine also use this road (RMA 2006). The 1994 noise study evaluated the potential for increases in these levels related to operation of the mine, including ore transportation.

The BMI OP, Amendment Application, and 1994 baseline noise study were reviewed to evaluate noise impacts. The 1994 noise study was deemed sufficient for the purposes of this EIS because the mining methods and activities for the Proposed Action are similar. No recent noise monitoring or modeling has been conducted. To date, DEQ has not received any noise complaints about the Regal Mine (DEQ 2019d).

3.15.2 Affected Environment

The Regal Mine area is located in a rolling, open foothill setting on the western slopes of the Ruby Range, with low ambient noise levels typical of undeveloped and sparsely populated rural areas (DEQ 2007). The major source of existing noise is associated with periodic short-term activities at the Regal Mine and public vehicle use on Sweetwater Road adjacent to the mine site. Noise associated with mining includes blasting, trucks, ore transportation, and other ancillary activities within the mine.

The closest sensitive human receptor is the ranch resident along Carter Creek, which is approximately 1 mile from the Regal Mine site. The residence is at a lower elevation than the mine area; therefore, noise propagation from the mine to the residence is mitigated by the elevation difference and topography.

Sensitive animal receptors include terrestrial and avian wildlife. Given the ongoing activity at the Regal Mine, wildlife has been displaced by the activity or has acclimated to mining operations. The presence of a raptor nest along Hoffman Spring Creek near the active mine pit is evidence of acclimation (Colescott and Pfister 2016, Pfister 2019).

3.15.3 Environmental Consequences

3.15.3.1 No Action Alternative

Under the No Action Alternative, noise levels produced by the current operation would continue through approximately 2021 . Currently approved operations and associated noise impacts would continue under Operating Permit 00013.

The mine typically operates 7 a.m. to 4:30 p.m. Monday through Friday with the exception of occasional overtime on Friday and Saturday. Therefore, noise associated with mining generally occurs within this time frame.

The generally open hillside setting of the Regal Mine and location on privately owned land in a semi-remote setting, which is located 1 mile or more from the nearest residences or other areas of concentrated human activity. This setting reduces the potential for nuisance noise levels. The greatest potential for annoyance associated with permitted mine-related sound would generally be produced by haul trucks along the haul route from the Regal Mine site to Highway 41 and, in particular, near intersections that require haul trucks stopping and/or slowing and going around sharp corners or making turns along Sweetwater Road. Any activities that require a haul truck to stop, turn, accelerate, or decelerate (i.e., brake) would increase sound levels in the vicinity.

Blasting at the Regal Mine is infrequent and is typically conducted only once per week. The day of the week varies from week to week, but blasts are scheduled for around noon. Noise associated with blasting would be mainly contained within the mine pit. PAR blasting would occur toward the end of the workday.

During closure and reclamation, noise impacts would still occur but at a reduced level. Drilling would no longer be occurring. Blasting may be used to help create talus slopes; however, blasting would be minimal and short duration. Regular blasting for mining would no longer occur during closure and reclamation. Dozers and other equipment would still be used during reclamation for grading, placing soils, and seeding. Once the stockpiles are depleted, noise from haul trucks on public roads would no longer occur.

3.15.3.2 Proposed Action

Noise impacts associated with the Proposed Action would be similar to the No Action Alternative. No change in the general level of mining activity would result from Amendment 006 and, therefore, the potential noise effects on humans and wildlife are not expected to increase. The only difference would be that the Proposed Action would extend the life of the mine and, hence, the length of time of these minimal impacts by approximately 6 years through 2027.

Mine-generated noise as a result of equipment operation, blasting, and ore handling and hauling under the Proposed Action would not be expected to increase over the existing levels. Expanding the mine pit, expanding the WRDF, and constructing new water management features would create disturbance and noise on lands associated with the Proposed Action; therefore, noise would be more noticeable on disturbed lands and immediately adjacent areas. Short-term construction activities to build new water management infrastructure would result in temporary but measurable noise increases along portions of Sweetwater Road in and adjacent to the mine.

3.15.3.3 WRDF Grading and Mosaic Vegetation Alternative

The only aspect of the WRDF Grading and Mosaic Vegetation Alternative that differs from the Proposed Action would occur during the WRDF reclamation. Noise from blasting, hauling, and other mining activities would be the same as described for the Proposed Action. Changes to the design of the WRDF would not appreciably change the amount of time or noise generated during reclamation activities; therefore, noise impacts would be the same as the Proposed Action.

3.16 TRANSPORTATION

This section describes the affected environment and potential impacts of the proposed mine expansion on roads.

3.16.1 Analysis Methods

The analysis area for transportation encompasses the road system that would be used to access the Regal Mine and transportation of talc ore to the mill south of Dillon, Montana, including portions of Sweetwater Road, Carter Creek Road, Nissen Land, Highway 41, and Interstate 15 (I-15). BMI provided estimates of project traffic volumes and vehicle classifications during operations. Montana Department of Transportation (MDT) traffic count estimates for the city of Dillon and portions of I-15 near Dillon were compared to mine traffic.

3.16.2 Affected Environment

Sweetwater Road, which is a rural county gravel road, passes through the mine permit boundary between the existing pit and the WRDF. At the mine, Sweetwater Road goes through an underpass culvert to allow public traffic to travel under the active mine road and avoid mining equipment traffic. Employees of the mine would continue to use Sweetwater Road for daily access to the mine site. Depending on their location of residence, other roads would be used by employees to access the Sweetwater Road.

Ore from the Regal Mine is hauled in 40-ton trucks along Sweetwater Road from the mine pit to an ore transfer station (i.e., ore pad) located 4.5 miles northwest of the Regal Mine (**Figure 3.16-1**). From the ore transfer station, talc ore is transported in 20-ton trucks to BMI's existing mill facility. The haul route follows Sweetwater Road, turns right onto Carter Creek, and then turns left onto Nissen Lane to Highway 41. Haul traffic follows Highway 41 to I-15 and then I-15 to BMI's mill 11 miles southwest of Dillon, Montana.

Current mining activities result in the following estimated daily round-trip traffic use: 6 company-owned pickup and/or employee-transport vehicles; 1 vendor, service, or regulatory vehicle; and 10–15 highway legal ore haul trucks (BMI 2019a, RMA 2006). Haul traffic rate is dictated by customer demand and mill scheduling but normally occurs 4 days per week, 9 to 10 hours per day, approximately 200 days per year.

Table 3.16-1 shows historic average annual daily traffic. Traffic volumes on major haul route roads have slightly decreased from 2015 to 2018. No traffic data are available for rural roads. The average daily traffic count on I-15 near Dillon, Montana, is 4,800 vehicles (MDT 2018).

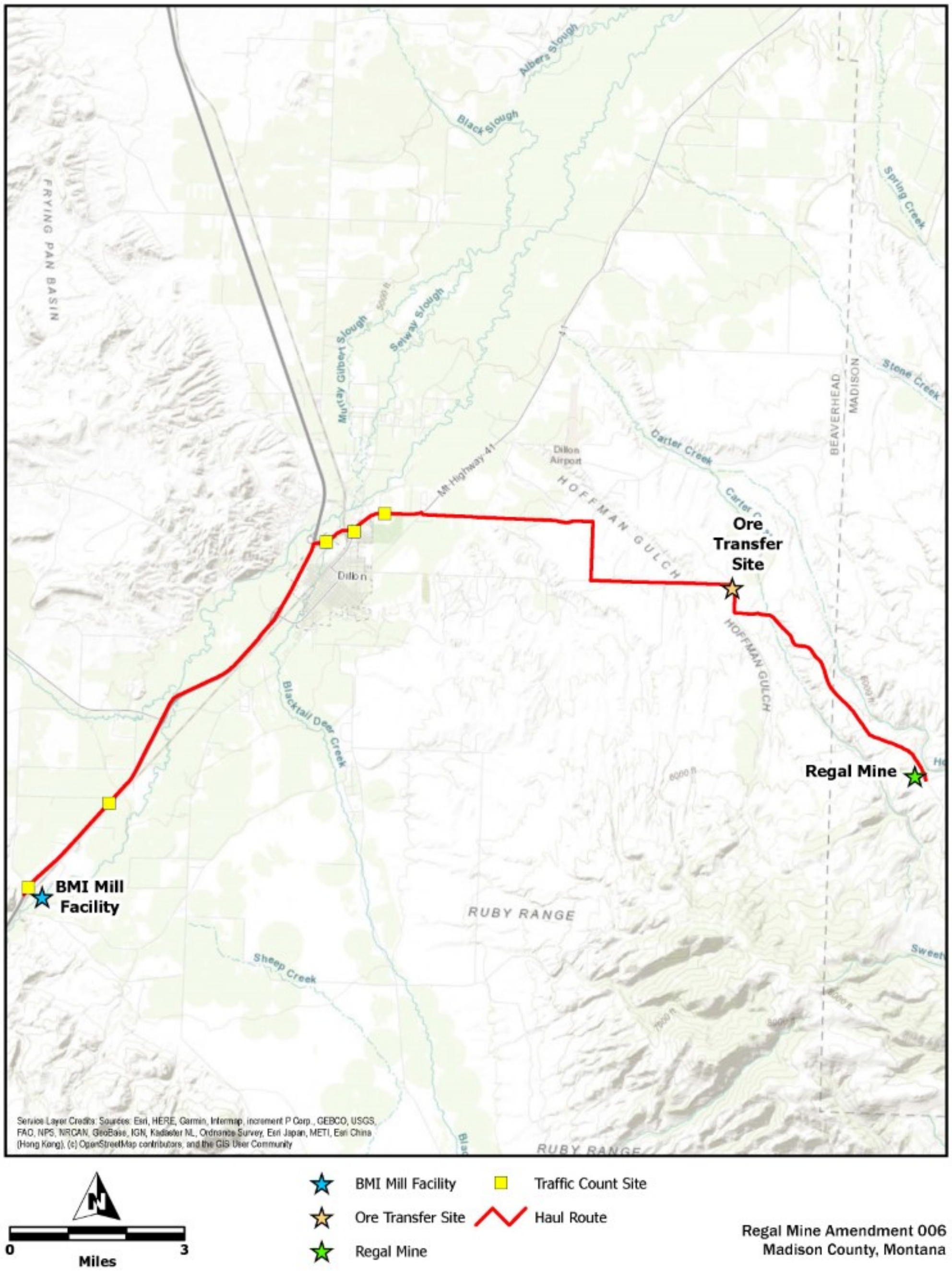

Figure 3.16-1
Haul Route and Traffic Count Locations

Table 3.16-1
Historic Two-Way Average Annual Daily Traffic Counts on Major Haul Route Roads (MDT 2018)

Road	Location Milepost	2015	2016	2017	2018
MT Hwy 41	E of Laknar Ln (NE of Dillon)	3,580	3,405	3,657	3,537
Business Route I-15	Between N Montana and Swenson Way	4,400	4,291	4,257	3,793
I-15	I-15 S On-Ramp at Dillon Twin Bridges	1,140	1,172	1,163	1,368
I-15	Ford, S of Jackson/Wisdom Interchange	4,350	4,112	4,262	4,254
I-15	I-15 S Off-Ramp at Barretts Mill	270	269	271	247

3.16.3 Environmental Consequences

3.16.3.1 No Action Alternative

The No Action Alternative would not impact traffic. Current mine traffic and ore-hauling volume would continue at the current traffic volume for another 2 years until the ore that is presently permitted to be mined is exhausted.

3.16.3.2 Proposed Action

The Proposed Action would require constructing new haul roads across the expanded WRDF. These roads would be constructed on top of the pile and would not add additional disturbance. Rough, unimproved roads or two-track roads would be constructed within the proposed permit boundary around the WRDF to allow access for constructing and maintaining desilting basins. No alterations of public roads are proposed.

Expanding the pit and WRDF would not result in changes to mine traffic on public roads. Traffic would be the same as for the No Action Alternative with the exception that traffic activity would be extended for a longer period. The Proposed Action mine expansion would result in continued mining and ore hauling for 6 additional years until about 2027. Traffic volume would be the same as present mine traffic volume and routes.

3.16.3.3 WRDF Grading and Mosaic Vegetation Alternative

Haulage routes and mine traffic would remain the same as described for the Proposed Action; therefore, transportation impacts would be identical to the Proposed Action impacts.

3.17 AIR QUALITY

BMI was issued an Air Quality Permit (#3086-00) in May 2000 for source-emission control and a minor revision in December 2010 (#3086-01). Sources of air-quality impacts exist at the Regal Mine site, including fugitive dust and combustion emissions associated with operating heavy equipment and talc ore mining and haulage. This section summarizes the regulatory framework, describes the affected air-quality environment, and presents a discussion of primary impacts to air quality in the area surrounding the Regal Mine for the proposed alternatives.

3.17.1 Analysis Methods

The objective of this section of the EIS is to review potential environmental impacts associated with air quality and particularly the non-ore rock that would be mined from the Regal Mine talc deposit. This work included reviewing available data and published literature. geologic mapping. mineralogy analyses including characterization of asbestiform mineralization. and personal air-quality monitoring results. Analysis methods for understanding the existing air quality within the mine permit as well as regional air-quality environments at Regal Mine included reviewing the following key documents:

- The proposed Amendment Application (BMI 2019a);
- "Barretts Regal Mine Non-Ore Rock Management Plan" (Maxim Technologies Inc. 2000a);
- Montana Air Quality Permit (MAQP) #3086-00 (DEQ 2000b); and
- MAQP #3086-01 (DEQ 2010).

No past monitoring of weather conditions or dispersion modeling has occurred at the Regal Mine site. On-site monitoring included personal air-quality monitoring with samples collected in June 2000 and April 2001 (a time with active PAR mining). These results were reviewed as part of this analysis.

The analysis area for direct impacts is the geographic area in the vicinity of the Project site in which air emissions would occur and could potentially increase ambient air concentrations attributable to the Project. The facilities that could have appreciable air emissions are the stockpiles of ore, waste rock and soil material stockpiles, and truck-loading facilities. During continuation of mining activities, construction of new mining facilities (including the expanded pit and WRDF and construction of new water management facilities) as well as active reclamation, engine emissions, and fugitive dust would impact air quality. The temporal boundary for the Proposed Action includes the commencing disturbance within the expansion boundary through final mine reclamation.

3.17.2 Regulatory Framework

3.17.2.1 Federal Air Quality Regulations

Under the federal Clean Air Act (CAA), , the USEPA sets National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment.

Among many other provisions, 1990 amendments to the CAA 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 Regal Mine facilities are not a USEPA-designated Title IV, Title V, or solid waste combustion source and do produce significant quantities of HAPs under the National Emission Standards for Hazardous Air Pollutants (NESHAP) (DEQ 2010).

The USEPA has set NAAQS for six criteria pollutants: carbon monoxide (CO); lead; nitrogen dioxide (NO_2); PM 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 2019a). The federal CAA established two types of standards for criteria pollutants. The 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 2019a). In 2012, the USEPA reduced the annual $PM_{2.5}$ standard to 12 micrograms per cubic meter ($\mu g/m^3$) (USEPA 2012).

Toxic air pollutants are airborne chemicals that cause or may cause cancer or other serious health impacts or adverse environmental and ecological impacts. HAPs are a defined subset of toxic air pollutants and subject to special regulatory status under Title III of the CAA 1990 amendments. Most of these NESHAP regulations apply to sources termed major sources of HAPs, which are those that can emit 10 tons per year of any single HAP or over 25 tons per year of all HAP emissions combined. The Regal Mine is subject to NESHAP standard (40 CFR 63, Subpart ZZZZ), which establishes emissions limits and operating limits for HAPs that are emitted from stationary internal combustion engines.

Surface operations at the Project site would be subject to mobile source and stationary source emissions standards set by the USEPA and adopted and enforced by DEQ through the Montana State Implementation Plan (USEPA 2019b). These standards set maximum emissions per unit horsepower for NO_2, CO, particulate matter (PM), and total organics. 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, including diesel exhaust, which is considered carcinogenic (PM and organic gases). However, no specific emission standard exists for diesel PM or the toxics released in engine exhaust. The

Regal Mine is subject to National Source Performance Standards (40 CFR 60, Subpart IIII and potentially subject to Subpart OOO), which apply to engine efficiency and emissions for new stationary sources (e.g., a diesel generator) (DEQ 2010).

3.17.2.2 Montana State Air Quality Requirements

The Clean Air Act of Montana (Title 75, chapter 2, parts 1 through 4, MCA) implements the federal Clean Air Act of Montana and authorizes the development of local air-pollution control programs to administer strategies to improve local air quality. State agencies (primarily 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. Under Montana's implementation of the Clean Air Act of Montana, Montana established Montana Ambient Air Quality Standards for criteria and other ambient air pollutants (ARM Title 17, chapter 8, subchapter 2). These state standards may be more stringent (i.e., lower concentrations) than federal requirements in some instances. Where Montana has implemented more stringent standards for certain pollutants and averaging times, conformance must be demonstrated with the Montana standard.

The Clean Air Act of Montana requires a permit for the constructing, installing, and operating 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 ARM Title 17, chapter 8. Several specific emissions standards for Montana would apply to the Project sources.

3.17.2.3 Asbestiform Air-Quality Regulations

No existing federal or state standards identify a regulated quantity of asbestiform mineral fibers in a rock. The rate of fiber release varies widely with rock type and style of mineralization and, therefore, a generalization about release rates is not possible to sufficiently establish suitable standards. Applicable standards are all exposure based and were developed primarily to protect workers in industrial and mining occupational settings as regulated by Occupational Safety and Health Administration (OSHA) and MSHA, respectively. These standards include the following:

- MSHA 30 CFR 58 – "Safety and Health Standards–Surface Metal and Nonmetal Mines";
- MSHA 30 CFR §§ 56.5001, 57.5001, and 71.701-702, 57, and 71 – "Asbestos Exposure Limit," Final Rule;
- OSHA 29 CFR § 1910.1001 - "Asbestos" (General Industry); and
- OSHA 29 CFR § 1926.1101 – "Asbestos" (Construction).

MSHA regulations prohibit any miner from being exposed to a concentration greater than 0.1 fibers per cubic centimeter (cc) of air in an 8-hour work shift (73 FR 11284). A fiber is defined as a particle greater than 5 microns in length and having a length to width ratio of 3:1.

Additionally, no employee shall be exposed at any time to an airborne concentration of asbestos fibers in excess of 1 fibers per cc of air over 30 minutes. As a nonmetal mining operation, BMI is regulated under MSHA.

Asbestiform mineral release is primarily an air-quality issue, although a standard does exist for protecting water resources. The water quality standard for asbestiform fiber release is very high—seven million fibers per liter (Montana Department of Health and Environmental Sciences 1994). No aqueous asbestos fibers were observed at the Regal Mine under the existing conditions. Further description of sample sites and analyses is located in Appendix C.

3.17.2.4 Worker Safety

Human exposure to air pollutants may result in adverse health effects depending on several factors such as type of air contaminant, duration and frequency of exposure, toxicity of contaminants, dispersion, and ambient air quality. MSHA is responsible for regulating and monitoring mine worker safety practices, including exposure to airborne dust. OSHA is responsible for worker health and safety at BMI's mill, including exposure to airborne dust.

3.17.3 Affected Environment

3.17.3.1 Baseline Data

The Regal Mine is located approximately 11 miles southeast of Dillon, Montana. The mine is in an area designated as either *attainment* or *unclassifiable* for all regulated pollutants (DEQ 2010). Generally, an unclassifiable designation applies when adequate data have not been collected to demonstrate attainment, but because of the location and/or lack of emission sources, the area is expected to be in attainment of the standard. No premining (i.e., pre-1972) air-quality monitoring of the site was conducted.

3.17.3.2 Climate

The Regal Mine is located at an elevation of approximately 6,300 to 6,500 feet above sea level in the western foothills of the Ruby Range, which is approximately 11 miles east of Dillon in southwestern Montana. The topography is hilly, and vegetation consists mostly of dry native grasslands and foothill sagebrush vegetation. The climate is a semiarid environment with relatively low precipitation.

Weather monitoring stations are located at the Dillon Airport and on the campus of Western Montana College and provide reasonable data for conditions anticipated in and around the Regal Mine area; however, the Regal Mine area may have somewhat higher precipitation levels since it is 1,000 feet higher in elevation. Annual precipitation, expressed as a 30-year average (1971 to 2000) for the airport (Station 242404) and the college (Station 242409), areas are reported as 9.94 inches and 11.65 inches, respectively (Western Regional Climate Center 2014). Precipitation for the area is greatest during the months of May and June and least during the months of December, January, and February (BMI 2019a). Temperatures at the airport and college weather stations typically range between 29 to 58 degrees. The existing Regal Mine site and the proposed expansion area are located in an open and rural native rangeland/foothill setting and the air quality is generally good.

3.17.3.3 Particulate Matter and Other Air Contaminants

The primary indicator for air-quality management of dust includes PM less than 10 microns in size (PM_{10}) and PM less than 2.5 microns in size ($PM_{2.5}$) from fugitive road dust and construction activities. The most common sources for PM in the vicinity of the Regal Mine are fugitive dust originating primarily from public and mine-related vehicle traffic on the Sweetwater Road and other local unpaved roads, as well as from wood-smoke from wildfires and slash burning, and seasonal agricultural practices in the area (DEQ 2007, BMI 2019a). Local public travel on unpaved roads in the vicinity of the Regal Mine is generally light, and dust emissions are quickly dispersed in the open terrain. Periodic ore-hauling activities at the Regal Mine also contribute to short-term dust emissions that are quickly dispersed (BMI 2019a).

The amount of particulate dust associated with vehicle travel and construction activities varies and is based on the length of travel on unpaved roads, size and type of vehicle/equipment, number of vehicles/equipment, silt content of the road bed as a source of PM, vehicle speed, weather and precipitation, and duration of the operation. Dust-abatement operations can greatly reduce generating PM. Such practices are currently in place at the Regal Mine and are described in various BMI OP documents and plans and summarized in Section 3.17.4.2 Proposed Action.

The amounts of CO_2, NO_2, and methane (CH_4) emitted from ore haul trucks and mine-related traffic emissions are regulated. The USEPA regulates emission for on-road and nonroad vehicles and engines under the CAA; therefore, on-road and nonroad vehicle-related engine emissions are expected to meet regulations and were not addressed further in this evaluation (USEPA 2019c).

3.17.3.4 Regal Mine Montana Air Quality Permit

On May 6, 2000, BMI was issued a Montana Air Quality Permit (MAQP) (#3086-00) for control of source emissions. Primary sources of air pollutants associated with the mine are fugitive dust and combustion emissions associated with operating heavy equipment and talc ore haulage (BMI 2019a). The MAQP allows BMI to drill, blast, crush, screen, and stockpile talc. The permit also covers emissions generated from diesel generators, bulk loading, stockpiles, diesel vehicle exhaust, and haul and access roads (DEQ 2010). A permit revision approved in December 2010 added the allowable usage of a Tier 3 diesel-fueled generator to the existing MAQP (#3086-01) (DEQ 2010).

Permitted emissions limits are summarized in **Table 3.17-1**. Under BMI's MAQP, the mine cannot cause a discharge with an opacity of 20 percent or greater (DEQ 2010). The Regal Mine's potential to emit is less than 10 tons per year for any one HAP and less than 25 tons per year of all HAPs (DEQ 2010). BMI conducts air-quality monitoring in accordance with the existing air-quality permit. All existing air-quality controls described in MAQP #3086-00 would be maintained under the No Action Alternative and the Proposed Action.

Table 3.17-1
Permitted Emissions Limit

Tons/year	Total Suspended Particles (TSP)	Particulate Matter (PM-10)	Nitrous Oxide (NO)	Carbon Monoxide (CO)	Volatile Organic Carbon (VOC)	Sulfur Dioxide (SO_2)
Drilling	3.75	3.75				
Blasting	1.50	0.75	4.08	16.08	5.02	0.48
Crushing	25.00	2.50				
Screening	7.50	0.75				
Conveying	6.00	3.00				
Emergency Diesel Generator (200kw)	0.19	0.19	2.70	0.58	0.22	0.18
180 hp Tier III Diesel Generator	0.23	0.23	4.67	1.69	1.98	1.62
Bulk Loading	0.50	0.20				
Stckpls/Wst Pl	8.75	4.38				
Haul Roads	115.52	51.99				
Access Roads	39.42	17.74				
Total	207.75	85.49	11.45	18.35	7.22	2.27

3.17.3.5 Asbestiform Minerals

Asbestiform minerals can occur in rocks associated with talc deposits. No asbestos has been identified at the Regal Mine, although minerals associated with asbestos (or PARs), occur in isolated zones. Six naturally occurring minerals have asbestiform characteristics of long, thin, fibrous crystals and include chrysotile, amosite, crocidolite, asbestiform anthophyllite, asbestiform tremolite, and asbestiform actinolite. The mineral morphology and physical characteristics result in asbestiform properties more so than the chemical composition; this is particularly the case for anthophyllite, tremolite, and actinolite, which can occur in asbestiform and non-asbestiform crystal shapes (DEQ 2001). PAR is defined as serpentine and amphibole mineralization in non-ore rock. These PAR minerals, if present, may or may not include asbestiform crystals.

Ore and waste-rock sampling at the Regal Mine identified chrysotile in an isolated area. At the Regal Mine, PAR is defined as asbestiform chrysotile in concentrations greater than 0.25 percent (i.e., the detection level). Concentrations of chrysotile in the PAR zone at the Regal Mine varies from below detection to 47 percent and averages 0.50 percent (DEQ 2001). PAR was identified as discontinuous veins and lenses in a 35-foot-wide zone at the lithologic contact of dolomite marble and amphibolite in the northwestern corner of the mine pit (DEQ 2001). Further details on sample locations and analytical results can be found in the "Barretts Regal Mine Non-Ore Rock Management Plan" (Maxim Technologies, Inc. 2000a).

Figure 2.3-1 depicts the approximate location of PAR that would be extracted as part of the Proposed Action. Within this zone, chrysotile occurrence is sporadic with variable concentrations over a 15-foot-wide zone near the geologic contact. In locations north of the mine pit, chrysotile mineralization has also been identified along the same contact (DEQ 2001). Chrysotile mineralization occurs in a block of rock that is 380 feet long, 40 feet wide, and 70 feet thick (BMI 2019a). The volume of PAR is calculated to be 93,500 tons (BMI 2019a). Exposures of PAR are likely common throughout the southern Ruby Range near the Regal Mine and may provide a natural background contribution of asbestiform mineral fibers (DEQ 2001).

No asbestiform minerals other than chrysotile were identified in the Regal Mine area (DEQ 2001). No asbestiform minerals or fibers have been detected in the talc ore, intrusive rock, or schist rock units. Approximately 28,000 tons of PAR were mined in April 2001 (BMI 2019c). No airborne asbestos fibers were detected during air monitoring at the Regal Mine while excavating PAR in 2001 (DEQ 2001, Maxim Technologies, Inc. 2001).

3.17.4 Environmental Consequences

Environmental consequences pertaining to air quality are generally compared to objective standards. Consequences are focused on determining the potential air-quality impacts that are directly related to the operation and reclamation phases of the Regal Mine. The projected emissions from the mining operations are detailed in the application for an MAQP and based on projected maximum levels directly related to the mine construction and ongoing talc ore production. Environmental consequences of the talc ore mining under the No Action Alternative and Proposed Action were reviewed to ensure minimal impact to the environment and a safe working atmosphere.

3.17.4.1 No Action Alternative

Under the No Action Alternative, the proposed permit amendment would not be approved and the existing Regal Mine pit and WRDF would not be expanded. BMI would mine the remaining permitted portion of the talc deposit as specified under the existing mining and air-quality permits. Impacts to air-quality resources under the No Action Alternative are those that are ongoing from activities approved under the existing permit.

The primary air pollutants associated with both the No Action Alternative and the Proposed Action includes a variety of air-pollutant sources that result from mining and material handling. These sources consist of primarily fugitive dust and emissions from combustion of motor fuels (diesel and gasoline) used to operate mining vehicles (e.g., haul trucks), fueled stationary engines, and support vehicles. Emissions from periodic blasting is also a source of air pollutants.

No additional PAR would be disturbed under the current mine plan. BMI would continue to implement their “Barretts Regal Mine Non-Ore Rock Management Plan” (Maxim Technologies, Inc. 2000a) to address asbestiform mineralogy at the Regal Mine. BMI will continue to collect a random sample of each non-ore rock type twice annually (when operating) and a sample of ore from the pit highwall annually to test for the presence of asbestiform mineralization. BMI monitors talc for asbestiform fiber content as part of its standard operational procedures. This practice has been in effect at BMI’s mill since before the startup of the Regal Mine. BMI would continue to monitor and manage PAR to meet worker exposure regulations as specified in 30 CFR Parts 56, 57, and 71 (U.S. Department of Labor/Mine Safety Health Administration). These regulations specify worker exposure limits, laboratory analysis, and reporting requirements for PAR.

3.17.4.2 Proposed Action

Particulate and gaseous emissions would not change appreciably as a result of Proposed Action. Mining and ore processing methods and rates would not change. Vehicle emissions would not change as a result of the Proposed Action, because the size of the fleet and types of vehicles to be used would be similar to those currently in use (DEQ 2007). The only difference would be that the Proposed Action would extend the life of the mine and, hence, the length of time of these minimal impacts by approximately 6 years. BMI would continue to conduct air-quality monitoring in accordance with the existing air-quality permit and would implement corrective action as necessary to maintain compliance (DEQ 2007).

Dust Control

Dust release comes from three primary sources: blasting, loading, and dumping. Other possible secondary sources of dust include haul traffic between the pit and rock pile, grading during reclamation, storm water sediment deposits downgradient of WRDF, the pit dewatering infiltration basins (only under dry conditions, once mining operations have ended), and the small portion of the north highwall where the PAR rock is exposed. Airborne chrysotile fibers released as dust into the air during operations (e.g., drilling and blasting, loading, hauling, and dumping) are the main health concern. Air-quality impacts are limited by the use of proposed BMPs for dust control as summarized below (Maxim Technologies, Inc. 2000a):

- Oversight of PAR mining would be directed by a BMI-designated competent person who can identify asbestiform hazards; regularly inspect job sites, materials, and equipment; and has the authority to correct hazards as required under OSHA Standard 1926.20 Subpart C.
- During mining of PAR, access would be restricted to essential personnel to certain identified regulated areas. Maintenance and surveying activities would be minimized during disturbance of PAR.
- Drilling in any PAR zone would use wet drilling techniques, and mine operators would work in enclosed and pressurized cabs (DEQ 2001, Maxim Technologies, Inc. 2000a).
- All blasts in the identified PAR zones would be shot at the end of a workday.
- During material transfer, drop heights would be minimized to reduce dust production from material transfer.
- Water application for dust suppression would continue to be used to stabilize access and haul roads. During dry and windy conditions, water would be applied to the PAR prior to placement on the WRDF (Maxim Technologies, Inc. 2000a).
- The PAR material would be disposed of in a designated area within the boundaries of the WRDF shown on **Figure 2.3-1** and encapsulated with other non-PAR waste rock and soil to minimize wind and water erosion. Water would be applied to the rock pile if the material is exposed for any significant period of time.
- Inactive soil and subsoil stockpiles that would be in place for 1 year or more would be temporarily revegetated. During reclamation, exposed soil areas will be minimized to the extent possible by prompt revegetation of reclaimed areas.
- As specified in the "Barretts Regal Mine Non-Ore Rock Management Plan," personal air monitoring would be conducted during PAR disturbance.

Non-Ore Rock Management Plan

The assessment of air-quality impacts and issues for the Proposed Action focused on worker exposure and safety from disturbance of asbestiform mineralization in Regal Mine rock. Direct correlations cannot be made between fibers bound to silica matrix of rocks and exposure risk to humans. This assessment evaluates the Proposed Action operational and closure practices regarding protecting worker health while operating near and handling PAR material including: regulatory compliance, engineering controls, monitoring, mitigation measures, and safety and health practices.

The primary concerns during the mine expansion would be the disturbance of a minor amount of localized PAR material in the northwest highwall to allow for deeper access for talc ore mining. As part of the open pit expansion, approximately 39,500 cubic yards of PAR would be extracted and stored per the “Barretts Regal Mine Non-Ore Rock Management Plan” (Maxim Technologies, Inc. 2000a). The PAR material represents roughly 0.5 percent of the remaining waste-rock tonnage to be extracted under the Proposed Action. **Figure 2.3-1** depicts the approximate location of in-place PAR and the proposed PAR disposal location. A PAR zone occurs on the southwest highwall of the pit and would be extracted during a 3-day period within the first 18 months of the pit expansion under the Proposed Action (BMI 2019a). Because this material is geologically and physically very isolated in its occurrence, at the contact between the amphibolite dike and the dolomitic marble, its identification would be quite straightforward on an operational basis.

As part of the Proposed Action, BMI would continue to adhere to “Barretts Regal Mine Non-Ore Rock Management Plan” (Maxim Technologies, Inc. 2000a). This plan has proven effective through the use of engineering controls and health monitoring programs to allow mining operations to proceed safely.

As part of Amendment 004 requirements, BMI previously committed to collect a random sample of each non-ore rock type twice annually, and an annual sample of ore from the pit highwall, for a total of seven samples per year (Maxim Technologies, Inc., 2000b). Samples would also be evaluated for the presence of asbestiform mineralization, a combination of X-Ray Diffraction, Polarized Light Microscopy, and Transmission Electron Microscopy (BMI 2019a). An ongoing assessment of mined rock would be conducted by the mine geology staff to identify zones where Polarized Light Microscopy testing is appropriate based on occurrence of serpentine mineralization, geologic relationships, and historical results. These commitments would continue as part of the Proposed Action.

Industrial Safety

One of the primary hazards to worker health and safety would continue to be airborne dust, which creates an inhalation hazard associated with the respirable portions of the dust. The main component of concern within the dust would be the potential presence of asbestos fibers that could be released into the air during mining of PAR. Engineering controls described in the “Barretts Regal Mine Non-Ore Rock Management Plan” (Maxim Technologies, Inc. 2000a) and Amendment Application would limit dust generation and, therefore, minimize worker exposure. The historical personal air-quality monitoring indicated that employee exposure during mining activities was below the permissible exposure limit and, although future exposures are likely to be minimal, monitoring and engineering controls would need to continue to be assessed by a competent person.

BMI would continue to monitor and manage PAR to meet worker exposure regulations as specified in 30 CFR Parts 56, 57, and 71 (U.S. Department of Labor/Mine Safety Health Administration). These regulations specify worker exposure limits, laboratory analysis, and reporting requirements for PAR (BMI 2019a). A respiratory protection program in accordance with 29 CFR § 1910.134 would be adhered to for affected employees (including fit test and facial hair policies). Mine operators would work in enclosed and pressurized cabs, which would reduce exposure to asbestos if present in the PAR. Respiratory protection (e.g., respirators equipped with high-efficiency particulate air filters) would be worn by all workers during PAR extraction until it is determined that exposures are below the permissible exposure limit. BMI would continue to collect a random sample of each non-ore rock type twice annually (when operating) and a sample of ore from the pit highwall annually to test for the presence of asbestiform mineralization. If all engineering controls, personal protective equipment, and monitoring are conducted as described in the Amendment Application and BMI's health and safety procedures, impacts to worker safety as a result of air quality would likely be minimal.

3.17.4.3 WRDF Grading and Mosaic Vegetation Alternative

No aspect of the WRDF Grading and Mosaic Vegetation Alternative would affect the amount or extent of excavation of the Regal Mine or the overall emissions and dust generated. Dust-control practices, fuel emissions, and duration of air-quality impacts would be the same as described for the Proposed Action. The only aspect of the WRDF Grading and Mosaic Vegetation Alternative that differs from the Proposed Action would occur during the WRDF reclamation. Under the AMA, enhanced revegetation and long-term stability of the WRDF is anticipated, which may result in a reduction of dust generated from the WRDF. However, impacts to air quality would be nearly identical as the Proposed Action.

4.0 CUMULATIVE, UNAVOIDABLE, IRREVERSIBLE AND IRRETRIEVABLE, AND SECONDARY IMPACTS AND REGULATORY RESTRICTIONS

4.1 METHODOLOGY

The cumulative impacts analysis for each potentially impacted resource is presented in Section 4.2, Cumulative Impacts. The cumulative impacts analysis for this Project was conducted in accordance with MEPA by completing the following:

- Identifying the location or geographic extent for each resource that may potentially be impacted by the Project;
- Determining the time frame in which the potential impacts of the Project could occur;
- Identifying past, present, and future actions or projects that overlap the Project's spatial and temporal boundaries and that, in combination with the Project, could impact a particular resource; and
- Analyzing the potential for cumulative impacts for each resource identified.

Unavoidable, irreversible, and irretrievable adverse impacts for each resource were identified during the impact evaluation described in Chapter 3.0, Affected Environment and Environmental Consequences. Unavoidable impacts are discussed in Section 4.3, Unavoidable Adverse Impacts, and irreversible and irretrievable impacts are discussed in Section 4.4, Irreversible and Irretrievable Commitment of Resources. Secondary impacts were evaluated by analyzing the Proposed Action for potential secondary effects over a larger geographic area that the mine disturbance; secondary impacts analysis is presented in Section 4.5, Secondary Impacts.

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 disturbance footprint, is the same area used to assess cumulative impacts. However, for other resources (e.g., air quality), the geographic extent is more expansive. The impacts analysis uses reasonable and rational spatial boundaries (e.g., hydrologic unit codes, wildlife management units, subbasins, areas of unique recreational opportunity, and viewshed) for a meaningful and realistic evaluation (Montana Environmental Quality Council 2017). **Table 4.1-1** 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
Ground Water Hydrology	Hoffman Creek and Carter Creek Watersheds
Surface Water Hydrology	Hoffman Creek and Carter Creek Watersheds
Air Quality	10-Mile Radius From the Project

4.1.2 Identification of Past, Present, and Future Projects or 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 caused by 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 3.0, Affected Environment and Environmental Consequences. Therefore, potential impacts from past projects and actions are already included in the evaluation of direct and secondary impacts. Related future actions may have an impact on a resource when combined with the Project. However, future actions “may only be considered when these actions are under concurrent consideration by any agency through pre-impact statement studies, separate impact statement evaluations, or permit processing procedures” (§ 75-1-208(11), MCA). This Environmental Impact Statement (EIS) refers to these projects as future actions.

The following actions were completed to obtain information regarding present and pending actions and projects in the vicinity of the current and proposed mine-expansion areas:

- 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.

4.2 Cumulative Impacts

Cumulative impacts described in this chapter are changes to resources that can occur when incremental impacts from one project combine with impacts from other past, present, and future projects. Cumulative impacts are "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), Montana Code Annotated [MCA]). Cumulative impacts can result from state or nonstate (private) actions that, "have occurred, are occurring, or may occur that have impacted or may impact the same resource as the Proposed Action," (Montana Environmental Quality Council 2002). Related future actions must 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).

Cumulative impacts are assessed using resource-specific spatial boundaries and often attempt to characterize trends over timescales that are appropriate to the alternatives being evaluated. Cumulative impacts can only be assessed for resources that are likely to experience primary or secondary impacts caused by an alternative.

At the time of this EIS publication, the present and pending future projects or actions that, in combination with the Project, could have cumulative impacts include the following:

- Potential prescribed burns on Bureau of Land Management (BLM) lands; and
- Potential spring development on BLM grazing allotments.

Both of these actions are described in the "East Bench Watershed Environmental Assessment" (BLM 2019). The locations of these potential future projects are shown on **Figure 4.2-1**. These two projects or actions that, in combination with the Project, were identified as having a potential to result in cumulative impacts are described in the following sections.

This EIS does not address the potential for additional future mine expansion at the Regal Mine or the Treasure Mine, because these options are not currently proposed or under consideration by any agency.

Possible projects managed by other local, state, and federal agencies were also researched for the area in and around the proposed amendment. No other local, state, or federal actions with the potential to affect the area in or around the proposed amendment to the Barretts Minerals, Inc. (BMI) operating permit were identified as being under review at the time of this EIS publication.

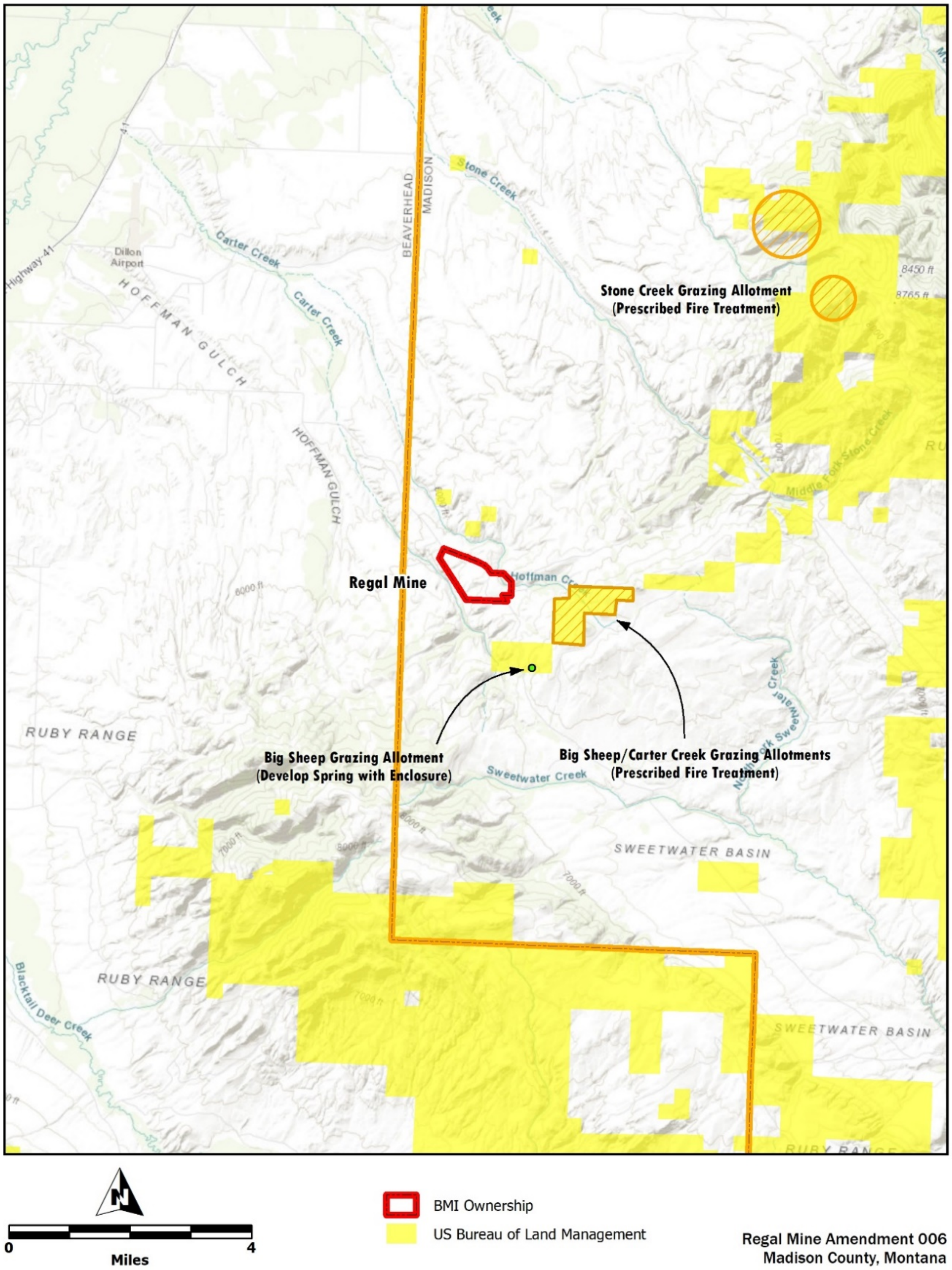

Figure 4.2-1
Cumulative Impacts Projects

4.2.1 Prescribed Burns

Resources listed in **Table 4.1-1** were evaluated for cumulative impacts related to proposed prescribed burns on BLM lands within 10 miles of the Regal Mine. Potential cumulative impacts were only identified for air quality; cumulative impacts were not identified for the remaining resources.

Prescribed burn areas on BLM lands are proposed as part of two alternatives of the "East Bench Watershed Environmental Assessment" (BLM 2019). As shown on **Figure 4.2-1**, prescribed burns are proposed for the Big Sheep/Carter Creek grazing allotments located approximately 1 mile east of the Regal Mine. Two prescribed burn areas are also proposed on BLM lands associated with the Stone Creek grazing allotments approximately 7 miles northeast of the Regal Mine (**Figure 4.2-1**).

Prescribed burns would be planned for early spring and later fall periods because fire intensities are lessened as air temperatures lower (BLM 2019). The proposed burns themselves would impact vegetation and habitat on the lands that are burned and could result in temporary off-site impacts to air quality.

4.2.1.1 Surface Water Hydrology

Fire on the landscape generally would increase runoff quantity and erosion. Vegetation removal by burning and establishing a hydrophobic layer on the soil surface would cause water to run off rather than be intercepted by vegetation or infiltrated into the soil. The proposed prescribed burns in the upper Hoffman Creek Watershed would likely increase the quantity of runoff, erosion, and sedimentation in Hoffman Creek and ponds along Hoffman Creek, which would result in cumulative surface water impacts.

4.2.1.2 Air Quality

The air-quality impacts of local prescribed burn activity would likely be minimized by burning areas under weather and wind conditions that would minimize smoke and other problems. Smoke from a prescribed fire may accumulate in the area, but impacts are typically light and often last no more than a few hours (Frisbey 2008). Because nearby sensitive receptors are lacking and the site is not within a nonattainment area, cumulative impacts to air quality from prescribed burns on BLM lands would be minimal and of short duration.

4.2.2 Spring Development

Resources listed in **Table 4.1-1** were evaluated for cumulative impacts related to proposed spring development projects on BLM lands within either the Hoffman Creek or Carter Creek watersheds. Potential cumulative impacts were identified for water resources and include ground water, surface water, and water rights. Cumulative impacts were not identified for the remaining resources.

The "East Bench Watershed Environmental Assessment" (BLM 2019) includes a proposed spring development project southeast of the Regal Mine on the Big Sheep grazing allotment. The proposed Project would include developing an undeveloped spring and constructing a trough, enclosure, and spring box. Discharge from the spring would not be increased by this Proposed Action.

4.2.2.1 Ground Water Hydrology

Because ground water discharge is not expected to change under the proposed spring development Project, the Montana Department of Environmental Quality (DEQ) does not expect any cumulative impacts to ground water hydrology.

4.2.2.2 Surface Water Hydrology

Proposed spring development by the BLM on the Big Sheep grazing allotment could result in flow reduction into a drainage on upper Carter Creek above the mine, although the mine will be monitoring flows above and below the mine to understand the degree of impacts if spring development does result in flow reduction.

A cumulative impact of sedimentation may occur in relation to livestock use of the spring waters and associated development. Additional sedimentation from construction and mining activities of the Regal Mine could combine with sedimentation from activities along the Big Sheep grazing allotment to decrease water quality flowing into and out of the Big Sheep grazing allotment. The significance of the cumulative impact would depend on the number of livestock in the allotment and whether or not their use would cause an actual change.

4.3 Unavoidable Adverse Impacts

Unavoidable adverse impacts are environmental consequences of an action alternative that cannot be avoided, either by changing the nature of the action or through mitigation. Unavoidable adverse impacts are discussed in the following sections for each resource as identified during the impact evaluation described in Chapter 3.0, Affected Environment and Environmental Consequences. Unavoidable adverse impacts were not identified for the remaining resources evaluated in Chapter 3.0, Affected Environment and Environmental Consequences.

4.3.1 Ground Water Hydrology

Dewatering associated with the Proposed Action operations would lower ground water levels around the mine site and could reduce base flows in Hoffman and Carter creeks near the mine during mining and for some years after dewatering ends and the mine is closed. However, water disposal to the infiltration basins and Underground Injection Control well and flow augmentation would partially offset the impacts from dewatering during operations and postclosure.

4.3.2 Surface Water Hydrology

Expansion of the mine pit would unavoidably impact 730 feet of Hoffman Spring Creek as the mine pit is expanded to the northeast and the channel would be removed and reconstructed. Changes to the natural flow, sediment, and gradient characteristics of a stream could occur. Incorporating bentonite into the Hoffman Creek channel would impact the sediment balance and induce changes to the stream. The Proposed Action would alter the natural flow regimes of Carter and Hoffman creeks through proposed dewatering, flow augmentations, and stream modifications. As a result of the proposed flow augmentation, impacts on base flow on Hoffman and Carter creeks are expected to be negligible. The Proposed Action may increase the levels of barium and nitrate plus nitrite in surface waters; however, levels would be below surface water standards. At the expanded waste rock disposal facility (WRDF), erosion associated with construction and the period before vegetation establishment would increase sedimentation into surface water resources.

4.3.3 Water Rights

Under the Proposed Action, impacts to water rights resulting from pit dewatering, including reductions of flows on Hoffman and Carter creeks, would be minimized by reinjecting dewatering water into the Underground Injection Control well and infiltration basins during operations. BMI should consult with the Department of Natural Resources and Conservation as a water rights permit may be required to augment stream flow and prevent negative impacts to downstream water users following mining completion.

4.3.4 Land Use

Under the Proposed Action, approximately 60.2 acres that are currently used for mining activities, livestock grazing, and wildlife habitat would be unavoidably lost. Disturbance of the expanded WRDF and open pit would temporarily change land use from grazing and wildlife habitat to mine disturbance. Livestock would lose access to current grazing in the WRDF expansion area and along Hoffman Spring Creek but would gain access to a proposed stock pond on upper Hoffman Spring Creek. Temporary impacts to any grazing and wildlife land uses would continue until reclamation begins. Grazing and wildlife land uses would eventually be restored at the WRDF site; however, reestablishing grazing and wildlife habitat similar to premining conditions could take several decades. The expanded open pit would eventually become a pit lake after reclamation is completed; therefore, loss of the existing mining, livestock grazing, and wildlife land uses would be unavoidable.

4.3.5 Soils

Unavoidable adverse impacts to soils would include soil horizon disturbance and soil compaction through soil salvage, storage, and mining activities. Although the function of soil can be rapidly established, soil horizons can take thousands of years to develop and cannot be recreated quickly after disturbance. Soil horizon disturbance should not affect soil productivity after salvage and replacement if best management practices are followed.

4.3.6 Vegetation

Unavoidable adverse impacts related to vegetation would include disturbance to vegetation communities caused by clearing and mining activities, primarily those associated with the expansion of the mine pit, WRDF, and water management features. Upon reclamation and closure, affected areas would generally be regraded and revegetated to vegetation communities with comparable stability and utility as the original conditions, but impacts would be unavoidable in the short term.

4.3.7 Wetlands

Wetlands within the Project area would have unavoidable adverse impacts related to wetlands through the Proposed Action realignment of a portion of Hoffman Spring Creek as well as lining a portion of Hoffman Creek. These activities would result in approximately 0.72 acre of permanently impacted wetlands. BMI obtained approval to impact the above wetlands via both a U.S. Army Corps of Engineers Section 404 Permit and a DEQ Section 401 Water Quality Certification (DEQ 2018) (Permit #NWO-2015-00766-MTH and MT4011037, respectively). As a condition of the U.S. Army Corps of Engineers permit and before impact to the site wetlands can occur, BMI would be required to purchase 0.72 acre of advanced precertified wetland credits or purchase 0.72 acre of certified wetland credits from the Montana Aquatic Resources Services In-lieu Fee Program.

4.3.8 Wildlife

Unavoidable adverse impacts related to the wildlife analysis would primarily include habitat removal. Terrestrial wildlife habitat would be removed where it overlaps Project features and would not be reclaimed to a similar functionality and value for several years. This habitat loss would result in a reduced carrying capacity on the landscape for all wildlife species. Wildlife populations would decrease in the short term, especially those that are less mobile or have smaller home ranges (e.g., small mammals). However, because the habitat loss would occur gradually, wildlife species would have some ability to adapt. Sagebrush communities and mature trees impacted by the Proposed Action would take longer to reestablish to premining conditions.

4.3.9 Air Quality

As part of BMI's approved Montana Air Quality Permit #3086-01, primary sources of air pollutants are associated with fugitive dust and combustion emissions. Under the Proposed Action, the Regal Mine would continue to operate for an additional 6 years and have similar air-quality impacts as present. As part of the open pit expansion, approximately 39,500 cubic yards (yd^3) of potentially asbestiform rock would be extracted over a 3-day period within the first 18 months of the pit expansion. Existing dust-control practices and respiratory measures would limit worker exposure to potentially asbestiform materials, and impacts to human health and the environment are anticipated to be minimal.

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 implemented (§ 75-1-201(1)(b)(iv)(F), MCA). Irreversible resource commitments generally refer to impacts on or a permanent loss of a resource (including land, air, water, and energy) that cannot be recovered or reversed. Examples include cultural resources losses or converting wetlands to another use. Irreversible commitments are usually permanent or at least persist for an extended period of 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. Habitat loss during this period is irretrievable, but the loss of the vegetation resource is not irreversible.

Irreversible or irretrievable commitments of resources are described in the following text for resources that were identified during the impact evaluation described in Chapter 3.0, Affected Environment and Environmental Consequences. Irreversible or irretrievable commitments of resources were not identified for the remaining resources.

4.4.1 Geology and Geochemistry

Under the Proposed Action, the mine pit would be expanded from its currently permitted acreage and mining at the Regal Mine would continue beyond 2021 to approximately 2027. Therefore, an additional period of irreversible removal of minerals from the Regal Mine would result compared to the No Action Alternative. Mineral removal would result from mining operations.

4.4.2 Ground Water Hydrology

Under the Proposed Action, dewatering activities would create a cone of depression around the mine pit. After dewatering activities are completed, the water table levels would gradually rebound; however, water level at the mine pit is predicted to equilibrate at an elevation of

6,335 ft (or approximately 65 ft below the premining water level). Long-term impacts would be localized near the pit lake.

Two types of springs are likely near the mine: perched (i.e., shallow) systems and those connected to a bedrock ground water source. Under the Proposed Action, the re-infiltration of dewatering water will likely increase the flows of some shallow springs. During postmining recovery, discharges should revert to premining conditions; however, during dewatering activities, flows from springs around the mine would be monitored. If the flow rates are reduced, flow augmentation to those springs will be determined by the nondegradation criteria under Administrative Rules of Montana 17.30, Subchapter 7.

4.4.3 Surface Water Hydrology

Under the Proposed Action, the Hoffman Spring Creek realignment is an irreversible impact in the permanent removal and relocation of a natural drainage and would impact 730 feet of the channel. The proposed Hoffman Spring Creek channel would be 200 feet shorter than the existing drainage path, which would result in an irreversible loss in total quantity of stream length and riparian habitat. Approximately 600 feet of Hoffman Creek would be sealed with bentonite clay. This action is irreversible; however the effectiveness of the sealing may decrease over time. The liner installation in Hoffman Spring Creek, cutoff walls, and bentonite incorporation into substrates of Hoffman Creek would irreversibly disrupt surface water and ground water interaction.

4.4.4 Soils and Reclamation

Under the Proposed Action, approximately 60.2 acres would be disturbed. The irretrievable commitment of soil resources means that all available soil or growth media would be removed (i.e., salvaged) before construction activities begins on new areas. The Proposed Action would generate an additional 274,508 yd^3 of salvaged soil. The soil salvage is not irreversible because salvaged stockpiles of soil would be stored until reclamation would be initiated; soil would then be replaced onto disturbed areas. The productivity would be restored to levels that support the postclosure land use of livestock grazing.

4.4.5 Vegetation

Irretrievable impacts on vegetation could include the temporary loss of vegetation communities during construction and operations of the WRDF. Although this vegetation loss in the WRDF would be temporary and reversible (upon reclamation and closure), a significant period of time would be required to reestablish relatively mature trees and functional sagebrush communities. Irreversible impacts to vegetation would occur as a result of the expanded pit being converted to open water habitat upon closure of the mine. After mining activities are completed, the mine pit would encompass approximately 45 acres and contain a pit lake with a surface area of approximately 27 acres. The 27-acre pit lake would permanently replace the vegetation communities that once occurred, and the remaining 18 acres would be reclaimed to various vegetative communities.

4.4.6 Wetlands

An irreversible impact related to wetlands within the Project area would occur through mine pit expansion activities. Wetland habitat (0.72 acre) associated with the Hoffmann Spring Creek drainage would be permanently converted to the open pit mine and would not be reclaimed to wetland upon mine closure.

4.4.7 Wildlife

Irreversible impacts on wildlife could include direct mortality to young or immobile wildlife that may be occupying habitat in the Project area at the time of disturbance. Conducting wildlife surveys before disturbance as well as conducting vegetation disturbance that are outside of the typical nesting season would minimize the potential for direct mortality and irreversible impacts. Irretrievable impacts on wildlife could include the temporary loss of habitat during construction and operations. Although this loss of habitat at the WRDF would be reversible and temporary (i.e., revegetation would occur during the reclamation phase), a significant amount of time would be required to reestablish the habitat created by relatively mature trees and sagebrush communities. Expansion of the mine pit by 8.8 acres would result in an irreversible loss of existing habitat in that area, although the pit highwalls and pit lake may provide a different type of wildlife habitat postclosure.

4.4.8 Visual Resources

Under the Proposed Action, the size of the open pit would increase by 8.8 acres and the WRDF would increase by 41.4 acres. Most of the visual impacts are temporary during mining operations and would be reduced during reclamation. However, the expanded pit and WRDF would be permanently visible to travelers along Sweetwater Road within the mine boundary. Because these features are already visible under the No Action Alternative, the permanent changes to the landscape associated with the Proposed Action are minor. The reclamation and revegetation activities associated with the Proposed Action represent a mitigation to the incremental increase in visual resource impacts caused by the expansion.

4.5 Secondary Impacts

Secondary impacts to the human environment are indirectly related to the agency action; i.e., they are induced by a primary impact and occur at a later time or distance from the triggering action. Secondary impacts are discussed in the following sections for each resource as identified during the impact evaluation described in Chapter 3.0, Affected Environment and Environmental Consequences. Secondary impacts were not identified for the remaining resources evaluated in Chapter 3.0, Affected Environment and Environmental Consequences

4.5.1 Surface Water

Under the Proposed Action, disturbance of the expansion area and channel drainages could introduce additional sediments into downstream waterways. The increased sediments could alter the stream's equilibrium and trigger changes to stream characteristics downstream.

Alterations to natural flow regimes of Carter and Hoffman creeks through proposed flow augmentation, channel lining, and cutoff wall installations may impact bankfull flow quantities. Changes to the bankfull flow regime may induce a response in channel characteristics to downstream reaches of Carter and Hoffman creeks.

4.5.2 Water Rights

No secondary impacts are anticipated under the Proposed Action. Any impacted water rights along Hoffman Creek, Carter Creek, or within the zone of drawdown influence would be mitigated via the proposed flow augmentation.

4.5.3 Socioeconomics

Under each alternative, adverse secondary impacts would occur upon mine closure and some portion of BMI jobs are lost. Tax revenues associated with talc production would end as well as a loss of secondary revenue associated with loss of spending by BMI employees. Under the Proposed Action, beneficial secondary impacts would occur from 6 more years of employment for approximately 15 people at the Regal Mine as well as 6 more years of tax revenue. The Regal Mine provides approximately 60 percent of the talc material to BMI's mill; the mill and all its 65 employees could lose their jobs within 5 years of mine closure under each alternative (Raffety 2019). The Proposed Action provides clear secondary socioeconomic benefits over the No Action Alternative.

4.5.4 Soils

Under the Proposed Action, the mine pit and WRDF would be expanded and approximately 60.2 acres of soil disturbance would occur. Erosion potential increases as soils are moved, and best management practices would be implemented to minimize secondary impacts to soils during reclamation. Secondary impacts would include sedimentation of downstream watercourses from erosion.

4.5.5 Vegetation

Under the Proposed Action, the mine pit and WRDF would increase in size and approximately 60.2 acres of vegetation disturbance would occur. Disturbed soils and soil stockpiles provide habitat for noxious weeds to establish within the expansion area. Noxious weeds that become established in the expansion area have the potential to spread to habitat outside of the Regal Mine permit area, which would result in a secondary impact. The Regal Mine weed management plan would be implemented for the mine life and during reclamation to prevent the noxious weeds from establishing and spreading to adjacent properties.

4.5.6 Wetlands

Direct impacts to surface water and shallow ground water within the expansion area have the potential to result in secondary impacts to wetlands and other aquatic habitat downstream of the expansion area. Flow reduction leaving the expansion area could result in lost wetland habitat downstream. The proposed Hoffmann Spring Creek channel is being designed so that surface water is not lost subsurface and flows leaving the area will be commensurate with flows before the disturbance.

4.5.7 Wildlife

Continued noise levels that would persist throughout the mine life under the Proposed Action may have secondary impacts on wildlife. Wildlife would avoid areas with higher noise levels that could affect some animals during certain times of year (e.g., breeding season for birds). Noise effects, however, are expected to be minimal (Section 3.15.3.2, Noise Proposed Action).

4.6 Regulatory Restrictions

MEPA requires state agencies to evaluate regulatory restrictions proposed to be imposed on private property rights as a result of major actions of state agencies, including an analysis of alternatives that reduce, minimize, or eliminate the regulation of private property (§ 75-1-201(1)(b)(iv)(D), MCA). Alternatives and mitigation measures required by federal or state laws and regulations to meet minimum environmental standards, as well as actions proposed by or consented to by the applicant, are not subject to a regulatory restrictions analysis.

No aspect of the alternatives under consideration would restrict the use of private lands or regulate their use beyond the permitting process prescribed by the MMRA. The conditions that would be imposed by DEQ in issuing the permit would be designed to make the project meet minimum environmental standards or have been proposed and/or agreed to by BMI. Thus, no further analysis is required.

5.0 COMPARISON OF ALTERNATIVES

The tables in this chapter compare the impacts of each alternatives to impacts that are most likely to occur or those that would have the potential to affect some aspect of the human environment in a substantial way. **Table 5-1** summarizes the potential primary impacts of each alternative for each resource.

Chapter 2, Description of Alternatives, provides a detailed description of the No Action Alternative, the Proposed Action, and the Agency Modified Alternative. Primary impacts are described fully in Chapter 3.0, Affected Environment and Environmental Consequences, and cumulative and secondary impacts are discussed in Chapter 4.0, Cumulative, Unavoidable, Irreversible and Irretrievable, and Secondary Impacts and Regulatory Restrictions.

Table 5-1
Summary of Primary Impacts of the No Action Alternative, Proposed Action, and Agency Modified Alternative Organized by Resource Area

Chapter	Resource Area/ Impact	No Action Alternative	Proposed Action	Agency Modified Alternative
3.2	Cultural Resources	No impacts.	No impacts to significant cultural resources are anticipated.	No impacts.
3.3	Geology and Geochemistry	No change from the current permitted extraction.	Disturbance of the geology would occur within the expanded and deepened mine pit as talc ore is mined and waste rock (including a zone of potentially asbestiform rock) is removed.	Same as the Proposed Action.
3.4	Ground Water Resources	Continued dewatering would lower the ground water table near the pit by an additional 180 feet or 280 feet below the premining water table.	The mine pit would continue to be dewatered for an additional 6 years and the ground water table would be reduced by approximately 395 feet. Predicted drawdown of 100 feet would extend 3,000 feet upgradient of the pit and 240 feet downgradient. Dewatering impacts to Hoffman and Carter creek flows would be offset by proposed flow augmentation.	Same as the Proposed Action.
3.5	Surface Water Resources	No change from the current condition.	Approximately 730 feet of the Hoffman Spring Creek channel would be permanently relocated at the top of the pit highwall. A 600-foot section of Hoffman Creek would have bentonite materials added into the channel to reduce infiltration. Flow depletions are	Impacts to Hoffman Creek, Hoffman Spring Creek, and Carter Creek would be the same as the Proposed Action. Post-reclamation drainage on the waste rock disposal facility (WRDF)

Chapter	Resource Area/ Impact	No Action Alternative	Proposed Action	Agency Modified Alternative
			anticipated in sections of Carter Creek, Hoffman Creek, and the unnamed tributaries of Hoffman Creek but would be mitigated by recharge and flow augmentation.	would better mimic natural drainage.
3.6	Water Rights	Dewatering would cease once mining is completed. The water right for SP-1 and other water rights on Hoffman Creek may be impacted.	During the dewatering phase of the Proposed Action, flows within the simulated drawdown area are likely to be impacted, although whether or not reduced stream flow would result in impacts to water rights depends on extent of the water use.	Same as the Proposed Action.
3.7	Geotechnical Engineering	No change from the current condition.	The east wall of the pit will be steeper, but slope-scale failures or other geotechnical impacts are not anticipated.	Same as the Proposed Action.
3.8	Land Use	No change from the current condition.	A total of 60.2 acres of existing land use would be temporarily impacted. All proposed disturbance would be reclaimed back to the existing uses after mine closure except for 8.8 acres, which would become a pit lake.	Same as the Proposed Action.
3.9	Visual Resources and Aesthetics	No change from the current condition.	Visibility of the WRDF and open pit from surrounding landowners and travelers would increase slightly. Reclamation would improve the landscape to more a natural-appearing landscape to minimize permanent visual impacts.	The post-reclamation landscape would better blend with the landscape and be more aesthetically pleasing.

Chapter	Resource Area/ Impact	No Action Alternative	Proposed Action	Agency Modified Alternative
3.10	Socioeconomics	No change from the current condition.	A beneficial impact of jobs and tax revenue would occur for a longer duration.	Same as the Proposed Action.
3.11	Soils and Reclamation	No change from the current condition.	Impacts to the native soils include soil salvage and stockpiling ahead of disturbing an additional 60.2 acres. Pit and WRDF reclamation would be similar to previously permitted reclamation and includes grading, capping, and revegetating the WRDF, select benches of the pit, and other associated mining facilities.	Soil disturbance would be the same as the Proposed Action. Excess available soil would be used for WRDF grading, and the alternative would also reduce material erosion and create a more stable landform.
3.12	Vegetation	No change from the current condition.	Approximately 8.8 acres associated with the pit would be permanently converted from grassland to open water and highwall or talus slope. Approximately 51.4 additional acres of disturbance to grassland, shrublands, and forested lands would occur for the duration of active mining.	Post-reclamation vegetation on the WRDF would be more diverse in species but would be more difficult to seed and treat weeds.
3.13	Wetlands	No change from the current condition.	Approximately 0.72 acres of delineated wetlands along Hoffman Spring Creek and Hoffman Creek would be disturbed. Mitigation would require purchasing wetland credits.	Same as the Proposed Action.
3.14	Wildlife	No change from the current condition.	Habitat would be lost loss (especially sagebrush) associated with the 60.2	The alternative would diversify the wildlife habitat on the WRDF and attract a

Chapter	Resource Area/ Impact	No Action Alternative	Proposed Action	Agency Modified Alternative
			acres of additional disturbance during operations.	greater number of animals and species to the site after revegetation.
3.15	Noise	No change from the current condition.	No change from the current condition other than the extended 6 years of mine life.	Same as the Proposed Action.
3.16	Transportation	No change from the current condition.	No change from the current condition other than the extended 6 years of mine life.	Same as the Proposed Action.
3.17	Air Quality	No change from the current condition.	Air quality would have minor primary impacts with no increase in ambient air impacts, but the potential for long-term impacts is increased.	Enhanced grading and mosaic vegetation of the WRDF may reduce post-reclamation erosion and dust generated from the WRDF.

6.0 CONSULTATION AND COORDINATION

The Montana Environmental Policy Act requires that Montana Department of Environmental Quality (DEQ) 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 (municipality, county, or consolidated city-county government) that could be directly impacted by the Project (§75-1-201(1)(c), Montana Code Annotated). The responsible state official shall also consult with and obtain comments from Montana state agencies with respect to regulating private property involved.

Consultation and coordination took place before and during the formal scoping period, as well as during the Environmental Impact Statement preparation. The names of individuals and organizations that DEQ consulted during the development of this Environmental Impact Statement are listed in **Table 6-1**.

Table 6-1
List of Agencies Consulted

Agency	Individual	Title	Date
Montana Department of Commerce Hard Rock Mining Impact Board			5/2/2019
Montana Department of Labor & Industry Building Codes Division			5/2/2019
DEQ	James Strait	Archaeologist	5/2/2019
DEQ, Storm Water Program			5/2/2019
DEQ, Water Protection Bureau			5/2/2019
DEQ, Storm Water Program			5/2/2019
DEQ, Air Resources Management Bureau	Dave Klemp	Bureau Chief	5/2/2019
DEQ, Waste and Underground Tank Management Bureau			5/2/2019
Montana Department of Natural Resources and Conservation, Water Rights Bureau			5/2/2019
Montana Department of Natural Resources and Conservation, Mineral Management Bureau	Teresa Kinley	Geologist	5/2/2019

Agency	Individual	Title	Date
Montana Department of Natural Resources and Conservation, Trust Lands Management Division			5/2/2019
Montana Department of Transportation	Mike Tierney	Planner	5/2/2019
Montana State Historic Preservation Office	Stan Wilmoth	State Archaeologist	5/2/2019
Montana Fish, Wildlife & Parks	Don Skaar	Habitat Access Bureau Chief	5/2/2019
Montana Army National Guard			5/2/2019
U.S. Fish and Wildlife Service			5/2/2019
U.S. Army Corps of Engineers			5/2/2019
U.S. Forest Service, Dillon Ranger District			5/2/2019
U.S. Environmental Protection Agency, Region VIII			5/2/2019
Bureau of Land Management Dillon Field Office			5/2/2019
Madison County Commissioners			5/2/2019

7.0 LIST OF PREPARERS

Table 7-1 provides a list of individuals who contributed to writing, reviewing, and/or preparing this Environmental Impact Statement (EIS).

Table 7-1
List of Preparers

Name	Role or Resource Area	Education
Department of Environmental Quality		
Brown, JB	Hydrologist	B.S. Natural Science A.S. Electronics
Freshman, Charles	Mine Engineer	P.E. M.S. Geological Engineering B.S. Civil/Environmental Engineering B.S. Geology
Henrikson, Craig	Air Quality	M.S. Civil Engineering B.S. Chemical Engineering
Jepson, Wayne	Hydrologist	M.S. Geology B.S. Earth Science
Jones, Craig	Montana Environmental Policy Act Coordinator Project Manager	B.A. Political Science
Rolfes, Herb	Hard Rock Supervisor EIS Reviewer	M.S. Land Rehabilitation B.A. Earth Space Science A.S. Chemical Engineering
Smith, Garrett	Geochemist	M.S. Geoscience/Geochemistry B.S. Chemistry
Strait, James	Archaeologist	M.A. Archaeology B.S. Anthropology
Walsh, Dan	Hard Rock Bureau Chief EIS Reviewer	B.S. Environmental Engineering
Whitaker, Nicholas	Legal Counsel	J.D. Attorney
RESPEC		
Cude, Seth	Soils	M.S. Soil Science M.S. Water Resources B.S. Geology
Haugen, Ben	Geotechnical Stability	M.S. Geological Engineering B.A. Geology

Name	Role or Resource Area	Education
Hocking, Crystal	Project Manager Geology Transportation	M.S. Geology and Geological Engineering B.S. Geological Engineering B.S. Geology
Johnson, Matt	Hydrology	B.S. Civil Engineering B.S. Environmental Science
Lipp, Karla	Document Production	A.S. Word/Information Processing
Michalek, Tom	Ground Water Hydrologist	M.S. Geology B.S. Geology
Naughton, Joe	Aquatic Biology	M.S. Fisheries and Wildlife Management B.S. Fisheries and Wildlife Management B.S. Sociology
Pettit, Michelle	Deputy Project Manager Land Use Visual Resources	M.S. Environmental Science B.A. Marine Science
Rouse, Nathan	Noise	Ph.D. Mining and Explosives Engineering M.S. Explosives Engineering B.S. Mining Engineering
Rotar, Michael	Hydrology	M.S. Civil Engineering B.S. Architectural Engineering
Triplett, Taran	Reclamation Pit Backfill	B.S. Mechanical Engineering
Vandam, Charlie	Principal in Charge Socioeconomics	B.A. Geology
Walla, Chris	Alternatives	B.S. Mining Engineering
Diversified Enviro		
Thomas, LeBlanc	Air Quality	B.S. Business Administration and Renewable Resources
HDR		
Traxler, Mark	Vegetation Wetlands Wildlife	B.S. Wildlife Biology
Historical Discoveries		
Krigbaum, Dagny	Archaeologist	M.A. Cultural Anthropology B.A. General Anthropology
PDC Inc. Engineers		
Conlon, Royce	Reviewer	B.S. Civil Engineering

Name	**Role or Resource Area**	**Education**
WGM Group		
Anderson, Susan	GIS	B.A. Music
McLane, Kaitlin	Water Rights	B.A. Landscape Architect
Merritt, Julie	Water Rights	B.S. Biology

8.0 RESPONSE TO COMMENTS

This chapter will be completed in the Final Environmental Impact Statement.

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APPENDIX A: TECHNICAL MEMORANDUM 1

Technical Memorandum 1

To:	Montana Department of Environmental Quality 1520 E. 6th Avenue Helena, MT 59601
From:	RESPEC Company LLC P.O. Box 725 Rapid City, SD 57709
Date:	November 26, 2019
Subject:	Barretts Regal Mine Project – Partial Pit Backfill

1.0 INTRODUCTION

The basis for this technical memorandum is the application for amendment 006 to Operating Permit Amendment No. 00013 (Barretts Minerals, Inc. 2019) that was submitted to the Montana Department of Environmental Quality (DEQ) in March 2018. The Amendment Application is referenced in the body of this memorandum as "Amendment Application" with the section and page number indicated as appropriate. The Metal Mine Reclamation Act (MMRA), at § 82-4-336(9), MCA, requires specific requirements for reclamation plans regarding open pits and rock faces:

> *(b) With regard to open pits and rock faces, the reclamation plan must provide sufficient measures for reclamation to a condition:*
>
> > *(i) of stability structurally competent to withstand geologic and climatic conditions without significant failure that would be a threat to public safety and the environment;*
> >
> > *(ii) that affords some utility to humans or the environment;*
> >
> > *(iii) that mitigates postreclamation visual contrasts between reclamation lands and adjacent lands; and*
> >
> > *(iv) that mitigates or prevents undesirable offsite environmental impacts.*

(c) The use of backfilling as a reclamation measure is neither required nor prohibited in all cases. A department decision to require any backfill measure must be based on whether and to what extent the backfilling is appropriate under the site-specific circumstances and conditions in order to achieve the standards described in subsection (9)(b).

2.0 BACKGROUND—CURRENT PERMITTED PIT DISTURBANCE AND RECLAMATION

The Regal Mine is located 11 miles southeast of Dillon in Madison County, Montana, and is located on private land accessed via Sweetwater Road. The open pit mine has been in operation since 1972. Barretts Minerals, Inc. (BMI) currently mines talc ore from the Regal Mine using conventional open pit methods of drilling, blasting, loading, and hauling.

The current permitted disturbance is 189.9 acres and the permit area is 243.2 acres (Amendment Application Table 1-1). The current permitted open pit disturbance is 36.6 acres (Amendment Application Table 3-1). The current permitted bottom pit elevation is 6,080 feet (i.e., 450 feet deep). The pit is currently dewatered by wells that surround the pit with water discharged to two infiltration basins and a shallow injection well.

The currently permitted pit reclamation would consist of a 37-acre open pit with benches and rockfaces; the pit would include rock talus slopes and an approximately 23-acre pit lake that would remain after mine pit reclamation operations are completed. The pit lake level elevation would be approximately 6,380 feet. The entire pit area would be fenced and a 4-foot-high safety berm surrounding the pit would be soiled, seeded, and remain in place as a physical and visual barrier.

3.0 PROPOSED ACTION

BMI proposes to expand and deepen the mine pit, increase the size of the waste rock disposal facility, modify the ground water capture and infiltration system, and realign Hoffman Spring Creek. The permit area would be expanded by 136.9 acres for a total permit area of 380.1 acres (Amendment Application Table 3-1).

BMI is seeking to expand the open pit by 8.8 acres for a total pit area of 45.4 acres (Amendment Application Table 3-1). As part of the expansion, the pit walls would be pushed back on the north and east sides. The pit would be deepened to 540 feet with a bottom pit elevation of 5,990 feet.

Reclamation of the mine pit is proposed to be similar with existing permit requirements and meet state requirements of being structurally competent. At closure, the open pit would be 45.4 acres with a 27-acre pit lake (Amendment Application Section 3.8.1). Waste rock and blasting would be used to create talus slopes on the southern and western pit edges. The final pit access ramp would extend from the rim of the pit to the pit lake and provide a point of egress for wildlife to exit the pit. Select pit benches and the access ramp projected to be above the pit lake elevation would be covered with 24 inches of soil or growth media and seeded (Amendment Application Section 3.8.4). **Figure 3-1** shows the Proposed Action pit reclamation (Amendment Application Figure 3-8). The pit would be fenced for safety and still remain partly visible from Sweetwater Road (Amendment Application Section 3.8.4).

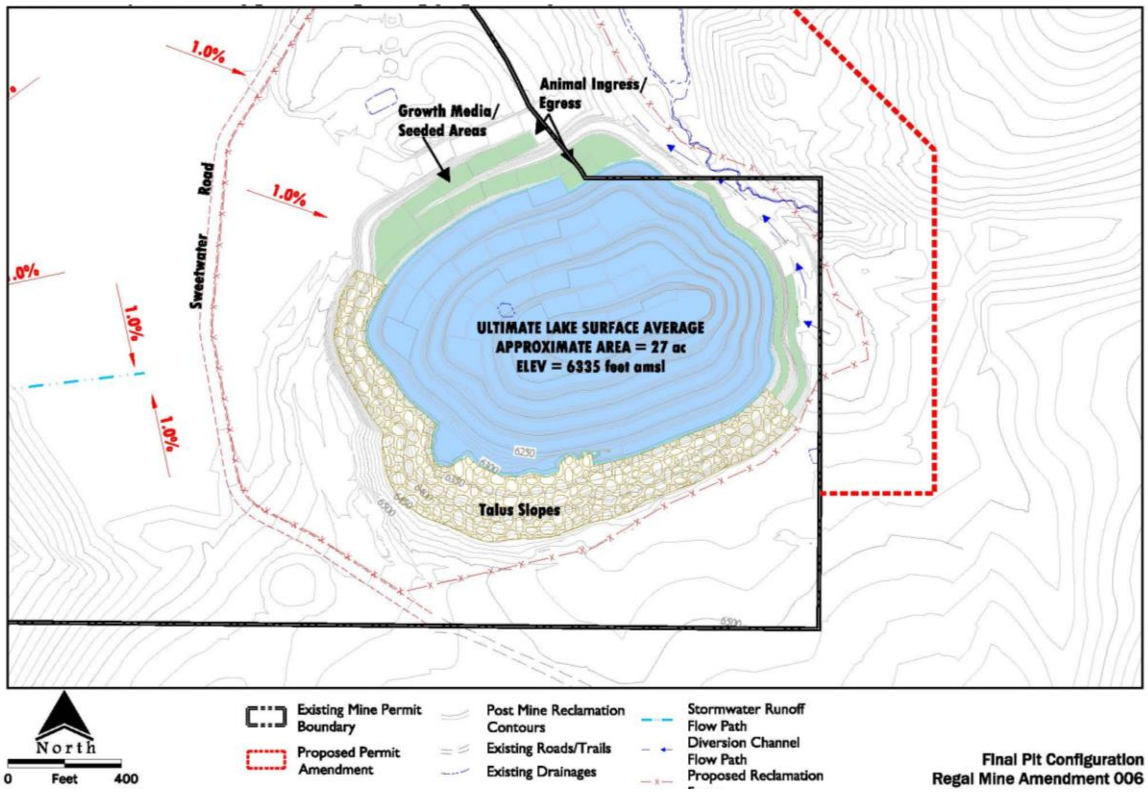

Figure 3-1
Final Pit Reclamation Concept

The Proposed Action would include seven new pit dewatering wells, a settling pond, and a new infiltration gallery (IF-3) to replace IF-2. During the operation phase of active mining, ground water would be intercepted by the dewatering wells and recovered water would be diverted into the proposed infiltration pond. The infiltration would be designed to accept a continuous flow of 500 gallons per minute. At the completion of mining and dewatering activities, the pit would gradually fill with water. The pit lake elevation is predicted to equilibrate to 6,335 feet (or 25 feet below the premine potentiometric surface) (Amendment Application Section 3.8.4).

4.0 TECHNICAL FEASIBILITY OF PARTIAL PIT BACKFILL ALTERNATIVES

Proposed Alternative reclamation methods for partial pit backfill were evaluated as part of the Environmental Impact Statement for BMI Operating Permit No. 00013 Amendment 004 (Montana DEQ, 2001). Three backfill reclamation alternatives were considered but eliminated from further study: (1) partial backfilling and reclamation of the open pit concurrent with active mining, (2) partial backfilling and reclamation of the open pit following the completion of mining, and (3) total backfilling of the open pit following the completion of mining.

To evaluate the technical feasibility of partially or completely backfilling the pit, RESPEC reclamation specialists reviewed these previous options regarding the 2019 Proposed Action. The analysis considered pit geometry, material tonnage, and haulage. Potential environmental consequences of the Proposed Action pit lake are discussed in Section 5, Environmental Issues of a Pit Lake, and potential impacts of pit backfilling are discussed in Section 6, Environmental Consequences of Backfilling.

Any degree of backfilling of the open pit would depend on several factors, including the following:

- The results of a geotechnical field investigation and laboratory testing program for the waste rock to determine the suitability of the material for use in backfilling the pit;
- A slope stability analysis to determine the maximum placement slope of the waste rock backfill material; this analysis should include variable horizontal placement limits of the waste rock material assuming different volumes of spoil material proposed for placement;
- Calculation of the slope stability factor of safety compared against the Corps of Engineer’s standards; and
- Geomorphological configuration to establish a safe, stable, and long-lasting post-reclamation environment. This configuration applies to both the final pit design and the final waste rock dump configuration.

Detailed design for backfilling the pit would require that the following details be provided in a work plan:

- Moisture content tolerance (±) from optimum during backfill placement;
- Horizontal thickness of the lifts during backfill placement;
- Compaction requirements of the fill;
- Estimated settlement of the completed fill if compacted to the required density and moisture content;
- Dewatering plan during the backfilling process;
- The equipment types, numbers, and cycle times used for the backfilling process;

- Work hours, number of shifts, and number of days worked per week;
- Water availability for compaction requirements and dust control; and
- Established monitoring programs during backfilling and after final reclamation is complete.

4.1 Partial Open Pit Backfilling During Operations

Partial backfilling of the open pit during active mining operations would reduce the size of the waste rock dump and the depth of the postmine pit lake. The proposed life-of-mine Regal Mine open pit is not large enough or configured to accommodate active mining and waste backfilling concurrently. The majority of the open pit area would be included in mining activities or used for haul roads and ramps throughout the mine life. This option would still require operating the Proposed Action dewatering system until the end of mining operations and backfilling was complete. A potential for limited operational backfilling of the open pit would not occur until very late in the life-of-mine development. Because the mine cannot deepen the pit to extract talc while simultaneously backfilling the pit, partial backfilling during active mining would reduce the amount of talc that could be produced, which is critical to the purpose of the expansion project. This would reduce BMI's technical ability to achieve the goals of its life-of-mine expansion plan and operations would not be able to continue for an additional 6 years as proposed. Therefore, backfilling the pit during operations would not meet the purpose and need of the Project (extending the life of the mine and availability of talc product), and this option will not be carried forward for further investigation.

4.2 Partial Open Pit Backfilling at the Completion of Mining

Reducing the depth of the final open pit by 50 percent (from a bottom elevation of 5,990 feet to 6,250 feet) would require approximately 9.1 million tons (3.86 million cubic yards [yd^3]) of waste rock backfill. Under this option, the size of the pit lake would remain the same as the Proposed Action (27 acres), but the depth of the pit lake would be reduced by 260 feet (from 345 feet to 85 feet). This option would also reduce the size of the final waste rock disposal facility.

To accomplish this partial backfilling scenario, approximately 183,000 round trips from the waste dump to the open pit by 50-ton capacity haul trucks would be required. Assuming two 10-hour shifts per day, 4 days a week for 50 weeks a year, this activity would require 2.7 years to complete. This assumption is based on five haul trucks and a 15-minute cycle time per truck. To complete this task, the dewatering and disposal system would have to be maintained for the duration of the backfilling process, thereby delaying the reclamation of these facilities and stabilization of the ground water and surface water flow systems.

A concern is that the waste rock would contribute nitrate to ground water moving through the backfilled portion of the pit and cause a contaminant plume downgradient of the pit, which would increase nitrate concentrations in the shallow pit lake. Nitrates would flush out of the backfill over a period of months or years. Nitrate concentrations could exceed ground water standards. Although this scenario is technically feasible, partial backfilling would impair ground water quality and add to reclamation time.

4.3 Total Open Pit Backfilling at the Completion of Mining

Approximately 33.5 million tons (14.6 million yd^3) of waste rock would be required to completely fill the open pit at the completion of mining. The Amendment Application indicates that the final waste rock disposal facility will contain approximately 19.5 million yd^3 of material; therefore, sufficient material is available for complete backfill. Under the complete backfill scenario, the waste rock disposal facility would be smaller than in the Proposed Action and only contain approximately 4.9 million yd^3 of waste rock.

Using the same assumptions as described in Section 4.2, Partial Open Pit Backfilling at the Completion of Mining, approximately 10 years would be required to completely backfill the open pit. This option would also require operating the dewatering system until the pit was backfilled to above the ground water table, thereby delaying the reclamation of these facilities and stabilization of the ground water and surface water flow systems. Complete backfilling would eliminate the pit lake. This option would require final grading to restore natural hydrological conditions to the area and developing a Stormwater Pollution Prevention Plan that includes erosion control using best management practices.

A concern is that the waste rock would contribute nitrate to ground water moving through the backfilled pit and cause a contaminant plume downgradient of the pit, which would increase nitrate concentrations in the shallow pit lake. Nitrates would flush out of the backfill over a period of months or years. Nitrate concentrations could exceed ground water standards. Although this scenario is technically feasible, complete backfilling of the pit is dismissed from a detailed analysis because it would not provide sufficient environmental benefit to justify increasing the site reclamation time by 10 years, adding significant fuel usage, extending the dewatering period and impacts to ground water and surface water, and potentially increasing nitrate in ground water.

5.0 ENVIRONMENTAL ISSUES OF A PIT LAKE

Impacts analyzed in the 2019 Environmental Impact Statement are limited to the environmental issues that would be associated with changes as presented in the Proposed Action and include the following:

- Increasing the size of the pit lake from 23 to 27 acres, and
- Increasing the depth of the pit lake from 450 feet to 540 feet deep.

5.1 Safety Hazards

Open pits pose many safety hazards to people, livestock, and wildlife, up to and including falling into the pit. The Proposed Action would include talus slopes along the southern and western slopes of the mine pit, which would reduce the steepness of the slopes and increase the safety of the post-reclamation site. Talus also provides stability of the slopes versus leaving the highwall intact. A slope stability analysis of the talus slope would be required to determine the final configuration of the slopes and the factor of safety for the configuration as compared to US Army Corps of Engineers' standards. The proposed design also includes a ramp for access and egress to the pit lake for wildlife, which further enhances the safety of the Proposed Action. The open pit and pit lake are planned to be fenced off to prevent injury to persons or livestock.

5.2 Visual Impacts

The open pit and pit lake of the Proposed Action would form a topographic depression and limit the visibility of the pit and visual impacts. The proposed berm around the pit would also reduce the degree to which the pit is visible from publicly accessible areas. Sweetwater Road offers the only public access with views of the open pit. Upper highwalls and benches within the open pit would be visible from a section of Sweetwater Road located immediately adjacent to the western side of the pit. Highwalls and possibly the pit lake would be visible from topographically elevated terrain on private property, particularly higher elevation slopes to the east of the open pit. The Proposed Action talus slopes along the western and southern pit walls would provide visual contrast to the site. The pit and pit lake are not visible from the homes of adjacent landowners. The visual impacts that would result from the pit or pit lake in the Proposed Action would not be significant and would be similar to impacts under the No Action Alternative.

5.3 Hydrology

As described in the Proposed Action, the pit lake would have a final size of approximately 27 acres, an estimated water surface at 6,335 feet elevation, and would be connected to the ground water flow system so as not to become stagnant (Amendment Application Sections 3.8 and 3.8.4). Water quality of a resulting pit lake, and ultimately downgradient ground water quality, could be affected by biological processes and anthropogenic activities. Residual nitrate from blasted rock and pit walls would have a minor impact to ground water quality immediately downgradient of the pit; however, water quality would likely remain within ground water quality standards. Post-reclamation usage of the pit lake by livestock could also occur.

The pit lake is predicted to receive inflow from the ground water flow system as well as direct precipitation. Outflow would occur as downgradient ground water flow and evaporation. The existence of an open excavation (pit lake) below the natural potentiometric surface elevation of the fractured rock aquifer would create an area of higher permeability within the ground water flow system. The hydraulic gradient across the lake would also be reduced but not completely flattened.

6.0 ENVIRONMENTAL CONSEQUENCES OF BACKFILLING

Backfilling the open pit poses several environmental concerns, the most important of which is the effects that nitrates contained in the waste rock would have on the ground water quality in the area. This consequence is discussed in detail in the proceeding sections. Other issues analyzed are the safety concerns and visual impacts. An environmental impact is posed because of the increased duration of backfilling activities. These impacts are a delay in establishing vegetation and the consumption of additional fuel in backfilling equipment.

6.1 SAFETY HAZARDS

Partial backfilling the open pit would not eliminate the pit lake; it would only make it shallower. Talus slopes are a form of partial backfilling and would decrease the danger of falling from the benches and/or highwall. Total backfilling would eliminate nearly all of the hazards that a partially backfilled or nonbackfilled pit would pose.

6.2 VISUAL IMPACTS

Partial backfilling would not substantially change the visual impacts compared to the Proposed Action and No Action Alternatives. Complete or nearly complete backfilling would dramatically alter the topography in comparison to the Proposed Action. Complete backfilling would allow for a natural-appearing landscape that would incorporate drainages and native vegetation that could nearly mimic the surrounding terrain. Total backfilling would also use approximately 75 percent of the material in the waste rock disposal facility and reduce the visual impacts of that Project facility. Because the visual impacts of the Proposed Action would not be significant, additional visual improvements of backfilling would not singularly justify an environmental benefit to backfilling.

6.3 HYDROLOGY

Partial or complete backfilling of the pit would impact ground water quality and water levels. The waste rock would contribute nitrate to ground water moving through the backfilled portion of the pit and cause a nitrate contaminant plume downgradient of the pit, which would increase nitrate concentrations in any remaining pit lake (depending upon the degree of backfilling). Nitrates would flush out of the backfill over a period of months or years, and nitrate concentrations could exceed ground water standards for many years into the future.

Comparing the final pit topography to the predicted stabilized ground water table elevation of 6,335 feet, the pit lake in the Proposed Action would contain approximately 1.45 billion gallons (4,460 acre-feet) of water. This water would primarily be derived from native ground water and, to a lesser extent, direct precipitation. Ground water modeling predicts that water levels in the pit would achieve 90 percent recovery in approximately 39.3 years and reach an equilibrium elevation of 6,335 feet approximately 115 years after the end of dewatering (Hydrometrics, Inc. 2019). In a scenario where the pit was backfilled to an elevation above the water table, the addition of waste rock backfill would reduce the amount of water needed to return the water table to the predicted level. Assuming a backfill porosity of 30 percent, the volume of water in the pit shell would be reduced to 435 million gallons (1,340 acre-feet). Using a ground water inflow recovery rate of 63 gallons per minute, a backfilled pit could reach 90 percent water level recovery in approximately 12 years.

7.0 CONCLUSION AND RECOMMENDATIONS

RESPEC recommends that the partial and full pit backfill alternatives be dismissed from detailed consideration because these alternatives do not provide sufficient environmental benefit. Design improvements to the waste rock disposal facility are recommended to reduce the need for several of the proposed erosion-control measures while also developing a mosaic vegetation pattern to increase biodiversity.

8.0 REFERENCES

Barretts Minerals, Inc. 2019. Application for Amendment 006 to Operating Permit No. 00013 for the Regal Mine, Madison County, Montana. Prepared by Barretts Minerals, Inc. Dillon, Montana. Prepared for Montana Department of Environmental Quality, Helena, Montana.

DEQ (Montana Department of Environmental Quality). 2001. Final Environmental Impact Statement Amending and Adopting the Draft Environmental Impact Statement, Barretts Minerals, Inc. Regal Life-of-Mine Expansion Plan. Prepared by the Montana Department of Environmental Quality. Helena, Montana.

Hydrometrics, Inc. 2019. Barretts Minerals Inc. Regal Mine Water Management Plan. Prepared by Hydrometrics, Inc. Helena, Montana. Prepared for Barretts Minerals Inc., Dillon, Montana.

APPENDIX B: TECHNICAL MEMORANDUM 2

Technical Memorandum 2

To:	Montana Department of Environmental Quality 1520 E. 6th Avenue Helena, MT 59601
From:	RESPEC Company LLC P.O. Box 725 Rapid City, SD 57709
Date:	December 16, 2019
Subject:	Barretts Regal Mine Project – Water Rights Assessment

1.0 INTRODUCTION

The basis for this technical memorandum is the application for Amendment 006 to Operating Permit (OP) Amendment No. 00013 (Barretts Minerals, Inc. 2019) that was submitted to the Montana Department of Environmental Quality (DEQ) on March 12, 2019, and revised September 2019. That document is referenced in the body of this memorandum as "Amendment Application" with the corresponding section and page number indicated as appropriate. In particular this analysis relies on Appendix A of the Amendment Application including the Water Management Plan (Hydrometrics, Inc. 2019a), which is referenced in the body of this memorandum as "WMP," and the Water Resources Sampling and Analysis Plan (Hydrometrics, Inc. 2019b); the section and page number are indicated as appropriate. The technical memorandum purpose is to disclose potential impacts from the Amendment Application to water rights at or in the vicinity of the Proposed Action. DEQ is conducting this memorandum to disclose impacts.

Water right permitting authority is administered by the Montana Department of Natural Resources and Conservation (DNRC). Regardless of flow augmentation, if any water rights are impaired, water right holders would have recourse under 85-2-114 and 85-2-125(2) MCA.

2.0 BACKGROUND

The Regal Mine is located 11 miles southeast of Dillon in Madison County, Montana, and is located on private land accessed via Sweetwater Road. The open pit mine has been in operation since 1972. Barretts Minerals, Inc. (BMI) currently mines talc ore from the Regal Mine using conventional open pit methods of drilling, blasting, loading, and hauling.

The mine is located completely within Montana Water Court Basin 41B (i.e., the Beaverhead River). In 2013, the Montana Water Court issued a preliminary decree for the historical water rights. Those water rights established before 1973 in this basin and the majority of the cases in the adjudication for this basin have been resolved. While the site is located approximately 1.25 miles from the boundary between Basins 41B and 41C (Ruby River), all of the surface water and ground water impacts are expected to be observed within Basin 41B.

The Beaverhead Basin is included in the Jefferson and Madison Basin closure (Section 85-2-341, *et seq.,* Montana Code Annotated [MCA]). This statute prohibits DNRC from issuing most new water right permits within the Jefferson and Madison River drainage basins including all of the tributaries. The Beaverhead River is a major tributary of the Jefferson River. Certain exceptions exist to the permitting requirements and to the basin closure provisions. The exceptions include the following:

- Ground water diversions of 35 gallons per minute (gpm) or less and/or 10 acre-feet (ac-ft) per year or less;
- Permits accompanied by viable mitigation plans;
- Permits to appropriate water for nonconsumptive uses; or
- Permits for ground water if a hydrogeologic report indicates there will be no net depletion to surface water as a result of the ground water appropriation.

Montana Water Law generally requires a water right whenever an action involves diverting water from its source for a beneficial use or when one wishes to protect a quantity of water in the source for a beneficial use. Note that the aspect of "beneficial use" is directly related to intention. Certain activities that involve moving water or inducing water to be exposed to the surface may not require a water right if the water does not have a beneficial use. For example, pumping ground water away from a mining site and disposing of it with no beneficial use does not require a water right. However, pumping ground water away from a mining site and returning it to a specific location for the express purpose of providing flow augmentation in nearby streams and/or ground water sources is a beneficial use of water (Section 85-2-102(4), *et seq.,* MCA) and requires a water right.

Under Montana Water Law, a party with a valid existing water right has the ability to seek injunctive relief if activities of another party with no water right interfere with the lawful exercise of the senior water right holder's right. Section 85-2-125 (2), *et seq.,* MCA states:

"*The party obtaining injunctive relief in an action to enforce a water right must be awarded reasonable costs and attorney fees. For the purposes of this section, "enforce a water right" means an action by a party with a water right to enjoin the use of water by a person that does not have a water right.*"

For a potential water right applicant to obtain a water right for flow augmentation to mitigate dewatering impacts, one or more of the exceptions to the basin closure listed in Section 85-2-

341, *et seq.,* MCA needs to be met. An applicant for a water right permit must also meet the criteria described in Section 85-2-311, *et seq.,* MCA. These criteria generally require that the applicant provide the following evidence:

- Water is physically available;
- Water is legally available;
- Existing water rights will not be adversely affected; and
- The proposed means of diversion is adequate.

Montana Water Law also allows the holder of an existing water right to apply for authorization to change a water right. Under Section 85-2-402, *et seq.,* MCA, a water right owner may apply to the DNRC to change the following information of an existing water right:

- Place of use;
- Point of diversion;
- Purpose; or
- Place of storage.

Regarding the proposed dewatering actions, water rights are not required for water discharge in the mining process. An applicant may obtain a water right for dust suppression or other beneficial uses of ground water that do not exceed the 35 gpm and/or 10 ac-ft permitting exemption limitations (note that both limitations apply because the 35 gpm is the maximum instantaneous flow rate that can be withdrawn and the 10 ac-ft is the total annual volume that can be withdrawn).

The measurement of adverse effect on existing water rights is site specific. Depending on the circumstances and the number and size of existing water rights, flows in a source could be diminished by a certain percentage without creating an adverse effect. In other situations, even a small reduction in flows could result in a finding of adverse effect. Under Montana Water Law, no set percentages are established by which the flows can be acceptably reduced. Note that to the extent that the operator of a mine is required to replace water as per Section 82-4-355, *et seq.,* MCA, this requirement is also subject to Title 85 Chapter 2, *et seq.,* MCA. In other words, providing augmentation to ensure that existing water rights are not harmed requires a water right and following regulations in Title 85, Chapter 2, *et seq.,* MCA.

2.1 Summary of Ground Water and Flow Modeling

An analytical element model was developed to predict ground water and surface water interactions from mining activities. AnAqSim was used to predict the locations, pumping volumes, and depths of dewatering wells and also to evaluate the connectivity between ground water, springs, and surface waters to determine any potential dewatering effects on them from mining activities.

Based on a 10-year pumping period, a transient model projected that seven wells would be required to dewater the pit at a rate of 595 gpm. Drawdown and mounding at the end of dewatering and injection is shown on **Figure 5-1**. At closure, the regional ground water system would be at an elevation of approximately 5965 feet, which would result in a decline in the regional ground water system of 395 feet over the course of mining operations. To the south (upgradient), drawdown of 100 feet reaches 3,000 feet from the pit; to the east, drawdown of 100 feet reaches 2,100 feet from the mine pit. To the west-northwest (downgradient), drawdown of 100 feet extends 240 feet from the mine pit, and drawdown to the west is mitigated by infiltration features in this area.

The postmining recovery simulation includes proposed postmining flow augmentation for Hoffman and Carter creeks. This scenario predicts that, following cessation of mining and dewatering, ground water levels recover in approximately 80 years.

2.2 Proposed Barretts Minerals, Inc. Mitigation Measures

Impacts to surface water flows in Hoffman and Carter creeks are anticipated to occur as a result of pit dewatering. BMI would dispose of dewatering water during operations and augment stream flow as necessary during postclosure from wells RMG-1 and/or RMG-3 to ensure that beneficial use is supported and water rights are not negatively impacted.

A new infiltration pond (IF-3) would be constructed to accept a continuous flow up to 500 gpm for disposal of dewatering water during active mine operations. Discharge of dewatering water would also occur using the UIC well, which could inject up to 120 gpm into the alluvium during mine operations. Approximately 5.6 to 29 gpm may be discharged seasonally between August and March during the postclosure period until flow augmentation of Hoffman Creek is no longer required (BMI 2019). The ground water model predicts that during operations, Spring SP-1 would be impacted by dewatering. To compensate for reduced flow, water from one of the new dewatering wells, RMG-1, and/or RMG-3 would be discharged into a collection trap at the head of the new portion of Hoffman Spring Creek. Discharge of dewatering water would also be accomplished by infiltration at IF-1 at an estimated rate of 70–100 gpm during mine operations. Flow augmentation of Carter Creek would be accomplished by recharging the alluvium associated with IF-1 at rates ranging from 1.4 to 2.9 gpm for the period of December through February as necessary (BMI 2019).

The modeling results predict that flow augmentation may be required for approximately 15 years on Carter Creek and 65 years on Hoffman Creek. Flow augmentation infrastructure will remain in place for 5 years following cessation of active mine operations or until sufficient flow conditions are reestablished to meet regulator criteria.

3.0 PROPOSED ACTION

The applicant proposes to expand and deepen the mine pit, increase the size of the waste rock disposal facility, modify the ground water capture and infiltration system, and realign Hoffman Spring Creek. The permit area would be expanded by 136.9 acres for a total permit area of 380.1 acres (Amendment Application Table 3-1). Not all of the proposed actions described in the Amendment Application have the potential to affect water rights. The following text summarizes the proposed actions that could influence water rights and are noteworthy as part of this water rights analysis.

Before mining, the elevation of the water table was estimated at approximately 6,360 feet above mean sea level (amsl). The outer rim of the Regal Mine pit sits at 6,530 feet amsl. Currently, the permitted depth of the Regal Pit bottom is 6,080 feet amsl and would be deepened to 5,990 feet amsl. This proposed pit depth would extend approximately 370 feet in to the local bedrock aquifer (Amendment Application Section 3.2, Page 16).

The deepening of the pit is projected to increase the ground water flow into the pit. Currently, BMI has six dewatering wells. BMI anticipates that three of the dewatering wells will become too shallow to be used effectively as the pit is deepened. The remaining three dewatering wells will be destroyed as the pit expands. Wells RMG-1 and RMG-3, used for dust abatement, are projected to become too shallow and may need to be deepened or abandoned and replaced by another well (Amendment Application Section 3.7.1, Page 24).

The existing dewatering wells will need to be replaced to effectively dewater the deepened pit. The Proposed Action specifies that up to seven additional wells (each at depths of up to 600 feet to target elevations of 5,965 feet amsl) would be used to dewater the pit before mining expansion activities. The proposed new dewatering wells would be sited similar to the existing dewatering wells (Amendment Application Section 3.7.1 Figure 3-5, Page 25). BMI has anticipated that the water pumped from these wells would total approximately 595 gpm. BMI proposes to monitor flow rates and volumes that are pumped and conveyed to the proposed infiltration points (Amendment Application Section 3.7.1, Page 24).

An existing infiltration pond (IF-1), located in the southwest corner of the permit boundary, would remain and be unchanged by the amended application. BMI is proposing to close and reclaim one of the existing infiltration ponds (IF-2). BMI is also proposing to construct a new infiltration pond (IF-3), which would be located north of the expanded waste rock disposal facility, which is approximately ¾ mile from the pit. A buried pipeline would connect IF-3 to the dewatering wells. The proposed location of IF-3 would be installed far enough downgradient to ensure that the water would not cycle back into the Regal Mine pit. IF-3 is designed to accommodate a continuous flow of 500 gpm, which would equate to 96,000 cubic feet of water daily (Amendment Application Section 3.7.2, Page 26).

BMI also has a UIC well (approved the U.S. Environmental Protect Agency) that is located adjacent to Hoffman Creek. The UIC well is designed to receive up to 120 gpm and provide both disposal of water during operations as well as postmining recharge or flow augmentation of Hoffman Creek alluvium and surface flow in Hoffman Creek below Hoffman Pond. BMI is proposing to use the UIC well until flow augmentation is no longer required (Amendment Application Section 3.7.3, Page 26).

The pit sump(s) would collect direct precipitation and storm water run-on collected in the pit as well as any ground water that was not intercepted by the dewatering wells. Water from the pit sump would be transported to a 1-acre settling pond (SED-1) before being released to IF-3 (Amendment Application Sections 3.7.4 and 3.7.5, Page 26–27).

BMI stated that if actions attributed to the Regal Mine cause adverse effect to beneficial uses associated with existing surface water rights, BMI would augment as needed to support flows during the postclosure period. During the mine's operational period, BMI anticipates that discharges from mine dewatering wells into IF-1, IF-3, and/or the UIC well would minimize impacts to water rights during mining. Once dewatering of the pit ceases, augmentation of Carter Creek may be required and would be accomplished by pumping water from wells RMG-1 and/or RMG-3 into IF-1. Similarly, the Hoffman Creek alluvium would be partially augmented with water from wells RMG-1 and/or RMG-3 that would be injected into the UIC well. A spring (SP-1), which is located adjacent to Hoffman Creek, is predicted to be impacted by dewatering. Water from a dewatering well would be routed to a collection trap at the head of the Hoffman Creek spring channel to augment flows from SP-1 (Amendment Application Section 3.7.6, Page 27). BMI is anticipating that flow augmentation may be required after dewatering ceases for intermittently for a period of up to 15 years on Carter Creek and 65 years on Hoffman Creek.

The expanded mine footprint would extend over a portion of a tributary of Hoffman Creek, which is known as Hoffman Spring Creek. Shallow ground water is seeping into the Regal Mine pit and results in partial dewatering of Hoffman Creek. Currently, BMI is mitigating this loss by routing a section of the creek's flow through a pipe laid in the existing channel.

BMI is proposing to permanently relocate a portion (i.e., 730 linear feet) of Hoffman Spring Creek (Amendment Application Section 3.7.8, Page 31). This channel would be lined to prevent water seeping into the mine pit. Water from upper Hoffman Spring Creek would flow into a catchment basin before flowing into the constructed channel. This catchment basin is proposed to provide controlled livestock watering for the adjacent landowner. The stock pond design is intended to reduce flow velocities and prevent water from flowing under the channel liner. Two subsurface cut off walls would be constructed to redirect shallow ground water into the stream channels and away from the mine pit.

BMI is also proposing to seal 600 feet of the Hoffman Creek channel by using bentonite granules. After sealing is completed, the piping in Hoffman Creek would be removed and the creek's flow would be restored. BMI is planning to monitor performance of the bentonite for 10 years (Amendment Application Section 3.7.8, Pages 31–33).

BMI estimates that the ground water table would decline by approximately 395 feet over the course of the mining operation because of the dewatering system. BMI's modeling predicts that the water table recovery would be within 50 feet of baseline levels 60 years after dewatering is concluded (Amendment Application Section 3.7.10, Page 34). As part of the reclamation plan, BMI plans to plug and abandon dewatering wells or those to which BMI no longer holds a water right(Amendment Application Section 3.8, Page 35). BMI states that the Regal Mine pit, SED-1, IF-3, and dewatering wells would be reclaimed within 2 years of the end of mining activity. IF-1, the UIC well, and SP-1 would remain for 5 years after mining ceases or until flow information has been gathered that supports removing the infrastructure (Amendment Application Section 3.8, Page 34–35). BMI has proposed that, depending on water rights, water from the pit lake could be used for stock or irrigation purposes as a postclosure land use (Amendment Application Section 3.8.1, Page 36).

BMI plans to monitor both surface water and groundwater in the areas surrounding the Regal Mine. This monitoring effort would include six surface water monitoring locations with three locations on each creek as well as a flume box on each creek. BMI is also planning to install two new ground water monitoring wells to record the elevation of the bedrock water table (Amendment Application Section 3.9, Page 45). BMI plans to monitor surface water and ground water during mine operations as well as after mining ceases. During the postmining period, certain wells would be used to monitor vertical and horizontal groundwater conditions (Amendment Application Section 3.12.1, Page 47).

The surface water monitoring sites are located on Carter and Hoffman creeks. Six monitoring sites are located on each stream. On Carter Creek, the furthest upstream site (CC-1) is approximately 0.5 mile upgradient of the mine pit, and the furthest downstream site (RMS-2) is approximately 1.5 miles downgradient of the mine. Flow and water quality data have been collected at some of these monitoring sites with varying frequency beginning in 1994; other measurement sites have been established since that time. BMI would install transducers at six surface water monitoring locations (three on Carter Creek and three on Hoffman Creek) to continuously monitor flow rate and two flume boxes (Amendment Application Section 3.9.1, Page 45).

The sampling plan (Hydrometrics, Inc. 2019b, Section 2.1.1, Page 2-2) anticipates relocating three of the sites on Hoffman Creek to better capture water quality and streamflow data. The location of the monitoring sites that would be used are identified on Figure 2-1 in the sampling plan. The Hoffman Creek sites would also be sampled on at least a semiannual basis plan (Hydrometrics, Inc. 2019b, Section 2.1.1, Page 2-2).

4.0 EXISTING WATER RIGHTS

4.1 BARRETTS MINERALS, INC.

Two active water rights, one terminated water right permit application, and one pending application for a ground water certificate are associated with the Regal Mine. The two active water rights are Groundwater Certificate Nos. 41B 86002 and 41B 30047773 and are shown on **Figures 4-1** and **4-2**, respectively. Both rights allow for diversion and use of ground water for the purpose of pollution abatement, which includes dust control (suppression) and cleaning of vehicles and the shop area.

Certificate 41B 86002 was filed for 35 gpm (up to 9.67 ac-ft) with a priority date of September 7, 1993. Certificate 41B 30047773 for well RMG-3 was filed for 20 gpm (up to 0.86 ac-ft) with a priority date of December 29, 2009. The description of well RMG-3 provided in Table 4-1 of the WMP matches location information on the well log in the water right file.

A pending application, or Notice of Completion of Groundwater Development, was filed by BMI to allow for an additional 9.14 ac-ft of water to be withdrawn from well RMG-1 for the purpose of pollution abatement. Neither the existing water rights or the pending application allow for the use of water for the purpose of flow augmentation. However, under 85-2-402 MCA *et seq*, BMI may apply to DNRC to change the beneficial use to mitigation (i.e. flow augmentation).

4.2 ADJACENT AND DOWNSTREAM LANDOWNERS

The water rights included in this analysis were categorized as follows:

- Surface water diversions on Hoffman Creek above and below the mine;
- Surface water diversions on Carter Creek above and below the mine;
- Ground water diversions near the Carter Creek channel; and
- Surface and ground water diversions within the area of projected drawdown.

Water right diversions on or near Carter and Hoffman creeks were identified down to the location where Carter Creek meets Highway 41. The landowners who own water rights that fall into one or more of the above categories are listed in **Table 4-1** and depicted in the map on **Figure 4-3** (DNRC 2019, Montana State Library 2019)**.**

June 12, 2019
41B 86002-00

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General Abstract

STATE OF MONTANA
DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION
1424 9TH AVENUE P.O.BOX 201601 HELENA, MONTANA 59620-1601

GENERAL ABSTRACT

Water Right Number: 41B 86002-00 GROUND WATER CERTIFICATE
Version: 1 -- ORIGINAL RIGHT
Version Status: ACTIVE

Owners: MINERALS TECHNOLOGIES INC
7225 MT HWY 91 S
DILLON, MT 59725-9640

Priority Date: SEPTEMBER 7, 1993 at 09:30 A.M.

Enforceable Priority Date: SEPTEMBER 7, 1993 at 09:30 A.M.

Purpose (use): POLLUTION ABATEMENT
DUST SUPPRESSION

Maximum Flow Rate: 35.00 GPM

Maximum Volume: 9.67 AC-FT

Source Name: GROUNDWATER

Source Type: GROUNDWATER

Point of Diversion and Means of Diversion:

ID	Govt Lot	Qtr Sec	Sec	Twp	Rge	County
1		SWNENE	2	8S	7W	MADISON

Period of Diversion: MARCH 10 TO OCTOBER 10
Diversion Means: WELL
Well Depth: 420.00 FEET
Static Water Level: 80.00 FEET
Casing Diameter: 4.63 INCHES
Pump Size: 5.00 HP

Purpose (Use): POLLUTION ABATEMENT
Volume: 9.67 AC-FT
Period of Use: MARCH 10 to OCTOBER 10

Place of Use:

ID	Acres	Govt Lot	Qtr Sec	Sec	Twp	Rge	County
1			SWNENE	2	8S	7W	MADISON

Geocodes/Valid: 25-0243-02-1-01-01-0000 - Y

Figure 4-1
BMI Water Right Abstract Certificate No. 41B 86002 00 (RMG-1)

June 12, 2019
41B 30047773

Page 1 of 1
General Abstract

STATE OF MONTANA
DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION
1424 9TH AVENUE P.O.BOX 201601 HELENA, MONTANA 59620-1601

GENERAL ABSTRACT

Water Right Number: 41B 30047773 GROUND WATER CERTIFICATE
Version: 1 -- ORIGINAL RIGHT
Version Status: ACTIVE

Owners: BARRETTS MINERALS INC
8625 MONTANA HWY 91 S
DILLON, MT 59725-8003

Priority Date: DECEMBER 29, 2009 at 08:47 A.M.
Enforceable Priority Date: DECEMBER 29, 2009 at 08:47 A.M.
Purpose (use): POLLUTION ABATEMENT
Maximum Flow Rate: 20.00 GPM
Maximum Volume: 0.86 AC-FT
Source Name: GROUNDWATER
Source Type: GROUNDWATER

Point of Diversion and Means of Diversion:

ID	Govt Lot	Qtr Sec	Sec	Twp	Rge	County
1		SWNENW	2	8S	7W	MADISON

Period of Diversion: JANUARY 1 TO DECEMBER 31 **Flow Rate:** 20.00 GPM
Diversion Means: WELL
Well Depth: 310.00 FEET
Static Water Level: 255.00 FEET
Casing Diameter: 4.00 INCHES

Purpose (Use): POLLUTION ABATEMENT **Purpose Clarification:** DUST CONTROL, TRUCK & SHOP CLEANING
Volume: 0.86 AC-FT
Period of Use: JANUARY 1 to DECEMBER 31

Place of Use:

ID	Acres	Govt Lot	Qtr Sec	Sec	Twp	Rge	County
1			SWNENW	2	8S	7W	MADISON

Geocodes/Valid: 25-0328-35-3-01-01-0000 - Y

Figure 4-2
BMI Water Right Abstract Certificate No. 41B 30047773 (RMG-3)

Table 4-1
Area Land and Water Rights Owners

ERB East Beaverhead County LLC
Geoduck Land & Cattle
Helle Livestock
Helle Livestock, & Tom W Helle, & John C Helle
Rebish & Helle Partnership
Rebish Konen Livestock Limited
Rebish Konen Lvstk Limited Partnership
Rebish Peter & Helle Agnes TC
Ruby Dell Ranch Inc
State of Montana State Lands
U.S. Department of Agriculture Bureau of Land Management

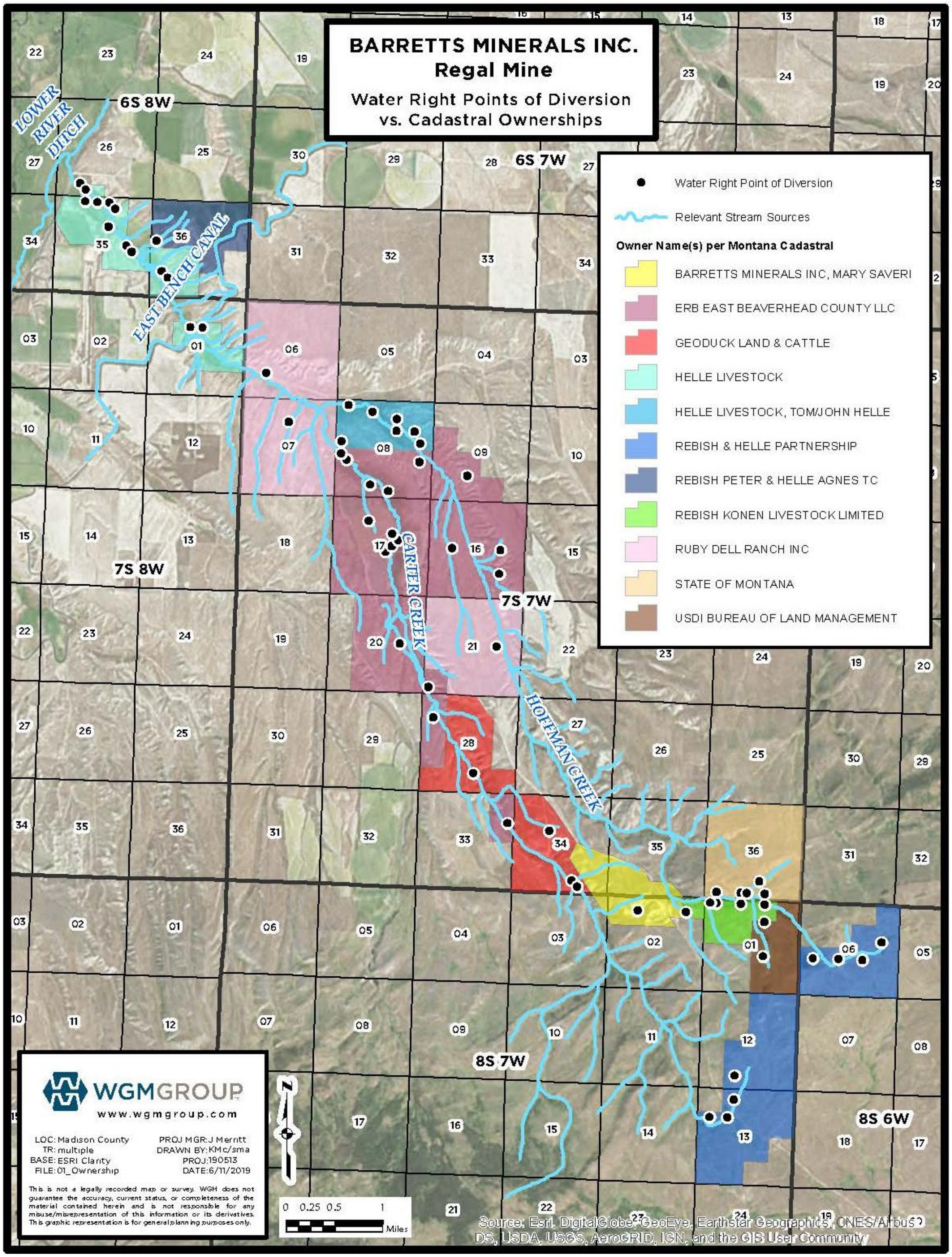

Figure 4-3
Water Right Points of Diversion and Cadastral Ownership

5.0 ANALYSIS OF POTENTIAL IMPACTS TO WATER RIGHTS

5.1 CURRENT CONDITIONS

This analysis considered the following water features that may be impacted:

- Hoffman Creek;
- Carter Creek; and
- Ground water wells and springs.

The current conditions of each of these features are discussed in the following text.

5.1.1 Hoffman Creek

Hoffman Creek arises east of the mine with a portion of the channel bordering the eastern edge of the site and flows generally west-northwest toward the Beaverhead River. According to the information in the Amendment Application (Section 4.2.1, Page 48), Hoffman Creek is fed by ground water from springs in the area above the mine. Measurements indicate that Hoffman Creek is a gaining reach from the headwaters above the mine to approximately 2.6 miles downstream from the mine site. In this stretch, Hoffman Creek is a perennial-flowing stream. The portion of the creek below this point is intermittent.

Eleven water rights exist on Hoffman Creek, its named tributary Bishop Creek, its unnamed tributaries, and on springs that appear to be directly connected to Hoffman Creek. All of these water rights, except one, are for stock use and are mainly for livestock to drink directly from the surface water sources where water is available. One of the rights is for domestic use. The flow rates and volumes for these rights are not usually quantified. Montana Water Law protects these uses to the extent that they have been historically and beneficially exercised. No data have been presented regarding the extent to which the water rights have been used in the past or are currently being used. The existing water rights holders are responsible for providing evidence of their historical use to show that they have been impacted.

Synoptic stream flow data are included in the WMP for several measuring sites on Hoffman Creek from 2006 through 2017 (WMP Section 2.2.3, Pages 2–23). From 2013 through 2016, flows in Hoffman Creek at Site RMS-1 were affected by inflows into the mine pit. According to the WMP, this situation has been resolved by routing the flow through a pipeline in the stream channel.

5.1.2 Carter Creek

Carter Creek arises south of the mine and runs northwest along the western border of the mine. According to the Amendment Application, Carter Creek is perennial in its upper reaches, and becomes intermittent approximately 2 miles downstream of the Regal Mine area (WMP Section 4.2.1, Page 48). Carter Creek is fed by ground water in the perennial reach (WMP Section 2.1.4, Pages 2–5). The WMP asserts that the perennial reach of Carter Creek terminates near the location of certain irrigation ponds located on the creek (WMP Section 2.1.4, Page 2–5). The referenced ponds are assumed to be those located in NE 1/4 Section 33, Township 7 South, Range 7 West, Beaverhead County. Synoptic flow data for several sites on Carter Creek are presented in the WMP (Section 2.2.3, Page 2–22).

Twelve water rights exist on Carter Creek and unnamed tributaries of Carter Creek. Two of those water rights are in the reach between the headwaters and the irrigation ponds. Those two water rights are for stock use directly from the source. The remaining ten water rights for Carter Creek are for irrigation pond use, as well as stock and domestic uses below the ponds.

5.1.3 Springs Ground Water Claims

BMI identified and monitored three seeps and sixteen springs in the vicinity of the mine. Information collected about these seeps and springs is presented in the WMP with a map of the site locations that have been investigated (Section 2.2.1, Figure 2-5). Based on the results of site monitoring, the springs appear to be supplied by deeper ground water and the seeps are associated with shallow structures and flow in response to runoff and infiltration of precipitation (Amendment Application Section 4.2.1. Pages 48–49). The only spring in this inventory that appears to be associated with a specific water right is Spring SP-1 (Claim 41B 194158-00), which is located at the upper end of Hoffman Spring Creek.

Several monitoring wells have been installed and ground water data have been gathered over several years. According to the Amendment Application (Section 4.2.2, Page 50), the aquifer near the mine area is semiconfined. One ground water right is within 2 miles of the mine site and a second ground water right is located within approximately 2 miles of the mine site. All other ground water rights for wells are located near Carter Creek, which is over 2 miles downstream from the mine site.

5.2 Proposed Action-Predicted Conditions During and Postmining

The Proposed Action includes installing up to seven new dewatering wells, installing a new water line and infiltration pond, using the UIC well for water disposal and flow augmentation, relocating a portion of Hoffman Spring Creek, and sealing a portion of the Hoffman Creek channel with bentonite (Amendment Application Section 3.7.1, Page 24; Section 3.7.2, Page 25; Section 3.7.3, Page 26; and Section 3.7.8, Page 31).

Pumping water from the dewatering wells during active mining operations does not require a water right permit because the applicant is pumping the water exclusively to dispose of it; the water is not being put to a beneficial use. Once active mining ceases, water for flow augmentation would be pumped from wells RMG-1 and/or RMG-3 (Amendment Application Section 3.7.7, Page 27) Augmentation is a beneficial use of water and diverting water for this use requires a permit under 85-2-302, MCA or a change of use under 85-2-402, MCA. The applicant presently has water rights for wells RMG-1 and RMG-3 that allow each well to be pumped at a rate of 20 gpm and 35 gpm, respectively, up to a total volume of 10.53 ac-ft for the purpose of pollution abatement. BMI filed a Notice of Completion of Groundwater

Development (Form 602) with DNRC on July 30, 2019 for well RMG-3 that would change the appropriation from this well to 10 acre-feet per year. Upon approval of the Notice of Completion, BMI may have a combined total appropriation from wells RMG-1 and RMG-3 of 19.67 acre-feet annually (Amendment Application Section 1.1.6, Page 8).

5.2.1 Hoffman Creek

Three aspects of the Proposed Action directly or indirectly involve Hoffman Creek. One of those actions is relocating a portion of Hoffman Spring Creek that would be required because of the proposed pit expansion. The Proposed Action includes relocating approximately 730 lineal feet of the stream channel. The design of the new channel includes placing a 100-mil high density Polyethylene liner and constructing a pond at the upper end to reduce velocities and prevent water from flowing under the liner (Amendment Application Section 3.7.8, Page 33). The channel would remain in the new location at the end of the Proposed Action.

The intention to allow the use of the pond at the head of the new portion of the channel for stock watering would require a water right as this would be a new beneficial use of water. DNRC should be consulted by BMI about this topic.

The second part of the Proposed Action related to Hoffman Creek is the effort to reduce surface water infiltration from the stream channel into the pit. The amount of water entering the pit requiring disposal would also be reduced. The channel sealing would be accomplished by removing a layer of rocks and debris from the bed and the banks of the stream and incorporating bentonite into the bed material. The bentonite installation would be monitored for 10 years (Amendment Application Section 3.7.8, Page 33). Impacts that may occur after this 10-year period is uncertain.

The third aspect of the Proposed Action related to Hoffman Creek is injecting water from the dewatering wells into the UIC well. The UIC well has been approved by the U.S. Environmental Protection Agency (Amendment Application Section 3.7.3, Page 26). The UIC well provides an additional location for discharging water that is pumped from the dewatering wells. The UIC well consequently recharges the Hoffman Creek alluvium and contributes flow back to the surface water in the stream (Amendment Application Section 3.7.3, Page 26). The applicant anticipates continuing to use the UIC well for flow augmentation in the closure period if necessary.

5.2.2 Carter Creek

The existing infiltration basin (IF-1) would continue to receive water from the dewatering wells during operations. In the postclosure period, water from wells RMG-1 and RMG-3 will be discharged into IF-1 to recharge the alluvium associated with Carter Creek.

5.2.3 Springs/Ground Water Claims

One aspect of the Proposed Action could involve a spring with a water right. Based on the ground water model, flow in spring SP-1 could be affected by dewatering during operations. BMI proposes to pump water from one of the dewatering wells into the pond (to be constructed) at the head of the portion of Hoffman Spring Creek (Amendment Application Section 3.7.6, Page 27). This action is proposed to offset the predicted depletions to Spring SP-1.

The ground water table is expected to be reduced by approximately 395 feet during mine operations (Amendment Application Section 3.7.10, Page 34). After dewatering ceases, the ground water table is projected to recover to within 50 feet of the baseline levels within 60 years.

5.3 Potentially Impacted Water Rights

As discussed briefly in Section 4.2, Adjacent and Downstream Landowners, the water rights were categorized based on the following:

- Upstream or downstream location relative to the mine pit; and
- Location relative to the simulated drawdown area depicted in Figure 4-2 of the WMP.

Figure 5-1 contains a map that depicts the location of the points of diversion for the water rights within the area identified for review. The diversion points are color-coded based on category, and surface water diversions are differentiated from ground water diversions.

5.3.1 Hoffman Creek Above the Simulated Drawdown Footprint of the Mine

Only one water right exists on Hoffman Creek with diversions above the simulated drawdown footprint of the mine—Statement of Claim 41B 196140 owned by Rebish & Helle, Inc. The source of water for the water right is described as a spring tributary of Hoffman Creek. This water right allows stock animals to drink directly from the surface water (livestock direct from source). The period of use of this claim is from April 1 through November 1 of each year.

Note that this right has no quantified flow rate or volume, which is common with historical stock claims that are characterized as livestock direct from source. Because of the difficulty of assigning an appropriate flow rate and volume to this type of use, the Montana Water Court decrees these rights with generic statements that indicate the flow rate and volume of the water rights are limited to the amount historically used. This statement does not mean that no flow rate or volume is associated with the water right, only that the values have not been numerically quantified. In a situation where the flow rate or volume is disputed, the water right owner is responsible for providing information to substantiate those values.

Given the location of this water right above and outside of the simulated drawdown area, dewatering at the mine would not likely impact this right.

5.3.2 Hoffman Creek Below the Simulated Drawdown Footprint of the Mine

Four water rights (with several diversion points) exist on Hoffman Creek below the mine. These water rights are listed in **Table 5-1**, and the locations of the diversions are depicted on **Figure 5-1**. All four of these water rights are for year-round use of surface water characterized as "livestock direct from source." Of the four water rights, two have quantified flow rates.

Table 5-1
Hoffman Creek Drainage Below Mine – Water Right Flow Rate and Volume Data

Water Right Number	Period of Diversion	Flow Rate	Volume
41B 132586 00	01/01 to 12/31	NQ	NQ
41B 137165 00	01/01 to 12/31	NQ	NQ
41B 30117195	01/01 to 12/31	30 gpm	21.8 Ac-ft
41B 30119197	01/01 to 12/31	35 gpm	17 Ac-ft
	Flow Rate Totals in gpm:	65+	

NQ= Flow Rate/Volume not quantified.

For the purposes of this analysis, the total flow rate of the water rights on Hoffman Creek below the mine is assumed to be greater than 65 gpm. Mine activities appeared to impact stream flows during the period from 2013 to 2016; however, that situation appears to have been mitigated through the temporary pipeline in the stream channel. The current mine activities do not appear to be impacting the flows of Hoffman Creek. BMI's comparison of predicted mean monthly flow and the ground water model-predicted maximum stream depletion rate indicates that flows will be depleted below 65 gpm between December and March; however, current mean monthly flow is estimated to be below 65 gpm during the time frame, regardless of future mine dewatering (Amendment Application Table 3-4, Page 29). Based on this analysis, the Proposed Action may impact water rights listed in **Table 5-1**, although impacts are predicted to be mitigated through flow augmentation.

5.3.3 Carter Creek Above the Simulated Drawdown Footprint of the Mine

Only one water right exists on Carter Creek above the simulated drawdown footprint of the mine—Statement of Claim 41B 196142. This water right is an unquantified livestock direct from source with permitted use from April 1 through November 1 each year. The diversions for this right are in the very upper reach of one of the tributaries to Carter Creek (outside the simulated drawdown area). The closest measurement site is CC-1 (WMP Figure 2-10, Page 2–24), which is above the mine but downstream of the diversions for Claim 41B 196142. The water flow measurements at this site range from 152 gpm to over 1,500 gpm. The Proposed Action is not likely to reduce these flows enough to impact this water right.

5.3.4 Carter Creek Below the Simulated Drawdown Footprint of the Mine

Carter Creek drainage below the simulated drawdown footprint of the mine has a variety of water rights, including ten groundwater rights, nine surface water rights, and two spring water rights. **Table 5-2** lists the water right number, source, use, period, and rate of diversion. During the dewatering period, flow depletions in Carter Creek are anticipated to occur but would be mitigated by recharge through discharge to IF-1 (Amendment Application Section 3.7.7, Page 27-28). In the closure period, the applicant proposes to pump water into IF-1 from wells RMG-1 and/or RMG-3.

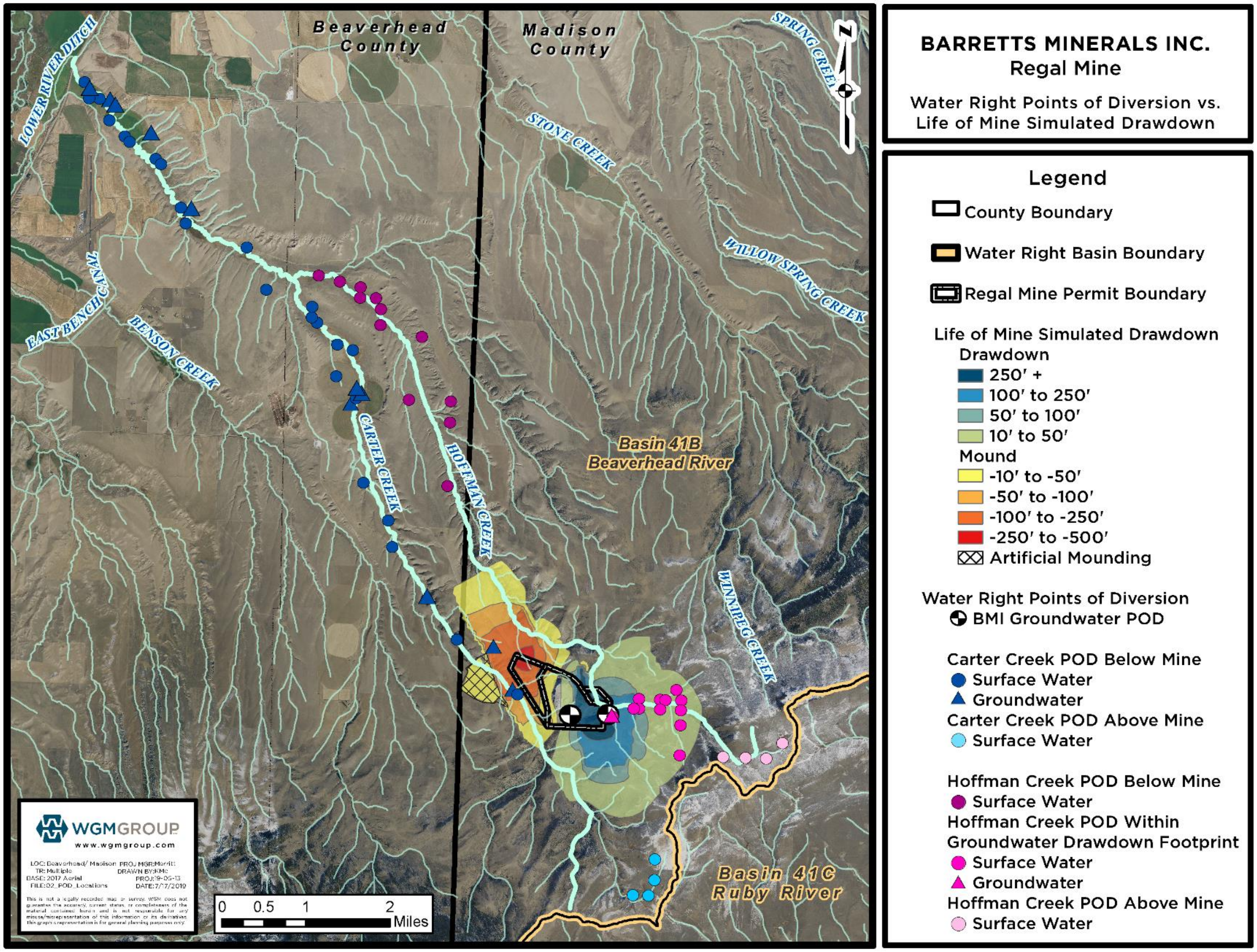

Figure 5-1
Water Right Points of Diversion and Life-of-Mine Simulated Drawdown

Table 5-2
Carter Creek Drainage Below Mine – Water Right Flow Rate and Volume Data

WR Number	Source Name	Use	Period of Div.	Flow Rate	Volume	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
41B 107872 00	GROUND WATER	DM/ST	01/01 to 12/31	10 gpm	2.42 AF	10	10	10	10	10	10	10	10	10	10	10	10
41B 132585 00	CARTER CREEK	ST	01/01 to 12/31	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ
41B 179293 00	GROUND WATER	ST	01/01 to 12/31	10 gpm	NQ	10	10	10	10	10	10	10	10	10	10	10	10
41B 2306 00	GROUND WATER	IR	05/01 to 10/01	448 gpm	160.3 AF					448	448	448	448	448	448		
41B 24604 00**	GROUND WATER	DM/ST	01/01 to 12/31	15 gpm	3.3 AF	15	15	15	15	15	15	15	15	15	15	15	15
41B 30028813	GROUND WATER	ST	01/01 to 12/31	35 gpm	10 AF	35	35	35	35	35	35	35	35	35	35	35	35
41B 30117196	CARTER CREEK	ST	01/01 to 12/31	30 gpm	21.8 AF	30	30	30	30	30	30	30	30	30	30	30	30
41B 77937 00**	GROUND WATER	DM/LG	01/01 to 12/31	11 gpm	6 AF	11	11	11	11	11	11	11	11	11	11	11	11
41B 82215 00	GROUND WATER	DM/ST	01/01 to 12/31	25 gpm	1.87 AF	25	25	25	25	25	25	25	25	25	25	25	25
41B 88337 00	GROUND WATER	DM	01/01 to 12/31	20 gpm	1.5 AF	20	20	20	20	20	20	20	20	20	20	20	20
41B 88600 00	CARTER CREEK	IR	01/01 to 12/31	224.4 gpm	NQ	224.4	224.4	224.4	224.4	224.4	224.4	224.4	224.4	224.4	224.4	224.4	224.4
41B 88601 00	CARTER CREEK	IR	01/01 to 12/31	336.6 gpm	NQ	336.6	336.6	336.6	336.6	336.6	336.6	336.6	336.6	336.6	336.6	336.6	336.6
41B 88602 00	CARTER CREEK	IR	01/01 to 12/31	1.25 CFS	NQ			561	561	561	561	561	561	561	561	561	
41B 88739 00	CARTER CREEK	IR	03/01 to 11/01	6.25 CFS	NQ			2.805	2,805	2,805	2,805	2,805	2,805	2,805	2,805	2,805	
41B 88740 00	CARTER CREEK	ST	03/01 to 11/01	NQ	NQ			NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	
41B 88741 00	CARTER CREEK	IR	04/01 to 11/01	300 gpm	NQ				300	300	300	300	300	300	300	300	
41B 88742 00	SPRING, UT OF CARTER CREEK	ST	01/01 to 12/31	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ
41B 88745 00	GROUND WATER	ST	01/01 to 12/31	2 gpm	NQ	2	2	2	2	2	2	2	2	2	2	2	2
41B 88772 00	GROUND WATER	ST	01/01 to 12/31	35 gpm	NQ	35	35	35	35	35	35	35	35	35	35	35	35
41B 92149 00	SPRING, UT OF CARTER CREEK	DM	01/01 to 12/31	35 gpm	7 AF	35	35	35	35	35	35	35	35	35	35	35	35
41B 92150 00	CARTER CREEK	ST	01/01 to 12/31	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ
			MONTHLY FLOW RATE TOTALS IN gpm:			789	789	4,155	4,455	4,903	4,903	4,903	4,903	4,903	4,903	4,455	789

5.3.5 Water Rights from Multiple Sources Within the Simulated Drawdown Area

The water rights owned by neighboring landowners, with diversions in the simulated drawdown area, were reviewed separately from those above and below the mine site. **Table 5-3** contains a list of the water rights in the simulated drawdown area.

The water rights listed in **Table 5-3** include surface water and ground water and all are for stock-watering purposes. As noted in **Table 5-3**, some of the rights are for year-round use while others allow use from March 1 through November 1. Four out of the six rights do not have quantified flow rates or volumes. The two water rights with quantified flow rates are for ground water and surface water related to a spring adjacent to the location labeled “Hoffman Place” on the U.S. Geological Survey topographic map and are 41B 194157 and 194152, respectively. The remaining water rights in this area are for livestock direct from source with no quantified flow rates or volumes.

Because quantified values are lacking related to some of these rights, determining the exact extent to which the Proposed Action would impact these unquantified water rights is difficult. Whether or not stream flows are reduced, impacts to the water rights depend on the full extent of the water use. Given the local connectivity between groundwater and surface water that has been referenced in the Amendment Application, the availability of surface water in Bishop Creek, Carter Creek, Hoffman Creek, and the unnamed tributaries of Hoffman Creek may possibly be diminished during operation, and potentially after operation, until the ground water levels return to premining conditions. In areas where perched ground water (i.e., lacks connectivity to the deeper ground water system) feeds springs and seeps, impacts to surface water flows may be less than model predicted.

According to the Amendment Application (Section 3.7.7, Page 27–28), SP-1 (water right 41B 194158) would be affected by the Proposed Action of the pit expansion, channel realignment, and operation of the dewatering wells. During mining, proposed disposal of water would mitigate impacts to flows at SP-1. Postmining, the proposed mitigation would discharge water from RMG-1 and/or RMG-3 into a collection trap at the head of the realigned portion of Hoffman Spring Creek for the purpose of replacing flows to SP-1. The applicant’s existing water rights need to be changed to allow this use.

Table 5-3
Hoffman Creek Drainage Within Life-of-Mine Drawdown Footprint – Water Right Flow Rate and Volume Data

WR Number	Source Name	Period of Div.	Flow Rate	Volume	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
41B 194153 00	BISHOP CREEK	03/01 to 11/01	NQ	NQ			NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ		
41B 194159 00	HOFFMAN CREEK	03/01 to 11/01	NQ	NQ			NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ		
41B 194157 00	SPRING, UT OF HOFFMAN CREEK (Groundwater)	01/01 to 12/31	35 gpm	NQ	35	35	35	35	35	35	35	35	35	35	35	35
41B 194152 00	SPRING, UT OF HOFFMAN CREEK (Surface Water)	01/01 to 12/31	10 gpm	0.01 AF	10	10	10	10	10	10	10	10	10	10	10	10
41B 194158 00	SPRING, UT OF HOFFMAN CREEK (Surface Water)	03/01 to 11/01	NQ	NQ			NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ		
41B 30106951	UT OF HOFFMAN CREEK	03/01 to 11/01	NQ	NQ			NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ		
Monthly Flow Rate Totals in gpm					45	45	45+	45+	45+	45+	45+	45+	45+	45+	45	45

UT = Unnamed Tributary
NQ = Not numerically quantified

6.0 CONCLUSIONS

6.1 WATER RIGHT PERMITS FOR BMI

BMI has two water rights for use of groundwater for pollution abatement (e.g., dust suppression and washing vehicles at the shop area). Certificate 41B 86002 00 is for well RMG-1 with a maximum flow rate of 35 gpm and maximum annual volume of 9.67 ac-ft; and Certificate 41B 30047773 is for well RMG-3 with a maximum flow rate of 20 gpm and maximum annual volume of 0.86 ac-ft. A Notice of Completion Form has been submitted to the DNRC; however, the Notice has not yet been processed.

Regarding the proposed dewatering actions, water rights are not required for water discharge in the mining process.. In particular, the proposal to use water from one or more dewatering wells to mitigate for reduced flows in Hoffman Spring Creek and SP-1during dewatering operations is a use that would require a change to an existing water right or a new water right permit. A change of beneficial use for wells RMG-1 and RMG-3 may be required to authorize postmining mitigation or flow augmentation. While the Jefferson River and Madison River basin closure presents certain challenges to obtaining a new water right for flow augmentation, the existing water rights may provide for an adequate amount of water to accomplish the needed augmentation. BMI should consult with DNRC about the needed water rights for during mining and postclosure.

6.2 POTENTIAL IMPACTS TO WATER RIGHTS

During the dewatering phase of the Proposed Action, some water rights may be impacted; specifically, SP-1 and those water rights within the simulated drawdown area immediately upgradient of the mine pit (see **Figure 5-1**).

During the dewatering phase of the Proposed Action, water from the dewatering wells is proposed to be discharged into IF-1, IF-3, and a UIC well. This action can be conducted without a water right because the intention is to discharge water with no intention to put the water to a beneficial use.

During the closure phase, BMI proposes to continue pumping water from some dewatering wells into the infiltration units and the UIC well if necessary. This action would be taken for the express purpose of mitigating depletions/augmenting flows in Hoffman Creek and Carter Creek if necessary. The existing and pending water rights appear to allow for adequate volume for augmentation; however, an application to change the purpose of the water rights may be needed. Without the ability to continue to divert water to IF-1, IF-3, and/or the UIC well, impacts to the water rights on Carter Creek and Hoffman Creek are likely to occur and impacts to water rights may occur.

7.0 REFERENCES

BMI (Barretts Minerals Inc.) 2019. Application for Amendment 006 to Operating Permit No. 00013 for the Regal Mine, Madison County, Montana. Prepared by Barretts Minerals Inc. Dillon, Montana. Prepared for the Montana Department of Environmental Quality. Helena, Montana.

DNRC (Department of Natural Resources and Conservation). 2019. Water Rights Query System. Accessed: June 12, 2019. Retrieved from http://wrqs.dnrc.mt.gov/default.aspx

Hydrometrics, Inc. 2019a. Barretts Minerals Inc. Regal Mine Water Management Plan. Prepared by Hydrometrics, Inc. Helena, Montana. Prepared for Barretts Minerals Inc. Dillon, Montana.

_____. 2019b. Regal Mine Water Resources Sampling and Analysis Plan Barretts Minerals Inc. Prepared by Hydrometrics, Inc. Helena, Montana. Prepared for Barretts Minerals Inc. Dillon, Montana. April 2016, revised February 2019.

Montana State Library. 2019. Natural Resource Information System. Accessed: May 20, 2019. Retrieved from http://nris.msl.mt.gov/

APPENDIX C: TECHNICAL MEMORANDUM 3

Technical Memorandum 3

To:	Montana Department of Environmental Quality 1520 E. 6th Avenue Helena, MT 59601
From:	RESPEC Company LLC P.O. Box 725 Rapid City, SD 57709
Date:	November 26, 2019
Subject:	Barretts Regal Mine Project – Ground Water Model and Creek Design Assessment

1.0 INTRODUCTION

The basis for this Technical Memorandum is the application for Amendment 006 to Operating Permit Amendment No. 00013 (Barretts Minerals, Inc. 2019a) that was submitted to the Montana Department of Environmental Quality (DEQ) in March 2018 and revised in March 2019 and September 2019. That document is referenced in the body of this memorandum as "Amendment Application" with the section and page number indicated as appropriate. This Technical Memorandum has the following objectives:

- Review and evaluate the technical adequacy of the Analytic Aquifer Simulation (AnAqSim) model submitted with the Amendment Application to assess the impacts of the Proposed Action on ground water and springs;
- Review and evaluate the technical adequacy of the Proposed Action modifications to Hoffman Spring Creek and Hoffman Creek; and
- Evaluate the technical feasibility and environmental impacts of connecting Hoffman Spring Creek to the mine pit.

This Technical Memorandum summarizes background information regarding the current permitted Regal Mine operations that impact ground water and surface water; describes the Proposed Action outlined in the Amendment Application; provides an analysis of the ground water model and surface water designs; summarizes the analyses of the Hoffman Spring Creek realignment, Hoffman Creek lining, and the impacts of connecting the pit lake to Hoffman Creek; and presents conclusions and recommendations.

2.0 BACKGROUND

The Regal Mine is located 11 miles southeast of Dillon in Madison County, Montana, and is located on private land accessed via Sweetwater Road. The open pit mine has been in operation since 1972. Barretts Minerals, Inc. (BMI) currently mines talc ore from the Regal Mine using conventional open pit methods of drilling, blasting, loading, and hauling.

The Regal Mine talc deposit is present within a 100- to 200-foot-wide vein that trends approximately northeast-southwest and dips 60 degrees to the northwest. The deposit is bounded on the northwestern side by coarse-grained dolomitic marble and on the southwestern side by micaceous quartz schist (Okuma 1971). A diabase dike is present along the southwest side of the pit.

BMI has studied ground water flow in and around the mine using analytical modeling, stable isotope and other geochemical analysis, as well as tracer, infiltration, and aquifer testing. Much of this work is based on data collected from local springs, seeps, and monitoring wells. This information was reviewed as part of this analysis.

Ground water in the mine area occurs in a confined-to-semiconfined aquifer within the local metamorphic rock, which consists of dolomitic marble, gneisses, schists, and amphibolite units. These units are strongly deformed and folded, trend to the northeast, and dip to the northwest. The units are intersected by diabase dikes that trend generally northwest along fault systems. The known faults in the area include the Carter Creek Fault, Stone Creek Fault, and East Regal Fault. These faults predate the diabase dike formation. **Figure 2-1** depicts the geology around the mine area. Ground water flow is highly controlled by local structure, the diabase dikes, fault systems, and the lithologic sequence of metamorphic rock. Ground water flow (see **Figure 2-2**) is generally to the northwest from the mine site toward Beaverhead Valley.

Hoffman Creek is an intermittent, gaining stream east of the mine and is sourced by springs (including Hoffman Spring SP-1) above and below the mine site. Flows in Hoffman Creek at the Hoffman Homestead have been measured between 1 and 70 gallons per minute (gpm). Flows below the mine site (HC-2) have been measured between 1 and 270 gpm (Hydrometrics, Inc. 2019a). Hoffman Creek becomes intermittent 2.6 miles downstream from the mine site, which coincides with the location where the Carter Creek Fault crosses the Hoffman Creek drainage. Carter Creek is a perennial stream west of the mine site and is fed by ground water along most of the perennial reach. Flows in Carter Creek above the mine site have been measured between 180 and 840 gpm; below the mine site, flow have been measured between 180 and 1,900 gpm (Hydrometrics, Inc. 2019a). The perennial reach of Carter Creek terminates near the location of the storage ponds that were constructed to hold water for irrigation purposes.

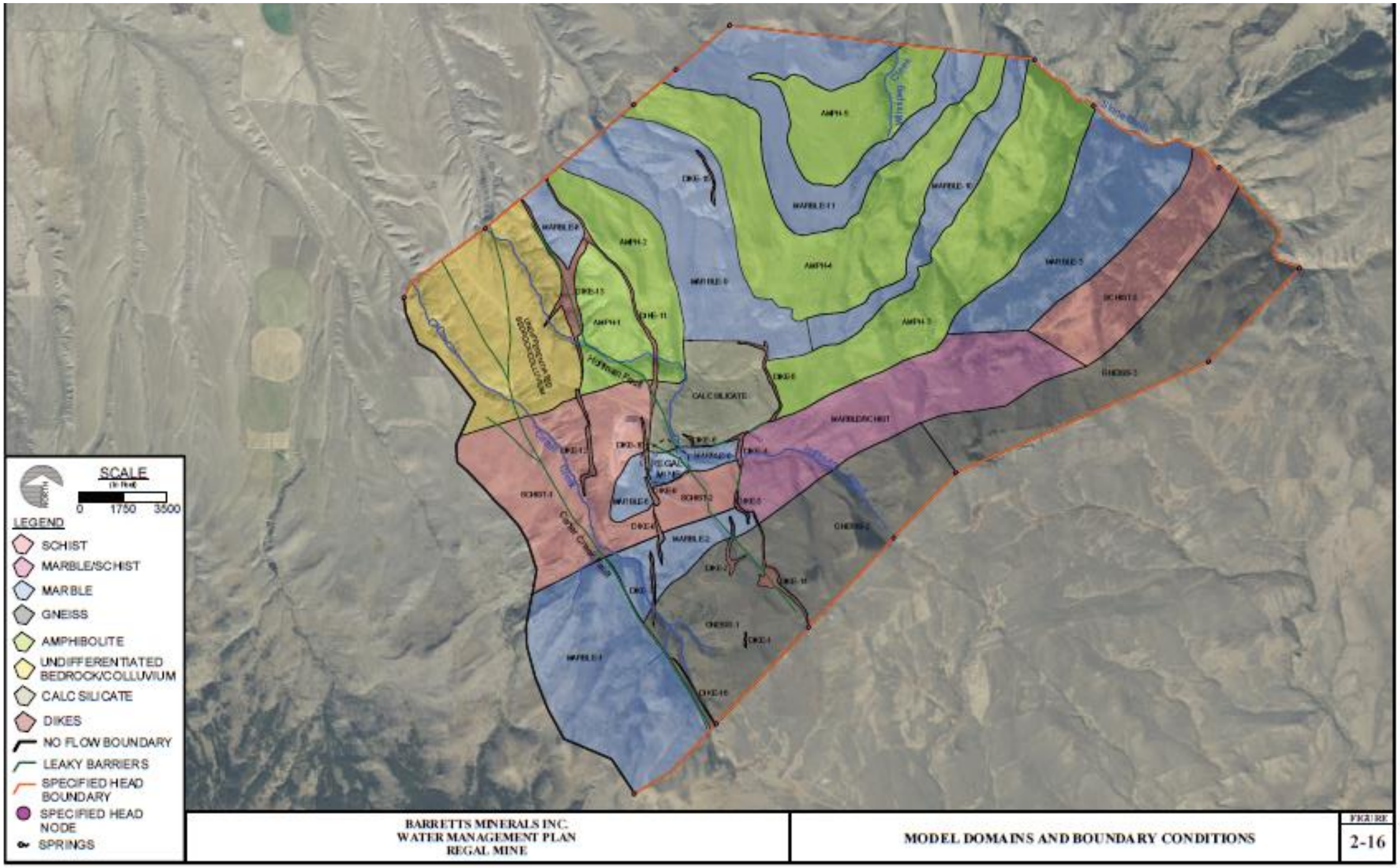

Figure 2-1
Geological Map of the Regal Mine (Hydrometrics, Inc. 2019a)

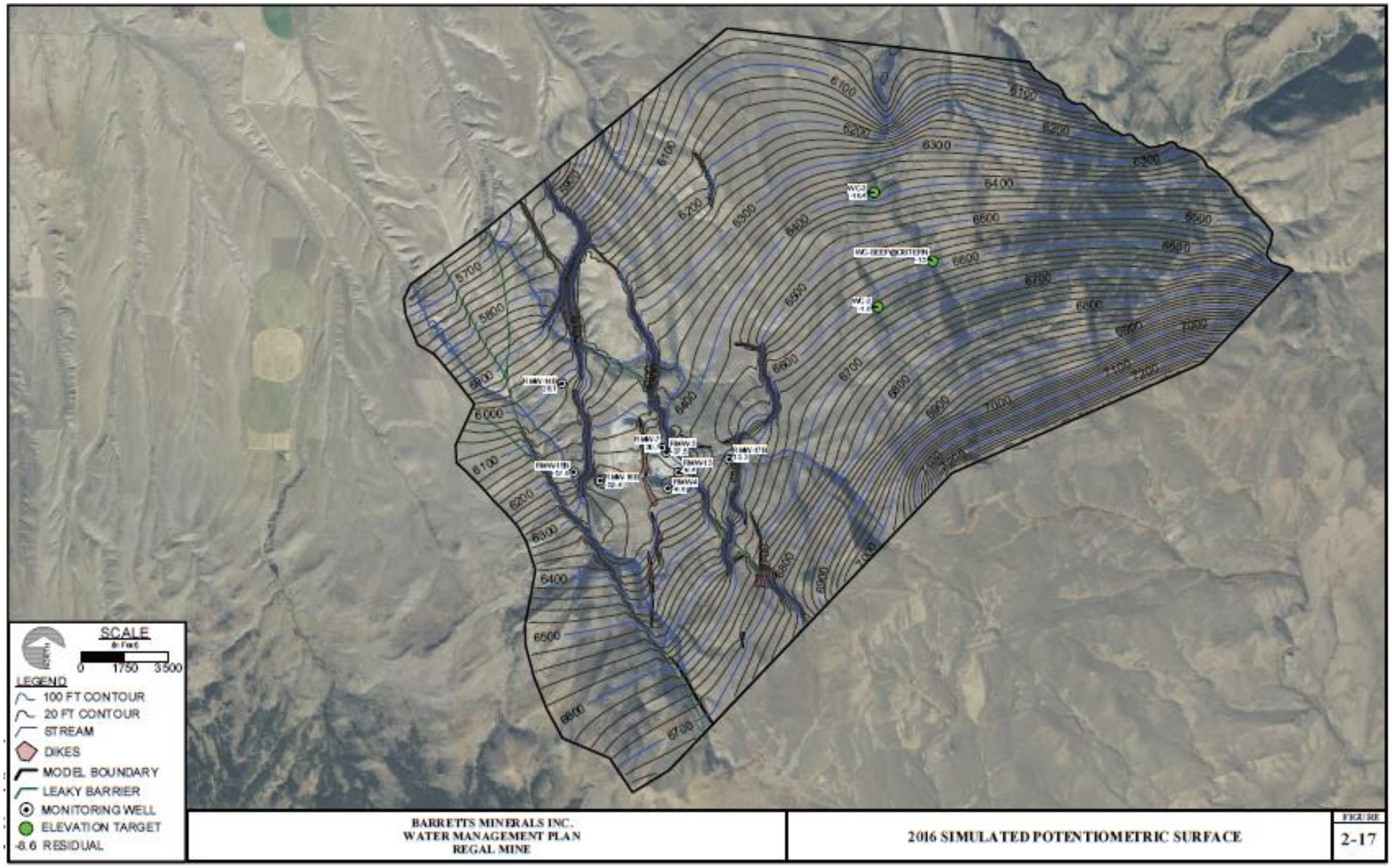

Figure 2-2
Potentiometric Surface (Hydrometrics, Inc. 2019a)

Water management at the Regal Mine includes means for water capturing, handling, and disposal. Ground water is currently captured by six dewatering wells that are located around the mine pit that typically pump a total of 135 gpm (Hydrometrics, Inc. 2019b). Two wells (RMG-1 and RMG-3) are pumped up to 32 gpm for dust suppression (Hydrometrics, Inc. 2019b). A pit-bottom sump pump captures additional ground water and direct precipitation into the pit at a rate of approximately 8 gpm (Hydrometrics, Inc. 2019a). The collected water is routed through piping and released to two existing infiltration (IF) galleries (i.e., IF-1 and IF-2) that are located in drainages near the mine site as well as to an Underground Injection Control (UIC Class V injection well. The UIC well is designed to inject up to 120 gpm (Hydrometrics, Inc. 2019b); the injection rate in 2016 was 93 gpm. IF-1 is used to reinject ground water into the subsurface in the Carter Creek drainage. In 2016, the injection rates into IF-1 and IF-2 were 70 and 16 gpm, respectively (Hydrometrics, Inc. 2019b).

3.0 PROPOSED ACTION

BMI proposes to expand and deepen the mine pit, increase the size of the waste rock disposal facility, modify the ground water capture and infiltration system, and realign Hoffman Spring Creek. The Proposed Action would include seven new dewatering wells, a settling pond, and a new infiltration gallery (IF-3) to replace IF-2. The Regal Mine expansion proposes to modify the natural watercourse of Hoffman Creek and Hoffman Spring Creek. The two objectives of the proposed modifications include (1) relocating Hoffman Spring Creek to accommodate the pit expansion and (2) reducing Hoffman Creek and Hoffman Spring Creek surface water infiltration into the pit by incorporating channel lining.

3.1 GROUND WATER DEWATERING AND INFILTRATION SYSTEM COMPONENTS

Under the Proposed Action, seven new dewatering wells would be installed to replace the existing dewatering wells. The proposed well locations are shown on **Figure 3-1**. The new dewatering wells would extract a combined 595 gpm. Existing wells RMG-1 and RMG-3, which are used for dust suppression, would continue to be used, although the wells would likely need to be deepened or replaced to continue providing water for dust suppression. The modeling estimates that approximately 25 gpm would flow to the pit sump and require extraction.

A new infiltration pond (IF-3) would be constructed to accept a continuous flow up to 500 gpm (**Figure 3-1**). The existing infiltration gallery (IF-2) would be closed and reclaimed. IF-3 would be located approximately ¾ mile northwest of the mine pit (between the Hoffman Creek and Carter Creek watersheds) and located downgradient of the mine pit to ensure that pumped ground water does not flow back into the pit.

During operations, Spring SP-1 would be impacted by dewatering. To compensate flow reduction, water from one of the new dewatering wells would be discharged into a collection trap at the head of the new portion of Hoffman Spring Creek. IF-1 would remain in use to dispose of dewatering water and augment flow of Carter Creek through recharge of alluvium.

Flow augmentation of Hoffman Creek would occur using the UIC well, which would inject until the water table is reestablished and flow augmentation of Hoffman Creek is no longer required. Modeling predicts that flow augmentation may be required for approximately 15 years on Carter Creek and 65 years on Hoffman Creek.

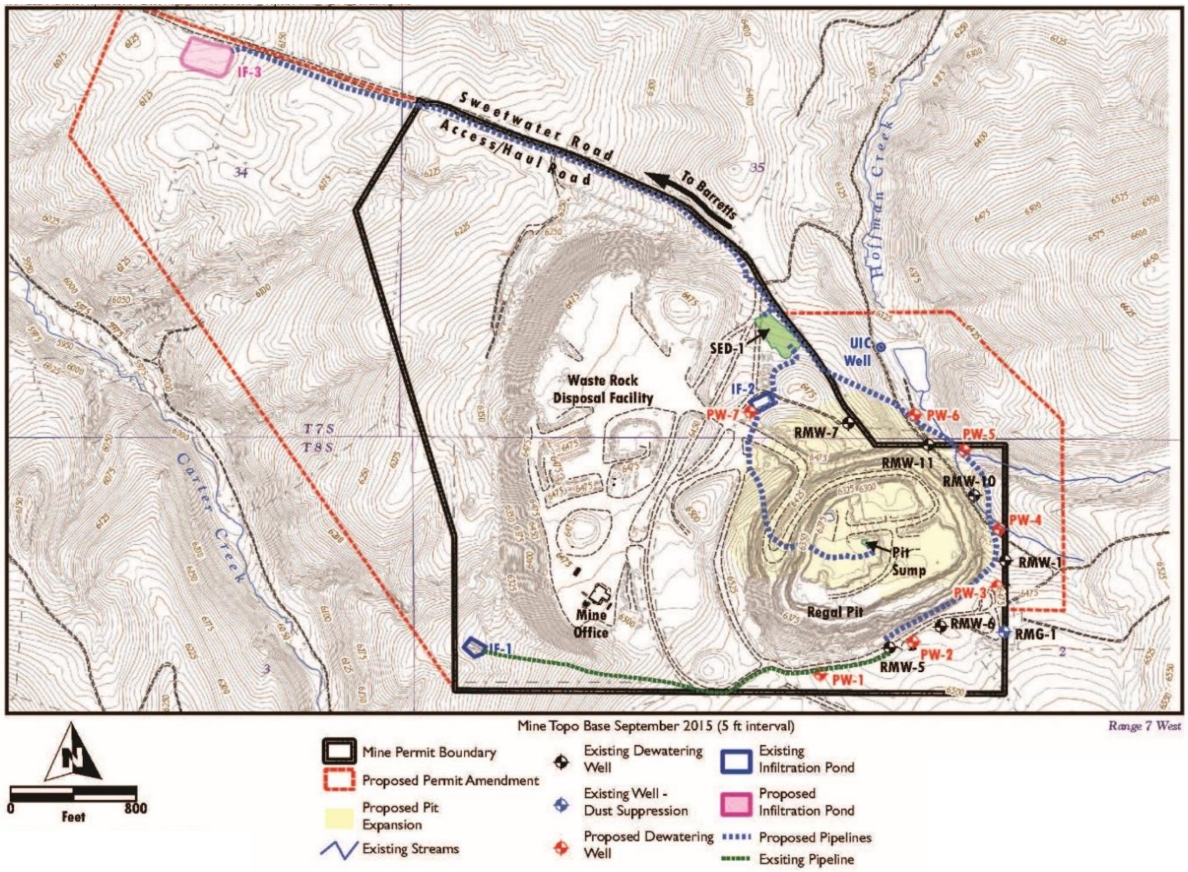

Figure 3-1
Current and Proposed Water Management Components

3.2 Modifications to Hoffman Spring Creek and Hoffman Creek

BMI is seeking to expand the open pit by 8.8 acres for a total pit area of 45.4 acres (Amendment Application Table 3-1). As part of the expansion, the pit walls would be pushed back on the north and east sides and encroach on the natural watercourse of Hoffman Spring Creek before entering Hoffman Creek. An engineered realigned channel would be constructed to transport surface water from upper Hoffman Spring Creek to Hoffman Creek near its current confluence. An overview of the Proposed Action related to Hoffman Spring Creek and Hoffman Creek is shown on **Figure 3-2**.

The expanded pit would intersect Hoffman Spring Creek and impact approximately 730 feet of channel to the northeast of the mine pit. Approximately 530 feet of channel would be removed and reconstructed on a safety bench located at the top of the proposed pit expansion highwall (an elevation change of approximately 50 feet). Approximately 200 linear feet would be

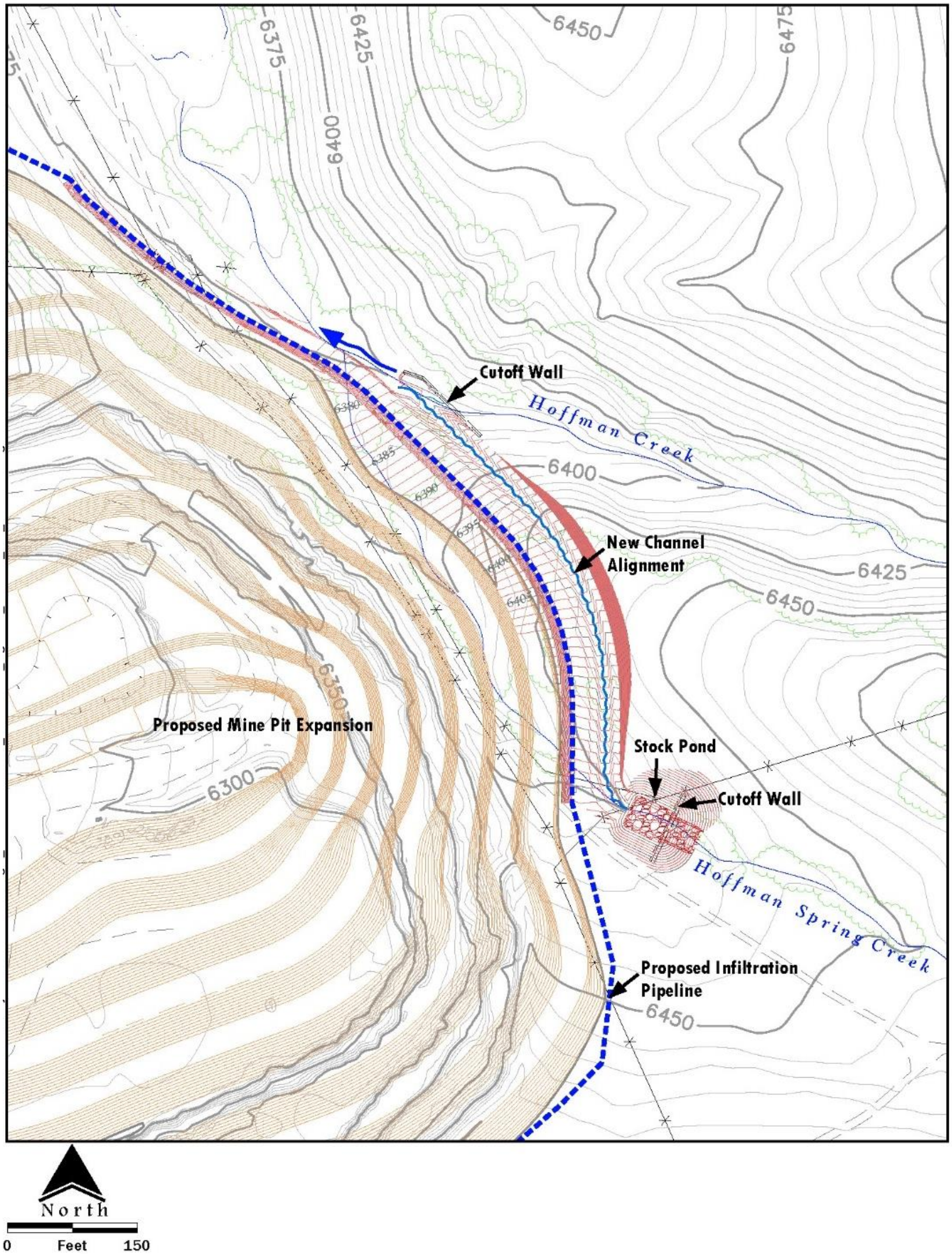

Figure 3-2
Proposed Action–Hoffman Spring Creek Realignment

affected by construction of the uppermost part of the realigned channel, including a catchment basin and cut off wall. At the confluence, the realigned channel would merge with the natural Hoffman Creek channel and would include a ground water cut off wall constructed beneath and perpendicular to Hoffman Creek immediately upstream of the confluence.

The realigned Hoffman Spring Creek channel sections are designed to convey the peak runoff flow from a 100-year, 24-hour storm event, while armoring is designed to withstand peak flow velocities from the 10-year, 24-hour storm. Design details of the 100-mil high density polyethylene (HDPE) lined engineered channel are depicted in drawings and cross sections. Any water that might exceed the engineered channel capacity of a 100-year, 24-hour storm event would flow westward out onto an access road, flat bench, and safety berm, and then to the mine pit. The east side of the channel will have a cut slope, so overflow would not go in that direction. The upper end of the engineered channel would be a constructed stock pond that would reduce upstream flow velocities and help prevent water from flowing under the channel liner that would be installed 2 feet below stream bed surface. This realigned channel segment would be constructed with the following:

1. Catchment basin at the upstream end of the realigned channel to collect natural flow from upper Hoffman Spring Creek, transfer the water into the realigned channel, and provide for controlled livestock watering;
2. Subsurface cut off wall beneath and perpendicular to Hoffman Spring Creek at the upstream side of the new catchment basin to direct shallow alluvial ground water flow into the catchment basin and realigned channel rather than into the mine pit; and
3. Subsurface cut off wall beneath and perpendicular to Hoffman Creek at the upstream side of its confluence with Hoffman Spring Creek to direct shallow alluvial ground water flow into Hoffman Creek rather than into the mine pit.

The Proposed Action would alter approximately 600 feet of Hoffman Creek. Vegetation and rock would be removed from the channel bed and bank, and bentonite clay granules would be incorporated into the bed and bank. Rock, surface debris, and fascines (i.e., a bundle or sticks or other material used to strengthen a structure and reduce erosion) would be installed to capture suspended sediment. After incorporating the bentonite clay, the existing temporary pipeline in the channel would be removed and flow would be reestablished. The U.S. Army Corps of Engineers (USACE) approved this channel modification using bentonite in BMI's 404 permit (404 Permit No. NWO-2015-00766-MTH).

4.0 ANALYSIS OF ANALYTICAL AQUIFER SIMULATION MODEL

4.1 OVERVIEW

An analytical element model was developed to predict ground water interactions from mining activities. The model used was Analytical Aquifer Simulation (AnAqSim) by Fitts GeoScience. AnAqSim was used to predict the locations, pumping volumes, and depths of dewatering wells that would be needed to dewater the expanded pit. AnAqSim was also used to evaluate the connectivity between ground water, springs, and surface waters to determine any potential dewatering effects on them from mining activities. **Figure 2-1** shows the model domain used in this evaluation. The model was developed to reflect the following four time periods:

1. **Baseline (pre-2000):** A baseline model was developed to reflect conditions that were observed before dewatering (i.e., pre-2000). The baseline model was calibrated using base conditions such as spring flow, stream flow, and static water levels from monitoring wells observed during the fall 2000. Calibration of the base condition model was deemed successful when the simulated flows and heads in the model were within the calibration targets. The calibration targets are described in the "2018 Ground Water Modeling Report" (Hydrometrics, Inc., 2019b), which is included in Appendix A of the Amendment Application. Figure 3-2 of the modeling report presents the modeled baseline potentiometric contour map around the Regal Mine.
2. **Current Dewatering (2016–2017):** The model was further calibrated to observed heads and flows. Current conditions reflect the spring flows, stream flows, pumping flow rates, and ground water levels that were measured in October 2016 and October 2017. Considerable effort was placed in the model development to maintain the calibration targets and conditions measured in the last 6 months. Multiple iterations of the model were run with revisions being made to the baseline model to maintain the model integrity and calibration targets. **Figure 2-2** presents the simulated current conditions potentiometric contour map around the Regal Mine. The model shows a strong correlation between the geologic structures (intrusive dikes and faults) that tend to limit and influence ground water movement.
3. **Proposed Action Dewatering:** The calibrated model was used to analyze the Life-of-Mine (LOM) condition; evaluate dewatering well placement, depth, and volume pumped, and assess infiltration sites that would be used to reinject those waters back into the ground water system. Based on a 10-year pumping period, a transient model projected that seven wells would be required to dewater the LOM pit at a combined rate of 595 gpm. To project a cone of depression across the pit, the pumps were set at elevations between 5,781 feet and 5,958 feet above mean sea level during modeling. Locations of the proposed dewatering wells are shown on **Figure 4-1**.
4. **Postmining**: The simulated heads from the LOM dewatering model were used as the starting condition for the recovery model to simulate the termination of pit dewatering. The recovery model included an additional domain to simulate the pit volume. This domain was modeled as a circular unit with a 1,040-foot-diameter to simulate the approximate volume of the pit at the LOM. This geometric simplification was done because the model is simulated with one layer and is not capable of simulating a sloped pit. Properties applied to the pit subdomain include a hydraulic conductivity of 1,000 feet per day and the storativity was increased to 0.8. The pit storativity was based on 80 percent of the pit area as open pit and 20 percent as bedrock within the pit subdomain. All of the dewatering wells and infiltration wells were turned off for the postmining analysis. The pit recovery model ceases all dewatering and discharges to infiltration basins at the start of the transient model.

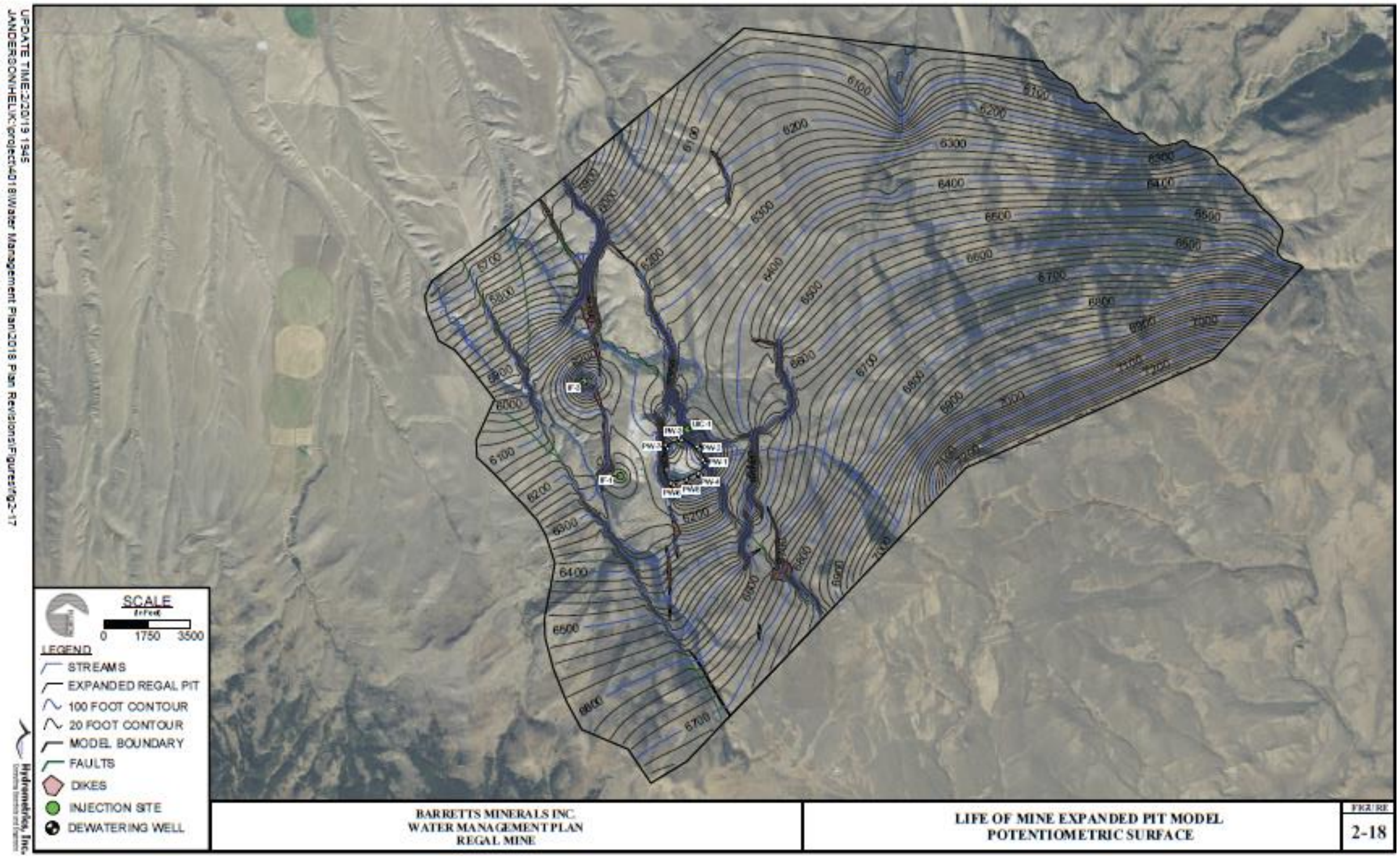

Figure 4-1
End of Mining-Predicted Potentiometric Surface (Hydrometrics, Inc. 2019a)

4.2 Data Adequacy

4.2.1 Boundary Conditions

The model was constructed with a no-flow boundary on the western edge of the domain (see **Figure 2-1)**. This boundary type is appropriate because the boundary is aligned generally perpendicular to the direction of ground water flow, and water in the conceptual model does not flow through the boundary. This boundary condition is conservative in the sense that use of this type of boundary could result in greater simulated drawdown.

Specified head boundaries are used on the upgradient and downgradient margins of the model. The assigned heads are based on the elevations of streams and springs (i.e., observed data) in these areas of the model domain. This boundary type is used generally to match the observed ground water flow gradient across the area of interest. The specified head boundary does not allow for mounding or drawdown of ground water at the boundary and should be used with care because they can create unrealistic flux rates through the boundary. (The AnAqSim model does not allow for free-surface boundaries such as specified flux.) Therefore, an analysis was conducted to evaluate the magnitude of boundary effects on ground water flux and concluded that the boundaries cause an insubstantial effect to the model, with respect to the amount of dewatering water being pumped. In this situation and model geometry, the specified head boundaries are appropriate.

Other boundary conditions internal to the model (i.e., river boundaries) are based on a combination of observed data (i.e., spring flows) and calibrated parameters. These conditions are appropriate for this type of model. The model thickness was set to 500 feet to allow room for the predicted drawdown and appropriately provides distance from the bottom boundary to the area of interest (i.e., proposed pit depth).

4.2.2 Aquifer Properties

The distribution of aquifer properties within the model is complex and reflects the complexly deformed metamorphic environment (see **Figure 2-1**). Five aquifer tests that used 13 wells provided a sufficient dataset to adequately estimate the hydraulic conductivity of the various hydrostratigraphic units. Test data for the intrusive dikes were not available but the hydraulic conductivity of these units was reasonably estimated. Model calibration was reasonable, and a generalization of the parameters is appropriate for a fractured rock aquifer simulation.

4.2.3 Potentiometric Surfaces

The AnAqSim modeling produced pre-dewatering and current condition (2016) potentiometric surfaces that were adequately calibrated to observed measurements for use in predictive scenarios. The 2016 simulation uses sufficient observed flow and water-level data to provide for eight primary and three secondary calibration targets. This simulation is reasonable for the size of the model domain. A general sensitivity analysis for the models was produced from evaluating the calibration process. This analysis concluded that the model is sensitive to hydraulic conductivity and streambed conductance, which is a reasonable conclusion.

4.3 Model Prediction Adequacy

The predictive scenarios include the proposed LOM conditions, simulating the proposed dewatering and the infiltration plan. The following drawdowns were predicted by this model at the end of dewatering:

- To the south (upgradient), drawdown of 100 feet reaches 3,000 feet from the pit;
- To the east (cross gradient), drawdown of 100 feet reaches 2,100 feet from the mine pit;
- To the west-northwest (downgradient), drawdown of 100 feet extends 240 feet from the mine pit; and
- Drawdown to the west is mitigated by infiltration features in this area.

The model also predicts that mine dewatering will decrease ground water discharge to Hoffman and Carter creeks, but this decrease is more than offset by reinfiltrating the pumped water. Predicted effects on local springs include increases, decreases, and no change in flow. These predictions are reasonable based on the model configuration and the observed aquifer conditions.

The postmining recovery simulation includes proposed postmining flow augmentation for Hoffman and Carter creeks. This scenario predicts that, following cessation of mining and dewatering, ground water levels recover in approximately 80 years. The ground water model predicts that surface water flow conditions are reestablished (i.e., 15 percent of the mean monthly flow) in Carter Creek in approximately 15 years and Hoffman Creek in approximately 65 years. These predictions are reasonable based on the model configuration and the observed aquifer conditions.

4.4 Impacts to Range Front Fault Springs

DEQ received a complaint from the Helle Livestock Ranch (located approximately 3 miles north of the Regal Mine) that alleged that decreases to spring flow on the property were related to ground water pumping at the Regal Mine. Initial concerns were filed with DEQ in 2008 and a subsequent complaint was made in 2017. The first substantial decrease in spring flow was noted to have occurred in approximately 2005.

DEQ concluded in their investigation (DEQ 2017) that initial reports of decreases in spring flows on the Helle Livestock Ranch predated regular dewatering at the Regal Mine and the most likely cause of such decreases was the Magnitude 5.6 earthquake that occurred in the Dillon area on July 25, 2005. Other factors that decrease the likelihood of impacts include separation distance (3 miles) and the springs being in a different drainage. However, the geologic source of the Helle Livestock springs is undetermined, and it is theoretically possible that future mine dewatering has the potential to impact downgradient springs. Such a cause and effect would be difficult to isolate from other factors (i.e., changing climate). Monitoring wells are located in the northernmost part of BMI's property. The location of monitoring wells further north would require landowner approval and is not advisable as a permit stipulation because land ownership and approval could change.

5.0 ANALYSIS OF HOFFMAN SPRING CREEK REALIGNMENT

The proposed modifications to Hoffman Spring Creek are technically feasible. The USACE, along with the local Conservation District and Montana Fish, Wildlife and Parks, have permitted the proposed realignment design. Concerns from those agencies have been incorporated into the latest design within the Amendment Application, including constructing the realigned Hoffman Spring Creek to be a permanent feature.

5.1 HYDROLOGIC AND HYDRAULIC DATA THAT SUPPORTS THE CHANNEL DESIGN

The engineering design of the realigned channel presented in the Amendment Application was reviewed and analyzed for technical feasibility, stability, and potential negative environmental impacts. Additional information from the applicant regarding hydrologic and hydraulic analyses in support of channel design was also reviewed, including a technical memorandum that describes the modeling approach using Autodesk Storm and Sanitary Analysis 2014 (Metzger and Lorenson 2015). The applicant sized the primary Hoffman Spring Creek corridor (i.e., floodplain) to accommodate the 100-year recurrence flood event, and sized a bankfull channel within the floodplain that is based on the 2-year recurrence peak flow. Because flood frequency calculations often have wide error margins, a different methodology for calculating flood flow quantities was explored within this memorandum for comparison purposes.

The United States Geological Survey Streamstats online application (McCarthy *et al.* 2016) is an industry-standard approach that uses regression equations derived through correlation of basin characteristics to historic stream flow records. The Streamstats application was run for Hoffman Spring Creek, at its confluence with Hoffman Creek, to provide different flood flow quantities for comparison purposes. **Table 5-1** compares the applicant's flood flows to those developed through the Streamstats application. Comparing the results between the two methodologies illustrates their significant differences and highlights the overall uncertainty for calculating flood flows.

The 2-year flow the applicant used to develop sizing for the bankfull channel is missing from the Amendment Application. Sizing of bankfull channel parameters (e.g., bankfull width and depth) are commonly developed through measurements of a reference reach rather than a modeled approach presented in the Amendment Application. Additional details such as reference channel slope, sinuosity, pool/riffle spacing, and overall stream type are often also measured from the reference reach and used to design the bankfull channel. Creating a stream design using bankfull channel parameters from a reference channel section is industry standard but not required.

Table 5-1
Comparison of Applicant Flood Flow in Cubic Feet per Second (cfs) to U.S. Geological Survey Streamstats Methodology

	Peak Flow (cfs)	
	Applicant	**Streamstats**
2-year	a	1.65
10-year	41	6.80
100-year	167	20.7

[a] Data not provided

5.2 Assessment of Design Details

The channel design details were reviewed to provide a scoping-level evaluation of the proposed Hoffman Spring Creek realignment design. Appendix A of the Amendment Application contains design plans (stamped by a professional engineer) for the realigned Hoffman Spring Creek. The plans show grading for the proposed stream alignment along with a safety berm and access road. The plans also provide a profile for the stream and a typical section of the proposed channel and floodplain. The proposed floodplain section appears appropriately sized to achieve conveyance of the estimated 100-year peak discharge. The typical section includes dimensions that are sufficient for emplacing the 100-mill HDPE liner (to reduce infiltration into the pit), its bounding fabric to protect against damage, the overlying material thicknesses, the geogrid geotextile to provide long-term channel stability, and the overlying topsoil thickness.

The cut slope into the eastern side of the hill is steep (0.5 horizontal:1 vertical). However, one of the engineering drawings notes that if cut slopes are not constructed in competent bedrock or are required to be steeper than 1.4H:1V, slope stability analysis would be performed to determine the maximum stable slope.

The Amendment Application and design plans would reduce the overall floodplain and channel length for Hoffman Spring Creek. The proposed profile is relatively steep with an 8.0 percent grade for the upper reach and 9.5 percent grade for the lower reach (Hydrometrics, Inc. 2019a, Appendix G). The proposed profile is steeper than the natural condition because the stream is being shortened from its existing length. The model results predict velocities in excess of 8 feet per second in the realigned reach of Hoffman Spring Creek during the 10-year event, which is an erosive flow condition. The 100-year event velocities were not provided from the Storm and Sanitary Analysis results. However, a calculation output from the geoweb channel sizing tool was included in the memorandum for the 100-year discharge (Metzger and Lorenson 2015). This tool reports a stable condition for the vegetated geoweb channel and indicates the unvegetated geoweb channel is unstable. Long-term stability of this system will be achieved through successful revegetation. If an appreciable event occurs before vegetation is established, the channel section may fail.

To evaluate the potential occurrence of supercritical flow through the realigned reach, an independent Manning equation calculation was performed that used the channel parameters provided in the proposed design. The Manning equation is:

$$V = \frac{1.49}{n} R^{2/3} S^{2/2} \qquad (1)$$

where:

S = slope of the energy line, in %

R = the hydraulic radius, in feet

n = the roughness coefficient of the channel.

For this exercise, a trapezoidal channel was evaluated with a 10-foot bottom width, 2.5 foot per foot side slopes, roughness coefficient of 0.03, and channel slope of 0.0875.

The results of this calculation indicate that a 100-year event will have a Froude Number of 2.46 and a velocity of 12.4 5 feet per second. As the supercritical flow transitions back to the 2 percent existing conditions channel, a hydraulic jump will occur. Aside from the geogrid geotextile, no other scour protection or energy dissipation features are shown in the design plans or described in the Amendment Application. Without adequate scour protection for this flow transition, a large scour hole will likely develop. Natural systems with similar parameters are characterized with abundant roughness, robust woody vegetation, and frequent step-pool-type drops to dissipate energy; all of these design characteristics are lacking from the Proposed Action design.

5.3 Potential Design Enhancements

The following additional design enhancements for Hoffman Spring Creek could promote long-term, permanent stability of the realigned channel:

- Rock/wood step-pool drops and coarse woody roughness elements should be keyed into stream banks and floodplain to dissipate energy along the steep reach.
- A hydraulic jump stilling basin should be incorporated at the confluence of Hoffman Spring Creek with Hoffman Creek to reduce the potential for scour hole formation and head cut migration upstream.
- The current design does not include revegetation specifications or details. A detailed revegetation plan incorporating native grasses, forbs, shrubs, and trees is recommended to promote long-term channel stability and increase floodplain roughness.
- A sinuosity of the bankfull channel could be incorporated in the design plans to reduce the slope of the channel over the steep floodplain. Alternatively, a qualified stream restoration specialist could be on site to direct construction of the bankfull channel plan and profile throughout the floodplain corridor.

6.0 ANALYSIS OF HOFFMAN CREEK LINING

The proposed modifications to Hoffman Creek are technically feasible. Along with Hoffman Spring Creek, the USACE; the local Conservation District; and Montana Fish, Wildlife and Parks have permitted the proposed work in Hoffman Creek to reduce infiltration into the pit. Concerns from those agencies have been incorporated into the latest design within the OP.

6.1 ASSESSMENT OF DESIGN DETAILS

The Proposed Action would seal 600 feet of Hoffman Creek channel with bentonite granules. If mixed thoroughly at an adequate rate based on the native material type, this approach can be effective at significantly reducing infiltration. A narrative description of the general work activities is included in the Amendment Application (Appendix A, Water Management Plan). To summarize the Proposed Action, the channel will be opened up by removing rock and surface debris from the channel bed and bank. Bentonite granules will be incorporated into the channel bed and bank up to the bankfull elevation, with an application rate of 1 pound per square foot, and incorporated into the subsurface to a depth of 6 inches. Rock and surface debris will be replaced with additional fascines installed to capture natural suspended sediment. Fascines will be installed at logical breakpoints in the channel and will not exceed a 10-foot spacing limit. The worked channel will be compacted before water is diverted back into the channel.

6.2 POTENTIAL DESIGN ENHANCEMENTS

RESPEC recommends the following information for Hoffman Creek lining be included in the Amendment Application:

- Modify engineering design drawings to illustrate details such as limits of work area for the upstream channel, temporary diversion plan, depth of removal, proportion of bentonite, mixing specifications, and placement thickness/depth;
- Document the dimension, plan, and profile for the existing condition of Hoffman Creek to facilitate reconstructing the stream following scraping of materials and incorporating bentonite; and
- Develop a detailed riparian revegetation plan that includes best practices for successful revegetation.

7.0 ANALYSIS OF IMPACTS TO CONNECT THE PIT LAKE TO HOFFMAN CREEK

As documented in BMI's May 2019 "Project Options Analysis Regal Mine Expansion," one of the preliminary pit designs that was considered but dismissed involved a pit with a larger footprint and greater disturbance to the east toward Hoffman Creek (BMI 2019b). The proposed alternative of connecting the pit lake to Hoffman Creek originated after DEQ reviewed this preliminary design. The preliminary and rejected design would have enlarged the pit into the creek channel and routed Hoffman Creek and/or Hoffman Spring Creek flow into the pit; as the pit filled, it would eventually spill into Hoffman Creek. This considered alternative of connecting the pit lake to Hoffman Creek originated after DEQ reviewed this preliminary design; however, the pit design and creek modifications in the Proposed Action are not the same as the preliminary designs. The results of geotechnical slope stability analysis (Golder Associates Inc. 2017) allowed for a pit design with steeper pit slopes that decreased the disturbance footprint of the pit and increased the distance of the pit from Hoffman Creek.

The Proposed Action, as presented in the permit Amendment Application, indicated that the predicted pit lake elevation of 6,335 feet would be approximately 40 feet lower in elevation than the elevation of Hoffman Creek and the rerouted Hoffman Spring Creek. At its closest point to the northeast rim of the pit, Hoffman Creek is 35 to 40 feet from the rim of the pit.

If the pit lake were connected to the creek using the proposed pit layout, a waterfall would be created into the pit, which would result in a sink where surface water would enter the pit and not return to surface flow but, rather, enter the ground water flow system. This was not the intention of either the preliminary design plan or the Proposed Action design. Eliminating the flow in Hoffman Creek and/or Hoffman Spring Creek at the site of the pit would negatively impact downstream surface water flow and water rights. In addition to flows and water rights concerns, if Hoffman Spring Creek is not realigned, but rather allowed to flow directly into the pit, there would be a quantifiable loss of stream channel length and its associated riparian and wetland area. Riparian and wetland areas improve water quality by filtering nutrients and sediment and provide habitat for aquatic and terrestrial life. Furthermore, routing surface water into the pit would impose a discontinuity in habitat for species that rely upon riparian habitat.

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1 GROUND WATER

The level of effort, including analytical modeling (AnAqSim), stable isotope and other geochemical analysis, as well as tracer, infiltration, and aquifer testing meets accepted standards of practice for investigations into ground water/surface water interactions. The amount of ground water and surface water data collected is also sufficient to establish baseline conditions.

In response to comments on the Amendment Application, BMI indicated the ground water model will be recalibrated annually using additional water-level and flow data collected in the various monitoring sites (BMI 2019c). Existing ground water-level monitoring occurs quarterly at dewatering wells and monitoring wells (Hydrometrics, Inc. 2019c). As part of the Proposed Action, BMI would install two new ground water monitoring wells (one located northwest of IF-3 and one south-southeast of the pit) with transducers to record the elevation of the potentiometric surface (Hydrometrics, Inc. 2019c). These additional monitoring wells, located outside of the model domain and upgradient and downgradient of the mine property, could provide useful data to adjust model boundary conditions and also detect changing ground water conditions further away from the mine.

8.2 SURFACE WATER

An analysis of the Proposed Action stream diversion designs and proposed construction for Hoffman Spring Creek and Hoffman Creek was performed to determine the adequacy of the design to limit environmental impact and produce a stable hydrologic system. The Proposed Action surface water modifications are reasonable and supported with technical documentation as summarized below:

- The proposed floodplain section appears appropriately sized to achieve conveyance of the estimated 100-year peak discharge on Hoffman Spring Creek;
- The proposed construction of Hoffman Spring Creek includes dimensions large enough for locating the 100-mill HDPE liner to reduce infiltration into the pit, bounding fabric to protect against bank damage, geotextile to provide long-term channel stability and prevent significant scouring of the stream bed, and revegetation of grasses and shrubs to enhance stability; and
- The sinuous design of the stream bed within the realignment corridor would help reduce the water velocity and erosion.

Additional design enhancements could be added to enhance and promote long-term stability of the realigned Hoffman Spring Creek channel and the reworked Hoffman Creek Reach. Such potential design enhancements could include the following:

- Additional roughness elements (e.g., woody revegetation) into the floodplain design;
- Scour protection at the interface of supercritical and subcritical flow regimes (e.g.,. stream drop structures); and
- Revegetation details to promote successful vegetation establishment.

Extents and details of the work on Hoffman Creek could be added to construction drawings. The analysis concluded that these enhancements would not substantially reduce environmental impact of the Proposed Action realignment of Hoffman Spring Creek and modifications of Hoffman Creek. The USACE; the local Conservation District; and Montana Fish, Wildlife and Parks have permitted the proposed work in Hoffman Spring Creek and Hoffman Creek.

9.0 REFERENCES

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